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Case Study

Backgrounds

Projects Name: Menara Kerja Raya 2
Architects: JAF Design & Arkitek MAA
Completion of Buildings: 2 years
Construction Periods: 2013 – 15 April 2015
Main Contractor: Ahmad Zaki Resources Berhad (AZRB)
Owner: Jabatan Kerja Raya Malaysia (Public Works Department, JKR)
Total Floor Area: 47,000 sqm

Synopsis of Structure

Menara Kerja Raya 2, a prominent high-rise government office tower located in Kuala Lumpur, exemplifies the smart implementation of Industrialized Building System (IBS) using full precast concrete construction. The building's structure comprises **precast columns, beams, walls, slabs, and staircases, all manufactured off-site** and assembled on-site with precision. This method not only **enhanced construction speed** but also **ensured high levels of quality control and consistency**. The use of IBS precast concrete significantly **reduced reliance on on-site labour** and **minimized construction waste**. It is also Malaysia's goverment proudly first recognised platinum GBI building.

Skeleton frame systems, made of reinforced concrete, consist of columns and beams that **support a building's interior floors and exterior walls**. This system is widely used in Malaysia, including in the Kompleks Kerja Raya 2 (KKR2) tower, because it is well-suited for tall buildings. Although skeleton frames require many structural members, the use of formwork systems can speed up construction and improve efficiency.

Rigid Frame System vs Skeleton Frame System

Rigid frame systems are used to **provide lateral stability,** especially in low seismic zones or for shorter buildings in seismic areas. They are often combined with **core structures** to **improve overall resistance**, as core systems are the most effective method for stabilizing tall buildings. However, rigid frames are complex to construct due to the need for many large beams and columns.

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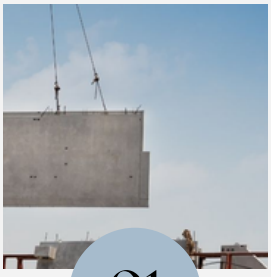
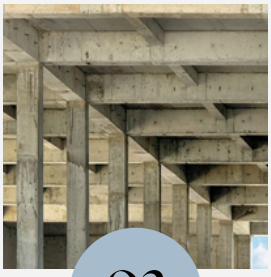
Key Features



01

Concrete elements are manufactured off-site.



02

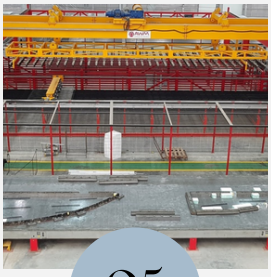
Components include walls, slabs, beams, columns, and stairs.

03

Standardized and modular units for easy assembly.

04

Designed for quick installation and reduced on-site work.



05

High precision and quality due to factory production.

06

Components are transported to site and assembled using cranes.

07

Can be combined with steel or other structural systems.

08

Supports mass production and repetitive designs. Often includes integrated reinforcement and services.

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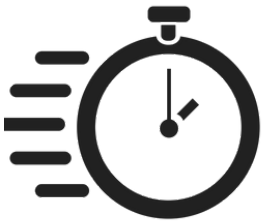
Pros and Cons

Benefit of IBS Precast Concrete

- Speeds up construction time due to factory-made components.
- Ensures high-quality control and uniformity of elements.
- Reduces on-site labor and minimizes construction waste.
- Enhances durability and resistance to weather and pests.
- Improves safety with less on-site work.
- Facilitates modular construction and easy future modifications.
- Can reduce overall construction costs in large-scale projects.




Disadvantages of IBS Precast Concrete

- High initial investment for factory setup and molds
- Transportation challenges due to size and weight of components
- Requires careful planning and logistics coordination
- Limited flexibility for on-site design changes
- Potential joint and connection issues if not properly executed
- Site storage space needed for precast elements before installation
- Risk of damage during transport or handling
- Not ideal for highly customized or unique architectural forms
- Dependency on skilled labor for assembly and finishing

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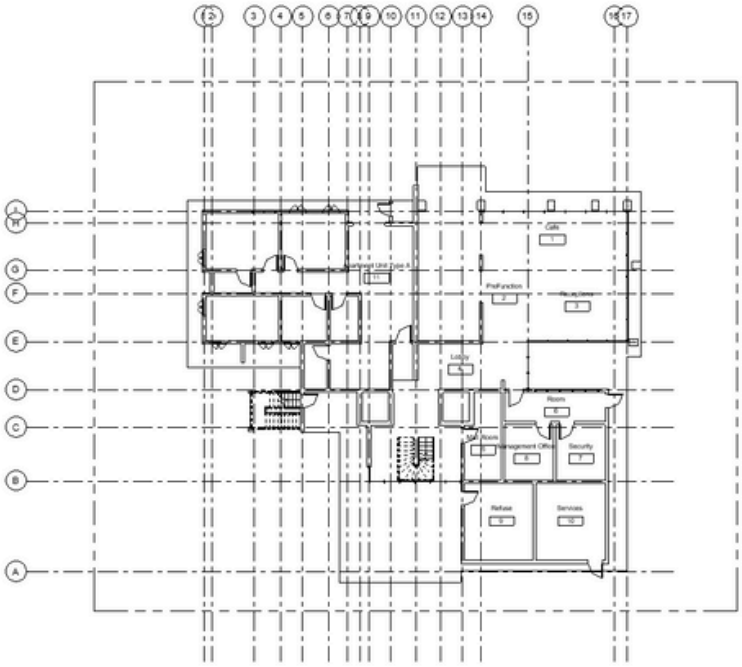
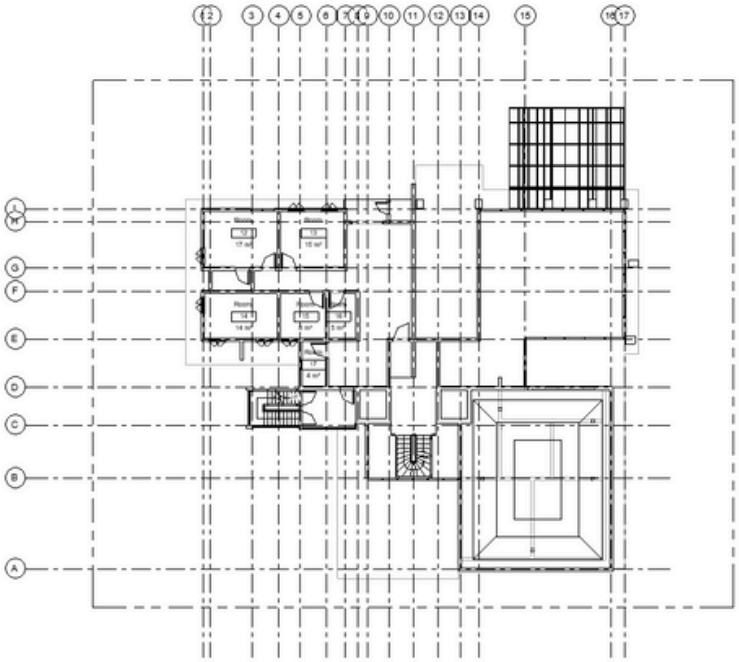
Floor Plan

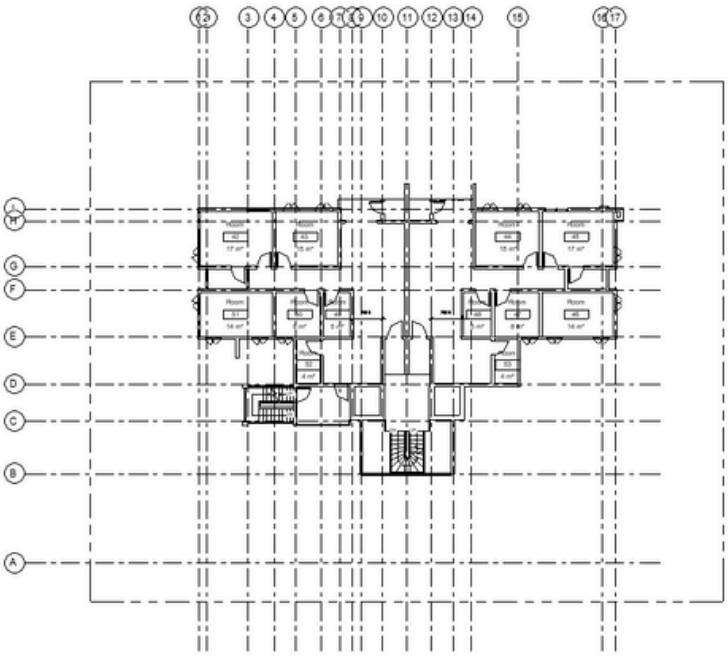
Ground Floor



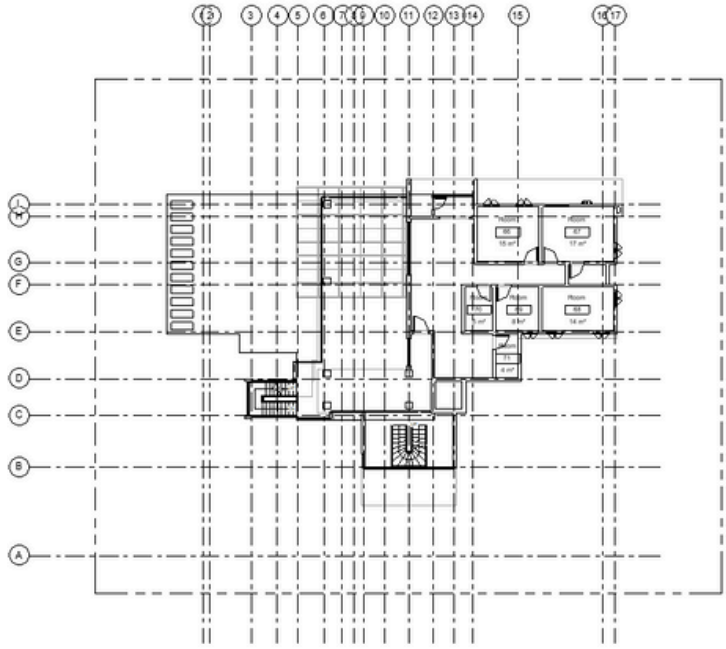
First Floor



Second-Fifth Floor



Penthouse Level 1 & 2



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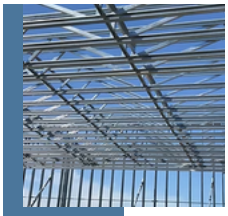
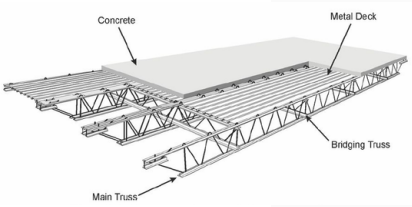
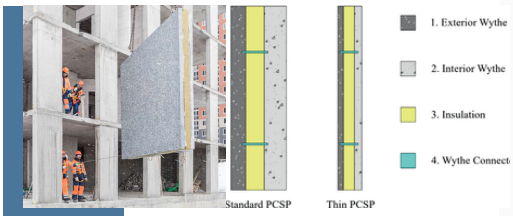
Perspective



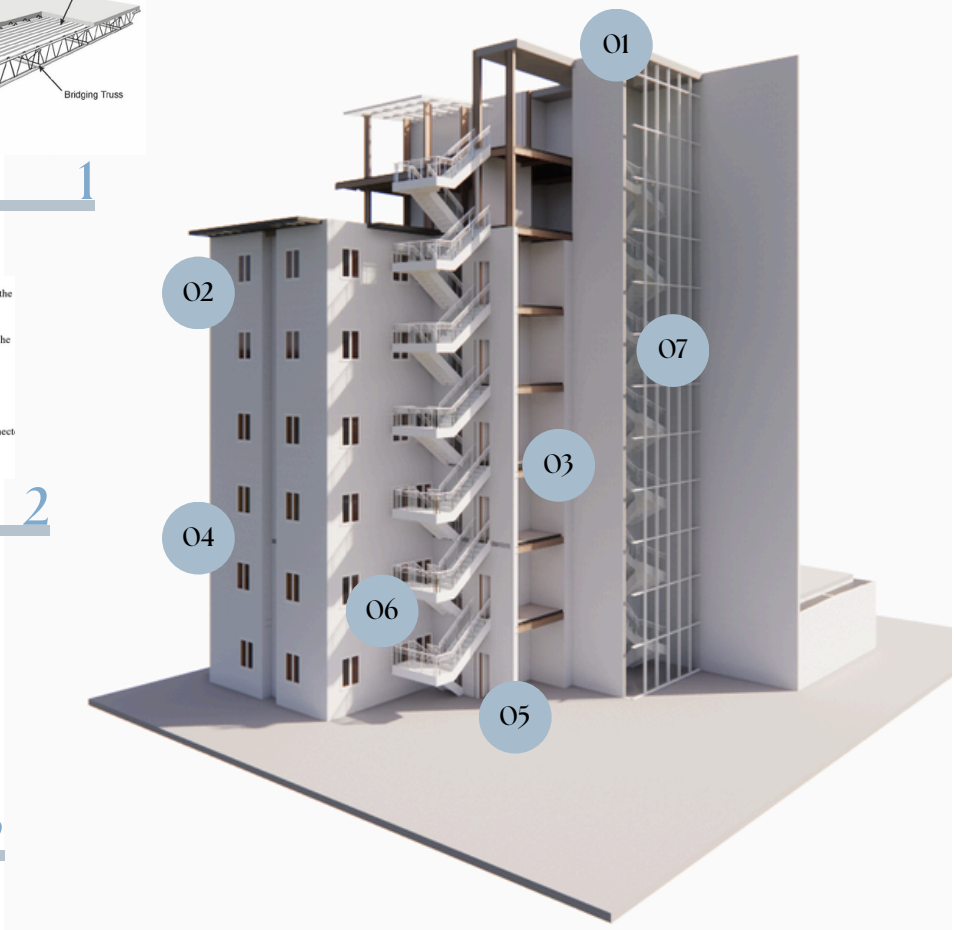


Steel Trusses Flat Roof 1



Precast Concrete Sandwich Panels 2

Hollow Core Slab 3



Types of Components applied and its Details

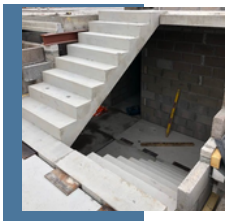
Brickwall 4

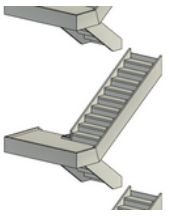
Door 5

Door sizes
IBS preferred sizes:
900mm x 100mm

Window 6

Double casement windows
IBS preferred sizes:
1200mm x 1800mm





Staircase 7

Precast Reinforced Concrete Staircase

06 IBS System Selection: IBS Precast Concrete System

IBS Score Calculation

Part 1: Structural System

No.	Structural Component	Construction Area (m2)	IBS Factor	Coverage	IBS Score
1	Precast columns + precast beams + precast hollow core slabs Ground Floor	550.76	1	0.19	9.5
2	Precast columns + precast beams + precast hollow core slabs First Floor	146.98	1	0.05	2.5
3	Precast columns + precast beams + precast hollow core slabs Second Floor	325.123	1	0.11	5.5
4	Precast columns + precast beams + precast hollow core slabs Third Floor	325.123	1	0.11	5.5
5	Precast columns + precast beams + precast hollow core slabs Fourth Floor	325.123	1	0.11	5.5
6	Precast columns + precast beams + precast hollow core slabs Fifth Floor	325.123	1	0.11	5.5
7	Precast columns + precast beams + precast hollow core slabs Penhouse Level 1	232.647	1	0.08	4
8	Precast columns + precast beams + precast hollow core slabs Penhouse Level 2	232.647	1	0.08	4
9	Steel Trusses Flat Roof	372.3379	1	0.13	6.5
	Total Part 1	2835.8639			48.5

Part 2: Wall System

No.	Structural Component	Length (m)	IBS Factor	Coverage	IBS Score
1	External Wall- Precast concrete panels	666.4	1	0.54	10.8
2	Internal Wall- Precast concrete panels	404.01	1	0.32	6.4
3	Internal Wall- Brick Walls	120.77	1	0.1	2
	Total Part 2	1245.78			19.2

Part 3: Other Simplified Construction Solutions

No.	Description	Area / Length	IBS Factor	Coverage	IBS Score
1. Repetition of the Structural Layouts					
	Repetition of floor to floor height	/	/	/	3
	Vertical/ Horizontal repetition of structure floor layout	/	/	/	3
2. Utilisation of Standardised Components					
	Door	/	/	/	4
	Window	/	/	/	4
3. Productivity Enhancing Solutions and Technology Adoption					
	Simulation and Modelling	/	/	/	6
	Digitalisation and Virtualisation	/	/	/	0
	Smart Construction	/	/	/	0
	Other Enhancing Solutions	/	/	/	6
	Total Part 3				26
	Grand Total				93.7

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IBS System Comparison With Case Study

PNB Merdeka 119

Menara Kerja Raya 2

Z Residence

	Steel Frame System	Precast Concrete System	Blockwork System
Sustainability	• Steel are highly recyclable building materials used in Merdeka 118, considering the end of building life cycle • Locally sourced steel, reduced transport emission. • Integration of steel frames and large glazing, loweing the operational energy and improve energy effixiency for Merdeka 118.	• Locally Manufactured in Factory and locally sourced aggregates reduce transportation emissions and on-site waste. • Promotes reuse and recycling of materials in the production process. • Reduces water usage on-site and Enhances energy efficiency of buildings due to excellent thermal mass properties. • Supports green certifications like Green Building Index (GBI) or LEED	• Prefabricated interlocking blocks are produced in controlled factory conditions, trimming material wastage by up to 50–80% compared to traditional on-site block cutting and plastering. • Prefab blocks use lightweight materials with higher strength-to-weight ratios, reducing embodied energy in production and transport • Can cut CO_2 emissions by roughly 20%, thanks to standardized off-site manufacturing
Structural performance	• Steel have strong **height-to weight ratio**, which gives Merdeka have long structures towards the top and columns free spaces with exceptional structural integrity. • Sophisticated outrigger and belt truss system of Merdeka providing **excellent seismic resistance**, which only feasible by IBS precise fabrication.	• Provides high compressive strength and dimensional stability, able to **resists fire, weather, and corrosion,** increasing building lifespan. • Factory-controlled production **ensures consistent quality and performance**, stable for vertical loads and wind pressure, suitable for high-rises. • **Allows integration** with other structural systems (e.g., steel or post-tensioning).	• Interlocking geometry enables stronger lateral load resistance and better energy dissipation under lateral forces compared to conventional block systems • Reinforced interlocking-block columns, when engineered properly, show axial load capacity between 65–185% of standard reinforced-concrete predictions
Speed of Constructions	• Rapid on-site assembly reduced time through prefabricated components are delivered "**just in time**", and less impactful from weather impact. • Merdeka 118 was constructed **one floor per 3 days,** which atrributed to intricate steel components prefabricated off site and lifted in place, • This saves immense amout of time by adopting IBS Steel Frame System	• Speeds up the construction process due to parallel off-site fabrication and eliminates the need for time-consuming formwork and curing on-site. • Reduces weather-related delays, as production continues off-site regardless of site conditions. • Simplified scheduling and logistics, enhancing project timeline certainty and enables quick assembly with crane installation, especially for repeatable modules.	• The IBS block work system propelled the Z Residence timeline by cutting wall and slab construction by roughly 30–40%. • Key to speed gains: parallel factory/site workflow, modular interlocking blocks, and pre-integrated structural elements. • Outcomes: 12–16 weeks per tower for structure vs. 20–24 weeks in traditional approaches.
Suitability for high rise buildings	• Steel Frame are suitable for Merdeka 118 as a skyscrapers that need to withstand seismic forces from height altitude, such as wind. • Steel frames easily integrate with various cladding systems, complex MEP requirements, and composite floor systems (like Merdeka 118's). • Complex geomtry are only possible by integrating higher level of BIM to fabricate the steel components to a tall, slender skyscrapers.	• Suited for repetitive vertical components and facilitates floor-by-floor installation with high consistency. • Supports just-in-time delivery, reducing on-site storage needs and minimizes site congestion, which is critical for urban high-rise projects. • Compatible with hybrid structural systems, allowing flexible design • Reduces dependency on skilled labour on-site	• Waste reduction & improved site cleanliness, cuts on-site waste by up to 90%, minimizing over-ordering, spoilage, and site disruption, while simplifying logistics and waste segregation systems like those at Z Residence • Enhanced durability & lifecycle, fire-resistant (up to 4 hours), moisture-resistant, and structurally stable—with a service life of 50+ years—reducing repair needs and material impact over time
IBS Scoring Performance	• Merdeka 118 showcased the proactive implementation of IBS steel framing system through meticulous planning and coordination. • This is seen through parallel workflow of on-site labour and off-site prefabrication to reduce time, cost and labour of the construction. • It is a benchmark for adopting IBS steel system to achieve sustainability and tallest high rise in Malaysia	• Precast systems score highly due to standardisation, prefabrication and reduced manual site labour • Contributes to higher Structural IBS Score, especially when full-frame or panel systems are used. • Improves quality control and site safety, both indirectly influencing IBS performance evaluation. • Encourages use of digital tools (BIM) for coordination, which complements IBS planning and execution.	• The systematic application of CNC-manufactured blocks with precise alignment and reduced site variability supports a strong structural score • Off-site production, reduced need for on-site formwork, and BIM-based planning (for block positioning, delivery, and erecting sequences) qualify under this category. • Emphasize modular coordination and contribute significantly to the structural section.

07 IBS System Selection: IBS Precast Concrete System

IBS System Comparison With Case Study

Celcom Digi Tower

T3 Minneapolis

The Edge

Formwork System

- Lower Environmental Disturbance: As IBS Formwork System takes shorter on-site construction time, it reduces noise pollution dust and particulate emissions as well as optimize impact on local communities.
- Material Efficiency & Waste Reduction: Prefabrication of components of structures leads to more precise measurements and minimal material wastage.
- Reusable formwork systems (e.g., steel, aluminum) reduce the need for timber and disposable materials.

- IBS components are produced under controlled conditions, offering tight tolerances, consistent material properties, and high structural integrity
- Pre-engineered connections ensures reliable structural performance comparable to traditional in-situ concrete

- 20–50% faster than conventional methods: A typical 2- storey, ~1,500 sqft IBS home in Malaysia completes in 4.5–6 months, versus 6–9 months traditionally—a time reduction of 20–50%
- High-rise projects see 30–40% shorter durations, due to concurrent off-site fabrication and faster on-site assembly

- Engineered formwork is built to be durable yet lightweight, balancing strength with ease of handling. Its high reuse capacity helps to reduce the cost for extra labor and materials to support the building.
- Factory-fabricated formwork yields precise finishes, consistent quality, and safer, neater worksites even for hundreds of copies of same component.

- Application of some types of formwork system ((such as Tunnel Formwork) allows repetition of layouts with similar design.
- Most components take off-site prefabrication which enhance the performance and speed of construction

Timber Frame System

- Uses locally sourced and renewable timber
- Significantly lower embodied carbon compared to steel or concrete
- Stores carbon - helping with climate goals
- Minimal site waste
- Supports green certifications

- Engineered wood like CLT and Glulam provides high strength-to-weight ratio
- Lightweight but capable to support low to mid-rise structures
- Performs well when integrated with hybrid steel or concrete systems

- Fast because of off-site preparation and dry installation
- Reduced noise, labour and construction time - approximately 1 floor every 3-5 days in T3
- Crane-lifted timber panels enable rapid stacking

- Best suited for low to mid-rise buildings
- Reaches up to 18-stories in modern design with hybrid cores
- Structural loading for high-rise buildings are eased due to the lightweight materials

- High IBS score due to high levels of prefabrication and modularity
- Accurate dimensional control
- Sustainability features boost performance on GBI/IBS assessments
- Contributes significantly to the environmental and structural IBS criteria

Innovative System

- Uses advanced materials with low embodied carbon.
- Integrates smart energy systems to reduce operational carbon footprint.
- Prefabricated in controlled environments to minimize site waste and noise pollution.
- Designed for disassembly and recyclability to support circular construction.

- Combines modular components with lightweight yet high-strength materials.
- Allows flexible layout and integration with smart technologies and sensors for structural health monitoring.
- Tailored structural systems based on performance simulations and digital fabrication techniques.

- Incorporates modular MEP (Mechanical, Electrical, and Plumbing) pods for faster assembly and service integration.
- Prefabricated volumetric units allow significant reduction in on-site labor and time.
- Digital twins and BIM streamline coordination and reduce delays.
- Construction time cut down by 30–50% compared to traditional methods.

- Customizable hybrid systems make it suitable for both mid- and high-rise buildings.
- Efficient for projects requiring rapid delivery with minimal on-site disruption.
- Capable of supporting complex geometries through 3D-printed and CNC-fabricated components.

- Achieves high IBS scores due to full integration of modular prefabrication and innovative pods.
- Offers accurate tolerances, efficient connections, and plug-and-play service systems.
- Optimized sustainability and smart system integration improve GBI/LEED scoring.