

Sustaining Green Efforts: How Tech Parks in Bangalore Address Environmental Crises

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ABSTRACT

Bangalore, the capital of Karnataka is known as the Silicon Valley of India for the high number of ICT (Information and Communications Technology) companies and tech parks it has. The ICT industry has provided millions of people with jobs in this city and has resulted in a population explosion, which has over time led to Bangalore facing infrastructural crises along with strain on its natural resources. This paper discusses how sustainable architecture can set up a model for sustainability in perpetuity in Bangalore's tech parks in the 21st century.

Introduction

Bangalore is one of Asia's largest tech hubs. There are thousands of IT companies registered in the city today. Many of these IT companies are located in technology parks, or tech parks, spaces developed specifically to provide office space for companies involved in technology or science. The presence of tech parks in the city has helped boost Bangalore's economy, in terms of providing millions of jobs, attracting multinational companies, and inviting foreign capital. However, the presence of so many tech parks and tech companies also means that there is a lot of people present in the city, which has put a strain on the natural resources and the infrastructure of the city.

Sustainable architecture seeks to minimize the impact that the construction of and daily use of a building has on its environment. Although there is no rigid definition of sustainable architecture, most building projects seeking "sustainability," have obtained a certification such as LEED (Leadership in Energy and Environmental Design) which determines how efficient the building is. In India, buildings can obtain LEED certification from the IGBC (Indian Green Building Council). Sustainable buildings, as I will argue in this paper, should be economically, socially, and environmentally viable in the long run.

Bangalore, the Silicon Valley of India

The city of Bangalore, the capital of the state of Karnataka, served as an important administrative center under British rule. In 1909, India's first research university, IISC (Indian Institute of Science) was founded in Bangalore. The choice to build this important institute in Bangalore was made in part because of the city's existing infrastructure, including hydroelectric power plants and large highways that connected the city to other major southern metropolises, such as Chennai and Hyderabad. After the country attained independence in 1947, Bangalore evolved into a hub for public sector industries – particularly in aerospace, telecommunications, heavy equipment, and defense – which encouraged manufacturing giants like Hindustan Aeronautics, Bharat Heavy Electronics, Indian Telephone Industries, and Bharat Earth Movers to establish offices in Bangalore. During the 1950s and 1960s, the government invested heavily in companies like Hindustan Machine Tools (HMT),

Bharat Electronics Limited (BEL), and Indian Telephone Industries (ITI). Major research and development organizations (like Indian Space Research Organisation, Defence Research and Development Organisation, and National Aerospace Laboratories) set up headquarters in Bangalore, which encouraged scientists, engineers, and academics from all over the country to come and settle here.

By the 1980s, Bangalore was already a major center of education and research. In 1983, Infosys, one of India's first tech startups, decided to move its startup from Pune to Bangalore, and in 1985, Texas Instruments became the very first multinational company to set up operations in Bangalore (Basant, 2006, p. 10). In the early 1990s, a combination of new economic liberalization policies in India and the emergence of a robust education system in the city encouraged the development of an information and communications technology (ICT) sector in Bangalore. It paved the way for its rapid growth into both a national and a global ICT center. The first tech park built in Bangalore was the International Tech Park (referred to as ITPL) in Whitefield which was created as a joint venture between India and Singapore in 1994.

The benefits of Bangalore's infrastructure and abundance of resources led many multinational corporations (MNCs) to place their offices in the city, including IBM, Accenture and Apple, among many other corporations. In Bangalore, around 456 multinational corporations have set up offices in the city, 48% of the national total (CITATION). The presence of this high number of tech companies led to tech parks being set up in the city, which allows multiple companies to set up offices in one region. Companies rent space in tech parks and most of these tech parks are concentrated in the neighborhoods of Whitefield, JP Nagar, Koramangala, and Electronics City. Some of the largest developments in the city are Manyata, Bagmane, RMZ Ecoworld, and Embassy Tech Village tech parks.

The construction of tech parks in Bangalore is highly dependent on the zoning guidelines in the city. Most of the tech parks are built in regions called special economic zones (SEZs). Constructing tech parks and having your tech company located in an SEZ is beneficial for both import and export. It also promotes the export of software services and offers major benefits such as companies not needing to pay certain taxes or duties on imports, having no GST applied to your rent, operational cost, etc. The presence of SEZs in Bangalore is what makes this city one of Asia's largest tech hubs.

An Infrastructure Crisis

In the 1960s, Bangalore was home to around 280 lakes. Today, only about 80 of them remain. Some of these lakes were encroached upon and had residential areas built over them. Some of the lakes that do remain are highly polluted due to the release of untreated sewage water. The BWSSB (Bangalore Water Supply and Sewerage Board) expects an acute water shortage in the city of Bangalore by 2039 due to the growing population (Lalitha, S. (2021, April 10). *BWSSB pumps additional 35million litres per day to quench Bengaluru's thirst*. . . The New Indian Express). There is a developing deficiency in Bangalore's water supply, with 1450 million litres per day being transported from the Cauvery to the city every single day. 19 thousand million cubic feet of the water allocated to the city comes from the Cauvery River and a small percentage of water being used in the city is groundwater (mostly in rural areas, or the outskirts of the city).

Tech parks have contributed to the already strained transportation infrastructure (This strain is also compounded by an influx of immigration from rural places. There is also the issue of rapid unplanned urbanization. While the city continues to grow in certain areas, not all parts of Bangalore can benefit from urban development. This urbanization resulted in the cost of living increasing and this has increased.). In parts of the city, when visitors venture into layouts, narrow streets become common. Near regions like Outer Ring Road, the sides of the roads are used as parking spaces. Interior access roads near huge commercial spaces in the city are also very congested due to all these infrastructural issues which lead to high TVOC levels near areas with a lot of built-up areas, like Whitefield, JP Nagar, Koramangala, and Electronics City. Tech parks in Bangalore

have an enormous carbon footprint since they use copious amounts of electrical energy, water, and natural resources to sustain the employees inside the buildings daily.

Building and Designing Tech Parks: An Introduction to RMZ Corp.

There are several large construction and development firms in India that specialize in building tech parks, for example, Embassy, Brigade, Prestige, and RMZ group. To analyze the social and environmental effects of sustainable tech parks in Bangalore, this paper examines tech parks developed by RMZ Corp., a company that has expressed a strong commitment to sustainability.

RMZ Corp. is a privately owned development and management firm, whose main focus is real estate investment. It was established in 2002 and most of its projects are billed as “eco-friendly office spaces for rent.” (RMZ Corp. (n.d.-b). *RMZ Corp: Designing Eco Friendly Buildings & Office Spaces For Rent.*). Most of their projects are sustainable, with LEED and IWBI (International WELL Building Institute (WELL Building Standard rating system is a verified pathway for measuring, benchmarking and improving building performance to support human health and well-being.)) certification. They received their first LEED-certified building in 2008, which was RMZ Ecospace, located in Bangalore and their ultimate goal is for them is to develop ‘net-zero spaces’. Their ESG report for 2020-21, sustainability policy, sustainable procurement, and supply chain policy, among other documents, are open to the public. In the ESG report (2020-21) document, the company outlines their focus on certain SDGs (Sustainable Development Goals) which they focus on while planning and constructing a building. This consists of SDGs: clean water and sanitation (no. 6), affordable and clean energy (no.7), decent work and economic work (no.8), industry, innovation and infrastructure (no.9), sustainable cities and communities (no. 11), responsible consumption (no. 12), life on land (no.15). The case studies that I have selected, RMZ Ecoworld and RMZ Infinity are both gold certified.

LEED (Leadership in Energy and Environmental Design) certification is the most widely used and recognized green building rating system in the world. In India, the IGBC (Indian Green Building Council) uses LEED to recognize buildings that have been “proven to save money, improve efficiency, lower carbon emissions, and create healthier places for people.” (*USGBC homepage | U.S. Green Building Council.* (n.d.). U. S. Green Building Council.). Compared to the average commercial building, LEED Gold buildings in the General Services Administration’s portfolio consume a quarter less and also generate 34% less greenhouse gas emissions, compared to buildings that don’t qualify to be LEED certified (Dinsdale, N. (2021, March 11). *LEED Certification: What it Means, How You Can Maintain it, and Why it’s More Important than Ever.* 2021–03-11 | *Engineered Systems Magazine.*). LEED projects are also responsible for diverting more than 80 million tons of waste from landfills (*Press: Benefits of green building | U.S. Green Building Council.* (n.d.). USGBC.). LEED certifying a building could help lower the operating costs of the building, resulting in durable buildings with better air quality, and buildings that could help support the local economy. It is important to note that not all sustainable buildings are zero-carbon, or have absolutely no negative impact on the environment, but all zero-carbon buildings are sustainable. LEED certifying a building also offers other benefits, such as reduced electricity consumption in urban areas, it supports decarbonization initiatives in cities and it also enables governments to supply electricity to remote villages.

It is a relatively new system for determining the sustainability of buildings around the world and was established in 1993. It is considered the international measure of green architecture. The builders/ architects/engineers working on the project select a kind of LEED certification for their project. They can choose from Building Design and Construction (BD+C), Interior Design and Construction (ID+C), Building Operations and Maintenance (O+M), Neighborhood Development (ND), Homes, Cities, and Communities, or LEED Zero certification.

Out of these 5 categories of certification, the case studies I have selected were only considered for the Interior Design and Construction (ID+C) category. This is because the ID + C category is not just about the

construction and design of the building but about the long-term use of the building, which is what makes it, I argue, truly a sustainable project. For each type of certification, the building is scored out of 110 points (35% of the credits in LEED are related to climate change, 20% of the credits directly impact human health, 15% of the credits impact water resources, 10% of the credits affect biodiversity, 10% of the credits relate to the green economy, 5% of the credits impact community and 5% of the credits impact natural resources.), which are divided into 9 categories: integrative process, location and transportation, sustainable sites, water efficiency, energy and atmosphere, materials and resources, indoor environmental quality, innovation, and regional priority credits. Based on how many points the building gets in each category, it is either only registered as ‘certified’ (40-49 credits), silver (50-59 credits), gold (60-79 credits), or platinum (80+ credits).

Each certification is only valid for three years, at the end of which the building must get recertified. Depending on how well the project scores, it will either gain higher certification, retain the same score, or receive a lower score. The practice of reassessment makes sure that these building projects are not simply branded as sustainable upon completion but are sustainable projects in the long term. It determines how sustainable a building is—the green solutions that a building or project has for real-world problems cannot be short-term solutions, which cause more complex problems in the future, and only solve the problems at the surface. These solutions should be long-term because the purpose of LEED certification is to recognize methods of construction and design that set the model for sustainability in perpetuity.

Case Studies

Case study 1: RMZ Ecoworld

RMZ Ecoworld is a 650,000 sqm technology park located in the eastern Bangalore neighborhood of Marathahalli. The tech park consists of 16 towers spread out over 77.8 acres. Apart from providing office space, RMZ Ecoworld also has amenities like an art gallery, a 500-seat amphitheater, restaurants, convenience stores, a gym, art installations, and a social lobby. The facades of the buildings are mostly made out of blue-tinted glass and sandy-colored concrete. Apart from this tech park’s LEED certification, RMZ Ecoworld’s spaces are “visually” green, the architects having incorporated lawns, thick foliage, and abstract sculptures that incorporate the concept of plant life in the landscape (Fig. 1). The use of green, blue, and brown materials evokes the natural environment which is meant to remind visitors about the natural, green, and sustainable nature of this tech park. The facade of the buildings is not flat; parts of the building jut out, creating an abstract, vaguely cuboidal outline for each tower (Fig. 2). By using this kind of design for the towers and incorporating a lot of elevated decks and pathways, this tech park, to a visitor, creates the illusion of more open space than what is there.

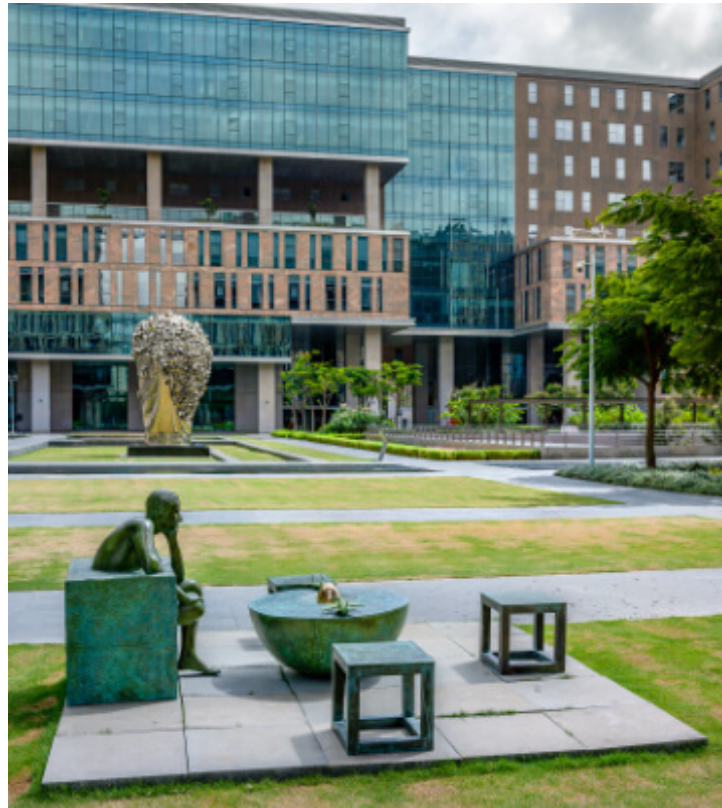


Figure 1.



Figure 2.

All of the buildings in RMZ Ecoworld have large windows which allow for the offices inside the buildings to receive a lot of natural light, which adds to the positive experience of working inside these “green” spaces. Additionally, with most buildings receiving high amounts of sunlight, the tech park saves some energy during the day when artificial light usage is low.

RMZ Ecoworld only pursued LEED Gold certification in interior design in 2019. Of the 16 towers, only four buildings are LEED-certified (Buildings 5A, 5B, 8A, and 8B). These buildings provide over million square feet of office and recreational space and service approximately 10,000 people. The building's sustainable interior was evaluated based on five sub-categories: "water, waste, energy, transportation, and the human experience".

In the water category, RMZ integrated an already existing on-site sewage treatment plant. Through this treatment plant, the tech park was able to clean water for reuse in various areas (e.g., landscape irrigation and toilet flushing). The consistent recalibration of water fixtures in the tech park ensures that the use of water is as optimized as possible. In the pre-existing rainwater collection systems installed around the RMZ Ecoworld campus, a re-use system was implemented that helped to significantly reduce water consumption (U.S. Green Building Council, 2019, p.3). Currently, the water consumption of the buildings examined by LEED on Ecoworld's campus is 3699.0273 gallons per occupant per year ((U.S. Green Building Council, 2019, p.3). In terms of on-site waste management, RMZ relies on private contractors as well as municipal departments to pick up recyclable waste on-site and transport it to various recycling facilities around Bangalore. This public-private model ensures that waste is disposed of in an organized manner and prevents contamination of recycling waste onsite. Ecoworld's management also integrated an organic waste management system into the office buildings. This has helped to manage food waste being produced on-site, diverting it from landfills and converting it into compost.

While re-certifying RMZ Ecoworld, the project team installed technologies that automatically turn off artificial lights when exposed to natural lighting. Additionally, while the team was not able to make renovations that should've been mandatory within spaces that had already been rented, the project team made sure to fit the external areas, like the lobby and other common open spaces to accommodate LED light fixtures (which were more energy efficient than the pre-existing fixtures) (U.S. Green Building Council, 2019, p.2). This is why sustainability requires long-term commitment, which is not only directed towards maintaining structures in buildings that make them sustainable, but to also recognize places in the building which require further operations to be set up in order for the space to be sustainable. The HVAC (Heating, Ventilation, and Air Conditioning) system present in the tech park's buildings was re-programmed, along with the operating schedules of the systems. Through re-calibration, Ecoworld was able to set new operating controls that ensured the systems were always running at optimal loads. After taking all these measures, RMZ Corp. found that they had reduced RMZ Ecoworld's energy use by 30% which also cut down its energy operation cost.

The location of RMZ Ecoworld is highly accessible to public transportation and many of the occupants of the tech park use carpools or company transportation to reach the tech park every single day. In terms of location and transportation, Ecoworld scored 12/14 points. Reducing transportation emission levels by at least 10% would result in one more point scored (U.S. Green Building Council, 2019, p.5).

Most of the buildings certified by LEED in RMZ Ecoworld were not able to meet the TVOC (Total Volatile Organic Compounds) thresholds set by LEED. This is a category that many LEED Projects struggle with, especially in India, mainly because of high air pollution levels, a part of which might be transport emissions. To fight high TVOC levels, the project team at Ecoworld prioritized infrastructure installation across the campus. They introduced carbon filters, UV lamps, and photocatalytic oxidation units to the tenant spaces that most exceeded the maximum limit of TVOC levels. Another major problem with handling indoor TVOC levels is that many tenants have complete control over the interiors of their office spaces, and there is no central body in this tech park that defines what paints and materials can be used. With this lack of a central body, many of the materials used in interiors do not meet LEED's TVOC thresholds. After a particular space is rented out to a company, it is the tenant's responsibility to carry out efforts in order to improve the certification of a building. If a space has been rented out and the tenant is still carrying out the process of LEED-certifying the area every 3 years, that means they would also be making consistent efforts to improve the area. This would also display the commitment that a tenant would give to developing a sustainable space for their employees.

The highest TVOC level measured within the Ecoworld buildings certified by LEED is 1,900 micrograms per cubic meter. The upper limit of safe TVOC levels is only 1000 micrograms per cubic meter, meaning that there is considerable work that will need to be done to ensure the well-being of RMZ Ecoworld's occupants. This can be assisted by the further installation of activated carbon filters, improved filtrations in air handling units, and the use of certified chemicals for cleaning and ongoing maintenance.

Case Study 2: RMZ Infinity

RMZ Infinity is an approximately 112, 000 sqm technology park located on Old Madras Road, in the eastern part of Bangalore. This tech park was built in 2006 and has since undergone multiple small-scale renovations to boost its LEED certification over time. It consists of 5 towers and contains amenities like a social lobby, restaurants and cafés, convenience and retail stores as well as a gym. This tech park's design emphasizes the use of glass and steel structures with elevated decks and platforms around the tech park (Fig. 3). This tech park is relatively smaller and older than RMZ Ecoworld but it also seems to be a lot more responsible in terms of its management of water, transportation, and energy. The facade and landscape of the tech park focus on the use of blue and grayish materials; the tech park has also incorporated fountains and water features in the landscape (Fig. 4). To a visitor, the rigid form of the elevated decks and buildings contrasts with the fluidity of water and the rest of the landscape. This tech park has scored a 12/12 in water efficiency, but they have a lot of small water fountains outside the tech park. Water fountains do require high amounts of water and it has not been clearly stated where this water is being sourced from, if it is recycled or not, and how the use of these fountains affects the LEED water efficiency score.



Figure 3.



Figure 4.

It does not seem like this tech park receives a lot of natural light inside its buildings, or is well lit from the inside, which reflects in its LEED score. It only scored 4/17 points in terms of indoor environmental quality (Synopsys, RMZ Infinity-Tower B 2nd Floor | *U.S. Green Building Council*. (n.d.). U. S. Green Building Council.) in Tower B and scored no points in some of the subsections of this category, some of which include: daylight, interior lighting, thermal comfort, quality views, and low-emitting materials (which relates to materials being used to lower TVOC levels inside the building). As previously discussed, sometimes the levels of TVOCs cannot be helped in certain cities, like Bangalore and this is mostly because there is a high level of pollution outside the tech park out of which a certain percentage is brought in by the approximately 9,000 community members who work there daily.

Each of the 5 towers in RMZ Infinity has received individual LEED certification, but Tower B's LEED certification is the most recent. This building has been judged in 8 categories: integrative processes (2/2), location and transport (17/20), water efficiency (12/12), energy and atmosphere (25/38), material and resources (2/13), indoor environmental quality (4/17), regional priority credits (4/4) and innovation (5/6). In terms of integrative processes, water efficiency, as well as the energy and atmosphere, all come under the same category because they discuss how efficient the tech park is with its basic resources: water and energy. This tech park has scored well in all these categories, but especially in water efficiency because it has reduced its water consumption by 50%, which means that it has installed water fixtures, assessed all potential non-potable water sources, such as on-site rainwater and greywater, municipally supplied nonpotable water, and HVAC equipment condensate. This allows the tech park to be as efficient with its water usage as possible, along with setting up water recycling plants that minimize water waste as much as possible.

In terms of energy use, this tech park has not done much to score points in renewable energy production, enhanced refrigerant management, or green power and carbon offsets. Tech parks leave an enormous carbon footprint, given that they are heavily dependent on electricity, and having renewable energy production on-site would reduce operational costs as well as carbon footprint, even giving back to the grid on a certain level. There is a need for renewable energy production that needs to be fulfilled in all of Bangalore's tech parks, but

so far there has not been much that has been done in that sector. However, this park optimized its energy performance and installed HVAC systems, and improved its energy performance from the previous certification (in 2017) by 16%. This tech park has optimized its energy performance, gives employees access to good quality transportation to the tech park, and has reduced interior water consumption.

Conclusion

Sustainable architecture has had a positive environmental and social impact in the tech parks I have analyzed. Although these projects might not be the best examples of sustainable architecture in India, they demonstrate how companies can promote sustainable architecture and make sustainability plans for the future. Moreover, the reevaluation of LEED certification is what determines how sustainable a building is in the long term– it displays the commitment to finding green solutions. Sustainable architecture is an ongoing process; it is not something that can be achieved once. LEED’s practice of reevaluation makes sure that these projects are not simply branded as sustainable upon completion, but are sustainable projects in the long term. The city of Bangalore is using its major industry–technology and science–to solve infrastructural and environmental problems with the help of sustainable architecture. This same model can be applied to different Indian cities, where we can analyze how each city’s major industry might be burdening the environment and try to solve it by investing in sustainable architecture that should be economically, socially, and environmentally viable in the long run.

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