

URBAN STUDENTS HOUSING WITH IBS

(Industrialized Building System)

A THESIS

Submitted in partial fulfillment of the requirements for the award of
Bachelor of Architecture degree

By

DHARUN RAJ V
(39210018)



DEPARTMENT OF ARCHITECTURE
SCHOOL OF BUILDING AND ENVIRONMENT

SATHYABAMA

INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY) Accredited

With Grade “A” by NAAC

JEPPIAAR NAGAR, RAJIV GANDHI SALAI,
CHENNAI - 600 119

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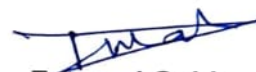
This is to certify that Thesis Report is the Bonafide work of **DHARUN RAJ V (39210018)** who carried out the Thesis entitled "**Urban Students Housing with IBS (Industrialized Building System)**" under our supervision from December 2023 to May 2024.



Internal Guide
Ar. Ramesh Kumar



Internal Review Member
Ar. Mohana Gopiraj



External Guide
Ar. Maheshwaran



Dean and Head of the Department

Dr. DEVYANI GANGOPADHYAY

Submitted for Viva voce Examination held on 20/05/2024



Internal Examiner

External Examiner



DECLARATION

I, **DHARUN RAJ V** hereby declare that the Thesis Report entitled “Urban Students Housing with IBS(Industrialised Building System) done by me under the guidance of **Ar. Ramesh Kumar** (Internal Guide), **Ar. Mohana Gopiraj** (Internal Review Member) and **Ar. Maheshwaran** (External Guide) Sathyabama Institute of Science and Technology is submitted in partial fulfillment of the requirements for the award of Bachelor of Architecture Degree.



DATE: 20/05/2024

PLACE: Chennai

SIGNATURE OF THECANDIDATE

ACKNOWLEDGEMENT

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I would like to express my sincere and deep sense of gratitude to my Thesis Internal guide **Ar. Ramesh Kumar**, Internal Review member **Ar. Mohana Gopiraj** and External Guide **Ar. Maheshwaran** their guidance, suggestions and constant encouragement which paved the way for the successful completion of my Thesis work.

I wish to express my thanks to all Teaching and Non-teaching staff members of the **Department of Architecture**, all my family members and also juniors Dinesh and Anushree helpful in many ways for completion of the Thesis.

DHARUN RAJ V

THESIS SYNOPSIS

- This topic is highly relevant given the housing challenges in the urban areas. It aligns with my dissertation's study on the feasibility and adaptation of Industrialized Building System (IBS) in the construction of high-rise buildings in India.
- An industrialized Building System (IBS) is a construction system that is built using Pre-cast & pre-fabricated components which has a huge scope in the Indian construction Industry and it's the future of Architecture.
- Designing a student housing with the implementation of IBS would solve the housing demand with shorter construction time and making it more affordable.
- Student relocations in India currently number 11 million, and is projected to reach 31 million by 2036, opening up a significant opportunity for the student housing sector, which is an emerging asset class, according to Colliers India.
- Until recently, the sector was unorganized and unregulated, despite thousands of students migrating to metro cities each year to pursue higher education. Moreover, poor conditions in campus hostels and PG homes, along with spiking rentals, stepped up the demand for quality student housing across the country, especially in education hubs with a high footfall of students each year, the report noted.
- Student bed availability at on-campus accommodations stands at 7.5 million, indicating the demand-supply gap of 3.5 million and potential for growth.

TABLE OF CONTENTS

CHAPTER No.	TITLE	PAGE No.
	THESIS SYNOPSIS	v
	LIST OF FIGURES	v
1	INTRODUCTION	1
1.1	INTRODUCTION	1
1.2	NEED OF THE PROJECT	1
1.3	AIM AND OBJECTIVE	1
2	LITERATURE CASE STUDIES	2
2.1	UNIVERSITY OF SOUTHERN DENMARK STUDENT HOUSING	2
2.2	UCSB San Joaquin Student Housing	5
2.3	IIIT-BANGALORE	12
3	STANDARDS	9
4	SITE STUDY AND ANALYSIS	13
5	ARCHITECTURAL DESIGN	14
5.1	SPATIAL REQUIREMENTS	14
5.2	CONCEPT	16
5.3	DETAILED DRAWINGS	17
6	IBS	24

LIST OF FIGURES

FIGURE No.	TITLE	PAGE No.
2.1	Plan	2
2.2	Section	3
2.3	Siteplan	3
2.4	view	4
2.5	plan	5
2.6	section	6
2.7	view	7
2.8	Waste Sustainable public school	8
2.9	Plan	9
2.10	Waste materials	9
3.1	Chennai building rules, 2017	10
4.1	Site analysis	15
5.1	SOA	17
5.2	concept	18
5.3	Site plan	19
5.4	Floor plan	20
5.5	section and elevation	22
5.6	view	25
6.1	Precast wall panel	26
6.2	Fixing of wall panels	27
6.3	Precast beam	29
6.4	Precast column	33
6.5	Precast concrete slab	33
6.6	Precast hollow core slab	34
6.7	Connections details	30
6.8	Connections detaials for coloumn and beam	34

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

IBS construction and conventional wet construction to compare performances in terms of time, cost, quality and utilization of manpower. Four low-rise building projects which adopted IBS and conventional methods of construction were selected for case studies. The findings suggest that construction using inter-locking blocks and prefabricated systems can reduce the overall cost, time, manpower and produces better quality housing than the conventional method. Environmentally, IBS also facilitates waste minimization and reduction, thus further highlighting its positive economics, while reductions in overall manpower requirements may also bring about less dependency on foreign labour.

1.2 NEED OF THE PROJECT

Student relocations in India currently number 11 million, and is projected to reach 31 million by 2036, opening up a significant opportunity for the student housing sector, which is an emerging asset class, according to Colliers India.

Until recently, the sector was unorganized and unregulated, despite thousands of students migrating to metro cities each year to pursue higher education. Moreover, poor conditions in campus hostels and PG homes, along with spiking rentals, stepped up the demand for quality student housing across the country, especially in education hubs with a high footfall of students each year, the report noted.

Student bed availability at on-campus accommodations stands at 7.5 million, indicating the demand-supply gap of 3.5 million and potential for growth.

1.3 AIM AND OBJECTIVE

Designing Affordable and Sustainable IBS – based Highrise student housing solutions for Indian Universities

CHAPTER 2

LITERATURE CASE STUDIES

2.1 UNIVERSITY OF SOUTHERN DENMARK STUDENT HOUSING

Location - **University of Southern Denmark, Odense, Denmark**

Architect- C. F .MOLLOR ARCHITECTS

completion – 2012

Size: **13,700 m2 (250 housing units)**

2.1.1 SPACIAL ANALYSIS:

The University of Southern Denmark's student housing project by C.F. Møller Architects is a testament to innovative architectural design that harmonizes with community values. The 250 residences, housed within three 14-storey interconnected buildings, offer a unique 360-degree aesthetic, ensuring no distinction between front and back. This design not only integrates seamlessly with the campus environment but also stands out as a landmark, reflecting its purpose and fostering a strong sense of belonging among the students.



Fig 2.1: Plan



Fig 2.2: SECTION



Fig 2.3: SITE PLAN

2.1.2 MATERIAL ANALYSIS:

The surrounding landscape is designed in accordance with principles of sustainable use of resources, where soil balance, precipitation and wildlife habitats are considered in a recreational hierarchy of managed areas and wild nature. A series of precisely defined, square plots at the northern end constitute parking areas and multifunctional garden spaces with features such as tennis courts, seating and urban farming. They are distributed in proximity of the building, interspersed by wild nature with wetlands, reeds and wild herbs. The garden spaces are linked by a network of paths, which allow the rest of the Science Park and the University to experience the residence's lush garden.

The indoor climate and energy requirements are planned to meet the 2020 Danish low-energy building codes, featuring for example a highly insulated and airtight building envelope, low-energy pre-fab concrete components, use of natural cross-ventilation, and extensive heat recovery from exhaust air, waste water, showers, etc.



Fig 2.4: VIEW

2.2 UCSB San Joaquin Student Housing

PROJECT NAME : UCSB San Joaquin Student Housing

LOCATION: Santa Barbara ,CA

ARCHITECT: Lorcan O'Herlihy Architects [LOHA]

CLIENT/OWNER: UC Santa Barbara

PROJECT TYPES: Residence Hall ,Multifamily ,Student Housing

SIZE: 95,000 sq. feet

YEAR COMPLETED: 2017

2.2.1 SPACIAL ANALYSIS:

Organized around the activated courtyards, outward-facing student rooms are conceived as regularized, economically stacked units with a subdued architectural expression—providing a quiet exterior edge that contrasts with the active interior walkways. Solid perimeter façades are clad in corrugated metal panels with punched windows, and L-shaped sunshading devices shield exposed openings from the Southern California sunlight.



Fig 2.5: Plan

Reading rooms, gathering spaces, and dining facilities were conceived as social hubs and are distributed throughout the blocks. These public spaces feature floor-to-ceiling glazing and their open expression relates to the exposed frame walkways and stairs, establishing a clear formal relationship between public spaces and public circulation. Most are located on the second and third floors, helping to activate the external corridors as they draw students.



Fig 2.6(a),(b): Views

Passive design strategies and innovative material choices resulted in a project that is substantially more efficient and utilitarian than standard new construction and will continue to reduce ecological and economic impact in the years and decades to come. Regularized units that seamlessly stack upon one another as well as the utilization of off-the-shelf industrial grade materials create efficiency in both short-term resource management and long-term adaptability. Ecologically, LOHA remained committed to utilizing the ideal coastal climate of Santa Barbara as the centerpiece of our design, allowing the natural habitat to fully inform the built environment.

Outdoor single-loaded corridor with aluminum sunshades were designed to encourage both an outdoor lifestyle and passive ventilation throughout units. Passive fresh air intake units were also designed for each unit's entryway. Additionally, with a built environment that is more than 90% permeable, considerable measures were taken to prevent heat island effects onsite.

2.3 IIIT BANGALORE

Location - Bangalore

Architect – Flying Elephant Studio

Year - 2015

Area – 7 acres

2.3.1 SPACIAL ANALYSIS:

This 250,000 sq ft building houses a 600 room student residence, indoor sports and recreational facilities, a food court and central kitchen, medical clinic, offices, retail kiosks, and a parking floor. The client's intention was to construct a relatively high density development in the rear part of the existing 7 acre campus – in order to retain open space for academic areas towards the front.

The building is of a 'podium and tower' type, with housing above and common facilities tucked into the podium. A split-level central courtyard forms a community space with a food court on the lower level and student plaza above. A grand open-to-sky stair forms a central feature, connecting parking floor with lower and upper plazas.

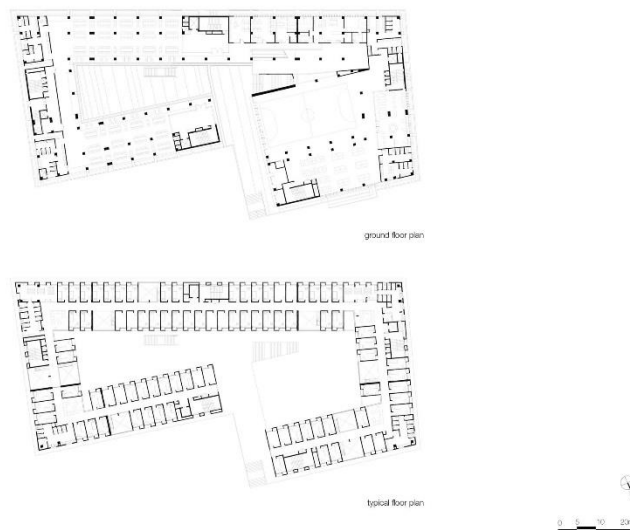


Fig 2.7(a),(b): Plan

2.3.2 MATERIAL ANALYSIS:

1. Facade cladding: Green Marble, White Plaster
2. Flooring: Polished + Rough Kota Stone
3. Doors: Laminated Flush Doors With Hard Wood Frames
4. Windows: Jindal aluminum sections



Fig 2.8(a),(b): Waste materials

The generic design is a linear strip of individual rooms serviced by a doubly loaded corridor and interspersed with lifts, stairs, toilets, laundry facilities & lounges. The overlay creates a complex and varied rhythm of individual rooms, common facilities and social spaces. Building mass of the tower is punctuated by large terrace garden voids that form student community spaces; while making the structure porous. The program layers are visually distinguished externally by the use of material - exposed concrete for lower service areas, green marble cladding in public spaces and white plaster for the upper residential part.

3.2 STANDARDS:

Source: CMDA

Permissible with the special sanction of the CMDA: Hostels, Dormitories, Boarding and Lodging houses and Welfare Institutions occupying a floor area not exceeding 500 sq.m.

Rules for multi-storeyed residential buildings

Site Extent: The minimum extent of site for construction of multi-storeyed buildings shall not be less than 1500 square metres.

Road width: The site shall either abut on a road not less than 18 metres in width or gain access from public road not less than 18 metres in width through a part of the site which can be treated as an exclusive passage of not less than 18 metres in width.

The extent of the site, FSI, Set back etc. for Multi- storeyed Building shall be regulated according to the table below:

Sl.No	Description	Category I(a)	Category I(b)	Category II		Category III
A	Minimum Plot extent	1200 sq.m	1200 sq.m	1500 sq.m		2500 sq.m
B	Minimum Plot width/frontage	25m	25m	25m		40m
C	Minimum Road width	12m	15m	18m		
D	Maximum FSI	1.5	1.75	2.50	2.25	2.00
E [♣]	Maximum Coverage					
	(a) Normally allowable	30%	30%	30%	Above 30% up to 40%	Above 40% up to 50%
	(b) allowable for Economically Weaker Sections/ Low Income Group housing developments	40%	40%	40%	Above 40% up to 50%	Above 50% up to 60% [♣]

F	Maximum height above G.L	G+6 or Stilt + 7 floors subject to a max. 24m	G+8 Stilt +9 floors subject to a max. 30m	60 metres where the width of the abutting road is minimum 18 metres, and exceeding 60 metres where the width of abutting road is minimum 30.5 metres, subject to such conditions as may be necessary.
G	Minimum set back all around	Height of the building above ground level	Minimum required setback space from the property boundary	
		Above 15.25m upto 30m	7 m	
		Above 30m	For every increase in height of 6m or part thereof above 30.5m, minimum extent of setback space to be left additionally shall be one metre.	
H	Spacing between blocks in case of group developments	Height of the building above ground level	Minimum required spacing between blocks	
		Above 15.25m upto 30m	7 m	
		Above 30m	For every increase in height of 6m or part thereof above 30.5m, space to be left additionally shall be one metre.	

Fig 3.1: Chennai building rules, 2017

Minimum Width Provisions for Stairways		
S. No.	Type of Building	Minimum width for each stairway (m)
(A)	(B)	(C)
1	Residential Non High Rise Buildings	1.00
2	Other Residential Buildings e.g. Apartments, Hostels, Group Housing, Guest Houses, etc.	1.25
3	Educational Buildings like Schools, Colleges	1.50
4	All other buildings including Hotels, Nursing Homes etc.	1.50
5	Institutional Buildings like Hospitals etc.	2.00
6	Assembly Buildings like Auditoria, Theatres and Cinemas	2.00

Parking Area to be provided in All Buildings			
Sl. No	Category of building/activity	Parking area to be provided as percentage of total built up area	
		Municipal Corporations & Selection Grade Municipalities	First Grade, Second Grade Municipalities, Nagar Panchayats and Gram Panchayats in Master Plan areas and in Development Authority Areas
(A)	(B)	(C)	(D)
1	Multiplexes	60	50
2	Information Technology Enabling Services Complexes, Shopping Malls (above 4000sq. m).	50	40
3	Business buildings, Cinema halls, Hotels, Kalyana Mandapams, Lodges, Offices, Other Commercial buildings, Restaurants & High-Rise Buildings / Complexes of Non Residential Category	30	25
4	Colleges, Godowns, Hospitals, Industrial buildings, Institutional buildings, Residential Apartment Complexes, Schools, Educational Buildings & Other Buildings	20	20

Fig – 3.2(a),(b): Staircase and Parking area percentage

3.3 PREMIUM FSI:

The Authority may allow premium FSI over and above the normally allowable FSI subject to a maximum of 1 relating the same to the road width parameters as follows:

S.No.	Road Width	Premium FSI (% of normally allowable FSI)
(i)	18 metres and above	40%
(ii)	12 metres – below 18 metres	30%
(iii)	9 metres – below 12 metres	20%

The Premium FSI shall be allowed in specific areas as may be notified, subject to Guidelines and on collection of charge at the rates as may be prescribed by the Authority with the approval of the Government. The amount collected towards the award of Premium FSI shall be remitted into Government account to be allotted separately for this purpose for utilising it for infrastructure development in that area as may be decided by the Government.

3.4 PARKING AND PARKING FACILITIES:

In cases where upper floor/floors over a stilt parking floor is/are proposed for parking to satisfy the minimum number of parking required as per the Development Regulations, such upper parking floor/floors shall conform to the special regulations prescribed in the Annexure XXV-A.

3.5 VEHICULAR ACCESS WITHIN THE SITE:

Internal Vehicular Access way including passage, if any within the site shall have a clear width of 7.2 m. and such vehicular access shall be available for every building block in the site. Further, it shall be a clear width of open to sky and no projection in structure over it is permissible.

3.6 CORRIDOR WIDTH:

The corridor serving as access for units in the development in whichever floor they may be situated shall not be less than the standards prescribed in Annexure XVII.

3.6 ANNEXURE:

Rain water harvesting provisions as prescribed in the regulations given in Annexure XIX shall be provided.

Solar energy capture provisions as prescribed in the regulations given in Annexure XXIII shall be provided where applicable.

Special regulations for physically disabled stated in the regulations given in Annexure XXII shall be adhered to.

Areas set apart for multi-storeyed building developments are given in the Annexure IX.

A watchman or caretaker booth or Kiosk not exceeding 2.5m.x2.5m. in size at each gate and not exceeding 3 m. in height.

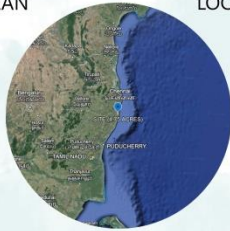
Power transformer room not exceeding 4 m. in height shall be permitted in the set back space at ground level after leaving 7 metres clear set back from the main structure. Provided that the height restriction shall not apply for an open transformer.

Gate pillars without or with arches with a min. headroom clearance of 5.50m atleast to a width of 3.5m. may be permitted in the set back space after leaving 7 metres clear set back from the main structure.

CHAPTER 4

SITE ANALYSIS URBAN STUDENTS HOUSING

KEY PLAN



LOCATION PLAN



LOCATION COORDINATES - 12°51'16"N 80°13'37"E

SITE ADDRESS - 124/1A, SEMMENCHERRY NAVLUR, RAJIV GANDHI SALAI, CHENNAI - 600 117.
SITE AREA - 19,621 SQUARE METERS (4.84 ACRES)

SITE AREA - 19,621 SQUARE METERS (4.84 ACRES)



- TRANSPORTATION ACCESS -
- ENTRANCE OPPURTUNITIES -
- CENTRAL AREA -
- RICH BUILDING TYPES -

S



DIFFERENT BUILDINGS HARMONY -
THE LOCATION OF THE EXISTING -
PRIVATE PLOT
GRAVEYARD NEARBY -

W

O

AS THE SITE IS SURROUNDED BY COLLEGES -
WILL BE MORE PROFITABLE FOR THE HOUSING
AS ENTERANCE ON ALL THREE SIDES -

T

EXISTING PG'S AND STUDENTS -
HOUSING NEARBY

EXTENTION OF EXISTING -
RAJIV GANDHI ROAD

SITE PHOTOS

ISSUES ON SITE

CLAY SOIL HAVE THE TENDENCY OF SOIL SHIFTING DUE TO DRYING AND MOISTENING.

OBSCURED ROAD SIGNS



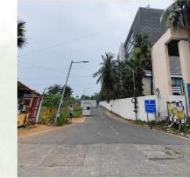
HIGH TRAFFIC DURING PEAK HOURS.



NO NEARBY OUTDOOR
PLAY AREA.



LACK OF VEGETATION



SITE
19621 SQ.M (4.84 ACRES)

19621 SQ.M (4.84 ACRES)

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URBAN STUDENT HOUSING

NAME: DHARUN RAJ V
REG. NO: 39210018

CHAPTER 5

5.1 SPATIAL REQUIREMENTS

Residential Total Units					
Type	Name	Qty(Unit)	Beds	Area(M)	Total Area(M)
Type 1	Triple Sharing	69	207	51	3519
Type 2	Single cot	26	26	24.1	626.6
Type 3	Accessibility Unit	13	13	30	390
Type 4	Double Sharing	208	416	25	5200
Type 5	3 Bedroom, 4 Pax	39	156	88	4312
Type 6	2 Bedroom, 4 Pax	13	52	58	754
	Total	366	858		14801

Statement of Areas General				
No.	Space	Units	Zoning	Area(Sq.m)
1	Admin	1	Private	274
2	Cafeteria	1	Public	480
3	Café toilet	2	Public	45
4	Minimart	1	Public	241
5	Laundry Area	1	Public	65
6	Retail 1	1	Public	37
7	Retail 2	1	Public	55
8	Retail 3	1	Public	44
9	Mail Room	1	Public	26
10	Main Lobby	1	Public	91
11	Common Toilet	13	Public	52
12	Caretakers Room	1	Private	26
13	Management Office	1	Private	34
14	Lounge A	1	Public	81
15	Launge B	1	Public	136
16	Lounge C	1	Public	116

17	Trash Disposal Area	1	Public	105
18	Suction & Pump Room	1	Private	18
19	Power Room	1	Private	27
20	Service Area	3	Private	32
21	Security Cabin	1	Private	15
Parking Details				
No.	Vehicle	Nos	Zoning	Floor
1	Car	85	Public	GF
2	Car (Disabled)	4	Public	GF
3	Motorcycle	370	Public	GF

Fig 5.1: Area requirements

5.2 CONCEPT

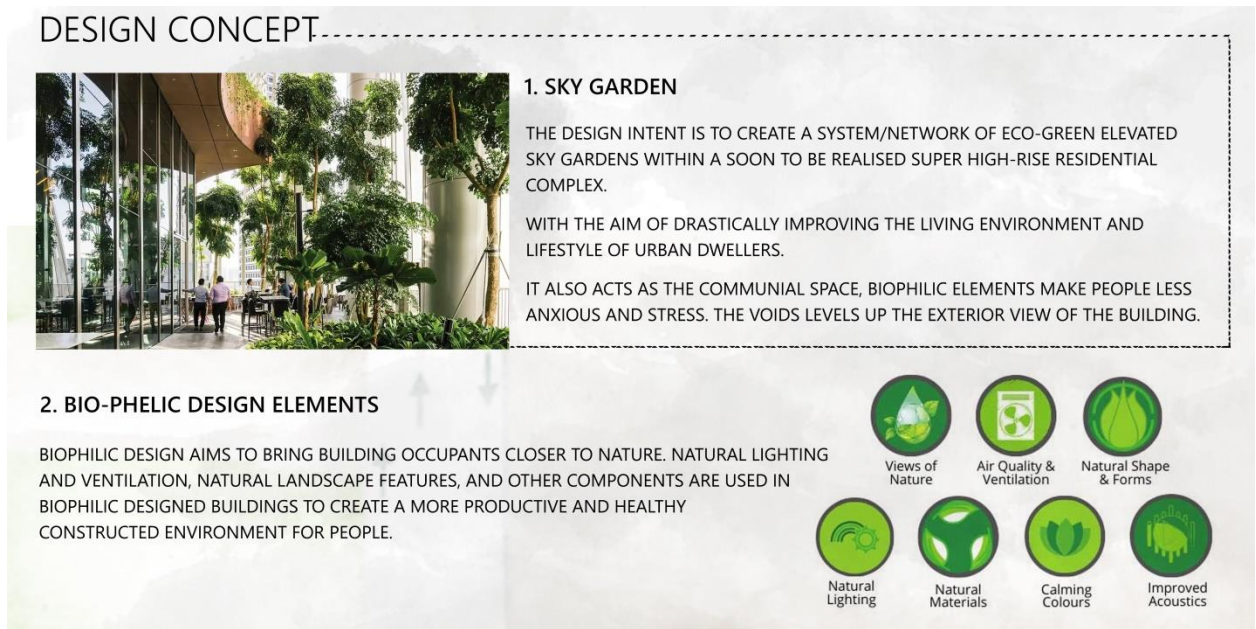


Fig 5.2: Design Concept

5.3 DETAILED DRAWINGS

5.3.1 Site plan:



Fig 5.1: Site plan

5.3.2 FLOOR PLANS:



Fig 5.2 Typical floor plan 1st to 5th floor



Fig 5.3 6th and 7th floorplan

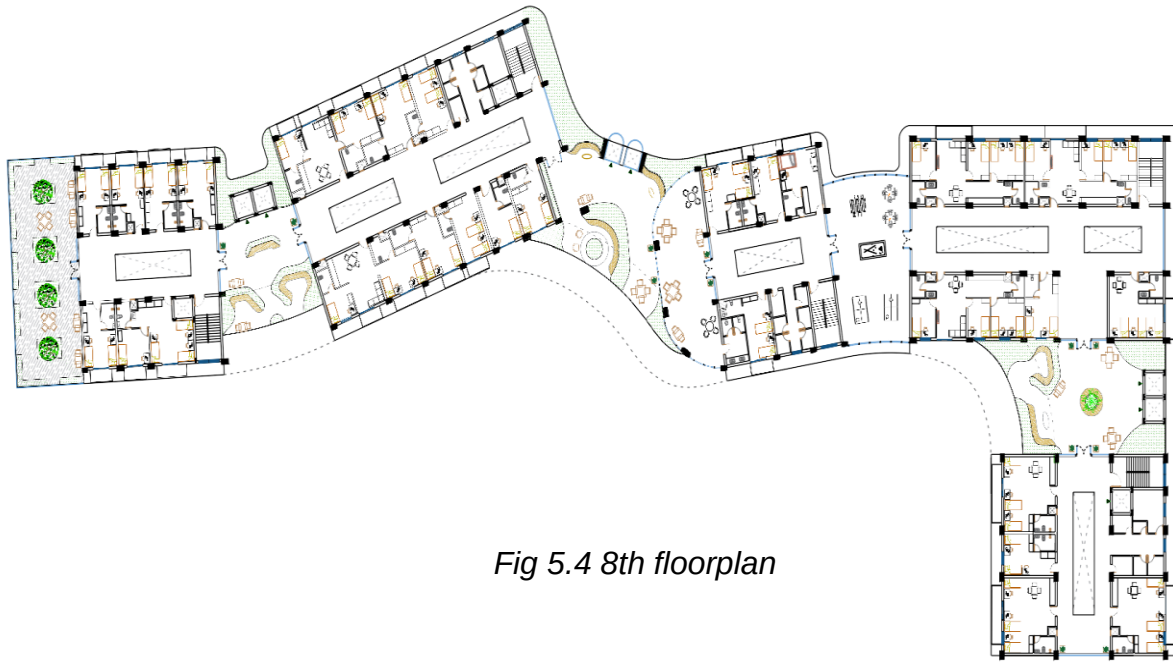


Fig 5.4 8th floorplan

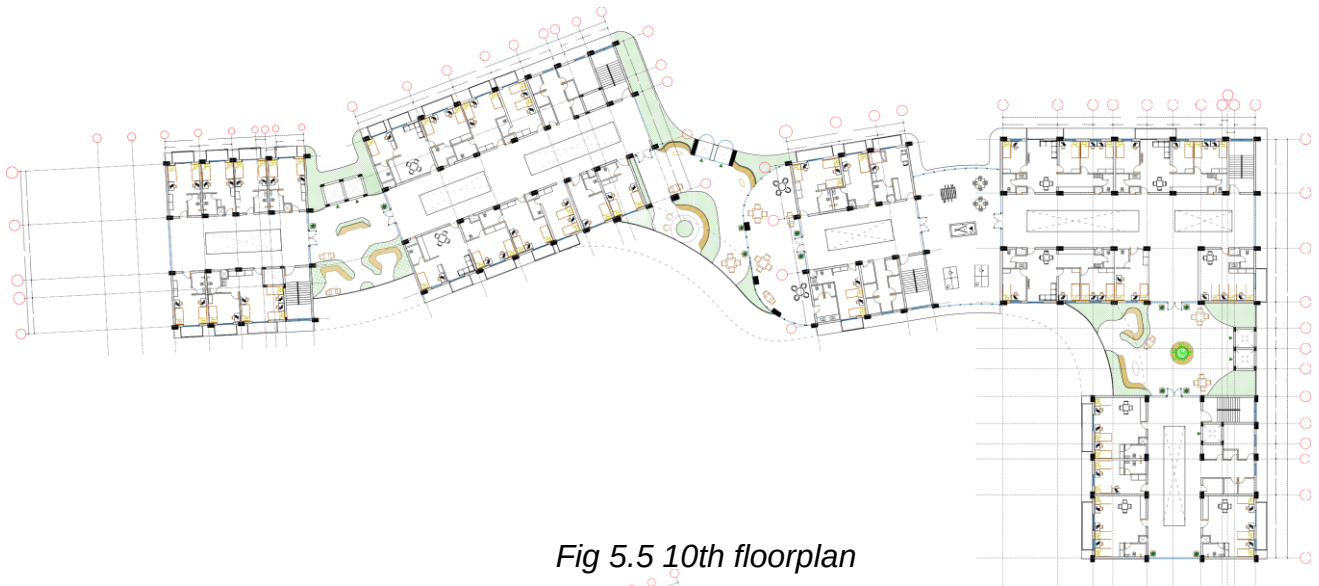


Fig 5.5 10th floorplan

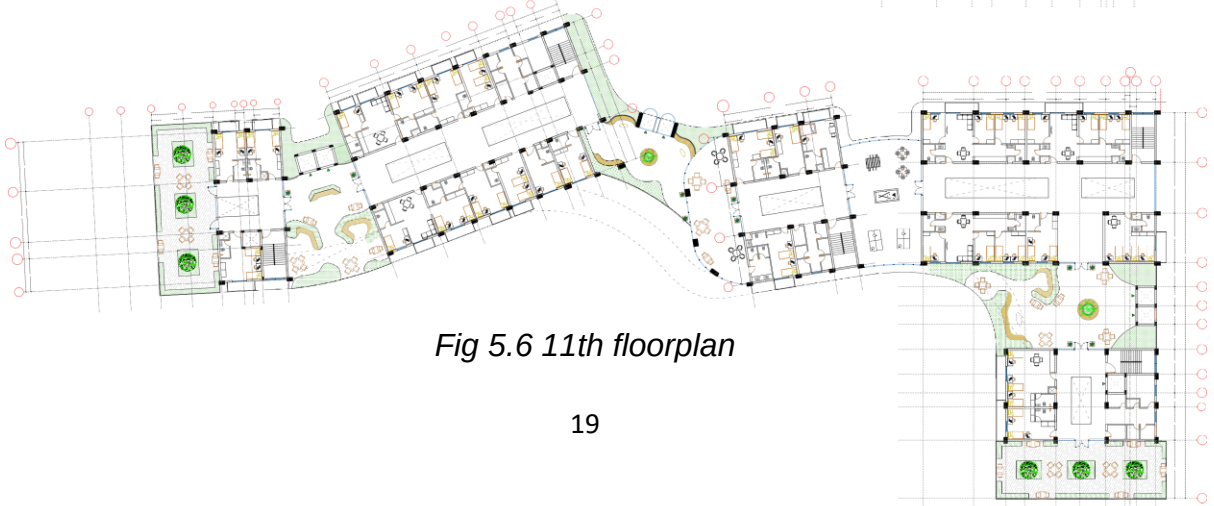


Fig 5.6 11th floorplan

5.3.2 ELEVATION AND SECTIONS:



Fig 5.7 elevation

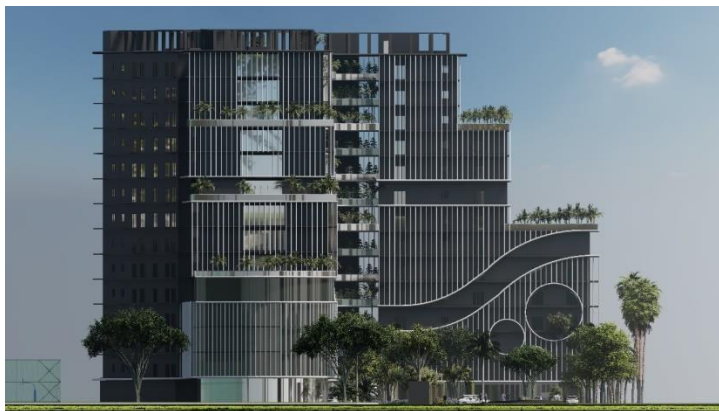


Fig 5.7 elevation



Fig 5.7 elevation



Fig 5.7 elevation

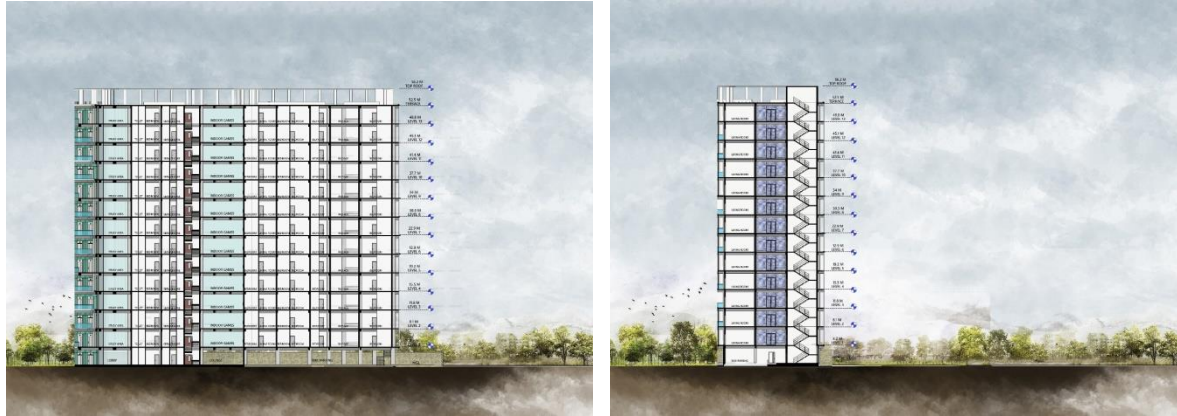


Fig 5.8 section



Fig 5.8 section



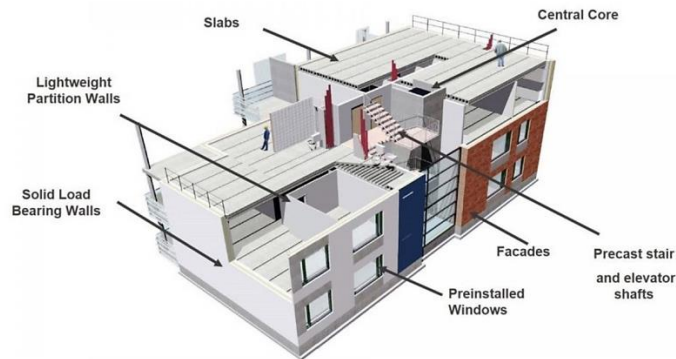
Fig 5.8 section



Fig 5.9 view

CHAPTER 6

IBS



- **Pre-cast wall panels:** Precast wall panels provide a multitude of advantages within the realm of construction. Notably, they offer a superior finish surface, characterized by precision and consistency, effectively eliminating the necessity for plaster and touch-up work. This inherent quality not only enhances the aesthetics of the structure but also expedites the construction process by reducing the time and effort traditionally required for surface finishing. Moreover, these precast wall panels contribute significantly to the structural integrity of the building.

They play a crucial role in bolstering lateral stability, fortifying the structure against forces such as wind, seismic activity, and other lateral loads. By virtue of their precision manufacturing and seamless integration, these panels act as a cohesive and robust component of the building's overall structural system. In essence, the utilization of precast wall panels represents a harmonious fusion of form and function, enhancing both the visual appeal and structural resilience of the construction project. This duality of benefits underscores their growing popularity within the construction industry.

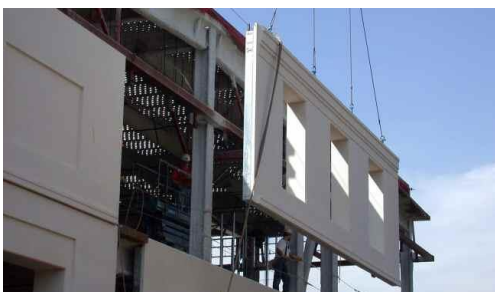


Figure 6.2 Precast wall panels



Figure 6.3 Fixing of wall panel

Image source: <https://theconstructor.org/concrete/precast-concrete-floor-wall-frame-construction/273/>

- **Pre-cast Beams & Columns:** In the context of construction, prefabricated columns often come equipped with brackets for straightforward column support connections. These brackets simplify the assembly process and enhance the structural integrity of the column support system, ensuring secure and efficient connections. Additionally, when it comes to beam systems, they are typically categorized based on their position within the overall structural system.



Figure 6.4 Precast columns



Figure 6.5 Precast beams

Image source: <https://www.precastbuildcon.com/product2.html>

- **Pre-cast stair case:** The utilization of precast staircases offers several advantages in construction. Notably, when precast staircases are employed, the need for on-site shuttering (the temporary mold used for casting concrete) and reinforcement becomes obsolete. This is because precast staircases are manufactured off-site under controlled conditions, ensuring that they are precisely cast and reinforced according to design specifications. As a result, the installation process on-site becomes significantly more efficient, saving both time and labor costs. Furthermore, precast staircases are renowned for delivering a high-quality finish. The controlled manufacturing environment guarantees that the surface finish of the staircase is consistent and meets the desired standards. This not only enhances the aesthetics of the staircase but also reduces the need for post-construction finishing work, such as plastering or additional surface treatments.
- Another advantage is the flexibility in casting options. Precast staircases can be cast as a single, cohesive unit or as individual units for each flight and landing separately. This versatility in production allows for customization based on the specific requirements of the construction project. Whether a continuous staircase or modular components are needed, precast staircases offer a solution that aligns with the architectural and structural demands of the building. In summary, the use of precast staircases streamlines the construction process by eliminating on-site shuttering and reinforcement, ensures a high-

quality finish, and provides flexibility in casting options. These benefits collectively contribute to the efficiency, quality, and adaptability of construction projects.



Figure 6.6 Precast concrete stairs

- **Pre-cast slab:** Precast slabs in construction are typically categorized into two distinct types: hollow slabs and solid slabs. The differentiation between these two types is essential for understanding their structural and functional characteristics. In the context of hollow slabs, they are intentionally designed with voids or hollow portions strategically placed in areas where structural stresses are minimal or negligible. These zones of "zero stresses" refer to sections of the slab where the load-bearing requirements are relatively low or where additional support is not essential. By incorporating these voids in such areas, the overall dead load of the structural system is effectively reduced.
- This reduction in dead load has several advantages like Reduced Structural Weight, Hollow slabs are inherently lighter than their solid counterparts due to the voids within their structure. This translates into less overall weight being supported by the building's foundations and structural elements, potentially leading to cost savings and a more efficient design. Improved Thermal Insulation, the presence of hollow portions within the slab also contributes to enhanced thermal insulation properties. These voids act as natural insulators, helping to regulate indoor temperature and reduce heat transfer, which can result in improved energy efficiency and occupant comfort.
- Ease of Installation, hollow precast slabs are generally more manageable and easier to transport and install compared to solid slabs of equivalent size and strength. This can expedite the construction process and reduce labor and equipment requirements. Versatility in Utility Installation, The voids in hollow slabs can provide space for utility installations, such as electrical wiring, plumbing, or HVAC ductwork, without the need for additional chases or recesses. In contrast, solid slabs have a continuous, solid structure throughout their entire thickness, making them suitable for areas with higher load-bearing requirements or where the absence of voids is necessary for various reasons, such as fire resistance or acoustic performance. In summary, the categorization of precast slabs into

hollow and solid types is a deliberate design choice that optimizes the structural and functional performance of the building. Hollow slabs are particularly advantageous in zones of zero stresses, as they reduce dead loads, enhance insulation, and offer versatility in construction. This thoughtful selection of slab types aligns with the specific requirements and objectives of the construction project.



Figure 6.7 Hallow core concrete slab

Image source: https://www.spcind.com/en/product_details/13/Precast%20Hollow%20Core%20Slab

2.3 CONNECTIONS FOR PRE-CAST CONSTRUCTION

In precast construction systems, the connections between precast components serve a dual purpose: not only do they transfer loads effectively, but they also provide continuity and promote monolithic behavior throughout the entire structure. These connections are crucial elements in ensuring the structural integrity, stability, and functionality of the building. They can be categorized into two main types: horizontal joints and vertical joints.

1. **Horizontal Joints:** Horizontal joints are connections that occur along the horizontal plane of precast components. These joints are typically found in areas where floor slabs, beams, or other horizontal elements meet. The design and execution of horizontal joints are essential for distributing loads, maintaining alignment, and ensuring the structural stability of the floors and roof.

2. **Vertical Joints:** Vertical joints, on the other hand, are connections that occur along the vertical plane of precast components. These joints are prevalent in wall panels, columns, and other vertical structural elements. Vertical joints play a crucial role in aligning components, transferring vertical loads, and resisting lateral forces.

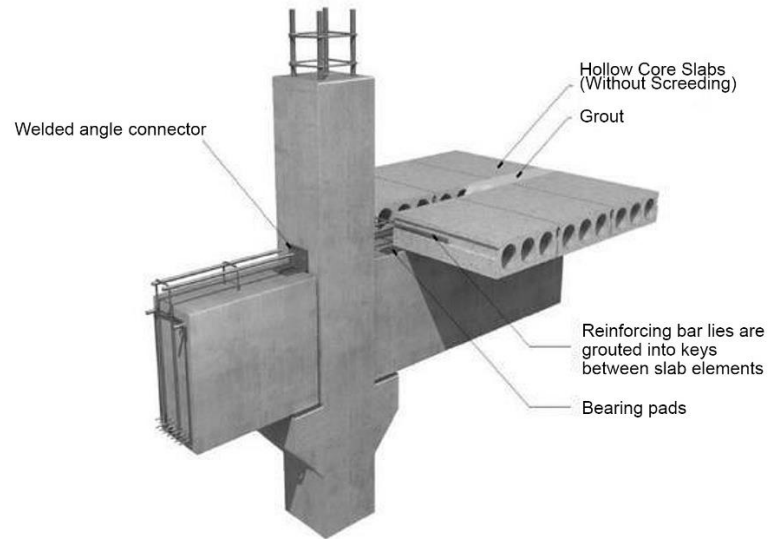


Figure 6.8 Connections details for the Hollow core slab to beam

Image source: <https://in.pinterest.com/pin/455004368583562513/>

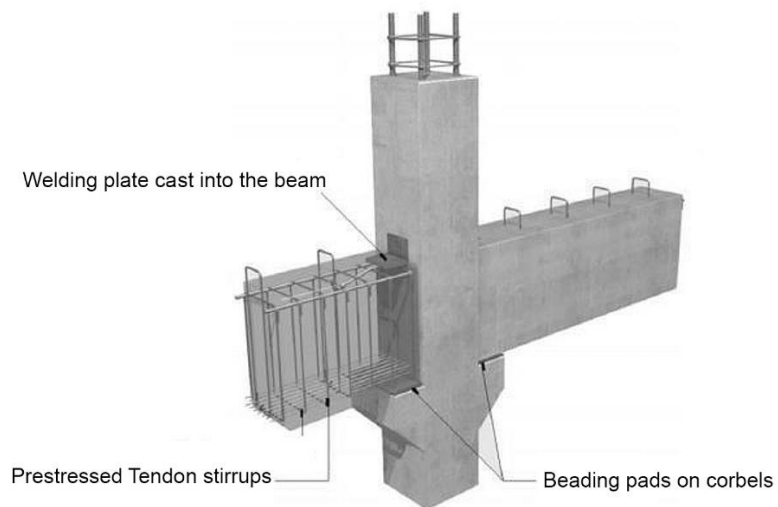


Figure 2.9 Connection details for beam to column

Image source: <https://in.pinterest.com/pin/207024914116972104/>

CHAPTER 7

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