



e-ISSN: 2319-8753 | p-ISSN: 2347-6710

IJIRSET

International Journal of Innovative Research in
SCIENCE | ENGINEERING | TECHNOLOGY



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 13, Issue 11, November 2024

ISSN INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA

Impact Factor: 8.524



9940 572 462



6381 907 438



ijirset@gmail.com



www.ijirset.com

A Timeline History of Buildings-from Stone Age to Smart and Intelligent Buildings

Manjunath A N, Poornima M

Lecturer, Department of Civil Engineering, Government Polytechnic, Nagamangala, Karnataka, India

Lecturer, Department of Civil Engineering, Government Polytechnic, Nagamangala, Karnataka, India

ABSTRACT: This paper summarizes the developments that lead to the evaluation of smart and intelligent buildings and also focuses on the evolution of home that reflects the broader trajectory of human civilization. From the basic need for shelter to the sophisticated smart houses of today, homes have always been a mirror of the society that builds them. As we look to the future, it's clear that the concept of home will continue to evolve, driven by technological innovation, environmental concerns, and the changing needs of the people who live in them. A comprehensive review on existing research provides great benefits to identify where more efforts are needed and therefore the future research directions.

KEYWORDS: Evolution, technological developments, smart buildings, intelligent buildings

I. INTRODUCTION

The progression of human dwellings, from rudimentary Stone Age shelters to today's sophisticated smart buildings, mirrors the evolution of human civilization itself. This journey reflects advancements in technology, shifts in societal values, and our deepening understanding of the environment. By examining this timeline, we can appreciate how each architectural phase not only provided shelter but also encapsulated the cultural, technological, and environmental contexts of its era. This exploration offers insights into how past innovations have paved the way for contemporary smart buildings and hints at the future trajectory of architectural design.

II. EVOLUTION OF SMART BUILDINGS

Early humans sought protection from predators and harsh weather conditions by utilizing natural shelters such as caves and rock overhangs. Over time, they enhanced these habitats by adding stone floors, constructing walls at cave entrances, and building fireplaces for warmth and cooking. One of the earliest indications of human-made shelters dates back to approximately 1.75 million years ago at Olduvai Gorge in Tanzania, where a circular arrangement of basalt stones suggests the construction of simple structures, possibly to support branches for shelter. Additionally, evidence from Terra Amata near Nice, France, dating to between 450,000 and 380,000 BCE, reveals remnants of wooden huts featuring hearths, constructed by bracing branches with circles of stones. These findings underscore the early human drive to create and improve living spaces for safety and comfort.[1]

Mohenjo-Daro (Indus Valley Civilization):

The ancient city of Mohenjo-Daro featured a central marketplace with a large communal well. Some residences—likely belonging to the more affluent citizens—had designated bathing rooms, and one notable building contained an underground furnace, possibly used for heated baths. Most houses were designed with inner courtyards and doors that opened onto side streets. A few buildings even had two stories.

Pueblo Indians:

The Pueblo people constructed their homes using locally available materials, creating shelters that provided protection from the elements. They often built near water sources and used overhanging cliffs for additional defense against enemies. Around 700–900 AD, they transitioned from pit houses carved into cliffs to interconnected rectangular rooms arranged in apartment-style complexes made of adobe. By 1050 AD, they had developed planned villages with large, terraced buildings containing multiple rooms. These villages were often strategically located on elevated, defensible sites such as rock ledges, mesa tops, or steep cliffs.

Barns (Traditional Construction Techniques):

Traditional barn construction also utilized local materials. These structures often incorporated natural ventilation systems and daylight chimneys to create a chimney effect for airflow. Permeable floors were used to aid drainage and help maintain a clean interior environment.

Nature-Inspired Architecture and Human Ingenuity

Human curiosity about nature led to a deeper understanding of natural elements such as the sun and its rays, wind directions, rainfall and water flow, as well as sound and acoustics. This knowledge gradually shaped architectural practices as people began adopting nature's principles into building design. Concepts such as the Design-Building-Lifetime process, passive solar design, simple mechanical systems for heating, cooling, and lighting, site-sensitive planning, and the use of local materials were understood and applied to meet the needs of lifestyle and environment. Some classic architectural examples that reflect this integration of natural principles include:

Konark Sun Temple, Odisha, India (13th Century AD):

This temple is meticulously aligned to the east so that the first rays of the sunrise strike its main entrance. The temple's wheels function as sundials and can accurately tell time down to the minute, day or night.

Hawa Mahal, Jaipur, India (1799):

Built by Maharaja Sawai Pratap Singh, this "Palace of Winds" has 953 small windows (jharokhas) that provide natural ventilation. The intricate lattice design creates a Venturi effect, allowing cool air to circulate and naturally air-condition the palace during the intense heat of summer.

Jantar Mantar, Jaipur, India (18th Century):

Constructed under the reign of Maharaja Jai Singh II, this astronomical observatory features the world's largest sundial. Jai Singh, an enthusiastic scholar of astronomy, architecture, and philosophy, designed geometric instruments to measure time, observe celestial bodies, and track the sun's movement across the sky.

By the 1700s, inventions such as the thermometer and incubators began to offer a more scientific understanding of temperature control, marking a shift toward more advanced climate-responsive building techniques.

Evolution of Architecture and Technology in the 20th Century

Early 1900s – Railways and Urban Expansion:

During the early 20th century, residential development often occurred alongside expanding railway lines and around existing towns and cities. Improved transportation systems enabled the wider distribution of building materials, leading to more affordable housing. The introduction of underground sewage systems significantly enhanced public health. Homes were typically smaller and featured deep porches, which played an important role in passive solar design, helping regulate indoor temperatures naturally.

1930s – Technological Advancements and Shifting Trends:

The 1930s saw a major transformation in urban architecture due to the emergence of new technologies. The use of air conditioning, structural steel, and reflective glass reshaped city skylines. However, this period also marked a growing dependence on non-renewable energy sources, which led to what some consider a regressive shift away from nature-integrated architecture toward more mechanical and artificial systems.

1930s to 1950s – The Rise of Electrical and Electronic Controls:

This era witnessed groundbreaking advancements in electrical and electronic automatic control systems. These developments were crucial not only in architecture and infrastructure but also played a significant role in the early stages of modern weapons systems, communications technology, and the foundation of semiconductor circuitry—paving the way for the digital age.

Rapid Technological Advancements and the Rise of Sustainable Architecture

The invention of the transistor revolutionized technology, marking the beginning of an era where everything seemed to change at lightning speed. With the rise of computer technology, electronic control systems, and digital automation, computer-controlled buildings became a reality. Software systems for building automation became more robust and user-friendly, making advanced energy and facility management accessible to operators of automated buildings.

At the same time, concerns over limited natural resources and the rapid rate of consumption sparked a global awareness about the need for energy conservation, efficiency, and renewable energy sources. Governments and organizations around the world began introducing standards, policies, and conservation acts aimed at reducing energy usage and improving efficiency. This gave rise to the concept of energy-intelligent buildings—structures equipped with advanced technologies to monitor occupants and automate the optimization of energy usage.

From the 1930s to the 1960s, innovations like air conditioning, reflective glass, and structural steel significantly influenced the construction of inner-city buildings. The widespread adoption of these technologies led to the iconic glass-box high-rises that came to define many American city skylines. However, this era of enclosed, energy-intensive buildings was soon challenged.

The earliest forms of Building Automation Systems (BAS) were introduced, primarily aimed at improving task efficiency. These systems functioned as labor-saving devices, automating basic operation. During the 1970s, rising fuel costs and the growing environmental movement inspired a new generation of architects, environmentalists, and ecologists to reimagine the built environment. This movement laid the foundation for what we now call green building. The celebration of the first Earth Day in April 1970 marked a symbolic turning point in public awareness and interest in sustainable building practices.

The concept of the smart building emerged in the early 1980s, initially characterized by the extensive use of centralized electronic systems to control building support functions and communication networks for voice and data. While various definitions have emerged over time, one of the most widely accepted is provided by the Cerdà Institute in Barcelona [4], which defines a smart building as:

“A system that supports the flow of information throughout the building, offering advanced services of business automation and telecommunications. It allows for automatic control, monitoring, management, and maintenance of different subsystems or services in an optimal and integrated manner, either locally or remotely. It is designed with sufficient flexibility to enable simple and economical implementation of future systems.”

This definition emphasizes flexibility, integration, and future-readiness as foundational principles of smart building design.

Early implementations focused primarily on centralizing word processing services and enabling limited interaction between building occupants and building automation systems (BAS) through simple user interfaces, such as touch switches.

Over time, intelligent buildings evolved to leverage technological advancements aimed at enhancing the built environment for occupants and tenants. An intelligent building is defined as one that provides an efficient and cost-effective environment by optimizing four fundamental elements: structure, systems, services, and management [5]. These systems improve building functionality, efficiency, and user experience, while maintaining cost-effectiveness. Key goals include improving occupant safety, comfort, and accessibility, all of which contribute to higher levels of productivity and satisfaction.

Between 1990 and 1995, the U.S. Green Building Council (USGBC), in collaboration with the American Society for Testing and Materials (ASTM), developed a sustainability rating system known as LEED (Leadership in Energy and Environmental Design). LEED provides a framework for designing, constructing, and certifying green buildings. Based on a point system, buildings are classified as Certified, Silver, Gold, or Platinum depending on their performance across six categories:[2]

- Sustainable Sites
- Water Efficiency
- Energy and Atmosphere
- Materials and Resources
- Indoor Environmental Quality
- Innovation and Design Process

In India, the Indian Green Building Council (IGBC) was established in 2001 as part of the Confederation of Indian Industry (CII). IGBC offers various services including the development of green building rating systems, certification services, and training programs. Its annual flagship event, the Green Building Congress, serves as a major platform for promoting practices.

During 2000, Concept of Computer-Integrated Buildings (CIB) emerged, aligning building operations with IT infrastructure. Came into existence

Now the focus has shifted to enterprise-level integration, where smart buildings are linked to broader organizational networks, allowing real-time data analytics, predictive maintenance, and remote operation.

There are some exciting advancements in technology that Smart Buildings may take advantage of in the future. One of these developments will focus on the people within the building. IoT (Internet of Things) could gather data about people's body temperature, heart rate, and perspiration to automatically match the building conditions, such as temperature, to make it a more comfortable environment for the people in it. This could have a knock-on effect on people's health and mental well-being so that they can be as productive as possible.

According to World green building trends 2016, smart market report countries with green building activity above the global average of 24 percent include South Africa, Singapore, India, Germany and Mexico [3]. Many of the countries with lower levels of green activity, however are the same ones anticipating rapid growth in the area.

III. CONCLUSION

From simple shelters built for survival to today's highly sophisticated smart homes, each stage of development reflects the values, technologies, and priorities of the society that created it. As we look toward the future, it is evident that the concept of home will continue to transform—shaped by technological advancements, environmental imperatives, and the shifting lifestyles and expectations of those who inhabit them.

REFERENCES

- [1] Building Design and Construction, "White Paper on Sustainability", , November 2006
- [2] "An Introduction to the USGBC and LEED Green Building Rating System", www.usgbc.org 19Building Design and Construction, "White Paper on Sustainability", .
- [3] World green building trends 2016 smart market report
- [4] Lafontaine, J. (1999). Intelligent Building Concept. Ontario: EMCS Engineering Inc.
- [5] Wang, S. (2010). Intelligent Building and Building Automation. USA: Spon Press.



INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

 9940 572 462  6381 907 438  ijirset@gmail.com



www.ijirset.com

Scan to save the contact details