



# ANALYSIS OF INCREMENTAL COST TOWARDS THE ACTIVE AND PASSIVE DESIGN STRATEGY IN A HIGH-RISE RESIDENTIAL GROUP DEVELOPMENT IN CHENNAI.

ANNAMALAI A

SPADE, Hindustan Institute of Technology and Science, Chennai, India.

## ABSTRACT

Indian cities are witnessing immense demographic expansion due to migration from surrounding villages, leading to urban sprawl, housing demand, rise in cost of land. Housing has developed into an economy generating industry. Given this demand, while high-rise residential structures have become a solution in the metropolitan cities due to urbanization. The residential industry consumes lot of energy and materials and impact the environment. By sustainable development we meet the needs of the present without compromising the future generation needs and also reduce the negative impacts from the building. Where in the evidence from the literature highlights the incorporation of this will increase the cost of Construction.

As the Present real estate scenario is sluggish, from the real estate perspective to optimize the construction cost the sustainability developments is given the least priority.

The need for the study is to understand the incremental cost towards the Sustainability design features spent on a High-Rise Residential Group development in a Real estate Perspective in Chennai.

**Keyword's: Real Estate, Sustainability, Passive design, Active design, Incremental cost, Additional FSI**

## 1. INTRODUCTION

Real estate sector is the single most significant sectors in terms of CO<sub>2</sub> contributions. The sector consumes over 40% of global energy annually and there is a projected 56% increase in building CO<sub>2</sub> emissions by 2030 (World Economic Forum Industry Agenda Council on the Future of Real Estate & Urbanization). About 1/3rd of the CO<sub>2</sub> emissions leading to climate change, has been attributed to building segment. With the concepts of "Housing for All" (Growth of Indian building sector CWF, 2010) there will be a possible increase in CO<sub>2</sub> emissions.

To reduce the consumption & depletion of the natural resources and to save the energy and preserve for the future, the sustainable building becomes the most suitable solution. The Study is to analyze the Incremental cost towards the Active and passive design Strategy in a High-rise Group housing in Chennai.

## 2. OBJECTIVE & METHODOLOGY

The Objective is to study the literature about the various Passive & Active design Strategy, with reference to IGBC & ECBC and incorporate those strategies in the design of high rise building and calculate the incremental cost.

The Methodology is as follows.

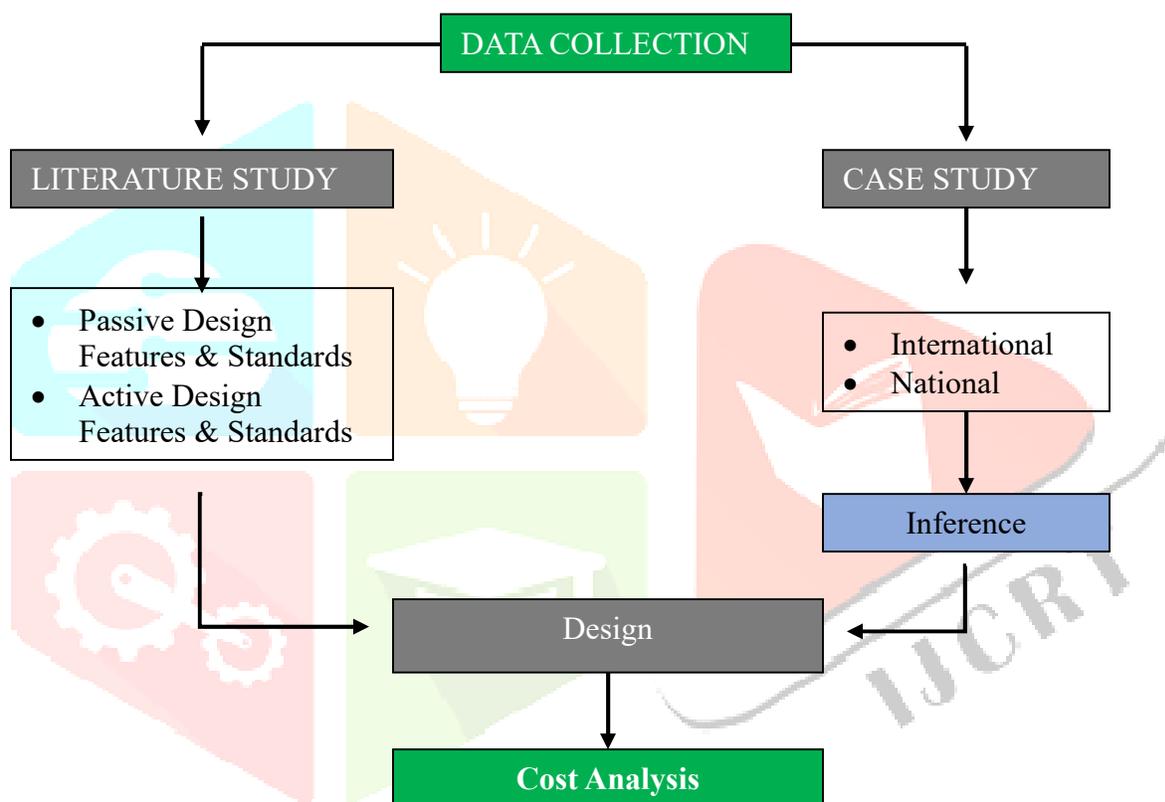


Figure 1: Methodology Flow Chart

## 3. DATA COLLECTION

### 3.1 References from IGBC & ECBC:

S.o	Parameter	Description
01	Site selection	Site with access to at least seven basic house-hold amenities, within a walking distance of 1 km from the building entrance
02	Natural Topography/Vegetation	Avoid disturbance to the site by retaining natural topography or vegetation and/ or design vegetated spaces for at least 15% of the site area

03	Heat Island Effect - Non roof	For at least 50% of exposed non-roof impervious areas (such as footpaths, pathways, roads, uncovered surface parking and other impervious areas) within the project site, provide at least one or combination of the following, Shade from tree cover within 5 years or Open grid pavers, including grass pavers
04	Heat Island Effect - Roof	50 % of the exposed roof with China mosaic or heat reflective tiles or 50 % with terrace garden
05	Cross Ventilation	Ensure that minimum 50% of the regularly occupied spaces (by area) in each dwelling unit shall have an opening (doors/ventilators/windows) to the outdoor environment, in at least two of the orientations
06	Natural Ventilation	Provide openable windows or doors to the exteriors in all regularly occupied spaces of each dwelling unit such that the openable area is designed to meet the criteria of 10,8 & 4 % of the carpet area of the Living, Kitchen & Toilets.
07	Projection Factor	Shading devices with the Projection factor $0.25 \leq PF \leq 1.0$ , Recessed windows
08	Building Envelope	To have materials with Low U Value and Windows with Double Glazing.
09	Others	Use of Solar Energy for 1/3 <sup>rd</sup> of the Terrace as per CMDA Norms. Rain water harvesting for Roof and Surface. Grey water Recycling.

Table 1: IGBC &amp; ECBC References

### 3.2 Case study Inferences

**Project Name: Osian Chlorophyll, Chennai**

S.no	Description	Status
1	Heat Island Effect - Roof	Terrace Garden, China Mosaic Tile Provided

2	Heat Island Effect – Non-Roof	Landscape Lawn, and paved tiling provided
3	Landscape area- Micro Climate	25 % Landscaping done but not on the direct Ground
4	Amenities	Amenities are provided and connected to outside amenities also
5	Waste water treatment & Re use	Provided for Landscape & Toilet Flushing
6	Rain water harvesting- Terrace & Surface	For Surface alone provided
7	Day lighting	10 % of the Carpet area of the Rooms are provided
8	Cross Ventilation	Not provided
9	Orientation	Major blocks Face East –West orientation but the Majority of the Windows are provided with shading devices
10	Shading devices	Provided for Most of the Windows

Table 2: Case Study Inferences

#### 4. COST ANALYSIS

To analyze the cost, a 25 acres site at Porur, Chennai is taken and designed for Highrise group development based on the Inferences and references from Case study and Literature study, There are Three types of Blocks and each block have the combination of 1, 2 & 3 BHK Combination.

Each block is G+14 Floors and the building height is 49.5 m and the car parking is provided at the basement. The blocks are arranged to get maximum views and Facing towards the landscape & open spaces on two sides. Some of the blocks are connected at multiple levels which will acts a communal gathering space. There is viewing deck with the seating arrangement at the corridor to have a view towards the landscape.

Individual unit have cross ventilation and adequate natural lighting and open towards outside. Each unit will have a open terrace and this will be staggered vertically. This terrace is in addition to the balcony area. This terrace can be used as place for vertical landscaping and this creates shade to the building as well.

The design meets the requirements of the site selection, 15 % of landscape area, Heat Island effect roof and Non roof, Cross ventilation, Window wall ratio, Projection Factor, Use of Solar energy and Rain water harvesting for the roof and non-roof as per the IGBC & ECBC reference value and the cost is calculated.



Figure 2: Site Plan

Block Type	No of Blocks	Area/Block sq.m	Total Area sq.m
Type A	2	54488.8	108977.6
Type B	2	28088.64	56177.28
Type C	8	17602	140816
			<b>305970.88</b>
<b>Land area (25 Acres))</b>			<b>101175</b>
<b>FSI Achieved</b>			<b>3.02</b>

Block Type	No of Blocks	1 BHK	2 BHK	3 BHK	Total
Type A	2	64	320	192	576
Type B	2	128	640	384	1152
Type C	8	384	1024	256	1664
		576	1984	832	<b>3392</b>
		<b>16.98%</b>	<b>58.49%</b>	<b>24.53%</b>	
<b>Area (Sq.ft)</b>		600	1000	1175	
<b>Carparking</b>			1984	832	<b>2816</b>

Table 3: Area Statement

No of Flats	3392			Remarks
Built up area	4279071	Sq.ft		
Cost of the Project(Rs)	₹ 1,027	Crоре		
15% of Land area	<b>3.75</b>	Acres		Statutory Requirement as per MOEF ,EIA Approval.Incremental cost is Calculated for Lush Landscaping
	163357.155	Sq.ft		
<b>1 Landscaping (Rs)</b>	100	Sq.ft		
	₹ 1,63,35,716			
<b>Incremental cost</b>			<b>0.16%</b>	
<b>2 50 % of the Terrace area</b>	<b>102914.604</b>	Sq.ft		
Landscaping (Rs)	220	Sq.ft		
<b>Incremental cost</b>	₹ 2,26,41,213		<b>0.22%</b>	
<b>3 Cross Ventilation</b>				
75 % of the Flat ( All Bedrooms)				
Windows area/Flat	64	Sq.ft		
For 2544 Flats	162816	Sq.ft		
Cost (Rs)	550	Sq.ft		
<b>Incremental cost</b>	₹ 8,95,48,800		<b>0.87%</b>	
<b>4 Double Glaazing(Rs)</b>	750	Sq.ft		
Window area	628918.992	Sq.ft		
<b>Incremental cost</b>	200	Sq.ft		
	₹ 12,57,83,798		<b>1.22%</b>	
<b>5 Total Incremental Cost</b>	₹ 25,43,09,527		<b>2.48%</b>	
<b>Say (Rs)</b>	<b>25</b>	<b>Crоре</b>		
<b>6 Solar Panel /Flat (Rs)</b>	22000			
No of Flats	3392			
<b>Incremental cost</b>	₹ 7,46,24,000		<b>0.73%</b>	Statutory Requirement as per CMDA Norms.Not Considered in the Total incremental cost
<b>7 Rain water Harvesting &amp; Storage</b>				
Roof Storage	430000	Litres		
Cost (Rs)	22	Litres		
<b>Incremental cost</b>	₹ 94,60,000		<b>0.09%</b>	
Surface water	270000	Litres		
Each Recharge pit	9000	Litres		
Cost (Rs)/Pit	18000			
No of Pit	80			
<b>Incremental cost</b>	₹ 14,40,000		<b>0.01%</b>	
<b>8 Envelope Wall</b>				
Wall Quanity	383040	Sq.m		
Concrete Blocks (Rs)	1700	Sq.m		
AAC Blocks (Rs)	2200	Sq.m		
<b>AAC Blocks Incremental Cost</b>	₹ 19,15,20,000		<b>1.86%</b>	
	₹ 27,70,44,000		<b>2.70%</b>	
<b>Say (Rs)</b>	<b>28</b>	<b>Crоре</b>		

Table 4 : Cost Analysis

<b>Total Incremental cost</b>	<b>₹ 45,67,29,527</b>	<b>4.45%</b>
<b>Incremental cost/Sq.ft</b>	<b>₹ 107</b>	

## 5. CONCLUSION

The Cost analysis is done based on the design, for the key component of the Passive and the active design such as Landscaping, Cross ventilation, Natural lighting, shading devices, Heat Island effect of Roof and Non roof, Double glazing, AAC blocks, solar panels at the terrace, zero discharge of Rain water and found that the incremental cost is **4.45 %** of the total project cost and it is approximately **Rs 107 /sq. ft** of increase in the construction cost.

By this increase in the additional cost, we have tangible and intangible benefits to the community in terms of enhancing the Living quality of the People by providing the Natural lighting and indoor environmental quality. By using the Low U value and double glazing the thermal transmission is less to the indoor and there by reduction in the HVAC load and corresponding electrical energy saved.

By considering the benefits towards the sustainability and protecting the natural resources, it is recommended to spent the additional cost to have a sustainable environment and preserve the natural resources for the Future.

In a developer perspective to spend the additional/incremental cost and to benefit them as a policy can be brought in the Tamilnadu Development control rules (CMDA), for some percentage of additional FSI can be given if the project is meeting the Sustainable parameter and Green building certification.

This additional FSI will leads to additional saleable area for the developer and this motivates for the development of Sustainable buildings.

## REFERENCES

- **IGBC** – Indian Green Building Council manual on Homes.
- **ECBC**- Energy conservation Building code.
- **NBC**-National Building code
- **DCR**- Development Control Rules of CMDA
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