International Journal of Advances in Engineering and Management (IJAEM)
Volume 4, Issue 12 Dec. 2022, pp: 623-626 www.ijaem.net ISSN: 2395-5252

Smart Construction Materials and Techniques

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Submitted: 10-12-2022 Accepted: 23-12-2022

ABSTRACT: Smart materials as the golden key to the development of the 21st century smart materials have been in many fields to the application and application of ideas.The paper deals with an introduction and implementation of super performing building materials and techniques all in terms of energy saving efficiency of the material, cost efficiency, application feasibility, availability, vernacular characteristics, life span, etc. A material is considered smart only when it contributes something to upgrade the quality of building.Smart structures and material technologies are a tool for sharing the knowledge of how various building materials can significantly increase production and profit using advanced communication, collaboration and management technologies. The paper provides an overview of the types of materials available giving a new insight into innovative methods and techniques that will be available, and open new doors for advancement and improvement in the construction industry. The new materials discussed in this paper present a small fraction of the options that are available for use by industry.

KEYWORDS: Smart materials, material technolgies, application feasibility, vernacular, Smart structures

I. INTRODUCTION

Research into smart materials by engineers and materials scientists has been going on since the 1980s. This is entirely necessary, both in terms of human civilization and the civil engineering profession. The search for more efficient and innovative materials has therefore been a constant goal of generations of researchers.

To understand more about super performing construction materials we must study materials according to their use from very root to tip. By that way we can easily conclude and infer about the application, implementation and feasibility of that particular construction material. Elements of construction where these smart materials and techniques shall be implemented are:

- Foundation
- Plinth
- Beam
- Column
- Wall
- Sill
- Window
- Door
- Roof
- Parapet
- Finishing Work

Construction materials are said to be super performing when they:

- Construction materials are said to be super performing when they
- Make building esthetically pleasing
- Cut cost of construction
- Easily available
- Upgrade building quality
- Increase life span of building

II. SMART CONSTRUCTION

Smart construction is not the same thing as SMART Technology, although it would be easy to confuse the two. SMART is an acronym that stands for Self-Monitoring Analysis and Reporting Technology. Smart construction, while utilizing technology, encompasses more.Smart construction is building design, construction and operation that through collaborative partnerships makes full use of digital technologies and industrialised manufacturing techniques to improve productivity, minimise whole life cost, improve sustainability and maximise user benefits. This way of working can not only transform the housing industry, but also maximise the benefits of a home for the occupants and provide them with a better quality of life.

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III. WHY DO WE NEED SMART CONSTRUCTION

Smart buildings integrate technology and the IoT to provide solutions to the age old issues of overspend and inefficiency in building construction and use. Within a smart building all the systems are connected, from air conditioning to security and lighting.With the use of sensors, such as occupancy and people counters, actionable data about how the buildings is really used can be gathered to enable it to perform better. These are five of the key benefits of smart buildings:

1. Reduce energy consumption

Figures vary depending on systems and buildings, but you could reduce the energy consumption in a building by around 5% -35% with the use of smart technology. This translates into significant financial savings, as well as a much more efficient and effective approach to meeting green goals.

2. Improve building efficiency

Unobtrusive sensors provide anonymous data about how the building is being used. This enables smart systems to make adjustments about where heat and light are required, for example, and on the use of infrastructure such as air conditioning.Sensors also help to identify overused and underused areas in the building, providing the opportunity to optimise space utilisation, which in turn can facilitate growth.

3. Predictive maintenance

Maintenance costs can be substantial when handled manually. However, without maintenance building equipment requires far more frequent replacement, which takes chunks out of budgets. Smart buildings enable simpler predictive maintenance.Sensors can detect building performance and activate maintenance procedures before an alert is triggered. When you have a more insightful overview of how the building is operating – and used - it's far easier to implement maintenance at the right time.

4. Increase productivity

Smart buildings have been specifically designed to deliver a more comfortable experience for their occupants. They can raise standards and ensure that health and safety considerations are being met, as well as ensure that this is implemented in a cost efficient way.Smart buildings make people more productive by continually monitoring building use and adjust systems to ensure that occupants have the facilities that they need.

5. Better use of resources

The data generated by a smart building provides key insights that can be fed into planning and make use of resources more efficient. There removes the need to rely on guesswork or anecdotal data as this can be informed by real-time, genuine intelligence.

IV. ADVANCE CONSTRUCTION TECHNIQUES

It is difficult to quantify the intangible benefits of advanced construction technologies and the risks involved in implementing such technologies with the use of traditional economic analysis techniques. An analytical approach to assessing the intangible aspects of technical innovation in construction is presented. The approach uses the analytical hierarchy process (AHP) technique and incorporates both favorable and unfavorable evaluation factors in one framework. Consistency of the pair wise comparisons, and aggregating the eigenvectors for the matrices to produce a final result are discussed. The sources of information for evaluation using the AHP method are identified and the significance of the method as a communication tool for group discussion is addressed. An example evaluation of two tower- crane alternatives, one traditional and one semiautomated, is given to demonstrate the viability of the proposed approach. The effect of the managerial judgments on the acceptability of a new technology alternative is shown via a sensitivity analysis.

V. SUPER PERFORMING MATERIALS

1. Light Transmitting Concrete

The days of dull, grey concrete could be about to end. A Hungarian architect has combined the world's most popular building material with optical fiber from Schott to create a new type of concrete that transmits light. A wall made of "LitraCon" allegedly has the strength of traditional concrete but thanks to an embedded array of glass fibers can display a view of the outside world, such as the silhouette of a tree, for example. "Thousands of optical glass fibers form a matrix and run parallel to each other between the two main surfaces of every block," explained its inventor Áron Losonczi. "Shadows on the lighter side will appear with sharp outlines on the darker one. Even the colours remain the same. This special effect creates the general impression that the thickness and weight of a concrete wall will disappear." The hope is that the

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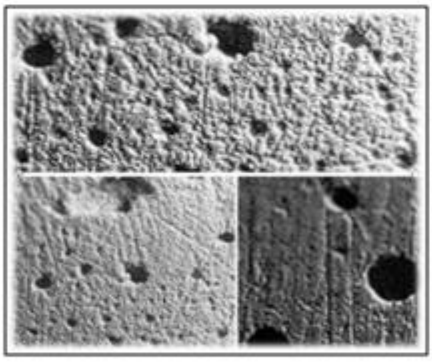
new material will transform the interior appearance of concrete buildings by making them feel light and airy rather than dark and heavy.

2. Aerated Concrete

It was discovered in 1914 in Sweden that adding aluminum powder to cement, lime, water, and finely ground sand caused the mixture to expand dramatically. The Swedes allowed this “foamed” concrete to harden in a mold, and then they cured it in a pressurized steam chamber-- an autoclave. Autoclaved aerated concrete is produced by about 200 plants in 35 countries and is used extensively in residential, commercial, and industrial buildings. At a density of roughly one-fifth that of conventional concrete and a compressive strength of about onetenth, AAC is used in load-bearing walls only in lowrise buildings. In high-rises, AAC is used in partition and curtain walls

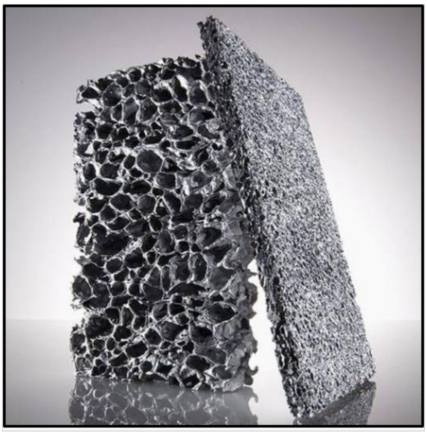
3. Floating Concrete

By replacing sand and gravel with tiny polymeric spheres, University of Washington materials scientists have created a concrete stronger than traditional concrete but so light it floats in water. The team won the regional American Society of Civil Engineers Concrete Canoe Competition last year.



4. Foamed Almunium

Light-as-air, stronger-than-steel materials are justbeginning to shape our world. Foamed aluminum firstemerged from the lab in the frame of a 1998 Karmanconceptcar.Tentimesstrongerthantraditionala luminum at just one tenth the weight, the materialallowsamorefuel-efficientvehicle.Itsisotropiccellular structure helps the frame absorb shock andserves as an insulating firewall between the engineand the rest of the car. The foaming process can alsobe applied to steel, lead, tin, and zinc.”The product isa high strength, extremely light weight material thatpossesses high durability, excellent finish and lastingvalue. The foam comes in an assortment of densitiesand sizes up to five feet wide and up to fifty feet long.It has numerous applications including architectural,automotive, marine, military, aviation, transportation,electronics,appliances,andsignage.

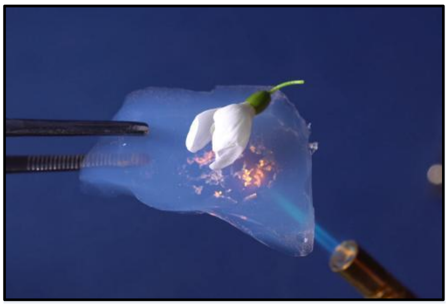


5. BannerWorks

Koryn Rolstad is a Seattle-based industrial artist who leads an integrated team of industrial designers, graphic designers, project managers and production staff in creating large-scale aerial sculptures and public art installations around the world. Known as “Banner works,” her pieces dexterously cross the boundaries between sculpture and signage, art and engineering.

6. Aerogel

Aerogel or "Air glass" is a transparent material that looks like glass, insulates better than mineral wool and is more heat resistant than aluminum. The material has many interesting properties and possible applications such as insulation in windows and solar collectors, windows in firewalls, a component in air- conditioning equipment, etc. It is molded, giving the possibility of getting different shapes: cylinders, cubes, plates of varying thickness etc. Chemically,it is composed of quartz and a great deal of air, making it fragile. The grains of quartz are small compared to the wavelength of light, giving it good transparency properties. At around 750°C (1380°F), it starts to shrink and slowly collapses to a piece of ordinary quartz. It can be cut with a band saw and holes can be drilled with a metal drill. It should be noted that Aerogel is non- flammable and non-toxic.



7. Super Black

British scientists have invented the darkest material on Earth. The super-black coating was developed by researchers at the National Physical Laboratory in London. It could revolutionize optical instruments because it reflects 10 to 20 times less light than the black paint currently used to reduce unwanted reflections. The key to the nickel and phosphorous coating's blackness is that its surface is pitted with microscopic craters. "Super-black" is especially effective at absorbing light which hits it at an angle. With the light source at right angles, the coating reflects less than 0.35%. Black paint reflects about 2.5% - seven times more.

VI. CONCLUSION

We have studied smart construction materials & advanced construction techniques. These are useful in speeding up construction activities and making them economical. Since the pandemic, it has become crucial to save money and use it wisely for other investments. There are different techniques too that can be employed in construction activities. Initially, these techniques may cost a lot of money as they are sophisticated, but as time will go, it will prove to be economical since maintenance and other extra charges will be reduced. Therefore, it is the sole responsibility of the civil engineer to make use of time and money in the most efficient manner.Figuratively speaking, the use of intelligent materials is equivalent to adding a brain capable of thinking to traditional buildings, when a bridge has a problem with concrete somewhere the brain makes an autonomous judgement to repair it; an eye capable of observing, if a deformation or crack exists somewhere in the aircraft, advance warning is given; an arm capable of waving, when a large change in the external conditions of the structure occurs, the "muscles in the arm " move autonomously to counteract noise or vibration. Smart materials will be the key to unlocking developments in the 21st century, so let's look forward to more of his wonders for the civil engineering sector.

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