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DEPARTMENT OF CIVIL ENGINEERING

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Department Vision:

To be the leading department providing quality education to develop competent Civil Engineers, Entrepreneurs, and innovators to serve the nation.

Department Mission:

M1- To provide quality technical education.

M2- To prepare competent students for employment.

M3- To focus on developing values and professional skills.

Program Educational Objectives:

- 1. To ensure that graduates will have a mastery of fundamental knowledge, problem solving skills, engineering experimental abilities, and design capabilities necessary for entering civil engineering career and/or graduate school.*
- 2. To incorporate verbal and written communication skills necessary for successful professional practice.*
- 3. Demonstrate knowledge of management principles and engineering techniques for effective project management.*
- 4. To prepare graduates to deal with ethical and professional issues, taking into account the broader societal implications of civil engineer.*

Revolutionizing Construction: Exploring the Potential of 3D Printing with Concrete

Dr. A. M. Bhoi

In recent years, the construction industry has seen a game-changing innovation: 3D printing with concrete. By enabling faster construction, intricate designs, and reduced material waste, this cutting-edge technology has the potential to reshape the way we build structures ranging from houses to bridges. This article delves into the concept of 3D printing with concrete, including its current status, opportunities, challenges, limitations, benefits, and drawbacks, as well as the promising future scope of research in this field.

3D printing with concrete entails deposition of specially formulated concrete mixes layer by layer to create three-dimensional structures. This method is used in place of traditional construction techniques, which frequently involve formwork and manual labor. Printers precisely extrude concrete layers using computer-aided design (CAD) models, enabling intricate shapes and geometries that were previously difficult or expensive to achieve.

3D printing with concrete is currently gaining traction in both research and practical applications. Several projects around the world have shown that this technology can be used to build a variety of structures. Notable examples include the Netherlands' 3D-printed pedestrian bridge and the first 3D-printed houses in multiple countries. These projects demonstrate how technology can significantly reduce construction time and labor costs.



India's first 3D printed House Built by IIT Madras startup Tvasta
Courtesy: Times of India



World's first 3D-printed steel bridge opens to public in Amsterdam
Courtesy: The Hindu

The Process: From Digital Design to Physical Reality in 3D Printing Using Concrete

The convergence of technology and construction has given birth to a game-changing approach: 3D printing with concrete. This innovative process is changing the way we think about and build structures, providing architects, engineers, and builders with a new toolkit to bring their visions to life. In this article, we will take an in-depth look at the intricate process that connects the digital and physical worlds, demonstrating the remarkable evolution from digital design to tangible architecture using 3D printing technology.

i) Digital Design: Blueprint of the Future

The journey begins in the digital realm, where architects and designers use computer-aided design (CAD) software to their advantage. As architects translate their imaginative visions into detailed three-dimensional models, their creativity knows no bounds. Design complexities emerge digitally, encompassing architectural nuances, aesthetic considerations, and structural integrity.

ii) Slicing: Deciphering Layers of Innovation

Once the digital model is complete, it is time to prepare it for 3D printing. This includes a critical step known as slicing. Slicing software divides the digital model into horizontal layers, similar to cake cross-sections. Each layer serves as a road map for the 3D printer to follow when depositing the concrete material. Each slice represents a tangible layer that will contribute to the overall structure.

iii) G-Code: The Language of Construction

The layered instructions generated by slicing are then translated into G-code, a language understood by 3D printers. This is a detailed set of instructions that govern the printer's movements, nozzle position, speed, and the amount of concrete extruded. G-code orchestrates the mechanical ballet of the 3D printer by transforming the abstract digital design into tangible actions.

iv) Printing: Building Layer by Layer

The 3D printer comes to life with the G-code in hand, becoming a tangible link between the digital and physical worlds. The printer's nozzle, guided by the G-code, precisely extrudes a specialized concrete mixture. This method of layer-by-layer deposition adds depth to the design one layer at a time. As intricate architectural features begin to take shape, the technology's potential for creativity and complexity shines through.

v) Curing: Strength in Time

Allowing time for the concrete to cure and gain strength before adding the next layer is critical as each layer is deposited. The curing process is affected by factors such as the concrete mixture, environmental conditions, and project requirements. It is critical for the overall structural integrity of the final product to ensure that each layer has sufficient strength.

vi) Complexity and Innovation: Pushing Boundaries

What distinguishes 3D printing with concrete is its ability to overcome the limitations of traditional construction methods. Complex geometries, organic forms, and intricate details that were previously impossible to realize are now within reach. Architects can push the boundaries of design by creating structures that are both functional and aesthetically pleasing.

vii) Post-Printing Touches: Bridging the Gap

While 3D printing technology can create complex forms, it may not always provide the desired surface finish or functional characteristics. As a result, post-printing processes are involved. Smoothing surfaces, reinforcing structural elements, and integrating additional components such as windows and doors are examples of these. This transition from raw print to finished architecture emphasizes the seamless integration of technology and craftsmanship.

Advantages of 3D Printing Using Concrete: Unleashing Innovation in Construction

In the world of construction, where tradition meets innovation, 3D printing with concrete represents a technological breakthrough with far-reaching implications. This construction method offers numerous benefits that are changing the way we think about architecture, sustainability, efficiency, and even disaster response. In this article, we will look at the incredible benefits that 3D printing with concrete brings to the table, ushering the construction industry into a new era of possibility.

i) Speed and Efficiency: Redefining Timelines

3D printing with concrete's layer-by-layer construction method is synonymous with rapid progress. Traditional building methods frequently involve labor-intensive processes such as formwork assembly and manual concrete pouring. In contrast, 3D printing can drastically reduce construction time, allowing structures to be built in a fraction of the time that traditional methods would require. This time advantage is a game changer for both small and large-scale projects.

ii) Complex Geometries: Architectural Freedom

When attempting to bring complex designs to life, the traditional construction industry frequently faces challenges. Concrete 3D printing overcomes these constraints by allowing the creation of intricate and unusual geometries. Architects can venture into uncharted territory, creating structures that were previously thought impractical due to the constraints of traditional building methods.

iii) Material Optimization: A Greener Future

The accuracy of 3D printing technology enables efficient material distribution. Due to inaccuracies and formwork requirements, traditional construction can result in significant material waste. Waste is reduced when 3D printing with concrete, contributing to more sustainable construction practices and lowering the industry's overall environmental footprint.

iv) Labor Reduction: Shaping Tomorrow's Workforce

While construction has traditionally relied heavily on manual labor, 3D printing with concrete eliminates the need for extensive on-site workforce involvement. Skilled labor is still required for design, programming, and process oversight, but technology significantly reduces the overall labor-intensive aspects of construction.

v) Customization: Tailoring to Needs

The inherent flexibility of 3D printing with concrete allows for customization based on specific project requirements. Structures can be designed to meet energy efficiency standards, environmental conditions, or even specific needs. This adaptability enables architects and engineers to precisely tailor their designs.

vi) Affordable Housing Solutions: Empowering Communities

The global housing crisis is a huge challenge, especially in underserved communities. Concrete 3D printing offers a potential solution by significantly lowering construction costs. This could pave the way for more affordable housing options, making homeownership more accessible to a wider range of people.

vii) Disaster Response: Rapid Recovery

Construction must be completed quickly and efficiently in times of disaster. The speed and efficiency of 3D printing with concrete can help in the rapid construction of emergency shelters, medical facilities, and infrastructure. This technology has the potential to transform disaster response and recovery operations.

viii) Innovation Beyond Boundaries

The application of 3D printing with concrete goes beyond traditional construction. It paves the way for innovation in a variety of fields, including space exploration, where 3D printing technology can be used to build structures on other planets, and the replication of historical artefacts for preservation and education.

Exploring the Limitations of 3D Printing Using Concrete: Navigating Challenges on the Path to Innovation

The potential for 3D printing with concrete to revolutionize the way we build structures has captured the imagination of the construction industry. This innovative approach, like any emerging technology, is not without limitations. In this article, we will look at the difficulties that 3D printing with concrete faces, as well as the obstacles that must be overcome for the technology to reach its full potential.

i) Scaling Up: Bridging the Gap Between Small and Large Projects

The current size constraint of the printers is one of the primary limitations of 3D printing with concrete. Most concrete 3D printers are intended for small-scale projects, limiting their use in the construction of large buildings or infrastructure. It is difficult to scale up technology while maintaining precision and structural integrity.

ii) Material Formulation: Balancing Strength and Printability

The formulation of the concrete mixture is critical to the success of 3D printing with concrete. It is a difficult task to create a concrete mix that is both printable and structurally sound. Many traditional concrete mixes are unsuitable for 3D printing due to issues such as nozzle clogging, setting too quickly, or a lack of sufficient strength. The challenge of balancing printability, strength, workability, and durability remains significant.

iii) Quality Control and Consistency: Ensuring Structural Integrity

It is critical to ensure consistent strength and quality across all printed layers when building safe and long-lasting structures. Layer bonding, material uniformity, and the prevention of air voids or weak points within the printed object are all issues that require more research and development.

iv) Lack of Standards and Regulations: Navigating Uncharted Territory

The concrete 3D printing field lacks standardized processes and regulations. In contrast to traditional construction, which has well-established codes and standards, 3D printing presents unique challenges that necessitate the development of new guidelines. The lack of industry-wide standards may impede widespread adoption and integration of the technology into mainstream construction practices.

v) Post-Printing Processes and Finishing

While 3D printing can help to speed up the construction process, it frequently necessitates additional post-printing steps to achieve the desired aesthetics and functionality. Smoothing surfaces, reinforcing structures, and integrating other components can be time-consuming and labor-intensive, negating some of the technology's initial time-saving benefits.

vi) Limited Material Selection

Current concrete 3D printing is primarily limited to printing with concrete-based materials. While concrete is a versatile building material, it may not be appropriate for all types of projects. The scarcity of diverse material options, such as metals and polymers, limits the potential applications of 3D printing in various industries.

vii) Initial Investment: Balancing Costs and Benefits

The initial investment required to set up a 3D printing infrastructure using concrete infrastructure can be significant. Purchasing printers, specialized software, and training a skilled workforce all add to the cost. While the technology has the potential to lower labor and material costs in the long run, the initial costs can be prohibitive for smaller construction companies or projects.

viii) Skilled Workforce: Adapting to New Skill Sets

The complexity of operating and maintaining 3D printers, combined with the need for skilled personnel, presents difficulties. Adopting this technology can have a steep learning curve and dealing with technical glitches or issues during

the printing process can cause projects to be delayed.

Exploring Opportunities in 3D Printing Using Concrete

In the construction industry, the incorporation of technology frequently creates new opportunities that can reshape traditional practices. One such innovative path is 3D printing with concrete, a cutting-edge method with enormous potential to transform the construction industry. This note delves into the exciting opportunities presented by this innovative approach, which ranges from architectural design to sustainable construction practices.

i) Architectural Innovation: Pushing Boundaries of Design

With the advent of 3D printing with concrete, architects now have unprecedented design freedom. Intricate and complex geometries that were previously prohibitively expensive or time-consuming to build using traditional methods can now be realized relatively easily. This allows for architectural innovation, allowing for structures that challenge conventional norms and serve as iconic landmarks of modernity.

ii) Rapid Construction and Disaster Relief

One of the most significant opportunities is to shorten construction timelines. The layer-by-layer deposition process of 3D printing with concrete reduces the time required to build structures significantly. This opportunity is especially valuable in disaster-stricken areas, where the rapid and efficient construction of emergency shelters and infrastructure is critical for relief efforts.

iii) Affordable Housing Solutions

A pressing global issue is the scarcity of affordable housing. By providing an affordable and scalable method of construction, 3D printing with concrete has the potential to address this crisis. This technology can pave the way for cost-effective house construction in a fraction of the time, making homeownership more accessible to a larger population.

iv) Customization for Specific Needs

Concrete 3D printing also enables the creation of customized structures tailored to specific needs. Buildings, for example, can be designed to be energy efficient or to be optimized for specific environmental conditions. This opportunity aligns well with the growing demand for environmentally conscious and sustainable construction practices.

v) Reduced Environmental Impact

3D printing with concrete has the potential to reduce construction waste. Due to the need for formwork and the imprecision of manual labor, traditional construction processes frequently generate significant material waste. This technology reduces waste and contributes to more sustainable construction practices through precise material deposition.

vi) Cultural Preservation and Replication

3D printing with concrete can play an important role in historical preservation and restoration. The technology allows for the precise replication of intricate architectural details, sculptures, and cultural artefacts. This is especially useful for preserving historical sites and creating exact replicas for educational purposes.

vii) Infrastructure Development

Large-scale infrastructure projects like bridges and tunnels could benefit from 3D printing with concrete as well. The ability of technology to build complex and long-lasting structures could lead to more efficient infrastructure development, ensuring longevity and reducing maintenance requirements.

viii) Research and Material Development

There are also opportunities in research and material development. Engineers and scientists are constantly working to improve the concrete mixtures used in 3D printing in order to improve structural integrity, durability, and sustainability. This study contributes to the overall advancement of construction materials.

Conclusion

In 3D printing with concrete, the journey from digital design to physical reality is a symphony of technology, creativity, and engineering. Each layer deposited represents a step closer to realizing the full potential of this transformative process as the industry evolves. The convergence of design, software, hardware, and materials heralds a new era in construction, one in which structures rise from the digital realm to reshape the physical landscape, owing to the wonders of 3D printing technology.

The benefits of 3D printing with concrete are propelling the construction industry into previously uncharted areas of innovation and efficiency. As this technology advances, the benefits it provides have the potential to reshape how we build, think about design, and address global challenges. The benefits of 3D printing with concrete are transforming construction into a realm of limitless possibilities, from redefining architectural possibilities to assisting disaster relief efforts.

As with any transformative technology, 3D printing with concrete has limitations. While these challenges are significant, they are not insurmountable. Through ongoing research, material development, and technological innovation, researchers, engineers, and innovators are actively working to address these limitations. While the journey to widespread adoption may be difficult, the potential benefits of more efficient construction, architectural creativity, and sustainable practices make it a worthwhile endeavor. As solutions emerge and technology evolves, today's limitations may pave the way for tomorrow's possibilities.

While 3D printing with concrete has the potential to completely transform the construction industry, it is not without its challenges. Architects, engineers, policymakers, and industry stakeholders must work together to navigate the complexities of material formulation, scaling up, ensuring quality control, and establishing standards. The path to widespread adoption will undoubtedly be fraught with challenges, but if these challenges are met through collaboration and innovation, the construction industry may eventually reap the benefits of a more efficient, sustainable, and technologically advanced future.

To summarize, 3D printing with concrete offers a variety of exciting opportunities in various aspects of the construction industry. This technology is poised to revolutionize how we build and shape our environment, from pushing the boundaries of architectural design to addressing affordable housing challenges and sustainable construction practices. As research and development progresses, the full scope of these opportunities will be realized, promising a future in which buildings will rise more efficiently, creatively, and sustainably than ever before.

SCHEDULING OF RESIDENTIAL BUILDING

Ms. Kalyani Pagar TE student, Ms. M. B. Murkute Seminar Guide

Buildings and their construction have become increasingly complex. New innovations in methods, designs and materials mean that the management of construction projects requires professionals with the knowledge and skills to deliver on time and on budget in a demanding and rapidly changing industry. Construction Management a combine a wide range of techniques and knowledge. Including: Budgets and cash flow, Construction law, Construction Planning, Procurement, Supply chain management and tendering, Quality Management, Construction risk management, including Health and Safety. Construction planning or programming uses formal techniques to schedule activities, identify dependencies between tasks, and allocate resources. Planning is the foundation of the construction project. It forms the basis for cost, time and resource management. Without adequate planning the Construction Manager can't monitor progress against budget or schedule and can't make efficient use of resources be they materials or people. So, the application of construction management techniques is required to achieve quality economy and time management. Scheduling of work can be simplify using CPM Network, Gantt Bar charts and many more techniques. Which will save more cost, time and will make the project more efficient. Construction scheduling uses formal techniques to schedule activities, identify dependencies between tasks, and allocate resources. In this study The duration of residential building as per Gantt bar chart is 120 days and after modification it is 101 days.

EARTHQUAKE RESISTANCE STRUCTURE BASE ON ISOLATION TECHNIQUE

Mr. Yuvraj Pagar TE student, Ms. M. B. Murkute Seminar Guide

The occurrence of every major earthquake, there has been in the past, almost worldwide tendency to Increase the capacity demand of the structure to counteract such events. The events be like the earthquake Disaster. Various problems faced during earthquake. The problems are not only faced by environment but also, by human lives & animals at the same time. The problems like falling of building, cracking of ground, short circuits & fire due to breaking of electric lines & also when earthquake in sea floor may create Tsunamis due to that lots of people & animals get died. So, to avoid those things the new strategies have been successfully developed to handle such problem (i.e., earthquake disaster) economically. So, the Earthquake resisting structure by using base isolation technique is one of that method which is used to protect the structure from seismic force. It is imperative that structure is designed to resist earthquake force, in order to reduce the loss of life. So, how the system is actually used in the structure the base isolation system for making the earthquake resistance structure is the subject of these paper. Seismic base isolation method has proved to be a reliable method of earthquake resistant Design. The success of this method is largely attributed to the development of isolation devices and proper planning. Different types of isolation devices have been proposed and extensive research has been made on them.

They can serve the purpose for almost all types of conditions. Adaptable isolation systems are required to be effective during a wide range of seismic events. Besides, the existing devices are expensive and to make isolation feasible for ordinary buildings, it is efforts are required to develop cost effective devices

Shifting to Green Cement for a Better Future

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The most recent few decades have seen flare-ups of many zoonotic illnesses like Coronavirus, SARS, pig influenza, to give some examples, getting over from creatures into people. While no one might have anticipated the obliteration the Coronavirus pandemic has left afterward, disease transmission experts have been cautioning us for a really long time that with humankind's exceptionally relaxed approach towards the climate, this may very well be the start!

Specialists accept that flare-ups are turning out to be increasingly more typical only for the straightforward explanation that mankind's annihilation of biodiversity is setting out open doors for the overflow of new infections and illnesses. This combined with the populace blast is a worldwide calamity in the works. More individuals in the world mean a requirement for additional exercises like farming, ranger service, mining and oil investigation. World over, biodiversity is being debased at a disturbing rate, prompting consumption of our timberlands by sensational numbers; pushing the world onto the edge of a grave natural emergency. Consistently, for an enormous scope, we are hacking our regular oxygen generators and fewer trees mean less oxygen to relax!

Our evil treatment of the planet has likewise prompted a large number of ecological issues, for example, an Earth-wide temperature boost, consumption of stratospheric ozone, corrosive downpours, soil disintegration, obliteration of tropical backwoods, exhaustion and termination of numerous species, and quick downfall of biodiversity, which are all connected to the deluge of catastrophic events and different weather conditions the earth is seeing regularly nowadays.

It is time we awaken and understand that each decision we make, has worldwide repercussions and act and pick astutely. Embracing the Lessen - Reuse - Reuse strategy; polishing off fuel, power and water prudently and utilizing just climate-cordial items, are basic things we can undoubtedly do to have an immense effect.

Aside from these straightforward things, something else you can do is change to Green Concrete. Here is some something worth mulling over... Did you had any idea about that an ordinary item like concrete that we use without really thinking about to, has major natural effects? One of the premier issues of the Concrete business is discharge of CO₂, which we as a whole know is hurtful for the soundness of every single living being. Concentrates on show that the concrete business' overall creation of 1.6 billion + tons contributes around 7% of carbon dioxide's yearly emanations.

The critical lies in changing to Green Concrete or Green Substantial which is delivered with the assistance of a "carbon-negative assembling process" wherein the assembling system of concrete is reasonably modified to cut down the CO₂ discharge levels fundamentally. Almost 60% less nuclear power is consumed when Green Concrete is created when contrasted with OPC (Common Portland Concrete). Green Concrete likewise lessens ozone-depleting substance outflows by over 60% for every significant amount of OPC. It additionally diminishes the metropolitan intensity island impact by expanding the reflectivity of cement.



At JSW Cement, Slag, produced during the steel-making process, is used to produce green cement. Slag is extremely effective in reducing permeability and helps increase the durability of concrete. Slag Cement can replace 70-80% of OPC in most common concrete mixtures, and up to 100% in massive concrete elements and other specialized structures. JSW Cement is India's first-ever cement manufacturer to receive the coveted GreenPro Certification for Portland Slag Cement (PSC) from the CII-IGBC (Confederation of Indian Industry – Indian Green Building Council) and are GreenPro Certified for three products, Portland Slag Cement (PSC), Composite Cement (CC) and Ground Granulated Blast Furnace Slag (GGBS).

JSW Cement has received GreenPro certification for the following initiatives:

- Reduction in CO₂ emissions
- Use of alternate raw material
- Enhancement of mines life; conservation of Limestone
- Efficient Water management
- Restoration of mines
- Green belt development
- Biodiversity

Based upon the Life Cycle Assessment & EPD certification of JSW's PSC product, it can be concluded that JSW PSC has less ecological footprint, covering the following key parameters with respect to OPC:

- Least global warming potential
- Maximum usage of secondary materials
- Less acidification & eutrophication potential
- Minimal non-renewable primary energy usage

The relationship between us and The Mother Earth is dangerously unbalanced at the moment. The recent pandemic is just an indicator that our planet is in red and the rapid environmental changes taking place every day are wreaking havoc on

the social and economic wellbeing of the entire human race. The bottom line here is we should stop taking nature for granted and start making intelligent choices like switching to green cement to help protect our future!

3D Printing Technology

Ammarah Imran Shaikh
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3D printing is a process where a digital model created using computer-aided design software (CAD) is turned into a physical three-dimensional object by adding material a layer at a time.

3D printing is an additive process whereby layers of material are built up to create a 3D part. This is the opposite of subtractive manufacturing processes, where a final design is cut from a larger block of material. As a result, 3D printing creates less material wastage. What Is 3D Printing? Three-dimensional (3D) printing is an additive manufacturing process that creates a physical object from a digital design. The process works by laying down thin layers of material in the form of liquid or powdered plastic, metal or cement, and then fusing the layers together.

The materials used for 3D printing are as diverse as the products that result from the process. As such, 3D printing is flexible enough to allow manufacturers to determine the shape, texture and strength of a product. Best of all, these qualities can be achieved with far fewer steps than what is typically required in traditional means of production. Moreover, these products can be made with various types of 3D printing materials. Graphene has become a popular choice for 3D printing because of its strength and conductivity. The material is ideal for device parts that need to be flexible, such as touchscreens. Graphene is also used for solar panels and building parts.

As a single step manufacturing process, 3D printing saves time and therefore costs associated with using different machines for manufacture. 3D printers can also be set up and left to get on with the job, meaning that there is no need for operators to be present the entire time. The history of 3D Printing started in the early 1980s, when the inventor, Charles Hull, originally called it "stereolithography".

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