



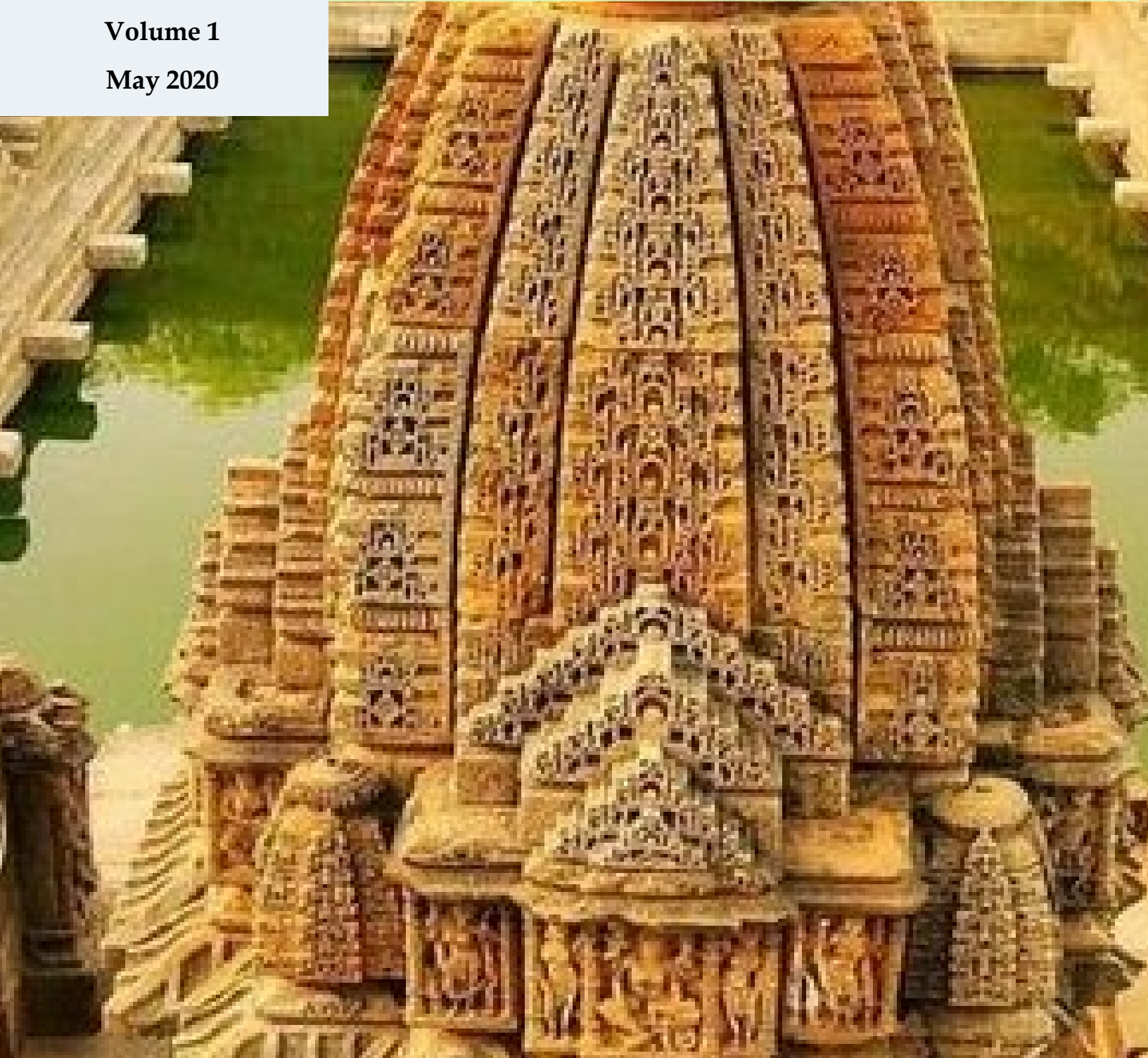
NIRMAAN

TO BUILD A SUSTAINABLE INFRASTRUCTURE

Department Magazine

Volume 1

May 2020



Vidya Pratishthan's Kamalnayan Bajaj Institute of Engineering and Technology, Baramati

Department of Civil Engineering

About the Institute

VPKBIET has student-centered institutional development as a motto. We are committed to pursue academic excellence to develop a student with comprehensive technical knowledge and integrated personality. We prepare students to think globally, act locally, involve individually and systemize institutionally to meet emerging industrial and social needs. The Institute is consistently among the top 5 colleges of Savitribai Phule Pune University examination results. The excellent infrastructure, friendly, clean environment, well-equipped modern laboratories and dedicated faculty and staff have also helped to achieve these results. Our system is clean and transparent for any student to judge his own performance and be satisfied. The open access system in Library enables the student to choose and then select the books the needs to study. The student does not require to spend much more time for issuing and returning the books. We provide accommodation to 80% of our students. Our efforts to put the student and VPKBIET on Global map continue with more vigor and enthusiasm.

Institute Vision/Mission

Institute Vision

To achieve Academic Excellence through Persistent and Synergic Collaborations amongst all Stakeholders.

Institute Mission

- ⇒ To ensure holistic development of students as lifelong learners and problem solvers through value-based quality education.
- ⇒ To motivate faculty to attain the state-of-the-art knowledge and wisdom in their domain and be a facilitator towards cocreation of knowledge.
- ⇒ To frame and deploy conducive and empowering policies for multifaceted growth of students, faculty and staff to make them contributors towards excellence.
- ⇒ To partner with industry for mutually beneficial relations to generate employable and deployable workforce.
- ⇒ To fulfil the aspirations of alumni, parents, society, region and nation at large by generating technically competent and contributing manpower.

About the Department



The Department offers one undergraduate and one post-graduate courses leading to bachelor and master degrees in civil and structural engineering respectively. The department is enriched with combination of young and experience faculties with expertise in academics and research in the domain of civil engineering. The faculties strive hard to create the thrust in the students to take active participation, both in academics and research. With the inclusion of doctoral faculties from various IIT's and NIT's and foreign universities. The department has extended the new horizons to students, which provides quality education and success in their profession.

Department Vision/Mission

Department Vision

Achieving competency in Civil Engineering for building sustainable infrastructure to enhance quality of life.

Department Mission

- ⇒ To impart knowledge of Civil Engineering for development of professional skills.
- ⇒ To encourage faculties for upgrading knowledge with practical approach to solve emerging problems in Civil Engineering.
- ⇒ To provide adequate infrastructure and conducive environment for overall development of student, faculty and staff.
- ⇒ To develop entrepreneurship skills in students.
- ⇒ To develop technically competent graduates for solving real life problems.

Program Education Objectives (PEO's)

1. Serve industry, government or other organizations by applying engineering and allied fundamental knowledge.
2. Analyze and design Civil engineering systems with social awareness and responsibilities.
3. Exhibit continuous learning professionally and ethically with good leadership.

Program Specific Outcomes (PSO's)

PSO1: An ability to solve civil engineering problems by applying knowledge of domain area

PSO2: Support the society with solutions to various civil engineering problems focusing on sustainable development and upholding professional ethics.

PSO3: To enhance the entrepreneurship skills of students by making them aware about challenges and emerging needs of our society.

About the Magazine

Aim

To provide a common platform to all our stakeholders viz. students, faculties, alumni's etc. to motivate them and express their views regarding recent trends, Innovations and technologies.

To keep students updated with latest practices which are used in industries/technical world through the articles provided by industrial experts.

Scope:

The articles provided in the magazine are opinions and understanding of the writers (Departments faculties, students, industry experts and alumni's) in the respective areas of their interest, expertise, etc. "Nirman" Magazine provides a platform to showcase writers' views.

Principal's Message



Dr. R. S. Bichkar
Principal,
VPKBIET, Baramati.

I am pleased to hear that, Department of Civil Engineering is publishing volume 1 Department magazine “NIRMAAN”. The result of high intention, sincere efforts, and intelligent execution, always leads to excellence with choices not chances.

The articles composed with these magazines will sow the seeds of ideas, germinate to the fullest extent possible, and this will lead to the success story. In the era of cut-through competition, the molding of tomorrow's technocrats happens to be all-round engineers, not only Civil Engineers.

I am sure, the task force of Civil Engineering Department has taken lead, to one of the best examples of not only the land of ideas but also the forest of excellent products.

HoD's Message



Dr. G. N. Narule

Head of Department,
Civil Engineering

It is matter of pride that the department of Civil Engineering is releasing technical magazine, named “NIRMAAN” volume 1, May 2020 for the academic year 2019-20. I congratulate chief editor and the team of editors for their success in bringing out the first issue of the magazine. “NIRMAAN” is creating new platform for students, Alumni and faculties to showcase their updated knowledge in different fields. A commendable job is done by faculty advisor to make it possible. Last but not the least, I convey my wishes to all students and faculty members who contributed directly or Indirectly for covering this idea in to reality.



Faculty Achievement



**Dr. Chittaranjan Nayak successfully completed
Ph.D. in Civil Engineering from Savitribai Phule
Pune University.**

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Overview on steel-concrete composite construction



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Construction materials of different properties are combined to interact and respond against loads in synchronization rather than individually. These composite materials are physically connected to utilize their distinct strengths and features to form a single unit stronger than any separate parts. Composite construction is meant to achieve efficient and lightweight structural solutions for construction and other related industries.

The basic concept of composite construction is:

Concrete: Strong in Compression and very weak in Tension.

Steel: Strong in Tension and weak in Compression due to overall buckling of the gross section or local buckling of individual elements of a section.

Composite construction ensures a proper combination between the above two materials to ensure enhanced strength, efficient & lightweight

- **Effective utilization of their best properties**
- **More economical solution to a construction process.**

Composite Construction in the Developed Countries

This concept is already in use western countries as steel and concrete composite structures are a structurally efficient, fast-to-erect.

- Design of composite beams and composite slabs for buildings are covered by BS EN 1994-1-1.
- Design of composite steel and concrete structures are covered by BS EN 1990/1999 Eurocode 4
- Design of Composite Steel and Concrete Structures are covered by BS EN 1990-1999 Euro code 4.

- Australian Bridge Design Code, Section 6: Steel and composite construction.
- BS 5400 British Standard code of practice for the design and construction of steel, concrete and composite bridges.
- ASHTO: Standard Specifications for Highway Bridges; 24 CFR 200 Sub-parts S.
- Concrete Slab Stresses in Partial Composite Beams and Girders, American Institute of Steel Construction, Vol. 21

Composite Construction – Indian Scenario

Codes for Composite Construction

For General Construction in Steel: IS: 11384

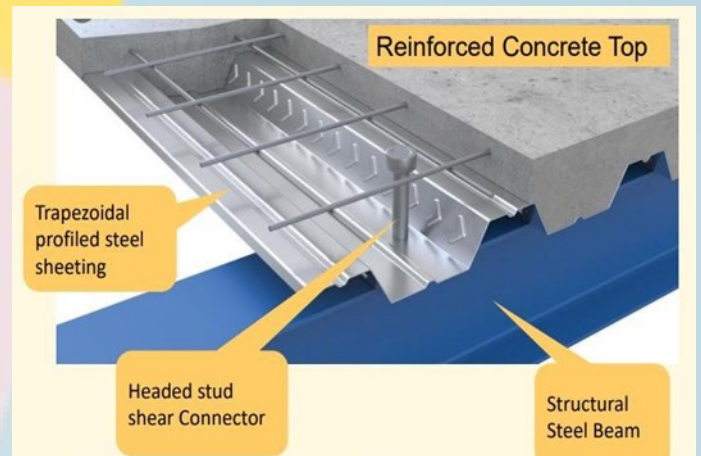
- IS: 11384 -1985 version dealt with design of composite beams only
- Code adopts Limit State Method of Design.
- INSDAG under the CED: 38 committee of BIS has been in the premier role in drafting the code.
- New reviewed IS: 11384 -2022 version include composite columns, composite slabs along with adoption of modern research results for composite beams.

Advantages- Composite Beam

- Effective utilisation of steel and concrete
- Economic steel section for same span & loading
- Enhanced head-room due to less Depth of Beam
- Lesser deflection due to larger Stiffness
- Greater stiffness of composite beams as compression flange, which is vulnerable to bending Compression, gets restrained.
- Large column free space achieved by efficient arrangement
- “Fast-Track” construction, by using pre-fabricated components in place of in situ concrete.
- Improved fire resistance and corrosion using encased steel beam sections.

Application Areas

- Extensive use in bridges,
- Multi-storey buildings- Mainly Non – Residential
- Many buildings with this technology has been built in Delhi, Kolkata and Mumbai, Bangalore Also has been in practice for quite a while in the ROB's and Flyovers in the Urban Sector.
- Recently used in many flyovers in Delhi and Kolkata.
- Walkways in metro Stations v elevated car park
- Warehouses,
- Marine structures
- Order of the day in steel based construction in the building sector.



Configuration of a Composite Floor

Issues, challenges and opportunities with rise in urbanisation in India.



Prof. Dilip G. Patil,
Assistant Professor, Civil Engg,
VPKBIET Baramati

Urbanization is the movement of people from the countryside or rural areas to more developed urban areas like towns and cities. This has led to rapid growth in these areas. The movements are usually motivated by the belief that urban areas have more to offer in terms of growth, job opportunities, and development than rural areas. Urbanization primarily stems from the industrial revolution as it played a big part in bringing people from rural areas to the developing industrial urban areas, which had factory jobs that rendered agricultural jobs less popular. In modern times, urbanization is taking place on a large global scale as most of the development projects tend to focus more on towns and cities.

This is also evident in both developing and developed countries, as governments and municipalities allocate urban areas more resources than rural areas, which encourages urbanization. Currently, half of the total population of the world lives in urban areas, a trend that is definitely going to continue for years to come. Despite urbanization creating opportunities for people who take the leap to look for greener pastures in urban areas, it is often faced with a lot of challenges.

Urbanization is now becoming a global phenomenon, but its ramifications are more pronounced in developing countries. High rate of population growth, declining opportunities in rural areas and shift from stagnant and low paying agriculture sector to more paying urban occupations, largely contribute to urbanization. The unexpected immigration has also caused the burgeoning of slums and the growth of squatters and informal housing all around the rapidly expanding cities of the developing world.

Some of the major problems of urbanisation in India are 1. Urban Sprawl 2. Overcrowding 3. Shortage of good quality affordable Housing 4. Slums and Squatter Settlements 5. Transporting issues wrt traffic jam, inadequate space for parking of vehicles, prolonged travel time 7. Scarcity of enough good drinking Water 8. Sewerage Problems and water pollution 9. Trash Disposal 10. Urban Crimes 11. Problem of air Pollution 12. Urban flooding 13. Pandemic diseases.

In many cities the rapid population growth has overwhelmed the capacity of municipal authorities to provide even basic services. Urbanization directly contributes to waste generation, and unscientific waste handling causes health hazards and urban environment degradation.

Solid Waste Management which is already a mammoth task in India is going to be more complicated with the increase in urbanization, changing lifestyles and increase in consumerism. Financial constraints, institutional weaknesses, improper choice of technology and public apathy towards Municipal Solid Waste (MSW) have made this situation worse. The current practices of the uncontrolled dumping of waste on the outskirts of towns/cities have created a serious environmental and public health problem.

Urbanization and industrialization make a lot of people move to urban areas, but they do not prepare them for the conditions they are likely to face when they arrive there. Urban areas tend to have a high cost of living. The housing problems fuel this even more, as all the people who move to urban areas cannot be adequately accommodated. This leads to the advent and growth of slums as safe havens for those who cannot afford the high costs of rent or lack substantial money to purchase apartments or build homes in urban areas. The slums arise from the construction of houses on under-developed or undervalued land due to how scarce and expensive apartments or land is in urban areas.



Fig. Solid waste accumulated near road side

Urban flooding is significantly different from rural flooding as urbanization leads to developed catchments, which increases the flood peaks from 1.8 to 8 times and flood volumes by up to 6 times. Consequently, flooding occurs very quickly due to faster flow times (in a matter of minutes). Urban areas are densely populated and people living in vulnerable areas suffer due to flooding, sometimes resulting in loss of life. It is not only the event of flooding but the secondary effect of exposure to infection also has its toll in terms of human suffering, loss of livelihood and, in extreme cases, loss of life.

Urban areas are also centres of economic activities with vital infrastructure which needs to be protected 24x7. In most of the cities, damage to vital infrastructure has a bearing not only for the state and the country but it could even have global implications. Major cities in India have witnessed loss of life and property, disruption in transport and power and incidence of epidemics. Therefore, management of urban flooding has to be accorded top priority.



Fig: Urban floods in cities

Increasing trend of urban flooding is a universal phenomenon and poses a great challenge to urban planners the world over. Problems associated with urban floods range from relatively localized incidents to major incidents, resulting in cities being inundated from hours to several days. Therefore, the impact can also be widespread, including temporary relocation of people, damage to civic amenities, deterioration of water quality and risk of epidemics.

These problems can be solved with proper planning of cities and upgradation of infrastructural facilities through different schemes of urban renewal through government departments. Plan before development will be further challenging step to be achieved to see cities as growth engine and good for living. More Town planners need to be appointed in local bodies and to streamline development from time to time from villages to small, medium town to metropolitan cities. More number of courses in Town planning profession & infrastructure planning -management will be required to train manpower required so. Our rural areas should be provided with ample opportunities for development by provided good infrastructural facilities to have enough employment in rural areas and to avoid migration to crowded towns. Indirectly we need to take care of environment too through sustainable development practices, use of non-conventional-renewable sources of energy and alternate materials, technology to reduce pollution.

APPLICATION OF PIEZOELECTRICS TO SMART STRUCTURES



Dr. C. B. Nayak
Assistant Professor,
VPKBIET, Baramati

There is an increasing awareness of the benefits to be derived from the development and exploitation of smart materials and structures in applications ranging from hydrospace to aerospace. With the ability to respond autonomously to changes in their environment, smart systems can offer a simplified approach to the control of various material and system characteristics such as noise, shape and vibration, etc., depending on the smart materials used.

A smart structure is defined as a structural system having built-in or intrinsic sensors, actuators and control mechanism whereby it is capable of sensing a stimulus, responding to it in a predetermined manner and extent, in a short time, and reverting to its original state as soon as the stimulus is removed. In the present context, the structures have been instrumented with smart piezoelectric material based sensors, which inform the status (here dynamic characteristics) to the user.

Role of Civil Engineering in Solar Energy Generation



Mrs. Pooja N Jaiswal
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Solar power is playing a vital role in development of energy sources as it is inexhaustible, renewable and harmless for the environment. Solar photovoltaic system convert sunlight directly into electricity and India has placed globally fourth rank in solar power generation in 2021. The practical skills are required to be competent to utilize the maximum solar energy. Power generation is a part of electrical engineering but Civil Engineers carry a larger responsibility of building the infrastructure to accommodate solar power plants to generate power in the form of electricity or any other useable power output.

The Civil Engineer will decide the activities related to the site design of Solar Photovoltaic projects which includes;

Site planning : Planning of activities like , site survey site, planning of manpower, planning of subcontractor and planning of material In this aerial, radar and topographic geotechnical investigation, studies, analysis and reporting are done.

Execution : First step is survey and its execution work. Civil Engineer carries the execution work like grading, storm water modeling, erosion control design, and writing of SWPPPs and storm water reports. It requires survey and monitoring task.

Construction: Civil Engineer need to take care of modifications in construction of road, building, drain which accommodates solar power plant.

Electrical and civil engineering together can create healthy and safe environment with new technologies.

Civil Engineering Career in Government Sector



Mr. Ajay P. Yadav
Planning Assistant,
Town Planning and Valuation Department,
(Alumni)

Working in the government sector not just comes with stability and good salary but also with the factor of job security. Indian Engineering Services is one of the sought after field as it provides almost equal benefits as offered to IAS officers and Civil Servants. Pay Scale for Civil Engineers in Govt. jobs starts from INR 45,000 to INR 50,000.

The versatility of the civil engineering branch exists in the fact that it has ample opportunities for all. Equal numbers of opportunities are available for Civil engineers both in government as well as in the private sector. Various fields in government sector offer jobs for civil engineers: Municipal Corporations, Jal Boards, Delhi Development Authority, New Delhi Municipal Corporation, Metro Rail, National Highway Authority of India, Indian Oil Corporation, Delhi State Industrial Development Corporation, Public Works Department, Central Public Works Department, Border Roads Organization, Military Engineering Services, Airport Authority of India, Indian Air Force, Railways, Irrigation & Flood control department, Public Health Engineering department, National Hydro-electric Power Corporation, National Thermal Power Corporation, Oil and Natural Gas Corporation Limited, Defence Research and Development Organisation, RITES, DRDO, Pollution Control Boards, Building and Construction department of organizations and the list is endless.

The profiles in the government sector include Assistant Engineer, Assistant Executive Engineer, Executive Engineer, Chief Engineer etc, and starts from Trainee Engineer to Chief Executive Officer in the private sector.

Carbon Negative Concrete



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Concrete is among the world's most consumed materials second only to water. That's because its durability, affordability, and availability make it essential to countless construction projects, from bridges, to roads, to buildings.

Since concrete is used on such a large scale, it also produces large amounts of heat-trapping greenhouse gases, mostly from a manufacturing process that emits carbon dioxide (CO₂). Yet, the world will need concrete to build infrastructure that can cope with climate change and population growth. So the question is: how do we lower concrete's environmental impacts even as we continue to rely heavily upon it?

Concrete: its ingredients and impacts

Concrete is a mix of several different materials: water, fine aggregates (or sand), coarse aggregates (or gravel), chemical additives, and, most importantly, cement. Cement is what binds all of these ingredients together to give concrete its durability and distinctive, grey appearance. Cement production, however, also generates most of concrete's emissions: in fact, a 2016 study found that cement accounts for around 7% greenhouse gas emissions worldwide.

Cement begins as crushed minerals that are heated in a kiln to make what is called "clinker." Clinker is ground into a powder, mixed with a few additives, and then blended with some other minerals to create cement.

This process creates CO₂ in two main ways. The first is the chemical reaction that occurs as clinker forms. The second is heating the kiln to temperatures above 2600°F, which must be done using fossil fuels.

One material. Many opportunities

There are many ways to reduce or even eliminate the emissions from cement production. While some are available today, others may require more investment.

One strategy is to use alternative fuels instead of fossil fuels to heat cement kilns. Today, these alternative fuels are mainly waste products, like used tires.

Another strategy is to make blended cements that use less clinker. One type of blended cement, portland-limestone cement, works as well as conventional cements but emits around 10% less CO₂.

Low-carbon concrete can be made with blended cements and Supplementary Cementitious Materials (SCM), which, like conventional cement, bind sand and gravel together when mixed with water. These SCMs include by products, such as fly ash from coal-fired power plants and granulated blast furnace slag from iron and steel production.

Making concrete with net-zero emissions will require more ambitious actions, almost certainly including some amount of carbon capture in cement production. Fortunately, CO₂ captured when making cement (or from any other industrial process) can be “mineralized” and become part of the finished concrete itself. Unlike plans to pump captured carbon underground, mineralization chemically transforms the carbon and permanently stores it.

Once concrete has hardened, it also naturally absorbs CO₂ through a process called “carbonation,” transforming it into a solid within the concrete. This process can offset some of the CO₂ emissions from cement production.

Governments, industry, consumers, and academia will have to collaborate to ensure that low-carbon concrete becomes viable, affordable, and available. If they are successful, this highly consumed material could have a far lower impact and even act as a “carbon sink,” with a net-negative effect on the world’s greenhouse gas emissions.

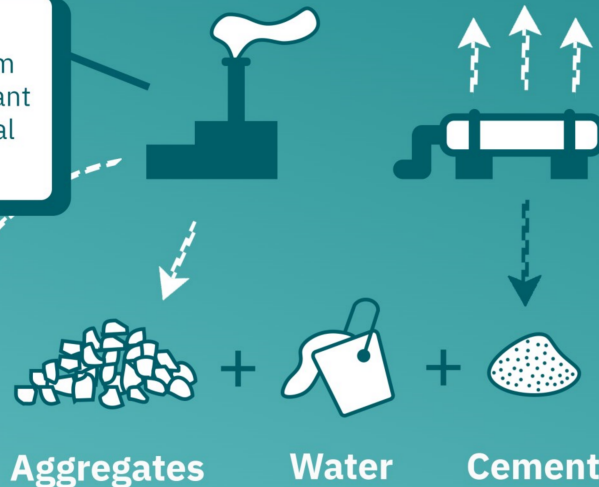
Carbon-negative concrete

We're not there yet, but in the right circumstances, the production of concrete could actually store more CO₂ than it releases into the atmosphere.

This graphic shows a carbon-negative process for making concrete. White arrows represent the movement of carbon as it is used, emitted or absorbed, while blue arrows represent the flow of other materials.

1. First you need a supply of CO₂. Most likely, it comes from carbon capture at a power plant or industrial plant burning coal or natural gas.

2. You also need cement, which is made at high temperatures in a kiln. The process releases CO₂, which can be captured to replace the need for CO₂ from another industrial source.



3. The key ingredients of concrete are “aggregates” (like sand and gravel), water, and cement. One way to use your supply of CO₂ is by turning it into aggregates through “mineralization.” In this process, the CO₂ reacts with elements like calcium or magnesium to form a solid.

4. Once the cement, water and aggregates are mixed, the concrete has to be slowly “cured” to become more durable and prevent cracking. A second way to use your CO₂ is to inject it in the curing process, which provides added strength.

5. When the concrete hardens in a finished building or road, there is one last opportunity to store carbon. Concrete structures absorb some CO₂ from the surrounding air in a natural process called “carbonation.”

Concrete is carbon-negative when it stores more carbon than was emitted in its production. In the best case, all the CO₂ emissions along the way are captured, mineralized, and become ingredients in the finished concrete, either as aggregates or in the curing process.

Constructions using 3D Printing

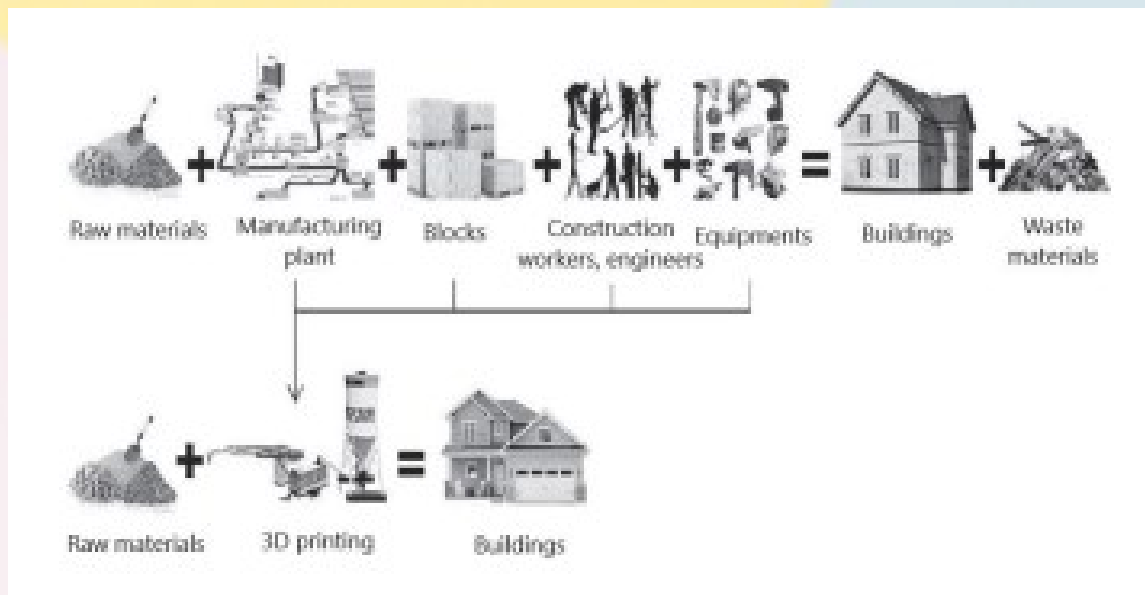


Ms. Jyoti Bhong,
Assistant Professor,
Civil Engineering,
VPKBIET Baramati

Innovations have started to emerge in the construction sector with the developing technology. One of these innovations is the utilization of 3-dimensional printing technology. Civil engineers build structures using materials and techniques available in the times. 3D printing technology attracts attention since it is faster than traditional construction, less costly, less labor and less error margin in today. It is possible to produce structures with complex designs and small scaled various products, under favor of this technology. First of all, 3D model design is needed in order to produce structures with 3D printing printers. Optimized cement-based mortar material is used in 3D printing printers. In order to be able to build layers on top of each other without collapse, and to perform 3D printing without shrinkage cracks, a building material recipe should be prepared by obtaining appropriate mixing ratios. While placing the building material, layered production is made without using a mold, and the width and thickness of the printing layer is constantly controlled during placement. Attention is paid to the use of sustainable building materials in buildings built using this technology. In addition, studies are carried out for zero waste in the use of materials.

Industries have begun to re-establish their production systems with the developing technology. 3D printing technology has also been improving of late years, along with additive manufacturing. 3D printing technologies enable design optimization and have advantages over traditional manufacturing methods. It is necessary to keep up with the new age in order to survive in the variable sector with the increase in the competitive environment. The construction industry is also under the pressure of change due to technological developments. Therefore, it is attracting great attention in the construction industry as a new strategic challenge.

The application of 3D printers has taken its place in the field of engineering, especially in the field of medicine and automotive. There have been developments in additive production technology in layers with cement and various materials. This technology has emerged as a joint product of materials science, robotic coding and architectural design studies, using the advantages of shotcrete and self-compacting concrete. In this type of printing, the ability to pump, workability and construct of fresh concrete and the strength of hardened concrete are of great importance.



Comparison diagram of 3D printing automated building production with the traditional method



3D concrete printed objects at SC3DP (prototype)

Environment friendly green concrete



Mr. Parshuram Dhalape

BE, Civil

VPKBIET, Baramati

Concrete which is made from concrete wastes that are eco-friendly are called as “Green concrete”. Concrete that uses less in energy in its production and produces less carbon dioxide than normal concrete is green concrete. The other name for green concrete is resource saving structures with reduced environmental impact for e.g. Energy saving, CO₂ emissions, waste water.

Materials used in green concrete :



Need of Green Concrete

Cement-based materials are the most abundant manufactured materials in the world. Today's exciting trend is the Green building is in our country. The potential environmental benefit to society of being able to build with green concrete is huge. Green Concrete as the name suggests is eco friendly and saves the environment by using waste products generated by industries in various forms like rice husk ash, micro silica, etc to make resource-saving concrete structures. Use of green concrete helps in saving energy, emissions, waste water Green concrete is very often also cheap to produce as it uses waste products directly as a partial substitute for cement, thus saving energy consumption in production of per unit of cement.

Green concrete has greater strength and durability than the normal concrete. It is realistic to assume that the technology can be developed, which can reduce the CO₂ emission related to concrete production. Generally the construction industry accounts for a massive environmental impact due to its high demand of energy. As a result of the awareness built during the past few years about green house effect and damage to the nature, more people and countries became conscious about their future.

Green concrete capable for sustainable development is characterized by application of industrial wastes to reduce consumption of natural resources and energy and pollution of the environment. Marble sludge powder can be used as filler and helps to reduce the total voids content in concrete. Natural sand in many parts of the country is not graded properly and has excessive silt on other hand quarry rock dust does not contain silt or organic impurities and can be produced to meet desired gradation and fineness as per requirement. Consequently, this contributes to improve the strength of concrete. An attempt has been made to durability studies on green concrete compared with the natural sand concrete by usage of quarry rock dust and marble sludge powder as hundred percent substitutes for natural sand in concrete. Recent focus on climate change and the impact of greenhouse gas emissions on our environment has caused many to focus on CO₂ emissions as the most critical environmental impact indicator.

Study on Canal Automation in India



Ms. Snehal Deshmukh,
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Dam automation provides efficient control and monitoring of water. By automating the canals and dams the wastage of water can be prevented to a greater extent. The main objective of this project is to control and monitor the distribution of the water to the areas according to their requirement. Floods are also avoided because the gates are operated automatically when the level increases. Presently manual control is employed to control the gates of the dams and canals. When they are automated the water is released automatically. It prevents over flow of the water which causes flood in some areas.

In India, approximately 3200 dams are present and it cover 1,70,000 sq.km for collecting water. Dam are manmade or artificial barriers usually constructed across to impound water. There is also 2067.68 km long and complex canal network through which about 10 lakhs hectare land gets water for irrigation and drinking purpose. The farmers are dependent on seasonal rain and after that bore well water for their crops. Recently, all the farmers use in flood irrigation system for plant their crops which needs more water. The biggest advantage of automation is that it saves man power however, it is also used to save energy and waterfalls and to improve quality, accuracy and precision. Various literature surveys stated the controlling procedure using different modules by sensing the level, sending it to the controller where the corresponding gates are open. Already proposed methods include Arduino programming, Raspberry Pi programming, PLC programming and SCADA monitoring to actuates the motor to open and close the gates. For transmitting the water level, in flow rate and momentary status of the gates, RF module have been used.

Augmented Reality in Civil Engineering



Ms. Pallavi Bokey,
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VPKBIET, Baramati

The ability to view constructions virtually before using the real resources to construct them has been of main interest in civil engineering over a long period of time. This has been achieved partially through virtual reality. Virtual Reality helps in visualizing the operations on computer generated jobsites and to study the available alternate plans. Even though the latest software in virtual reality helps us in designing and drawing the plans, the question of reality still arises. The plans that are done in computer sometimes do not match with the real practical applications. This shows that it is difficult to bring the experiences of practical world into the computer. In order to overcome the gap between the real and virtual environments, this paper highlights the use of Augmented Reality (AR) in all the areas of civil engineering instead of using Virtual Reality.

Civil Engineering is the field which uses a lot of man power. In order to use the man power efficiently, the planning of jobs should be done well in advance. Usually the planning is done with the help of 3D drawing software. These plans are drawn using the computers in the virtual environment. Even though the planning is done before, the practical constraints sometimes will waste the energy and resources. This shows that some practical constraints cannot be brought into the computer, leading the plans to be an approximate but not an accurate one. In order to overcome this problem, augmented reality can be used to such situations which help in merging the real and virtual environments. This also helps the constructors to plan the alternate ways well before by considering the most of undesirable events that usually happens during a construction project. Putting these all together, construction contractors and owners can build facilities very fast and at minimal cost taken care of well ahead of time.

Augmented Reality:

Augmented Reality (AR) is a growing area in virtual reality research. AR is a very interesting field because it requires multidisciplinary expertise to be achieved correctly. An augmented reality is a combination of the real scene viewed by the user and a virtual scene generated by the computer that augments the scene with additional information. AR technologies are based on combining, in real time, synthetic images with real images, giving more information about the real environment around the user. This information can help the users to have a better performance on the tasks at hand; minimizing the time spent in completing them. The application domains reveal that the augmentation can take on a number of different forms. As this field is still young, no standard methodology and product seems to be recognized yet. The prototype AR systems along with Head Mounted Devices (HMD) track the position and orientation of the user's head so that the overlaid material can be aligned with the user's view of the world. Through this process, known as registration, graphics software can place a three-dimensional image over it. In order to generate the computer graphics enriched by supplementary information, a spatial model of the user's environment is required. One of the most valuable applications of AR, which can also be expected to become of considerable interest for the consumer market, is its capacity to provide situation awareness in built-up areas.

Applications of Augmented Reality in Civil Engineering

Construction:

The virtual reality based applications require a significant level of effort in creating a virtual environment that represents the real world. More time, expertise and money are wasted because of the misinterpretation of plans or drawings, or the information is transferred imprecisely from the plan to the real object. When Augmented Reality is used, the need for creating the model of the real world is minimized and the time is saved to a large extent. By displaying the reference virtual object registered to the real location, the plans become more readily available.

It would be easier to build quickly and precisely as planned. AR in construction-related tasks helps the builders to view the different plans immediately at the jobsite itself with the real field as the background. The planning of additional building structures along with the existing one, extra columns, beams, walls, doors and windows are well visualized through AR for considering the alternate plans. In construction, the exploration and mapping of hazardous environments like nuclear reactors or contaminated storage sheds, underground pipelines, minefields, damaged buildings, or any area where it is either impossible or dangerous for a human to witness it first hand, can also be done using AR. Urban planning also shows a promising sign for the AR application.

Interior Design: The interactive graphics combined with the real-time video is required for the purpose of interior design. Design visualization plays a critical role in achieving an accurate, shared understanding of the design. An augmented reality system combined with the database of various design models can be used for visualizing the different interior decoration patterns at the instance itself. This helps the decorators and the owners for taking the decisions as per their preferences.

Renovation/Maintenance: AR can be used to overlay locations of subsurface electrical, telephone, gas, and water lines onto real-world views. AR systems may help the maintenance workers to avoid the hidden features such as buried infrastructure, electrical wiring, and structural elements when they make changes to the buildings and outdoor environments. This promises to speed up maintenance and renovation operations, as well as reduce the amount of accidental damage that usually occurs during maintenance. Risks of maintenance works in remote or hazardous environments can be reduced by AR based platform that can be used together with corresponding equipment (HMD, GPS receiver, and a portable computer) to generate a mixed view of the real world and superimposed virtual simulation objects in an outdoor environment.

Environmental Management: AR allows in visualizing the future environmental changes and helps in planning for the proper management. Monitoring water quality levels in natural water bodies and artificial lakes, monitoring of the pollution levels can be done effectively by using AR. Visualization of the characteristics of physical structures and natural elements by the superimposition of generated images of the past or predicted scenes on real images helps in managing the environment efficiently. This facilitates the detection and analysis of changes in the nature of a landscape.

Highway Planning: The highway route plan on the terrain surface can be done efficiently by using augmented reality. With the help of AR system, the designer can visualize the route image on the three-dimensional terrain surfaces and the group work for highway planning is possible at the jobsite itself. Planning of roads, bridges, flyovers in the proposed area can be visualized and the alternate plans can be considered immediately which saves resources.

Position Monitoring: Interaction with the natural environment creates numerous situations where it is relevant to have access to further information that we cannot perceive by direct observation through our senses. Augmented Reality technologies allow real time superimposition of generated objects on real images, providing an augmented knowledge about the surrounding world. When the user carries a GPS receiver wearing a head-mounted display, the position of the user is tracked by differential GPS while orientation data is provided by the head-mounted display itself. As the user looks around the environment through the see-through head worn display, the position is monitored and its relevant graphical information is overlaid on the real world.

Soil Mechanics: AR can be used in locating infrastructures for public supply networks (water, sewage, telephone, electric power) in order to avoid damage when intervention to the subsoil is necessary. Through the use of this application the users are able to look at the soil and see, projected on it, virtual images revealing its internal constitution like subsoil at the current point in space and time. Superimposition of the virtual images on the ground to reveal the soil's composition can be useful in efficient handling of the soil.

Transparent Concrete Using Plastic Optical Fiber



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The economic growth and science technology development, more and more large-scale civil engineering structures such as tall buildings, underground buildings and landmark buildings and so on are built around the world. Those buildings are isolated biosphere only based on manmade lights to maintain people's optical activities. At the same time, most of the big buildings are built close to each other, all in the same areas, like sky scrapers. When many buildings are stacked close to each other, there is not much natural sunlight passing through and the importance of natural sunlight is pretty well known. Translucent concrete comes in as a blessing solution for easier day lighting. By arranging the high numerical aperture Plastic Optical Fibers (POF) or big diameter glass optical fiber into concrete, Optical fibers transmit light so effectively that there is virtually no loss of light conducted through the fibers.

Optical fiber have very good light guiding and sensing capability. The light is conducted through the stone from one end to the other. Therefore the fibers have to go through the whole object. Transparent concrete is also known as the translucent concrete and light transmitting concrete because of its properties. It is used in fine architecture as a facade material and for cladding of interior walls. The main purpose is to use sunlight as a light source to reduce the power consumption of illumination and to use the optical fiber to sense the stress of structures and also use this concrete as an architectural purpose for good aesthetical view of the building

Properties of Transparent Concrete

- High density concrete
- Synthetic fibers added to the mix gives some flexibility without losing strength
- The fiber can work up to almost 20 m running length without losing light
- The prefabricated blocks are loaded bearing and provide the same effect with both artificial and natural light
- Color remains same on the other end of the block
- Versatile building material
- Illumination

Transparent concrete is a concrete based building material with light Transmissive properties due to embedded light optical elements usually Optical fibers. Light is conducted through the stone from one end to the other. Therefore the fibres have to go through the whole object. Transparent concrete is also known as the translucent concrete and light transmitting concrete because of its properties. It is used in fine architecture as a facade material and for cladding of interior walls. The main purpose is to use sunlight as a light source to reduce the power consumption of illumination and to use the optical fiber to sense the stress of structures and also use this concrete as an architectural purpose for good aesthetical view of the building.



Fig. 1. Transparent Concrete

Ingredients of Transparent Concrete

1. Cement
2. Fine Aggregate
3. Optical fiber
4. Glass powder
5. Water

Performance of the CFRP Axially Wrapped RC Columns with Constant Slenderness Ratio in Various Shapes



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In industrialised cities today, finding land to build on is out of reach for most people. In order to accommodate the need, this necessitates increasing the number of floors in the structure. For this, the building's existing columns in the frame structure must have a sufficient weight bearing capability. Therefore, an efficient strengthening technique is required to increase the strength and ductility of columns in accordance with design specifications. Due to its strong characteristics, fibre reinforced polymer composites have gained popularity in the construction sector for usage in civil engineering applications, particularly in structural upgrading. To decrease structural flaws and lengthen the useful life of structures, CFRP are frequently utilised for column rehabilitation and retrofitting. The confinement process strengthens the columns. With respect to the geometry of the column, CFRP wraps' confining strength varies greatly. Numerous researchers have noted that the confinement provided by FRP composites to columns with non-circular cross sections is less effective than that provided to columns with circular cross sections. For RC columns, CFRP is wrapped in a direction that is horizontal to the length of the columns. This type of CFRP wrapping technology enhances strength and stiffness in one direction while serving as a load carrier along the length of the fibre.

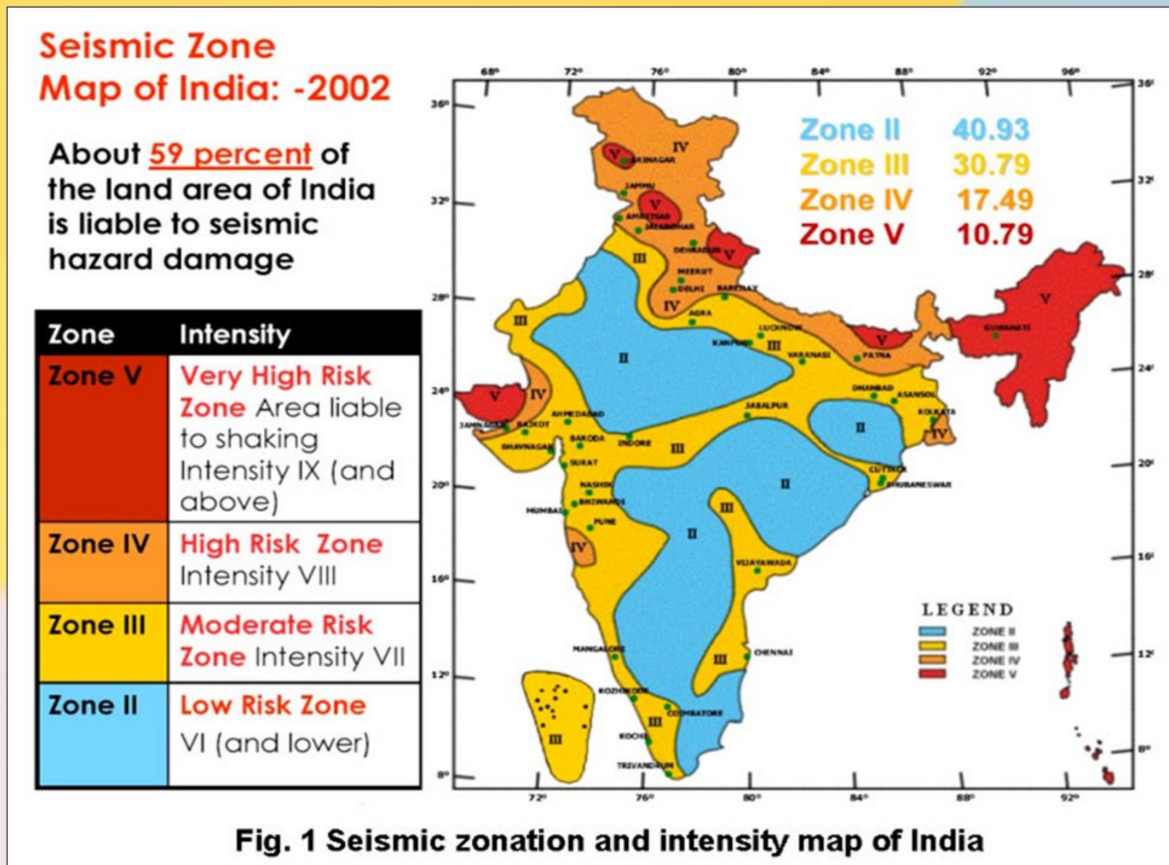
Fiber-reinforced polymers (FRP) have opened up new vistas in the field of infrastructure engineering for improving current structures and structural components. Because of its superior corrosion resistance, outstanding fatigue qualities, and high strength to weight ratio, carbon fibre reinforced polymer sheets are ideally suited for RC columns in this application. To study how shapes affect the axial behaviour of CFRP-wrapped RC columns with the same cross sectional area and slenderness ratio, experimental and computational work has been done. Using the guidelines in IS: 456:2000 and ACI 440.2R.08, columns enclosed in CFRP wrap were developed. All test specimens were loaded in axial compression until they failed, and the patterns of failure for each kind of column were examined. The findings of each experiment were compared to analytical values computed using the ACI-440.2R-08 code. The test results unmistakably showed that a change in form has an impact on the axial behaviour of CFRP-confined RC columns. Compared to square and circular columns, the axial distortion is greater in CFRP-wrapped RC rectangular columns. According to stress-strain behaviour, circular columns had a considerable increase in yield strength from CFRP confinement compared to square and rectangular columns. Due to the influence of shape on lateral deformation in the case of CFRP-wrapped circular columns under effective confinement action, this behaviour may be attributed. These elements that affect the column's restricted compressive strength. In the design procedure for strengthening that is advised in ACI-440-2R-08, confined compressive strength is a key factor.

The Risk of Earthquakes in India



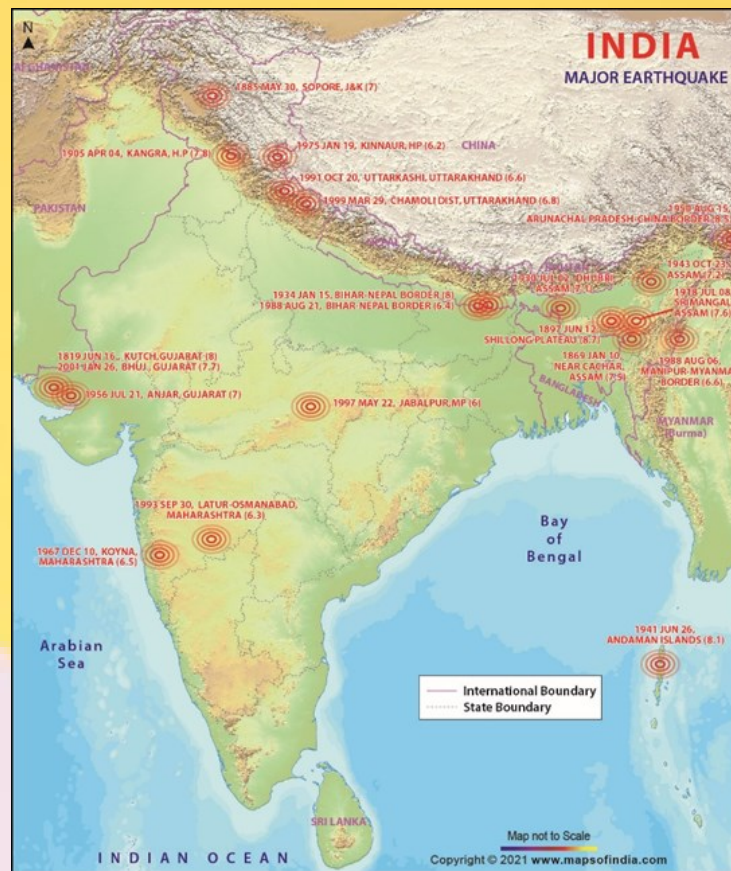
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India's increasing population and widespread faulty constructions, such as multistory luxury apartments, huge factory buildings, gigantic malls, supermarkets, as well as warehouses, and masonry structures, place the nation at a high level of risk. Over 20,000 people have died because of 10 major earthquakes that have occurred in the country over the past 15 years. According to the current seismic zone map of the country (IS 1893: 2002), more than 59 percent of India's land area is at risk of moderate to severe seismic hazard, meaning that it is susceptible to shaking of MSK Intensity VII and above (BMTPC, 2006). In fact, the entire Himalayan belt is prone to earthquakes of magnitude greater than 8.0, and four such earthquakes have occurred in the past 50 years: 1897 Shillong (M8.7), 1905 Kangra (M8.0), 1934 Bihar-Nepal (M8.3), and 1950 Assam-Tibet (M8.6). Several scientific publications have warned of the likelihood of extremely strong earthquakes in the Himalayan region, which could threaten the lives of millions of Indians. Away from the Himalayas and other inter-plate borders, portions of the nation were formerly largely protected from severe earthquakes. However, even these locations have recently witnessed catastrophic earthquakes, although of a lesser magnitude than the Himalayan earthquakes. The Koyna earthquake in 1967 caused a modification of the seismic zoning map, which resulted in the removal of the non-seismic zone. The areas around Koyna were also reclassified as Seismic Zone IV, signifying a high risk of seismic activity.



The 1993 Killari earthquake caused a revision of the seismic zoning map in which the low hazard zone or Seismic Zone I was merged with Seismic Zone II, and portions of Deccan and Peninsular India were placed in Seismic Zone III, which consists of areas designated as moderate hazard zone areas. Recent research suggests that as the seismic hazard of these regions is better understood, more areas designated as low hazards may be reclassified as high hazards, or vice versa.

The Northeast continues to experience moderate to large earthquakes at frequent intervals, including the two major earthquakes described above. Several minor earthquakes have occurred in the area since 1950. Every year, the area is hit by an earthquake with a magnitude higher than 6.0. The Andaman and Nicobar Islands are also located on an inter-plate boundary, which causes severe earthquakes.



The recent increase in earthquake risk is due to a rise in development activities supported by urbanization, economic growth, and India's economic globalization. The growing use of modern equipment and products in the industrial and service sectors has rendered them more vulnerable to disruption caused by moderate ground shaking. Therefore, the loss of human life is no longer the only determinant of earthquake risk. Severe economic losses caused by an earthquake that lead to the collapse of the local or regional economy may have long-term negative effects on the whole nation. This impact would be amplified if an earthquake hit a mega-city like Delhi or Mumbai.



Concrete Vibrator Sensor

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CVS is a PZT-based prefabricated, ready-to-use embeddable dynamic strain measuring composite sensor especially developed to facilitate structural health monitoring of reinforced concrete (RC) gauges Structures.

In isolation, a PZT patch is too fragile to be embedded inside concrete in civil structures, such as bridges and buildings. It cannot withstand the harsh environment element at the time of construction. In addition, it is also susceptible to deterioration from water. CVS, on the other hand, is rugged, high performance and RC compliant in following ways:

1. It has sound encapsulation to the PZT element such that it is protected against deterioration by water.
2. The outermost layer of encapsulation being concrete based, the prefabricated sensor achieves a near perfect bonding with the surrounding concrete of the host structure, imparting it near perfect strain. Compatibility with the host structure hence, strain lag is minimized.
3. The resulting product is as rugged in appearance and properties as the surrounding concrete. After embedding, it becomes a permanent part of the host structure and provides signals throughout the life of the structure.

SILENT FEATURES:

High Sensitivity.

Superior signal to noise ratio as compared to conventional electrical/ vibrating wire strain.

Special encapsulation of the sensing element to prevent damage during casting.

Higher longevity, negligible decay of the sensing.

Low cost.

Miniature size (25mm diameter, 12 mm thickness).

No frequency bandwidth limitation.

Can facilitate determination of strain mode shapes for direct use in structural health monitoring.

APPLICATIONS:

Vibration testing of structures

Strain time history.

Structural health monitoring.

Dynamic load monitoring.

Energy harvesting.

TECHNOLOGY TRANSFER:

This technology has been transferred from IIT Delhi to CEL to commercialize CVS in the global market.

From the Editors

Dear readers,

We are happy to share our department's technical magazine 'NIRMAAN' May Issue (2020). Our magazine is available in print, mobile and digital edition that makes magazine content easier to explore and engage with. As a technical magazine, it is going to cover many issues related to emerging technologies in Civil Engineering, career opportunities, technological innovations, overall development and much more. Our aim for inspiring our readers by keeping them updated with the latest technological developments. Also, our focus to motivate writers and content providers by giving them a platform for sharing their views. We highly appreciate and thank our proficient writers, who have allowed us to share their views and stories. We are glad to present our magazine's May 2021 Issue, which features clean and thoughtful layout and new approach for reader's experience.

Thanks for your time!!

Let us know, what you think,
your suggestions are highly
appreciated!!!

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