

Amaravati - A City Reborn, Journey Towards a World-Class Smart City

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Abstract. Amaravati, a small village located in Guntur district, remembered vaguely only for its history became the talk of the nation as soon as it was sanctioned to become the next capital of Andhra Pradesh, along with being chosen in the 2nd phase for the ambitious Smart Cities Mission undertaken by the Govt. of India. India is a fast developing economy and projects such as these are furthering its growth. The plan was presented by the Govt. of Singapore to the Andhra Pradesh Chief Minister, N Chandrababu Naidu. It is a 5-phase plan sprawled over 16.9 sq.kms. which mainly concentrates on “providing jobs and homes, world-class infrastructure, quality living, protecting identity and heritage and resource management and environment.” The SEED Capital Area (SCA) Master Plan aims to implement a well-connected network of transport hierarchy, effective disaster management, innovative waste management systems paving way for a greener tomorrow and sustainable, futuristic infrastructure based on sustainable development strategies. This paper covers the planning (SEED Master Plan), current progress and projected goals along with the importance of such a formidable plan for the state of Andhra Pradesh and a country like India.

1 Introduction

India, an integral part of BRICS (acronym for Brazil, Russia, India, China and South Africa which are deemed as the association of five major emerging national economies), the 7th largest economy of the world, with a phenomenal GDP growth rate of 7.5% as of 2015 has been consistently developing towards becoming a full-fledged super power. The democratic government has contributed greatly towards this growth. One such initiative was undertaken by the Government of India with key people such as Venkaiah Naidu and Narendra Modi, in 2015. A total of 100 cities from the various states in India had to undergo a rigorous multi-stage selection process in order to get funding. Amaravati although not technically a city, entered this competition and cleared the 2nd phase selection process and hopes are high that it gets sanctioned to be chosen and funded under the Smart Cities Mission.

Andhra Pradesh, one of the major states in the southern part of India underwent bifurcation in June 2014 giving rise to the new state of Telangana. While the previous capital of Andhra Pradesh, that is, Hyderabad continued to serve as capital for Telangana, Andhra Pradesh was left without one, which led to the need for a new capital and following certain disagreements, none of the existing cities fit the profile, hence a new

city was sanctioned to be designed and constructed. The area selected for this project was located between the two biggest regions of Andhra Pradesh, that is, Guntur and Vijayawada. Thus the dream of Amaravati was born. Amaravati, believed to be the regional center during the Mauryan rule and later the capital of the Satavahanas dynasty soon lost its stature with modernization and remained relevant only in terms of historical importance. The selected region consists of a large number of villages and is one of the biggest and most successful examples of Land Pool Scheme wherein the inhabitants of the collective area gave up their small pieces of land to the government in return for compensation, thus enabling the formation of a uniform and well-designed skeleton.

The project has consistently been in the media limelight due to continued efforts by Chief Minister of the state, N Chandrababu Naidu who came up with various novel techniques to achieve just that, one being a very elaborate event dedicated to laying foundation, wherein holy water from different pilgrimage sites all over the world was poured on the foundation stone and the event was attended by important government officials and dignitaries from India. Another interesting scheme used was “My Bricks – My Amaravati” through which the general public could contribute towards building the state capital by buying these virtual “bricks” each costing a meagre INR Rs. 10 thereby further funding the project of making Amaravati a world class city.

An MoU was signed between the Singapore and Andhra Pradesh government on December 8, 2014 to collaborate on conceptualizing the design for the capital city. Surbana International Consultants Pte Ltd. and Jurong Consultants Pte Ltd. were hired to do the same, while L&T, one of the largest construction companies in India was assigned to implement it. In January of 2016, the Andhra Pradesh Capital Region Development Authority (AP CRDA) kicked off the Amaravati Government Complex Concept Design Competition which saw participation from three Master Architects to come up with a lean and unique design for the capital, and was concluded in March, 2016 with Fumihiko Maki of Maki & Associates winning the competition.

This ambitious project has had its shares of ups and downs, with some calling it “too good to be true” but is built on the dreams of millions who gave up a lot to contribute towards making this a reality, while the challenges are many, the goals are not unattainable, the detailed planning, execution timeline, achieved targets, etc. will be discussed in the following sections.

2 Site Selection

Andhra Pradesh is the 8th largest state in India covering an area of over 160,000 km and surrounded by the Indian states of Karnataka, Telangana, Odisha, Chhattisgarh and Tamil Nadu with Bay of Bengal terminating the land area in the east. The major cities of Andhra Pradesh (AP) are Vishakhapatnam, Vijayawada and Vizianagaram to name a few. The reason for not choosing any of the pre-existing cities was two-fold. One was due to the conflict amongst the masses each claiming that their city deserved to be the new capital and other was due to accessibility, the APCRDA and the Hon’ble Chief Minister desired the capital to be centrally located which gave rise to the need for a new city and a new capital as a whole.

Table 1. Existing land distribution

Land use	Area (ha)	%
Developable land	1449.29	85.55%
Village settlements	29.40	1.74%
Island	182.13	10.75%
River Krishna	31.80	1.88%
Water bodies	1.43	0.08%
Total	1694.05	100%

The site selected was that of Amaravati, flanked on either side by the two major regions of Vijayawada in the north-west and Guntur in the south. It was nothing but a collection of small villages, and rural landscapes mainly uninhabited (Refer Table 1 for the Existing Land Usage). Post the hugely successful land pooling scheme, the area acquired was over 200 kms and is a riverfront site facing Krishna river in the north.

Within the proposed city, the large north-south axis was chosen, to provide grandeur and ceremonial quality to the government house and also to be closer and easily accessible to the neighbouring city of Vijayawada with a large population of over a million while retaining its own identity as the new state capital. Neerukonda hills will terminate this axis on the southern end while the northern axis appears to extend endlessly to the Kandapalli Hill forest. (Refer Figs. 5 and 6 for available site options and final selected site).

In January 2015, Surbana and Jurong teams undertook a 2 days elaborate site visit to get a first-hand feel of the site and surroundings. The team also interacted with local people to understand their concerns and issues to be considered during the formation of the master plan. All this information was utilized in the site analysis and formation of the plans (Table 2).

Site Selection Criteria:

- Proximity to Krishna river, one of the major Indian rivers which gives the capital its stature of riverfront capital.
- Flood free zone, since the land selected is mainly flatlands hence is least prone to flooding and does not necessitate drastic measures to combat the same.
- Proximity to Vijayawada, the 2nd largest city in the state in terms of GDP and a population of over a million. Ease of access is increased but at the same time the individual identity of the state capital is retained.
- Blank canvas, since the area selected has a rather small population of just 1.74% of the total land area, the site could be developed appropriately without worrying about pre-existing systems and without affecting livelihood, businesses and culture of the inhabitants.
- Vaastu, an important aspect of construction and architecture in India which was a part of ancient texts in India detailing the spatial/geometric layout of designed site along with placement of various integral structures in a house, building or region. The north-south axis is considered most auspicious and hence will form the core of the government in accordance with Vaastu Shashtra principles.

Table 2. SEED: landuse distribution table

Sl. no.	Landuse	Total area (ha)	Percentage (%)
1	Business park	39	2.30%
2	Commercial	47	2.80%
3	Existing habitation	29	1.74%
4	Government administration	50	3.53%
5	High density residential	45	2.63%
6	Infrastructure	11	0.64%
7	Institution	17	0.99%
8	Low density residential	84	4.99%
9	Medium density residential	52	3.69%
10	Mixed use developments	255	15.07%
11	Neighbourhood centre	4	0.23%
12	Parks and greens	331	19.96%
13	Roads	277	16.37%
14	Schools	14	0.82%
15	Special use	119	7.01%
16	Special development zone	225	13.27%
17	Village buffer	4	0.22%
18	Water	70	4.13%
	Total area	1694	100%

- Scenic beauty, the location is one of the most aesthetically pleasing ones with a good number of natural formations, historical structures and vantage points with great view of the landscape and would serve as a good tourist attraction garnering significant tourist revenue.
- Good connectivity, since it is located between Vijayawada and Guntur district.

Although the challenges posed were minimal, the main ones were the hindrance in optimal use of the inhabited area of 1.74% which is but a minor problem. The bund located at a distance of 250 m from the water edge needs to be realigned in order to continue the development without any obstacles. Apart from these, the site selection has proven to be very successful and hassle-free thereby ensuring speedy completion of the project.

3 Methodology

Surbana and Jurong teams collected the necessary data from the Andhra Pradesh agencies during the period of December 2014 and May 2015. Using this data, the teams filtered out specific relevant data that can be applied in the development of the Capital City and SEED development Master Plans. The data was received in several formats including GIS, Autocad, Excel sheets and hard copy reports (Fig. 1).

Several meetings were held during the team's stay in Hyderabad that included CRDA officials and Dr. P. Narayana, Minister of Municipal Administration & Urban Development, Urban Water Supply and Urban Planning for Andhra Pradesh. The team

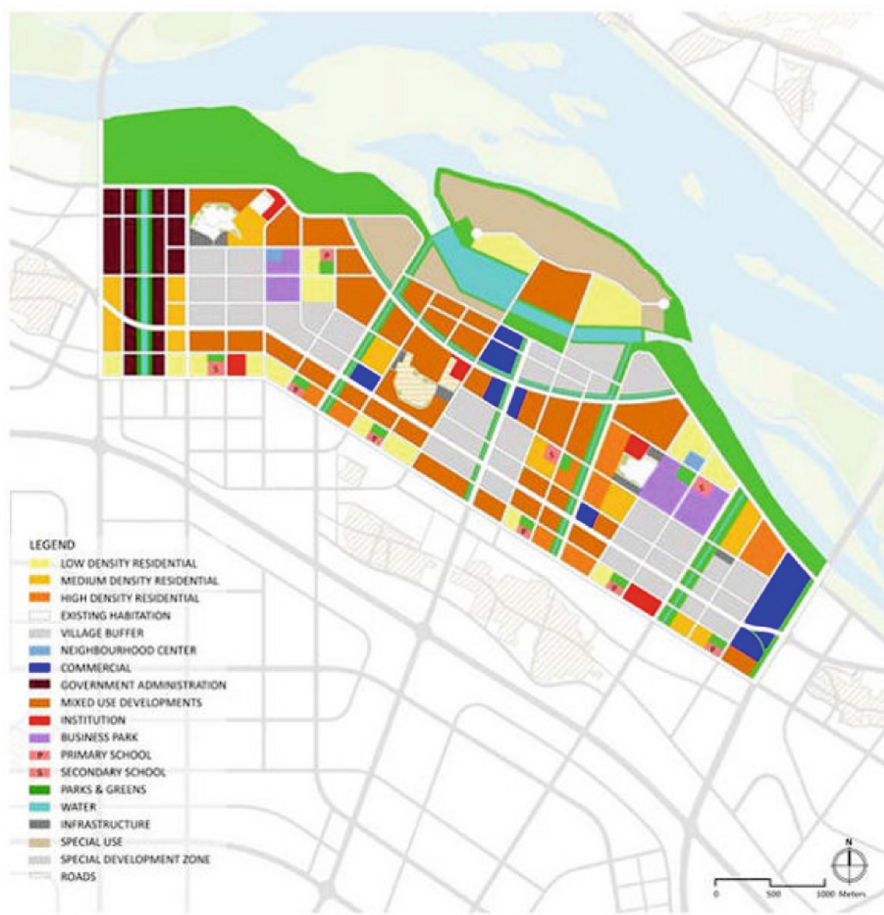


Fig. 1. SEED MasterPlan

from Singapore included officials from Surbana International Consultants Pte Ltd. (Surbana), JURONG Consultants Pte Ltd. (Jurong), Centre for Livable Cities (CLC), Ministry of Trade and Industry (MTI), Singapore Cooperation Enterprise (SCE) and International Enterprise (IE).

A delegation of 23 Andhra Pradesh officials attended the APLUGP (Andhra Pradesh Leaders in Urban Governance Programme) organized by CLC in Singapore from 19th to 24th January. Surbana and Jurong teams were actively involved throughout this workshop. Surbana and Jurong presented and discussed the progress of the Master Plan with the delegation members to get their insights and views on the ideas being considered.

Parallel to this, planners from Surbana and Jurong were analyzing the relevant data received from the Andhra Pradesh agencies. The analysis included understanding of physical site features such as hills, rivers, canals, forests, drains, etc., along with an understanding of the socio-demographic and economic profile of the Capital City and the SEED development area.

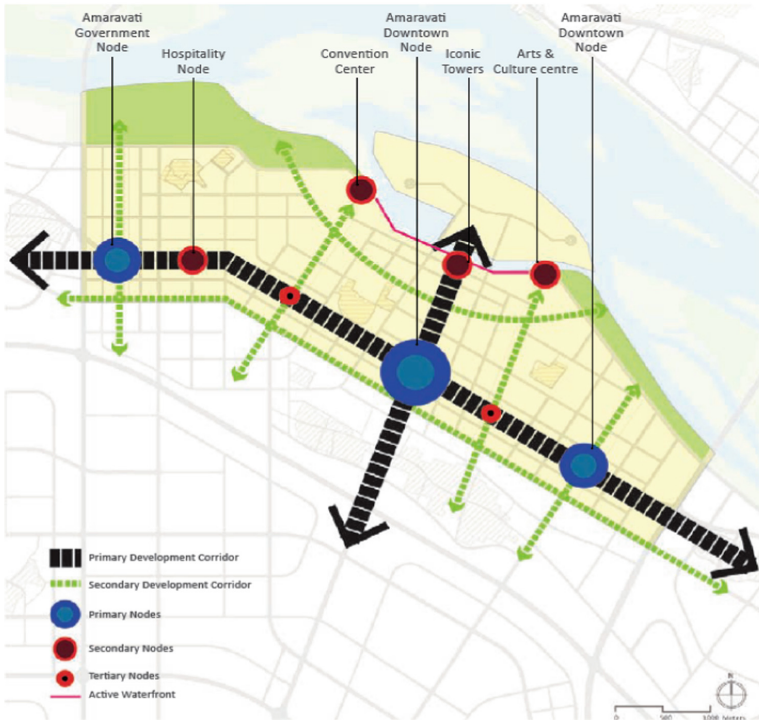


Fig. 2. Structure plan for SEED development area

4 Smart City

While there is no fixed definition for a smart city, the most vital step for a city to be considered smart is its infrastructure which needs to be prepared to handle the population explosion efficiently, be disaster proof, constructed keeping in mind the pressure on public transport, and in general be superior in every aspect as compared to the present city designs.

Some well-known smart cities in the world are Stockholm, Southampton, and Amsterdam. India too is attempting to jump on this wagon by implementing the Smart Cities Initiative wherein 100 cities selected from all over India would be funded to be converted into a smart city. The procedure consists of rigorous inspection and competition at various levels to qualify for the funding. Amaravati, technically not an existing city of India was not selected for this prestigious status in the first two rounds but hopes are high that it will meet the standards soon. Despite that, the program is primarily funded by the central government aside from state funding and foreign investments.

The city is designed to be built on a Smart City Framework (Refer Fig. 3 at the end of the paper) with six primary goals, each corresponding to the three pillars of sustainability. Establishing this framework is the most critical step preceding the Vision as this guides the Goals and Strategies. It lays out the Key Performance Indicators to address the social, economic and environmental issues specific to the focus area.

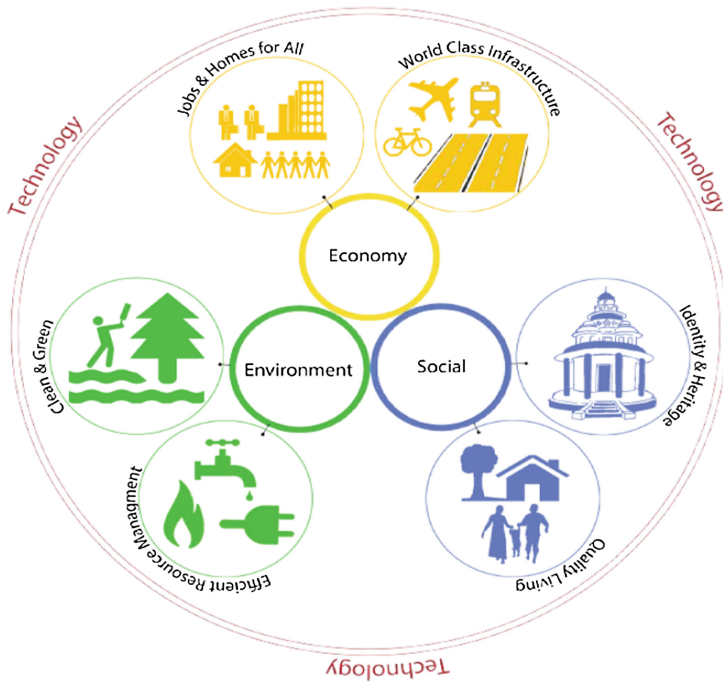


Fig. 3. Smart city framework

1. ECONOMIC

- Jobs & Homes for All
- World Class Infrastructure

2. SOCIAL

- Identity & Heritage
- Quality Living

3. ENVIRONMENT

- Clean and Green
- Effective Resource Management

To achieve the above mentioned goals, the planning has been done as follows:

1. 4 hierarchies of commercial and 5 residential developments have been proposed.
2. A well-woven network of parks and open spaces running across the capital and terminating at the riverfront.
3. A well connected road and public transport network is in works.
4. The iconic sites of the city have been restored and well-maintained to preserve the heritage of the capital.
5. Waste water management, flood prevention, solid waste management, water and power supply methodologies to be implemented throughout Amaravati.

4.1 Residential Plans

5 residential developments are offered to provide a variety of lifestyle to the public.

1. **High Density Residence:** This is expected to house almost 15% of the total population and is proposed along the river Krishna waterfront and along the linear parks lining the waterfront. The type of building suggested is high rise apartments (of up to 20 stories) which are an effective way to deal with the land availability problem in India and are quite popular among middle class families. The apartments would also be integrated with community centers, playground, club house, pools, etc. giving the feeling of a typical gated community.
2. **Medium Density Residence:** This would house a smaller percentage of the population and is expected to be more affordable as, with common facilities within the apartment compound and built along green corridors. The height would be restricted to 8 stories and about 30% of the apartments would be meant for government employees and their families.
3. **Low Density Residence:** These would consist of detached and semi-detached houses limited to two-stories. Although land occupancy versus families housed ratio would be high, this residential plan would appeal to public that can afford individual housing and would prefer decongested residences. A set of luxury villas are also proposed on the island to limit the population residing there.
4. **Mixed Use Residence:** This type of residential space is expected to accommodate almost 60% of the SEED population and is built on the principles of “live, work and play” with a 70%–30% combination of residential and commercial spaces respectively. It would be built along the transit nodes to maintain high mobility in the region, even post office hours. A height of about 25 stories is set as upper limit for these apartment complexes.
5. **Village Residence:** Amaravati before being transformed into a world-class smart city consisted of small village tracts and that is exactly what this type of residency is trying to preserve, staying true to the character of this ancient city. Three villages would be retained as they are, each with unique characteristics situated near the Government Core, Downtown and near the arts and cultural hub of the capital.

4.2 Transportation

The road network is very well-planned for the capital in order to meet the demands of the expected and projected population with a hierarchy of transport layers each with a unique role (Refer Fig. 4 for SEED Road Network Plan). Out of the 88 km of road planned, 1.5% is for expressway, 5.7% for arterial roads, 8% downtown, 24% sub-arterial and 60% collector roads.

1. **Urban Expressways:** Built on the eastern edge of the development, this is expected to serve as the entrance to the city, consisting of the iconic gateway bridge. Also, it would serve as a connected to the neighbouring city of Vijayawada and Ganavaram airport.

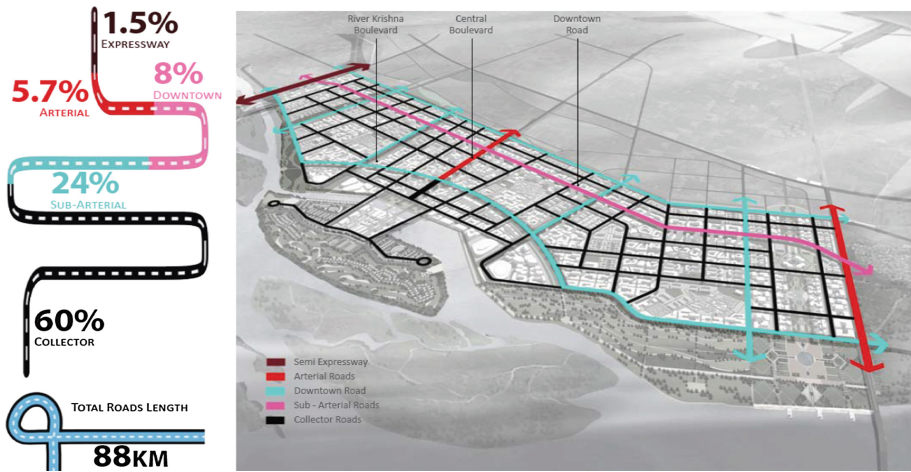


Fig. 4. SEED road network plan

2. Major Arterial Road Network: Responsible for carrying major vehicular traffic and mass transit, this arterial network would connect the government core to NH9, and residential areas. Also, it would connect to the newly proposed airport suggested to be built on the south region of the capital.
3. Sub-Arterial Road Network: Sub-arterial roads by definition, support the arterial roads and are responsible for providing access to chunks of the city, built along the green transit.

The public transport network is meant to encourage the public to travel by public transportation rather than resort to private vehicles, thereby reducing traffic and stress on the roads. It is built on three main network idea, i.e., Mass Rapid Transit Networks (MRT), Transit Oriented Development (TOD) and Bus Rapid Transit Loop.

The typical Character Roads defined by the type of building it is surrounded by and the public are: Downtown Road, Central Boulevard, River Krishna Boulevard and Collector Roads.

4.3 Amenities

4.3.1 Flood Management

Since the capital is planned along a huge water body, the risk of flooding exists and could be due to overflowing of Krishna River or runoff from Kondaveeti Vagu which is a tributary of Krishna River. Based on previous data and reports, the maximum rise of water is expected to be around 20 m above Mean Sea Level (MSL) while the bunds constructed to protect the capital range from 25 to 27 m above MSL.

To combat the flooding situation, the solution provided is simple yet elegant:

- Realigning and strengthening the river by lowering the existing bund platforms.
- Raising of platform on the island to prevent the water from entering the infrastructure in case of flooding.
- Construction of diversion channels to direct the water into Krishna river.

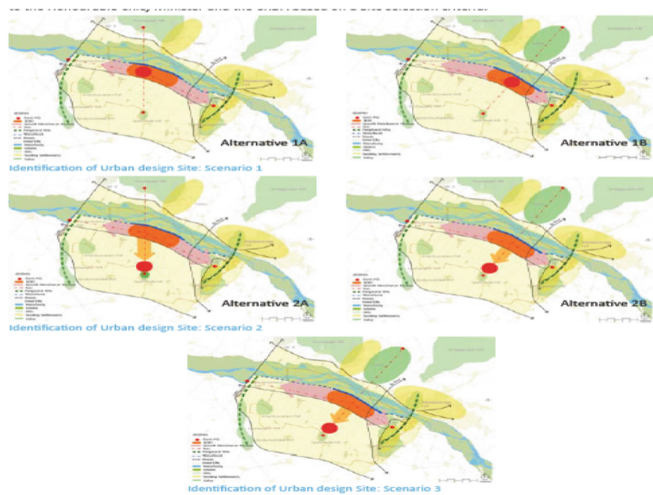


Fig. 5. Site options available

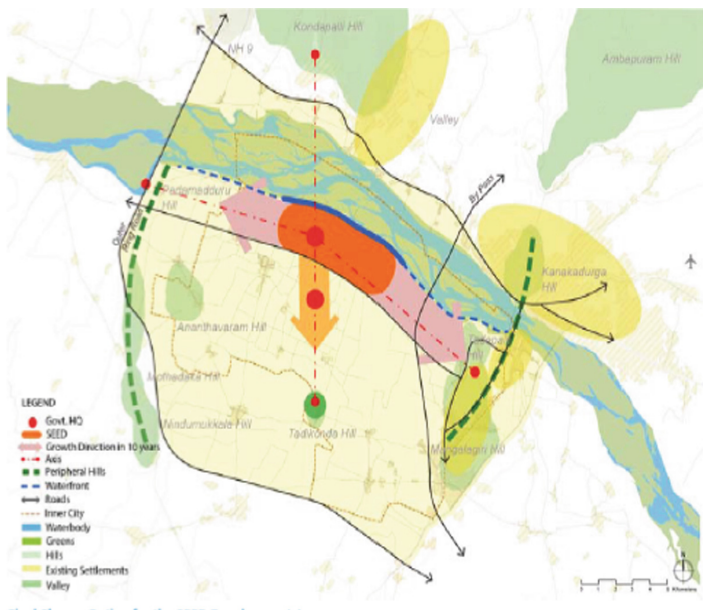


Fig. 6. Selected site

4.3.2 Water

Since a proper water supply plan and infrastructure is not already in place at the capital, a new one has to be built from scratch to meet the water needs of the city. (Refer Table 3 for Water Demand Projections).

Table 3. Water demand projections

	Water demand (MLD)	Service zone
Phase 1	11.6	WDC1
Phase 2	26.1	WDC1
Phase 3	26.1	WDC2
Phase 4	13.6	WDC3
Phase 5	18.3	WDC3
Total	95.7	

Water Treatment Plant would be built in stages but needs to be complete before Phase 1 of the SEED plan is implemented, it can be expanded based on the demand. It will draw water from the Krishna River.

Water Transmission Mains would be the means of transporting the treated water and would be built along the Downtown Road. The transmission mains need to be laid down at the same time as the road network so as not to disturb the infrastructure in case expansion is required.

Water Distribution Centers would collect water from the Water Main and store for later supply.

The waste water can be dealt with the temporary sewage treatment plant (STP) or gravity trunk sewer. (Refer Table 4 for Sewage Treatment Projections) Temporary sewage water treatment plant would be constructed outside the SEED development and its capacity would increase with the implementation of successive phases. Gravity Trunk Sewer would run along the downtown road connecting to the temporary STPs.

Table 4. Sewage treatment projections

	Sewage projections (MLD)
Phase 1	9.3
Phase 2	20.9
Phase 3	20.9
Phase 4	10.9
Phase 5	14.6
Total	76.6

4.3.3 Solid Waste Management

As a temporary solution, the landfill site at the neighbouring city of Guntur could be utilized to dispose of the solid waste generated. Instead of relying on heavy infrastructure, it is planned to construct a simple integrated solid waste management system in Vijayawada, wherein waste could be converted to energy.

5 Green Amaravati

Pollution has been a major problem in India for decades now, and keeping that in mind, Amaravati tries to curb it before it becomes serious. One simple way to achieve this is by having protected green belts, forested regions and multiple green parks spread

throughout the city. The civic axis is meant to be a ceremonial one running along the downtown road all the way to the government core. It gives a sense of easy accessibility to the core while at the same time serving as a gathering ground for the government and public, useful in times of parade as well. (Refer Fig. 7).



Fig. 7. Green Amaravati

The canal parks would be an extension of the arterial roads, meant to promote recreational activities within and along the canal. They serve a dual purpose because in case of flooding, they can act as natural drains into the Krishna River.

Community parks would line the river Krishna having a unique arc-shape complementing the concave of the river.

The Botanical Garden is planned to skillfully display the existing flora and fauna of the region, and would be a central attraction for the public.

The Wetland Park would seamlessly merge the beauty of the waterfront with that of the vegetation. It would serve as a picnic, camping, jogging spot and would be a characteristic feature of the green Amaravati plan.

All of the above mentioned plans would serve as primary greens. Secondary greens will act as park connectors and shaded walkways and promenades which would beautifully tie together the waterfront greens.

The tertiary network would connect the primary greens to nearby parks. All in all, a total of 282 HA of land would be dedicated to primary greens, 69 HA to secondary greens and neighbourhood parks and 20.6 km to green pedestrian walkways.

6 Place-Making Strategies

4 key nodes of development have been planned, each dealing with a different aspect of the city life (Refer Fig. 2 for Structure Plan for SEED Development Area):

1. **Government Core:** This is the whole reason for construction of the capital. It would consist of the three important arms of the government viz. The Secretariat, The Assembly and The High Court. Along with all the official space, accommodation for the office bearers and their families would also be provided. A large green central region would serve as a center for F&B activities, the aim being to make the core as accessible as possible to the public but not at the cost of security. Vehicular traffic will need to be diverted and must be minimized around the Core.
2. **Amaravati Gateway:** It would be the eastern entrance to the city consisting of the iconic gateway tower and iconic bridge providing the incoming tourists with a sense of grandeur as soon as they approach the city. The gateway would also be rife with a lot of open green places further emphasizing the beauty of the entrance.
3. **Amaravati Downtown:** As per the SEED Master Plan, the downtown is the commercial heart of the capital which would see maximum activity in terms of community involvement. It is planned to be well-connected by all public transit with the interchange of two transit lines at the central TOD serving as the high density commercial hub consisting of parks, canals, central boulevard, downtown road, etc.
4. **Amaravati Waterfront:** The waterfront is planned to be utilized to its full extent in terms of commercial and recreational usage. Community centers, parks, walkways, amphitheaters, etc. would all serve to attract the public. At the same time, the waterfront would be advertised as a high-end residential plot to maintain the serenity of the region by reducing congestion.

7 Implementation

The execution of this master plan is set to be in 5 major phases. (Refer Table 5 for Phase-wise Development Plan)

Table 5. Phase-wise development plan

	Total seed area	Residential population	Gross floor area (mil. m ²)	Total jobs
Phase 1	18%	26,000	2.49	95,000
Phase 2	18%	94,000	4.03	160,000
Phase 3	18%	99,000	4.04	152,000
Phase 4	11%	29,000	3.29	177,000
Phase 5	35%	50,000	3.35	113,000

Phase 1: The ultimate goal of building this new city is so that the newly formed government can immediately shift its headquarters to Amaravati and that is what the Phase 1 aims to implement. Hence development would start from western end of the region, with transport and downtown road network given high priority. The pre-existing village settlements would be retained as is.

Phase 2: Once the government core is complete, the growth would naturally be eastward with more emphasis on residential settlement. With growth in residents, pressure on road networks would also be high and hence the Bus Rapid Transit system (BRT) has to set in place. Other key developments include botanic Gardens on the river Krishna bank.

Phase 3: Following Phase 2 development, Phase 3 would grow in a similar fashion as that of Phase 1. BRT would be expanded and the arc road and collector road would be developed and completed in this phase. This phase would also concentrate on development of the commercial center and eastern business park.

Phase 4: The iconic gateway bridge and towers, in essence, the eastern entrance to the capital would be completed in this phase. The pressure on traffic is expected to rely completely on Mass Rapid Transport (MRT) corridors by the end of this phase. The city wetland park, complementing the botanical gardens would also be completed in this phase.

Phase 5: This phase would concentrate more on the development along the waterfront, that is along Krishna River, completing the island cluster. Since most of the roads and transit networks would be completed in the previous phases, only intimate road networks would have to be built based on the growing demands, if any.

8 Conclusion

Amaravati was envisioned to be a dream city for the state of Andhra Pradesh, it is one of the most ambitious infrastructure development projects taken up by the government. As per planning Phase 1 is expected to be completed by 2018, and progress is being made in that direction. The new Andhra Pradesh government will be moving to the partially complete core on the auspicious day of Dusshera, an important festival in India. A lot of talk has been rife regarding the plausibility of completing a project of this magnanimous scale within the estimated timeline, and many have written off the realization of such tall claims, but the work being done has managed to keep the critics at bay at least for the time being. The capital Amaravati is constantly on the news, scrutinized by the media and public alike with respect to the progress, which perhaps serves as another incentive for the parties involved to ensure timely completion of the development.

Although the government of India launched the Smart Cities Initiative in 2015, Amaravati is not yet officially a part of the selected cities, hence the funding comes from different international investors, to whom the government of Andhra Pradesh is answerable. Amaravati is already pioneering the new wave of emerging smart cities in India and hopefully would do a good job of the same.

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