

NIRMANA

VOLUME - 09



DEPARTMENT OF CIVIL ENGINEERING

VISION OF THE INSTITUTE

To become a globally recognized Institution that develops professionals with integrity who excel in their chosen domain making a positive impact in industry, research, business, and society

MISSION OF THE INSTITUTE

- *To provide the ambiance necessary to achieve professional and technological excellence at the global level.*
- *To undertake collaborative research that fosters new ideas for sustainable development.*
- *To instill in our graduate's ethical values and empathy for the needs of society.*

About Department of Civil Engineering

The Department of Civil Engineering, TIST (Estd. 2006) offers Under Graduate course B.Tech in Civil Engineering (NBA accredit edup to 2023) and Post Graduate course M.Tech in Construction Engineering and Management. The department continues to conquer new frontiers of knowledge through quality research work, Conferences, QIP and FDP programs for enhancing the Teaching Learning process and moulds the students to be change agents with high professionalism, ethics and sustainability in addition to the curriculum objectives. The department is in close association with Institution of Engineers (IE), Indian Society for Technical Education (ISTE) and has an active student chapter of Indian Concrete Institute (ICI) and Indian Green Building Council (IGBC). The design wing "Rachana" of the department takes up research and consultancy work to offer technical advisory support to various leading organizations like KMRL, Naval base, STICON, PWD etc. The department also undertakes the socially relevant projects like Rebuild Kerala Initiative through which students learn humanitarian concept and their duties towards the society. The department focuses on emerging as a center of excellence in the field of cost-effective green building materials.



VISION OF THE DEPARTMENT

To transform into a centre creating change agents in civil engineering with professional competency, integrity and ethical values for serving the society with the highest level of proficiency through their chosen domain.

MISSION OF THE DEPARTMENT

1. Provide ambience to create civil engineers of global standards to serve the society collaboratively, competently and ethically.
2. To provide an academic environment for lifelong learning nurturing the skills in research and development for the benefit of all stakeholders.
3. To inculcate professionalism in students through team work, effective communication and leadership skills.
4. To encourage and empower the faculty in the field of engineering education and mentoring for enhancing the teaching-learning process.
5. To impart hands on experience to aspiring undergraduates through interdisciplinary research projects, industrial training and consultancy work.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

The graduates of Civil Engineering will

1. Apply technical expertise to identify and resolve any complex civil engineering problems with the help of modern engineering tools and lifelong learning to meet the specified needs of their chosen domain viz. employment, higher studies or research and development.
2. Develop cost-effective solutions for a sustainable environment with deep insight in societal and ecological issues by adhering to professionalism.
3. Exhibit professional ethics, management and leadership qualities with good communication skills facilitating to work in a multidisciplinary team for evolving as an entrepreneur.

FORWARD



Dr. Vasudev R
HOD, Civil

I have great pleasure in presenting before you the 9th volume of NIRMANA. The pandemic situation which is prevailing in the country since 2020, has made us learn to explore various means and methods to explore the digital world. This prompted us to release NIRMANA volume 9 virtually.

The technical papers presented here is an outcome of continuous exploration of the research possibilities in the program of Civil Engineering. The articles incorporated in the magazine shall be an inspiration to the young aspirants of this program to understand the wide scope that they could have in their career. As usual the quizzes related to civil engineering are also included in the magazine which triggers the thought process.

NIRMANA, is thus a very good platform to all budding students of civil engineering, to showcase their research knowledge which will help them to improve their skills in writing technical papers, articles thereby improve their communication skills too.

I extend my warm regards and support to all students who have contributed their research work in the form of technical paper or articles for this edition of NIRMANA. I also thank the team of faculty members who have given the guidance to the students to bring out this edition.

Inviting your attention to the meritorious work of our students and hope you will find the articles interesting and useful.

Editorial board

We are very happy to bringing forth our technical magazine NIRMANA. Nirmana is an annual technical magazine which comprehensively reflects the technical and research development in the field of civil engineering .It widely covers student articles, projects, features etc. This revised and enlarged edition of volume 9 is now respectfully presented to the society .this magazine has been prepared to meet the requirement of students getting updated in new trends of civil engineering. Ever since the trade was introduced, a need has been felt for a magazine on this subject of basic standard, leaving aside all trends, only the essential facts have been discussed in this magazine. It has a direct link with the project work, that all the research done in civil engineering in the academic year 2020-2021 has been explained in nutshell. I hope that this magazine will be useful for all the students of civil engineering department of our institute. This is the ninth volume promising more of its edition in the time to come. We would like to thank all who supported the magazine heartfully.

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STUDENTS ARTICLES



PROGRAMMABLE STRUCTURES FROM THE PRINTER

Mayakrishnan ,S6 CE

This process has been collaboratively developed by Tiffany Cheng and Prof. Dr. Achim Menges from the Institute of Computational Design and Construction (ICD) and the Integrative Computational Design and Construction for Architecture Cluster of Excellence (IntCDC) at the University of Stuttgart, together with Prof. Dr. Thomas Speck from the Plant Biomechanics Group and the Living, Adaptive and Energy-autonomous Materials Systems Cluster of Excellence (livMatS) at the University of Freiburg.

4D-printing defines shape changes

3D-printing has established itself as a manufacturing process for a wide range of applications. It can even be used to produce intelligent materials and material systems that remain in motion after printing, autonomously changing shape from external stimuli such as light, temperature or moisture. This so-called '4D-printing', in which predetermined shape changes can be triggered by a stimulus, immensely expands the potential applications of material systems. These changes in shape are made possible by the chemical composition of the materials, which consist of stimuli-responsive polymers. The printers and base materials used to produce such materials systems are usually highly specialized, custom-made and expensive

Using standard 3D-printers, it is possible to produce materials systems that react to changes in moisture. Given their structure, these materials systems can undergo shape changes in the entire system or simply in the individual parts. The researchers at the Universities of Freiburg and Stuttgart combined multiple swelling and stabilizing layers to realize a complex movement mechanism: a coiling structure that pulls tighter by unfolding 'pockets' as pressors and which can loosen up again on its own when the 'pockets' release and the coiled structure returns to the open state.

Natural movement mechanisms transferred to technical material systems

For this new process, the scientists used a mechanism from nature: the air potato climbs trees by applying pressure to the trunk of the host plant. To do this, the plant first winds loosely around a tree trunk. Then it sprouts 'stipules', basal outgrowths of the leaves, which increase the space between the winding stem and the host plant. This creates tension in the winding stem of the air potato. To imitate these mechanisms, the researchers constructed a modular material system by structuring its layers so that it can bend in different directions and to different degrees, thereby coiling and forming a helix structure. 'Pockets' on the surface cause the helix to be pushed outwards and put under tension, causing the entire material system to contract. So far, process is still limited to existing base materials that respond to moisture. That in the future, inexpensive materials that also respond to other stimuli will become available for 3D-printing and can be used with process.

NOVEL SMART CEMENT CAN BE USED TO BUILD MORE DURABLE ROADS AND CITIES

Baby Xavier ,S8CE

Forces of nature have been outsmarting the materials we use to build our infrastructure since we started producing them. Ice and snow turn major roads into rubble every year; foundations of houses crack and crumble, in spite of sturdy construction. In addition to the tons of waste produced by broken bits of concrete, each lane-mile of road costs the U.S. approximately \$24,000 per year to keep it in good repair. Engineers tackling this issue with smart materials typically enhance the function of materials by increasing the amount of carbon, but doing so makes materials lose some mechanical performance. By introducing nanoparticles into ordinary cement, Northwestern University researchers have formed a smarter, more durable and highly functional cement. With cement being the most widely consumed material globally and the cement industry accounting for 8% of human-caused greenhouse gas emissions, civil and environmental engineering professor Ange-Therese Akono turned to nano reinforced cement to look for a solution. Nanomaterials reduce the carbon footprint of cement composites, but until now, little was known about its impact on fracture behavior. The role of nanoparticles in this application has not been understood before now, so this is a major breakthrough. It can change cement production to enhance the fracture response. Traditional fracture testing, in which a series of light beams is cast onto a large block of material, involves lots of time and materials and seldom leads to the discovery of new materials.

By using an innovative method called scratch testing, Akono's lab efficiently formed predictions on the material's properties in a fraction of the time. The method tests fracture response by applying a conical probe with increasing vertical force against the surface of microscopic bits of cement. It requires less material and accelerates the discovery of new ones. The method is applied directly at the micrometer and nanometer scales, which saves a considerable amount of time. And then based on this, materials behaviour, how they crack and ultimately predict their resistance to fracture can assess. Predictions formed through scratch tests also allow engineers to make changes to materials that enhance their performance at the larger scale. Graphene nanoplatelets, a material rapidly gaining popularity in forming smart materials, were used to improve the resistance to fracture of ordinary cement. Incorporating a small amount of the nanomaterial also was shown to improve water transport properties including pore structure and water penetration resistance, with reported relative decreases of 76% and 78%, respectively. Implications of the study span many fields, including building construction, road maintenance, sensor and generator optimization and structural health monitoring. Introducing green concrete that employs lighter, higher-performing cement will reduce its overall carbon footprint by extending maintenance schedules and reducing waste. Alternately, smart materials allow cities to meet the needs of growing populations in terms of connectivity, energy and multifunctionality. Carbon-based nanomaterials including graphene nanoplatelets are already being considered in the design of smart cement-based sensors for structural health monitoring by increasing the fraction of nanomaterial that cement contains. Properties like the long-term performance is yet under consideration.

GROWING 'METALLIC WOOD' TO NEW HEIGHTS

Aishwarya Vijayan, S8 CE

Natural wood remains a ubiquitous building material because of its high strength-to-density ratio; trees are strong enough to grow hundreds of feet tall but remain light enough to float down a river after being logged. It is a type of material they've dubbed "metallic wood. Their material gets its useful properties and name from a key structural feature of its natural counterpart: porosity. As a lattice of nanoscale nickel struts, metallic wood is full of regularly spaced cell-sized pores that radically decrease its density without sacrificing the material's strength. The precise spacing of these gaps not only gives metallic wood the strength of titanium at a fraction of the weight, but unique optical properties. Because the spaces between gaps are the same size as the wavelengths of visible light, the light reflecting off of metallic wood interferes to enhance specific colors. The enhanced color changes are based on the angle that light reflects off of the surface, giving it a dazzling appearance and the potential to be used as a sensor. It is being manufactured at meaningful sizes: eliminating the inverted cracks that form as the material is grown from millions of nanoscale particles to metal films big enough to build with. Preventing these defects, which have plagued similar materials for decades, allows strips of metallic wood to be assembled in areas 20,000 times greater than they were before. When a crack forms within an everyday material, bonds between its atoms break, eventually cleaving the material apart. An inverted crack, by contrast, is an excess of atoms; in the case of metallic wood, inverted cracks consist of extra nickel that fills in the nanopores critical to its unique properties. Inverted cracks have been a problem since the first synthesis of similar materials in the late 1990s, Figuring out a simple way of eliminating them has been a long-standing hurdle in the field. These inverted cracks stem from the way that metallic wood is made. It starts as a template of nanoscale spheres, stacked on top of one another. When nickel is deposited through the template, it forms metallic wood's lattice structure around the spheres, which can then be dissolved away to leave its signature pores. However, if there are any places where the spheres' regular stacking pattern is disrupted, the nickel will fill those gaps, producing an inverted crack when the template is removed. The standard way to build these materials is to start with a nanoparticle solution and evaporate the water until the particles are dry and regularly stacked. The challenge is that the surface forces of water are so strong that they rip the particles apart and form cracks, just like cracks that form in drying sand. These cracks are very difficult to prevent in the structures we are trying to build, so developed a new strategy that allows us to self-assemble the particles while keeping the template wet. This prevents the films from cracking, but because the particles are wet, we have to lock them in place using electrostatic forces so that can fill them with metal. With larger, more consistent strips of metallic wood now possible, the researchers are particularly interested in using these materials to build better devices. New manufacturing approach allows to make porous metals that are three times stronger than previous porous metals at similar relative density and 1,000 times larger than other nanolattices, it can be used to make a number of previously impossible devices, which are already using as membranes to separate biomaterials in cancer diagnostics, protective coatings and flexible sensors.

NOTABLE BUILDINGS IN 2021

Maya krishanan, S6 CE

Hong Kong International Airport expansion-Location: Hong Kong, China



In August, Balfour Beatty announced that its joint venture, Gammon, was awarded a four-year, roughly \$1.6 billion contract to expand Terminal 2 at Hong Kong International Airport, by the Airport Authority Hong Kong. Gammon will be responsible for work on the main Terminal 2 building and construction of interconnecting bridges, mechanical and electrical works and associated roads. The expansion of Terminal 2 forms part of the three-runway system project at the airport, which, upon completion, will allow for arrivals and departures from one terminal and increase overall passenger capacity. No completion date has been announced.

Victoria Cross Tower-Location: Sydney, Australia



In July, Lendlease secured final development approval for a major transit-oriented commercial building in downtown Sydney, Australia. The 42-story tower will have room for up to 7,000 office workers inside approximately 600,000 square feet of premium office and retail space. Beneath the tower, the retail space will connect with the Sydney Metro network, making it the biggest public transport project in Australia. The metro will be incorporated heavily in the tower's design and development, according to the press release. The project is on a three-year construction timeline, beginning early this year.

Al-Zour Mega Refinery-Location: Al-Zour, Kuwait



Fluor is leading the joint venture with Daewoo Engineering and Construction and Hyundai Heavy Industries that is working to deliver two engineering, procurement, fabrication and construction packages for the highly complex Al-Zour Refinery project in Kuwait. When finished, the refinery is expected to be one of the largest in the world and process 615,000 barrels of oil per day, more e than doubling the nation’s processing capacity. The JV was awarded the contract in 2015, and the first 14 of 188 prefabricated modules for the project arrived in Kuwait in June 2018. As of September, the JV had completed and handed over many facilities to the project owner.

Red Sea International Airport Expansion\ -Location: Saudi Arabia



In December, Los Angeles-based AECOM signed with the Red Sea Development Co. to oversee work on the Red Sea International Airport Expansion project, U.K. architect Foster + Partners designed the expansion. Announced in 2017, the Red Sea Development tourism project will cover 13,100 square miles on the Red Sea coast, and include attractions like coral reefs and dormant volcanoes across an archipelago of 90 islands. TRSDC hoped to award \$2.7 billion in construction contracts by the end of 2020. Work will begin this month and is scheduled for completion in 2022, as part of plans to expand the airport by 2030.

P180 Office Building -Location: Warsaw, Poland



In Warsaw, near metro stations and bus stops, Skanska is constructing the P180 office building. When finished, the building will comprise 15 floors and offer about 344,000 square feet of leasable space. The building will be constructed in accordance with the WELL certification guidelines, which means the building will meet a number of strict criteria related to health, well-being and comfort at work, according to a release. It also will apply for LEED certification and the Building without Barriers certificate. Construction started in Q3 2020 and is scheduled for completion in Q3 2022.

AI TECHNOLOGY COULD HELP PROTECT WATER SUPPLIES

Emmanuel Jose, S6 CE

Progress on new artificial intelligence (AI) technology could make monitoring at water treatment plants cheaper and easier and help safeguard public health. Researchers at the University of Waterloo have developed AI software capable of identifying and quantifying different kinds of cyanobacteria, or blue-green algae, a threat to shut down water systems when it suddenly proliferates. This tool will arm us with a sentinel system, a more rapid indication when they are threatened. The exciting piece shown testing utilizing AI can be done quickly and well. The operational AI system uses software in combination with a microscope to inexpensively and automatically analyze water samples for algae cells in about one to two hours, including confirmation of results by a human analyst.

Current testing methods, which typically involve sending samples to labs for manual analysis by technicians, take one to two days. Some automated systems already exist as well, but they require extremely expensive equipment and supplies. The AI system would provide an early warning of problems since testing could be done much more quickly and frequently.

Moving forward, the goal is an AI system to continuously monitor water flowing through a microscope for a wide range of contaminants and microorganisms. This brings our research into a high-impact area. Helping to ensure safe water through widespread deployment of this technology would be one of the great ways to really make AI count.

The researchers estimate it may take two to three years to refine a fully commercial sample testing system for use in labs or in-house at treatment plants. The technology to provide continuous monitoring could be three to four years away. It's critical to have running water, even if have to boil it, for basic hygiene.



<https://www.google.com/search?q=AI+TECHNOLOGY+COULD+HELP+PROTECT+WATER+SUPPLIES&rlz=1>

NEW 3D PRINTABLE PHASE-CHANGING COMPOSITES CAN REGULATE TEMPERATURES INSIDE BUILDINGS

Sarin Xavier , S8 CE

Changing climate patterns have left millions of people vulnerable to weather extremes. As temperature fluctuations become more commonplace around the world, conventional power-guzzling cooling and heating systems need a more innovative, energy-efficient alternative, and in turn, lessen the burden on already struggling power grids. In a new study, researchers at Texas A&M University have created novel 3D printable phase-change material (PCM) composites that can regulate ambient temperatures inside buildings using a simpler and cost-effective manufacturing process. Furthermore, these composites can be added to building materials, like paint, or 3D printed as decorative home accents to seamlessly integrate into different indoor environments.

The ability to integrate phase-change materials into building materials using a scalable method opens opportunities to produce more passive temperature regulation in both new builds and already existing structures. Heating, ventilation and air conditioning (HVAC) systems are the most commonly used methods to regulate temperatures in residential and commercial establishments. However, these systems guzzle a lot of energy. Furthermore, they use greenhouse materials, called refrigerants, for generating cool, dry air. These ongoing issues with HVAC systems have triggered research into alternative materials and technologies that require less energy to function and can regulate temperature commensurate to HVAC systems.

One of the materials that have gained a lot of interest for temperature regulation is phase-change materials. As the name suggests, these compounds change their physical state depending on the temperature in the environment. So, when phase-change materials store heat, they convert from solid to liquid upon absorbing heat and vice versa when they release heat. Thus, unlike HVAC systems that rely solely on external power to heat and cool, these materials are passive components, requiring no external electricity to regulate temperature.

The traditional approach to manufacturing PCM building materials requires forming a separate shell around each PCM particle, like a cup to hold water, then adding these newly encased PCMs to building materials. However, finding building materials compatible with both the PCM and its shell has been a challenge. In addition, this conventional method also decreases the number of PCM particles that can be incorporated into building materials. Imagine filling a pot with eggs and water. If each egg has to be placed in an individual container to be hard-boiled, fewer eggs will fit in the pot. By removing the plastic containers, the veritable shell in our research, more eggs, or PCMs, can occupy a greater volume by packing closer together within the water/resin.

To overcome these challenges, past studies have shown that when using phase-changing paraffin wax mixed with liquid resin, the resin acts as both the shell and building material. This method locks the PCM particles inside their individual pockets, allowing them to safely undergo a phase change and manage thermal energy without leakage.

Similarly combined light-sensitive liquid resins with a phase-changing paraffin wax powder to create a new 3D printable ink composite, enhancing the production process for building materials containing PCMs and eliminating several steps, including encapsulation.

The resin/PCM mixture is soft, paste-like and malleable, making it ideal for 3D printing but not for building structures. Hence, by using a light-sensitive resin, they cured it with an ultraviolet light to solidify the 3D printable paste, making it suitable for real - world applications.

Additionally, they found that the phase-changing wax embedded within the resin was not affected by the ultraviolet light and made up 70% of the printed structure. This is a higher percentage when compared to most currently available materials being used in industry. Next, tested the thermoregulation of their phase-changing composites by 3D printing a small-scale house-shaped model and measuring the temperature inside the house when it was placed in an oven. The analysis showed that the model's temperature differed by 40% compared to outside temperatures for both heating and cooling thermal cycles when compared to models made from traditional materials.

In the future, the researchers will experiment with different phase-change materials apart from paraffin wax so that these composites can operate at broader temperature ranges and manage more thermal energy during a given cycle. It is potential of our material I to keep buildings comfortable while reducing energy consumption and can combine multiple PCMs with different melting temperatures and precisely distribute them into various areas of a single printed object to function throughout all four seasons and across the globe.



<https://www.google.com/search?q=NEW+3D+PRINTABLE+PHASE->

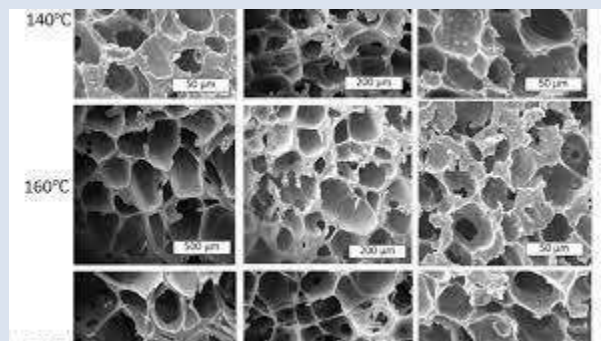
TURNING PLASTIC INTO FOAM TO COMBAT POLLUTION

Deepthi Varier, S6 CE

Biodegradable plastics are supposed to be good for the environment. But because they are specifically made to degrade quickly, they cannot be recycled. A method to turn biodegradable plastic knives, spoons, and forks into a foam that can be used as insulation in walls or in flotation devices. It was a "nonfoamable" plastic, into a chamber filled with carbon dioxide. As pressure increased, the gas dissolved into the plastic.

When suddenly released the pressure in the chamber, the carbon dioxide expanded within the plastic, creating foaming. The process is like opening a can of soda and releasing the carbonation. Tweaking temperature and pressure, there is a window where we can make good foams. It's not that every temperature or every pressure works and found what temperature or what pressure is the best to make those nonfoamable plastics into foams. Each time plastic is recycled; it loses a bit of its strength. Foams are an ideal new material, because they are not required to be strong in many applications. Whenever we recycle, each time, we degrade the plastics. Let's say we have a biodegradable spoon. We use it once, and we recycle it back into another spoon.

The ideal structure of foam depends on its final use. Bulky foams, which have large or plentiful air pockets, are good for buoys. The researchers found, contrary to what was previously thought, lower chamber pressures led to bulky foams. Making biodegradable plastics recyclable could alleviate some of the global pollution problem. While biodegradable material eventually breaks down in nature, it is even better for the environment if plastics can be repurposed. Biodegradable and recyclable plastics can be used more than once but are also less of an environmental threat if they end up in oceans or landfills. The team believes this process could be implemented on a large scale.



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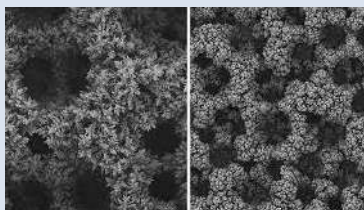
TECHNIQUE DOUBLES CONVERSION OF CO₂ TO PLASTIC COMPONENT

Ardra Shine, S8CE

Fossil fuels have long been the precursor to plastic, but new research from the University of Nebraska -Lincoln and European collaborators could help send that era up in smoke -- carbon dioxide, to be exact. Produced almost entirely from burning fossil fuels, carbon dioxide concentrations in the atmosphere have risen from 280 parts per million in the pre-industrial era to about 410 PPM today. That trend, combined with the finite supply of fossil fuels, has pushed researchers to explore methods for producing plastic from CO₂ rather than petroleum or natural gas -- recycling CO₂ just as plastic is now.

A catalyst-based technique that can double the amount of carbon dioxide converted to ethylene, an essential component of the world's most common plastic, polyethylene. The conversion of CO₂ is very important to help offset the emissions that lead to global warming and other detrimental processes in the environment. Copper has emerged as the prime candidate for catalyzing chemical reactions that convert carbon dioxide to plastic-forming polymer molecules, which it does when voltage is applied to it. But some copper-based setups have failed to convert more than about 15 percent of CO₂ into ethylene, a yield too small to meet the needs of industry. So researchers try coating copper with different polymers in the hope of increasing that efficiency. After overlaying it with a polymer called polyacrylamide, they found that their copper foam's conversion rate rose from 13 to 26 percent.

The polyacrylamide breaks up CO₂ and reassembles it into a pair of bonded C-O compounds, then stabilizes that new molecule as it drives further chemical reactions -- those ultimately producing ethylene. CO₂ is a very stubborn molecule because it has double bonds that are very difficult to break. That's the most challenging part of trying to convert it to something else. Even as researchers look to further improve that efficiency, they have an eye toward a larger goal: turning CO₂ directly into the polyethylene that makes up plastic bags, containers and films. One of the things that experimentalists want is to go from synthesizing simple molecules, like ethylene, to very complicated molecules in one batch reaction. Put in CO₂ catalysts, and end up with polymer structures that can sell in a store. But those molecules have very complicated structures.



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PLASTIC BOTTLE WASTE INTO ULTRALIGHT SUPERMATERIAL

Aleena Josey , S2

Plastic bottles are commonly made from polyethylene terephthalate (PET), which is the most recycled plastic in the world. The PET aerogels developed by the NUS-led research team using plastic bottle waste -- a world's first -- are soft, flexible, durable, extremely light and easy to handle. They also demonstrate superior thermal insulation and strong absorption capacity. These properties make them attractive for a wide range of applications, such as for heat and sound insulation in buildings, oil spill cleaning, and also as a lightweight lining for firefighter coats and carbon dioxide absorption masks that could be used during fire rescue operations and fire escape. Plastic waste is toxic and non-biodegradable. Such waste often ends up in oceans and landfills, affecting marine life and causing problems such as groundwater contamination and land scarcity. Globally, the annual consumption of plastic bottles has been rising steadily, and it is expected to exceed half a trillion tons per year by 2021.

Plastic bottle waste is one of the most common type of plastic waste and has detrimental effects on the environment. Our team has developed a simple, cost-effective and green method to convert plastic bottle waste into PET aerogels for many exciting uses. One plastic bottle can be recycled to produce an A4-sized PET aerogel sheet. The fabrication technology is also easily scalable for mass production. In this way, we can help cut down the harmful environmental damage caused by plastic waste. PET aerogels are very versatile can give them different surface treatments to customise them for different applications. For instance, when incorporated with various methyl groups, the PET aerogels can absorb large amounts of oil very quickly. Based on our experiments, they perform up to seven times better than existing commercial sorbents, and are highly suitable for oil spill cleaning.

Another novel application is to harness the heat insulation property of the PET aerogels for fire safety applications. Existing firefighter coats are bulky and they are often used with other breathing and safety equipment. This could take a toll on firefighters, especially during extended operations.

When coated with fire retardant chemicals, the novel lightweight PET aerogel demonstrates superior thermal resistance and stability. It can withstand temperatures of up to 620 degree Celsius this is seven times higher than the thermal lining used in conventional firefighter coats, but weighs only about 10 per cent of the weight of conventional thermal lining. The soft and flexible nature of the PET aerogel also provides greater comfort. By adopting PET aerogels that are coated with fire retardants as a lining material, firefighter coats can be made much lighter, safer and cheaper. It is also possible to produce low-cost heat-resistant jackets for personal use.

When coated with an amine group, the PET aerogel can quickly absorb carbon dioxide from the environment. Its absorption capacity is comparable to materials used in gas masks, which are costly and bulky. To illustrate this application, a thin layer of PET aerogel into a commercial fine particle mask to create a prototype mask that can absorb both dust particles and carbon dioxide effectively. In highly urbanised countries like Singapore, the carbon dioxide absorption masks and heat-resistant jackets made using PET aerogels can be placed alongside fire extinguishers in high-rise buildings to provide added protection to civilians when they escape from a fire.

Masks lined with amine-reinforced PET aerogels can also benefit people living in countries such as China, where air pollution and carbon emission are major concerns. Such masks can be easily produced, and can also potentially be made reusable making simple e surface modification to the PET aerogels for absorption of toxic gases such as carbon monoxide, which is the deadliest component of smoke.



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UPCYCLING PLASTIC BAGS INTO BATTERY PARTS

Nazneen Niyaz ,S2

Plastic bag pollution has become a huge environmental problem, prompting some cities and countries to heavily tax or ban the sacks. But what if used plastic bags could be made into higher-value products? Now, researchers have reported a new method to convert plastic bags into carbon chips that could be used as anodes for lithium-ion batteries.

Many plastic bags are used only once and then disposed, ending up in landfills, oceans and elsewhere in the environment, where they can take hundreds of years to decompose. Scientists have long recognized that the polyethylene in plastic bags could be an inexpensive source of energy-storing carbon. However, previous methods to upcycle polyethylene into pure carbon have been inefficient or required expensive, complex processes and develop a simpler yet efficient approach to convert plastic waste into useful carbon-containing materials. The researchers immersed polyethylene plastic bags in sulfuric acid and sealed them inside a solvothermal reactor, which heated the sample to just below polyethylene's melting temperature. This treatment caused sulfonic acid groups to be added to the polyethylene carbon-carbon backbone so that the plastic could be heated to a much higher temperature without vaporizing into hazardous gases. Then, they removed the sulfonated polyethylene from the reactor and heated it in a furnace in an inert atmosphere to produce pure carbon. The team ground the carbon into a black powder and used it to make anodes for lithium-ion batteries. The resulting batteries performed comparably to commercial batteries



<https://www.google.com/search?q=UPCYCLING+PLASTIC+BAGS+INTO+BATTERY+PARTS&tbm=isch&ved=2ahUKEwiDhvaGqPnzAhUZg0sFHaxrA68Q2>

10 OF THE LARGEST CONSTRUCTION PROJECTS IN THE WORLD

Ayesha tanha , S4 CE

Al Maktoum International Airport, Dubai

No other airport would prepare you for the scale of Dubai's Al Maktoum International Airport, which extends over more than 21 square miles. The facility is designed to handle 200 wide-body aircraft at a time. The airport's second expansion phase alone has an estimated cost of more than \$32 billion. Originally scheduled for completion in 2018, the latest expansion phase has been delayed, with no definite completion date.

Jubail II, Saudi Arabia

Jubail II is a 22-year-long industrial city project that began its second phase in 2014 with an \$11 billion expansion budget. When completed, it will comprise at least 100 industrial plants, an 800,000-cubic-meter desalination plant, miles of railways, roads and highways, and an oil refinery producing at least 350,000 barrels per day. The entire project is slated to be finished in 2024.

Dubailand, Dubai

A total of three Walt Disney Worlds can fit inside the Dubailand complex. At 278 sq.km in size, the \$64 billion Dubailand will have six parts: theme parks, sports venues, eco-tourism, health facilities, science attractions, and hotels. It will also have the world's largest hotel, with 6,500 rooms, and a 10-million-sq.ft mall. The project is scheduled for completion in 2025.

International Space Station, Space

The International Space Station (ISS) circles the earth every 92 minutes. Created by a consortium of 15 nations and five space agencies, it has a currently scheduled construction cost that exceeds \$60 billion. The eventual cost of the space station and its contemplated expansions could exceed \$1 trillion, by which point it could become a habitat for up to 1 million off-planet occupants.

South-North Water Transfer Project, China

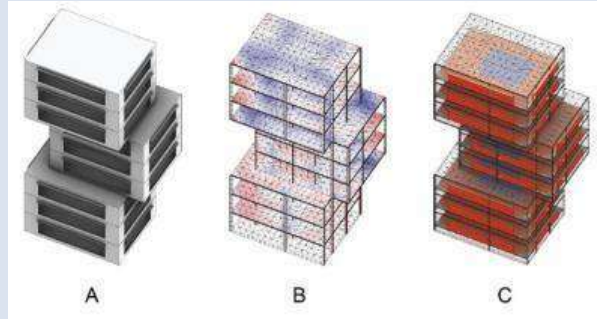
The north of China is home to almost 50 percent of China's population but has only about 20 percent of the country's water resources. To remedy this imbalance, China has funded the construction of three huge canals, each more than 600 miles long and will carry water to the north from China's three largest rivers. The project has a 48-year construction schedule. When completed, it will supply 44.8 billion cubic meters of water each year.

London Crossrail Project

The world's first underground train system continues to grow, adding 26 miles of tunnel that will eventually connect 40 stations. The estimated cost of construction is \$23 billion. The project is scheduled for completion in phases, with the first new line—the Elizabeth line—expected to go into service in 2019, followed by the remaining lines

NEW SIMULATION TOOL FOR BUILDING DESIGN

Jibi kurian, MTech II year



(A) Thermal multi-zone model. (B) Structural model: red indicates compressive and blue tensile stresses. (C) Daylighting model, combining the thermal and structural mesh models: red signifies 100% and blue 0% daylight autonomy

Designing and building are interconnected processes in civil engineering. Every project that is thoroughly designed tackles fewer issues during the construction process. However, not all parameters can be defined during the design hence, engineers handling the construction must come with solutions to certain issues that emerge. Moreover, there is a critical issue that arises in engineering projects associated with the design and construction phases. Changes and corrections can be readily adapted when the project is under design, however, once the construction initiates and progresses, an unidentified fault will probably create a situation that would be very difficult to address. In addition, the financial damage in the second case will be much higher. Apart from the construction procedures, the design process of a structure has to account for other factors. Some of them include the location of the project, the availability of raw materials, problems that can arise from climate change (possibly floods or extreme erosion in the location of interest) and others. What is certain is that when taking more and more factors into consideration during the design of a project, it is less likely to have unpredictable difficulties in construction. A new, powerful tool known as Sustainability Evaluation for Early Design (SEED) considers multiple parameters that affect the design and the initial construction stages of a building.

SEED is software that takes into consideration multiple design parameters (e.g., costs and materials, energy equilibrium, CO₂ emissions, daylighting of indoor rooms) and can create multiple design scenarios for engineers and architects. The tool provides the designers with a lot of options that can be employed during the construction process. Moreover, it aids in identifying potential issues that could emerge and that would not have been detected in time. SEED will help designers at deriving the optimum design, reduce costs, save time and create more sustainable buildings. The future goals are to improve SEED by making it more user-friendly and include more options regarding construction schedules, building design, etc. Their database will also be provided as an open-source archive.

M.TECH PROJECTS



MATERIAL PRICE FORECASTING WITH THE AID OF ARTIFICIAL NEURAL NETWORK USING MACROECONOMIC INDICATORS FOR ERNAKULAM CITY

Estimating project cost at the planning phase is vital for any construction projects to get delivered under budget and on time. Various studies illustrate that the material cost form about 63% of the total cost of the construction projects. Thus, the fluctuations in the material prices lend a huge impact on the overall cost of the project. Tracking the correlation between the economic conditions and construction cost prior to cost estimation will prove effective in this context. There are many tools that can help the construction contractors by its ability to accurately predict the future material price. Some of the methods normally used for prediction of materials prices are Artificial Neural Network, Fuzzy Logic, Statistical Method (includes regression analysis, MONTE CARLO method, ANOVA), and Trend Analysis. The type of predictors to these tools can be any factors that tend to have an impact on the prices of material. Artificial Neural Network is an operative tool and is the most advantageous among other methods that can be utilized to predict the future prices of construction materials. MATLAB software is used in the study to build the neural network. The materials under study are identified as the ones which form the majority of the construction cost i.e., cement and reinforcing steel. The inputs to the constructed neural networks are identified as macroeconomic indicators which have more impression on pricing the construction materials such as bank lending rate, steel production, consumer price index, currency exchange rates etc.

Keywords: Cost estimation; Artificial Neural Network; Macroeconomic indicators

INVESTIGATION ON CONCRETE WITH COLD BONDED LIGHTWEIGHT AGGREGATE MADE BY FLY ASH AND CEMENT

Cement concrete is a building material which consist major portion of hard inorganic materials called aggregates such as crushed stone aggregate. Due to continuous usage of natural resources within short length of time, these natural resources get depleted and there will be nothing left for future generations. Hence there is a necessity for preparing artificial aggregates making use of waste materials from industrial wastes. Artificial lightweight aggregate can be produced by nebulizing the fly ash in a pelletizer with a proportionate quantity of water, and further hardened by adopting sintering, cold bonding or autoclaving. This reduces the use of natural resources by the manufacture of artificial aggregate by pelletization process using fly ash. Replacements of natural aggregate by artificial cold bonded lightweight aggregate partially or fully shall produce the concrete having lower weight. This has an added benefit that it can reduce overall cost of construction, especially in transportation and placing etc. In this experimental study, strength and durability parameters of M40 grade concrete with cold bonded fly ash aggregate is investigated and also the optimum replacement of cold bonded lightweight aggregate (0%, 25%, 50%,75%,100%) is evaluated. From the study, it is found that the optimum percentage of replacement is 50% and the density of the same mix is reduced to 1943.70 kg/m³. From the studies, it was noted that the ALWAC have a trend in strength reduction. To compensate for the same, metakaolin is added to concrete while making the control mix. The obtained concrete can be considered for various applications like wall panels, masonry blocks, roof insulation material, structural load bearing elements etc.

Key words: Pelletization, cold bonding, light weight aggregate, fly ash aggregate, metakaolin



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Keywords: Cost estimation; Artificial Neural Network; Macroeconomic indicators

**PROPOSAL OF A MODEL TO REDUCE COST OVERRUN CAUSED BY DELAYS IN B-O-T CONSTRUCTION
PROJECTS BY RISK MANAGEMENT TECHNIQUES**

Infrastructure investments are important in developing countries as it improves the economic growth of the country. The Government of India identified public-private partnerships (PPP), which is basically an agreement or contract, as a way of developing the country's infrastructure. There are different types of PPP contracts, one among that are Build Operate Transfer or B-O-T. The BOT scheme is essentially a form of leasing, where the government (project sponsor) allows a private entrepreneur (project promoter) to design, finance, and build an infrastructure facility. BOT (Built Operate Transfer) scheme is one of the prevailing ways for infrastructure development in India to meet the need of Indian future economic growth and development. The objective of this paper is to identify study and assess the risk factors with respect to cost overruns and delays associated with B-O-T projects in India. And to propose a model to reduce the risk occurred due to cost overrun caused by delays. Risk analysis is done by risk management techniques. The methods adopted are based on descriptive scale from high to low level and also determining the probability and impacts of the risks identified based on numeric estimations.

Keywords: PPP, B-O-T, cost overrun, delays, risks, risk management techniques, construction management.



IMPACT OF DUST ON HEALTH AND SAFETY OF CONSTRUCTION WORKERS

Concrete is the world's most used construction material. Cement production releases large amount of carbon dioxide (CO₂). Various studies show that the global cement industry contributes around 6 % of total CO₂ emission. Geopolymer is a new construction material which could be produced by the chemical action between alumino-silicate material such as fly ash and alkaline solutions like sodium silicate or sodium hydroxide. Geopolymer concrete reduces the CO₂ emission by 9 % compared to the concrete made with ordinary portland cement. Fibre reinforced geopolymer concrete has already been used as a repair material for different construction purposes such as for tunnel linings and sewage pipes repairs [40] due to its improved tensile characteristics and crack control properties [28]. This study involves the experimental investigations on a fibre reinforced geopolymer concrete as a repair material for rigid pavements. A mixture of sodium silicate and 8M sodium hydroxide solution is used as the alkaline activator to prepare the fly ash based geopolymer concrete. To increase the mechanical properties at ambient temperature calcium additives in the forms of calcium hydroxide and calcium oxide are added separately by replacing fly ash in the proportion 3%, 5% and 7% by weight of fly ash. The optimum mixes were geopolymers with 5% calcium hydroxide and calcium oxide based on the fresh and hardened concrete properties. The setting time was found to be reduced by 38% for calcium hydroxide mixes and 50% reduction was shown for calcium oxide mixes from the control mix. The mixes remained in highly workable state even after the addition of 5% calcium hydroxide and calcium oxide. The compressive strength of the mixes was increased by 23% and tensile strength by 12% compared to the control mix. Further to increase the low tensile strength of GPC addition of polypropylene fibre in 0.2%, 0.4% and 0.6% by volume of concrete were also incorporated. The optimum values were determined based on the fresh concrete properties and mechanical properties. The results showed that the 7 day compressive and tensile strengths of fibre reinforced geopolymer concrete increased by 36% and 14% respectively from fly ash GPC. The bond strength between the pavement substrate and the geopolymer repair material is also studied. The bond strength of the fibre reinforced repair material is found to be more than the permissible values as per relevant codes of practice (ASTM C496-1996 and ASTM C882-1999). Abrasion resistance of the repair material is also tested to measure the durability aspects for to be used as a repair material for rigid pavements.

Keywords: Geopolymer Concrete, Alumino-Silicate, Rigid pavements, Substrate, Alkaline solution, Repair material

NUMERICAL MODELLING OF THE STRESS STRAIN BEHAVIOUR OF KUTTANAD CLAY

Soil has been used as a construction material since antiquity with both success and failure. As the earth material is widely available and relatively economical, it has been found very useful in the construction of foundations, subgrades, embankments and as backfill. The collapsibility of soil is mainly due to the decrease of shear strength and macro-deformation with the increase of moisture content. This can result in some serious problems, such as the differential settlement of the foundation, landslides, and slope instability, resulting in a series of damages of infrastructures and loss of human lives to some degree. Fine-grained soils are the most complicated engineering material. It is of great importance in civil engineering to make realistic predictions of the behaviour of soil under various conditions. Studying the effect of moisture content on the shear strength of cohesive soil during different confining pressure helps to find a relationship between them. Triaxial tests under unconsolidated undrained conditions are to be carried out. The relation of stress and strain of soils is represented by the Duncan-Chang constitutive model which can provide a brief idea about how soil will behave under different conditions.

Keywords: Shear strength, Triaxial test, Moisture content



SAFETY PERFORMANCE MANAGEMENT OF PIPELINE SLEEPER USING ANALYTICAL NETWORK PROCESS AS A MULTICRITERIA DECISION MAKING TOOL

Construction industry is one of the largest and most relevant sectors in India which contributes significantly to national development. Deplorable safety management practices are damaging the reputation of the construction sector. Due to the increasing complexity of construction projects, the construction industry is acknowledged as having inherent risks with high levels of change and uncertainty. There is a dearth of efforts that document the need for simultaneous achievement of safety and productivity on construction sites. The topic deals with safety performance management of pipeline sleeper using Analytic Network Process as a multicriteria decision making tool. The research methodology will be carried out in various phases. The preliminary phase deals with gathering background information on safety and identifying the factors to be considered for safety during the construction of sleeper from various literatures. This will help to capture key issues for developing the questionnaire in the second phase. The third phase of the research methodology focus on the prioritization of potential risks in the construction of pipeline sleeper and to study the interconnections of these hazards along with the frequency of occurrences. Frequency adjusted importance index (FAII) and Analytic Network Process (ANP) tool were jointly utilized to capture the interconnections and their frequencies based on the results from the survey distributed to construction professionals. The ranking calculation will be carried out with the help of Super Decision software. Project also measures the safety performance by calculating safety performance index and provides viable solutions for safety by developing a safe lift plan using software.

Keywords: Pipeline sleeper, ANP, FAII, super decision, safety performance index

EXPERIMENTAL INVESTIGATION ON THE EFFECT OF MINERAL ADMIXTURES IN HIGH STRENGTH CONCRETE

High strength concrete is defined as concrete with characteristic cube strength above 40 MPa. The applications of high strength concrete are bridges, aqueducts, dams, high rise buildings etc. From literatures, it is seen that the addition of mineral admixtures results in improved workability and setting time of concrete. It also increases the strength characteristics of the concrete. This work involves the comparative study of various mineral admixtures such as alccofine, metakaolin and GGBS on high strength concrete. Alccofine is a new generation micro fine concrete material which is beneficial with respect to workability as well as strength. The desirable properties of Metakaolin and GGBS make it mostly preferred additives in high strength concrete. GGBS improves the strength, durability and appearance of the concrete. In this study, cement is partially replaced with alccofine, metakaolin at 5, 10 and 15% and combination with GGBS at 20, 30 and 40% in high strength concrete. The mechanical properties like compressive strength, flexural strength and split tensile strength are evaluated and compared. The strength properties are maximum for the concret mix with combination of Alccofine and GGBS. The durability studies were done from literatures. The studies are carried out on M50 , M60 and M80 grade concrete. Rapid Chloride Permeability test and Water Permeability test are taken for review. The durability properties were found to be reduced with the addition of mineral admixtures.

Keywords: High strength Concrete, GGBS, Alccofine, Metakaolin



STABILIZATION OF CLAY USING PET PLASTIC BOTTLE STRIPS

Kuttanad clay is expansive clay in which any type of construction is very difficult as the expansive clay is poor in drainage and weak in strength. Therefore, it requires an efficient stabilization method to improve its load bearing capacity. With rapid advancements in technology globally, the use of plastics such as polyethylene bags and bottles are also increasing. The disposal of thrown away wastes pose a serious challenge since most of the plastic wastes are non-biodegradable and unfit for incineration as they emit harmful gases. There are several studies which suggests that PET bottle strips can improve the engineering properties of weak expansive clays by controlled compaction. This study explains the stabilization of expansive clay through the application of PET (Polyethylene Terephthalate) bottle strips. PET bottle strips of sizes 15mm x 4mm are added in different percentages (0.2%, 0.3% & 0.4%) to the expansive clay and then Standard Proctor Compaction Test (SPCT), & Unconfined Compressive Strength (UCC) are conducted to evaluate the strength characteristics. Based on the UCC test results, 0.3% was obtained as the optimum percentage of PET bottle strips in Kuttanad Clay. The maximum unconfined compressive strength obtained was 51.58 kN/m² when the expansive clay was replaced with 0.3% of PET bottle strips. The results show that PET plastic bottle strips have a great effect on the strength properties of the expansive clay. Performance comparison of different additives in clay such as palm fiber, glass fiber, polyethylene, sisal fiber, jute fiber, terassil, biopolymers (xanthan gum & guar gum), fly ash, cement, and lime were also carried out in this study. From the performance, it may be concluded that fibers can be more cost effective for the stabilization of clay.

Keywords: PET bottle strips, Expansive clay, Stabilization, UCC, SPCT

EXPERIMENTAL INVESTIGATION ON STABILIZATION OF KUTTANAD CLAY USING GGBS BASED GEOPOLYMER

In order to confront the problems associated with clay for construction, some adequate ground improvement technique is essential. Ground-granulated blast furnace slag is highly cementitious and high in CSH (calcium silicate hydrate), which is a compound that improves strength. Geopolymer is an alternative cementitious material synthesized by combining source material that are rich in silica and alumina such as fly ash, GGBS, with strong alkali solution such as sodium hydroxide(NaOH) and potassium hydroxide(KOH). In many civil engineering constructions, soft and weak soils are often stabilized with Ordinary Portland cement (OPC) and lime. The production processes of traditional stabilizers are energy intensive and emit a large quantity of CO₂. Geopolymer offer a better alternative to OPC, with its high strength, low cost, low energy consumption and CO₂ emissions during synthesis. Due to the major environmental impacts involved in the manufacturing of OPC, the use of industrial by-products has been encouraged. The reason for the increase in compressive strength is due to the high calcium content in GGBS. Stabilization is carried out with GGBS and alkaline activator consisting of sodium silicate and sodium hydroxide of different molarities (8, 12, 16 M). The ratio of sodium silicate to sodium hydroxide considered in this study is 2.5. The different mixes are prepared by replacing the soil with 10%, 20%, and 30% of GGBS and 1%, 2% and 3% of alkali solution. These polymers are cheaper as compared to many chemical alternatives. They are more effective and significantly less damaging to the environment. In this experimental study the Compaction test and Unconfined Compressive Strength (UCS) test of the alkali activated soil were conducted. The California Bearing Ratio (CBR) values of the soil were predicted from literatures. The characteristics of the soil improved for the combination of 20% GGBS and 2% alkali solution.

Keywords: Alkali activation, Geopolymer, GGBS, clay, stabilization



PROPOSAL OF CONSTRUCTION MATERIAL FLOW INDEX FOR MULTI-STOREY RESIDENTIAL BUILDINGS

Construction materials are the largest flows which approach the sites after water. Administration and movement of these supplies are the challenges experienced on sites nowadays due to the scarcity of materials, delays in terms of availability, inefficient transport facilities, damage and waste and limited space for storage. Effective flow of material is very critical for maintaining a productive and cost efficient location. Poor disposal and haulage during site operations is an important issue that jeopardizes the efficiency of construction projects. Unsatisfactory handling, storage and management of materials on work sites will seriously hinder the performance of the project. In construction site, a new approach is therefore required to analyze the flow of materials. The project deals with the identification of optimum material flow factors identified from literature review and analyzed for index generation by developing formula for index. This includes measures of material movement, its consumption and excess disposal of waste. The proposed construction flow index (CFI) is a composite indicator that illustrates the repetitive construction project efficiency of the output flow. The CFI is a powerful instrument for assessing the efficiency and effectiveness of construction projects and monitoring the movement of supplies. An index is generated for the quantitative analysis of the material flow at work sites in this project

.Keywords: material flow, CFI, construction projects, material management

EXPERIMENTAL INVESTIGATION ON FLYASH BASED SELF-COMPACTING CONCRETE WITH METAKAOLIN AND RECYCLED COARSE AGGREGATE

Self-Compacting Concrete (SCC) is a fresh concrete which is highly flowable, and it can flow readily into place, fill the formwork without any compaction and without undergoing any significant segregation. It is used in the construction where it is hard to use vibrators for consolidation of concrete. High amount of cement and chemical admixtures used in SCC reduces its wide scale usage. Metakaolin can be used as a better substitute to cement due to its cementitious properties. Metakaolin combines with $\text{Ca}(\text{OH})_2$ produces additional cementation compounds and makes concrete strengthen. Now-a-days there is scarcity of Natural Coarse Aggregates (NCA) in various zones of the world. Recycled Coarse Aggregate (RCA) are a good alternative to natural coarse aggregate in concrete considering its environmental and economical benefit apart from reducing load on natural resources in construction industry. Over the last decades, large amount of experimental works has been carried out to investigate the material properties of recycled coarse aggregates; the compressive strength of RCA was reportedly decreased. So, the present study focuses on the fresh and hardened properties of Flyash based SCC designed by partially replacing NCA with RCA at 20%, 40% & 60% and cement is partially replaced with metakaolin by an amount of 10%, 15% & 20%. The combination of metakaolin and RCA can improve the fresh properties as well as strength parameters in flyash based SCC. Therefore, it is feasible to produce a sustainable concrete and thereby, we can reduce the environmental impact.

Keywords: Self - Compacting Concrete, Recycled Coarse Aggregate, Metakaolin



EVALUATION OF MODULUS OF ELASTICITY OF PLASTIC AGGREGATE CONCRETE

Modulus of elasticity of a material is defined by the ratio of the applied stress to the corresponding strain within the elastic limit. It is also known as elastic modulus or the coefficient of elasticity. Physically it indicates a material's resistance to being deformed when a stress is applied to it. Modulus of Elasticity of Concrete can be defined as the slope of the line drawn from stress of zero to a compressive stress of $0.45f_{ck}$. The value of elastic modulus of a concrete can be calculated using some empirical formulae provided by different codes to obtain the elastic modulus of concrete. These formulae are based on the relationship between modulus of elasticity and concrete compressive strength. As concrete is a heterogeneous material, the strength of concrete depends on the relative proportion and modulus of elasticity of the aggregate. The codes are providing formulae for finding the elastic modulus of normal concrete with conventional aggregates. Nowadays a lot of experimental studies are being carried out to make concrete economical with replacements or addition of alternative materials in concrete. The applicability of these empirical formulae for such concretes is not clear. So, it is important to evaluate the elastic modulus of different types of concrete. In this experimental study, the modulus of elasticity of plastic aggregate concrete is evaluated. Plastic aggregate concrete refers to the concrete mixed with Polyethylene Terephthalate (PET) bottle waste or in various proportions. PET bottle waste is used as partial replacement for aggregates.

Keywords: Modulus of elasticity, plastic aggregate concrete, compressive strength, PET bottle Waste

EXPERIMENTAL INVESTIGATION ON PERVIOUS CONCRETE WITH METAKAOLIN AND RECYCLED AGGREGATES

Pervious concrete is a type of lightweight porous concrete with no fine or with small percentage of fine aggregate. It is generally used for flatwork applications that allow water from precipitation and other sources to pass directly through, thereby reducing the runoff from a site and allowing ground water recharge. Large scale of cement production causes the discharge of high amount of carbon dioxide resulting in global warming. This can be reduced by the use of metakaolin, as a partial replacement for cement contributing to long term strength. The acute shortage and high price of natural coarse aggregate led to the enormous increase in construction cost. Use of recycled coarse aggregate as a natural coarse aggregate is a good alternative to natural coarse aggregate and a better remedy to the disposal of recycled coarse aggregate. Recycled concrete aggregates are fragments and pieces of concrete buildings which are demolished or rebuilt. The incorporation of metakaolin helps in increasing the strength properties and the utilization of recycled coarse aggregates from construction wastes reduces the amount of virgin aggregates to be created, hence less evacuation of natural resources. In this project an attempt is made to experimentally investigate the mechanical and hydraulic properties of pervious concrete with different levels of metakaolin and recycled coarse aggregates. Metakaolin were incorporated in pervious concrete by replacing cement at 5%, 10% and 15% by weight of cement. Recycled coarse aggregates were incorporated in pervious concrete by replacing natural aggregate at the levels of 20%, 40% and 60%, by weight of natural coarse aggregates and are compared with M 15 equivalent pervious concrete having a porosity of 20-25%. The strength parameters increased and hydraulic properties decreased as the percentage of MK increased. Also the strength parameters showed a decreasing trend as the recycled coarse aggregate increased while the hydraulic properties increased.

Keywords: Pervious concrete recycled coarse aggregates, metakaolin.



EXPERIMENTAL INVESTIGATION ON GEOPOLYMER PAVER BLOCK USING CERAMIC TILE WASTE AS PARTIAL REPLACEMENT OF COARSE AGGREGATE

Paver blocks are used in many areas like street roads and for other construction works. Due to rapid infrastructure development the use of cement is increasing. Cement emits large amount of carbon dioxide (CO₂) and this leads to global warming. Today researches on waste management lead to an eco-friendly product called geopolymer mortar and concrete. To support the development of pavement construction, a new approach to predict the performance of the geopolymer paver block (GPB) has been proposed. A huge quantity of ceramic waste is generated during processing, transportation and handling. To reduce this waste disposal, ceramic waste can be used as an alternative material to natural coarse aggregate. Fly ash and Ground Granulated Blast -furnace Slag (GGBS) are activated using alkaline solution such as sodium silicate and sodium hydroxide to get cementitious binder. There are various papers and research works based on cement and natural coarse aggregate replaced by various percentages of other industrial waste material and it is found that there is increase in strength, durability and reduction in cost and utilization of waste material. Various waste materials can be used for improving strength of paver blocks. The primary objective of this project is to understand the properties as well as economical and environmental benefits of GPB using ceramic tile waste corresponding to M40 grade (16M). From the mix designed, flyash was replaced with GGBS in the percentages of 25%, 50% and 75% in GPC. 75% fly ash replaced with GGBS shows maximum strength. The natural coarse aggregate was replaced with crushed ceramic tile in the percentages of 10%, 20%, 30% and 40% in fly ash and GGBS based GPB. The compressive and flexural strength values were higher for 30% ceramic tile replacement, 56.9 N/mm² and 21.8 N/mm² respectively for 28 days, and all blocks met the standard requirement of 40 MPa for medium traffic at a curing age of 28 days. Water absorption values are within the limit. These results show that it is possible to replace 75% of flyash with GGBS and 30% of natural coarse aggregate with ceramic tile wastes and produce paving blocks suitable in medium vehicle traffic areas. Thus, this research demonstrates that the use of ceramic tile waste as a component of GPB manufacturing is technically feasible.

Key Words: Geopolymer Paver Block, Fly Ash, GGBS, Cementitious binder, Alkaline solution, Ceramic tile waste.



B.TECH PROJECTS



PLANNING, ANALYSIS AND DESIGN OF RETIREMENT HOMES AND COMMUNITY KITCHEN.

This project discusses Planning, Analysis and design of Retirement homes and community kitchen. This construction is going to be carried out in Ezhattumugham in Ayyampuzha Panchayath of Ernakulam district. We are designing the retirement homes, community kitchen and space for agriculture and aquaculture, sewage, rainwater harvesting and water storage. This kind of community living ensures that there is neither loneliness nor alienation, and therefore better mental health. This study is also able to indicate several critical factors in the analysis for improvement of the retirement homes design in the future. The critical factors considered in the design of retirement homes can be divided into Resort requirements and Regional style. The Regional style comprises important considerations for adequate ventilation for cooling and reduction of humidity using low thermal building materials, avoiding direct sunlight and glare, protection against rain, and the site's location with natural vegetation's to provide cooler micro climate. Based on these considerations this project finds importance in the proposed area. The Retirement homes are planned as per Kerala Panchayath Building Rules (2019), Harmonized Guidelines and Space Standards for Barrier (2016) and Model Building Bye Laws (2016) rules. Analysis and design of all structural members is carried out using ETABS software. Through this project we aim to familiarize with the software's used for drafting and designing in civil engineering, namely: Auto CAD, Revit, ETABS etc. and to understand different stages of a civil engineering project like Site Investigation, Surveying, Planning, Designing and Estimation. Site planning in landscape architecture and architecture refers to the organizational stage of the landscape design process. It involves the organization of land use zoning, access, circulation, privacy, security, shelter, land drainage, and other factors.

KEYWORDS: Analysis, design, AutoCAD, ETABS, 3D birds view

SHORT TERM IMPROVEMENT METHODS ON BLACK SPOT

A crash black spot is a term used in road safety management to denote a place where road traffic accidents have historically been concentrated. It may have occurred for a variety of reasons, such as a sharp corner in a straight road, a hidden junction on a fast road, poor or concealed warning signs at cross-roads. Black Spot Management (BSM), which is a reactive approach within the discipline of traffic safety, involves scientific analysis of accident data, identifying the nature and cause of accidents and designing appropriate engineering interventions leading to prevention of such road accidents in future. Identification, analysis and treatment of these black spots are widely regarded as one of the most effective approaches in preventing road crashes. In this study black spots are identified and prioritized based on available crash data of the years 2016-2018. Geometric analysis and road safety inspection is carried out to analyze the factors influencing road safety. Based on this analysis, short term improvement methods on selected stretches have been proposed. Short term improvement measures give an immediate impact on road safety with less effort and less economy. Remedial measures can include better signs, road markings, pedestrian facilities, fencing, guard rails, junction modifications, and improvements to visibility. Traffic calming through various speed reduction measures has proven particularly effective where vulnerable road users are at risk.

Keywords: Crash black spot, local hazardous, remedial measures



DESIGN OF WATER SUPPLY SYSTEM FROM SOOLAM QUARRY TO MARADY GRAMA PANCHAYATH USING QGIS AND EPANET

Water scarcity is a crucial problem in 13th ward of Marady Grama Panchayath in Ernakulam district. This hilly area of 150 hectare is populated with around 200 families. In this area half of the families does not have its own wells and ponds for proper irrigation and for other purposes they are depended on water authority pipeline connection and this become a huge problem in summer season due to unavailability of water. Haritha Keralam Jala Sangamam lift irrigation Project in Marady Grama Panchayath has been proposed as the 31st project of the Haritha keralam focus group in Ernakulam district. The projects consist of lifting of water from Soolam quarry to virippukandom and Kandanchira. The cost of the project is around 98 lakhs. This project aims to reduce the water scarcity of that area to 50% compared to the previous summer of that area. A pumping station is to be constructed very close to Soolam quarry which pump water to the water tank which is to be situated in Anchirippu Thandumala which is the highest place of 13th ward of Marady Grama Panchayath. The Soolam reservoir connected to storage tank which is to be situated in Anchirippu Thandumala which is the highest place of 13th ward of Marady Grama Panchayath with inlet conveyance system. The water pumped through the inlet conveyance system using pump. The project consists of designing the pump and water distribution system using QGIS and EPANET. The water that reaches the storage tank from quarry should require purification to kill the microbial bacteria present in them. It can be done by chlorination. The project is designed in such a way that it satisfies domestic demand and the irrigation demand can be considered separately.

Keywords: Haritha Keralam Jala Sangamam lift irrigation Project, Marady Grama Panchayath, Haritha keralam focus group, Soolam quarry, virippukandom, Kandanchira, QGIS, EPANET.

BUILDING INFORMATION MODELING (BIM) TO IMPROVE SAFETY AT CONSTRUCTION SITES

Construction site safety is an important aspect in a construction industry. Fatalities and injuries occur on construction site every day. The risk of fatality or injury at work in construction sector is significantly greater than in other industries. The application of BIM in construction is growing rapidly. It explores the use of BIM-based modeling and 4D simulation as a central technology for construction site safety. This study is to create a safety environment in the construction site by incorporating BIM with time dimension and BIM 360 cloud based system. The utilization of BIM and visualization tools can enhance site safety performance by allowing design team members to visually assess work environment situations and detect hazardous situations. A questionnaire survey is conducted to identify the safety risks at construction site. Then, by the application of BIM (Building Information Modeling) to Construction Safety Management, the onsite safety risks and hazards can be resolved. Construction site hazards are then eliminated with appropriate measures at planning stage of the project. Also provides Cloud connected system for ensuring construction safety at sites using BIM 360-Cloud based safety management. In conclusion, the health and safety in a construction site is increased by the application of BIM by including time dimension at the planning stage. It also attempts to prevent accidents before happening to decrease rate of fatalities and injuries in the construction sector.

Keywords: construction industry, site safety, building information modeling (BIM), risks.



INVESTIGATION OF CORROSION BEHAVIOR OF STEEL IN REINFORCED CONCRETE WITH SUPPLEMENTARY CEMENTITIOUS MATERIALS

Cement concrete is the most widely used material for various constructions. Properly designed and prepared concrete results in good strength and durability properties. The corrosion behavior of steel in reinforced concrete with supplementary cementitious materials were investigated. Supplementary cementitious materials like fly ash, GGBS, metakaolin and silica fume are often used to reduce cement contents and improve the workability of fresh concrete and enhance the strength and durability properties of hardened concrete. In this project the compressive strength characteristics of M35 concrete is evaluated with varying percentages of silica fume (5%, 10%, 15%) and metakaolin (10%, 15%, 20%) separately as partial replacement of cement. The optimum percentage replacement for silica fume and metakaolin was obtained as 5% and 10% respectively. Supplementary cementitious material have particle size less than that of cement it fills the pore space and helps in pore refinement, as a result more denser and impermeable concrete is obtained. There by due to reduction in permeability concrete act as a barrier between steel and reduces corrosion. Various accelerated corrosion methods are used to reduce the time period of testing. Theoretical study was conducted for the corrosion behavior of steel in concrete with SCMs. Investigated the effect of silica fume, metakaolin, fly ash and GGBS on the corrosion of steel in reinforced concrete.

Keyword: SCMs, compressive strength, corrosion, accelerated corrosion.

DESIGN OF AN AQUEDUCT FOR A CANAL IRRIGATION SYSTEM

Canal is an artificial channel constructed to carry water to fields from source. An aqueduct is just like a bridge in which a canal is carried over a natural drain. As part of development in Irrigation Works, Kerala Government has launched several projects for equitable distribution of water among the stakeholders and for its efficient use in farms. Muvattupuzha Valley Irrigation Project (MVIP) was launched by Kerala Government in 1974 with estimated cost of Rs 20.86 crore. Under MVIP scheme, an irrigation canal was constructed in Peruva. As per the actual hydraulic particulars of this area, an aqueduct was to be constructed here. But in order to minimize the cost of construction of an aqueduct, a filling canal was constructed here to equalize cutting and filling quantity, sand was filled in the valley portion and to retain this sand a retaining wall was constructed. But later, due to percolation of water sand got washed off and the retaining wall was destroyed in an area of about 50 meters. In order to restore the lost waterways an aqueduct was to be constructed and our project aims at the design of this aqueduct. Design of transitions, slab, beam, pier and abutment are carried out in this project. Auto CAD and STAAD software are used for the completion of this work.

Keywords: Muvattupuzha Valley Irrigation Project, Hydraulic particulars, Aqueduct, Filling canal, Auto CAD, STAAD etc.



EXPERIMENTAL STUDY ON PERFORMANCE OF RUBBER LATEX MODIFIED COIR ON MARINE CLAY

Soil stabilization has become a major issue in construction engineering and the studies regarding the effectiveness of soil stabilization using natural wastes are rapidly increasing. Soil reinforcement by rubber latex and coir fiber could be an effective soil stabilization method because of its cost effectiveness and easy adaptability. Clayey soil which are also called swell-shrink soil have tendency to shrink and swell with variation in moisture content. This type of soil is not suitable for construction due to their undesirable characteristics. Therefore, soil stabilization is done to improve the properties of soil. In this study, the marine clay is mixed with rubber latex modified coir at 0,1,2,3 % by weight of marine clay. The coir of length 3cm is treated with colloidal form of rubber latex which increases the strength of the soil. The preliminary tests conducted are particle size analysis, pycnometer method for specific gravity and Atterberg's limit. Other tests conducted are Standard compaction, Unconfined Compression test (UCC) and Consolidation. The compaction curve obtained from standard compaction is used for calculating optimum moisture content and maximum dry density of marine clay. Also, the shear parameters are evaluated by performing UCC test. The performance of rubber latex modified coir on improving the engineering properties of marine clay at 0% & 1% values were evaluated from the experimental results and at 2% & 3% values were predicted using comparative method of analysis. From experimental and predicted values, optimum percentage is 2%.

Keywords: Rubber latex, marine clay, coir fiber, UCC

PROPOSAL OF COST PREDICTION MODEL FOR CANAL REVAMPING USING ARTIFICIAL INTELLIGENCE

In modern construction, it is crucial to develop a reliable parametric cost prediction model in spite the existing tech. Existing methods like statically and probabilistic methods for cost prediction is really unreliable as they provide with inaccurate results and inconsistent result prediction. The aim of the project is to generate a cost prediction model for canal revamping using Artificial Intelligence. An artificial intelligence system can be developed to produce consequent outputs and actions depending on the observed inputs and outputs of the system. Artificial intelligence (AI) and machine learning (ML) algorithms include numerous models and algorithms for supervised regression applications. Machine learning and artificial intelligence (AI) needs sufficient dataset size to model and predict the cost and duration of canal revamping. In this project data were collected, it is analyzed and model is generated which is then verified with the help of case studies. AI techniques are aspects of human knowledge and computational adaptively to become more vital in system modelling than classical mathematical modelling.

Keywords: Artificial Intelligence, Machine Learning, Conceptual cost, and Parametric cost Model





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