

Prefabricated and modular construction Innovative construction techniques

What is modular construction?

Modular construction is a process in which a building is constructed off-site under controlled plant conditions using the same materials and designing to the same codes and standards as conventionally built facilities.

Buildings are produced in “modules” that, when put together on-site, reflect the identical design intent and specifications of the most sophisticated site-built facility.

Modular construction types

Modular building – Industrialized housing and buildings

Industrial housing – A residential structure designed for the occupancy of one or more families

- One + module
- Or one + modular component
- Built off-site

Industrialized building – A commercial structure

- One + module
- One + modular component
- Built off-site
- Designed for commercial use

Modular component – A subassembly, subsystem or combination of elements including:

- Panelized systems
- Building shells
- Bathroom pods
- Plumbing
- Mechanical
- Electrical
- Fire protection

Module – A three-dimensional, volumetric section of a modular building designed and approved to be transported as a single section, independent of other sections, to a site for on-site construction

Panelized system – Wall, roof or floor components that are constructed off-site in a manner that prevents the construction from being inspected at the building site without disassembly, damage or destruction thereof

Benefits

Less material waste

- Recycling
- Controlled inventory
- Stock control

Reduced construction schedule:

Because construction of modular buildings can occur simultaneously with site and foundation work, projects can be completed 30% to 50% faster than traditional construction.

Elimination of weather delays

- Construction is completed inside a factory
- No need to “dry in” the building
- Buildings are occupiable sooner

Safer construction

- Modules built in a factory
- No need to work at height

Enhanced quality control

As the majority of the construction takes place in an indoor, factory-controlled environment, another big advantage of modular construction is that it allows for much greater quality control compared with traditional construction methods.

Modular building process

Design approval by the authority having jurisdiction (AHJ) and end users

Architects and engineers create exterior and interior plans. Once the owner approves the plans, they are submitted to the local AHJ or third-party service for approval and building permit applications are submitted.

Modular building process

Construction of modular components

The module components are built in a manufacturing plant while site excavation and grading is going on simultaneously.

Transportation of modules to a desired location

Modular buildings are shipped on chassis integrated into the structure or carriers towed by trucks.

Erection of modules to form a finished building

- Once at the jobsite, the modules are stacked by crane or rolled onto the foundation, bolted together and sealed for weather-proofing.
- Utilities are hooked up.
- Exterior components are completed.

Challenges

Logistical complications

Shipping

- Damage
- Across the country
- Across the ocean

Staging

- On-site storage
- Protection from damage

Permitting and inspection

- Differs from state to state and jurisdiction to jurisdiction
- Local code amendments
- Creates complications for manufacturing plants that fabricate modular construction for installation in multiple states
- AHJs may be wary of modular construction since the installation of building elements within closed construction must be inspected at the manufacturing plant.

Assembly on site

- On-site storage

- Interconnecting panels in a panelized system
- Interconnecting modules
- On-site testing and inspection

Fire performance with voids and cavities

- Draftstopping
- Fireblocking
- Penetrations

Fire performance concerns with materials

- Combustible structural elements
- Combustible surface lining
- Combustible insulation or void-filling materials

UL Solutions

Modular building inspection services

UL Solutions inspects the construction of modular units before they're shipped. We observe various building systems in operation to assess whether fire, life safety and security systems will operate as designed in the event of an emergency once they are assembled at the installation site.

<https://www.UL.com/services/modular-building-inspection-services>

UL Solutions has the expertise to assist you in optimizing the compliance of your modular building's life safety systems to international code requirements. A key issue is that when a modular building is constructed at an off-site location, the local code official cannot review or witness the critical systems and equipment located within walls or behind panels.

Relevant codes and standards are based on both international and local regulations, such as:

- ICC building and fire code
- National Electrical Code® (NEC®)
- NFPA 5000®, Building Construction and Safety Code®
- NFPA 1, Fire Code
- NFPA 101®, Life Safety Code®
- NFPA 855, Standard for the Installation of Stationary Energy Storage Systems
- UL 3401, Outline of Investigation for 3D Printed Building Construction
- UL 3223, Outline of Investigation for Data Center Certification

Commercial and industrial prefabricated buildings and units, QRXA

This category covers the installation of electrical systems in commercial or industrial prefabricated buildings and units such as:

- Power distribution buildings and units
- Refrigeration buildings and units
- Guard sheds
- Toll and phone booths
- Drive-up ATM booths
- Canopy shelters
- Traffic-control booths
- Indoor data/cash offices
- Water pump station buildings
- Stationary ITE server or data center buildings
- Storage buildings (for other than hazardous materials)

Prefabricated medical headwalls and medical supply units, KEZR

This category covers prefabricated medical headwalls and medical supply units that are factory-built assemblies for use in, within or as part of healthcare facilities and may be part of a building structure.

These assemblies may incorporate pre-installed materials and certified equipment that is usually concealed and may not be accessible for inspection at the installation site.

- Receptacles
- Switches
- Clocks
- Timing devices
- Patient monitors
- Vacuum stations
- Gas fittings

Composite panels, QRSY

This category covers composite panels, which are factory-built panel assemblies intended for use within or as part of the structure of buildings for commercial, industrial and residential use.

ICC 1200 standard for off-site construction: Planning, design, fabrication and assembly

Chapter 1: Application and administration

Chapter 2: Definitions

Chapter 3: Design

Chapter 4: Special requirements based on product type

Chapter 5: Manufacturing plant

Chapter 6: Fabrication

Chapter 7: Transportation and storage

Chapter 8: On-site installation

Chapter 9: Referenced standards

ICC 1205 standard for off-site construction: Inspection and regulatory compliance

Chapter 1: Application and administration

Chapter 2: Definitions

Chapter 3: Plan approvals and inspection procedures

Chapter 4: Third-party review and inspection agencies

Chapter 5: Requirements for compliance assurance programs

Chapter 6: Authority having jurisdiction

Chapter 7: Insignia and data plates

Chapter 9: Referenced standards