International Journal of Early Childhood Special Education (INT-JECSE)
DOI: 10.48047/intjecse/ V12I2.201080 ISSN: 1308-5581 Vol 12, Issue 02 2020

Green Buildings as Work of Art Showcasing New Age Architecture

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Abstract
The concept of green construction has gained great significance in a developing country like India. The theory recommends cutting down on waste and development costs. With the growth of urbanization, regular resources were used in foolish ways, which encouraged us to use green architecture and the concept aids in making the best use of common resources. The basic idea of "REDUCE, REUSE, and RECYCLE" is what makes the green building sector an environmentally responsible one. Long-term, the cost of an abnormal state of financial and building execution is managed by green structures, propelling us toward the advent of a new era.

The aims of a green construction configuration are to decrease the value placed on fossil fuels assets, raise the efficiency with which these assets are used, and boost the reduction, reuse, and exploitation of renewable assets. It makes better use of sources of renewable energy, water and waste management techniques, as well as interior convenience and hygiene by increasing the use of efficient construction supplies and development techniques, improving the use of natural assets and sinks via bio-climatic design, and using a small amount of energy for powering itself.

Keywords: innovative materials, sustainable materials, bio-building, green building.

Introduction

Without understanding the nuances and foundation of the term "Green Buildings," we can just describe it as an exceptional way of working. Actually, there are many different types of materials and equipment used in green buildings. They also don't look like any regular building. Energy efficiency features are a common addition to green buildings. The exterior of a structure (the barrier among condition and unrestricted space) may be made more efficient with the use of tall-efficiency windows as well as insulation in the roofs, walls, and floors.

It is well accepted that the building industry across the world is responsible for a significant share of harmful emissions. In order to reduce the negative effects that buildings have on the ecology and the amount of resources they use, the survey focused on cutting-edge environmentally friendly methods and materials, such as cement, glass, bamboo, and ceramics.

The "health" of the planet and environmental conservation have emerged as major global concerns. Disturbing evidence has emerged from scientific research: the amount of harmful gases produced by human activities worldwide is wreaking havoc on the natural world and the global climate. As a result of this crisis, people are rethinking the connection between mineral extraction and habitat quality, which has prompted the rise of ecological awareness and the adoption of "green" resources in the quest for greater harmony among nature, geography, and human wellbeing. Bio-building is the acknowledgment and execution of current centuries' worth of creative knowledge, as seen by the use of non-polluting, recyclable materials, a preference for locally accessible natural ones, and the use of cutting-edge processes and systems.

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That's why it's so important to carefully consider the materials you use to construct, how you put them to use, and the technologies you use. It paves the way for the development of a framework that has a minimal impact on the environment and on people's health while yet providing optimal circumstances for both their mental and physical health.

Methodology

This work was produced as a consequence of bibliographic research using virtual library archives that date from 2012 to 2017. The most significant studies were picked from worldwide journals and demonstrated clear inventive components in construction materials.

Discussion of Findings

The study's findings attest to the development of bio-buildings and highlight the most important sustainable advancements that can be used in building and construction. These outcomes are displayed based on the kind of data used:

a) Cement
b) Wood
c) Glass
d) Ceramicsurface.

a) Cement-based materials: Light-emitting cement

Researchers from Michoacan University of San Nicolás de Hidalgo in Mexico created a unique cement that collects solar energy during the day and emits it at night.Reduced energy use and pollution from typical cement are the main objectives of this study. Roads, highways, cycle routes, and buildings might all be illuminated with the help of this phosphorescent cement.

Typically, cement is an opaque substance that prevents light from passing through to the inside. In reality, it is a powder mixture that dissolves into an effervescent pill when mixed with water and then begins to solidify into an extremely robust gel. The gel is also transformed into crystal flakes during this process, which serve to stop sunlight from entering (Rubio 2016).

This cement offers a wide range of advantages. Because they deteriorate when exposed to UV radiation, the majority of fluorescent materials currently on the market are made of plastic and have a short lifespan of no more than three years. However, this novel cement can last up to 100 years and is resistant to the sun. It has a low impact on the environment since it conserves energy and reduces the need for electric lights. And finally, it is a cheap product to produce.

The use of a luminescent surface to illuminate roads and sites is not unique to the Mexican effort; for example, a phosphorescent bicycle track in the nation of Netherlands was motivated by Van Gogh's star night. The lighting comes from a special paint rather than the pavement itself.

The research group is now putting the finishing touches on bringing the product to market.

b) Martian Concrete

Inventive eco-cement, a building material that can endure the unique circumstances of the red planet, has been developed by a team of scientists at Nortwestern University in Illinois. This concrete doesn't require water and blends sulfur with raw ingredients found in the planet's crust. It is also quite easy to make and entirely recyclable.

The key challenge this team, lead by Lin Wan, Roman Wendner, and Gianluca Cusatis, faced was that water is a limited resource on Mars and is primarily present in the form of ice. The capacity to make

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cement is due to sulfur, as stated in a paper summarizing their research. It changes from a solid to a liquid state when heated to 240 degrees and used as glue. Following that, it is blended with substances and minerals found on Mars' surface and allowed to cool (Wan et al., 2016).

c) Self-healing of cracked concrete:

Although concrete is the most common building material in the world, it has a serious flaw: it is prone to cracking when under tension. The steel reinforcement will corrode if these cracks get too big, endangering the mechanical integrity of the building in addition to giving it an unsightly appearance. Researchers from the Technology University of Delft in the Netherlands have created a truly inventive and environmentally friendly solution to cement's brittleness, allowing this substance to have a substantially longer lifespan. By incorporating bacteria into a sand, water, and debris mixture, Professor Hendrik Jonkers of Delft University's department of microbiology has developed a sort of self-repairing cement that enables concrete to mend microfractures entirely on its own, without the aid of a human. Jonkers selected bacillus bacteria for the job because they can grow in alkaline environments and create spores that can endure for a very long time without food or oxygen. For the bacteria to manufacture the lime required to repair the fissures, they need a supply of food.The original plan was to combine sugar with microorganisms, but this would damage the concrete structure. After conducting several tests, Jonkers settled on calcium lactate. He combined the calcium lactate and bacteria in biodegradable plastic capsules, then added the capsules to the wet concrete mixture.

When the concrete gradually develops fractures, water seeps in, opens the capsules, and activates the bacteria. Thus, by eating lactate, the bacteria grow and reproduce. In the process, they combine calcium with carbonate ions to make calcite, or limestone, which plugs the crevices.In theory, using bacterial concrete might result in significant savings, particularly for steel-reinforced concrete. As a result, while constructing concrete structures, durability difficulties can be dealt with in a novel and more practical approach. The goal of current research is to optimize the distribution of food for the bacteria and to establish the ideal environment for them to manufacture as much calcite as possible.

d) Smog-eating Cement

Engineers are developing innovative methods to shed light on pollution, one of the world's top worries right now. A group of scientists from the Italcementi Group, led by chemist Luigi Cassar, created "smog-eating" cement. The European Patent Office (EPO) listed it as one of the finalists for the 2014 European Inventor Award under the heading "Industry."

Although Cassar's studies began in 1991, when he first began working at Italcementri, this particular cement has been sold since 2006 under the name TX Active (the new photocatalytic active principle, capable of capturing pollutants in the air).Designers needed to employ a substance that could withstand the effects of pollutants over time, which led to the creation of the new material. It's not just a problem of aesthetics; it's also an issue of finances: buildings with smog-blackened facades need to have regular, expensive cleaning and painting done.

Titanium dioxide, a substance that can activate oxygen molecules in the air, has been added to cement by Italian researchers to change the chemical composition of the material. Figure 3 illustrates how this causes a photocatalysis reaction, which speeds up the natural oxidation process by which oxygen breaks down pollutants into nitrates and carbonates, which are chemicals that may be easily removed by rainwater. The substance is cleaned in a manner akin to how air is cleaned.

The same chemical makeup can be used to make floors, tiles, prefabricated panels, safety or soundproof barriers, as well as exterior and interior paints. Using smog-eating cement for the façade of a ve-story building costs 15% extra but results in a 20% reduction in air pollution, according to laboratory tests and field research. A large city's air pollution would therefore be decreased by 50% if all of its buildings were constructed using this material (Cassar 2014).

e) Sus-Con

Sustainable, Innovative, and Energy-Efficient Concrete (SUS-CON) is a project created and run by the Consortium CETMA [6], Design Center, Design & Materials Technology of Brindisi. It has two goals: to come up with new ways to use second-tier raw materials, which usually end up in landfills, in the process of making lightweight concrete, and to make 100% new products out of recycled materials that are good at keeping heat in. This has made it possible to make an eco-cement that uses only recycled materials as binders and particles. In the past, there has been a lot of study on how to use different kinds of urban waste in the building materials industry, like using waste plastic to make concrete [7].

Wood-based materials

(i) The Biomimetic Pavilions: Hygroskin and Hygroscope

The idea that both of these works are based on is biomimicry, which is a type of technology that looks to nature for "invented" answers.The researchers looked at wood's natural qualities, especially its hygroscopicity, or its ability to take in moisture from the air when it's dry and give it back to the air when it's wet, keeping its moisture content in balance with the relative humidity of the air around it. This hygroscopic mechanism doesn't need energy or a biological process to work. Instead, it relies on changes in the weather to keep going. So there's no use of energy.

The HygroskinPavillion is an excellent illustration of this concept. The concave spruce panels are attached to a steel frame.There are spherical windows in the centre of each of the building's twenty-eight sections.A mesh framework and 1,100 thin triangle hardwood sheets make up the openings, which seal when humidity levels are high and release air as the temperature within the building increases. The structure has a range of sensitivity from thirty percent on a dry day to ninety percent on a wet one.

Menges et al. (2014) say that the flexibility of wood in relation to humidity levels makes it possible to make a smart system where the panels open and close on their own in reaction to changes in time without the need for electrical or mechanical power.

(ii) Wood Foam

To make the building industry more sustainable, it needs to reduce the pollution it causes. A group of scientists from the Fraunhofer Institute [9], Wilhelm Klauditz-Institute (WKI) in Braunschweig, Germany, worked together to create a new wood-insulating foam with impressive properties.

Since it is lighter, softer, and made from renewable resources, wood foam can be used in place of petrochemical-based high-impact plastic foams (ole, 2014). Wood foam, unlike other foam products, is simple to recycle. In order to create the foam, researchers crush wood until the small pieces of wood produce a sticky mass. Suddenly, they inject gas into the mixture, causing the suspension to froth up and harden. Wood's inherent compounds contribute to its durability. The final product might also be manufactured by distinct chemical methods.The resultant wood foam has excellent insulating properties, is impervious to moisture and pressure, and performs similarly to standard plastic foams. In fact, it is an ideal insulating material for homes, where the aim is to maintain a steady indoor temperature for the occupants.

(iii) Cellulose Nanocrystals from Wood Waste

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The US Forest Service's Forest Products Laboratory has opened a test plant that costs $1.7 million to make cellulose nanocrystals (CNC) from wood waste like wood chips and sawdust. The goal is to make a material that is totally new, stronger, lighter, and cheaper than carbon fiber and Kevlar.

Nanocrystals are made by processing wood pulp, which is then used to get lignin, which gives wood its power and rigidity. Through this process, very small cellulose fibers that are about 10 microns wide and 1 mm long are suspended in water (Figure 7). Smoothing out more cellulose bers creates a three-dimensional grid that makes the product strong. In the third step of the production process, the lattice is compressed and compacted, and an acid is used to get rid of the air in the cavities. This is done to get a very high level of rigidity and grip, similar to that of carbon fibers, which are, however, about 10 times more expensive.

One of the best things about cellulose nanocrystals is that they are cheaper than carbon fiber or Kevlar. This is because wood waste can be used to make them. This makes it possible to recycle waste, and it also gives the rural sector a chance to use things in ways that are different from the standard. Using natural and recyclable materials also cuts down on the need for fossil fuels and the amount of greenhouse gases released during production.

(iv) Transparent Wood

Optically Transparent Wood (TW) was developed by scientists at Sweden's Royal Institute pf Technology and might significantly alter the way structures are constructed.The plan is to enhance wood's traditional qualities, making it an even more dependable and popular construction material. And with good reason: it's durable, inexpensive, and recyclable under the right conditions.

(v) Glass-based Materials

Scientists at the prestigious Lawrence Berkeley National Laboratory (Berkeley Lab) in California have developed a device that can regulate the amount of light and heat that travel through the glass in response to the external environment. Improve the intelligence of existing smart windows is the target. The journal Nature [12] has detailed this innovative technique. As opposed to the status quo, the coating allows for independent regulation of both visible light and heat-generating infrared radiation (NIR—Near Infra Radiation). This implies that windows may be used effectively in a variety of climates to provide maximum energy savings & occupant comfort (Milliron, 2013).

This allows natural light to enter the home without letting in excess heat. As a result, less energy is required to run air conditioners and light bulbs.The novel material is composed of a glassy matrix comprising niobium oxide and a thin layer of titanium dioxide nanocrystals that can be formed on demand by a charge of electricity. At rest, the tiny crystals are transparent, thus they are placed on two layers. The initial coating may be triggered to filter heat-sensitive infrared light, and the subsequent one can be activated to block a substantial percentage of visible light, turning the glass matte. You may now regulate the window's transparency and thermal performance independently by toggling to a blackout mode. (a) A visual representation of wood both before (top) and after (bottom) delignification. Images (b, c) of a cross section of original wood (OW) at low magnification reveal the microscopic structure of wood. Cross-sectional photographs of looks dull wood (DLW) at a low magnification (d, e) are indicative of a relatively intact wood structure. (This publication has been authorized by the American Chemistry Society. Bright, filled with a bunch-transparency mode as described in Journal of Green Building, Volume 153. The ability of the new material to transmit or block light in response to an applied voltage gives rise to the term "electrochromic."

(vi) Smart Glazing with Micro-Mirrors

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The work of a research team at the Politecnico di Lausanne (EPFL) has helped the smart window industry advance. The micro-mirror layer on the new glass that the researchers produced measures only 0.15 to 0.2 millimeters thick. They want to control sunlight in order to improve air conditioning and natural lighting while also lowering the building's heating and cooling expenditures. A futuristic building being erected in Dübendorf, Switzerland will serve as the first test site for an innovation that was just reported in the International Solar Energy journal [14]. The micro-mirrors are carved out of a polymer lens that is sandwiched between the double-glazed window panes using a high-precision laser. ¬This system comprises of a second array of secondary reflective surfaces connected with a one-dimensional array of parabolic reflective surfaces.

(vii) Glass Fiber Panels

Spanish scientists have developed an early version of a fiberglass built façade that can absorb solar energy and release it into the space for heating purposes, greatly increasing the building's thermal efficiency and reducing its carbon footprint. The prototype was built by the Sustainable Building Division of Tecnalia's San Sebastian study center, and its results [16] may be seen on CORDIS, the primary site of the European Union. A prefabricated panel composed of glass fiber with organic binder was selected for use in the "pilot model" application to a building in Merida. Resistance to cables, water and wind, thermal insulation, and acoustic insulation were the four main metrics against which the fiberglass wall was measured. Architect JulenLarrazAstudillo disclosed that the primary motivation for the experiment was to determine the panel's corrosion resistivity. The reason has to do with the panel's durability; it's made up of glass fiber and organic binders. The results of the test were excellent, with all readings falling squarely inside the range recommended by the European Union.

The watertightness has been tested by making sure the tech doesn't fall apart. Based on the findings, it was determined that the wall is effective so long as the rain does not penetrate to the interior, which is located immediately behind the technological components. If this happens, the system may be more vulnerable to breakdowns. The façade can take a pressure of roughly 305 kg / mq without showing any signs of collapsing, suggesting that its resistance to wind power is high.

(viii) **The Hydrophobic and Self-Cleaning Glass**

The ENEA Faenza Materials Technology Unit has developed hydrophobic and self-cleaning glass [17], a significant Italian patent that takes its cue from lotus leaves, which, due to their unique surface roughness, prevent water from accumulating and instead allow it to flow away. However, despite their proximity to swampy ponds, the lotus leaves' surfaces are always spotless.This is made feasible by a technique called a "lotus eect," which takes advantage of the unique shape of the leaf surfaces themselves. ¬The surface of a leaf is not as smooth as it looks to the naked eye; rather, it is ruffled by nanometric projections that reduce the amount of precipitation that hits the plant.So, when a drop of water lands on the leaf, it rolls across it rather than staying still. The water flows over the leaf's surface, capturing any dirt or debris, and carrying them away.

Conclusions

The objective of this study is to highlight recently generated materials that are not yet well-known outside of the academic community. Considering environmental, economic, and social sustainability, the following research demonstrates that the new materials under consideration offer numerous benefits. In fact, they leave little to no trace in the natural world and need little in the way of resources to manufacture.They maintain great levels of comfort at the same or lower price than competing options on the market. They have also been shown to be a more advanced eco-sustainable alternative to traditional synthetic materials due to their status as natural source materials. The focus of this study is on finding ways to provide for the demands of the present without compromising those of the future.

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