[ARC60104]

ADVANCED ARCHITECTURAL CONSTRUCTION

Assignment 2

Integrated Building System & Construction Solutions

PRECASE CONCRETE SYSTEM

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INTRODUCTION OF INDUSTRIALIZED BUILDING SYSTEM (IBS)

Definition

A **system or method** of building construction in which the components are produced in **controlled conditions** (in a factory or on a construction site), transported and installed during construction with the minimal use of workers on site.

Industrialized Building System (IBS)

Open System

Allows components from different suppliers to be used together. More flexible and customizable

Close System

Uses fixed, proprietary components from one supplier. Limited flexibility; all parts must come from the same system

History

Early Beginnings (1960s)

Early 1960s

The Malaysian Ministry of Housing and Local Government sent PWD architects to Europe (Germany, Denmark, France) to explore prefabricated building techniques

1964–1968

The first pilot projects launched:

Jalan Pekeliling, KL: 7 blocks of 17-storey flats (~3,000 units) plus shops built using Danish large-panel precast by Gammon & Larsen-Nielsen, completed in 27 months at RM 2.5 million

Jalan Rifle Range, Penang: 6 × 17-storey and 3 × 18-storey flats using the French Estiot system, built in 1965

Expansion & Hybridization (1990s)

Late 1980s to Early 1990s

State agencies like PKNS in Selangor built around 52,000 units of low-cost and bungalow housing using the German Praton Haus IBS technology

1994–1997

Construction boom saw hybrid IBS in public landmarks:

Bukit Jalil Sports Complex
KL Convention Centre
LRT, KLIA, KL Tower
KL Sentral
Petronas Twin Towers

All used combinations of steel frames, precast slabs, roof trusses and hybrid construction systems

Challenges and Stagnation (1970s–1980s)

Early 1970s

Early systems were often unsuitable for Malaysia's climate, lacked wet-area functionality, and had leakage and poor finishes, which damaged confidence in IBS

Phased initiatives continued:

1978

Penang State built ~1,200 prefabricated housing units

1980

The Ministry of Defence erected 2,800 naval quarters in Lumut using large-panel systems

1984

The Dayabumi Complex (KL) became Malaysia's first high-rise steel-structure IBS project

Formalization & Growth (2000s–2010s)

1999

CIDB launched the IBS Strategic Plan

2003–2010, 2011–2015

Government issued successive IBS roadmaps, catalyzing training, incentives, vendor development, and R&D

2008

Mandatory requirement set for 70% IBS content in public-sector projects via Treasury Circular SPP 07/2008

Today and Beyond

IBS is now a mainstream construction method in Malaysia, evolving from prefabrication to mechanization, automation, and robotics

TYPES OF IBS SYSTEMS IN MALAYSIA

Precast Concrete System

The Precast Concrete System involves the **casting of building components** such as walls, slabs, beams, columns, and staircases in a **controlled factory** environment, which are then transported to the construction site for assembly

This system ensures better quality control, faster construction, and reduced on-site labour

Steel Framing System

The Steel Framing System uses **prefabricated steel structural members** such as columns, beams, and trusses.

It is commonly used in **high-rise buildings** and **industrial** structures due to its strength, speed of erection, and flexibility in design.

Timber Framing System

The Prefabricated Timber Framing System consists of **timber components** that are **cut, shaped, and pre-assembled** in factories.

Although less common in urban construction, this system is often used for resort-style buildings, chalets, and rural housing projects.

Block Work System

The Block Work System utilizes **interlocking or lightweight concrete** blocks that are produced in factories and assembled on-site.

This method is faster than traditional brickwork and results in more uniform wall surfaces that require less finishing work.

Formwork System

The Formwork System uses **reusable moulds** made of metal or other materials to cast concrete directly on-site.

Systems like tunnel formwork or aluminium formwork allow for rapid construction of repetitive units and are widely used in high-density residential buildings.

Hybrid System

The Hybrid System refers to the **combination of two or more IBS systems** in a single project.

For example, a building may use a precast concrete frame with steel roof trusses and in-situ floor slabs.

This approach allows for flexibility, cost-efficiency, and optimized performance based on different parts of the building.

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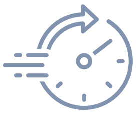
INTRODUCTION OF IBS

ADVANTAGES AND DISADVANTAGES OF IBS

Advantages of IBS

Faster Construction



Prefabricated components reduce on-site work and speed up the overall construction process

Reduced Labour Dependency

Less on-site labour is needed, helping to overcome skilled worker shortages

Cleaner and Safer Site

Minimizes on-site waste and improves site organization, resulting in a safer working environment

Cost Efficiency in Long Term

Though initial setup may be higher, IBS reduces wastage, labour costs, and time delays, leading to savings over time

Design Flexibility (with Open Systems)

Modern IBS allows integration of various materials and designs to suit different architectural needs

Disadvantages OF IBS

Transportation and Handling Issues

Large prefabricated components are bulky and may be difficult or costly to transport and lift on-site

Need for Skilled Workforce

Although on-site labour is reduced, skilled workers still needed for accurate installation and handling of prefabricated parts

Site Accessibility

IBS components require cranes and access for heavy vehicles, which can be problematic in congested or remote sites

High Initial Cost

Setting up factories, molds, and equipment for IBS requires significant upfront investment.

Design Limitation (in Closed Systems)

Closed systems restrict flexibility in architectural design and require strict adherence to a single supplier's specifications

1.4

INTRODUCTION OF IBS

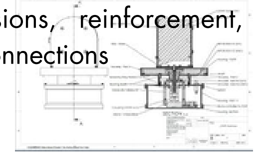
IBS WORKFLOW

Design Phase

Architects and engineers prepare the building design with IBS components in mind, ensuring standardization, modularity, and compatibility

Drawing & Detailing

Detailed technical drawings of each component are created for factory production, including dimensions, reinforcement, joints, and connections



Approval & Coordination

All stakeholders (clients, consultants, manufacturers) review and approve the design. Coordination ensures smooth integration between trades and systems

Manufacturing

IBS components such as precast walls, slabs, columns, and steel frames are fabricated in a controlled factory environment to ensure quality and consistency

Transportation to Site

The prefabricated elements are carefully transported from the factory to the construction site, using suitable logistics and handling equipment

Site Preparation

Foundations and temporary works (such as staging and cranes) are set up to receive and install IBS components

Installation / Assembly

IBS components are assembled on-site using cranes, skilled labour, and precise alignment tools, often in a short time frame

Finishing Works

Internal finishes, joint treatments, M&E (mechanical & electrical) integration, and touch-ups are completed to finalize the structure

Inspection & Handover

Final inspections ensure all components meet quality standards. Once approved, the building is handed over to the client

INTRODUCTION OF PRECAST CONCRETE SYSTEM IN MALAYSIA

Definition

The Precast Concrete System is a modern construction method where structural components such as **walls, slabs, beams, and columns** are cast in a **controlled factory environment** and then transported to the site for assembly. This system enhances construction speed, quality, and safety by allowing off-site fabrication and reducing reliance on on-site wet works.

Origin of Precast Concrete System (Europe)

Ancient Times (Pre-modern concept)

- **Early 20th Century**

  Ancient Romans used molded concrete to build arches, aqueducts, and dome segments

Modern – Early 1900s Europe

- **Early 20th Century**

  The modern precast concrete system began in the early 1900s in Germany and the UK, where it was used for infrastructure like pipes and manholes

History

Global Origins

- **Early 20th Century**

  Originated in Europe to address post-war housing shortages

  Countries like Germany, France, and Denmark pioneered large-scale prefabricated concrete housing blocks

  It became popular due to mass production capability, cost-effectiveness, and construction speed

Introduction in Malaysia

- **1960s**

  Malaysia adopted the precast concrete system in the 1960s to solve urban housing shortages

  Malaysian officials visited Europe to study industrialized construction techniques

- First Precast Concrete Projects in Malaysia:

1964–1968
Pekeliling Flats, Kuala Lumpur
Built using the Danish large-panel system
Consisted of 7 blocks of 17-storey flats and shop lots (over 3,000 units)

1965
Rifle Range Flats, Penang
Constructed using the French Estiot System
Included high-rise flats for low-cost housing

Challenges/ Slow Adoption (1970s–1980s)

- Early precast systems faced problems like leakage, joint failures, and poor wet area detailing
- Limited local expertise and unsuitable designs for tropical climates led to negative perceptions
- As a result, the system was not widely accepted during this period

Revival and Expansion (1990s)

- The Praton Haus system from Germany was used in PKNS housing projects, building over 52,000 units.

- Precast elements were combined with steel and in-situ methods, creating hybrid systems

  Featured in major developments like KL Sentral, KLIA, and Petronas Twin Towers

Institutional Support and Growth (2000s–Present)

- The Construction Industry Development Board (CIDB) began promoting PCS as part of its IBS roadmap
- Government introduced policies like SPP 07/2008, making IBS (including precast) mandatory in public projects
- Precast system gained popularity for its efficiency, quality, and speed
- Now widely used in residential apartments, schools, infrastructure, and commercial buildings

TYPES OF STRUCTURAL PRECAST CONCRETE SYSTEM

Large Panel System

The Large Panel System consists of large precast concrete wall panels that act as **structural (load-bearing) or non-structural elements**.
These panels are used to form both the internal and external walls of a building.
This system is widely adopted in mass housing projects because it allows for **rapid installation** and **repetitive layouts** across multiple floors, especially in residential flats or apartment blocks.

Frame System

The Frame System uses precast beams and columns to form a **skeletal structural** framework.
This system is highly suitable for commercial buildings, industrial facilities, and car parks, where **large, open internal spaces** are needed.
The precast frame is then combined with **floor slabs and wall panels**, either precast or cast in-situ, to complete the structure.

Slab-Column System

The Slab-Column System, often called a **flat slab system**, eliminates the need for beams by directly connecting floor slabs to columns.
In this system, precast concrete slabs—such as **hollow-core or solid slabs**—are supported by precast or in-situ columns.
It is popular in high-rise office or residential buildings because it provides a clean ceiling surface, reduces overall floor height, and simplifies formwork.

Tunnel Form System

The Tunnel Form System is a method where **concrete walls and slabs** are cast simultaneously on-site using a **reusable tunnel-shaped** formwork.
Although this method involves in-situ casting, it is considered part of IBS due to its modular, repetitive construction technique.
Tunnel form systems are especially efficient for **constructing multi-unit housing** projects quickly and consistently.

Precast Shell or Folded Plate Structures

The **Precast Shell** or **Folded Plate Structures** refer to specially shaped precast components used mainly in roofs or open-air structures.
These thin concrete forms **span large distances** with minimal material, offering both structural performance and architectural interest.
They are typically used in stadiums, hall roofs, and public shelters.

Precast Facade System

The Precast Facade System involves **non-structural precast panels** used to enclose or decorate the exterior of a building.
These panels can be **flat or curved**, and often incorporate textures, patterns, or finishes to enhance the building's visual appeal.
Facade panels allow for **quick installation** and **weather protection** while adding aesthetic value.

ADVANTAGES & DISADVANTAGES OF PRECAST CONCRETE SYSTEM

Advantages of IBS

Faster Construction

Since precast elements are produced in advance and only assembled on-site, the overall construction period is significantly shortened, allowing for faster project delivery

Reduced Labour Dependency

As much of the work is done off-site, the system minimizes the need for large numbers of on-site workers, which helps overcome skilled labour shortages

All-Weather Construction

Since the majority of the work is completed off-site, construction progress is less affected by bad weather conditions. This is especially useful in tropical or monsoon climates where rain often delays conventional construction

Cost Savings in the Long Run

Although initial investment may be high, savings are gained through faster construction, reduced waste, fewer delays, and lower maintenance over time

High Quality Control

The components are manufactured in a factory-controlled environment, which ensures consistent quality, accurate dimensions, and better durability compared to cast-in-situ construction

Disadvantages OF IBS

Transportation and Handling Issues

Precast components are often large and heavy, which makes them difficult to transport and handle on-site

Factory and Supply Dependency

Any delay in fabrication or transportation can affect the entire construction schedule, particularly for large projects that follow a just-in-time delivery model

Site Accessibility

In dense urban environments or tight construction sites, the lack of access and staging area can limit the use of precast systems.

High Initial Investment

One of the main drawbacks of the precast concrete system is the high initial cost involved in setting up the production process.

Limited Modifications After Casting

Once a precast component is manufactured, it is difficult to make changes or modifications without damaging the product

Key Features

Factory-Based Production

Structural components are cast in a controlled environment, ensuring consistent quality and precision.

Modular Construction

Precast elements are designed for repetition and standardization, ideal for large-scale developments

Reduced On-Site Work

Minimal wet trades and formwork at the construction site lead to cleaner, faster, and safer operations.

Speed and Efficiency

Simultaneous off-site fabrication and on-site foundation work significantly shorten project timelines

2.4

PRECAST CONCRETE SYSTEM

CONSTRUCTION ELEMENTS OF PRECAST CONCRETE SYSTEM

Precast Beams

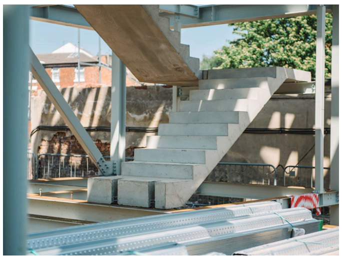
Horizontal load-bearing members that transfer loads from slabs to columns; may be L-beams, inverted T-beams, or rectangular

Concrete Foundation

Some systems include precast footings or piles, depending on ground conditions and design

Precast Columns

Vertical structural elements designed to support beams and slabs, often with cast-in base plates and connection inserts



Precast Staircase

Precast flights with or without landings, reducing on-site construction time and improving safety

Precast Walls (Shear/Load-Bearing)

Structural wall panels that act as vertical load-bearing or shear-resisting elements in the frame

Concrete Slabs

Floor or roof systems made from hollow-core, solid, or double-tee slabs; allow fast installation with minimal formwork

Double Tees

Precast concrete elements shaped like two T-beams joined side by side, providing both structural support and floor or roof surface in one unit

Reinforced Bars

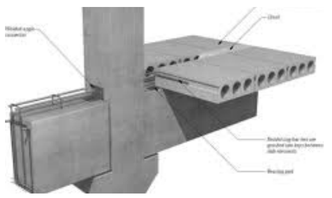
Steel rods embedded in precast concrete to improve its tensile strength, which concrete lacks on its own.

2.5

PRECAST CONCRETE SYSTEM

CONNECTIVITY OF PRECAST CONCRETE FRAMING

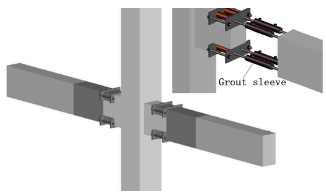
Beam-to-Slab Connections



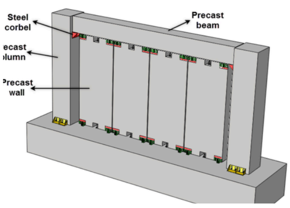
Beam-to-slab connections involve placing **precast slabs on top** of or **between** precast beams, often using corbels, ledges, or embedded inserts.
These connections are designed to transfer vertical loads and ensure the continuity of the structural floor system.

Beam-to-Column Connections

This connection joins **horizontal beams to vertical columns**, typically using steel plates, dowels, or grouted sleeves.
It must transfer both vertical and lateral loads, providing stability and moment resistance in the building frame.



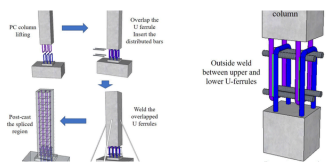
Wall-to-Frame Connections



Wall-to-frame connections attach precast **wall panels to the structural skeleton** (beams and columns), either as load-bearing or cladding elements.
These connections ensure lateral stability, wind resistance, and proper alignment during installation.

Column-to-Foundation Connections

This connection anchors **precast columns to the foundation** using starter bars, base plates, or grouted pockets.
It is critical for transferring axial loads safely into the foundation and maintaining the column's vertical alignment.



2.6

PRECAST CONCRETE SYSTEM

METHOD USED TO CREATE PRECAST CONCRETE ELEMENTS

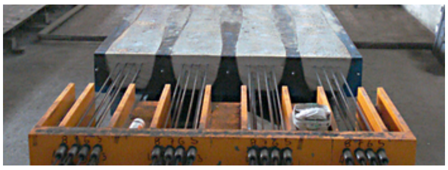
Wet-Cast Method

The wet-cast method uses high-slump (flowable) concrete that is poured into detailed molds. It allows for better surface finishes, intricate designs, and is ideal for large structural components like walls, beams, and architectural panels.

Dry-Cast Method

The dry-cast method uses low or zero-slump concrete, which is stiff and almost dry, allowing immediate demolding after compaction. It is typically used for small, repetitive elements like pipes, manholes, kerbs, and paving blocks.

Precast Prestressed Concrete Method



This method introduces prestressing forces by tensioning steel tendons either before (pre-tensioned) or after (post-tensioned) the concrete is cast. It increases the load-bearing capacity of precast elements such as beams, slabs, and girders, making them more efficient over long spans.

Autoclaved Aerated Concrete Method

The Autoclaved Aerated Concrete Method is a type of precast lightweight concrete production where concrete elements are made from a mixture of cement, lime, sand, water, and aluminum powder. After mixing and molding, the material undergoes a chemical reaction that forms tiny air bubbles within the concrete, giving it a lightweight and porous structure.

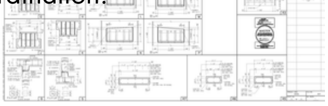
2.7

PRECAST CONCRETE SYSTEM

WORKFLOW OF PRECAST CONCRETE SYSTEM

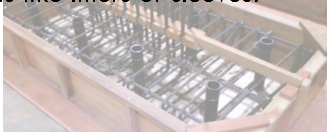
Design and Engineering

Designers and engineers prepare detailed drawings and calculations for each precast element using CAD or BIM to ensure coordination.



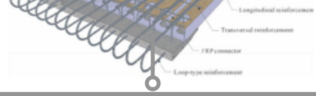
Mold Preparation

Molds are cleaned, oiled, and set up based on the required shape and size, including embedded items like lifters or sleeves.



Reinforcement Placement

Steel bars or prestressed tendons are placed inside the molds according to the structural design to provide strength.



Concrete Casting

Concrete is poured into the molds using wet or dry-cast methods, then vibrated to remove air and ensure compactness.

Curing Process

Elements are cured under controlled or accelerated conditions to gain the required strength and durability.

Demolding and Finishing

Once cured, the element is removed from the mold and surface finishing or patching is carried out if needed.

Transportation to Site

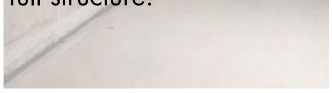
Elements are loaded carefully and transported to the construction site using suitable lifting and support equipment.

On-Site Installation

At site, components are lifted into place, aligned, and connected securely using joints like grout, bolts, or sleeves.

Final Adjustments and Integration

Final touch-ups, sealing, and service connections are completed to integrate the precast parts into the full structure.



3.1

CASE STUDY

MULTILEVEL CAR PARK, HOSPITAL KUALA LUMPUR

Introduction

The multi-level car park at Hospital Kuala Lumpur was constructed using a fully precast concrete system under the Industrialized Building System (IBS) approach. Over 11,000 components, including columns, beams, hollow-core slabs, staircases, and wall panels, were factory-produced and assembled on-site, enabling faster, cleaner, and more efficient construction. The use of precast concrete allowed the superstructure to be completed in just 198 days, averaging 56 components installed per day. This method provided high precision, reduced site disruption, and helped address urgent parking demands by delivering nearly 2,000 bays within a limited urban space. The project stands as a successful example of large-scale IBS implementation in Malaysian healthcare infrastructure.

Overview

Architect / Main Contractor
Teraju Construction Sdn. Bhd., a leading IBS specialist in Malaysia

Location
Jalan Pahang, 50586 Kuala Lumpur, opposite the Maternity Hospital at HKL

Date of Completion
Completed 29 October 2015

Area & Capacity
Seven levels with approximately 1,951 to 4,080 parking bays (public + staff)
including ground-floor cafe and rooftop tennis court

IBS System
Full precast IBS framing

Main Materials
Precast Columns & Beams
Hollow-Core Slab

History

October 30, 2014
The project officially commenced with site clearing, earthworks, hoarding setup, and preliminary utilities relocation.

November–December 2014
Piling, pile cap construction, and ground beam installation were carried out to support the upcoming precast frame.

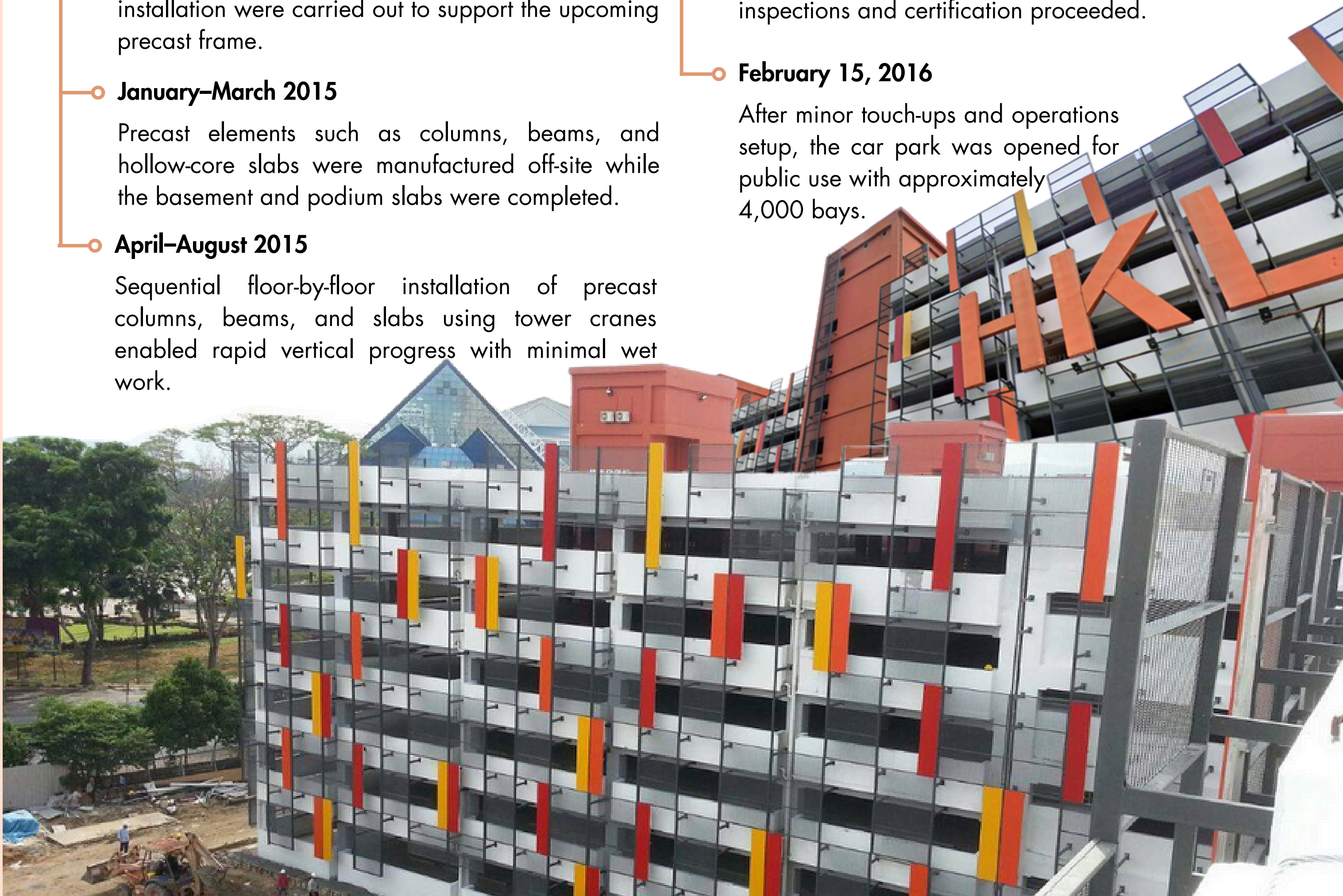
January–March 2015
Precast elements such as columns, beams, and hollow-core slabs were manufactured off-site while the basement and podium slabs were completed.

April–August 2015
Sequential floor-by-floor installation of precast columns, beams, and slabs using tower cranes enabled rapid vertical progress with minimal wet work.

September 2015
Final structural elements were installed including roof level slab, staircases, and M&E trunking integration.

October 2015
Surface finishes, drainage systems, lighting, signage, and quality checks were completed; final inspections and certification proceeded.

February 15, 2016
After minor touch-ups and operations setup, the car park was opened for public use with approximately 4,000 bays.



3.2

CASE STUDY

CONSTRUCTION PERFORMANCE AND RESOURCE EFFICIENCY

LABOUR REQUIREMENTS

Reduced On-Site Labour

Required up to 50–60% fewer workers compared to conventional methods due to prefabrication.

Shifted Workforce to Factory

Labour demand moved to off-site precast yards where work was safer, more controlled, and more efficient.

COST EFFICIENCY

Total cost: ~RM 60 million

Cost Savings Strategy

Lower Formwork & Scaffolding Expenses

Precast elements eliminated most temporary structures typically required for casting.

Minimal Material Waste

Factory precision in casting led to better yield from raw materials and reduced rework.

EFFICIENCY MEASURES

The precast concrete system used in the Hospital Kuala Lumpur Car Park significantly improved construction efficiency by reducing the overall timeline to just 12 months.

Factory-controlled production minimized material waste and rework, while ensuring consistent quality and dimensional accuracy.

On-site efficiency was enhanced with faster assembly, fewer workers, and reduced reliance on wet trades, leading to smoother project coordination and lower overall risk.

MATERIAL EFFICIENCY

Precision Casting in Factory

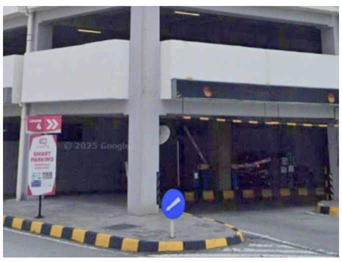
Components were manufactured to exact dimensions, reducing material overuse and rework.

Reduced Temporary Materials

Little to no timber formwork or scaffolding was needed, lowering consumption of non-permanent materials.

Minimal Waste Generation

Controlled environment led to better use of cement, aggregates, and steel, with very low offcuts and rejects.



Integrated Systems

Precast units were designed to include embedded conduits and service routes, eliminating extra material use on-site.

Optimized Structural Design

Use of hollow-core slabs and standardized elements minimized unnecessary material mass without compromising strength.

Efficient Transport & Handling

Components were designed for ease of lifting and stacking, reducing damage and waste during logistics.

3.3

CASE STUDY

PRECAST CONCRETE COMPONENTS USED IN CAR PARK HKL

Precast Beams

Primary and secondary beams to support floor slabs
Custom-sized to fit the structural grid, enabling fast craning and dry jointing

Precast Columns

Standardized 600 mm × 600 mm square columns
Designed based on modular coordination (MS 1064) for ease of alignment and fast installation

Hollow-Core Slabs (HCS)

Used for all floor decks to reduce self-weight and allow service routing
Provided high span-to-depth ratio with less concrete compared to solid slabs

Precast Staircases

Factory-moulded staircase flights for rapid, safe vertical circulation during and after construction

Precast Wall Panels

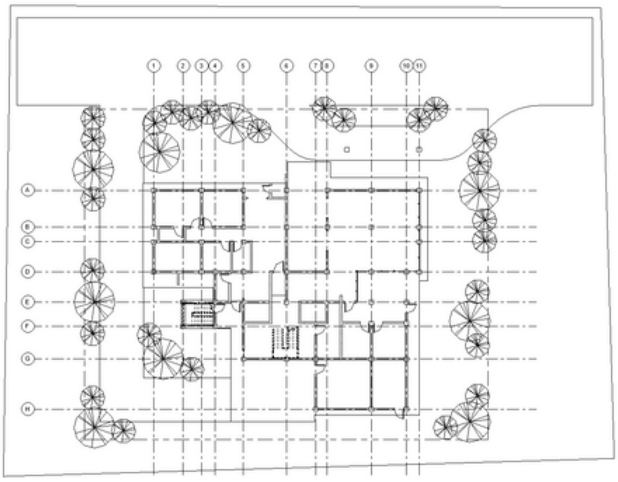
Limited use for elevator shafts and stairwell enclosures
Integrated M&E ducts in wall panels where required

Precast Parapet and Façade Panels

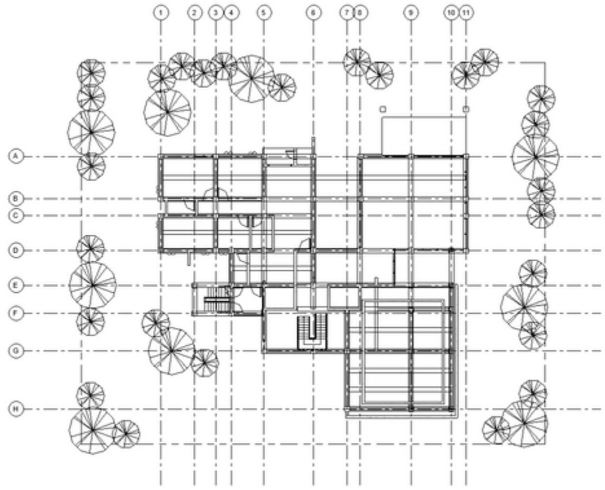
Installed for perimeter edge safety and architectural treatment
Offered smoother finishes and weather resistance

FLOOR PLANS

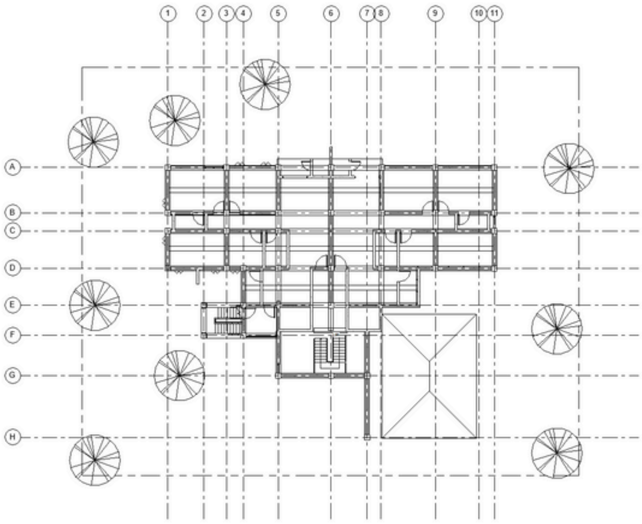
Ground Floor Plan



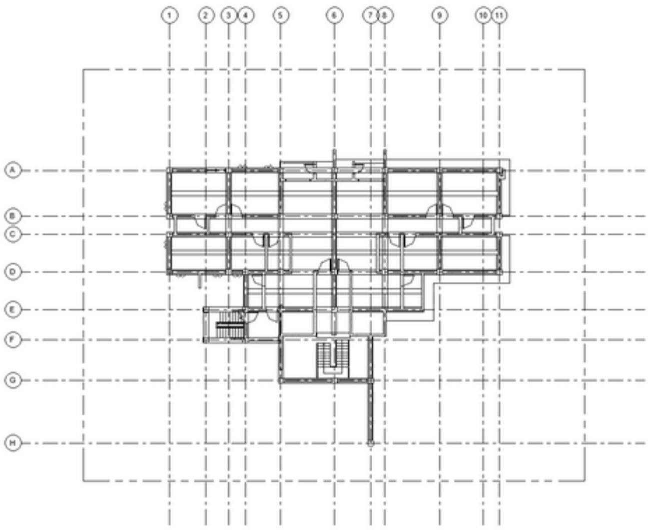
First Floor Plan



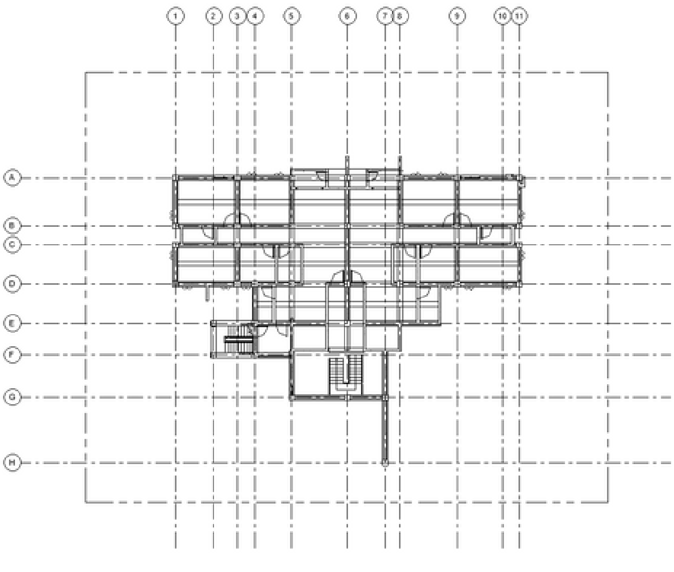
Second Floor Plan



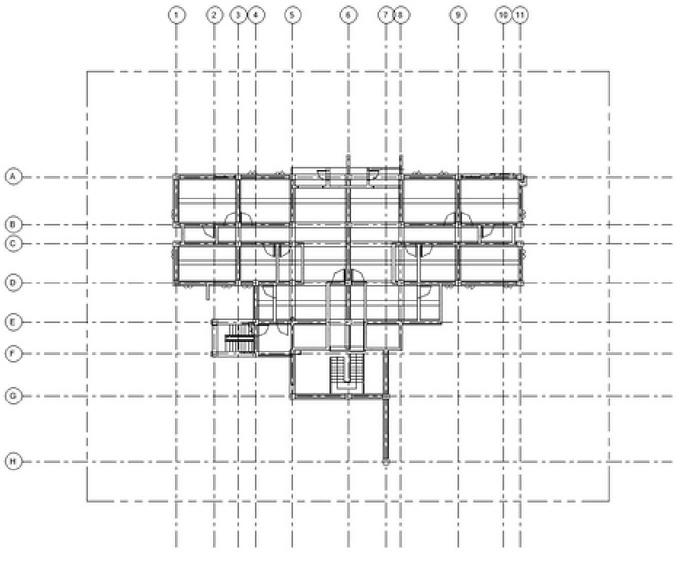
Third Floor Plan



Forth Floor Plan



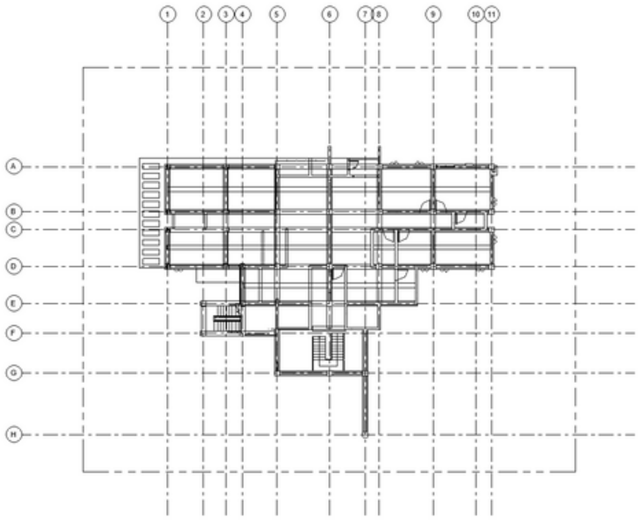
Fifth Floor Plan



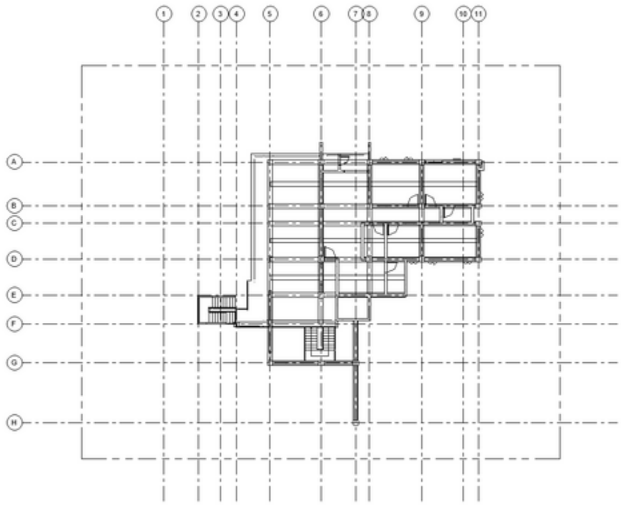
MODIFIED BIM MODEL

FLOOR PLANS

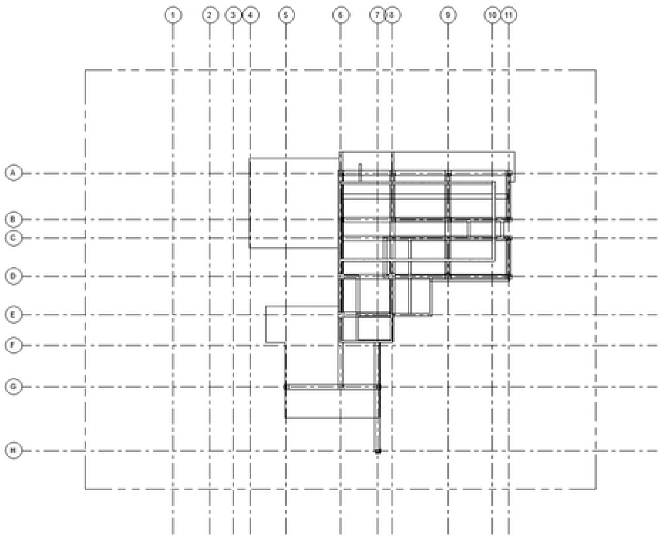
Penthouse L1 Floor Plan



Penthouse L2 Floor Plan



Roof Plan

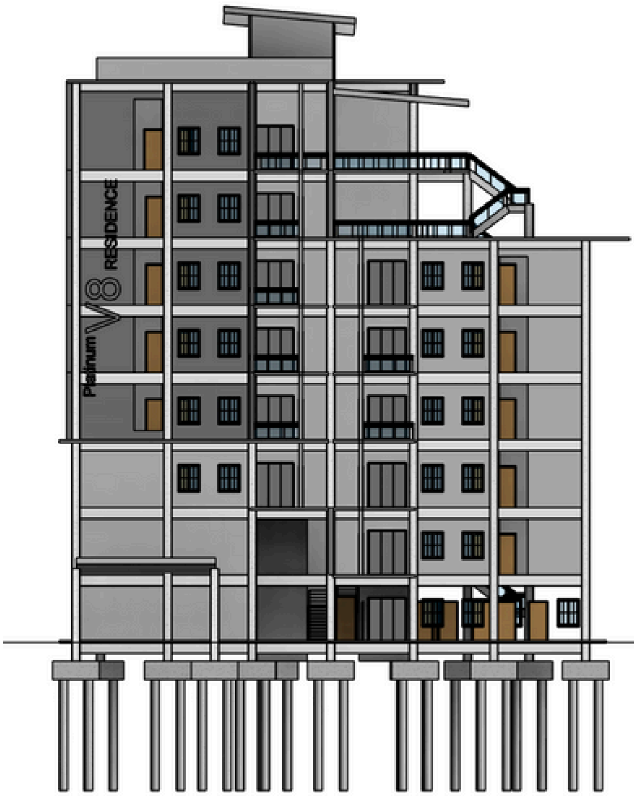


4.2

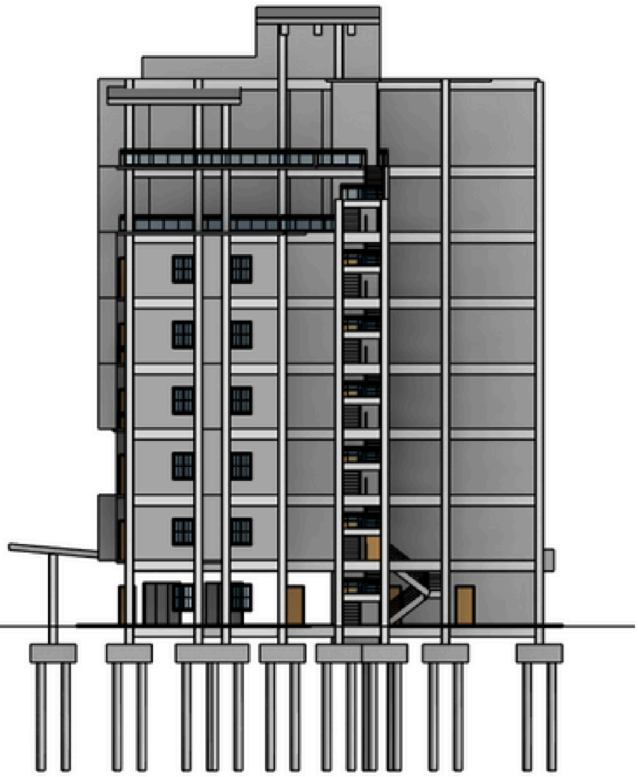
MODIFIED BIM MODEL

ELEVATIONS

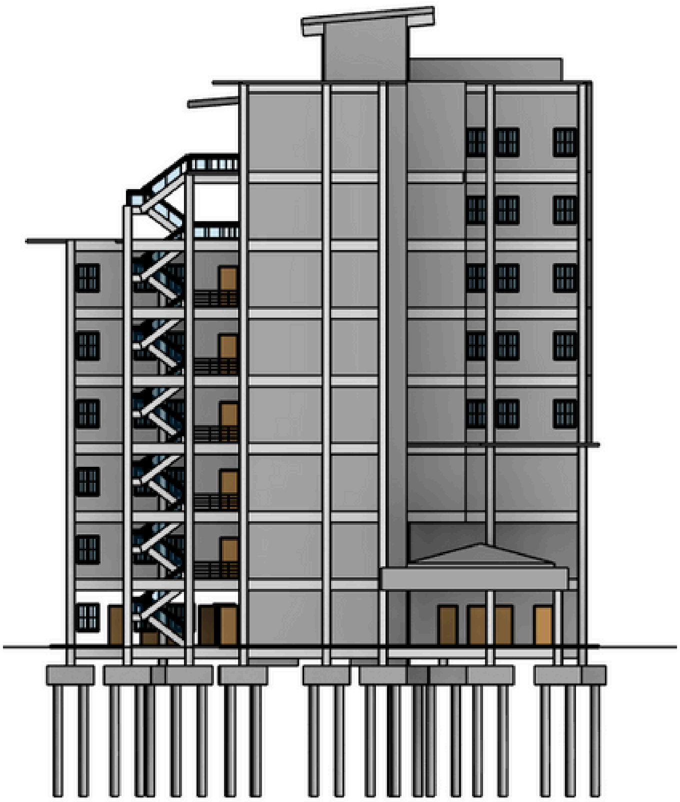
Front Elevation



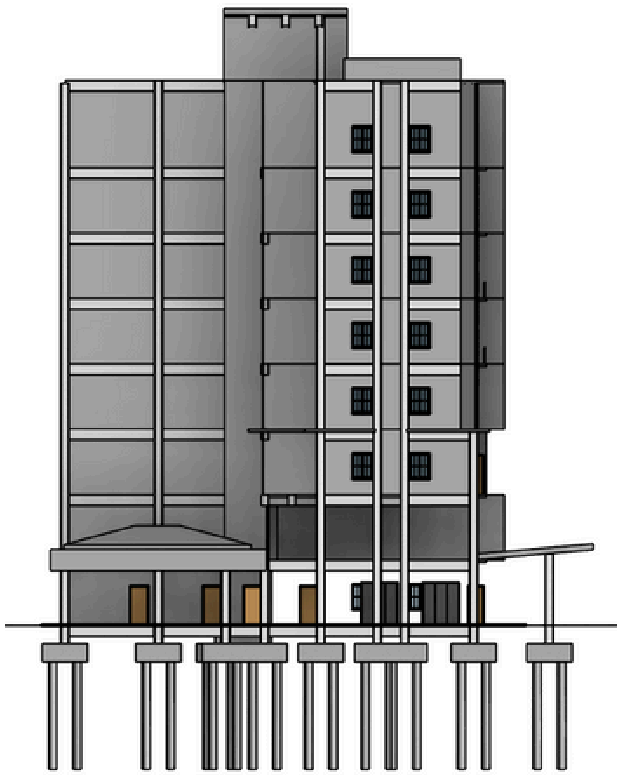
Left Elevation



Back Elevation



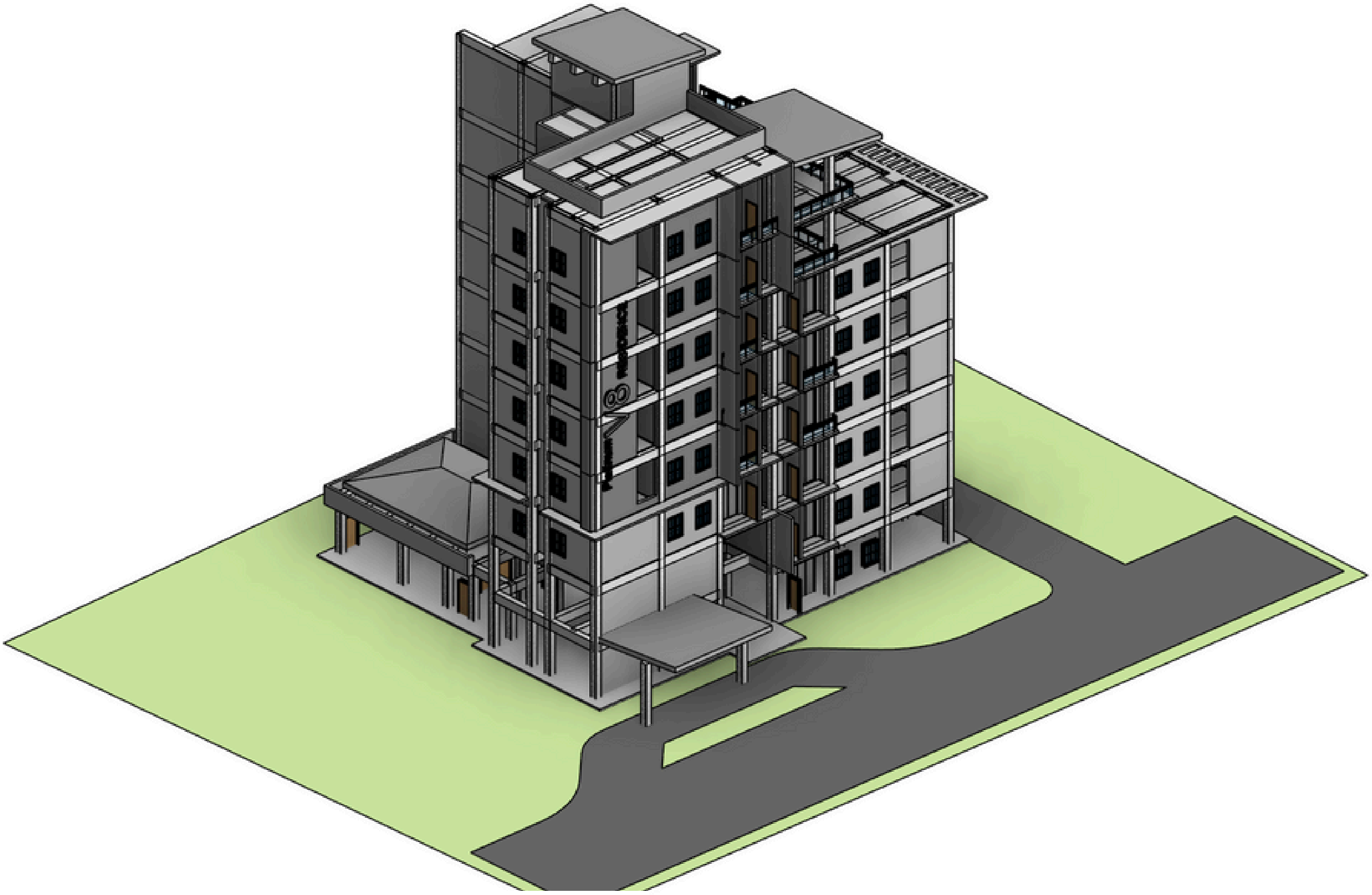
Right Elevation

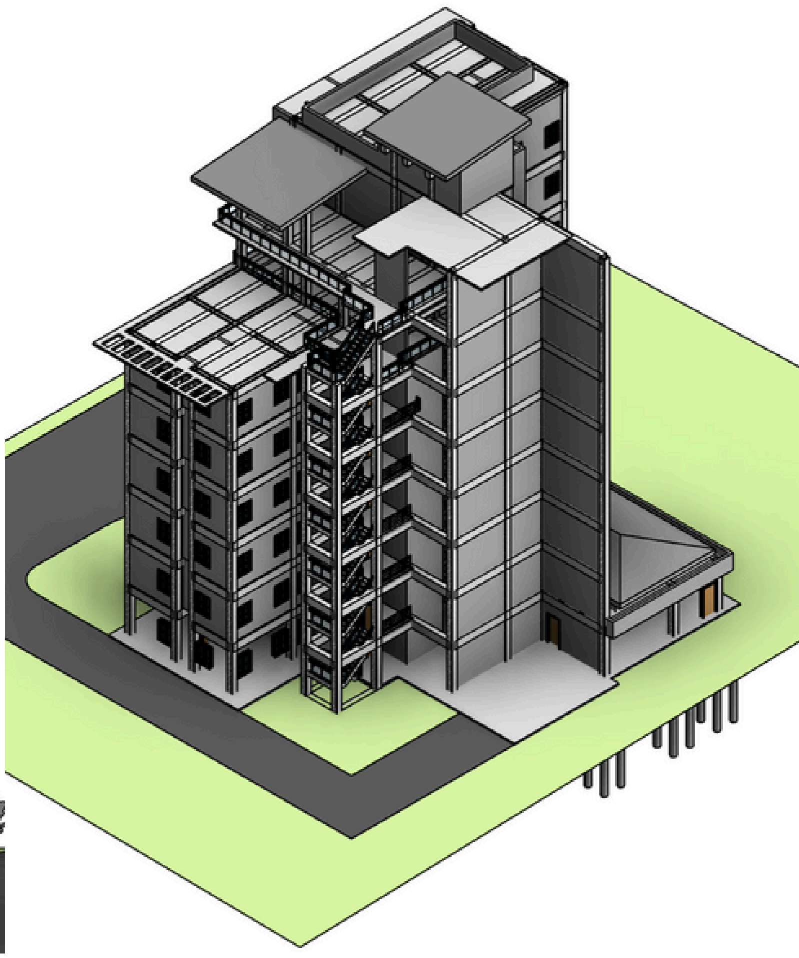


4.3

MODIFIED BIM MODEL

PERSPECTIVE VIEWS





REVIT SCHEDULES

Structural Column Schedule				
Type	Family	Base Level	Count	Top Level
305x305x283UC	UC-Universal Column-Column	FIRST FLOOR	1	THIRD FLOOR
450 x 450mm	Concrete Rectangular - Precast	T.O.F	46	<varies>

Grand total: 47

Wall Schedule					
Area	Volume	Type	Family	Length	Unconnected Height
dry wall					
9 m^2	0.94 m^3	dry wall	Basic Wall	3,000 mm	3600
113 m^2	<varies>	dry wall	Basic Wall	4,200 mm	<varies>
289 m^2	<varies>	dry wall	Basic Wall	11,200 mm	<varies>
363 m^2	<varies>	dry wall	Basic Wall	102,300 mm	<varies>
138 m^2	<varies>	dry wall	Basic Wall	38,000 mm	<varies>
14 m^2	2.73 m^3	dry wall	Basic Wall	4,160 mm	3000
38 m^2	2.56 m^3	dry wall	Basic Wall	12,900 mm	3600
54 m^2	2.71 m^3	dry wall	Basic Wall	18,000 mm	3600
96 m^2	2.75 m^3	dry wall	Basic Wall	34,300 mm	3600
60 m^2	4.03 m^3	dry wall	Basic Wall	16,500 mm	3600
282 m^2	<varies>	dry wall	Basic Wall	90,000 mm	3600
289 m^2	57.80 m^3	dry wall	Basic Wall	13,380 mm	21600
pre cast concrete					
8 m^2	<varies>	pre cast concrete	Basic Wall	2,000 mm	<varies>
1 m^2	0.11 m^3	pre cast concrete	Basic Wall	450 mm	1200
8 m^2	<varies>	pre cast concrete	Basic Wall	3,000 mm	<varies>
5 m^2	<varies>	pre cast concrete	Basic Wall	1,400 mm	<varies>
25 m^2	5.04 m^3	pre cast concrete	Basic Wall	1,300 mm	21000
12 m^2	0.50 m^3	pre cast concrete	Basic Wall	6,800 mm	3600
4 m^2	0.86 m^3	pre cast concrete	Basic Wall	1,400 mm	4800
18 m^2	0.91 m^3	pre cast concrete	Basic Wall	5,840 mm	3600
9 m^2	0.92 m^3	pre cast concrete	Basic Wall	2,960 mm	3600
121 m^2	<varies>	pre cast concrete	Basic Wall	42,000 mm	<varies>
20 m^2	0.67 m^3	pre cast concrete	Basic Wall	9,600 mm	3600
15 m^2	<varies>	pre cast concrete	Basic Wall	3,600 mm	<varies>
71 m^2	14.26 m^3	pre cast concrete	Basic Wall	2,100 mm	31000
9 m^2	1.72 m^3	pre cast concrete	Basic Wall	2,450 mm	3513
88 m^2	<varies>	pre cast concrete	Basic Wall	5,000 mm	<varies>
40 m^2	7.98 m^3	pre cast concrete	Basic Wall	2,650 mm	21000
81 m^2	16.28 m^3	pre cast concrete	Basic Wall	2,800 mm	30000
47 m^2	1.55 m^3	pre cast concrete	Basic Wall	17,400 mm	3600
19 m^2	3.84 m^3	pre cast concrete	Basic Wall	3,040 mm	7200
534 m^2	<varies>	pre cast concrete	Basic Wall	158,100 mm	<varies>
67 m^2	<varies>	pre cast concrete	Basic Wall	18,840 mm	<varies>
15 m^2	2.98 m^3	pre cast concrete	Basic Wall	3,750 mm	4200
155 m^2	<varies>	pre cast concrete	Basic Wall	45,600 mm	<varies>

REVIT SCHEDULES

Wall Schedule					
Area	Volume	Type	Family	Length	Unconnected Height
40 m^2	<varies>	pre cast concrete	Basic Wall	11,460 mm	3600
80 m^2	<varies>	pre cast concrete	Basic Wall	23,040 mm	3600
14 m^2	2.75 m^3	pre cast concrete	Basic Wall	4,160 mm	3000
76 m^2	<varies>	pre cast concrete	Basic Wall	29,400 mm	<varies>
114 m^2	<varies>	pre cast concrete	Basic Wall	38,700 mm	3600
61 m^2	2.03 m^3	pre cast concrete	Basic Wall	26,400 mm	3600
46 m^2	<varies>	pre cast concrete	Basic Wall	13,500 mm	<varies>
168 m^2	<varies>	pre cast concrete	Basic Wall	58,800 mm	<varies>
21 m^2	4.13 m^3	pre cast concrete	Basic Wall	5,150 mm	4200
47 m^2	<varies>	pre cast concrete	Basic Wall	11,000 mm	<varies>
24 m^2	4.72 m^3	pre cast concrete	Basic Wall	5,850 mm	4200
15 m^2	1.50 m^3	pre cast concrete	Basic Wall	12,500 mm	1200
44 m^2	<varies>	pre cast concrete	Basic Wall	13,200 mm	3000
23 m^2	4.65 m^3	pre cast concrete	Basic Wall	6,700 mm	4200
17 m^2	1.70 m^3	pre cast concrete	Basic Wall	14,200 mm	1200
215 m^2	42.92 m^3	pre cast concrete	Basic Wall	7,300 mm	29400
10 m^2	1.93 m^3	pre cast concrete	Basic Wall	8,250 mm	1200
21 m^2	4.20 m^3	pre cast concrete	Basic Wall	8,400 mm	3600
263 m^2	52.58 m^3	pre cast concrete	Basic Wall	9,039 mm	30000
22 m^2	2.18 m^3	pre cast concrete	Basic Wall	18,200 mm	1200
70 m^2	<varies>	pre cast concrete	Basic Wall	18,600 mm	<varies>
67 m^2	13.39 m^3	pre cast concrete	Basic Wall	9,400 mm	7200
11 m^2	2.29 m^3	pre cast concrete	Basic Wall	9,750 mm	1200
146 m^2	<varies>	pre cast concrete	Basic Wall	49,000 mm	<varies>
502 m^2	<varies>	pre cast concrete	Basic Wall	150,000 mm	<varies>
38 m^2	7.53 m^3	pre cast concrete	Basic Wall	11,000 mm	3600
14 m^2	2.81 m^3	pre cast concrete	Basic Wall	11,700 mm	1200
15 m^2	2.98 m^3	pre cast concrete	Basic Wall	12,410 mm	1200
45 m^2	9.00 m^3	pre cast concrete	Basic Wall	12,500 mm	3600
80 m^2	<varies>	pre cast concrete	Basic Wall	26,760 mm	<varies>
Storefront					
22 m^2		Storefront	Curtain Wall	3,200 mm	7200
46 m^2		Storefront	Curtain Wall	6,400 mm	7200
60 m^2		Storefront	Curtain Wall	8,300 mm	7200
Storefront 2					
28 m^2		Storefront 2	Curtain Wall	950 mm	29400
57 m^2		Storefront 2	Curtain Wall	3,000 mm	<varies>
10 m^2		Storefront 2	Curtain Wall	4,100 mm	2400
5647 m^2				1,352,339 mm	

REVIT SCHEDULES

Floor Schedule			
Area	Family	Level	Perimeter
GROUND LEVEL			
167.500 m²	Floor	GROUND LEVEL	53800
425.615 m²	Floor	GROUND LEVEL	97200
593.115 m²			151000
FIRST FLOOR			
13.515 m²	Floor	FIRST FLOOR	20800
43.929 m²	Floor	FIRST FLOOR	74700
134.580 m²	Floor	FIRST FLOOR	52000
192.024 m²			147500
SECOND FLOOR			
6.758 m²	Floor	SECOND FLOOR	10400
137.268 m²	Floor	SECOND FLOOR	56800
137.992 m²	Floor	SECOND FLOOR	56800
282.018 m²			124000
THIRD FLOOR			
6.758 m²	Floor	THIRD FLOOR	10400
137.982 m²	Floor	THIRD FLOOR	56800
167.998 m²	Floor	THIRD FLOOR	63300
312.738 m²			130500
FOURTH FLOOR			
6.885 m²	Floor	FOURTH FLOOR	10500
137.270 m²	Floor	FOURTH FLOOR	56800
137.982 m²	Floor	FOURTH FLOOR	56800
282.137 m²			124100
FIFTH FLOOR			
6.885 m²	Floor	FIFTH FLOOR	10500
136.985 m²	Floor	FIFTH FLOOR	56700
137.982 m²	Floor	FIFTH FLOOR	56800
281.852 m²			124000
PENTHOUSE LEVEL 1			
322.443 m²	Floor	PENTHOUSE LEVEL 1	131400
322.443 m²			131400
PENTHOUSE LEVEL 2			
233.208 m²	Floor	PENTHOUSE LEVEL 2	72692
233.208 m²			72692
ROOF LEVEL			
235.825 m²	Floor	ROOF LEVEL	84400
235.825 m²			84400
2,735.359 m²			1089592

Structural Framing Schedule		
Type	Family	Count
400x600	Precast Beam - Rectangular - Straight Ends	219

Grand total: 219

Structural Foundation Schedule		
Type	Family	Count
Standard	Pile Cap-4 Round Pile	44

Grand total: 44

Room Schedule			
Area	Level	Name	Unbounded Height
GROUND LEVEL			
30 m²	GROUND LEVEL	Cafe	4000
14 m²	GROUND LEVEL	PreFunction	4000
32 m²	GROUND LEVEL	Receptions	4000
57 m²	GROUND LEVEL	Lobby	4000
11 m²	GROUND LEVEL	Mail Room	4000
Not Enclosed	GROUND LEVEL	Room	4000
12 m²	GROUND LEVEL	Security	4000
10 m²	GROUND LEVEL	Management Office	4000
27 m²	GROUND LEVEL	Refuse	4000
17 m²	GROUND LEVEL	Services	4000
117 m²	GROUND LEVEL	Apartment Unit Type A	4000
327 m²			
327 m²			

6.0 IBS SCORE CALCULATION

PART 1 : STRUCTURAL SYSTEM

Componenent	Precast Elements	Area (m^2)	IBS Factor	Coverage	IBS Score
Ground - Roof Level	Precast columns and beams with no slabs	2735.539	1	50 x (2735.539/2735.539) x1	**50**

PART 2 : WALL SYSTEM

Componenent	Precast Elements	Length (mm)	IBS Factor	Coverage	IBS Score
Internal Wall	Dry Wall System	347 940	1	20 x (347940/1 352 339) x1	**5.15**
External Wall	Precast Concrete Panel	1 004 399	1	20 x (1004399/1 352 339) x1	**14.85**

PART 3 : OTHER SIMPLIFIED CONSTRUCTION SOLUTIONS

Utilisation of Standardised Components Based on MS 1064

Precast Elements	Coverage	IBS Score
Beam Sizes following MS 1064	100%	**4**
Column Sizes following MS 1064	100%	**4**
Wall Sizes following MS 1064	100%	**4**

Repetition of Structural Layouts

Precast Elements	Coverage	IBS Score
Repetition of Floor to Floor Height	86%	**2**
Vertical Repetition of Structural Floor Layout	77.8%	**2**
Horizontal Repetition of Structural Floor Layout	77.8%	**2**

Other Productivity Enhancing Solutions

Precast Elements	Coverage	IBS Score
Usage of BIM models for IBS Score Submission	Level 1	**3**
Usage of Modular Gridlines in drawings	100%	**4**

TOTAL IBS SCORE

PART	IBS SCORE
1	50
2	20
3	25
TOTAL	**95**

IBS SYSTEMS COMPARISON

COMPARISONS BETWEEN PRECAST CONCRETE SYSTEM, STEEL FRAMING SYSTEM, TIMBER FRAMING SYSTEM, BLOCK WORK SYSTEM, FORMWORK SYSTEM AND HYBRID SYSTEM

Criteria	Precast Concrete System	Steel Framing System	Timber Framing System	Block Work System	Formwork System	Hybrid System
Material Used	Precast concrete panels & elements	Steel columns, beams, trusses	Timber/wood frames	Concrete blocks or bricks	Reinforced concrete with formwork molds	Combination (e.g., steel + precast, timber + concrete)
Sustainability	Moderate (some waste reduction, high cement usage)	Low to moderate (recyclable but high energy in production)	High (renewable, low embodied energy if sourced sustainably)	Moderate (depends on sourcing and cement use)	Low (cement-intensive, temporary materials)	Can be optimized for sustainability through smart selection
Speed of Construction	Fast (off-site fabrication, quick on-site assembly)	Very fast (prefab elements assembled rapidly)	Moderate (lightweight, fast in small buildings)	Slow (manual laying, wet process)	Slow to moderate (due to casting and curing)	Varies depending on combination
Labour Requirement	Semi-skilled (crane ops, panel installation)	Skilled (fabrication, welding, bolting)	Skilled (carpentry)	Low to moderate (basic masonry)	Skilled (formwork, concrete pouring)	Mixed (needs both specialized and general labour)
Cost Efficiency	Cost-effective on large-scale projects	Higher material cost, but reduced time	Low material cost, high for skilled labour	Low material, high labour cost	Depends on formwork reuse and project scale	Cost optimized by combining systems
Environmental Impact	Moderate (less on-site waste, but cement footprint)	High (steel manufacturing impact)	Low (renewable, biodegradable if responsibly sourced)	Moderate (depends on cement and local sourcing)	High (cement + temporary materials waste)	Balanced depending on system choice
Durability	High (fire, weather, pest resistant)	Very high (long span, fire resistant, corrosion protected)	Moderate (requires treatment, maintenance)	Moderate (weather dependent, water absorption)	High (reinforced and protected)	Combined durability of chosen materials
Suitability for High-Rise	High (used commonly in towers, apartments)	Very high (excellent for skyscrapers and long-span needs)	Low (not ideal for tall structures)	Low (only suitable for low-rise buildings)	High (core structural use in towers)	High (can use strong systems for vertical structures)

IBS SYSTEMS COMPARISON

COMPARISONS BETWEEN PRECAST CONCRETE SYSTEM, STEEL FRAMING SYSTEM, TIMBER FRAMING SYSTEM, BLOCK WORK SYSTEM, FORMWORK SYSTEM AND HYBRID SYSTEM

Criteria	Precast Concrete System	Steel Framing System	Timber Framing System	Block Work System	Formwork System	Hybrid System
Structural Performance	Strong in load-bearing and seismic-resistant designs	Excellent (lightweight, flexible, long-span capable)	Adequate (best for low-rise/light loads)	Good for compressive load, weak in tension	Strong (especially in load transfer to foundations)	High – combines strengths of multiple systems
Design Flexibility	Moderate (limited by mold and transport)	High (adaptable for various complex geometries)	Moderate (flexible for small buildings)	Low (standard wall layouts, limited openings)	High (custom shapes possible via formwork)	Very High (strategic use of best-fit systems)
Transport & Logistics	Challenging (heavy, bulky, crane needed)	Efficient (lightweight, compact elements)	Easy (lightweight, manual handling possible)	Easy (local transport, stackable)	Moderate (wet materials, staging required)	Varies, must plan for multi-system logistics
Typical Use Cases	High-rise housing, malls, hospitals, carparks	Industrial, skyscrapers, stadiums	Houses, schools, cabins	Homes, boundary walls, rural buildings	All concrete structures (columns, slabs, walls)	Commercial or mixed-use buildings with diverse needs
Overall Summary	Fast, durable, cost-effective for mass housing	High performance, fast build, flexible but costly	Natural, aesthetic, suited for smaller builds	Traditional, cost-saving for basic builds	Flexible but slower; dependent on skilled labour	Smart, customizable , efficient when well-integrated

Conclusion

In conclusion, each construction system—Precast Concrete, Steel Framing, Timber Framing, Block Work, Formwork, and Hybrid—offers unique advantages and limitations depending on the project's requirements.

While precast and steel systems are ideal for speed and large-scale efficiency, timber provides a more sustainable and lightweight option for smaller structures. Block work and formwork remain cost-effective for traditional builds, while hybrid systems combine the best of multiple methods to achieve both performance and flexibility.

The comparison highlights the importance of selecting the right system based on structural needs, environmental impact, cost, labour, and site conditions to ensure successful and efficient construction outcomes.

8.0 REFLECTION

This project has expanded my understanding of different construction systems such as precast concrete, steel framing, timber framing, block work, formwork, and hybrid systems. By comparing them side by side, I was able to see how each system offers different strengths in terms of cost, speed, durability, and environmental impact. It gave me a clearer picture of how construction methods are chosen based on the building's purpose, site condition, and project scale.

I also learned how important structural performance, design flexibility, and transport logistics are in real construction planning. Creating the comparison table helped me think more critically and organize technical data in a way that's clear and accessible. It wasn't just about memorizing facts — it was about understanding how systems behave and interact in real-world applications.

Overall, this exercise has strengthened both my research and analytical skills. It helped me connect theory to practice, and I feel more confident in evaluating construction systems in future design projects. This knowledge will definitely guide me in making more informed and sustainable decisions moving forward.

9.0 REFERENCE LISTS

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