Rammed Earth Technology for Green Building

Market Scenario and Competitive Landscape

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Introduction and Methodology

"Market Scenario" is a customized and organized analysis to gather information about target markets and competitive landscape in a particular sector.

"Market Scenario" provides relevant information to identify and analyze market needs, market size and competition in the fields of interest of the customer. A technology or a product developed by the customer can be characterized according to the sectors and potentiality of application, target market, competitive advantages and potential partners of the technology. The analysis is performed with the application of technology and business intelligence tools. The research in the information providers is usually based on the use of keywords or by thematic area, according to the specific topic of interest.

The results of the assessment are data about the target or global market potential, market value and applicability of the technologies or products developed by the customer, the trends of the market of interest, the segmentation of the market (e.g., by application, geography or indication), the supply chain and the competitive advantages of products or technologies, the key players active in the market of interest and the possible direct or indirect competitors of the customer.

Context

This report provides an analysis of the main markets of interest for the topic, in particular:

- In **Chapter 1** an overview of the market and the main trends related to the **green technology and sustainability** market;
- In **Chapter 2** is reported the market for **earthen plasters**, with reference to the global market and market dynamics, the market segmentations by type, application and region and the competitive landscape;
- **Chapter 3** provides and overview of the market for **precast concrete**, with reference to market data and trends, the market segmentations by element, construction type, end-use industry, type, application and region and the competitive landscape;
- In **Chapter 4** is analyses the market for **modular construction**, with details about the global market, the market by type, material, end-use, region and the competitive landscape;
- **Chapter 5** provides **financial information** about selected players of interest.

1 Green Technology and Sustainability Market

Green technology is an applicable combination of advanced tools and solutions to conserve natural resources and the environment, minimize or mitigate negative impacts from human activities on the environment, and ensure sustainability. Green technology is also referred to as clean technology or environmental technology. It includes technologies such as IoT, AI, analytics, blockchain, digital twin, security, and cloud, which collect, integrate, and analyze data from various real-time data sources, such as sensors, cameras, and Global Positioning System (GPS).

According to the World Green Building Council, a **green building** is defined as a building that, in its design, construction, or operation, reduces or eliminates negative impacts and can create positive impacts on the climate and the natural environment. Green buildings preserve precious natural resources and improve the quality of life. Any building can be a green building, whether it is a home, an office, a school, a hospital, a community center, or any other type of structure if it includes the features listed below:

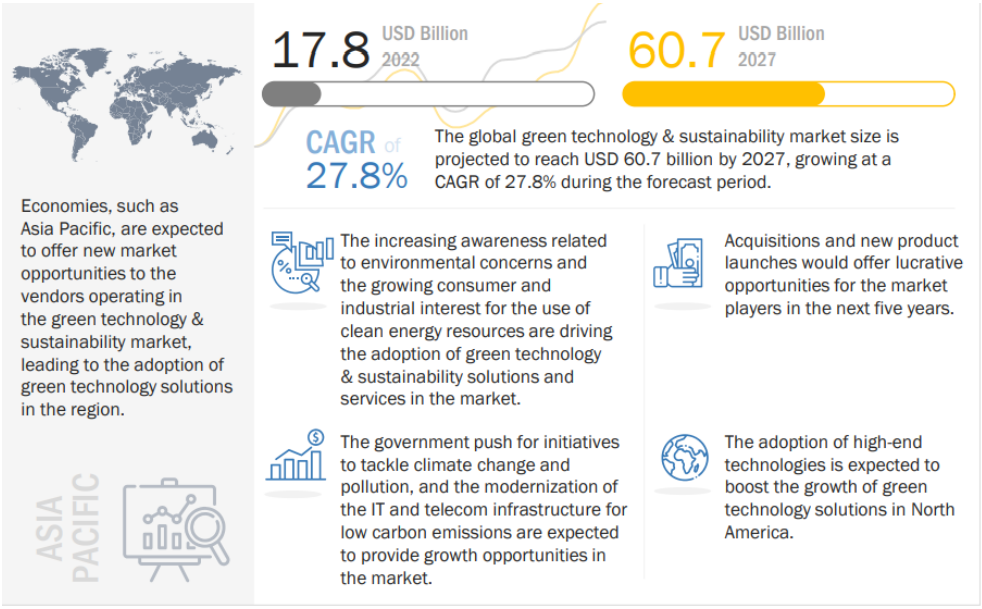
- A design that enables adaptation to a changing environment;
- Efficient use of energy, water, and other resources;
- Use of renewable energy (solar energy);
- Pollution and waste reduction measures;
- Enablement of re-use and recycling;
- Good indoor environmental air quality;
- Use of materials that are non-toxic, ethical, and sustainable;
- Consideration of the environment in design, construction, and operation;
- Consideration of the quality of life of occupants in design, construction, and operation.

The characteristics of green buildings will vary with countries and regions, as different locations have distinctive climatic conditions, unique cultures and traditions, diverse building types and ages, or wide-ranging environmental, economic, and social priorities.

1.1 Global Market and Market Dynamics

The **global green technology & sustainability market** is expected to grow from USD 17,809 million in 2022 to USD 60,778 million by 2027, at a Compound Annual Growth Rate (CAGR) of 27.8% during the forecast period (Figure 1).

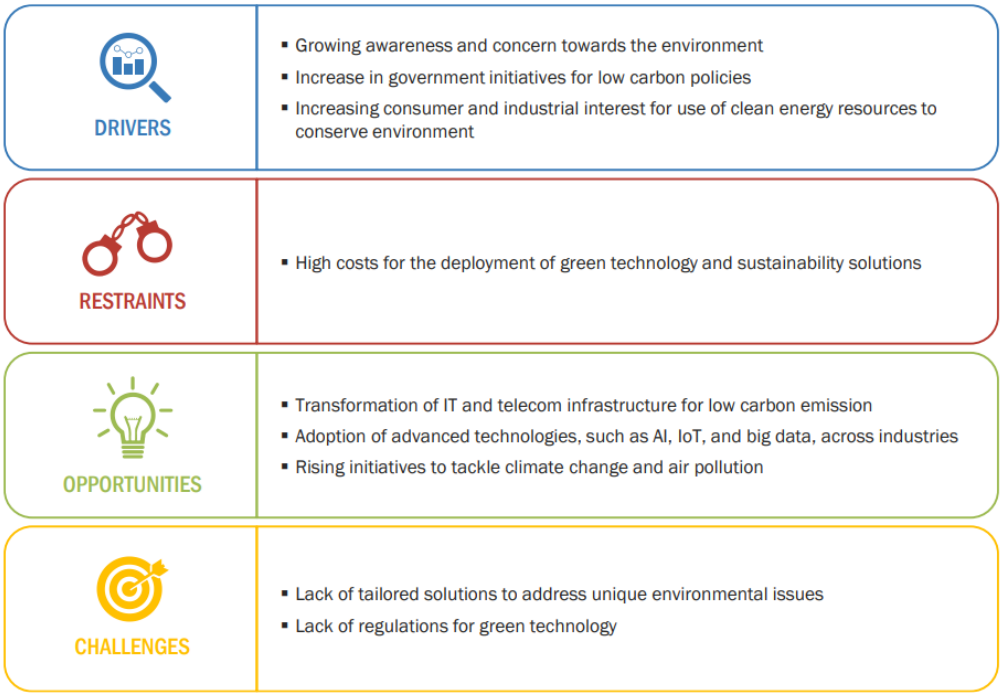
Figure 1. Global Green Technology and Sustainability Market, in the Period 2022 - 2027



The low-carbon technologies are rapidly evolving in terms of capabilities, costs, and impacts on environmental and natural resources. The benefits of these technologies may also vary among regions due to differences in the level of economic development, climate, and other impacting factors.

The growing public awareness and customer collaborations toward green initiatives are major factors **driving** the adoption in various sectors across the globe (Figure 2). The growing use of RFID and sensors across industries and consumer and industrial interest in the use of clean energy resources to conserve the environment are **opportunities** for this market. Various industries are making use of clean energy for different applications, such as crop monitoring, green building, fire detection, soil monitoring, weather monitoring, and forecasting.

Figure 2. Drivers, Restraints, Opportunities and Challenges: Green Technology and Sustainability Market



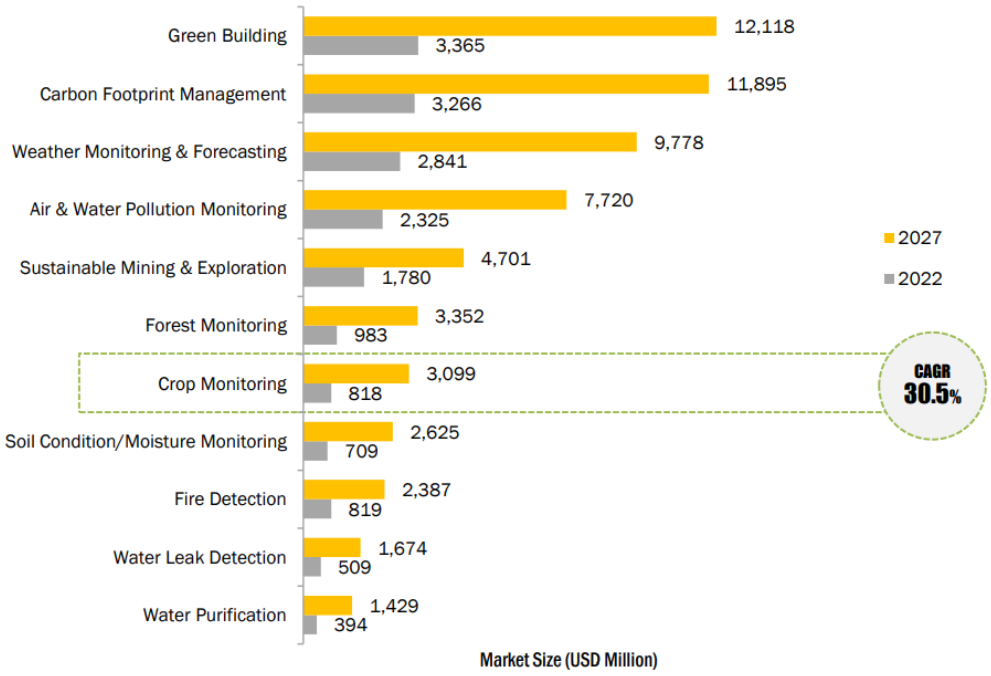
1.2 Market by Application

The green technology and sustainability market covers **11 broad applications**: carbon footprint management, **green building**, water purification, water leak detection, fire detection, soil condition/moisture monitoring, crop monitoring, forest monitoring, weather monitoring and forecasting, air and water pollution monitoring, and sustainable mining and exploration (Figure 3). Organizations offer green technology and sustainability solutions to reduce the carbon footprint of a business, enhance waste management, conserve water, and consume reduced energy as compared to traditional technologies.

The **green building segment** is estimated to account for the largest market size of USD 3,365 million in 2022 and grow to USD 12,118 million by 2027, at a CAGR of 29.2% during the forecast period. Technologies, such as AI, IoT, predictive maintenance, and blockchain, find multiple use cases in this application and have the potential to change how buildings are designed, built, and managed.

The focus on environment conservation, along with the growing integration of technology, while designing and constructing buildings to drive the growth of the green technology and sustainability market.

Figure 3. Green Technology and Sustainability Market, by Application, in the Period 2022 - 2027



Green building, also known as sustainable or high-performance building, refers to creating structures and deploying environmentally responsible and resource-efficient processes throughout a building's life cycle from siting to design, construction, operation, maintenance, renovation, and deconstruction. The practice complements the classical building design with aspects of economy, utility, durability, and comfort. The major considerations include energy and water efficiency, resource efficiency, indoor environmental quality, and the building's overall environmental impact.

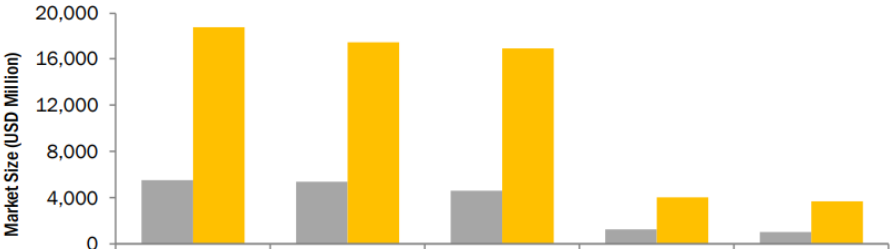
Technologies such as AI, IoT, predictive maintenance, and blockchain have the potential to change how buildings are designed, built, and managed. IBM Watson IoT solutions for buildings can connect facilities with AI and IoT-enabled infrastructure, streamline operations with predictive maintenance, and ensure the building occupants get an improved experience. IoT can enable the use of **prefabricated** building components in the construction of smart buildings and ensure a faster and more cost-effective way than traditional building methods. These buildings with **prefabricated** components could lead to less construction waste. On the other hand, blockchain can help streamline the supply chain and design documentation needed to build **prefabricated** offices and homes. The technology has the potential to connect the entire supply chain, including planning processes, construction contracts, and landlords, efficiently and securely. However, advancements come along with threats of security breaches.

1.3 Geographic Analysis

The green technology and sustainability market has been segmented into five regions: **North America, Europe, Asia Pacific, Middle East & Africa and Latin America** (Figure 4). Among these regions, **North America** is projected to take the largest market size during the forecast period. The key factors favoring the growth of the green technology and sustainability market in North America are the increase in technological advancements, increasing awareness to conserve resources and the presence of multiple green technology and sustainability vendors. The increasing number of players across regions is further expected to drive the global green technology and sustainability market.

Asia Pacific is expected to have the highest growth rate during the forecast period and witness considerable developments and adoption of green technology and sustainability solutions. **Europe** is the second-largest region in terms of market size during the forecast period due to a core focus on regulations, climate monitoring and saving nature. Various developments in vendor acquisitions, partnerships, and product launches, accompanied by investments in the development of technology, are the key factors driving the adoption of green technology and sustainability in Europe.

Figure 4. Green Technology and Sustainability Market by Region, in the Period 2022 - 2027



	North America	Europe	Asia Pacific	Middle East & Africa	Latin America
2022	5,516	5,377	4,610	1,272	1,034
2027	18,734	17,414	16,900	4,040	3,690
CAGR (2022–2027)	27.7%	26.5%	29.7%	26.0%	29.0%

1.4 Competitive Landscape

Some of the **major players** in the green technology and sustainability market include: GE (US), IBM (US), Enablon (France), Salesforce (US), Microsoft (US), Schneider Electric (France), Engie Impact (US), Intelex (Canada), Enviance (US), Sensus (US), LO3 Energy (US), Isometrix (South Africa), ConsenSys (US), CropX (Israel), Hortau (US), IOT Solutions and Consulting (Romania), Pycno (UK), MineSense Technologies (Canada), WINT (US), Envirosoft (Canada), ProcessMAP (US), Accuvio (Ireland), Taranis (Israel), Trace Genomics (US), Oizom (India), SMAP Energy (UK), Treevia (Brazil), EcoTrack (US), EcoCart (US), and AquiPor Technologies (US).

2 Earthen Plasters

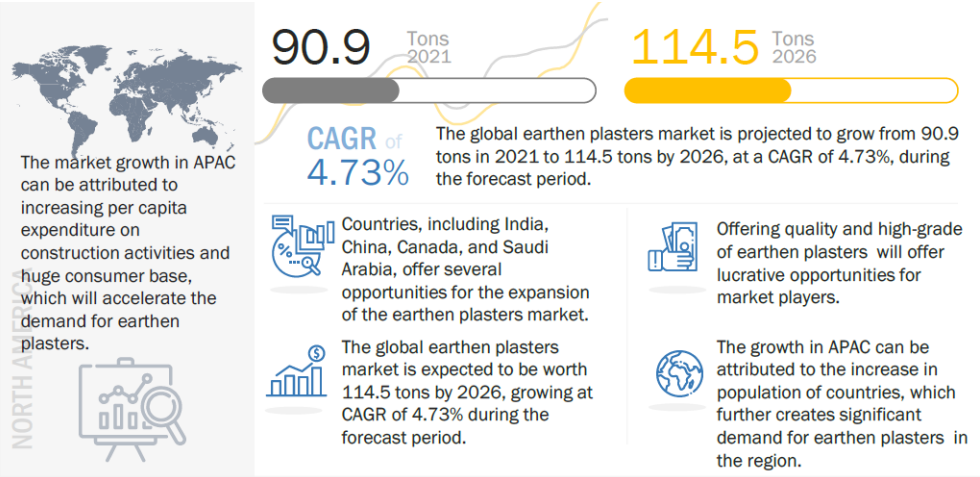
Earthen plasters or clay plasters are blends of unfired clays mixed with fine sand to provide a natural, breathable finish for internal walls, floors, roofs, masonry, agriculture, among other applications They have been used all over the world for thousands of years and still exist in many traditional vernacular buildings. Clay soil is one of the most ancient, rudimentary, yet effective building materials. Besides being naturally abundant across much of the earth, clay has unique properties that make it not only suitable, but also very desirable as a natural building material.

Increasing awareness toward sustainable construction and the use of green or eco–friendly products are expected to augment the demand for earthen plasters. Earthen plasters are the most versatile of all the natural plasters because its wide range of applications and the ubiquity of the material, which makes it affordable and easy to obtain. They can be used in indoor and outdoor settings, to make sculptures and relief carvings, and are easy to maintain. They do not require any heating or processing and can be mixed with other binders, fibers, and pigments to enhance its inherent durability and aesthetic qualities. It is also fireproof, mold–resistant, and visually pleasing. Earthen plasters are gaining popularity, owing to the rise in demand for sustainable and eco–friendly products.

2.1 Global Market and Market Dynamics

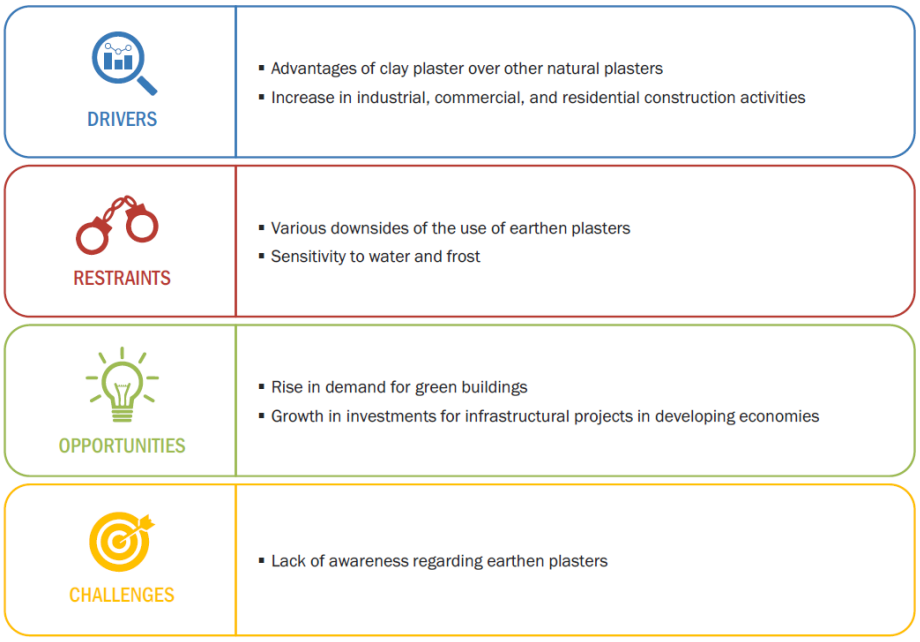
The **global market for earthen plasters** was valued at USD 84.35 million in 2020, and is projected to reach USD 103.04 million, by 2026 (Figure 5).

Figure 5. Global Earthen Plasters Market, in the Period 2021 - 2026



The global earthen plasters market is expanding and projected to witness moderate **growth** over the next five years (Figure 6). The growth of this market is attributed to the advantages of clay plaster over other natural plasters, the growth in industrial, commercial & residential construction activities. Various downsides of earthen plasters and sensitivity to water and frost are the factors **restraining** the growth of the market. However, the rise in demand for green buildings and growth in investment in infrastructure projects in developing economies are proving to be **opportunities** for the growth of the market. A lack of awareness toward earthen plasters is posing **challenges** to the market.

Figure 6. Drivers, Restraints, Opportunities and Challenges in the Earthen Plasters Market



2.1.1 Drivers

Earthen plaster is a practical, environmentally friendly, durable, affordable, and easy to repair material that can be used instead of paint to decorate interior walls and ceilings. It is made from pure **clays** and aggregates, with coloring that comes from natural oxides and mineral pigments. These plasters are porous, and hence they can breathe by absorbing humidity and moisture. They help to control the indoor climate and air quality. This helps regulate temperature, preventing the growth of mold and bacteria. All earthen plasters are fire retardant. Additional benefits of using natural clay plasters include:

- Unique design effects: Different varieties of clay plasters are available to create wall textures ranging from marble–smooth and soft suede to rugged finishes that include mica chips, shredded straw, and recycled colored glass;
- Versatility in application: It can be applied over drywall, stucco, wallpaper, concrete, brick, and adobe walls and ceilings. It can even be used in wet areas, such as kitchens and bathrooms, if the walls are sealed to protect against splashing from sinks, bathtubs and showers;
- Healthier indoor environment: Clay plasters add negative ions to the air, which help neutralize the electromagnetic effect created by computers, appliances, and synthetic plastics prevalent in today's homes. Negative ions are believed to produce biochemical reactions in the body that increase the serotonin level, helping to alleviate depression, relieve stress and boost daytime energy.

The **growth of the construction industry** is one of the major drivers of the earthen plasters market. According to Global Construction 2030, a study published by Global Construction Perspectives and Oxford Economics in 2021, the global construction market is expected to reach USD 8 trillion by 2030, driven by China, the US, and India. The rapid industrial growth has given rise to new commercial, non–commercial and residential buildings. The construction of factories, manufacturing plants, stadiums, shopping centers, office buildings, hotels, public facilities, public transportation buildings, and other government projects has increased rapidly. This will have a direct impact on the need for sustainable decorative building construction solutions in these structures, due to which an increase in the demand for earthen plasters is projected.

2.1.2 Restraints

Clay as a building material is not subject to any technical standard, because it is a natural material. The **downside** of earthen plaster is that it does not last like other plasters. Regular maintenance is a must as its durability is low. Direct water on the plaster can affect the finish negatively.

Clay is a **moisture–sensitive material** and should always be protected from rain and splashing water. If earthen plaster is permanently moistened, it loses its stability and begins to weather. For protection against rain, setting up horizontal barriers and providing suitable outdoor rain protection is a must. By absorbing and releasing water vapor, the volume of earthen plaster changes: therefore, the building material should only be provided with coatings that are elastic enough to not break. Another **disadvantage** of the use of earthen plasters is the relatively high frost sensitivity of the material. If there is a certain amount of water in the clay and this water freezes, then the result is frostbite. That is why wet clay is applied outdoors only in the months of April to September – this, of course, also applies to indoor areas in the unheated raw state.

2.1.3 Opportunities

Green buildings are defined as structures that are environmentally responsible and resource–efficient throughout their lifecycle. These buildings provide various benefits, such as energy efficiency, sustainability, efficient use of resources, environment protection, and higher resale value. Properties of clay, such as it being natural, durable, and affordable,

make it an excellent option to be used as a green building material. The increase in demand for green products will highly influence the growth of the earthen plasters market. Green buildings are already trending in the US and European countries. They are penetrating Asian, the Middle Eastern, and Latin American markets.

Cement production alone contributes to nearly 8% of CO_2 emissions, globally (Trends in Global CO_2 emissions: 2016 Report by PBL Netherlands Environmental Assessment Agency). The concept of earth houses is the limelight now across the globe. The structures, designed to use natural light and produce natural cooling, are built with local natural resources, such as bamboo, clay, cow dung, stones, and straw by local artisans, further reducing, the carbon footprint. Numerous organizations in India, such as Thannal and Vasthukam in Kerala, Made in Earth in Bengaluru, Auroville Earth Institute in Auroville — and architects, such as Dharamsala–based Didi Contractor, Chennai–based Benny Kuriakose, Kerala–based Eugene Pandala, and Goa–based Gerard da Cunha, are spearheading the movement to use natural products in construction.

The upcoming infrastructural and construction projects in developing economies, such as India and the countries of the Middle East, are providing opportunities to the earthen plasters market. Many construction projects are coming up in the Middle Eastern countries, such as Dubai, Saudi Arabia and the UAE. Largely ignored in North America for the past couple of centuries, the use of clay plasters is enjoying a remarkable resurgence as homeowners seek natural, healthy, and affordable ways to enrich their homes.

2.1.4 Challenges

Awareness toward earthen plasters is very low, globally. The know–how for earthen plasters is limited to small regions. The major companies are in Europe, whereas emerging countries have minor share in the earthen plasters market. The market has not witnessed major technology advancements and upgrades and are very less in use worldwide. Consumers are still reluctant to use earthen plasters over conventional plasters due to a lack of knowledge about the products and a low number of manufacturers.

2.2 Technology Analysis

Owing to the manual process of wall plastering on construction site, there is a large-scale requirement of labor, and hence the labor cost is responsible for increasing the price of construction or project work. The quality of work mostly depends on the skill of the labor work in the manual plastering process.

Currently, in the construction sector, near about all the processes are **manual**, which require more time for their completion. Therefore, the costs of the projects are very high due to which it is necessary to automate the processes in the construction work and improve their efficiency. Wall plastering is the main procedure among the processes followed in building construction, which is used for plastering the walls of the construction to get smooth and finished wall surfaces.

The solution of the above issues is just to introduce an **automatic plastering machine**, which automates the process to save the time and money and achieve better quality of plastering. The finishing of the walls obtained from automatic plaster machine is very smooth and accurate as compared to the manual process. Hence, the machine is time and cost–saving, thus reducing the total cost of the project. Automatic plastering machine has been developed successfully and is ideally suitable for the construction industry. This machine can improve the quality of the work with less wastage of material and fewer workers, which can solve the problem of shortage of skilled labors. Automatic plastering machine is fast, and the quality of the work is superior compared to the manual labor work.

2.3 Regulatory analysis

2.3.1 DIN 18947 Standards

Despite the increasing interest in earth–based plasters, there are still no European standards for earthen plasters, except in Germany, where standard DIN 18947 (DIN, 2013) on the subject was released. This standard has since been followed by several scientific studies regarding the assessment of mechanical and physical properties of this type of mortars (Delinière, 2014; Faria et al., 2014; Lima and Faria, 2014). The DIN standards include procedures for declaration of product essential features and consider aspects of Life Cycle Assessment (LCA) for sustainable building.

2.3.2 ASTM Standards

This standard provides guidance for earthen building systems that address both technical requirements and considerations for sustainable development. Earthen building systems include adobe, rammed earth, cob, cast earth, and other earth technologies used as structural and non–structural wall systems.

The considerations for sustainable development relative to earthen wall building systems are categorized as follows: materials (product feedstock), manufacturing process, operational performance (product installed) and indoor environmental quality (IEQ). The technical requirements for earthen building systems are categorized as follows: design criteria, structural and non–structural systems, and structural and non– structural components.

This standard does not provide guidance for structural support of roofs made of earthen material.

ASTM E2392/E2392M– This standard provides guidance for earthen building systems, also called earthen construction, and addresses both technical requirements and considerations for sustainable development. Earthen building systems include adobe, rammed earth, cob, cast earth, and other earthen building technologies used as structural and non–structural wall systems.

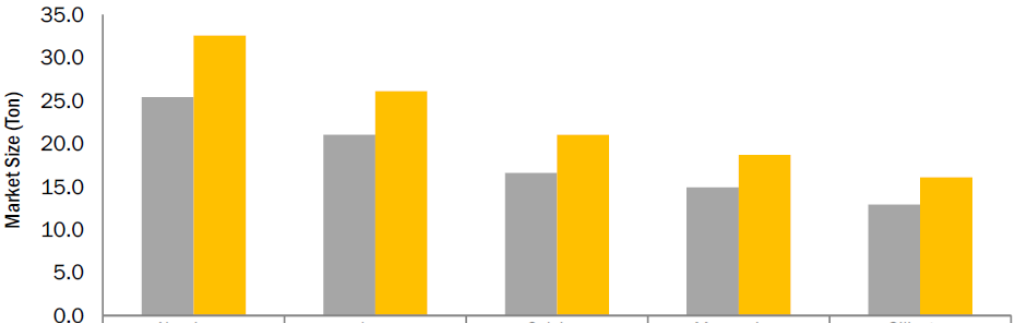
2.3.3 Indian Standards

The earthen walls may be kept not more than 400 mm thick. Steel holdfasts of Z–shape may be screwed to the wooden posts at least one for each triangle and be built into the cladding earthen wall, hence improving the properties of earthen plaster. The height of the adobe building should be restricted to one story plus attic only in seismic Zones V and IV and to two stories in Zone III. Important building (I>1.5) should not be constructed with earthen walls in seismic Zones IV and V and restricted to only one story in seismic Zone III.

2.4 Market by Type

The global market for earthen plasters has been segmented based on type as: iron, magnesium, calcium, silicates, and aluminum (Figure 7). In terms of value, aluminum accounted for the largest share in the overall earthen plasters market in 2021. Furthermore, the aluminum segment is projected to register the highest CAGR of 3.84% during the forecast period, in terms of value. The dominance of aluminum in the earthen plasters market position is attributed to the rise in standardization in the architectural & infrastructural industry, increase in the number of green buildings, energy–efficient buildings, and superior properties.

Figure 7. Earthen Plasters Market by Type, in the Period 2021 - 2026



	Aluminum	Iron	Calcium	Magnesium	Silicates
2021	25.4	21.0	16.6	14.9	12.9
2026	32.6	26.1	21.0	18.7	16.1
CAGR (2021–2026)	5.10%	4.47%	4.81%	4.55%	4.52%

Silicates are the most abundant class of minerals on Earth. Because of their unique properties, silicates have many cool technological uses. Ethyl silicate significantly improves the physical resistance of earthen plasters. Water absorption properties are clearly enhanced with ethyl silicate coatings. Earthen plasters present limited durability against rainwater and acid rain. The market segment for silicates by region is reported in Table 1.

Table 1. Silicate: Earthen Plasters Market Size, by Region, 2019–2026 (TON)

Region	2019	2020	2021	2026	CAGR (2021–2026)
APAC	3.9	3.7	3.9	5.2	6.0%
Europe	3.7	3.4	3.6	4.3	3.8%
North America	3.7	3.4	3.6	4.3	3.9%
South America	0.7	0.7	0.7	0.9	3.9%
Middle East & Africa	1.3	1.2	1.2	1.5	3.6%
Total	13.2	12.4	12.9	16.1	4.5%

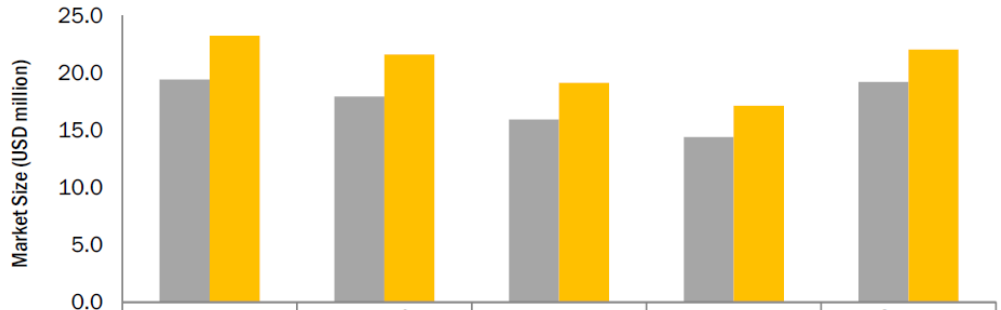
2.5 Market by Application

The global market for earthen plasters could be segmented by application in: **walls, roofs, masonry, and agriculture, and others** (floors and partitions) (Figure 8). In terms of value, the **walls** segment accounted for the largest share in the overall earthen plasters market in 2010. The dominance of the wall segment in earthen plasters market position is attributed to the advantage that earthen plasters are porous and can breathe, allowing moisture and humidity to pass slowly through the finishes. **Roofs** are projected to record the highest CAGR of 3.83% during the forecast period in terms of value.

Walls

According to an industry expert, "**Walls** are estimated to be the largest segment in the earthen plasters market in 2026. They account for the major share in the market and primarily used to improve the appearance of the buildings, to protect buildings from the elements, and hide the rougher qualities of the walls. Factors, such as earthen plasters being porous and able to breathe, allowing moisture and humidity to pass slowly through the finishes drives the market, especially in the emerging economies of APAC, South America and the Middle East".

Figure 8. Earthen Plasters Market, by Application, in the Period 2021 - 2026



	Walls	Roof	Masonry	Agriculture	Others
2021	19.4	17.9	15.9	14.4	19.2
2026	23.2	21.6	19.1	17.1	22.0
CAGR (2021–2026)	3.6%	3.8%	3.6%	3.6%	2.8%

For thousands of years, earthen plasters have been used to improve the appearance of the buildings, protect buildings from the elements, and hide the rougher qualities of the walls. They are used to cover and protect the outside walls of a structure. Though earthen plasters need to be maintained more often when used as an exterior render, any erosion can be mitigated by protecting the exterior walls with larger roof eaves and higher foundations. The significant change that earthen plasters bring about to a building is that they are porous and can breathe, allowing moisture and humidity to pass slowly through the finishes. All kinds of effects and colors can be achieved with any earthen plaster by adding pigments or minerals, and by changing the application technique. The availability of sustainable construction of buildings and spaces is driving the market for the walls. Walls accounted for the largest share of 22.3% in the overall earthen plasters market in 2020.

Roofs

High ceilings are notorious for energy wastage, as there is a fat layer of completely unused heat that skulks under the ceiling. Earth and clay, in and of themselves, are not insulating materials. They have thermal mass, which means they store heat (or cold), but do not reduce the transmission of heat energy from inside to outside (or vice–versa). The earthen plasters are breathable and require no additional vapor barrier and have excellent insulation performance. The earthen plasters are natural, ecological building materials, having good moisture absorption, buffering, and diffusion. They are easy to process and completely free of toxins, recommended for allergy sufferers. Roofs segment is projected to register the highest CAGR of 3.83% during the forecast period, in terms of value.

2.6 Geographic Analysis

The earthen plasters market was segmented, based on region, into: **North America, Europe, Asia Pacific (APAC), South America, and the Middle East and Africa** (Table 2). The market was dominated by **North America** in 2021, which is projected to register a CAGR of 3.0% between 2021 and 2026. The increasing infrastructure spending and the upcoming residential projects in the North American region are fueling the demand for earthen plasters. **Europe** is the second major market, in terms of value, with a projected growth of 3.2% in the period 2021 - 2026.

Table 2. Earthen Plasters Market Size, by Region, 2019–2026 (USD Million)

Region	2019	2020	2021	2026	CAGR (2021–2026)
North America	27.8	25.8	26.4	30.6	3.0%

Europe	26.8	24.9	25.6	29.9	3.2%
APAC	21.7	20.4	21.2	26.7	4.7%
Middle East & Africa	9.0	8.3	8.5	9.9	3.0%
South America	5.4	5.0	5.1	6.0	3.1%
Total	90.7	84.4	86.9	103.0	3.5%

Asia Pacific (APAC) is one of the largest and fastest–growing earthen plasters market. Countries covered in this region include India, China, Japan, South Korea, Australia, among others. China is the most dominant country. The APAC earthen plasters market has been growing rapidly over the past few years with the rising income level of the middle–class population and increasing government investments, especially in the building & construction sector. Owing to economic contraction and saturation in the European and North American markets, the demand is shifting to APAC.

The demand for earthen plasters from the building and construction industry is increasing, due to the rising demand for eco–friendly green buildings in the **North American** market. North America has a mature market, and the governments make huge investment plans for infrastructure development focusing on resiliency and sustainability. The demand for earthen plasters in Mexico is increasing, due to the growth of the building & construction industry in the country.

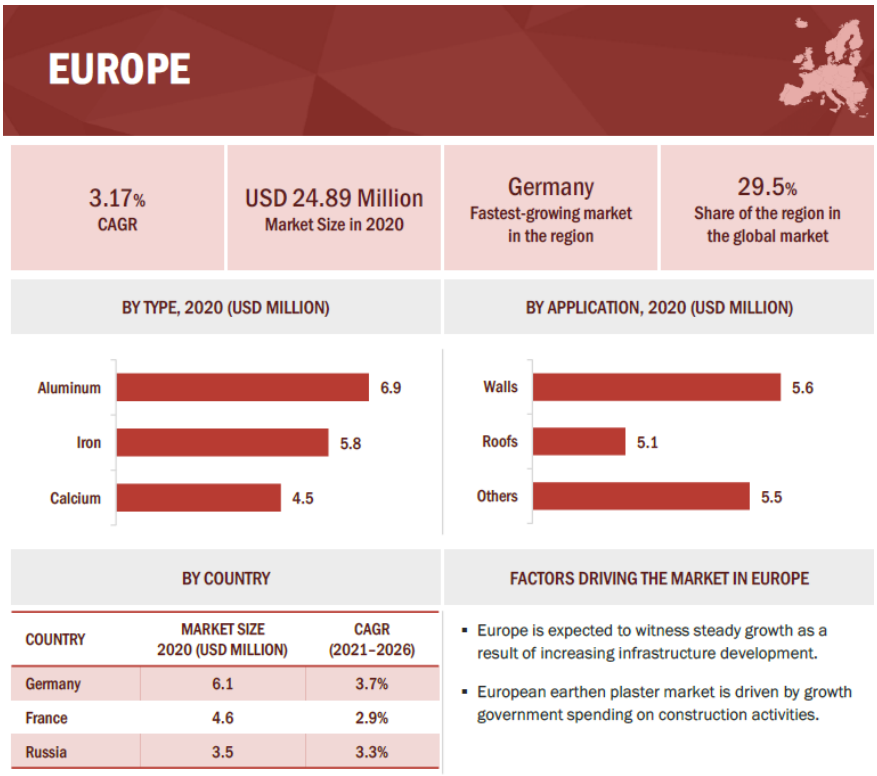
Europe was the second–largest earthen plasters market in 2021 (Figure 9). Owing to the recovery of the global economy and the reviving demand for earthen plasters, the market is expected to perform well in the near future. The building & construction industry is the pillar for the growth of the earthen plasters market, with new residential construction as the engine of growth, while the existing buildings are moderately driving the market.

Italy accounted for 12.0% of the European earthen plasters market in 2020 in terms of value. It is the ninth–biggest economy, globally. Its economic structure relies mainly on the services and manufacturing sectors. Italy suffers from political instability, economic stagnation, and a lack of structural reforms of various industries, contributing to its GDP. The construction industry has played an important role in the Italian economy in recent years. Despite the economic slowdown in the past few years, the new project finance rules and investment policies in the country are expected to improve and re–establish the construction boom in the country. This is expected to drive the Italian earthen plasters market growth. The increase in urbanization, infrastructural developments, and growth of the construction industry in the country have driven the demand for earthen plasters.

The **Middle East & Africa**, being an emerging market, provide huge growth opportunities for the earthen plasters manufacturers. Political instability in North Africa has affected the earthen plasters market over the past few years. The recent fall in oil prices may temporarily affect the regional market but will not affect its long–term growth. The rising demand for eco–friendly products for energy–efficient green buildings in the Middle Eastern & African countries is expected to drive the earthen plasters market. These countries have been standardizing building & construction activities over the last few years, which is also expected to drive the growth of this market.

In 2020, **South America** accounted for a share of 6.0% of the earthen plasters market in terms of value. The market in the region is projected to grow at the CAGR of 3.1%, during the forecast period, in terms of value. The region faces structural weaknesses and longstanding issues that have been aggravated with the pandemic, including fiscal constraints, social tensions, rising inequality, low productivity, and general discontent with democratic institutions. An increase in the need for housing and sustainable living has played a significant role in the growth of the construction industry in the region, which in turn, drives the demand for earthen plasters.

Figure 9. Europe: Earthen Plasters Market Snapshot



2.7 Competitive Landscape

American Clay Enterprises (USA), **Clayworks** (UK), **Claytech Baustoffe Aus Lehm** (Germany), **Conluto** (Germany) and **Clay.It** (Lithuania) are the **key players** in the earthen plasters market. These companies account for significant shares, owing to their extensive product portfolios, wide geographical presence, and strong customer base.

Other players include: Armourcoat Limited (UK), Studio Momo (India), Tierrafino B.V. (The Netherlands) and UKU Pure Earth (Estonia).

Claytech Baustoffe Aus Lehm produces and distributes sustainable building materials using natural clay. The company has been a professional for ecological clay drywall construction, **rammed earth prefabricated components**, authentic building materials, and techniques for half–timbered renovation. The company aims to use clay as a building material, which is characterized by excellent environmental properties to integrate it into its structures. The company has a presence across Europe and operates in Germany, Austria and the Netherlands.

Conluto produces and sells various clay products, which include clay plasters and paints. The company has a geographical presence in Europe and delivers clay plasters in Germany and all other parts of the region. It provides various training opportunities to architects, craftsmen, dealers, or end users. It produces and sells pioneering clay products, which include clay plasters and paints, renovation systems (interior insulation systems, earth blocks), modern earth building solutions (**rammed earth**, earth building panels) and materials for restoration.

3 Precast Concrete Market

Precast concrete refers to a construction product prepared by casting concrete in a reusable mold or matrix, and cured in a standard controlled environment, which is then transported to the site of construction and lifted into place.

Prefabricated or pre-assembled structures or prefabs are developed by assembling entire structure segments, including shafts, chunks, segments, and dividers, and moving them to the site where they are assembled. The construction work speeds up, guarantees reliable quality, and lessens wastage as most work is done at an offsite area. Prefabs, nowadays, are primarily utilized where on-location development is troublesome. The use of prefabricated technology in the construction industry is rapidly expanding to metros, streets, and interstates, among other construction sites.

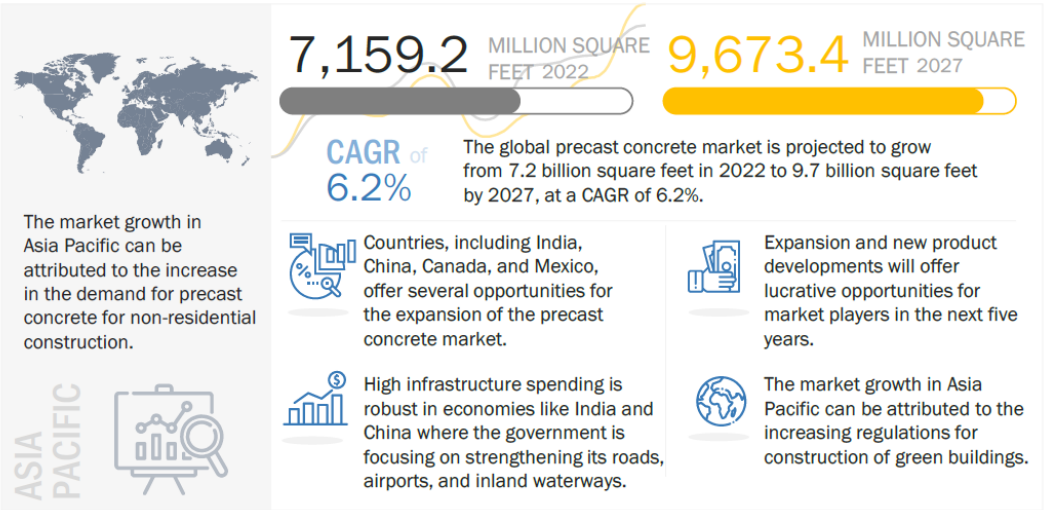
Prefabricated construction is an old method of constructing buildings. It has been around for nearly two centuries. However, its demand began to exceed in the past few years, especially during the ongoing pandemic for fast construction requirements, reflecting a significant growth amid building shortages across the globe. The prefabricated and modular construction market played a vital role in response to the COVID-19 crisis and meeting healthcare services' diverse needs. During the COVID-19 pandemic, this prefabricated technology has helped build new hospitals and quarantine facilities in lesser time than the general time taken by any hospital to get constructed.

This technology is also faster than traditional construction, as other construction-related activities can be done simultaneously. However, the capital expenditure cost of setting up a prefab unit is high.

3.1 Global Market and Market Dynamics

The **global market for precast concrete** was USD 137.2 billion in 2021 and is projected to reach USD 198.9 billion by 2027 (Figure 10).

Figure 10. Global Precast Concrete Market, in the Period 2022 – 2027 (Million Square Feet)

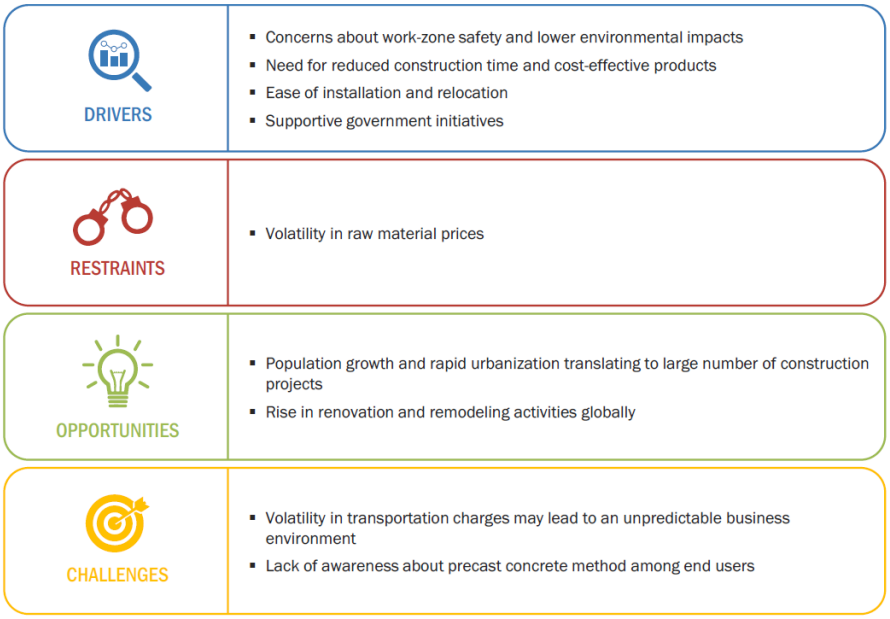


The **growth** of the precast concrete market is attributed to the booming construction sector, rise in renovation and remodeling activities and rapid urbanization and globalization (Figure 11). Due to COVID- 19, the market is being hampered due to slowing raw material production, supply chain disruption, trade movements, declining construction demand, and reduced demand for new projects.

However, the demand for modular buildings has increased owing to the requirement for healthcare and quarantine buildings/units due to COVID-19.

The increasing demand for cost-effective, time-efficient, low maintenance, green and energy-efficient buildings and accelerating construction of new residential and commercial spaces are likely to support the growth of the precast concrete market during the forecast period. However, the volatility in raw material prices is a **restraint**.

Figure 11. Drivers, Restraints, Opportunities and Challenges in Precast Concrete Market



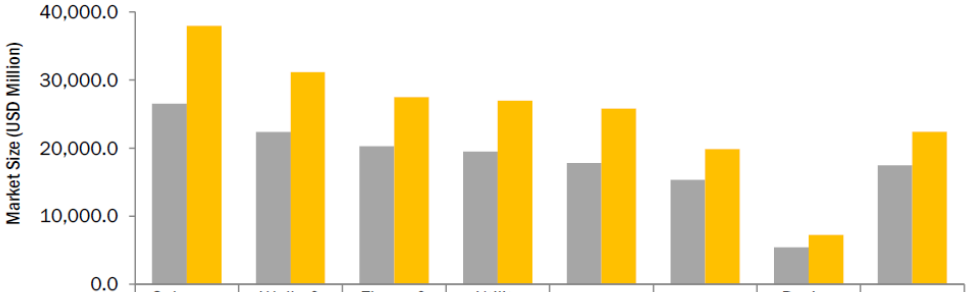
There has been a gradual shift in builders' and consumers' choices from traditional construction methods to sustainable infrastructure. The modular construction method is not only effective in terms of time and cost associated with it. However, it can also withstand the impact of natural calamities such as **earthquakes and storms**. Installation of modules is easy and time-saving; it can also be disassembled, refurbished, or relocated for subsequent use without much effort. Its relocation ability has made it a suitable construction method for schools, medical clinics, hospitals, construction site offices, sales centers, and emergency housing/disaster relief. This boosts the demand for precast modular construction across the residential and non-residential sectors.

3.2 Market by Element

The global market for precast concrete has been segmented based on elements into: **columns & beams, floors & roofs, walls & barriers, girders, pipes, paving slabs, utility vaults and others** (Figure 12). The rise in demand for new residential and commercial constructions and increased public and private investment in the infrastructural and utility sectors have driven the market.

In terms of value, the **columns & beams segment** accounted for the largest share of the precast concrete market in 2021. Columns & beams are used extensively in the residential and non-residential sectors and find application in both building and non-building structures. The increasing public and private expenditure on infrastructure projects, especially in emerging economies of Asia Pacific, South America, and the Middle East, and the growing demand for residential constructions due to rapid urbanization have contributed to the growth in demand for precast columns & beams.

Figure 12. Precast Concrete Market, by Element, in the Period 2022 - 2027



	Columns & beams	Walls & barriers	Floors & roofs	Utility vaults	Girders	Pipes	Paving slabs	Others
2022	26,504.8	22,362.6	20,246.5	19,478.9	17,784.3	15,323.7	5,408.1	17,466.5
2027	37,985.7	31,154.8	27,512.5	26,957.6	25,809.1	19,878.0	7,243.2	22,393.6
CAGR (2022–2027)	7.5%	6.9%	6.3%	6.7%	7.7%	5.3%	6.0%	5.1%

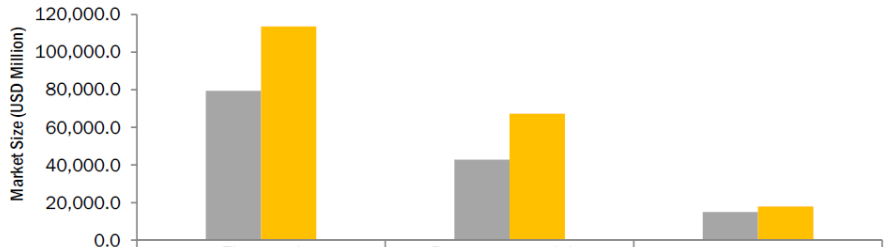
3.3 Market by Construction Type

The precast concrete market has been segmented based on construction types into: **elemental constructions, permanent modular buildings and relocatable buildings** (Figure 13). The **elemental constructions** segment is estimated to dominate the precast concrete market and is projected to be the second fastest-growing segment during the forecast period. This growth can be attributed to the keen interest from contractors and builders in using individual precast elements to build an entire structure across residential and non-residential construction sectors.

The **permanent modular buildings** segment is projected to record the highest CAGR (8.3%) from 2022 to 2027 in terms of value.

COVID-19 resulted in the shortage of healthcare facilities, boosting the need and demand for new **relocatable buildings**. The modular construction (relocatable buildings) played a vital role in response to the COVID-19 crisis and has emerged as a key to meet healthcare services' diverse needs.

Figure 13. Precast Concrete Market by Construction Type, in the Period 2022 - 2027



	Elemental constructions	Permanent modular constructions	Relocatable buildings
2022	79,482.9	42,803.3	14,885.3
2027	113,659.8	67,263.8	18,011.1
CAGR (2022–2027)	6.2%	8.3%	3.3%

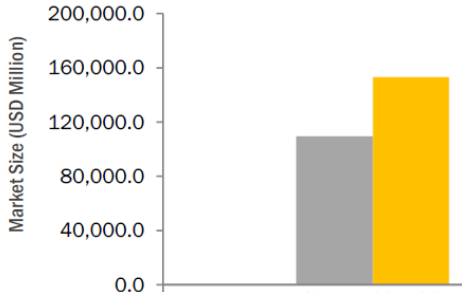
Relocatable buildings such as manufactured homes are prefabricated and produced in factories and transported to the site. Unlike permanent modular constructions, relocatable buildings are assembled into the final structure of a building in the factory or the site of manufacture. The entire structure is attached to a permanent wheeled chassis, through which the building is transported to the site of living towed by a truck upon the completion of the structure. This type of building is perfect for temporary living and site offices.

3.4 Market by End-Use Industry

The precast concrete market has been segmented based on end-use sectors into: **residential** and **non-residential** (Figure 14). The demand for new construction projects has increased globally, owing to which strong growth has been witnessed in new housing and infrastructural projects. Superior quality, low cost, ease of installation, portability, and increased work zone safety are expected to drive the market. The **non-residential** sector constituted a larger market share in 2021 and is also projected to grow at a higher rate during the forecast period.

The **residential** segment is estimated to register a CAGR of 5.4% during the forecast period in terms of value. The demand from the residential sector is supported by increased investments in new housing constructions and home renovation projects.

Figure 14. Precast Concrete Market, by End – Use Industry, in the Period 2022 - 2027



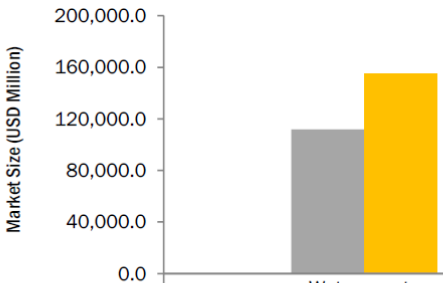
	Non-residential	Residential
2022	109,348.9	35,226.5
2027	153,080.1	45,854.5
CAGR (2022–2027)	7.0%	5.4%

3.5 Market by Type

Concrete, due to its versatility and durability, is the world's most widely used construction material. With increased focus on infrastructure and housing activities, the use of concrete in various forms is increasing. The precast concrete production process can take many forms, such as columns & beams, walls & barriers, floors & roofs, girders, pipes, and paving slabs, amongst others. Likewise, precast concrete forms can be produced in a variety of ways. Precast concrete elements represent a level of quality control and quality production of fresh concrete that is well-regarded. Precast elements have many natural advantages over pouring concrete at a job site. The environmental conditions in a precast concrete facility are much more consistent and can be managed much better than at a construction site, resulting in better quality.

The precast concrete market by type has been segmented into: **wet concrete** and **dry/semi-dry concrete** (Figure 15). The **wet concrete segment** accounted for 77.4% of the global precast concrete market in terms of value in 2021 and is projected to witness a CAGR of 6.8% from 2022 to 2027 in terms of value. The **dry/semi-dry concrete segment** is projected to record a CAGR of 6.0% from 2022 to 2027 in terms of value.

Figure 15. Precast Concrete Market, by Type, in the Period 2022 - 2027



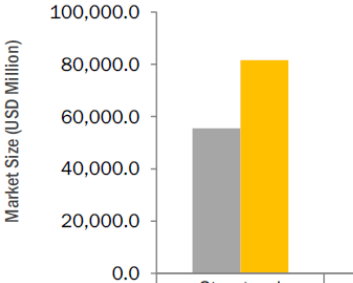
	Wet concrete	Dry/semi-dry concrete
2022	111,799.5	32,775.9
2027	155,157.7	43,777.0
CAGR (2022–2027)	6.8%	6.0%

3.6 Market by Application

The precast concrete market by application has been segmented into: **structural building components, architectural building components, transportation products, water & waste handling products and others** (include utility, cemetery, agricultural and marine products) (Figure 16).

The **structural building components** segment accounted for the largest share of the global precast concrete market in 2021 in terms of value. The **architectural building components** segment is projected to record the highest CAGR at 7.5% from 2022 to 2027 in terms of value.

Figure 16. Precast Concrete Market, by Application, in the Period 2022 - 2027



	Structural building components	Architectural building components	Transportation products	Water & waste handling products	Others
2022	55,410.7	39,206.4	22,870.4	11,606.0	15,481.9
2027	81,621.5	56,181.9	27,140.8	14,403.3	19,587.1
CAGR (2022–2027)	8.1%	7.5%	3.5%	4.4%	4.8%

3.7 Geographical Analysis

The precast concrete market by region has been segmented into: **North America, Europe, Asia Pacific, the Middle East & Africa, and South America** (Table 3).

The **Asia Pacific** region accounted for the largest share in 2022, in terms of value, followed by **Europe** and **North America**. The growth of the precast concrete market in this region is attributed to the higher consumer spending and increase in residential and non-residential constructions.

The recovery from the economic slowdown in 2007 has boosted urbanization globally, especially in emerging economies. This has prompted the need for housing developments and commercial establishments such as offices, educational institutions, healthcare facilities, hotels and recreation centers, and retail outlets. Growth in disposable income, change in lifestyles, and increase in population have fueled the need for new constructions, which presents potential opportunities for adopting precast construction techniques for building and non-building structures. Repairs and renovation requirements of the existing structures will also drive the demand for precast modules globally.

Table 3. Precast Concrete Market Size, by Region, 2021–2027 (Million Square Feet)

Region	2021	2022	2023	2024	2025	2026	2027	CAGR (2022–2027)
North America	1,142.6	1,194.8	1,253.5	1,318.3	1,389.6	1,464.8	1,544.2	5.3%
Europe	1,835.9	1,892.2	1,953.5	2,019.4	2,090.1	2,163.5	2,239.8	3.4%
Asia Pacific	3,109.0	3,306.2	3,542.0	3,816.7	4,134.4	4,479.6	4,854.7	8.0%
Middle East & Africa	369.2	387.2	408.1	431.7	458.2	486.3	516.3	5.9%
South America	358.5	378.7	401.6	427.1	455.6	485.9	518.3	6.5%
Total	6,815.2	7,159.2	7,558.7	8,013.2	8,527.8	9,080.2	9,673.4	6.2%

Europe is the second-largest market for precast concrete in the world. Europe is a well-established market for precast concrete. Government regulations, high disposable income, and changing lifestyles of the consumers are some significant factors contributing to the high demand for precast concretes. Construction is one of the largest and most important sectors in the region and is highly fragmented and consists of a significant number of large, medium, and small-sized concrete companies. The region's construction industry has adopted mergers & acquisitions and expansions as strategies to sustain the growing demand and competition. Due to technological developments in Germany, the precast concrete market in this country is projected to grow at a higher rate than in other European countries.

With **Italy**'s reviving economy and the growth of key end-use industries such as building & construction, the precast concrete market is expected to grow. The Italian economy is recovering from the crisis; the housing market has been rising since 2014, with the number of residential sale transactions increasing. The resurgence of the Italian housing market can be attributed to the substantial decrease in house prices, making purchasing residential properties more expedient, predominantly from the secondary market. Over the last three decades, the standard of living of the average Italian has improved to a great extent, eventually driving the demand for precast concrete.

3.8 Competitive Landscape

Cemex S.A.B. de C.V. (Mexico), LafargeHolcim Ltd (Switzerland), CRH Plc (Ireland), Boral Limited (Australia) and Balfour Beatty Plc (UK) can be considered the **leading players** in the precast concrete market.

Other players active in the market include: Atco Concrete Products (The Netherlands), Coltman Precast Concrete (UK), Consolis (France), DeVinci Precast (USA), Forterra (USA), Gulf Precast Concrete (UAE), Katerra (USA), Laing O'Rourke (UK), MacKay Precast Products (USA), Metromont Corporation (USA), MSE Precast (Canada), Oldcastle Infrastructure (USA), Skanska AB (Sweden), The Precast Group (Canada) and Tindall Corporation (USA).

4 Modular Construction Market

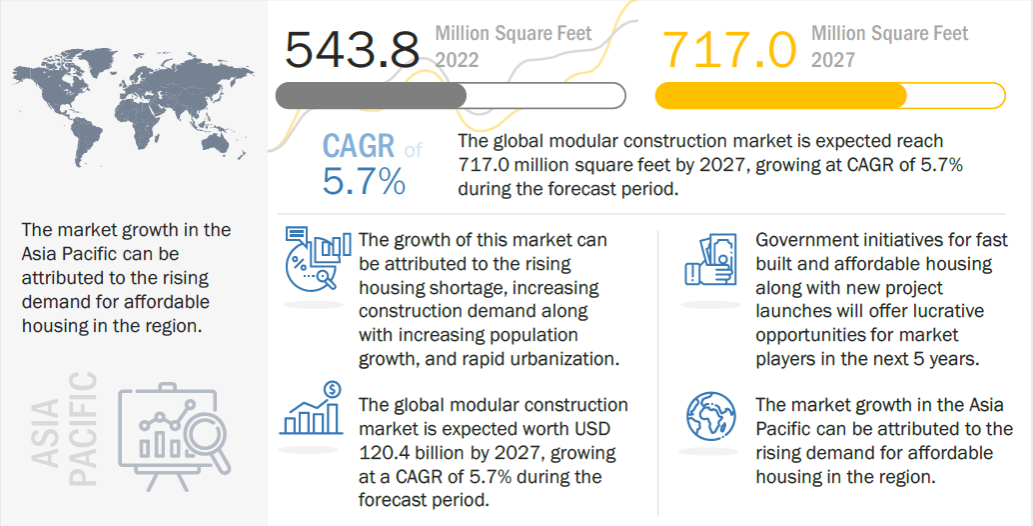
According to the Modular Building Institutes (MBI), "**Modular** is a construction method or process where individual modules stand

alone or are assembled together to make up larger structures." MBI classifies modular construction into permanent modular construction (PMC) and relocatable modular construction. Critical trends in the construction industry, such as shorter project schedules, the housing shortage in many countries, economic construction demand, and workforce shortages, are increasing the demand for modular construction methods.

4.1 Global Market and Market Dynamics

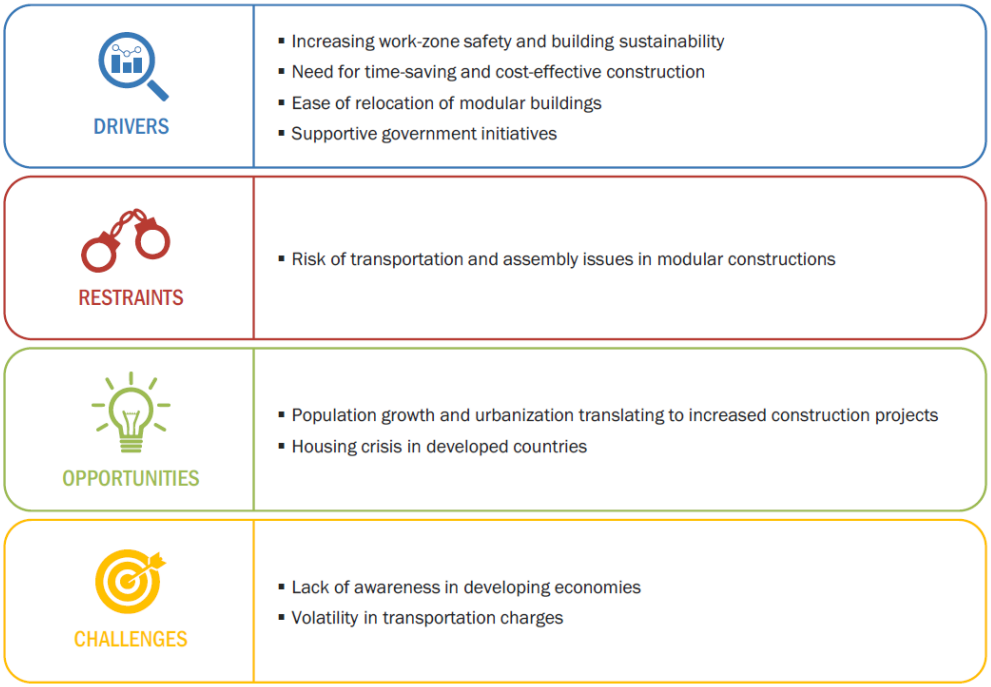
In 2021, the **global modular construction market** was estimated at USD 87 billion and is projected to reach 120.4 billion by 2027 at a CAGR of 5.7% (Figure 17).

Figure 17. Global Modular Construction Market, in the Period 2022 - 2027



The global modular construction market is expected to witness significant **growth** over the coming years (Figure 18). The growth is attributed to the increasing concerns about work-zone safety, the need for lower environmental impacts, and supportive government initiatives. The modular construction method offers benefits of greater flexibility and reusability, quality control, cost savings, faster build times, and environmental benefits. Critical trends in the construction industry, such as shorter project schedules, the housing shortage in many countries, economic construction demand, and workforce shortages, are the factors that are driving the volumetric modular construction method. An increase in population and rapid urbanization (translating to a large number of new construction projects) offer **opportunities** for the growth of the modular construction market. However, factors such as a lack of awareness in developing economies about modular construction techniques and volatility in transportation charges may **inhibit** growth. Modular construction is highly dependent on transportation facilities. Any fluctuation in transportation costs directly affects raw material and module costs for manufacturers. Heavy-duty cranes and other lifting tools are required to elevate and place large modules, which in turn incur more costs.

Figure 18. Modular Construction Market: Drivers, Restraints, Opportunities and Challenges



4.2 Regulation Analysis

The construction industry comprises a series of **administrative rules and regulations** and, in some cases, guidelines and standards in place. In the US, the state-adopted version of the International Building Code (IBC). The IBC is renewed every three years, with the latest version known as the "2018 IBC". Each state has its own code adoption cycle and policies for amending the IBC, resulting in a national base-model code with many regional variances. In Canada, most provinces adopt the National Building Code, which is updated every five years.

Standards are established when it is determined that there exists an absence of regulatory documents necessary to govern a given subject. There are many standard writing bodies, including ANSI, UL, ISO, and CSA, developing standards for everything from consumer products to classroom acoustics (ANSI S12.60 Parts 1 and 2).

The purpose of a standard is to bring together stakeholders, including consumers, producers, and regulatory authorities, on a particular subject to develop "the way things should be." As the name itself implies, they establish an agreed-upon standard way of doing something. In the modular construction universe, there are a few standards developed in Canada impacting the industry.

CSA A227

CSA A227 standard specifies the process for certification of prefabricated buildings and partially or fully enclosed modules and panels for buildings of any occupancy. The standard provides requirements for certification of the factory quality program and certification of the prefabricated product.

CSA A277 pertains to prefabricated buildings, modules, and panels constructed of any material, such as modular homes, manufactured homes, relocatable industrial accommodations, and other building modules or panels that are constructed in a factory before being shipped to the final site.

Ul-2600

UL-2600 provides the requirements for modular built relocatable temporary structures. Relocatable structures for short-term use are a form of modular construction built in an approved offsite facility, designed to be transported to a location, assembled, and utilized.

While A277 has been adopted and is in force in most regions in Canada, UL 2600 is a new standard that has not yet been adopted. An important item about standards to remember is that unless and until it's adopted by a local jurisdiction or referenced in the building codes, it is not in and of itself enforceable document.

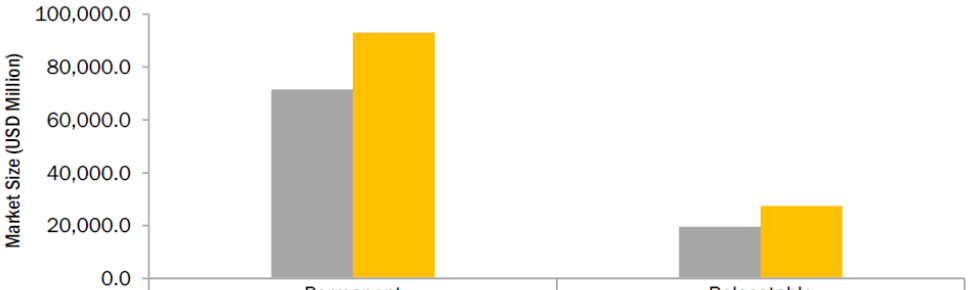
4.3 Market by Type

Modular construction is a process in which a building is constructed off-site, under controlled plant conditions, using the same materials and designed to the same codes and standards as conventionally built facilities but in about half the time. Two types of modular structures are available in the industry, namely, **relocatable modular buildings** and **permanent modular buildings** (Figure 19). Both construction types offer different benefits. Producing building components off-site provides more controlled conditions as well as allows manufacturers to improve quality and precision in the fabrication of the component.

In terms of value, **permanent modular construction** led the global market with a share of 79.0% in 2021 and is projected to be the fastest growing (5.4% CAGR) segment during the forecast period because of the rising demand for permanent residential housing and commercial buildings.

In terms of volume, **relocatable** modular construction accounted for a market share of 21.0% in 2021. The ease of reuse and relocation will boost the growth in the relocatable modular construction segment.

Figure 19. Modular Construction Market by Type, in the Period 2022 - 2027



	Permanent	Relocatable
2022	71,536.4	19,548.9
2027	93,027.3	27,418.3
CAGR (2022–2027)	5.4%	7.0%

Relocatable buildings are also known as portable buildings. They are completely constructed structures that also stand by set building codes and are assembled in a controlled manufacturing facility through the modular construction process. Relocatable buildings are made to be repurposed and transported to the various building sites.

A relocatable building is a completely or partially assembled building that complies with applicable state regulations or codes and is constructed in a factory-controlled environment using a modular construction process. These are prefabricated buildings that are produced in factories and transported to the site of use. The entire structure is attached to a permanent wheeled chassis, through which the building is transported to the site of living towed by a truck upon the completion of the structure. They are designed to be reused multiple times and transported to multiple locations.

These buildings offer ease of relocation, accelerated depreciation schedules, fast delivery, low-cost reconfiguration, and enormous flexibility. These building structures are not permanently affixed to the construction site but are installed in accordance with local code requirements and the manufacturer's installation guidelines. Relocatable buildings are utilized for construction site offices, schools, sales centers, medical clinics, and in any application where temporary space, speed, and the ability to relocate are of vital importance.

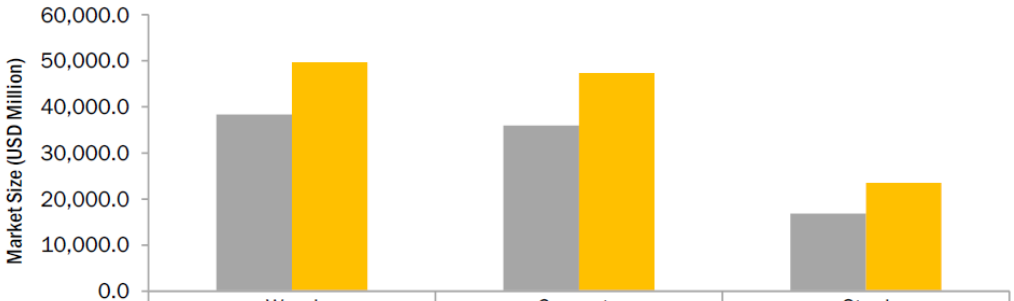
4.4 Market by Material

The modular construction market is segmented on material into: **concrete, steel and wood** (Figure 20). The **wood** segment led the global modular construction market in 2022 and is projected to reach USD 49,662.1 million by 2027. Factors such as insulators and wood help control energy loss, also reduce the risk of electrical shocks, have low toxic levels, have sustainable construction, moisture absorbing properties, increased structural integrity, and are lightweight are driving the market. Wood modular construction is preferred in developed countries, such as the US and European countries, owing to low-temperature requirements.

The **steel segment** is projected to grow at the highest CAGR of 6.9%, in terms of value, from 2022 to 2027. The growth in the steel segment can be attributed to the superior advantages offered by it, leading to the reduced need for repairs and maintenance throughout the building's lifespan.

The **concrete** segment is expected to record a CAGR of 5.7% during the forecast period. Factors such as heavy weight, very small margin for errors, limited building design flexibility, unfitness for two-way structural systems, costlier than steel and wood, and requirement of a skilled workforce are limiting the market growth.

Figure 20. Modular Construction Market by Material, in the Period 2022 - 2027



	Wood	Concrete	Steel
2022	38,340.1	35,929.0	16,816.1
2027	49,662.1	47,330.9	23,452.7
CAGR (2022-2027)	5.3%	5.7%	6.9%

Concrete refers to a construction product prepared by casting concrete in a reusable mold or matrix and cured in a standard controlled environment, which is then transported to the site of construction and lifted into place. In modular construction, concrete is one of the most widely employed raw materials. It provides a comfortable, safe, quiet, and durable environment for occupants. Concrete is known for its strength, thermal mass, excellent acoustic performance, natural fire resistance, flood resilience, durability, robustness, and low maintenance cost. Furthermore, due to its high compressive strength, concrete is employed in load-bearing stabilized systems for high-rise modular construction.

Unlike cast-in-situ construction, concrete uses fewer resources such as cement, steel, water, energy, and human labor, thereby generating less waste in the factory and construction site. This makes the CO_2 footprint of concrete lesser as compared to cast-in-situ construction. This material is widely used for permanent modular construction.

Wood is a biodegradable, easy-to-machine, natural, and reusable or recyclable material. In the residential sector, wood-framed modular construction is a useful and cost-effective solution. Wood is well-suited for modular construction because it is lightweight and easily transported, strong, straightforward to engineer, energy efficient, durable, and cost-effective.

This material is a favorable solution for one/to two-family housing unit construction; however, it has been limited by factors such as lateral force-resisting system requirements, available beam spans, and fire resistance, affecting its application in multistorey projects comprising dormitories and hotels. The following are some advantages of modular wood construction:

- Stronger buildings: Wood gets stronger as it dries and provides a structurally sound frame for modular buildings.
- Improved insulation: Wood is superior to steel as well as other metals as an insulator. In comparison to other building materials, it helps in controlling energy loss better.
- Better health conditions: In wood, toxin levels are extremely low as compared to other modular construction building materials. The manufacturing of buildings in a factory-controlled environment protects wood from inclement weather conditions, which means less moisture absorption by wood and results in lesser air quality issues.

Wood modular construction is preferred in developed countries such as the US and European countries owing to low-temperature requirements. Its availability, ease of working, esthetic appeal, renewable nature, performance, and serviceability further contribute to its wide usage in modular construction.

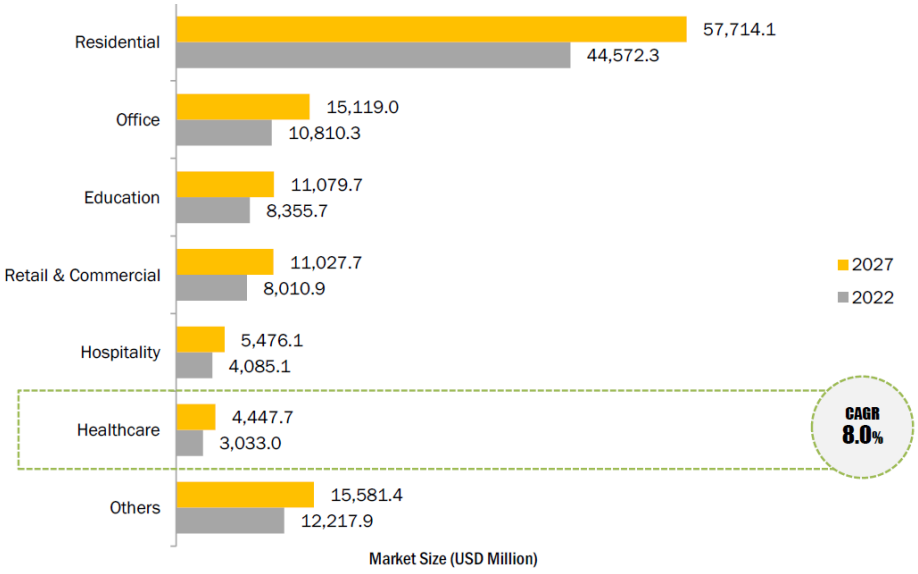
4.5 Market by End – Use

The modular construction market, on the basis of end-use, is segmented into: **residential, retail & commercial, education, office, hospitality, healthcare and others** (industrial, data centers, prisons and military buildings) (Figure 21). The rising demand for affordable houses in developing economies is expected to accelerate the growth of the modular construction market during the forecast period. The trends of sustainable construction methods and time-saving also drive the market. The residential segment is estimated to constitute the largest share of this market. The increase in the urbanized population, housing shortage, and rising demand for new construction across regions have driven the residential segment globally.

The **residential** segment led the modular construction market in 2022, owing to the growing population, rapid urbanization, rising single and multi-housing demand, and increased concern for construction costs and time. Through modular construction, residential buildings can be delivered in approximately half the time compared to traditional side construction, and it also increases eco-friendliness by reducing waste through efficient in-factory processes.

The **healthcare** segment is projected to be the fastest-growing segment in the global modular construction market, in terms of value, during the forecast period.

Figure 21. Modular Construction Market by End – Use, in the Period 2022 - 2027



4.6 Geographical Analysis

The modular construction market by region has been divided into: **North America, the Asia Pacific, Europe, the Middle East & Africa, and South America** (Table 4). **Europe** accounted for the largest share in terms of value and is projected to record a CAGR of 4.5%, in terms of value, from 2022 to 2027.

The **Asia Pacific** is estimated to be the second-largest regional market for global modular construction, owing to the rise in new residential construction activities, an increase in demand for building structures at affordable costs, and supportive government initiatives. In the Asia Pacific, China is projected to be the fastest-growing market for modular construction. The growing demand for better quality construction, shorter construction time, and a safer working environment are some of the factors that drive the modular construction market in the country.

Table 4. Modular Construction Market Size, by Region, 2021–2027 (USD Million)

Region	2021	2022	2023	2024	2025	2026	2027	CAGR (2022 - 2027)
North America	13,137.0	13,728.2	14,551.9	15,425.0	16,350.5	17,331.5	18,371.4	6.0%
Europe	40,716.0	42,426.1	44,335.2	46,330.3	48,415.2	50,593.9	52,870.6	4.5%
Asia Pacific	28,971.0	30,564.4	32,765.0	35,124.1	37,653.1	40,364.1	43,270.3	7.2%
Middle East & Africa	2,697.0	2,821.1	3,004.4	3,199.7	3,407.7	3,629.2	3,865.1	6.5%
South America	1,479.0	1,545.6	1,638.3	1,736.6	1,840.8	1,951.2	2,068.3	6.0%
Total	87,000.0	91,085.3	96,294.9	1,01,815.7	1,07,667.2	1,13,869.9	1,20,445.7	5.7%

Europe was the largest market for modular construction, in terms of volume, in 2022. The construction industry is highly fragmented and consists of a significant number of large, medium-sized, and small construction companies. It is one of the largest and most important manufacturing sectors in the region.

The key factors driving the European modular construction market during 2022-2027 include the rise in the number of new residential construction activities, an increase in demand for housing at affordable costs, fast construction, and supportive government initiatives. The increasing demand for new residential units in urban areas, coupled with subsequent private and public sector investments in residential and infrastructural construction projects, is also expected to create growth opportunities in the market.

Refugee influx is one of the prime factors that have boosted the demand for modularization and prefabrication in Germany, especially in residential building construction. Around 9% of new residential building permits are for prefabricated buildings, which shows the rising demand for modular and prefabricated housing.

Following a sharp decline in 2020 due to the effects of the COVID-19 pandemic, **Italy**'s GDP recovered above expectations in 2021. The Italian National Institute of Statistics (ISTAT) forecasts a 6.6% increase in GDP in 2021 over 2020. Domestic demand made a significant contribution to growth, particularly gross fixed capital formation, which increased in volume by 17.0%, primarily due to the construction component. According to the National Association of Italian Constructors (ANCE), the construction sector accounted for more than one-third of the GDP growth. According to Cresme's calculations based on data from the statistics bureau, ISTAT and Italy's Economy Ministry, local administrations in Italy plan to invest USD 59 billion in 2022, USD 73 billion in 2023, USD 74 billion in 2024, and USD 78 billion in 2025. This funding will be used to complete major infrastructure projects that are critical to the country's modernization and meeting affordable housing demand.

Another reason for the modular house boom in Italy is the greater awareness of the benefits they can provide among both customers and developers. On the one hand, customers are breaking down cultural barriers that portray modular homes as cheaply made and of low quality. Indeed, modern technologies enable the construction of functional, adaptable, and highly efficient structures. Consumers are now aware that these buildings are just as safe and efficient as modern "traditional" structures. Developers, on the other hand, have recognized the advantages of building prefab houses, such as the ability to build quickly and use waste materials.

The rising need for cost-effective and time-saving construction methods will boost the adoption and growth of the modular construction market. In Italy, **wood** is the most widely used material for modular construction due to superior benefits in terms of design flexibility, strength, structural integrity, and sustainability.

4.7 Competitive Landscape

Laing O'Rourke (UK), **Red Sea Housing** (Saudi Arabia), **ATCO Ltd** (Canada), **Modulaire Group** (UK) and **Fluor Corporation** (USA) can be considered the **leading players** in the modular construction market.

Other players active in the market include: Bechtel (USA), Blokable (USA), Bouygues Construction (France), BuildWright (Ireland), Design Space Modular Buildings (USA), DMD Modular (Poland), DuBox (UAE), Elements Europe (UK), Formhomes (Australia), Fullstack Modular (USA), Guerdon (USA), Kleusberg GmbH (Germany), Koma Modular (Czech Republic), Kwikspace (South Africa), Lendlease Corporation (Australia), Plant Prefab (USA), Premier Modular (UK), PT Blink Technology (Australia), Skanska AB (Sweden), Starrco (USA), The Alho Group (Germany), Turnuer Industries (USA), Vinci S.A. (France), Wernick Group (UK) and Westchester Modular Homes (USA).

5 Conclusions

According to the World Green Building Council, a **green building** is defined as a building that, in its design, construction, or operation, reduces or eliminates negative impacts and can create positive impacts on the climate and the natural environment. Green buildings preserve precious natural resources and improve the quality of life.

Properties of clay, such as it being natural, durable, and affordable, make it an excellent option to be used as a green building material. The increase in demand for green products will highly influence the growth of the **earthen plasters** market. Green buildings are already trending in the US and European countries and they are penetrating Asian, the Middle Eastern and Latin American markets. Earthen building systems include adobe, **rammed earth**, cob, cast earth, and other earth technologies used as structural and non–structural wall systems.

The boom in the construction industry and the development of new building codes in Europe for energy-efficient and green buildings are supporting the **precast concrete market**. However, the volatility in raw material prices is a restraint. The growing adoption of green and **modular** construction materials is expected to proliferate the demand for precast concrete in the construction sector.

The **global modular construction market** is expected to witness significant growth over the coming years. The growth is attributed to the increasing concerns about work-zone safety, the need for lower environmental impacts, and supportive government initiatives. The modular construction method offers benefits of greater flexibility and reusability, quality control, cost savings, faster build times, and environmental benefits. The modular construction method is not only effective in terms of time and cost associated with it but can also withstand the impact of **natural calamities**, such as earthquakes and storms. Modular buildings can also be disassembled, refurbished, or relocated for their next use without much effort. Its ability for relocation has made it a suitable construction method for schools, medical clinics, hospitals, construction site offices, sales centers, and emergency housing/disaster relief.

6 Sources

MarketsandMarkets Knowledge Store – Multisectoral database that collects market research reports in various technological fields and designed to process some information interactively[1]. The information provided have been extracted by the following reports:

- "Green Technology and Sustainability Market – Global Forecast to 2027", published in November 2022;
- "Earthen Plaster Market – Global Forecast to 2026", published in July 2021;
- "Precast Concrete Market – Global Forecast to 2027", published in July 2022;
- "Modular Construction Market – Global Forecast to 2027", published in October 2022.

Bureau van Dijk - Orbis Europe: Orbis provides comparable data resource on private companies with information on more than 400 million companies across the globe. Orbis captures and blends data from more than 160 different sources and treats it so it's standardized and comparable. The European database was consulted to obtain financial data and trend about European companies of interest.

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