

Construction Methodology Of Rotating Building Using Prefabricated Modules

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Abstract: Rotating buildings form a novel class of dynamic architecture in which each floor rotates independently around a fixed central core, enabling continuously changing façades, customizable views, and adaptive daylighting. This paper investigates the construction methodology of such buildings using prefabricated modular units, with emphasis on the structural system, sequence of assembly, integration of renewable energy, and practical feasibility. The analysis is based on secondary data from case-study papers on the Dubai Rotating Tower (Dynamic Architecture) and related literature on kinetic and modular high-rise construction. The typical configuration features a central reinforced-concrete core to which prefabricated steel-floor modules are attached, allowing independent rotation via bearing-based or air-cushion systems. Vertical-axis wind turbines are integrated between floors, and solar panels are mounted on the roof, contributing to partial or full energy self-sufficiency. The prefabricated approach reduces on-site labour by 70–80%, accelerates construction by 30–50%, and improves quality control. Despite these advantages, the system faces challenges in maintenance, logistics, and economic feasibility, especially in emerging markets such as India. The paper concludes that rotating buildings using prefabricated modules are technically feasible and conceptually suitable for contemporary high-rise design, but require detailed structural, mechanical, and economic studies before large-scale implementation.

Keywords: Rotating buildings, prefabricated modules, dynamic architecture, central fixed core, independent rotating floors, wind turbines, solar panels, modular construction, sustainable high-rise, India.

I. INTRODUCTION

Conventional high-rise buildings are largely static volumes, yet contemporary demands for energy efficiency, occupant comfort, and environmental responsiveness call for buildings that adapt over time. Dynamic or rotating architecture, in which architectural elements change form physically, offers one such response. Among the most emblematic examples are rotating skyscrapers, in which each floor rotates independently around a central core, continuously altering the building's silhouette and the views and solar exposure for each unit.

The concept of the rotating tower was proposed by architect Dr. David Fisher under the banner of Dynamic Architecture. The Dubai Rotating Tower, an 80-story, 420-meter-tall skyscraper, is widely cited as the prototype for this typology. The tower is designed to be constructed primarily from prefabricated modules assembled around a

fixed central reinforced concrete core, with each floor rotating up to 360° at controlled speeds.

This paper focuses on the construction methodology of rotating buildings using prefabricated modules, with special emphasis on:

- The structural system (central fixed core and independently rotating floors).
- The sequence of prefabrication, transportation, and on-site assembly.
- The integration of renewable energy systems (wind turbines and solar panels).
- The advantages and challenges of combining prefabrication with sustainable design.
- The conceptual feasibility of adopting such systems in the Indian construction context.

The study is conceptual and based entirely on secondary literature; detailed structural calculations, full-scale

simulations, and on-site cost analyses are beyond the scope of this seminar-based investigation.



Figure 1. Conceptual rendering of the Dubai Rotating Tower, showing the dynamic, continuously changing form achieved by independently rotating floors around a central core.

A. Aim

The aim of this seminar is to study and understand the construction methodology of rotating buildings using prefabricated modules, with special focus on the structural system, construction sequence, sustainability features, and practical feasibility.

B. Objectives

- To understand the basic concept and working principle of rotating buildings.
- To study the construction methodology of rotating buildings using prefabricated modules.
- To analyze the role of prefabrication in achieving precision, speed, and quality in construction.
- To understand the structural system consisting of a central fixed core and independently rotating floors.
- To understand the application of renewable energy systems such as wind turbines and solar panels in rotating buildings.

- To identify the advantages and challenges of combining prefabrication with sustainable design strategies.
- To study the feasibility of adopting sustainable rotating building concepts in the Indian construction context.

C. Scope

- The seminar focuses on the academic study of rotating buildings with emphasis on their construction methodology.
- It includes an overview of prefabricated construction techniques adopted for rotating building systems.
- The study covers the general structural configuration used in rotating buildings, including fixed core and rotating floor arrangements.
- It presents an outline of the construction sequence involved, from planning and fabrication to installation and assembly.
- The seminar examines sustainability aspects of rotating buildings at a conceptual level.
- Reference is made to selected international rotating building concepts to support theoretical understanding.
- The applicability of rotating building construction in contemporary high-rise architecture is discussed in general terms.

D. Limitations

- Based only on secondary data such as research papers and published literature
- Detailed structural, mechanical, and rotational calculations are not included
- Practical on-site construction issues are not covered
- Cost analysis and economic feasibility are not discussed in detail
- No experimental, simulation, or field study has been conducted
- Long-term operation and maintenance aspects are beyond the scope of this seminar.

II. LITERATURE REVIEW

A. Dynamic And Kinetic Architecture

Dynamic architecture refers to buildings whose form or envelope changes over time, often in response to environmental or user-driven inputs. Kinetic architecture is a broader category that includes movable building elements

such as roofs, louvres, or façade panels, as well as full-floor rotation. The underlying idea is that “time” is the fourth dimension of architecture, and movement enhances both function and aesthetics.

Early work on kinetic architecture dates to the 1960s–1980s, when designers experimented with rotating modules, sliding panels, and folding roofs for both artistic and environmental control purposes. Recent literature focuses on sensor-driven, digitally controlled façades and building envelopes that respond to sun, wind, and occupancy patterns.

B. Prefabrication In High - Rise Construction

Prefabrication has become increasingly important in high-rise construction due to its ability to improve quality, reduce on-site time, and minimize waste. In modular high-rise projects such as Collins House in Melbourne, prefabricated floor and façade units are manufactured off-site and lifted into position, achieving construction cycles of about 3 days per floor and 30–40% reduction in overall project duration.

The principles of prefabrication—standardization, controlled factory conditions, and parallel off-site and on-site work—are directly applicable to rotating buildings, where precision in geometry and alignment is critical for smooth rotation and safety.

C. Rotating Building Case Study

Several case-study and seminar-level papers examine the Dubai Rotating Tower and similar rotating-tower concepts. These studies highlight:

- A central reinforced-concrete core (diameter ≈ 22 m) carrying all vertical and lateral loads.
- Steel-floor modules (each ≈ 15 m cantilever) assembled off-site and attached to the core.
- Independent rotation enabled by steel bearings or air-cushion systems, with small motors per floor (≈ 4 kW).
- Integration of wind turbines between floors and solar panels on the roof for on-site energy generation.

These sources form the primary technical basis for the present work.

III. METHODOLOGY

This study adopts a secondary-data-based, qualitative and analytical approach, consistent with the stated seminar aim and limitations:

- Data are drawn from published research papers, conference proceedings, and technical reports on rotating buildings, dynamic architecture, and prefabricated high-rise construction.
- Key references include the CTBUH paper on the Rotating Tower Dubai, the IARJSET Case Study on Rotating Building (AITCON-43), and seminar-level analyses of rotating towers and dynamic architecture.

The analytical steps are:

1. **Inductive Classification:** Grouping rotating-building concepts according to structural configuration, rotation mechanism, and prefabrication strategy.
2. **Sequential Analysis:** Mapping the construction process from core casting to modular attachment and final servicing.
3. **Comparative Assessment:** Evaluating advantages and challenges of prefabricated rotating buildings versus conventional high-rises.
4. **Contextual Feasibility:** Assessing, at a conceptual level, how such systems might be adapted to the Indian construction context.

IV. BASIC CONCEPT AND WORKING

PRINCIPLE OF ROTATING BUILDING

Rotating buildings are high-rise structures in which each floor rotates independently around a vertical axis, typically centered on a fixed core. The rotation is continuous or stepwise, controlled by individual motor-ized systems. Rotation speeds are usually low (e.g., 0.25–1 rpm), such that occupants perceive change gradually rather than as sudden motion.

The core idea is that:- The central core remains static and bears all permanent and live loads, as well as wind and seismic forces.

- The floors, as discrete modules, rotate around this core, changing the orientation of apartments, views, and façade exposure.

Rotation can be:- User-controlled (e.g., residents select orientation or rotation schedules).

- Environmentally controlled (e.g., rotation optimizes solar gain, wind exposure, or views).

This system transforms the building from a static volume into a time-variant spatial assembly, aligning with the fourth-dimension paradigm of dynamic architecture.



Figure 2. Conceptual illustration of a prefabricated floor module showing the steel platform, cantilevered edge, façade panels, and integrated MEP runs. In a rotating tower, multiple such modules are stacked around the central core and attached to the rotation mechanism.

V. CONSTRUCTION METHODOLOGY USING PREFABRICATED MODULES

A. Prefabrication Strategy

The rotating tower concept relies heavily on prefabricated modular construction. Around 90% of the building—except the central concrete core—is fabricated off-site in factory-controlled conditions. Each module is a complete structural unit that includes:

- A steel floor frame (truss or plate system).
- Cantilevered floor slabs (cantilevers up to ≈ 15 m from the core).
- External cladding (aluminum, glass, and insulation).
- Interior finishes and integrated MEP (mechanical, electrical, plumbing) systems where feasible.

Because each floor must rotate reliably, dimensional tolerances are tight (on the order of millimetres), which is more easily achieved in a factory than on-site.

Advantages of prefabrication in this context: - **IMPROVED QUALITY CONTROL:** Consistent welding, panel-fitting, and testing of MEP systems.

- **Faster On- Site Assembly:** Modules are delivered “ready-to-hang.”
- **Reduced On-Site Labour:** Estimates suggest on-site workforce can be reduced by 70–80% compared with conventional high-rise construction.
- **Less Site Disruption:** Reduced noise, dust, storage, and traffic, especially in dense urban areas.

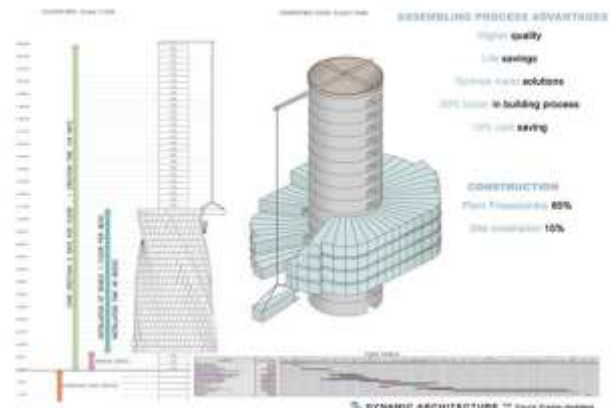


Figure 3. Schematic construction-sequence diagram for a rotating tower using prefabricated modules.

- (1) Cast-in-place reinforced-concrete core;
- (2) Prefabricated floor modules arrive at site;
- (3) Tower crane lifts each module and connects it to the core-mounted rotation mechanism;
- (4) Completed tower with rotating floors and between-floor wind turbines.

B. Construction Sequence

The construction sequence of a rotating building typically follows a core-first, modular-attachment approach:

1.Core Construction:- A circular reinforced-concrete core (diameter ≈ 22 m) is cast in-situ using slip-form or jump-form techniques.

- The core accommodates elevators, staircases, and major vertical services.

- In typical references, the core can be erected at a rate of about one floor per two days, allowing the core of an 80-story tower to be completed in approximately six months.

2. Module Fabrication:- While the core is being cast, floor modules are fabricated in factories.

- Each module is tailored to its floor level (e.g., corner geometry, cantilever length, façade treatment).

3. Module Transportation And Staging:- Modules are transported by road or sea to the site and stored in a staging area.

- Logistics of oversize modules can be a major constraint, especially in congested cities.

4. On- Site Assembly:- A large tower crane or a climbing-form crane system lifts each module into position.

- The module is aligned with the rotation mechanism (bearings or air-cushion tracks) and bolted or welded to the core.
- In conceptual sequences, one floor can be assembled per week, leading to completion of an 80-story tower in about 18–24 months, compared to 30–36 months using conventional methods.

5. Final Services And Systems Installation:- After the structural modules are attached, remaining MEP connections, wind turbines, and solar panels are installed.

- Quality tests and commissioning of the rotation system are carried out.

VI. STRUCTURAL SYSTEM

A. Central Fixed Core

The central core is a reinforced-concrete shear-wall system with a circular or near-circular cross-section (≈ 22 m diameter).

Its primary roles are:- Carrying vertical loads from all floors.

- Resisting lateral loads from wind and seismic action.

- Housing vertical transportation (elevators and stairs) and major vertical services.

The core is designed to current high-rise standards (e.g., Eurocode-style requirements), with high-strength concrete and detailed reinforcement detailing to resist bending, shear, and axial forces.

B. Rotating Floor Modules

Each floor is a prefabricated steel platform that cantilevers from the core by up to about 15 m. The module consists of:

- A steel frame or truss system spanning from the core to the façade.
- Composite or steel-deck floor slabs for habitable surfaces.
- Connection interfaces to the core's rotation mechanism (bearings, rails, or air-cushion pads).

Because the core is fixed and the floors rotate, the structural system is inherently decoupled in terms of motion: the core does not rotate, while the floors move independently. This arrangement can improve seismic performance by allowing some degree of damping and limiting global torsional effects.

VII. SUSTAINABILITY FEATURES:

A. Wind Turbines Between Floors:-

A distinctive feature of the rotating tower concept is the integration of vertical-axis wind turbines between adjacent floors. Typically, 48–79 wind turbines, each rated around 200 kW, are installed in the spaces between rotating modules.

THESE TURBINES :- Harvest wind energy that would otherwise pass by the building, reducing energy demand from the grid.

- Can generate surplus electricity, particularly in high-wind environments such as coastal regions or open desert-like settings.
- In conceptual studies, a single turbine per floor can supply enough energy to power 12–19 apartments annually under favorable wind conditions.

In addition to energy generation, the turbines may also function as part of the rotation mechanism (e.g., driving the

rotation in low-energy-regime scenarios), although this is still at the conceptual level in many studies.

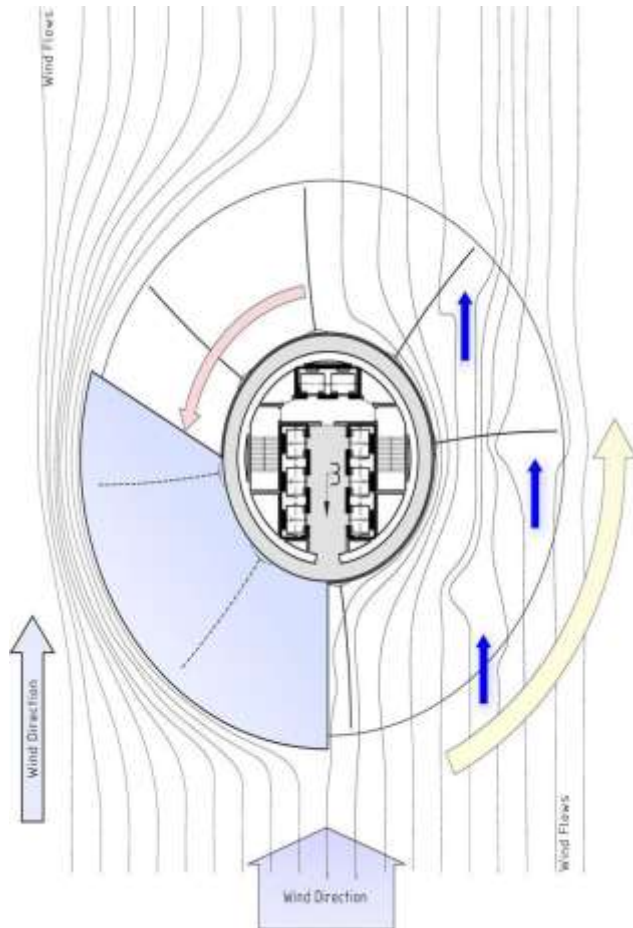


Figure 5. Conceptual rendering of wind turbines integrated between rotating floors. The turbines occupy the annular space between adjacent modules, allowing air to pass through while generating power for the building's internal systems.

Solar Panels:- Roof-mounted photovoltaic panels complement the wind turbines by generating electricity from solar radiation. The roof area of a tall tower may be modest in plan area, but its exposure to unobstructed sunlight can be high, especially in low-latitude cities.

Together, Wind And Solar Systems Can:- Supply a significant portion of the building's operational energy.

- Achieve net-energy-exporting performance in ideal conditions, contributing to district-level renewables.
- Reduce the building's carbon footprint and operating costs.

B. Synergy Between Prefabrication And Sustainability

Prefabrication itself contributes to sustainability by:- Reducing on-site material waste, because cutting and fitting occur in controlled factory environments.

- Minimizing site-based energy consumption (e.g., less concrete batching and curing on-site).
- Allowing higher-performance insulation, airtightness, and façade systems to be factory-integrated, improving energy efficiency.

VIII. ADVANTAGES CHALLENGES AND PRACTICAL FEASIBILITY

A. Advantages

- **Speed and quality of construction:** Prefabrication enables rapid assembly (one floor per week) and higher quality control, reducing project duration by 30–50% and on-site labour by 70–80%.
- **Architectura land experiential benefits :** Residents can customize views, daylight, and privacy by adjusting floor orientation, creating a unique and dynamic living experience.



- **Sustainability:** Integration of wind turbines and solar panels can lead to net-energy-positive or self-sufficient buildings over time, reducing dependence on the grid.
- **Seismic resilience:** The decoupled core-and-module system may provide better dynamic behaviour under seismic action by allowing independent motion of floors and damping effects.
- **Reduced construction impact:** Smaller on-site teams, less storage space, and lower noise and dust generation improve conditions in dense urban environments.

B. Challenges

- **Logistics and transportation:** Oversize prefabricated modules require careful planning for transport, crane planning, and site-access constraints, especially in congested cities.
- **Initial capital cost:** High initial investment is required for the rotation system, bearings, wind turbines, and control electronics.
- **Maintenance complexity:** Rotating components, bearings, and turbines need periodic inspection and maintenance; faults can disrupt building operation.
- **Mechanical and fire-safety complications:** Piping and ductwork must accommodate the relative movement between the fixed core and rotating floors.
- Fire-safety systems (sprinklers, smoke-control) require special detailing at the core–floor interface.
- **Acoustic and comfort issues:** Motor noise and low-frequency vibrations from rotation and turbines must be controlled for occupant comfort.
- **Economic and regulatory uncertainty:** In many countries, current building codes and insurance models are not tailored for rotating high-rise modules, leading to delays and extra validation requirements.

IX. FEASIBILITY IN THE INDIAN CONSTRUCTION CONTEXT

India's construction sector is rapidly urbanizing, and government-led initiatives such as PMAY and Smart Cities promote faster, higher-quality, and more sustainable housing. The rotating-building concept aligns conceptually with these goals, but several contextual factors must be considered:

- **Seismic and wind codes:** India's seismic zones (as per IS-1893) and wind-load requirements suggest that the

core-and-module system could offer advantages in damping and torsional control, but detailed local-code-compliant analysis would be essential.

- **-Prefabrication readiness:** The Indian market is beginning to adopt modular construction, but capacities for very large, high-precision steel modules are still limited compared with countries such as Singapore or the UAE.
- Renewable-energy targets India's national push for renewable energy and net-zero-energy-demand buildings makes the integration of wind turbines and solar panels highly relevant, provided technology.

X. CONCLUSION

Rotating buildings using prefabricated modules represent a promising evolution of dynamic architecture, merging kinetic spatial experience with contemporary construction techniques and sustainable energy strategies. The core of the system lies in a fixed reinforced-concrete central core that carries all vertical and lateral loads, while prefabricated steel-floor modules cantilever from it and rotate independently via bearing-based or air-cushion mechanisms. This configuration allows each floor to change orientation continuously, offering residents customizable views, daylight, and façade performance over time.

The construction methodology is centred on prefabrication and modular assembly. Around 90% of the building is fabricated off-site in factory-controlled conditions, with modules integrating steel frames, cladding, interiors, and MEP systems. This approach enables high dimensional accuracy and quality control, which is essential for smooth and reliable rotation. The core is first cast in-situ using slip-form or jump-form techniques, and subsequently each floor module is lifted and attached to the core-mounted rotation mechanism, typically at a rate of about one floor per week. Compared with conventional high-rise construction, this method can reduce overall project duration by roughly 30–50% and on-site labour by 70–80%, while also minimizing site-based waste, noise, and disruption.

Structurally, the separation between the fixed core and the rotating modules introduces a decoupled system that can enhance seismic performance by allowing independent motion of floors and improving damping characteristics. The central core behaves as a stiff shear-wall system

resisting gravity, wind, and earthquake forces, whereas the rotating modules act as cantilevered platforms that transmit their loads to the core at the rotation interface. This arrangement simplifies load-path clarity but demands careful detailing of bearings, tracks, and connection plates to handle repeated rotations and differential movements.

From a sustainability perspective, the rotating-building concept achieves notable integration of renewable energy. Vertical-axis wind turbines are installed between the rotating floors, capturing wind energy that would otherwise pass by the building, while solar panels are mounted on the roof to exploit unobstructed solar exposure. In conceptual analyses, such hybrid systems can generate a significant surplus of electricity, potentially enabling partial or full energy self-sufficiency and reducing grid dependence. The modular nature of construction further enhances sustainability by reducing on-site material waste, limiting construction-site energy consumption, and facilitating higher-performance façade and insulation systems that are factory-integrated.

Despite these advantages, rotating buildings face several practical challenges. The logistics of manufacturing, transporting, and lifting large prefabricated modules can be complex, especially in dense urban environments with limited access and strict crane-zone regulations. The rotation mechanism, including motors, bearings, and control systems, requires high initial investment and ongoing maintenance, while the interfaces between the fixed core and rotating floors demand special solutions for piping, ductwork, and fire-safety systems. Noise and vibrations from motors and turbines need careful acoustic design to ensure occupant comfort, and current building codes and insurance practices in many countries are not yet fully adapted to the unique demands of rotating high-rise structures.

In the Indian construction context, the concept remains largely at a conceptual and exploratory stage. India's seismic zoning, wind-load requirements, and rapidly urbanizing cities suggest that the core-and-module system could be beneficial, but only after detailed code-compliant structural and mechanical studies. The growing acceptance of prefabrication, government-led initiatives for Smart Cities and affordable housing, and national targets for renewable energy all provide a supportive background for the eventual adoption of such systems. However, large-scale implementation would require investment in local fabrication capacity, development of specialized

regulatory frameworks, and pilot projects to validate technical, economic, and operational feasibility.

In summary, rotating buildings using prefabricated modules are technically plausible and conceptually aligned with the goals of speed, sustainability, and user-centred design in contemporary high-rise architecture. The seminar-based investigation confirms that the basic construction methodology—prefabricated rotating modules assembled around a fixed central core with integrated wind and solar systems—is conceptually sound and rich in innovation potential. Nevertheless, the transition from conceptual design to real-world projects demands further work: detailed structural and mechanical calculations, prototype testing, economic assessments, and region-specific regulatory studies. Until such studies are completed, rotating-tower typologies should be viewed as an advanced, high-potential direction for future high-rise design rather than a mainstream construction standard.

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REFERENCES

1. Council on Tall Buildings and Urban Habitat (CTBUH):- Technical paper on the Rotating Tower Dubai
2. Fisher, D. (2008):- Conceptual design and structural reports for Dynamic Architecture and the Dubai Rotating Tower.
3. International Advanced Research Journal in Science, Engineering and Technology (IARJSET):- Case Study on Rotating Building (AITCON-43).

BIBLIOGRAPHY

4. Case Study: Collins House, Melbourne:- Documentation regarding prefabricated floor and façade units in modular high-rise construction.
5. Dynamic and Kinetic Architecture Theory:- Historical literature regarding movable building elements and the "fourth dimension" of architecture from the 1960s–1980s.
6. Modular Construction Systems:- General research on the reduction of on-site labor (70–80%) and



acceleration of construction cycles (30–50%) through factory-controlled prefabrication.

7. Sustainable High-Rise Design:- Technical reports on the integration of vertical-axis wind turbines (VAWT) and photovoltaic panels in dynamic towers.

WEBLIOGRAPHY

8. Dynamic Architecture Official Portal:- Accessed for conceptual renderings, schematic construction sequences, and technical specifications of the Dubai Rotating Tower