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Building Technology from Sustainability Perspective

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ABSTRACT

The research showed that sustainable thoughts in architecture is not a complementary element, but is a necessary element to achieve the building's functional, economic and environmental efficiency and helps preserve energy and the natural resources, meet the current and future needs, water management and adaptation to the environment.

The research also deals with the technical revolution of building technology from a sustainable perspective, then monitoring its repercussions on architecture and the accompanying urbanization, in light of encouraging sustainable architecture and rationalizing construction methods and energy consumption, which is one of the pillars on which the success of sustainable development in any society depends.

The research concludes that the idea of sustainability must be applied in architecture, as sustainable architecture is an integrated scientific approach. The development of architecture and urbanism from a sustainable perspective is due to the technological development of building technology, which is thus It represents the continuity of the relationship between the development of materials technology and construction methods and the contemporary architectural ideas.

The research ends with a set of recommendations that contribute to how to follow sustainable development strategies with the need to encourage sustainable architecture through a new vision of building technology, taking into account the rationalization of construction methods and energy consumption.

KEYWORDS: Building technology, sustainable development, sustainable architecture, building materials

1 INTRODUCTION

the world's interest at the present time to preserve the environment and the life of human societies, and there are many modern concepts that try to link between architecture and the environment through the use of engineering and technical capabilities that create the environment and make it livable and maintain its quality and the subsequent trend towards sustainable development that aims to Development that enables the enjoyment of environmental resources and the values of nature that we are exploiting now. Sustainable development has also adopted a set of strategies, including optimal building orientation, utilization of natural energies, care for planning systems, building details, and others,” as well as improving the quality of life for users, including public health, as well as helping to achieve economic development. By protecting natural resources and raw materials, In addition to the emergence of the concept of ecological architecture, which is concerned with the natural physical surroundings of the environment and recommends the use of materials that do not harm the environment and calls for the preservation of the natural resource base for the future. Sustainable design is an essential step for achieving sustainable architecture. Accordingly, development and development must be dealt with wide insight.

2 RESEARCH PROBLEM

Many countries suffer from delays in applying the idea of sustainability in architecture, which exposes them to the depletion of their natural resources and wealth without planning for future needs, so In order to achieve sustainability in the environment, its architecture must take into account all the resources contained in the building, whether they are energy materials or contribute to providing the needs of the building’s users in light of the holistic approach to sustainable architecture from the perspective of building technology.

Also, the great development of building technology, especially with regard to contemporary building materials, has a clear impact on the architectural character and urbanism, as it was reflected on contemporary architectural thought, and architecture was closely linked to it, and the use of technology and its applications became necessary for architectural design.

3 RESEARCH OBJECTIVE

- Studying the trends of developments of the technical revolution of building technology from the sustainable perspective, and its architectural formulations and what is its effect on architecture and urbanism.

- Studying the impact of contemporary building technology on the architectural style.

- Establishing the most basic and standards for the use of technology in contemporary building materials.

4 RESEARCH IMPORTANCE

The sustainable perspective of building technology takes into consideration all the constituent principles of sustainable architecture in an integrative format and the technological thought directed at the construction process in all its aspects such as materials, systems and methods of construction, so the building technology must be stemming and expressive of the environment and does not harm it, in light of the optimal and efficient exploitation of scientific capabilities.

5 METHODOLOGY

The research approach to achieve its goal is two main ways according to the nature of the research, they are as follows:

5.1 Theoretical part:

A theoretical study to define sustainability, sustainable architectural design and sustainability strategies, with an explanation of the modern trends of building technology in architecture from a sustainable perspective and an indication of the different effects and repercussions of the technical revolution of building technology on architecture and urbanism.

5.2 Analytical part:

Analytical study of some architectural models with a sustainable dimension to show how to apply building technology in preserving natural resources.

6 DISCUSSION

6.1 Sustainable design strategies

6.1.1 Sustainability concept

The concept of sustainability is the optimal use of available resources and capabilities, whether human, material or natural, in an effective and environmentally balanced manner, to ensure the continuity of sustainability without wasting the gains of future generations.

Sustainable design, green architecture, sustainable construction, green building, all these concepts are nothing but new ways and methods of design and construction that evoke the environmental and economic challenges that cast their shadows on various sectors in this era, as the new buildings are designed, implemented and operated with advanced methods and techniques that

contribute to reducing the environmental impact, and at the same time lead to reduced costs, especially operating and maintenance costs, and contribute to providing a safe and comfortable urban environment. Thus, the motives for adopting the concept of sustainability in the urban sector are not different from the motives that led to the emergence and adoption of the concept of sustainable development with its overlapping environmental, economic and social aspects.

The term sustainable architecture is used for the purpose of describing the movement associated with architectural design with an interest in everything related to the environment, and describes true sustainable architecture that we get what we need from the universe and this realization forces us to respond with attention and organization in the use of those resources.

Accordingly, the definition of the concept of sustainability in architecture is the preservation of the ecological, economic and social systems that make up the urban environment, a process that includes dealing with resources and technical direction for development in a harmonious manner and compatible with the current and future needs of humanity.

6.1.2 General principles of sustainability:

There are three basic principles of sustainable architecture and sustainable architectural design which are resource economy, life cycle design and human design.

- **The first principle is to conserve energy and water:**

The decision to conserve energy by conscious planning for it, i.e. determining specific climate conditions for building directionality, wall thickness, and conscious planning of the site and energy by utilizing its shape and resources includes all plants and trees.

- **The second principle: the life cycle of the building:**

The building goes through three phases: the pre-construction aspect, which includes recycled materials, materials with long life and low maintenance, the structural aspect related to the previous phase, which includes the non-use of organic materials, and the post-construction aspect, which includes the re-use of the building and the existing infrastructure.

- **The third principle of human design:**

Which includes the conservation of all existing topographical natural resources, urban design and site planning, i.e. the utilization of schemes to reduce energy and water demands and achieve human comfort by sustaining health.

1-3- The concept of strategy and architectural strategy

The strategy is generally known as the comprehensive plan to complete something, while architecturally, it is defined by defining the general framework of design to bring architectural visions through technology and design into reality, which is the plan to develop architecture

applications, and the architectural strategy is a way to support designers in creating fully conscious plans for design decisions concerning the shape and organization of the types of buildings, sites, or building elements.

6.2 Sustainable urban design

Sustainable urban design is not a style or pattern for a new building, but rather represents a revolution in how to think about designing, building and operating buildings spontaneously by coordinating open spaces, natural scenes and the surrounding environment by:

- Less energy consumption and higher quality of natural and artificial lighting.
- Conserving materials and natural resources and improving the internal environmental quality.
- Protection of internal and external water sources.

The ultimate goal of sustainable design is to use the old buildings approach in a logical combination with the best modern technologies.

6.3 Sustainable construction technologies

6.3.1 Building Sustainability

Sustainable construction technologies typically include mechanisms to lessen energy consumption. These techniques are meant to reduce the dependency on air conditioning and interior heating by using renewable energy such as solar energy for lighting and water heating.

Sustainable technology is an umbrella term that describes innovation that considers natural resources and fosters economic and social development. The goal of these technologies is to drastically reduce environmental and ecological risks and to create a sustainable product.

Sustainability means that when a product is described as sustainable it basically means that the product could continue being made exactly the same way, with exactly the same materials without having a negative impact for the foreseeable future.

Technology has the power to increase productivity, efficiency and cost savings, reduce product waste, chemicals and resources and measure, analyze and track progress, all of which can help minimize the impact on the environment.

In practice, building sustainability means living in harmony with the natural environment, considering the social, environmental and economic aspects of decisions, and reducing our footprint through a less energy, water and material intensive lifestyle.

Sustainable Building Features

- Energy Efficiency.
- Renewable Energy Generation.

- Water Efficiency.
- Storm water Management.
- Superior Indoor Environment

6.3.2 Building technology in architecture from a sustainable perspective

Technology is defined as a set of design, implementation and productivity actions and practices in the treatment and organization of materials to produce specific goods or to serve a specific purpose. Therefore, building materials technology is represented in how to deal with building materials, design, implementation and production, and the goal of this technology is to produce an architectural product that serves a construction function. or symbolic construction or aesthetic construction or other construction. Hence, the technique is how to deal with the method of installation and the method of linking, whether it is for one material or a number of materials.

Sustainable construction has been defined as the innovation and responsible management of building a healthy environment based on efficient resources and environmental principles. The goal of this type of architecture is to reduce the negative impact on the environment through energy and resource efficiency. The repercussions of the development and application of construction and building technology between societies of developed and developing countries is varied, and then its impact on architecture and urbanism, where modern trends of building technology in sustainable architecture are closely related to social, economic and construction conditions for the existing environment, where building technology is represented in the framework of sustainability as shown on Figure (1).



Figure (1): Considerations of the concept of sustainable development for construction conditions

From the social point of view, the considerations of the concept of sustainable development for construction conditions are represented in serving the needs of people inside their homes and responding to their way of living, the social systems surrounding them, urbanization, culture and education. And from the economic point of view, these considerations are represented in the actual

contribution to the construction industry process, moving the economic wheel, and learning about economic policies, and the standard of living and investment plans. Then from the construction conditions point of view, the considerations are represented in the environmental aspect concerned with the treatment of drinking water, sewage, heat, sound, and waste resulting from the use of natural resources and have different effects on the environment, and they also are represented in urban conditions which are concern with the building formation and its connection to the site and the environment, and the use of roads and means of transportation as shown on Figure (2).

Thus, the role of technology is increasing, as it is the main axis for the development of architecture and urbanization in both material and moral aspects. Within the framework of the concept of comprehensive sustainable development, which inter in its scope the construction conditions, the building technology appears to be the main and complementary axis of the sustainable architecture, to make it possible to reach a mechanism that achieves integration between sustainability and building technology in order to formulate a sustainable approach to building technology. Sustainable construction is an attempt to find a healthy environmental management that depends on the efficient use of resources, and respect for the principles that lead to harmony with the environment as buildings which are designed in a sustainable manner aim to reduce their negative effects on the environment. Sustainable construction is considered as a building method that seeks to integrate in terms of quality with the economic, social and environmental performance of the building. Thus, the rational use of natural resources and the appropriate management of the building lead to the preservation of limited resources, the reduction of energy consumption and preservation it, and the improvement of the quality of the surrounding environment in light of harnessing construction technology to the propositions of the age to complete the dimensions of sustainability. That means including taking into consideration the life span of the building, the quality of the environment it contains, the quality of performance of the building's systems, and the expected future values in society.

One of the architectural trends that applies modern technologies in the field of building technology within the framework of compatibility with the idea of sustainability in architecture is what is known as Eco-Tech, it is a term given to the architecture that is concerned with the fields of environment and modern technologies in architecture, and it is now one of the leading fields of architecture in the modern era. This term stands for two abbreviations:

Eco = Ecology = Environment Science

Tech = Technology = Technical Sciences

The interests of this field are related to the field of: sustainable architecture and advanced technology, such as an office tower in London in England in 2004 AD, where modern technical methods were used in the construction of the building with a distinguished structural system that

allowed the implementation of the distinctive mass appropriate to the surrounding environment, where the building is naturally ventilated through an inner patio through which natural air passes over the entire height of the building and exits through the openings in the facade, and this reduces the tower's dependence on air conditioning as shown in Figure (3).

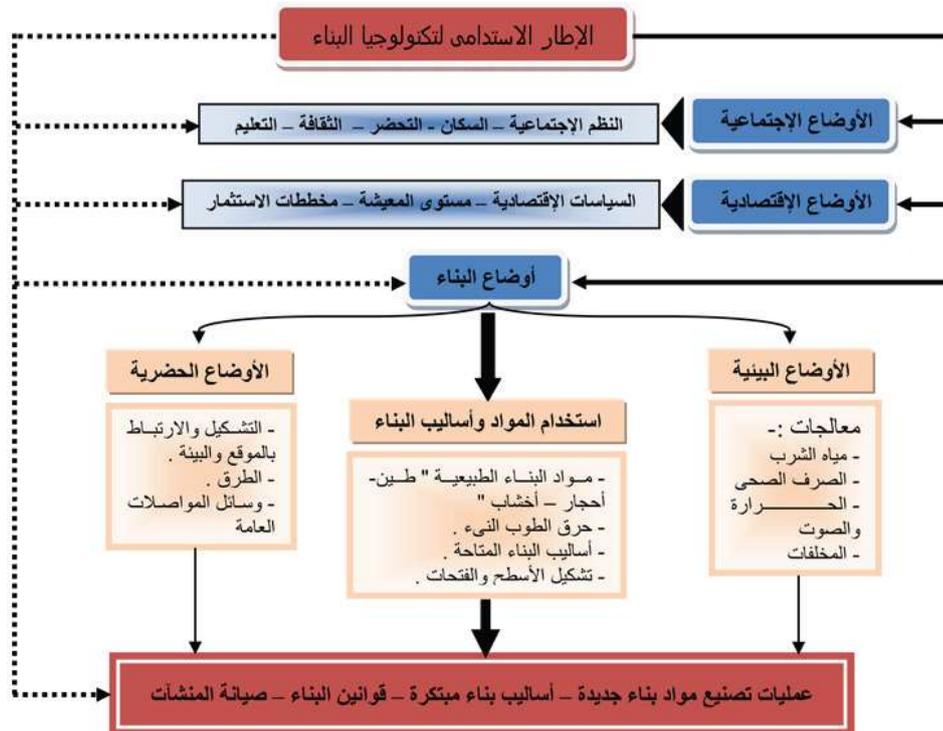


Figure (2): Sustainable development within the framework of construction processes



Figure (3): Office tower in London in England

And the impacts of **technology** on architectural thoughts are:

- Technology has contributed to change the thought of architectural design to match the modern technology. These changes have brought a great development in the form of contemporary architecture, as contemporary architectural trends is affected by technical development and its applications which brought out new architectural vocabulary differed from using deconstructive shapes, basic geometric space shapes, organic forms, hybrid forms of all kinds, and other architectural trends such as the trend towards new modernity and imaginative and virtual architecture, which are trends that would not have been possible without the progress in the fields of digital technologies and their applications in architecture, as shown in the Figure (4)



Figure (4): The main building of the BMW plant in Leesburg, Yokohama International Port

- The technological development in the field of construction has played a major role in the architectural form, and in achieving new architectural ideas, and the modern technology used in construction has become the engine of architectural thought, as the requirements of construction which needed to innovate new materials led to the possibility to reach high levels, as shown in Figure (5), resulting in a high building density and a new sky line that dominates the local natural environment in the city



Figure (5): Burj Khalifa, Dubai, UAE,

Alwaleed Bin Talal Tower, Jeddah, Saudi Arabia

- It is also expected that some functional spaces that depend on social relations, such as guest reception halls in residential buildings, halls for dealing with the public in office buildings, banks, and others, will be eliminated due to the enormous potential that information networks will provide from the possibility of obtaining administrative services without the need to move, as well. Transforming educational places from traditional places to virtual schools and eliminating functional spaces such as university auditoriums, with relying on online libraries. Stores will also be transformed into warehouses for goods, and traditional stores will be transformed into information stores, where the display of exhibits will be on the Internet. Also, with the development of e-mail capabilities, it is expected to eliminate post office building, as well as with increasing the video conferencing, it is expected that many halls will be eliminated inside buildings such as meeting rooms and conference buildings, it is also expected that there will be a change in the functional form of buildings and the emergence of multifunctional buildings, which are buildings that contain more than one function or activity at one time within one giant building, or buildings that contain all or part of the activity of an entire city, as shown in Figure (6).



Figure (6): Attempting to achieve the idea of multifunctional buildings in Milan, Italy

- Among the variables which modern digital technology entered into the concept of contemporary architecture is the entering of a new function for facades, which is advertising, where the facade has become a screen for displaying events or publicizing and advertising for various goods and merchandise, for example, King Abdullah Tower in Jeddah in the Kingdom of Saudi Arabia, also modern technology has changed the concept of fixed facades, as the shape of the building is constantly changing that the building is orientated according to the main directions, or the direction of the wind and the views with endless possibilities, such as the rotating tower in Dubai in the Emirates, and thus the facades do not belong to any architectural style or character and have no

relation with identity of local architecture, but it belongs to the type of digital technology to which these facades belong, as shown in Figure (7)



Figure (7): King Abdullah Tower, Jeddah, Saudi Arabia The Revolving Tower, Dubai, UAE

- The role of technological development also extended to the use of new building materials, as well as the development of building materials in many modern fields such as the manufacture of optical technologies, the manufacture of plastics and other applications, which led to influencing the intellectual trends of contemporary global architecture, in addition, improving the characteristics of traditional building materials and changing the nature of its uses as follows:

Modern technology has given the possibility to produce high quality materials such as metal, plastic or other materials so that they are harder, lighter and stronger, more durable than ordinary materials and bear tensile stresses, and this gave the architectural designer the possibility of forming new forms and liberating architectural creativity.

Modern technology allows the use of a small amount of raw material in the production of various products, which reduces the cost of production, reduces the volume of raw materials consumed, and reduces the necessary human effort.

- Building materials and contemporary construction methods have affected the development in the form of architectural space units, as new forms have emerged characterized by flexibility and multiple differences in the form of space. This difference and the multiplicity of construction methods and building materials reflects the emergence of structural systems such as frame systems, trusses, and space truss structures which caused changes in the ceilings forms and this was reflected in the architectural space, as shown in Figure (8)

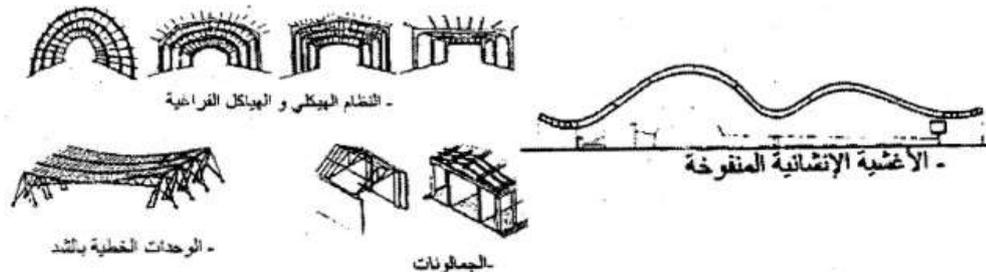


Figure (8):The multiplicity of construction methods in the formation of roof forms for the architectural space

- Digital technology has also helped in the production of modern materials so that they are light in weight, strong in endurance and can be controlled remotely, and they are easy to disassemble and install, and have wide capabilities in the field of free artistic formation, so It was employed in a developed way in the architectural formation and became having a major role in changing the language of the architectural formation. Among these materials are titanium, glass, aluminum and plastic materials. Also raw materials of various types are available, even if these materials are not available in the environment in which the project is located, as it has become easy to import them from abroad, and it is also possible to use new building materials that may not be compatible with the local environment

- The technological development of the computer and the development of programs for the production of architectural drawings and shapes led to the existence of architectural ideas to the utmost levels of architectural imagination and creativity, but as a result these ideas were focused on producing forms that achieve architectural dazzle without taking into consideration their effects on the project's economics, and their inappropriateness with the identity and nature of the project society, in addition to this, the focus has become on the architecture of the singular architect according to his personal thoughts and psychological emotions, thus the value of the architectural form increased over the rest of the other values, which include the architectural identity, and the natural environment in which the architectural product is located, as shown in Figure (9)



Figure (9): Technological development and its effects on architectural production and the architect's vision control over work

6.3.3 Architectural models with a sustainable dimension

- Swiss tower building

The tower is located in one London, in the shape of a cucumber fruit, consists of 41 floors, with highly energy efficient. Its design achieves energy savings of up to 50% of the total energy consumed by a similar traditional building, where energy is saved through the use of lighting and natural ventilation as possible. The facade of the building consists of two layers of glass, the outer layer is double glazed, and the two layers surround a void that is ventilated by computer-guided curtains, and the weather sensor system on the outside of the building monitors the temperature, wind speed and the level of sunlight, as it closes the blinds and opens the window panels when needed. The shape of the building is designed to maximize the use of natural daylight and reduce the need for artificial lighting as shown in Figure (10).



Figure (10): Swiss Building and using seasonal colors and reflective materials

- Conde Nast Tower Building

The building is located in Times Square in New York, and is one of the early examples that applied the principles of green sustainable architecture in a large building, and has used almost all technologies to save energy, the building used a special quality of glass that allows natural sunlight to enter and keeps heat and UV rays outside the building It reduces internal heat loss during winter. There are also two cells that run on natural gas fuels and supply the building with 400 kilowatts of energy, which is enough to supply the building with all the amount of electricity it needs at night, in addition to 5% of the amount of electricity it needs during the day. As for the hot water exhaust, it was produced by the fuel cells used to help heat the building and supply it with hot water, while the cooling and air conditioning systems were placed on the ceiling as a gas generator rather than an electric generator, and this reduces the energy loss associated with the transmission of electrical energy, and the photovoltaic panels on the building from the outside provide the building with additional power of up to 15 kilowatts, and inside the building the motion sensors control Fans and

lights turn off in low-occupancy areas such as stairs, and exit signals are lit by light diodes to reduce energy consumption, and the end result is that the building consumes 35-40% less energy compared to any similar traditional building as shown in Figure (11)..



Figure (11): Conde Nast Building and using seasonal colors and reflective materials

- The American University in New Cairo

Traditional materials were used in a contemporary manner. In terms of benefiting from technology, there is a system to control heating, ventilation, and air cooling, a temperature control system, and a system that ensures that all university spaces are not heated or cooled when they are empty, and the lighting system on the university campus, it works to reduce energy consumption and achieve a higher rate of efficiency, either in terms of preserving the environment, as the building focused on treatments that are compatible with the environment as the openings of the courtyards, patios and entrances between the buildings were directed towards the north eastern wind and towards the university garden, in addition to the use of internal patios, air terminals and solar chimneys in open spaces and interior halls, as well as relying on shading and its distribution, gardens and water to cool the air, and the use of a plant barrier to protect against dust-laden winds, in addition to the use of local materials, and in terms of reducing energy consumption, it was done by relying on ventilation control Naturalization by distribution and sizes of openings, and the use of wall segments to reduce gain Thermal process by building 80% of the outer walls of the campus of sandstone, which slows the transfer of heat and helps make rooms cool all day and warm during the night, which reduces the costs of using air conditioners by at least 50%, in addition of that using materials that consume less energy and recycled materials in the campus fence and external walls of buildings as shown in Figure (12).



Figure (12): The American University in New Cairo

7 CONCLUSION

- Sustainable architecture has emerged as realistic solutions with environmental, social and development dimensions, simulating the community and fulfilling the requirements of its groups. Sustainable architecture is an integrated scientific approach that looks at information and analyzes it, keeps pace with developments and develops them, and reads the community with its variables and aspirations of its different groups.

- Sustainability from a technological perspective does not mean retreating, imitating ancient and historical techniques, and singling out a strict adherence to heritage. Rather, it is the harmonization between originality and modernity, between beauty and reason, between economy and luxury in a way that serves the categories of users, their aspirations, and the plans in place.

- Sustainability from a technological perspective does not mean retreating, imitating ancient and historical techniques, and singling out a strict adherence to heritage. Rather, it is the harmonization between originality and modernity, between beauty and reason, between economy and luxury in a way that serves the categories of users, their aspirations, and the plans in place.

The development of architecture and urbanism from a sustainable perspective is due to the technological development of building technology, which thus represents the continuity of the relationship between the development of materials technology and building methods and contemporary architectural ideas, and building technology from a sustainable perspective is the mirror that reflects the reciprocal relationship between the intellectual and cultural development of society and its accompanying From the use of technological possibilities and building materials.

- Therefore, recent developments in technology and the possibility of transferring energy sources and advanced building materials helped to find constructive solutions in a different way, but many of these solutions drain the planet despite modern technologies.

- The great challenge facing architects and planners now is to choose and modify advanced technology in a way that does not negatively affect the environment, while at the same time developing the performance and comfort requirements of the environmentally compatible building.

8 RECOMENDATIONS

- The need to find architectural solutions that keep pace with the development of technology in all fields, as it expresses the development of architecture and urbanization, both material and moral, in order to avoid the dangers of environmental pollution and the importance of linking human requirements to his environment within the scope of building buildings with ecosystems and building materials that can be reused, which means reducing the depletion of natural resources.

- The need to encourage sustainable architecture through a new vision of building technology, taking into account the rationalization of construction methods and energy consumption, as it is one of the pillars on which the success of sustainable development depends in any society.

- The field of sustainable architecture and advanced technology is one of the vital and important fields for every individual in society and in all environments. Social awareness of the concept of sustainability must be increased and education about the advantages of modern technology in the field of construction.

- The necessity of using technologies that help the building achieve the principle of sustainability and environmental preservation.

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