

The Principles of Flexible Architecture as a mean for Enhancing Structural Forms of Lightweight Metal Buildings System

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Introduction:

With the acceleration of the successive developments in the field of construction techniques and the manufacture of materials, and in light of the many economic, environmental and societal challenges surrounding us, many variables have occurred in the methods of design, assembly and construction in search of achieving unique results to meet the increasing requirements of the beneficiaries, so many studies have tended to address the concept of Flexible Architecture and its contemporary applications are a response to the successive challenges in dynamic societies.

In simplified terms, this style of architecture is defined as "architecture that believes in responding to change rather than staying idle." It aims to embrace the changes and challenges in the modern dynamic world and requires a design that is shaped according to the nature of the situation to integrate the requirements of the present with the potential changes in the future. It is also a pattern of Architecture which is related to the dynamism of society and its culture.

Hence, the interest of designers and workers in the field of architecture and construction increased in the principles of flexible architecture and its applications, and sought to take advantage of its unique characteristics, which include: edge, folding, speed of installation, ease of movement, the possibility of expansion and extension, adaptation to functions, the ability to disassemble, install and grow, Precise pre-processing, multi-purposes use, and other characteristics of flexible architecture that make it meet the increasing demands of religious societies, and at the same time ensure that it occupies an important place in future architecture, and accordingly this study has tended to shed light on this style of architecture in order to benefit from and study its principles and analyze some of its applications to enhance the structural images of light metal construction systems.

Research problem:

The focus of the research lies in the need to employ the principles of flexible architecture in order to develop light metal construction systems to be more adaptive to the functional and potential environment changes, allowing future modifications to be made in line with the needs and desires of its users, and therefore the justifications for the research are launched in light of the following inquiries: What is flexible architecture and methods for utilizing its principles in enhancing the structural images of light metal construction systems?

How will this be reflected in the applications of these systems in the future?

Research objective:

The research aims to shed light on the concepts and principles of flexible architecture and analyze some of its applications, to devise the contents and methods of that style of architecture, seeking to establish the principles of design flexibility and to take advantage of these principles in enhancing the structural images of light metal construction systems.

Research axes:

To achieve the goal of the research, the study addressed the following axes:

The first axis: flexibility in architecture and light construction

This axis included the definition and concepts of flexible architecture, and the principles of flexible architecture, which were represented in "adaptability, mobility, transferability, and interactivity)."

Through this axis, the study found that flexible architecture expresses the directions and contents of pre-fabricated architecture, transformable architecture and interactive architecture, foldable architecture, mobile architecture and flexible membrane architecture, and tent architecture.

The second axis: an analytical study of some applications of flexible architecture

This axis included a study of some applied models of flexible architecture, including (flexible tent structures, framework structures, box structures, dynamic structures, and transforming structures)."

The third axis: flexibility and enhancement of structural images in the systems and applications of light metal construction.

This axis of the study dealt with a projection of the principle of flexible architecture on light metal construction systems, when the study concluded in this axis that the possibility of achieving design flexibility in light construction applications through several means, including: the possibility of re-use as in metal containers, open planes as in space structures systems Long-term adaptation, as in framework systems, extension or expansion, as in box and tent systems, or by transformation as in aesthetic systems.

Results:

The study found the following results:

1-The development in design techniques, manufacturing and building materials contributed to providing innovative construction solutions and images for light construction applications, making them more efficient, adaptive and flexible in facing economic, environmental and societal challenges.

2-Flexibility is a multi-semantic term that expresses several elements: space, structure, functions, materials, and technology; Its content has contributed to the development of design techniques, manufacturing and building materials, in providing innovative construction solutions and images for construction applications, lies in the ability to adjust, adapt, transform, respond and adapt, and the ability to deal with potential changes in light of insightful readings of use, functional, environmental and technological considerations.

3-The systems and applications of light steel construction are characterized by flexible construction characteristics, which make them the fastest in responding to the changes and challenges in dynamic societies and possible changes in the future.

4-Flexibility is embedded in the light structure design process in several stages: in basic design, upon awareness of uncertainties, when creating concepts for designing flexible systems, when exploring design space and when managing operations.

5-The application of flexibility needs a designer with flexible thinking who has the ability to transform and qualitatively move between situations and see problems in several angles, with the ability to find solutions or perceptions that achieve the purpose efficiently, and adapt suitably.

6-A light structure acquires the characteristic of flexibility if it is able to adapt to a greater amount of needs and expected changes, and respond to the requirements of the present and potential changes in the future, during which the optimal use of available resources and new technologies, and through which more special solutions are available that can be modified and added.

7-Flexibility in light construction applications can be enhanced by taking advantage of the development of digital technologies in design, manufacturing, material synthesis, and employing pre-fabricated principles, and by systematically expanding relevant interdisciplinary research related to innovation and development, exploration, analysis, experimentation and testing.

8-The flexible transformation feature enhances the environmental sustainability of light installations, by interacting with the external environment, responding to climatic situations, and making use of its structural components to make tangible changes in shape, and space.

9-Structural flexibility lies in adapting to various spaces and jobs, optimizing the use of available technologies and materials, minimizing environmental impacts, balance between efficiency and economy, designing for a minimum number of structural components, structural simplification and assembly with the least amount of skills, and manufacturing according to the principles of pre-processing and reuse.

10-The forms of flexibility in light construction applications vary to include: functional adaptability, versatility, convertibility, simple construction, expansion and growth, design for privacy, reactivity and dynamism, prefabrication, reuse, structural flexibility, structural economics, change and modification, portability, Jaw and fit, durability with light weight.

11-There are many trends in light construction that express the contents of flexible architecture such as: pre-fabricated construction, collapsible construction, container construction, construction with flexible membranes, construction with synthetic plastics, convertible construction, mobile construction, tensioned construction, air-supported construction, aluminum construction.

12-The employment and consolidation of general principles of resilient architecture in light of construction applications, providing frameworks through which design and construction methods can be strengthened in the search for new paths to find flexible applications that were not previously anticipated.

Recommendations:

1-study and analyze the concept of flexible design and the possibility of benefiting from it in the field of design in general and in the field of design for furniture and light metal constructions in particular.

2-Studying the new design theories and strategies with the aim of extracting the design principles that can be employed in the field of developing design ideas for designers of light metal construction systems.

3-Research in the field of manufacturing techniques and updated materials, whose applications can be used in developing innovative designs in the field of design for furniture and light metal construction systems characterized by flexibility, adaptability and compatibility with the successive future needs and changes of users' requirements.

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