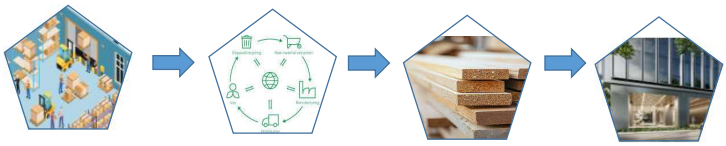
EMBODIED CARBON OPTIMIZATION IN COMMERCIAL BUILDING THROUGH LIFE CYCLE ASSESSMENT OF

KALPATARU INFINIA A



Inventory Analysis | Life Cycle Analysis | Alternate Materials | Design Finalization

Timelines of the Project : April - 2022 to May - 2024

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INTRODUCTION

- Location - Vakola, Santacruz East, Mumbai, Opposite Grand Hyatt Hotel.
- Configuration – 3B + Gr + 12 Floors.
- Total Construction area of 10,744.18 square meters.
- Connectivity –
  - Roads – Western Express Highway, Santacruz-Chembur Link Road (SCLR)
  - Train - Santacruz and Kurla Railway Stations,
  - Metro from Santacruz Metro Station.
- Environmental Parameters Considered - Energy Efficiency, Water Management, Solid Waste Management, Sewage Treatment Plant.
- Upon completion, the project was handed over to ICICI Prudential Asset Management Company.

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BROAD OBJECTIVE OF THIS STUDY

- To **evaluate** the environmental **impacts associated** with the design and construction phases of the building.
- To identify and **quantify** the **carbon footprint** and other key environmental indicators using the **One Click LCA tool**.
- To assess **material usage, energy consumption and waste generation** throughout the building lifecycle stages.
- To provide **data-driven insights** for reducing negative environmental impacts during construction.
- To support **sustainable decision-making** in building design and construction processes.
- To **benchmark** the **environmental performance** of the building against industry standards or regulations.
- To promote **awareness** of environmental sustainability in the construction sector.

SPECIFIC OBJECTIVE OF THIS STUDY

- To Optimize embodied carbon in building materials
- To Optimize multiple environmental impacts of building materials
- International benchmarking

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Tangible Benefits:

ENERGY BENEFITS

- Low-embodied-carbon materials often require **less energy** during **extraction, transport, and processing**, reducing overall energy usage in the construction supply chain.

RESOURCE BENEFITS

- Efficient material sourcing and manufacturing (**less cement, more recycled steel**) typically use **less water** than traditional high-carbon options.

CARBON REDUCTION

- Building with **optimized materials** and **efficient logistics** can lower construction-phase embodied carbon by reducing total project emissions sharply.

Intangible Benefits:

REPUTATION

- This Building is awarded Green Building **LEED Gold** Certificate.

SOCIAL AND WELLBEING BENEFITS

- Safer construction sites and Procuring material with supply chains result from using **non-toxic, responsibly sourced materials**, creating a **healthier environment for laborers** and communities

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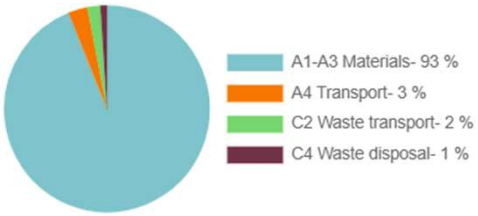
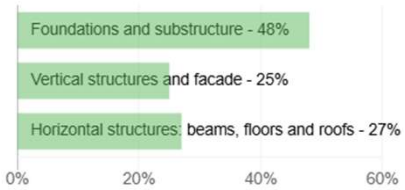
INITIAL LCA INSIGHTS



EMBODIED CARBON BY LIFE-CYCLE STAGE



EMBODIED CARBON BY STRUCTURE - A1-A3

STRATEGIES IMPLEMENTED

USAGE OF RECYCLED STEEL FOR REINFORCEMENT

- Recycled steel is widely used in construction for structural framing, reinforcing bars, and building components, offering significant environmental and economic benefits.
- Unlike many other materials, steel can be recycled repeatedly without losing its strength or quality, aligning it with the principles of a circular economy

USAGE OF FLY-ASH IN CONCRETE

- Fly ash is used in concrete as a supplementary cementitious material (SCM) to partially replace Portland cement.
- It improves the concrete's workability, strength, and durability while offering environmental and economic benefits.

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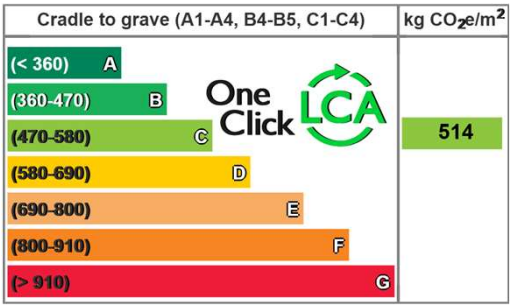
BENCHMARKING

Performance metric Carbon Heroes Benchmark (A1-A4, B4-B5, C1-C4)
Global office - 2023 Q3

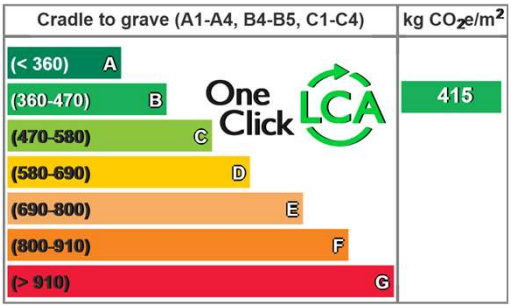
Average GWP impact: 636 kg CO2/m2,
70% percentile GWP impact: 729 kg CO2/m2.

This is a Benchmark created by One Click LCA based on Global data for office buildings

Initial Design Assessment



Final Design Assessment



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RESULTS IN ONE CLICK CLA BASED ON MATERIALS, TRANSPORTATION & WASTE PROCESSING

KALPA-TARU

	Result category	Global warming kg CO_2e	Ozone Depletion kg CFC11e	Acidification kg SO_2e	Eutrophication kg PO_4e	Formation of ozone of lower atmosphere kg Ethenee	Depletion of nonrenewable energy MJ	Biogenic carbon storage kg CO_2e bio	Mass of raw materials kg
A1-A3	Construction Materials	3,40E+06	1,46E−01	1,86E+04	3,93E+03	1,04E+03	3,31E+07	0,00E+00	1,83E+07
A4	Transport to the building site	1,49E+05	2,56E−02	2,64E+02	5,48E+01	2,10E+01	2,33E+06		
A4-leg2	Transportation to site - leg 2								
A4	Transportation to site	1,49E+05	2,56E−02	2,64E+02	5,48E+01	2,10E+01	2,33E+06		
B3a	Repair - materials	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00		0,00E+00
B3b	Repair - transport	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00		
B3b-leg2	Repair - transport leg 2								
B3c	Repair - waste	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	
B3	Repair	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00		0,00E+00
B4-B5a	Material replacement - materials	1,55E+04	3,97E−04	6,84E+01	1,81E+01	5,72E+00	1,75E+05		3,07E+04
B4-B5b	Material replacement - transport	1,42E+02	2,79E−05	6,45E−01	1,40E−01	8,38E−03	4,02E+03		
B4-B5b-leg2	Material replacement - transport leg 2								
B4-B5c	Material replacement - waste	1,87E+02	3,55E−05	1,08E+00	2,32E−01	2,31E−02	4,24E+03	0,00E+00	
B4-B5	Material replacement and refurbishment	1,58E+04	4,60E−04	7,01E+01	1,84E+01	5,75E+00	1,83E+05		3,07E+04
C2	Waste transport	8,78E+04	1,73E−02	4,01E+02	8,73E+01	5,36E+00	2,51E+06		
C3	Waste processing	2,11E+03	2,83E−04	1,48E+01	2,09E+00	7,17E−01	5,09E+04		
C4	Waste disposal	4,51E+04	8,10E−03	3,31E+02	7,09E+01	9,03E+00	6,52E+05		
C1-C4	End of life	1,35E+05	2,57E−02	7,47E+02	1,60E+02	1,51E+01	3,21E+06		
Full building	Full building to GHG	3,70E+06	1,97E−01	1,96E+04	4,16E+03	1,09E+03	3,88E+07	0,00E+00	1,83E+07
	Total	3,70E+06	1,97E−01	1,96E+04	4,16E+03	1,09E+03	3,88E+07	0,00E+00	1,83E+07
	Comparing total results with: 6 - Baseline case Plot-A								
	6 - Baseline case Plot-A Total	4,59E+06	2,28E−01	2,21E+04	7,64E+03	1,71E+03	4,61E+07	0,00E+00	
	6 - Actual design- Plot-A compared with 6 - Baseline case Plot-A	−19 %	−13 %	−11 %	−45 %	−37 %	−16 %	0%	

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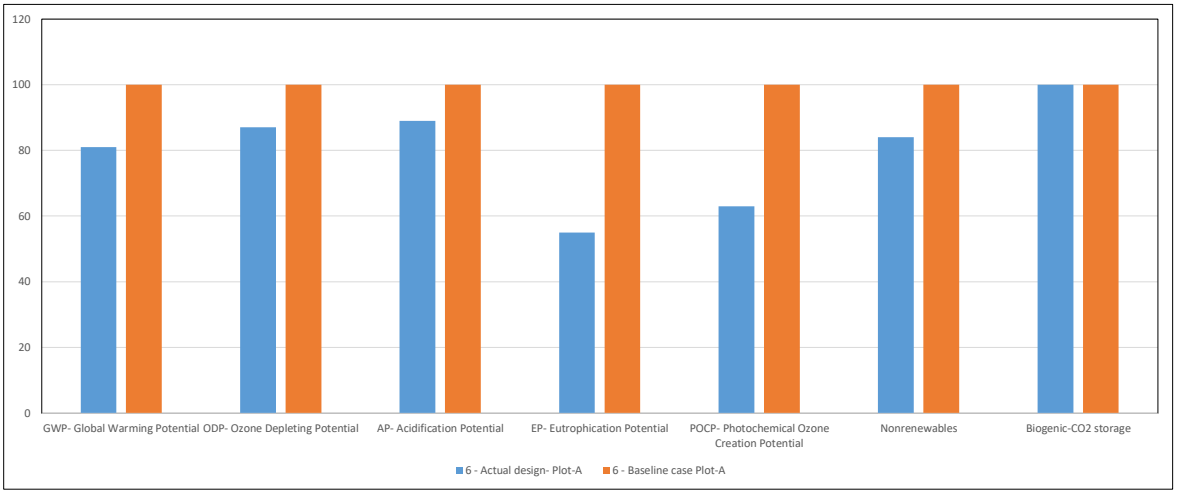
KALPA-TARU

COMPARISION AGAINST BASELINE



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CHALLENGES & MITIGATION

SR.	PARAMETER	CHALLENGE	MITIGATION
1	Data Collection	Difficulty in obtaining data on materials, energy, transport.	Used standardized LCA databases & asked respective Suppliers to provide their EPDs
		Vendors were not ready to disclose full material or energy inputs	Preferred Green-certified suppliers & Cross-verifed with multiple sources
2	System Boundary Definition	Some Transportation, packaging, and construction site operations **may** be missed.	Created a Checklist which Included upstream / downstream processes wherever relevant and proceeded.
3	Design Phase	Lack of LCA knowledge among design team	Included sustainability consultant in the team & Encouraged early-stage LCA with design architects.
		Cost & Aesthetics - Override sustainability	Promoted whole-life cost and benefit analysis
4	Waste Generation	Concrete, steel, and glass contribute significantly to emissions	Using low-carbon concrete and recycled steel Optimizing structural design to reduce material use
5	Resistance from stakeholders	Some Contractors prioritized cost and schedule over environmental goals	Communicate long-term benefits of green design.

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LESSONS LEARNT DURING THIS STUDY

- **Identifying hotspots** of environmental impact during design and construction stages.
- Facilitating informed decision-making by **minimizing material use** through efficient layouts, avoiding overdesign and utilizing modular options when possible.
- Providing a **quantifiable assessment** using LCA to evaluate and compare different design options, structural systems, and materials, ensuring carbon impact is quantified and optimized from the start.
- **Material substitution:** Where feasible, substituting high-carbon materials with lower-carbon alternatives.
- **Long lifespan:** Designing buildings for flexibility, future adaptation, and longer useful lifespans.
- Using **local materials** reduces transportation emissions.
- Encouraging the use of **eco-friendly materials** and sustainable construction practices.
- Enabling **cost savings** through efficient resource management and waste reduction.

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THANK YOU

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INTRODUCTION

- Kalpataru Infinia A is situated in Vakola, Santacruz East, Mumbai, opposite Grand Hyatt Hotel.
- The development comprises 3 basement levels + Ground floor + 12 upper floors, with a total construction area of 10,744.18 square meters.
- It offers convenient accessibility via road from the Western Express Highway and Santacruz-Chembur Link Road (SCLR), by train from Santacruz and Kurla Railway Stations, and by metro from Santacruz Metro Station.
- During the Design & Construction phase, multiple parameters including energy efficiency, water management, solid waste management, sewage treatment, and landscaping were carefully considered.
- Upon completion, the project was handed over to ICICI Prudential Asset Management Company.

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PROJECT: Embodied carbon optimization in commercial building- "KALPATARU INFINIA A"

Specific Objective of the Project:

1. To Optimize embodied carbon in building materials
2. To Optimize multiple environmental impacts during materials
3. International benchmarking

Timelines of the Project : April - 2022 to May - 2024

Major Milestones:

1. Initial Bill of material
2. Life cycle analysis
3. Assessment of alternative materials
4. Design finalization

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BENEFITS OF THIS STUDY

- Helps **identify hotspots** of environmental impact during design and construction stages.
- Facilitates informed decision-making to **minimize resource consumption and emissions**.
- Provides a **quantifiable assessment** that supports green building certifications.
- Encourages the use of **eco-friendly materials** and sustainable construction practices.
- Enables **cost savings** through efficient resource management and waste reduction.
- Enhances the environmental responsibility profile of the project and **stakeholders.**
- Supports **compliance** with environmental **regulations** and **sustainability goals**.
- Contributes to the global effort in **reducing carbon footprint** and mitigating climate change.

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