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## Smart Materials Innovative Technologies in Architecture; Towards Innovative Design Paradigm

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### Abstract

Smart materials technologies are the key to 21st-century competitive advantage. Various building materials can significantly increase levels of functionality. “Smart Materials” will play critical role in building technology development; these materials that form part of a smart structural system, which has the capability to sense its environment, so smart materials can perform like living systems. Recognizing that the traditional partition between Materials Science and Architecture is obsolete, the study intent is to show how these two fields are intrinsically connected while growing ever more symbiotic as we progress into the future. The paper provides an analytical study of the types of smart materials available, giving a new insight into innovative methods and techniques that will give a new inspiration for architectural design, which the study will introduce “A New Innovative Design Paradigm”.

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*Keywords:* Smart materials, Smart structural systems, Architecture, Innovative Design Paradigm

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### 1. Introduction

Regarding to the fact that buildings form a part of the environment, therefore cause a larger part of environmental pollutions. A great attention has been given to the use of innovative smart materials to enhance environmental sustainability, the cost-effectiveness, and security. New technologies and high-performance materials are being developed to meet these needs, offering creative and innovative solutions to long-standing problems especially negative impact on the environment. They all offer benefits, whether to structural stability, the environment or to the maintenance and repair process [1], which will affect positively on architectural design thinking. The major goal of researching smart materials is finding the new class of materials with the method, considered as a multipurpose material; what required for creative architecture and construction through sustainability.

According to previous vision, this research focuses on smart materials, which could bring new possibilities and make dramatic improvements to construction and architecture innovation. The research will discuss and analyze the integration of smart materials technologies and architecture, which promises to transform architecture thought in ways we can hardly imagine today. It will bring a paradigm shift in building’s design and performance, it could be said that smart materials will create a new revolution in our built environment. Moreover; the research will explain its potential to make a huge impact on serving new architectural innovative design methodologies (Paradigm).

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1.1. Research objectives

This research aims to study the terms of smart materials and their impact on architecture to investigate the role and function of smart materials as a flexible approach in architectural materials in order to reduce energy consumption which will reduce environmental emissions from the construction. That aim was reached through the following objectives:

- Study the relation between architecture and materials.
- Classify smart (materials, structure, and system) into that taxonomy.
- Analyze the properties and behavior of smart materials with an overview of smart (structure, system).
- Show how smart materials and its Innovative technologies application can be applied in the architectural field.
- Suggest the new Innovative Design Paradigm, the study introduce.

1.2. Research questions & hypotheses

There are many problems affect negatively on architectural design and creation, the progressive field of smart materials may help in:

- Application of proper smart materials in architecture can influence operation and maintenance of the environment.
- Applying smart materials in architecture to achieve new forms and new method, because refers to important issues such as smart materials and regarding the lack of using environmental pollutants.

But through that it still questions about:

- Does using smart materials leads to better quality of sustainable architecture?
- Does using smart materials put the building in front of nature or along with it?

1.3. Research methodology

Through the suggested vision of research, the study will use deductive analytical studies for smart materials effect on architectural form elements and functions to answer the research questions.

Based on the objective of this study to determine the application of smart materials in construction industry and architecture design creative paradigm, using analytical-descriptive methods, investigates various aspects of materials in construction and architecture then studies their effect on sustainable environment and reduction of pollution.

2. Architecture Creation Through Construction Materials

2.1. Architectural design process

Architectural design is a continual process of selecting and organizing elements, trying to create a functional creative space [2]. Material and structural systems are sub-systems in this configuration, which link all systems together. Both variables influence the extension of the design process as a whole, and consequently, the architectural product. Therefore, the character of the architectural space depends on how things are done and formed, and hence it is determined by its structural composition of the substances and the used building materials, (table 1).

Table 1: Interrelation in building design [2].

Interrelation in building design					
Environmental system		Building system		Human system	
Cultural context	Physical context	Building technology	Internal ambience	User requirements	Client objectives
social	Climate	Available resources	Structural mass	Organic	Security
Economic	topographical	Material equipment	Sensory environment (lighting/ sound control/ heating/ vent	Locational (static/dynamic)	Profit
Technological	Constrains	Structural systems			
historical		Services system			
political		Fitting system			
aesthetic					
religious		Spatial	The ability to change		

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