Sri Venkateswara College of Engineering

Pennalur, Sripermudhur Taluk, TamilNadu, India - 602117

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Department of Civil Engineering

CIVILIAN CHRONICLE

2019-20

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DEPARTMENT VISION

To become a department of excellence in Civil Engineering education producing globally competent civil engineers with an emphasis on research for the benefit of the industry and society.

DEPARTMENT MISSION

- To offer quality undergraduate technical education in civil engineering by providing state-of-the art resources that contributes to an excellent learning environment.
- To produce globally competent practicing civil engineers and entrepreneurs by imparting necessary skills, cultivating moral and ethical values who will contribute to the growth and development of the country and to the needs of the industry.
- To establish regular and efficient interaction with industries for the benefit of faculty members and students..
- To motivate the students to take up competitive exams and pursue higher education.
- To promote research and development activities in emerging areas of civil engineering and offer services to society and industry through education, research and consultancy activities.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

Civil Engineering graduates during the first few years of graduation will:

I. Practice civil engineering in construction industry, public sector undertaking or as an entrepreneur by applying ethical principles and following norms of civil engineering practice.

II. Pursue higher education for professional development

III. Exhibit leadership and team working skills in their profession and other activities with demonstrable attributes to contribute to the societal needs and to adapt to the changing global scenario.

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PROGRAM OUTCOMES (POs)

Students in the Civil Engineering program should, at the time of their graduation, be able to

1. Apply the knowledge of mathematics, science, engineering fundamentals and concepts of Civil Engineering to the solution of complex engineering problems. **(Engineering knowledge)**
2. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences. **(Problem analysis)**
3. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations. **(Design/Development of Solutions)**
4. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions for complex problems. **(Conduct Investigations of Complex Problems)**
5. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations. **(Modern Tool Usage)**
6. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice. **(The Engineer and Society)**
7. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development. **(Environment and Sustainability)**

8. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice. **(Ethics)**
9. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings. **(Individual and Team Work)**
10. Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions. **(Communication)**
11. Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments. **(Project Management and Finance)**
12. Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change. **(Life-long Learning)**

PROGRAM SPECIFIC OUTCOMES

Students in the Civil Engineering program should, at the time of their graduation, be able to
1.Provide solutions for real-life problems related to core areas of civil engineering by applying knowledge of mathematics, Basic and Engineering Sciences and by using appropriate engineering tools.
2.Plan, analyse, design, execute and manage infrastructure projects considering safety, societal and environmental factors.

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STUDENT ARTICLES

3D PRINTING

In 2004, Professor Behrokh Khoshnevis of the University of South Carolina attempted the first 3D printed wall. Since then, this innovation has exploded and it's now possible to build a house in just 20 hours! The professor developed an FDM 3D printer, mounted on a robotic arm, that extrudes concrete layers instead of plastic to create a 3D model.

This Contour Crafting technology demonstrated all the qualities needed to use additive manufacturing on construction sites: reduction in costs and waste, faster construction speed, reduction of accidents, complex architectural shapes, and more. His discovery marked the beginning of 3D printing in construction. However, it remains much less used than certain sectors such as aeronautics or medical.

3D printing processes in the construction sector

Robotic Arm Extruders

The Contour Crafting method involves the building material being deposited to create a large-scale 3D model with a smooth surface finish. Rails are installed around the building ground that will act as a structure to direct the robotic arm. It moves back and forth to extrude the concrete, layer-by-layer. Trowels placed on the side and above the nozzle to flatten the extruded layers and ensure the model's strength.

In this process, conventional concrete cannot be used as it would need to harden before you could continue the process. If it was 3D printed it therefore wouldn't be able to support its own weight. Therefore, concrete is used with quick setting properties.

Contour Crafting (company with the same name as the method) are very discreet about their progress. Chinese construction company Win Sun Decoration Engineering Co describes it as able to "steal the show" however. These machines are huge (32m long, 10m wide and 6.6m tall). This enables them to 3D print full structures and assemble them on the spot. This is done through mixing concrete and glass fibres on-site and then printing. This feat made made builders and construction workers aware of additive manufacturing.

Sand layers linked together

Italian architect Enrico Dini first made waves as 'the man who 3D prints houses.' More recently, he demonstrated an interesting 3D printing process using his 'D-Shape' 3D printer. This machine relies on the binding of powder which makes it possible to solidify a layer of material with a binder. Layers of sand are deposited according to the desired thickness before a print head pours droplets (the binder) to harden the sand. This 4 x 4 metre machine can create large structures of up to 6 cubic metres in size.Metal for solid structures

Dutch company MX3D have developed a unique construction method called WAAM (Wire Arc Additive Manufacturing), which enables you to 3D print metal structures with a 6-axis robot that drops 2 kilos of material per hour.

This robot was the result of collaboration with Air Liquide and ArcelorMittal and is equipped with a welder and a nozzle to weld, layer-by-layer, metal rods. This process is also compatible with other metal

allows such as stainless steel, bronze, aluminium and Inconel. The machine can be likened to a sort of giant soldering iron. The team commented that “we combined an industrial robot with a welding machine to turn it into a 3D printer that works with our own software.”

Though conceptualised by startups, these projects often require support by bigger names in construction. The Royal BAM Group partnered with Eindhoven University of Technology to design a 3D printed concrete bridge for cyclists. In addition, Bouygues Construction turned to 3D printing to build houses in the Lille, France. Moreover, Vinci Construction partnered with French startup XtreeE to test the construction of complex structures, and Swedish group Skanska recently collaborated with the University of Loughborough to develop a 3D concrete printing process.

Advantages of 3D printing in construction

In terms of materials usage, 3D printing is economical. With additive rather than subtractive processes, less materials are used than traditional manufacturing processes. This reduces the environmental impact as less waste is produced. Romain Duballet, one of the co-founders of XtreeE, explains “with an increased geometric mastery, we can build optimized shapes to limit the amount of materials used.”

However, there are still caveats to the dream of 3D printing houses, bridges and skyscrapers. Axel Thèry of Constructions-3D explains that “the main difficulties come from the fact that the process of 3D printing buildings is not today recognized as a construction method by many codes and standards bodies. As the printed structures are not traditional, the calculations of resistance and resistance in time are difficult to realize, that is why the habitable works will have to be tested on a case by case basis at the beginning.” These standards bodies are concerned whether these structures are really solid and if they can withstand their environments.

Mr.K.Gokul
I year B.E.(Civil Engineering)

BUILDING INFORMATION MODELING AND ITS INTER OPERABILITY WITH TRNSYS

INTRODUCTION

Wikipedia defines building information modeling (BIM) as the process of generating and managing building data using its life cycle using three dimensional , real-time, dynamic building modeling software to decrease wasted time and resources in building design and construction . This process produces the building information model, which encompasses building geometry, spatial relationships, geographic information, and quantities and properties of building components , including the life-cycle processes of construction and facility operation. Building Information Modeling began as a common name for a variety of activities in object oriented computer-aided design (CAD) that support the representation of building elements in terms of their 3D geometric and non-geometric attributes and relationships.

WHAT IS BIM ?

BIM is an intelligent model-based process that provides insight to help you plan, design, construct, and manage buildings and infrastructure. So BIM goes further than traditional CAD drawings by providing intelligence to individual building components (e.g. Windows, Walls, or chillers) as well as providing system-and building-Wide information and awareness (system flows or building loads)in addition to simple spatial relationships.

THE MAIN ADVANTAGES OF BIM ARE:

Improved information flow

Because a digital model represents a unified description of a building, it can significantly improve the flow of information in every stage of the design, construction, and life cycle of a building the digital model can be accessed by the architects, MEP engineers, contractors , facilities managers, and owners at different phases in the building life cycle to add, extract, or modify information in support of their role.

Better design visualization

The ability to predict how occupants, visitors, and neighbors will react to and interact with a building is a crucial part of the design process for architects and engineers.

Improved cost estimating

BIM can simplify and help provide better cost estimates because of the depth and precision of the information it provides.

Improved energy analysis

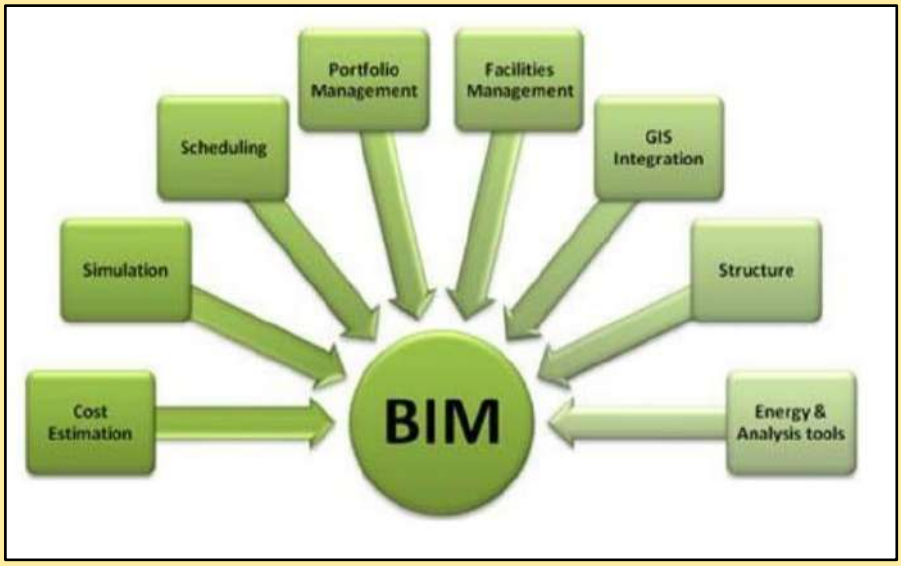
Here again, BIM can simply and improve the accuracy of energy analysis because the data required to perform such analysis is resident in the digital building model.

Reduced construction cost

Clash detection can be used long before construction begins to show where parts of the design occupy the same space. This can reduce or eliminate the need for changes in the field during construction.

Building history

As a building passes through design, construction, and into occupancy,the digital model can serve as an important information library for owners and service contractors.



TRYNSYS AND BIM

TRNSYS is a complete, modular, and expansible simulation environment for the transient simulation of thermal systems including multi-zone buildings. It is used by engineers and researchers around the world to validate new energy concepts, from simple solar domestic hot water systems to the design and simulation of buildings and their equipment, including control strategies, occupant behavior, alternative energy systems, etc.

One of the key factors in TRNSYS' success over the last 25 years is its open, modular structure. The source code of the kernel as well as the component models is delivered to the users.

CONCLUSION

The use and sophistication of BIM will continue to grow as more of the benefits of the technology have become evident. The number of buildings designed using the technology and the number of BIM users has grown dramatically over the past few years, and this trend is expected to continue. The benefits of BIM adoption depend on all parties being able to engage and collaborate in a well-informed way. In the BIM world all participants depend on each other to succeed. There may be a lot of focus on technology , but BIM is also about people and processes. People need to understand the opportunities offered by technology and make choices about how to use it.

Ajay Krishnamurthy

II Year Civil Engineering

RECENT TRENDS AND ADVANCEMENT IN CONSTRUCTION TECHNIQUES

If it's not broken don't fix it, right? Despite technological progress, it's not uncommon for construction companies to still rely on spreadsheets, manual data entry, and paperwork. Low IT budgets and lack of time for training have contributed to a hesitancy around adopting new methods and technology. These cutting-edge technologies are drastically changing how the industry operates and how future projects will be completed.

Types of Construction Technology Impacting the Industry:

- Mobile Technology
- Drones
- Building Information Monitoring (BIM)
- Virtual Reality and Wearables
- 3D Printing
- Artificial Intelligence

1. Mobile Technology

Mobile technology isn't just for games anymore. Apps are becoming more of the norm in construction and for good reason. The increased portability of tablets and smartphones allows for greater communication and the ability to work from anywhere. Integrating this type of technology into your current processes can be much simpler and require a smaller upfront investment while still providing major benefits and boosting productivity in your day to day operations. So if you want to start implementing technology, this is a good place to start.

Mobile technology can help to save time and keep your project moving forward faster by providing real-time updates and making information available between the job site and the office. You can easily access the latest revisions to plans or report a problem to the project manager off-site.

2. Drones

Drones are the most widely used emerging construction technology. They can conduct site surveys more quickly and accurately than a crew on the ground and are cheaper than aerial imaging. Their high-resolution cameras and the data collected can Create interactive 3D or topographical maps and models, and take volume measurements. Another benefit of using drones is the ability to inspect hard to reach places such as bridges or around tall buildings, and to do it safely. You can also use them to monitor progress on a job site and see how people are working.

3. Building Information Modeling (BIM)

BIM is similar to CAD (computer-aided design), but not exactly the same. It is software for 3D design to digitally model what will be built. But its capabilities don't stop there: "It doesn't just create a visually appealing 3D model of your building—it creates numerous layers of metadata and renders them within a collaborative workflow," writes Engineering.com. It captures things in a way that paper just can't. 32.7% of builders are currently using BIM/CAD software, JBKnowledge reports in their 2016 survey. The use of BIM has even been mandated in the UK for government construction projects.

The use of BIM provides space for better collaboration because each person and expertise area can add their piece to the same model, instead of broken out onto multiple versions of a 2D paper drawing. This way, the model evolves immediately as people contribute, streamlining the process and increasing efficiency. BIM also helps with problem-solving in the design and planning stages of a project, by automating clash detection and providing a more complete picture of the project.

4. Virtual Reality and Wearables

Virtual reality technology is often used in conjunction with BIM to help better understand complex projects. Think of the potential: you create a building design with BIM and then are able to use VR to actually walk around it. Pretty cool, right? This will give your team, or the client, an even more realistic idea of what the project will look like once completed. Having a more complete grasp on the project before it begins gives you the opportunity to avoid big changes and expensive change orders mid-way through. Wearables are a construction technology that will have an impact on job site safety and risk management. The Daqri smart glasses, though still in the early stages, are one example. The glasses have an augmented reality display, wide-angle camera, depth sensor and other features that allow workers to collect and see data based on their environment. The glasses give workers the information and instructions they need to complete a task right on the display, getting the job done faster and with less room for Error.

5. 3D Printing

3D printing as a construction technology has the potential to change material sourcing. For prefabrication, materials for a project can be printed and then transported to the job site, ready for use immediately. This can allow you to get materials faster and streamline the process by removing extra steps in the middle.

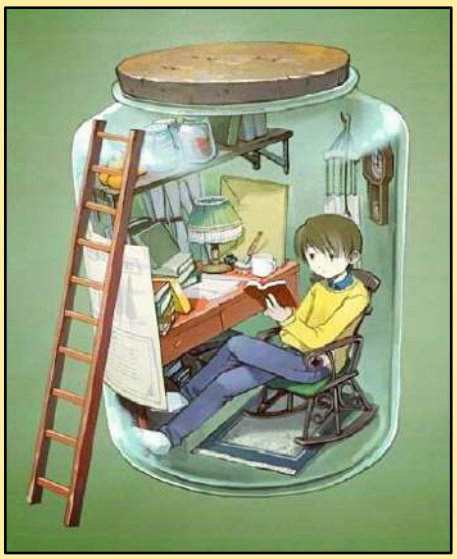
According to the U.K. Green Building Council, around 15% of materials delivered to construction sites end up in landfills, and the American Institute of Architects believe that building-related waste makes up between 25% to 40% of America's solid-waste stream, reports Fortune. With 3D printing it will even be possible to print materials right on-site, reducing waste and further saving on transportation and storage costs. One of the current challenges with the adoption of this technology is limitations with mass production. Although some 3D printers can produce on a larger scale, they are expensive.

6. Artificial Intelligence

The construction industry is already seeing the implementation of artificial intelligence on the job site with the use of robotics for tasks like bricklaying and autonomous equipment that can operate and complete tasks without the need for human interaction. Al can benefit construction projects through increased safety, improving workflows, and getting jobs done faster and better. “Al can replicate the judgments, decisions, and actions of humans without getting fatigued,” said Dan Kara of ABI Research. It Can identify when information or pieces are missing and ask questions, and use the data it collects.

A ROHAN LEWIS
I year B.E.(Civil Engineering)

“SURPRISINGLY INTROVERT”



An **introvert** by definition is a person who is predominantly concerned with his own thoughts and feelings rather than external things. Introverts possess characteristics seen as reserved, reticent, and are often assumed to be self-centered.

Introverts are people holding a treasure that is worth discovering. They are not people who hate people, but they prefer to be alone rather than to be in the surrounded crowd. There are positive aspects to both introverts and extroverts, and this article will explore the positive aspects of life as an introvert, and how you can embrace the different parts to live a happy life.

ACCEPTING PART (INTERNAL & EXTERNAL):

The part where the flow of the chemistry with oneself combines is the part where we accept ourselves as the person we are.

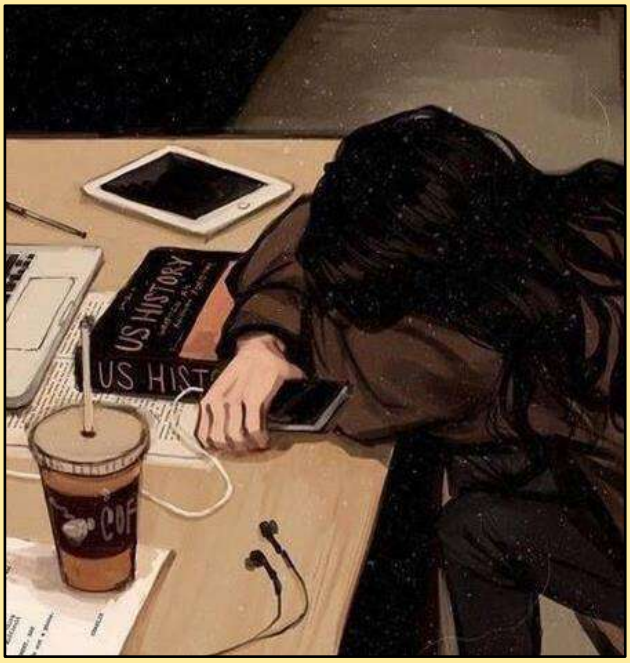
After confronting, we need to accept and live by that rule our whole life. It's something like having a code. Introverts live by the code expressed by the quote "I'm rarely bored alone; I'm often bored in groups and crowds."

Having fun and enjoying oneself is a gift that needs to be embraced. Lot people I personally know, and many of my close friends, can't be left alone. They seek someone to hangout and must be around the crowd. That states them as extroverts and they accept that.

Extroverts have one funny quote which describes them perfectly "When people assume something's wrong because you don't feel like talking." Usually, if we don't assume that is wrong, there is quite a big possibility that they are introverts because the mind speaks all the time, either we share that voice with people or we keep it to ourselves. Even when we sleep, we often dream. "That thing" up there never sleeps.

We have to confront ourselves, combine our feelings, see what makes us happy, and accept that we are the way we are.

SCHEDULE SOME "ME TIME":



As Introverts, we need our time and space to renew ourselves. It is fine to be alone and enjoy our own company. In this way, we make sure that nothing disturbs us mentally. Similarly, we can do thing which can make us happy like listening to music and playing instrument that we like, watching series and do things which make us laugh. This provides the needed solitude required to replenish, along with the added benefit of releasing endorphins that make you feel great. Do whatever works for you, and make sure that others do not encroach on your "me time."

JUST BE YOURSELF:

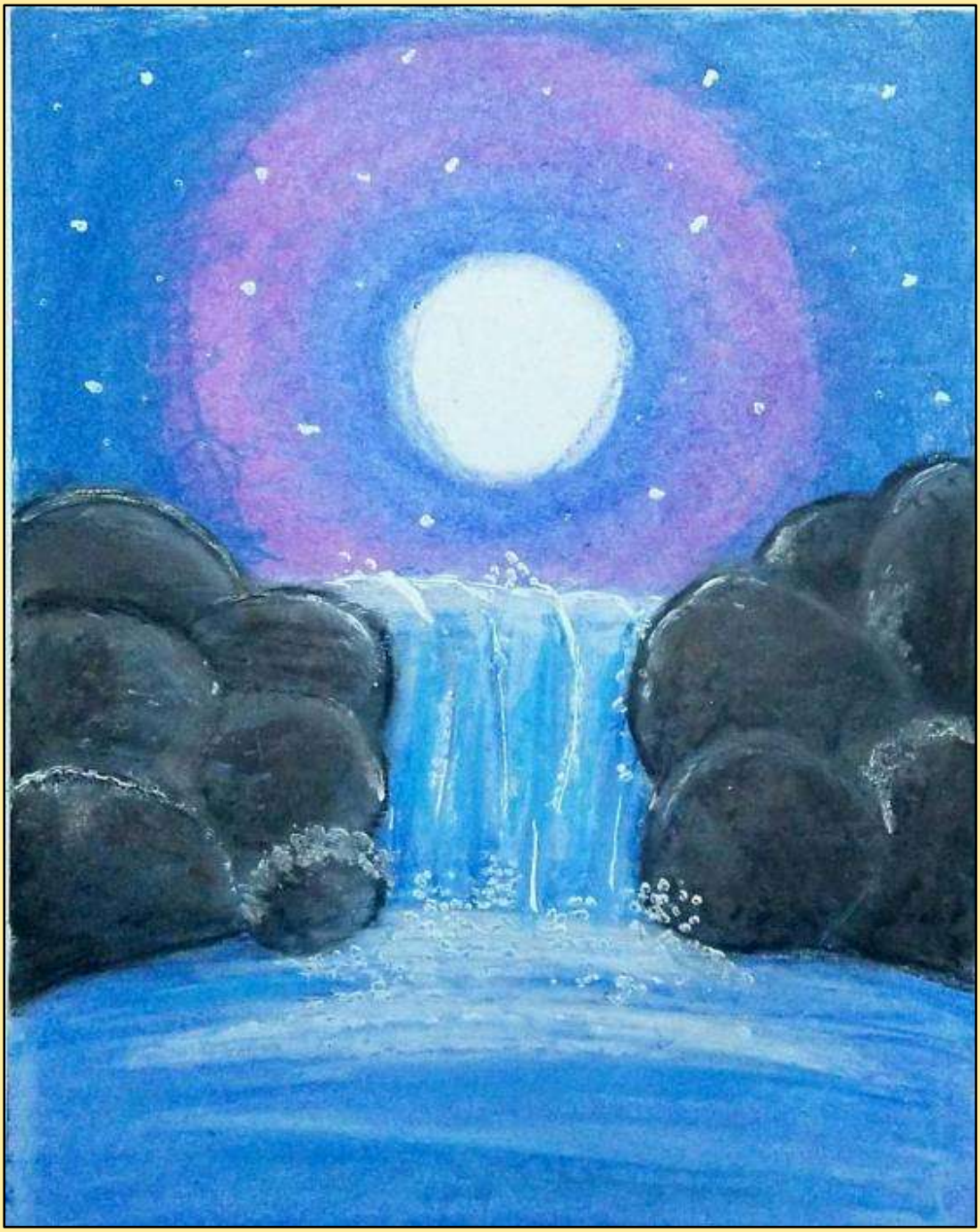
Introverts have feelings and emotions to hide away from everything and everyone around. Part of the reason might be that we do not like to explain ourselves or our actions to others. At best, our work contributes to ostracizing ourselves from the world. one needs to understand and celebrate the traits that make you an introvert. Sooner rather than later, you should realize that the traits that made you seem out of place earlier are the ones that help you to be successful in life.

THE BOTTOM LINE:

Introversion is a simple part of your personality. It's not a flaw or anything you need to change or alter. There is nothing wrong in needing a lot of time alone, preferring your own company or having just a few friends. "What really matters is that you feel comfortable with your way of being and accept **YOURSELF** as you are"**.**

Priyadharshani S
I year B.E.(Civil Engineering)

STUDENT SPECIAL TALENTS



Vivedhitha Varshini.V
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Jenani M
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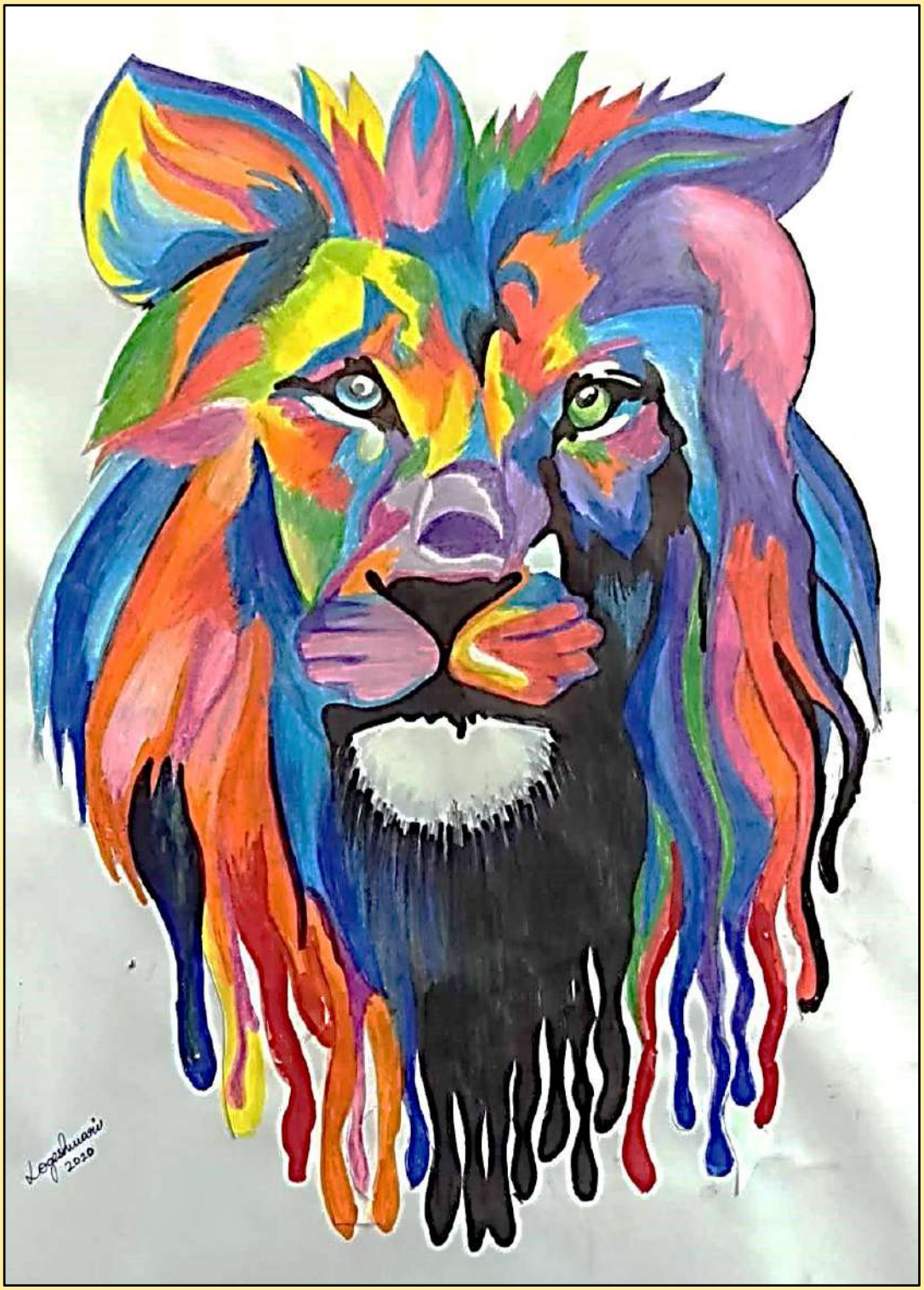

Logeswari.N
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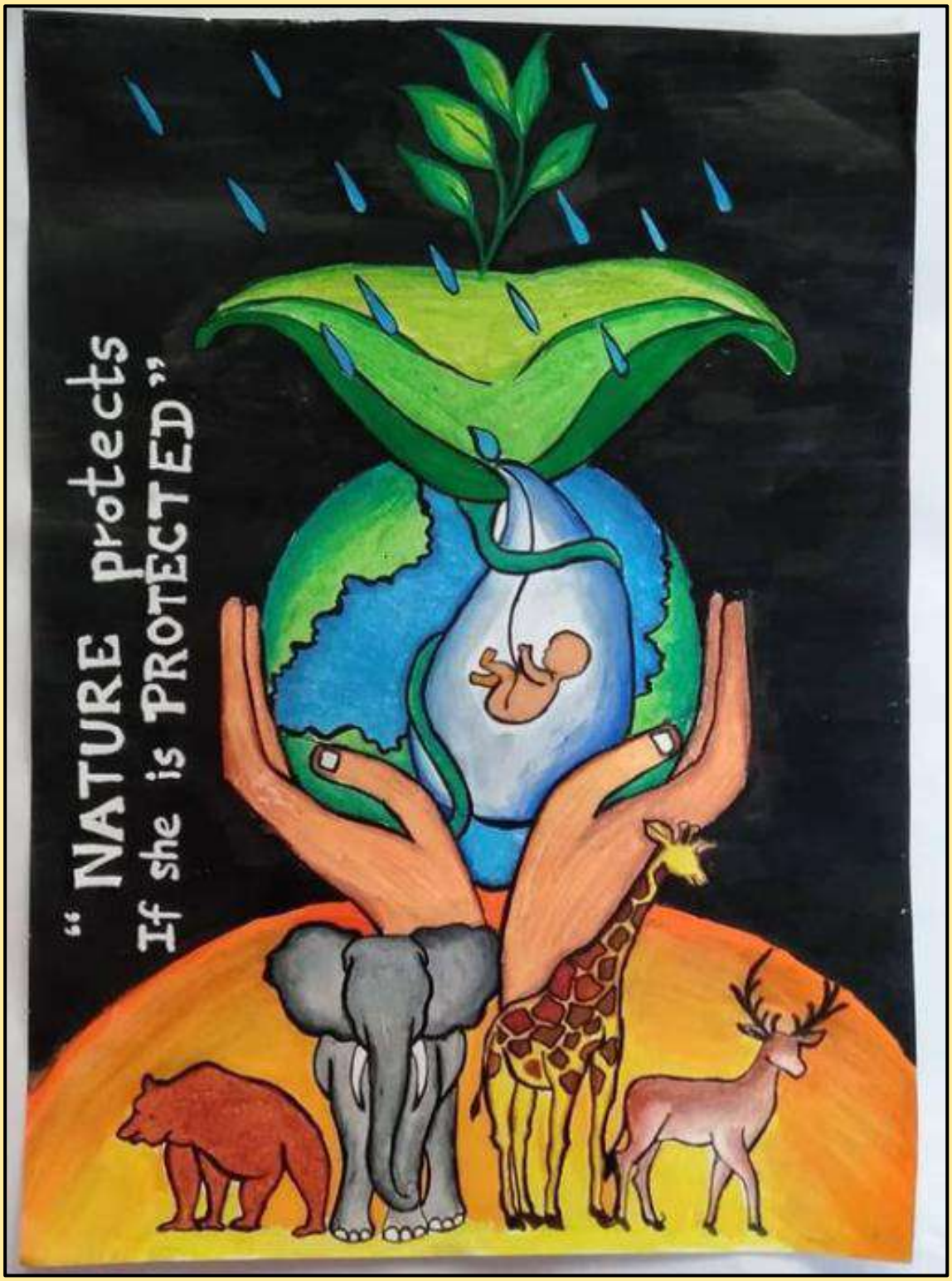

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FACULTY ARTICLES

GFRG PANELS CONSTRUCTION – A TECHNOLOGICAL ADVANCEMENT IN CONSTRUCTION

INTRODUCTION:

Glass Fiber Reinforced Gypsum (GFRG) Panel is a modern building component used for mass-scale construction of houses in a very short span of time. . It is also recognized as Rapid Walls This is a technological advancement in the construction Industry. It is made up of high strength resistant glass fibers bonded with high-density gypsum cement.

It was invented in 1990 by the GFRG Building System Australia. Now, this method of construction is broadly accepted by a few Asian nations such as India, Saudi Arabia, Oman, and China. GFRG houses are Fire-resistant up to 1000°C, Earthquake resistant, Naturally cooler up to 4°C, Eco-Friendly, Water-resistant and also Economical.

Dimension of GFRG Panels:

The **typical dimension of a GFRG building panel** is 12 x 3 x 0.127m which weighs around 1.6 tons. It is provided with 4 cavities within 1 meter of the panel.

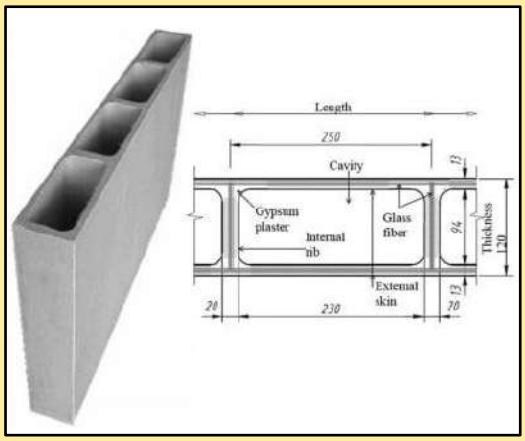


Image Source: https://theconstructor.org/building/gfrg-panels-construction

GFRG Technology:

The panels are manufactured at factories and brought at the site directly and fixed on the structure like a Lego system (The **LEGO System** means that: all elements fit together, can be used in multiple ways can be built together).

Manufacture and Transportation of GFRG Panels:

- The manufacture of GFRG panels is done in a semi-automatic plant using the slurry obtained by heating the calcined raw gypsum.
- The Calcined raw gypsum(plaster) is mixed with water, white cement and certain chemicals like D50(retarder) and BS94(water repellant) in a mixer.
- Different layers of slurries are then spread over a table and are interspersed with glass fibres and aluminum plugs (for creating hollow cavities).
- After half an hour or so, the aluminum plugs are removed and the panels are sent to a dryer.

Image Source: https://theconstructor.org/building/gfrg-panels-construction

- GFRG panels can be easily transported from factory to site via trucks or trailers. It must be ensured that the panels are put in a vertical position (using stillages) to avoid any damage during transportation.

Step-By-Step Construction Using GFRG Panels

1. The construction process up to the plinth level remains similar as in the conventional method. No special foundation is required for the installation of GFRG panels.

2. Concrete belts are built at the plinth area with protruding iron rods which are meant to strengthen the interlocking with the cells of the panel.

3. GFRG panels are placed at the appropriate positions using mechanical means, preferably a crane, and external supports are provided to maintain the verticality. Necessary cuts for doors, windows, sanitary fittings, vents etc. are made as per the design.

4. The hollow cavities are filled with concrete and reinforcement as per the requirement to strengthen the panels. Generally, concrete is filled in every third cavity of the panel and the remaining cavities can be filled with waste materials like quarry dust.

5. Finally, waterproofing treatment is carried out for the roofs and floors of the building.

Image Source: https://theconstructor.org/building/gfrg-panels-construction

Advantages:

1. Rapid Construction;Less construction cost
2. More carpet area for the same built-up area;
3. Less included the energy and carbon footprint, an essential reduction in the use of steel, sand, cement, and water;
4. Less building weight, hence reduction in design for seismic forces and savings in the foundation, especially in multi-storeyed buildings;
5. One can construct 8 to 10 storeyed buildings using GFRG Panels;
6. It gives a smooth finishing;
7. It releases less CO_2 compared to other traditional building materials;
8. GFRG Panel made building gives better thermal comfort inside in winter season

Disadvantages

1. It requires more space for the movement of a crane during the construction time.
2. It makes the construction method less cost-effective since the design of the GFRG Panel is complicated.

3. For installing the GFRG panels, highly experienced and skilled labour is needed. During the transportation and erection process, the GFRG Panel should be handled carefully.
4. To cut the GFRG Panel at the site, it requires specific machinery. GFRG panels can't be used for the construction of walls in circular or in curve shape.

Applications of GFRG Panels

1. As a light-weight bearing wall
2. As high-capacity vertical and shear load bearing wall
3. As partition wall
4. As roof slabs/horizontal floor
5. As compound wall/Security wall
6. As pitched roofing
7. As cladding in industrial structures

Ms. K. SathyaPriya,
Assistant Professor,
Department of Civil Engineering,

DECENTRALISED WASTEWATER TREATMENT SYSTEMS

[DEWATS SYSTEMS]

Introduction

Decentralized Wastewater Treatment Systems (DEWATS) convey, treat and dispose or reuse wastewater from small and low-density communities, buildings and dwellings in remote areas, individual public or private properties.

In DEWATS systems the treatment and disposal or reuse of the effluent is close to the source of generation.

Decentralized applications are a necessity in cases of new urban developments, where the construction of the infrastructure is not ready or will be executed in future.

In many countries and locations, the infrastructure development (roads, water supply and especially wastewater/drainage systems) is executed years after the housing development. In such cases decentralized wastewater facilities are considered as a temporary solution, but they are mandatory, in order to prevent public health and ecological problems.

Process

A typical DEWATS system undertakes the following processes as in series:

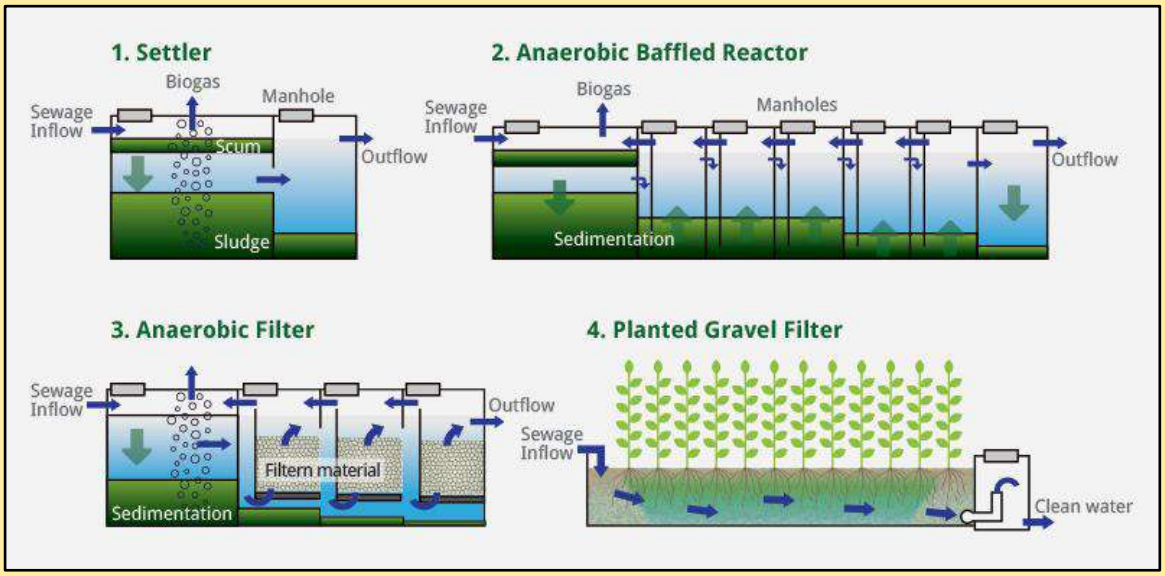
Pre-treatment done in a Settler – a device that separates the liquid from the solid

First treatment takes place in a Anaerobic Baffled Reactor – a device with several identical chambers through which the effluent moves from top to bottom. It removes the biodegradable organic solids. An anaerobic baffled reactor (ABR) is an improved Septic Tank with a series of baffles under which the grey-, black- or the industrial wastewater is forced to flow under and offer the baffles from the inlet to the outlet. The increased contact time with the active biomass (sludge) results in improved treatment. ABRs are robust and can treat a wide range of wastewater, but both remaining sludge and effluents still need further treatment in order to be reused or discharged properly.

Second treatment happens in an Anaerobic Filter – a device filled with a filter material (cinder), through which the effluent moves from top to bottom. As wastewater flows through the filter, particles are trapped and organic matter is degraded by the active biomass that is attached to the surface of the filter material.

1. Third treatment takes place in a **Planted Gravel Filter** – a structure filled with gravel material and planted with water-resistant reed plants, which provide oxygen to the passing effluent. It filters out particles and microorganisms degrade the organics.

The effluent from the DEWATS can be used for the non potable uses like toilet flushing, car washing, gardening, fishing and horticulture.



1. Figure 1. Settler | 2. Anaerobic Baffled Reactor | 3. Anaerobic Filter | 4. Planted Gravel Filter
Source: BORDA Germany

Advantages of DEWATS System

2. A treatment for domestic and industrial waste with low cost of operation and maintenance
3. National Standard of WWTP Effluent is fulfilled
4. 90% of contaminant removal
5. Able to treat wastewater up to 1000 m^3/day
6. Tolerant to inflow and loading fluctuation
7. Low maintenance and long interval of desludging
8. Low operation cost
9. Efficient

R.Mathiyazhagan

Assistant Professor

Department of Civil Engineering

SEISMIC ISOLATION USING SMART MATERIALS

1. Introduction

Seismic base isolation is an effective means of reducing the seismic effect on the structures and is achieved by decoupling a structure from damaging effects of earthquake ground motion by introducing flexibility and/or energy absorption capability to a system placed between the structure and its foundation. The performance of an isolation system depends on its capability of shifting the natural frequency to a value, well away from the frequency band of most commonly occurring earthquake ground motions and on the energy dissipation of the isolator. The transmitting force of a seismic wave to the superstructure through the support depends on the dynamic characteristics of the support. If the dynamic characteristics of the supports are tunable it will be possible to isolate a large range of vibrations to the superstructure. This tunability can be brought about by using magneto-rheological (MR) materials in which the characteristics (typically the storage moduli) are varied by applying an external magnetic field. Magneto-rheological (MR) materials are a class of smart materials whose rheological properties can be controlled rapidly, reversibly and continuously by the application of an external magnetic field. Magneto-rheological fluids (MRFs) and Magneto-rheological elastomers (MREs) are the most common MR materials.

2. Connection of isolator in a typical building

For the existing conventional isolators, the paramount requirement for installation of a base isolation system is that the building be able to move horizontally in relation to the ground, usually about a tenth of a metre and in some instances even up to a metre. A plane of separation must be selected to permit this movement. Final selection of the location of this plane depends on the structure but a few criteria are to be considered in the process. It is hard to isolate both horizontal and vertical movements. Column buckling, being a crucial phenomenon to avoid horizontal isolators, gain more importance compared to the vertical ones. The most common configuration is to install a diaphragm immediately above the isolators. This permits earthquake loads to be distributed to the isolators according to their stiffness. The mounting of isolator depends on the building in relation with its basement. For a building without a basement, the isolators are mounted on foundation pads and the structure constructed above them as shown in Figure 1. The crawl space is usually high enough to allow for inspection and possible replacement of the isolators, typically about 1.2m to 1.5m. Response of structure without and with base isolation system is shown in Figure 2.

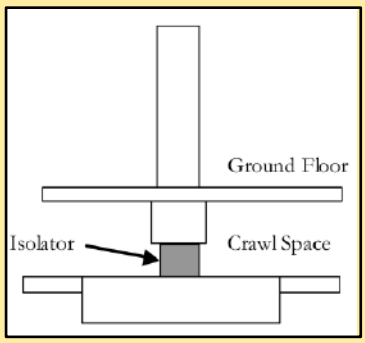


Figure 1: Isolator mounted on foundation pads for a building without a basement

From early efforts of achieving seismic isolation, it is known that seismic isolation systems can be broadly classified into laminated - rubber bearing isolators without and with lead core and friction type sliding isolators. These conventional types of isolators have certain limitations.

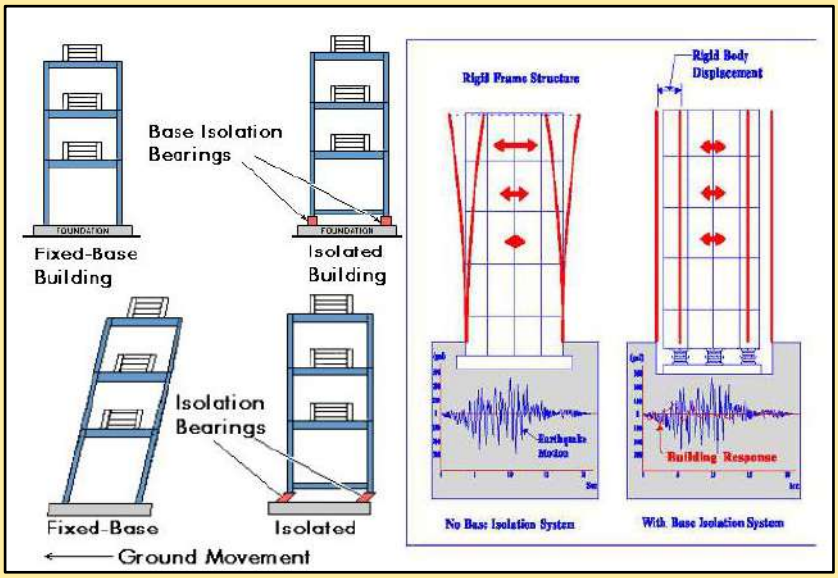


Figure 2: Response of structure without base isolation and with base isolation system (Source: Sabu, Dubai, UAE, Base isolation, 2006 (left figure) and A Verma et.al., Base isolation system: a review, 2017 (right figure)).

3. MR fluid and it's smart base isolation strategies:

MR fluid is a smart fluid composed of micron sized magnetizable particles suspended in a non-magnetic carrier oil. Rabinow first discovered the MRFs in 1948 and developed magnetic fluid clutch. Without a magnetic field, the fluid acts like traditional hydraulic oil. With the presence of magnetic field, the magnetic polarizable particles form chain like structure and the magneto-rheological fluid in turn acts like a highly viscous solid like fluid. Importantly, mechanical properties of the fluid in the presence of magnetic field are anisotropic. Thus in designing a MR fluid device, it is crucial to ensure that the lines of flux are perpendicular to the direction of motion to be restricted. Since MRFs lack stability of particles, they are coated with surfactants to reduce settling and aggregation of the particles. Polymers also used as surfactants are generally organic. The strength of MR fluids is characterized by field dependent yield stress which operates in the post yield regime. MRF dampers can resist large forces, with a capability of adapting to changing levels of shock and motion, i.e.500 times/s. Low power requirement (e.g. less than 50W), low voltage (e.g. 12 to 25v) and low current driven output (1 to 2 A) are the biggest benefits in using MR dampers in buildings. Such power levels can be readily supplied by batteries. Although MR damping systems are expensive to implement, it is worth investing, in the case of critical. MRFs are currently used for exercise equipment, automotive parts that include shock absorbers, engine mounts, and seat dampers and earthquake resistant structures. Some researchers have applied semi-active magneto-rheological fluid damper strategies to develop smart base isolation systems.

However, one of the problems associated with the magneto-rheological fluids (MRFs) is the sedimentation and agglomeration of the iron particles since the damper generally lies dormant for much of its life. The magneto-rheological elastomers (MREs), solid analogous of MRFs have high stability than MRFs. They provide an attractive option since their rheological properties (especially the stiffness and damping) can be controlled rapidly, reversibly and continuously by the application of an external magnetic field. Therefore, they are likely to make an impact in applications where resonance tunability and damping are needed.

4. MR Elastomer and it's applications

MR Elastomers (MREs) are composites, composed of magnetizable particles and elastic polymer. The time of response of MREs to magnetic fields is less than 10 ms. The fabrication of MRE can be done as either isotropic MRE or anisotropic MRE. During fabrication, when it is cured in a magnetic field, the particles form a chain like configuration inside the cross linked elastomer matrix called anisotropic MRE. When it is cured in the absence of magnetic field, the particles form a randomly dispersed configuration inside the cross linked elastomer matrix called isotropic MRE. Its mechanical properties such as shear storage modulus can be controlled by the application of

external magnetic field. The shear storage modulus is the ratio of stress to strain under vibratory conditions of viscoelastic solids. It measures the stored energy, representing the elastic portion.

MR elastomers will find their use in applications where stiffness or resonance tunability is required. Among these are the adaptive tuned vibration absorbers (ATVAs), the state switched absorber (SSA) and the variable stiffness vibration isolators. It is found that they perform better than traditional passive absorber in terms of vibration absorption capacity and frequency - shift property.

MR gels (MRGs), which are the soft form of MR elastomers could be a better alternative to improve further the stiffness tunability making it much safer for any frequency of earthquake ground excitations.

5. Magneto-rheological gels:

MR gel possesses micron sized polarizable particles suspended in a polymer matrix. The suspension of polarizable particles can be made before, during, and after the cross linking reaction. Then the resulting polymer could be a solid, gel or liquid state. MRGs are useful for damping control, vibration control and any other energy absorption applications. A bearing with MR gel and steel composite can be used as an isolating structure between the foundation and the superstructure. The compliance of this magnetic gel can be varied under the influence of an external magnetic field. MR gel, due to its soft form may have the capability of shifting the natural frequency of an isolation system to a lower value, which is quite away from the frequency band of most common earthquake ground motions.

Reference: P. Venkateswara Rao, Characterization and modelling of magnetorheological gels for dynamic applications, PhD Thesis, IIT Madras, 2013

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ALUMNI MESSAGE

Few Lines about SVCE:

SVCE is one of the best private engineering colleges in Tamil Nadu. It's got a good campus and offers good exposure to students, especially to those trying for high studies overseas.

Mr.Harish J, (2011-2015 Batch)
Senior engineer, Kalpataru Power Transmission Ltd.,
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I have had the best days during my college days. I have learnt so many life taking moments during this period. Moreover all the staffs are very friendly and they seek what's best for us. Everytime they push us to move further in life. That's the key point actually. Taking the first step towards our goal or ambition. And SVCE staffs fulfilled that in my life. I am very thankful to them life long.

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"Extending that personal attention to details and an attitude of attempting with the best shot, right at the first time, is what I have learnt during the tenure spent at SVCE"

Mr. Kishore Aravind,(2011-2015 Batch)
Founder,IK Infratech solutions,
Chennai,