

# **E.G.S PILLAY ENGINEERING COLLEGE**

**(AUTONOMOUS)**

**NAGAPATTINAM-611002**

**NBA Accredited Programmes(CSE,EEE,ECE,IT,CIVIL,MECH/Accredited by NAAC WITH “A” Grade**

**(AN ISO 9001:2015 CERTIFIED INSTITUTION) / Approved by AICTE New Delhi**

**Affiliated to Anna University, Chennai**

## **MAGAZINE**



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# **SRISHTI-2020**

**[DEPARTMENT OF CIVIL ENGINEERING]**

**(June' 2019- May' 2020)**



**DEDICATED TO OUR FOUNDER- CHAIRMAN  
CHEV. Dr. G.S. PILLAY**

**E.G.S PILLAY ENGINEERING COLLEGE, NAGAPATTINAM  
(AUTONOMOUS)**

**Department of Civil Engineering  
MAGAZINE: JUNE' 2019-MAY'2020**

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**DEPARTMENT OF CIVIL ENGINEERING**

**VISION**

To evolve as a centre of excellence by imparting quality technical education and promoting research to meet the emerging challenges in the field of Civil Engineering.

**MISSION**

Civil Engineering department is committed to

**M1:** Provide quality education through innovative teaching and learning practices

**M2:** Encourage faculty and students to pursue higher education and carry out socially relevant innovative research thereby establishing centers of excellence in emerging areas of research

**M3:** Offer consultancy services using state of the art facilities fulfilling the needs of the industry and society.

**M4:** Enable our students and faculty to play leadership roles in a sustainable manner by adopting professional ethics, entrepreneurship activities, interpersonal skills and lifelong learning attitude.

**ABOUT THE DEPARTMENT**

The Department of Civil Engineering was established in the year 2011 with the intake of 60 students. The intake is increased to 120 students in the year of 2013 The department has well qualified and experienced teaching faculties and technical staff with state of the art laboratories to meet the quality education required for present challenging societal and industrial needs. Department is involved in Research & Consultancy activities in the areas of Structural Engineering, Environmental Engineering, Geotechnical Engineering, Concrete highway Engineering and Surveying with many national and international publications. Department is actively involved in co-curricular and extra-curricular activities with the association of professional bodies. ..

**COURSES OFFERED:**

B.E-Civil Engineering

**Association Name: PEACE**

**PRECIOUS ENLIGHTENING ASSOCIATION OF CIVIL ENGINEERING**

**E.G.S PILLAY ENGINEERING COLLEGE, NAGAPATTINAM  
(AUTONOMOUS)**

**Department of Civil Engineering**

**PROGRAMME OUTCOMES**

**Engineering Graduates will be able to:**

- 1. Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
- 2. Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural science, and engineering sciences
- 3. Design/development of solutions:** 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
- 4. Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusion
- 5. Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations
- 6. The engineering and society:** 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
- 7. Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development
- 8. Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice
- 9. Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings
- 10. Communication:** 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
- 11. Project management and finance:** 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
- 12. Life-long learning:** Recognize the need for, and have the preparation and ability to engage in Independent and life-long learning in the broadest context of technologic

## **PROGRAM EDUCATIONAL OBJECTIVES (PEOs)**

**The civil engineering program aims at:**

**PEO1:** Preparing graduates to become a successful Civil Engineer to meet the demand driven needs in the field of Civil Engineering and related professions or pursue higher study and research or become an entrepreneur.

**PEO2:** Developing core competence by analyzing and design of Civil engineering systems with social awareness and responsibilities.

**PEO3:** Building professionalism, ethical approach, communication skills, teamwork in their profession and adapting to modern trends by engaging in lifelong learning.

## **PROGRAM SPECIFIC OUTCOMES (PSOs)**

**After successful completion of the programme, students will be able to**

**PSO1:** Analyze the effects of natural calamities like Tsunami, storms, earthquakes, landslides etc. in the design of stable structures.

**PSO2:** Use eco-friendly materials and mechanisms for sustainable and life-line infrastructures.

**E.G.S PILLAY ENGINEERING COLLEGE, NAGAPATTINAM  
(AUTONOMOUS)**

**Department of Civil Engineering**

**ACTION PLAN AND ACHIEVEMENTS**

S.N O	PLAN OF ACTIVE	ACHIEVEMENTS
1	Planned to send at least two faculty membersto go for research oriented higher studies.	<b>5 Faculty members are doing higherstudies.</b>
2	Planned to send at least three faculty membersto take part in the International and National Conferences, Workshops and Seminars.	<b>All the faculty members attended theInternational Conference.</b>
3	Planned to send all the faculty members topublish papers in the reputed National andInternational Journals.	<b>All the faculty members published papersin reputed International Journals.</b>
4	Planned to send the proposals to obtain assistance from Government bodies such as UGC, AICTE and other funding agencies formajor and minor projects.	<b>We have proposed and are trying to get funding from government bodies and we received funds from TNCST and TNSDC.</b>
5	We motivate all the students to take part in theworkshops, seminars, symposiums held in other colleges.	<b>Our students participated in various workshops, paper presentations and symposiums in other colleges.</b>
6	We have planned to improve the department-wise results at least 15% compared to earlier semesters.	<b>We increased our results by 10% whencompared to the last semester.</b>
7	Though a proper system of teaching, we will increase the subject-wise results to 90% andabove.	<b>Subject wise results increased 90% andabove in five subjects.</b>
8	<b>Planned to conduct at least one guest lecturerand one industrial visit this year.</b>	<b>We conducted guest lecturers for 5 subjectsand visited one industry per year.</b>



**MESSAGES:**

**FROM SECRETARY DESK**

This is indeed a happiness showered on me to know that the department of civil Engineering is organizing a national level technical symposium SRISHTI-2K19. Sky is the limit for one's excellence and perfection, but an attempt to reach the acme is praiseworthy.

As a secretary of this institution, I consider it my duty to motivate and congratulate the organizer who has been strenuously planning to make the national level technical Symposium a grand success.

**SHRI S.  
PARAMESHWARAN.,**

**SECRETARY,**

**EGSPEC**

**PRINCIPAL  
MESSAGE**

Empowerment of students for their all-round development through education is our cherished motto. Today education means much more than merely acquiring knowledge. It is acquisition of knowledge and skills, building character and improving employability of our young talent, this future leadership. I am sure, being stars and their painstakingly and gainfully developed EGSPEC culture, we inherited a strong foundation to march achieve the within mentioned education objectives for a stronger and brighter India.

It gives me immense pleasure to pen a few words as prologue to our in-house magazine SRISHTI-2K19 exclusively meant for churning out the latent writing talent which bears immense potentiality of sharpening your communication skills as part of your overall personality development. I congratulate all the contributors and the editorial board for bringing out such a beautiful magazine.

Wishing you all the best...!

**Dr.S.RAMABALAN.  
PRINCIPAL, EGSPEC**

## **HOD'S MESSAGE**

It gives me immense pleasure to encourage the department of civil engineering, which is organizing a symposium on 17th February, 2019. This kind of symposium provides a platform for the students to have interactions that are taking place in the outside world.

I have great pleasure in wishing the release of the magazine SRISHTI-2K19 a great success.

**Dr.V.MOHAN.,  
HOD/EEE**

I am very glad to wish a grand success for the symposium SRISHTI-2K19 arranged by the department of civil engineering, it is a fantabulous occasion where the students are interestingly performing all the activities, I wonder about their creativity and wish to be a part of it.

**Dr.G.GURUMOORTHY,  
HOD/MECH**

It gives me pride and pleasure to wish the civil engineering department symposium a grand success. I hope that you will enjoy exploring the symposium and I appreciate the interest in enhancing the creative potential of individuals.

The symposium is creating an environment where teaching and scholarship complement each other at all levels of educating the students to conceptualize and express ideas analytically and creatively and to reason critically.

**Dr. B. PADMANABAN  
HOD/ECE**



On behalf of Science and Humanities, I wish all the faculty members and students of Civil Department for their outstanding performance in academic activities. Also I convey my hearty wishes for the grand success of the symposium“SRISHTI-2K19”.

**Dr.A.R.Deepa**  
**HOD/S&H**

I am very happy to meet you through SRISHTI-2K19. Education is not an act of acquiring knowledge but learning a skill to lead life and forming one’s personality. This is an ennobling process of growth. I can boldly say that we have excellent in every initiative that we undertook and we have understood together in facing the challenges in providing quality education to students. It gives me great pleasure to see the birth of our college magazine. I congratulate all the contributors and the editorial board for making this happens.

**Dr.J.Vantha,**  
**HOD/MCA**

Greeting to Civil Department for wonderful and great coordination for organizing National Level Technical Symposium (SRISHTI-2K19).

Engineering is the way of delivering multi-disciplinary project and environment to create young talent and skills. Knowledge, Skill and Attitude are the importance for producing and talent, future leaders. I wish and congratulate faculty members and students for your wonderful support. I pray to god for creating a successful event.

**Mr. Dr.Manikandan**  
**HOD/IT**

## STAFF'S MESSAGE:

### List of Important Construction Materials and their usage Cement

Cement is a very useful binding material in construction. The applications of cement over various fields of construction have made it a very important civil engineering material.

Some of the numerous functions of cement are given below.

1. It is used in mortar for plastering, masonry work, pointing, etc.
2. It is used for making joints for drains and pipes.
3. It is used for water tightness of structure.
4. It is used in concrete for laying floors, roofs and constructing lintels, beams, stairs, pillars etc.
5. It is used where a hard surface is required for the protection of exposed surfaces of structures against the destructive agents of the weather and certain organic or inorganic chemicals.
6. It is used for precast pipes manufacturing, piles, fencing posts etc.
7. It is used in the construction of important engineering structures such as bridges, culverts, dams, tunnels, lighthouses etc.
8. It is used in the preparation of foundations, watertight floors, footpaths etc.
9. It is employed for the construction of wells, water tanks, tennis courts, lamp posts, telephone cabins, roads etc.

### TMT Bar

High Strength Thermo Mechanically Treated Bars with low carbon steel. TMT Bars are the main component to provide strength to your structure. TMT Bar bonds with RCC and holds the structure. It comes in Different Grades as per Indian Standards (IS) such as:

Fe 415 | Fe 415D | Fe 500 | Fe 500D | Fe 550 | Fe 550D | Fe 600

'D' denotes elongation. Fe 500D has the perfect balance of Strength & Flexibility. That is why it is most recommended for all types of construction purposes. It is essential to use the Fe 500D grade of TMT Bar for Earthquake prone areas.

### Sand

Different types of sands are available to the market for construction purposes. Sand is basically the particles of broken rock. Sand is an important material for construction because it provides bulk, strength and other properties to the concrete. Different types of sands are:

- River Sand – Whitish grey in color and rounded particles sands that are generally gathered from the bank of the river. River Sands are highly effective for plastering and other construction purposes.
- Coarse Sand/Pit Sand – Coarse Sand is procured from deep pits where the supply is abundant. In Course Sand the grains are sharp, yellow-reddish in color, salt free. It is commonly used in Concreting.
- M Sand – M Sand is used as a substitute of River Sand. It is manufactured by following the guideline of Indian Standards codes (IS). M Sand is manufactured by crushing granite/basalt rock. It is also known as Artificial Sand or Stone Sand.

## Bricks

Brick is an important material in construction mostly it is manufactured from clay and rectangular in shape. Different types of Bricks are:

- Unburnt Bricks – Bricks that are sun dried are known as Unburnt Bricks. These bricks are mostly used for temporary structures. These types of bricks are less durable, less water resistant and less fire resistant therefore it cannot be used for permanent structures.
- Burnt Bricks – Burnt Clay Bricks are sub categorized into four types
  - First Class Bricks – Standard Size, Sharp Edge, Smooth Surface bricks that are highly acceptable for load bearing and other masonry construction purposes.
  - Second Class Bricks – Bricks that are molded by ground molding are known as Second Class Bricks. Shapes of the bricks are irregular for ground molding.
  - Third Class Bricks – Poor quality bricks that have rough surface, unfair edges mostly used for temporary structures.
  - Fourth Class Bricks – Very poor quality bricks that can break easily are known as fourth class bricks. These bricks are not used for any structures; it has been used as coarse aggregate in most cases.

## Coarse Aggregate

Aggregate in construction is used for mixing with cement. The aggregate gives stability, volume to the finished structure. Coarse aggregate particles are either 0.19 inch or more in size. It acts as additives to concrete mixes.

## Wood

Wood is the most common material that is used as a construction material for various purposes. There are quite a few types of wood that are used for various purposes.

- Deodar Wood – In the Timber genre the softwoods mostly come from Deodar wood. It is moderately soft in nature and used for making cheap furniture, packing boxes, structural work etc.
- Mahogany Wood – High quality wood that is durable under water as well. For its longevity and durability it is commonly used for all types of furniture.
- Satin Wood – Hard and durable in nature. Mostly used for furniture making, ornamental works etc.
- Teak Wood – Fire resistant, durable, Termite proof wood that is used for all types of works such as furniture making, interior decoration etc. It is one of the most valuable timber trees in the world and limited for superior work.

Apart from these types there are other types of wood such as Sheesham wood, Sal wood, Rose wood, Pine wood, Mulberry wood and many more.

Apart from these 6 important construction materials there are others such as Metal, Glass, Foam, Tarpaulin and the list is endless. In construction an endless number of things are needed but, these are the Most Important Construction Material with which we cannot compromise on quality.

## Survey

### What Is Surveying?

Surveying is defined as a method of determining the relative position of the points on, above, or below the earth's surface by taking direct or indirect measurements of distance, direction, and elevation.

Two types of measurements are taken in surveying: Linear measurements and angular measurements. There are different types of surveying equipment used in civil engineering such as Chain, Theodolite, dumpy level, cross-staff, plane table, ranging rod, measuring tapes, etc.

### Importance of Surveying

- Planning and design of all civil engineering projects require measurements from surveying.
- Execution of work needs surveying too for transferring the points onto the ground.
- Fixing of state and national boundaries also required measurements obtained from surveying.
- Control points can be established with the help of surveying.
  
- Hydrographic and oceanographic charting and mapping are facilitated by surveying.
- A topographic map of the land surface can be prepared with the help of surveying.

### Types of Surveying

1. Chain
2. Theodolite
3. Traverse
4. Triangulation
5. Tachometric
6. Plane table
7. Photogrammetric
8. Aerial

#### 1. Chain

Some of the commonly used chains in surveying are

1. Metric chain– Widely used and available in lengths of 5, 10, 20, and 30 meters.
2. Surveyor's chain: Length is 66 feet and has 100 links. Widely used for land measurement as 10 square chains make 1 acre.
3. Engineer's chain: Length is 100 feet and has 100 links. Brass tags are installed every 10 feet.
4. Revenue chain: Length is 33 feet and has 16 links.

## 2. Theodolite

It is the most precise instrument for the measurement of horizontal and vertical angles. It is popular in various surveying applications.

There are two types of theodolite– transit and non–transit. Non–transit theodolites have become obsolete these days.

Transit theodolite is such theodolite in which the telescope can be resolved by  $180^\circ$  in the vertical plane.

## 3. Traverse

There are several methods of traversing, depending on the instruments used in determining the relative directions of the traverse lines. The following are the principal methods:

1. Chain traversing
2. Chain and compass traversing
3. Transit type traversing a)By fast needle method b)By measurement of angles between the lines
4. Plane table traversing

Brief descriptions of these traverse surveying methods are given below.

## 4. Triangulation

- Establishing accurately located control points for plane and geodetic surveys of large areas.
- Establishing accurately located control points in connection with aerial surveying
- Accurate location of engineering projects such as Center lines, terminal points and shafts for long tunnels, and Center lines and abutments for long span bridges.

## 5. Tachometric survey

The various methods of the tachometric survey may be classified as follows:

1. The Stadia System
  - i. Fixed Hair Method
  - ii. Movable Hair Method, or Subtense Method
2. The Tangential System
3. Measurements by means of Special

Instruments A brief description of these methods is given below.

**T.Adhava Nathan**  
**Assistant Professor**

## 7 of the Most Beautiful Bamboo Structures in the World

Despite having a strength on par with steel and being one of the fastest-growing plants in the world, bamboo

has been relatively underused in architecture. It's most frequently seen as scaffolding or as a decorative element, and more recently flattened and laminated into flooring planks. Once treated to resist insects and rot, the woody plant becomes a remarkably sustainable alternative to other materials, and it exhibits a structural integrity strong enough to warrant its use in disaster-resistant housing. Here, AD has selected some of the world's most visionary structures by the likes of Rocco Yim and Penda that make the case for building with bamboo.

### Green Ladder Pavilion

Designed to resemble a dense forest, this bamboo pavilion is the work of Vietnamese architect Vo Trong Nghia for Sydney's Sherman Contemporary Art Foundation Gallery. The temporary structure was built in 2016 to highlight the strength of bamboo as a construction material.

### Norwegian Pavilion

The Norwegian Pavilion at the Shanghai Expo 2010, which showcased sustainable architecture, was made using timber and sheets of laminated bamboo. Helen & Hard designed the structure to look like a canopy of trees.

### Flower Tower

Dubbed Flower Tower, this 2004 building by architect Edouard François is a 10-story residential structure in Paris's 17th arrondissement. The 380 pots of bamboo cannot be removed and are automatically watered with recycled rainwater.

### Bangkok Tree House

Prized for its durability and abundance, bamboo is the primary building material for the Bangkok Tree House, a hotel on the city's Phra Pradaeng Peninsula. In this lounge space, the material is both decorative and structural—it is used in the ceiling and floor.

### Bamboo Pavilion

Architect Rocco Yim designed this 2010 pavilion as a part of Festival of Vision: Hong Kong–Berlin, a series of events that highlighted dialogue between the two cities. Located at Berlin's House of World Cultures, the structure was built by scaffolders who routinely use bamboo for projects in Hong Kong.

### S House 2

Made using bamboo and coconut leaves on a concrete frame, S House 2 by Vo Trong Nghia Architects is an affordable, sustainable home in Vietnam's Mekong delta that is designed to withstand natural disasters.

### Raising Canes

Built in 2015 for Beijing Design Week, Raising Canes is a prototype bamboo pavilion that illustrates the basic unit of construction for architecture firm Penda's future hotel, One with the Birds.

**G.Prakash**  
Assistant Professor

## Applications of GIS in Various Fields

### 1. Urban and Town Planning

Developers, Builders, Architects, and Engineers are now using spatial data sets to plan on the futuristic township. With the help of granular information, it becomes easier for engineers and architects to hardly miss out on any of the parts. Governing bodies like CIDCO for New – Mumbai and BMC for greater Mumbai have also used GIS data and tools for planning out on various mega projects. The data is also useful to tackle water clogging during the time of flood and cloud burst in monsoons. It has also helped in redesigning the drainage models.

### 2. Oil Spill

Oil Spill can be intentional or accidental, depending on the conditions. The price is always paid by Marine life and the humans who have frequent access to that particular sea route. GIS and geospatial data sets are used to curb such havoc spreading spills. According to various reports, most oil spills happen in the Malaysian coastal areas. Governing bodies have implemented GIS to tackle such spills. It is more cost-effective than the hazardous oil spill, which is also harmful to marine life.

### 3. Disaster Management

GIS is used to monitor disaster and natural calamity prone areas. The geospatial data sets and databases allow organizations to store data of all levels. The database can contain all the information related to risk-prone areas like hospitals and isolation centers near the risk-prone zones, quick habitation centers, history of the calamities in that area, and the effect of the past disaster to plan for further contingency plans. Most Remote Sensing and GIS is used on the areas which are prone to Volcanic eruptions and earthquakes. With the help of both the technologies, organizations and municipalities of any city or admin can be prepared and ready to avoid the maximum effect. Using a GIS in a disaster is to create more awareness and be prepared and ready for the future



#### 4. Mapping and Navigation

The best example of today's world mapping and navigation is Google Maps. It is the most widely used service of Google by people. Humans around the world use it while traveling to a new place and also to review any place. It has also become a popular tool within Cab and carpool service providers. GPS, with the help of GIS, adds crisp and edge to the experience of navigation. It is not just about looking at the data on an application, but consumers are also allowed to post any unknown or unnamed information in the map data set. Google accepts consumer map edits and also has its map maker. However, Here Maps also collects data from local consumers and people in its proprietary tool, which is known as Map creator

#### 5. Reservoir and Dam Site location

Geo-Spatial data is used to find the perfect location for constructing a reservoir and dam. For selecting any dam site location, various factors should be looked after, Like economic factors, environmental conditions, and engineering factors. Geo-spatial data have all the information concerning this; hence it's feasible to use GIS before implementing any of such major engineering projects.

#### 6. Deforestation and Vegetation Management

Using GIS and geospatial data of forest lands allows organizations and governments to keep track of the rate of deforestation. The past information of different periods is used for analysis to plan for reforestation and vegetation. Due to the increasing number of deforestation, government bodies are also keeping track of forest and tree-related data. The datasets are used for the further analytical purpose of reforestation. With the help of heat maps and imagery sources, the data can be classified and visualized to take further actions.

#### 7. GIS for Business, Marketing, and Sales

Apart from all the above applications, GIS also has unusual usage in making business and marketing sales. Geospatial databases store data of target customers, marketing campaigns and sales territories. This application enables companies and organizations to become strategically more competitive and strong in the market.

### Applications of Geographic Information Systems



**Oil Spill - GIS allows prediction of Oil Spill locations and also estimating the intensity of Oil Pollution.**



**Urban Planning - GIS is used for town planning and urban planning with the help of various cartographic features.**



**Fleet and logistic management - GPS and GIS allows smooth scheduling and tracking of fleets and logistics.**



**Natural Disaster Management - GIS is also used to identify potential risk zones such as volcanic eruptions and earthquakes.**



**Resource Exploration - GIS can be also used for resource exploration with the help of available Geospatial data.**



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**N.R.Vedamoorthy**  
**ASSO.PROF/CIVIL**

## STUDENT'S MESSAGE

### Types of Ready Mix Concrete Plants

Following are the different types of ready mix concrete plants and their mixing actions:

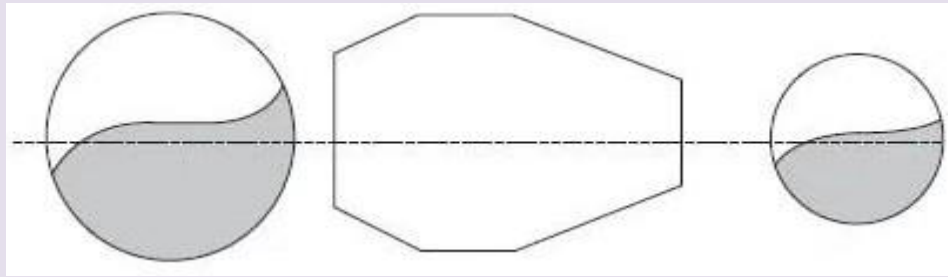
- Dry batch concrete plant
- Wet batch concrete plant
- Half-wet batch concrete plant
- Combination batch concrete plant



Ready Mix Concrete Batching Plant

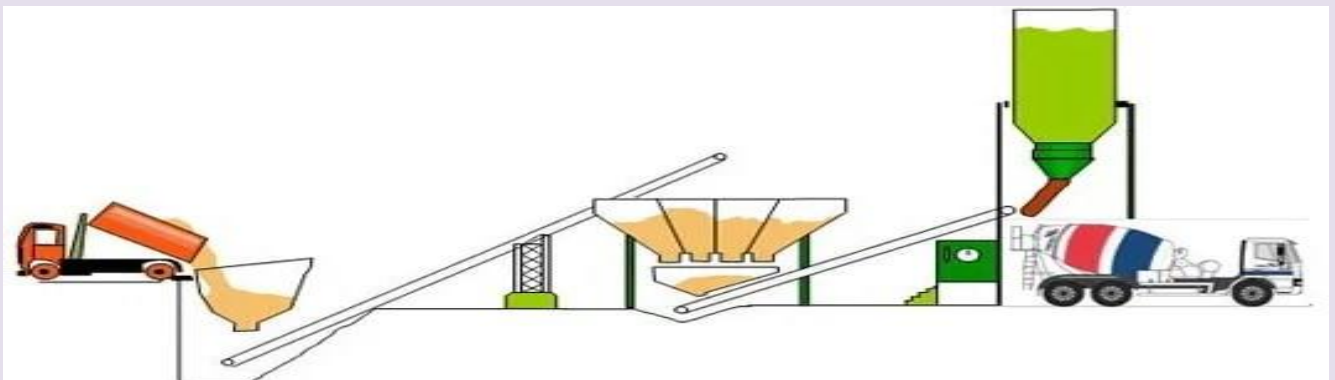
## Dry Batch Ready Mix Concrete Plants

This type of ready mix concrete plant produces uniform concrete mix through the mixing action of the truck mixer. The mixing action is basically a twofold mechanism. Consider the complex movement of already well mixed plastic concrete in the drum. At the beginning, neglect the blade action, then rotation of the drum and both concrete internal friction of the concrete and its friction against drum inside surface make the concrete appear to move up the right-hand wall of the drum.



Cross Section of Track Mix Action

There are two factors which affect the height that the concrete can climb up before gravity surpasses it and make it fall. Firstly, drum surface linear velocity which is based on its angular velocity and the inside diameter of the drum. Concrete falling point is increased with increasing linear velocity. Secondly, concrete workability which its decline leads to rise in concrete falling points. It is observed that, at speed of 22-27 rpm (normal speed is 10-14 rpm), the concrete spins full contact with the drum surface hence concrete falling will no longer exist. This may lead to problems because substantially efficient local mixing will be lost if concrete falling point is avoided.



Dry Batch Ready Mix Concrete Plant

## Wet Batch Ready Mix Concrete Plants

There are various types of wet batch systems and the wet batch system is a plant based mixer. This means that different components of concrete mixture such as cement, aggregate, and water are mixed in the system.

Comparatively, the output of wet batch concrete plant is greater than dry batch concrete plant that is why it is frequently seen as large plants. Moreover, the wet batch concrete plant is necessary in case mortar production is required. There are different mixers sizes that range from 0.8 m<sup>2</sup> to 6 m<sup>2</sup> and the largest mixer drum can adequately mix about 6 m<sup>2</sup> plastic concrete in around forty five seconds. Furthermore, there are several factors for example, required output, predominant type of mixes supplied, plant geometry, available space, initial and entire life expenses, upon which specific mixer is decided to be chosen.

## Types of Wet Batch Mixer and its Mixing Action

Following are the available different types of wet batch mixers and its mixing action:

### Rotating Drum Mixer

- Rotating drum, freefall mixing action, none tilting.
- Rotating drum, freefall mixing action, tilting.

### Fixed Trough Mixers

- Fixed mixing trough within which spiral blades revolve on horizontal shafts
- Fixed mixing trough within which paddles rotate on twin horizontal shafts

### Pan Mixers

- Fixed horizontal pan in which mixing paddles travel around an annular channel
- Fixed horizontal pan in which mixing paddles travel around an annular channel while revolving about their own axis
- Fixed horizontal pan in which the mixing blades traverse the entire pan floor with a planetary motion
- Fixed horizontal pan in which two sets of mixing paddles travel around an annular channel in opposite directions
- Horizontal pan rotating beneath a stationary motor unit carrying paddles, the axes of rotation being non-coincident

### Reversing Drum Mixers

- System of fixed blades and shovels within a non-tilting rotating drum giving a combined freefall and compulsory mixing action.

## Continuous Mixers

- Fixed trough mixer with twin rotating shafts and paddles angled at about 20° arranged to produce a continuous mixing action

## Half-Wet Batch Ready Mix Concrete Plants

Half wet system includes premixing of sand, cement, and water to make slurry, after that, the slurry and aggregate are added to the truck. Not only does the half-wet system decrease wear and tear on central mixer units but also substantially decline the time of batching.

## Combination Batch Ready Mix Concrete Plants

Both dry batch and wet batch systems are combined in this type of batching plant, and most of concrete is mixed in dry leg but small mixers with 0.8-2 m<sup>3</sup> is employed to deliver concrete to the customer.

**S.V.Sahana Devi II Year-B/Civil**

Membrane Bioreactor (MBR) What is a membrane bioreactor?

A membrane bioreactor (MBR) is a compact, highly effective solution for commercial and municipal wastewater treatment projects near ecologically sensitive areas.

Suitable for flows of up to 4,000 m<sup>3</sup> per day, Rewatec MBR systems use a unique ultrafiltration membrane to block fecal coliforms and other wastewater pathogens.

The membrane has pores that are just 0.4 µm wide, making it so effective that treated effluent can be reused for non-potable applications (where allowed).

Where are our MBR systems used?

Rewatec MBR systems are most often solutions for:

1. residential developments
2. municipal developments

- 3.schools
- 4.campgrounds and parks
- 5.roadside rest areas
- 6.work camps
- 7.sites near ecologically sensitive areas
- 8.installations with faulty membranes

How do our MBR systems work?

Primary treatment tank or fine screen

In typical installations, wastewater enters a primary treatment tank that allows liquids to separate from solids. Primary solids settle on the bottom of the tank and are removed by a septic pumper as often as needed.

Liquids pass through an integrated effluent filter before leaving the primary treatment tank. The filter captures suspended solids that could clog system components downstream.

Sometimes a fine screen takes the place of the primary treatment tank, acting as a simple physical barrier to remove solids from wastewater.

Equalization tank (if needed)

After primary treatment, liquids move downstream into an equalization tank. This tank collects wastewater from daily peak-use periods and sends controlled doses to the Rewatec MBR.

Rewatec MBR and final discharge

The Rewatec MBR combines two treatment processes in one tank to produce effluent that meets the most stringent standards.

In the first step, aeration cycles provide oxygen to microorganisms that feed on organic pollutants. As microorganisms increase in number, they mix with other solids to form activated sludge — the biomass that treats incoming wastewater.

Biomass remains in the tank, eventually reaching concentrations up to three times higher than those found in traditional activated sludge systems. This key feature minimizes the size of the installation, making Rewatec MBR systems the most compact solutions available.



In the second step, a low-pressure vacuum sucks wastewater through the pores of a rigid ultrafiltration membrane that blocks even the most persistent pollutants. Clarified wastewater is then pumped out of the tank and safely discharged into the environment.

The fine bubbles that aerate the biological process are also used to scour the membrane, preventing surface clogging and getting maximum value for all energy consumed.

#### Premier Tech's 360° support

Local expertise is the cornerstone of our global team. Together, we have the technical understanding and industry experience to guide every phase of your project.

#### Design

1. engineering support to guarantee the best solution
2. help with technical drawings and diagrams
3. advice for electromechanical equipment
4. control panel design, including electrical diagrams

#### Construction and installation

1. dedicated project managers
2. fast answers to all questions
3. on-site support to ensure high-quality installations
4. real-time troubleshooting

#### Start-up

1. commissioning by a qualified technician
2. verification of installation success
3. rapid responses to any areas of concern

#### Maintenance

1. full support from our process and mechanical experts
2. maintenance services from local technicians
3. remote support available

**K. Thatchayani II Year-B/Civil**

## **SOIL NAILS**

Nucor Skyline manufactures and supplies soil nails for a wide variety of geotechnical projects. Applications include slope stabilization for highway embankments, levee construction, tunneling, temporary excavation support for permanent retaining walls, and more. Reliable soil nail products are available in a variety of sizes and grades to suit any construction project.

### **What Are Soil Nails?**

Soil nails are fully threaded steel bars, placed into pre-drilled holes and grouted to keep them in place. Soil nails are placed horizontally into the soil and provide support to a soil mass by transferring tensile loads throughout the ground area. Bond (shear) stresses occur along the nail grout-to-ground interface and properly configured nail systems reach the resistance level required for the specific retaining wall design.

Considered passive reinforcing products, soil nails are not pre-stressed like tieback rods. Typically 20 to 30 feet in length, with small diameter sizes, soil nails are amenable to a variety of drilling patterns needed to support any retaining wall height. With soil nails in place, providing sufficient tensile resistance and pull-out resistance, the ground remains stable until the earth-resisting retaining wall is built. Corrosion protection contributes to the sustained performance of the earth-resisting system over the long term.

Soil nails are bars installed within an excavation or slope to provide reinforcement to an earth retention structure. They differ from tie backs in that they are considered passive elements and are not actively loaded in tension like a prestressed ground anchor. Soil nails are used in combination with a steel grid cover and shotcrete. As a system, the soil nail, grid cover, and shotcrete act as a coherent mass with enough strength to resist the overburden pressure of the surrounding soil mass, as well as any surcharge pressure.

In comparison to tie back anchors, soil nails have a few significant benefits. The equipment required to install soil nails is relatively small and mobile, providing a distinct advantage for applications with tight spaces or noise control issues. Using soil nails is typically a more flexible construction technique, allowing for simpler on-site modifications. Also, soil nails are installed early on in the construction process, limiting the disturbance on adjacent structures.

## **Advantages**

- Cutting-edge manufacturing process eliminates material loss
- Left- and right-hand thread configurations optimize threading flexibility
- Various grade options offer flexibility in yield strength
- Wide range of sizes
- Fully threaded bars provide ability to cut bars to desired length
- Ability to supply single bar lengths of up to 60 feet
- Wide variety of corrosion protection options available
- Complete range of accessories available to complement our threaded bars

## **Soil Nail Applications**

- Permanent retaining wall construction
- Retaining structure reconstruction or repair
- Temporary excavation shoring
- Erosion control
- Landslide prevention
- Slope stabilization for Tunneling
- Roadway cuts
- Bridge abutment support

## **Soil Nail Wall Design and Function**

During the excavation process to produce a retaining wall, soil nails form part of a passive system to reinforce and temporarily support the existing soil or weathered rock. Soil nails hold the earth in place, allowing for successful, permanent retaining wall construction, erosion control, rock-slope stabilization, and landslide prevention.

Soil nail wall design is tailored to the necessary strength and service load limits of the project by varying soil nail length, diameter, and spacing. Soil nails are generally used in conjunction with a steel grid cover and shotcrete facing for ground support in advance of retaining wall construction.

Soil nail wall design and construction must take into account seismic activity, external loads (hydrostatic and wind forces), drainage, frost penetration, and aesthetics. Soil nails are generally not ideal for high plasticity clay soils, sand, gravel, soil with high water tables or low (undrained) shear, with the possibility for soil creep. For

most other applications, these key ground reinforcement elements, (properly configured soil nails, grid cover,

and shotcrete grouting), work together, serving as a reliable foundation for building strong, pressure-resistant retaining walls.

### Advantages of Soil Nailing in Retaining Wall Construction

Soil nails are an integral part of a structurally sound retaining wall building project, providing increased reinforcement during the build.

Construction engineers choose soil nails for these reasons:

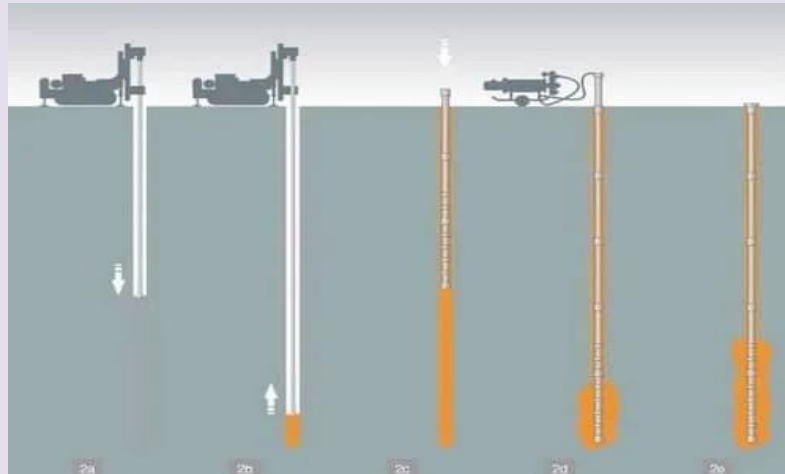
- Easily installed in tight spaces, with small equipment.
- Minimal right-of-way requirements and fewer traffic obstructions.
- Relatively quiet installation, thanks to the compact equipment/tool size.
- Versatile and flexible for multiple project types and soil conditions, including irregular shapes, new construction, temporary structures and remodels.
- Quicker installation than ground anchor walls.
- Requires less material than other options.
- Eco-friendly benefits, with a lower environmental impact than other stabilization methods.
- Cost-effective and comparatively budget-friendly due to quick construction with fewer supplies.
- Minimal shoring needed.
- Lower load requirements than tie back anchoring.
- Avoids time-consuming and costly steel pile driving.
- Wall height unrestricted.

When planning your next retaining wall project, you can count on soil nail products supplied by Nucor Skyline. No matter which type of soil nailing method is required, such as drilled and grouted, jet grouted, driven, launched, or self-drilled, Nucor Skyline delivers the products you need.

**R.Harikaran II Year-A/Civil**

## MICROPILE

### What Is a Micropile?



- Micropiles/ mini-piles/ pin-piles/ root-piles are high-strength, durable, small-diameter generally 6-12”(150-300mm) steel casing pile or rib or bar and stuffed with a high strength cement grout used to bore holes.
- The bearing stratum is logged throughout installation drilling to assure that bearing capability is adequate.
- Since small piles are smaller in diameter they will be advanced through the bottom at a better speed and may break through materials with larger ease than a caisson casing or a driven pile.
- The micropiles will penetrate any obstructions which will typically cause premature refusal whereas putting in mistreatment typical spile strategies.
- Grouting is achieved by tremie grouting, pressure grouting throughout casing retraction, and tremie-grouting with post-grouting. Post-grouting among the bond lengths will increase resistance forces with close soils, so achieving larger capability.
- Micropile capacities in way over four hundred kips (1,780 KN).
- Micropiles to depths surpassing two hundred feet (60 m).

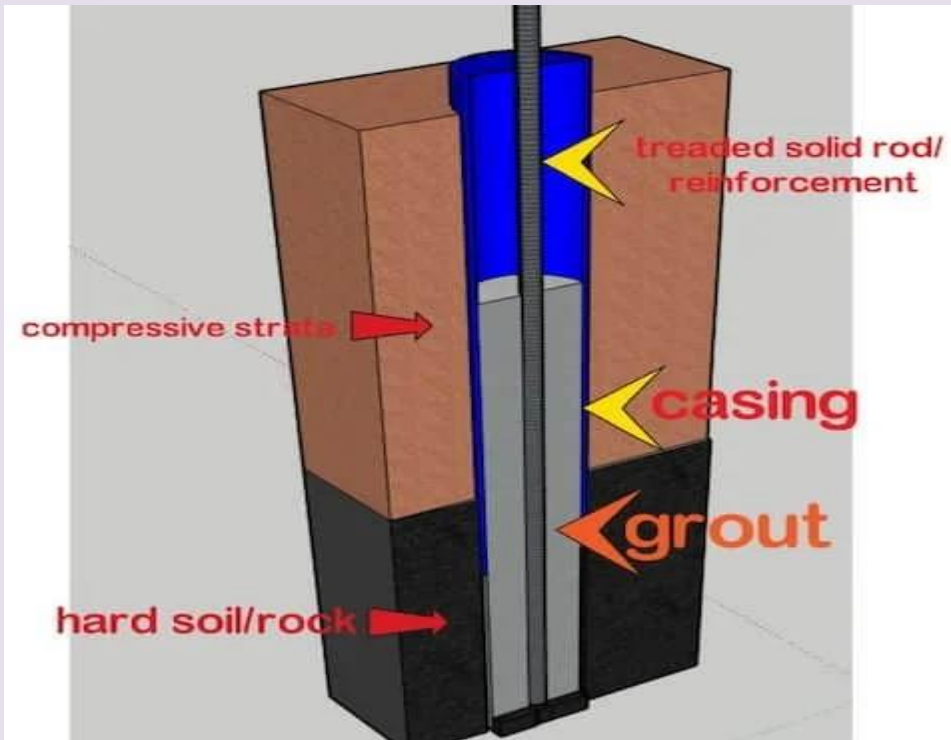
### Common Reasons to Use This Micropile

- To give structural support
- To underpin your foundation
- To transfer hundreds
- To enhance mass stability

## Common Uses of Micropile

- Provide structural support
- Underpin foundations
- Enhance mass stability
- Transfer loads

## Advantages of Micropiles



- The main advantage of a micropile is its ability to figure in terribly engorged and low height areas and on any soil surface regardless of its sort.
- Fast ballroom dancing installation even in environmentally-challenging conditions. They're little and comparatively lightweight. they're comparatively cheap.
- Simultaneous drilling and grouting allow low overhead, restricted access installation. Micropiles are typically preferred to "H" piles attributable to overhead physical constraints.
- Improves the bottom (densification)
- Offers higher skin friction
- Total single corrosion protection intentionally
- The restricted vibration and noise cause very little disturbance.
- Piling rigs may be low-emission or perhaps electrically driven.
- They can be put in on the point of existing walls with restricted headroom and engorged website conditions.

- They have a high load capability and a capability to resist compressive, tensile, and lateral masses.
- Micropiles can penetrate any surface.

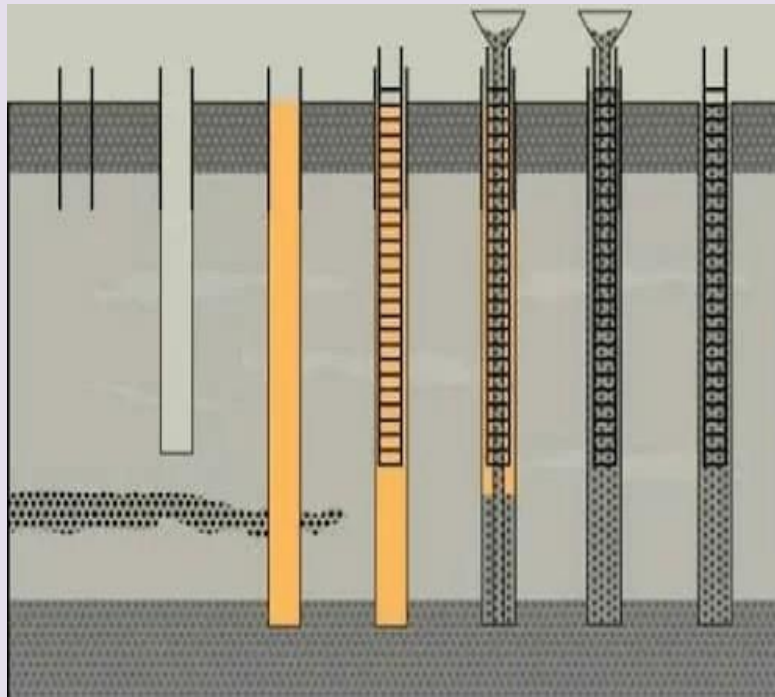
#### Disadvantages of Micropiles

- If there aren't any obstacles they're longer overwhelming than a driven pile
- Valuable
- Water infill is often a problem

#### Micropile Vs Typical Pile

- Micropiles are engaged in any difficult conditions involving soil and rock.
- Micropiles are custom and applied for tough terrains and applications.
- Micropiles are used for rehabilitation.
- Micropiles penetrate any surface and might be put in even though an existing foundation creating it is one of the simplest doable solutions for foundation rehabilitation and strengthening works.
- Small piles are used for slope stabilization, hill stabilization, and different soil improvement and any kind of ground improvement works.
- Micro piles are employed in areas wherever geological formation is high, urban backfills, areas having floating boulders or different tough terrains that can't even be accessed with a traditional pile.
- Used extensively within the rehabilitation of monuments, recent structures, sinking structures, etc altogether components of the globe.

#### Micro piles for Foundation Stabilization





Certain soil conditions will obstruct installation and even thwart the advancement of conventional underpinning solutions. When such conditions exist, trained and grouted micropiles provide an economical, deep foundation possibility capable of penetrating obstructions connected among competent bedrock.

- In compression applications, capability is achieved through finish bearing and conjointly skin friction on the interface of the grout column and therefore the bedrock.
- In tension applications, solely the skin friction contributes to the micropile capability.

#### Drilling Ways Adopted for Small Piles

The foremost common ways adopted for drilling are:

- Percussive Drilling used with a driving point/drill at an all-time low of the permanent casing is outlined as displacement technique whereas once the air is employed as a flushing medium. It is outlined as a non-displacement technique.
- Rotary drilling uses air or water as a flushing medium for removing the trained materials from the excavation. The air jet or water pumped up through the drilling system exits at the drilling bit and finishes flushing out the cuttings.

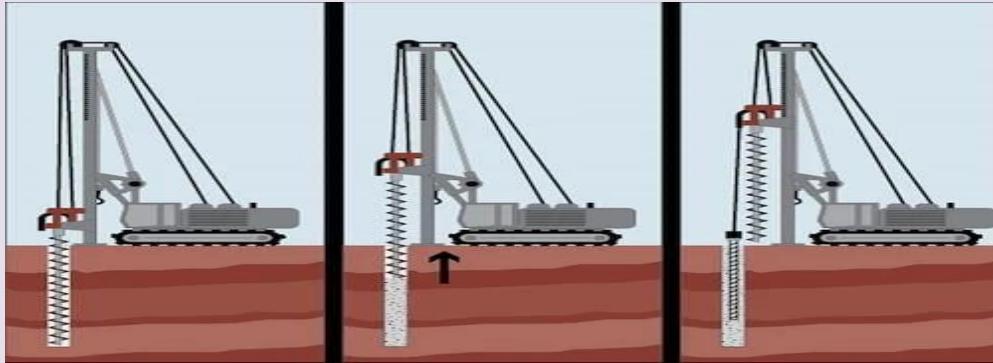
#### What Are the Everyday Applications for a Micropile?

- Micro-pile systems are most popular to support and stabilize buildings, bridges, highways, towers and alternative unreal structures, either as new foundations or remedial construction.
- Moreover, they are used for underpinning and shoring applications because of their high load capability and versatile installation techniques.

#### How Will the Micropile Installation Method Work?

- The first and foremost affair anyone would like to attempt, is to dig a cavernous hole with a tiny diameter.
- Once, house has been secured for the pile, lower that into the outlet and apply force to secure the pile.
- Then fill the outlet with a concrete grout concoction to keep everything in situ.

## How Are Micropiles Installed?



- Drilled into bedrock, micro-piles are bound to the rock socket wall for conveying a load.
- The casings of the mini piles are advanced as piles are trained into bedrock.
- Drill rod is withdrawn and the steel casing remains. On reaching the saturation level the drilling bit is withdrawn with casing left within the bore-hole.
- A reinforcement load bar is lowered into the casing. Assign reinforcement with centralizer within the borehole, along with tremie grout & cement water blend.
- Cementitious grout along with pressure is fed into the minipile casing and rock socket. After Tremie grouting, perform a pressure grouting through preinstalled grouting tubes.
- The casings for the mini piles are heaved up to a high of bedrock, which permits bonding to the bar.
- Excess steel is cut from the superiority of mini piles.

## Types of Micropile

Piles are generally categorized into 2 types:-

- Displacement Piles
- Replacement Piles

### 1. Displacement Piles

- Displacement piles are driven or vibrated into the bottom, thereby displacing the adjacent soil sideways during the inauguration.

### 2. Replacement Piles

- Replacement piles are constructed within a formerly drilled borehole, thus restoring the excavated ground.

## OZONE WATER TREATMENT

Ozone is a naturally occurring gas in earth's atmosphere and is one of nature's most powerful oxidizers. In the upper atmosphere, ozone filters the sun's ultraviolet light and protects earth from harmful radiation, but here on the surface, ozone plays a role in ensuring clean drinking water through ozone water treatment. Ozone water treatment is versatile and can be employed both commercially and in your home. Below you will learn about ozone water treatment, how it works, and whether an ozone water treatment system is right for you.

What is ozone water treatment?

Ozone water treatment is a water treatment method that reduces contaminants through ozone's oxidative strength. Ozone is an oxidant, which means it reacts with other substances and accepts their electrons. For example, when iron is oxidized, it becomes rust. Ozone water treatment begins with the creation of ozone in an ozone generator. Then, ozone is injected into water, and immediately starts oxidizing and eliminating contaminants, such as bacteria, viruses, and metals.

Ozone oxidizes organic material in the membranes of bacteria, viruses, and parasites. This weakens, ruptures, and kills their cells, eliminating the troublesome contaminants. Ozone also oxidizes iron, manganese, and copper into solid particles that can be easily filtered from water by mechanical filtration or certain activated carbon filters. Through oxidation, ozone water treatment systems can even rid water of turbidity and bad tastes and odors caused by chlorine.

How does ozone water treatment work?

Ozone water treatment works by dissolving ozone into water and through the ensuing oxidation of bacteria and other waterborne pathogens. To better understand the process, it is best to first understand how ozone is created. Ozone is born out of oxygen. An oxygen molecule contains two oxygen atoms ( $O_2$ ), while an ozone molecule contains three oxygen atoms ( $O_3$ ). When electricity or ultraviolet light stream through air, their energy splits oxygen molecules into two oxygen atoms. The loose oxygen atoms then recombine with ordinary oxygen molecules to form ozone. In the upper atmosphere, sunlight interacts with oxygen to produce earth's protective ozone layer. While closer to the surface, ozone is created when lightning strikes and electricity cuts through oxygen rich air. Both processes are mimicked in ultraviolet and electrical ozone generators, which make ozone water treatment possible. Ozone can also be produced by electrolytic and chemical reactions, but UV and electrical ozone generators are the most common for water treatment.

## Electrical ozone generators

Electrical ozone generators produce ozone through corona discharge, which mirrors the way ozone is created during a thunderstorm. Instead of lightning, a high voltage electrical discharge is passed through oxygen inside a glass, ceramic, or steel chamber. This facilitates the breakdown of molecular oxygen into atomic oxygen and allows for the formation of ozone. The ozone is then either bubbled into water or vacuumed in through a venturi tube and the oxidation process begins immediately.

## Ultraviolet light ozone generators

Ultraviolet light in the 160-240 nanometer (nm) range can create ozone from oxygen. Similar to the corona discharge process, UV light disrupts oxygen molecules and splits them into two oxygen atoms. The free atoms then combine with whole oxygen molecules to form ozone. In a UV ozone generator, ozone is produced as oxygen is passed between the lamp and the quartz sleeve of a UV light. The ozone is then drawn into water using a venturi and the water treatment process begins. However, UV ozone generators are not as powerful as electrical ozone generators and produce ozone at lower concentrations.

What do ozone water treatment systems remove from water?

- Bacteria
- Viruses
- Parasites, such as giardia and cryptosporidium
- Hydrogen sulfide
- Bad tastes and odors
- Turbidity
- Iron, manganese, and copper (when combined with another filtration method)

## Advantages of ozone water treatment systems 1. Cost

Ozone water treatment is expensive compared to more well-known water treatment methods, such as chlorination. It has high equipment and operational costs, and it may be difficult to find a professional who is proficient in ozone water treatment. Home ozone water treatment systems cost between a few hundred and a few thousand dollars. Although, for municipalities ozone water treatment could be cost effective overtime, because it offsets the chemical costs required for chlorination.

## 2. Difficult to transport

Ozone has a short half-life once dissolved in water, as its natural reaction is to turn back into oxygen. Therefore, it is difficult to store and transport and must be generated onsite for immediate use.

## 3. Potential corrosion and toxicity

Ozone is a toxic gas, so if an ozone generator leaks, it could create a hazard in your home. Common side effects of ozone exposure include headache and irritation of the eyes and throat. Also, because ozone is a strong oxidizer, it can corrode pipes and fixtures if they are not made of ozone resistant materials, such as stainless steel or Teflon.

What is ozone water treatment used for?

Ozone water treatment is used in commercial, industrial, and municipal water treatment systems, as well as in home systems. Major beverage companies rely on ozone water treatment technology and it is often used to disinfect bottled water. Ozone is also employed by cities to treat and disinfect municipal water supplies. Lastly, an ozone water treatment system can be purchased for your home. Their disinfectant properties are appealing to well owners who are concerned about the presence of bacteria and viruses in their water and may be used by people on a city water supply as an extra line of defense against contaminants. Also, ozone water treatment is an effective method to sanitize ice machines. For example, the Oxidice Ozone Sanitation System sanitizes the air, water, and surfaces within an ice machine, producing clean, odor-free ice.

### **Rajeshwari III Year-/Civil**

#### **SHALLOW FOUNDATION**

A shallow foundation is a type of building foundation that transfers building loads to the earth very near to the surface, rather than to a subsurface layer or a range of depths as does a deep foundation.

Shallow foundations include spread footing foundations, mat-slab foundations, slab-on-grade foundations, pad foundations, rubble trench foundations and earthbag foundations.

Shallow foundations are also called spread footings or open footings. The 'open' refers to the fact that the foundations are made by first excavating all the earth till the bottom of the footing, and then constructing the footing.

What is the Shallow Foundation in civil engineering?

A shallow foundation generally is defined as a foundation that bears at a depth less than about two times its width. There is a wide variety of shallow foundations. The most commonly used ones are isolated spread footings, continuous strip footings, and mat foundations.

Many shallow foundations are placed on reinforced concrete pads or mats, with the bottom of the foundation only a few feet below the ground surface.

The engineer will select the relatively inexpensive shallow foundation for support of the applied loads if analyses show that the near-surface soils can sustain the loads with an appropriate factor of safety and with acceptable short-term and long-term movement.

### Shallow Foundation Design

While designing a shallow foundation for a given loading system, the foundation must meet certain design requirements.

The three basic requirements or shallow foundation design criteria are as follows:

Placement of the foundation, which involves the depth and location of foundation.

Safety against bearing capacity is a requirement that includes suitable proportioning of the footing to avoid a catastrophic failure of the soil beneath the foundation.

Every soil settles due to load. Such settlement should be uniform and permissible. Tolerable foundation settlement includes keeping a check on the excessive settlement of a structure.

### Shallow Foundation Pros And Cons

We use a shallow foundation to distribute the structural loads over a wide horizontal area at shallow depth below the ground level. Shallow foundation is favorable for foundations having depth as equal as foundation width or where depth is less than the width.

#### Advantages Of Shallow Foundation

- It requires less excavation hence reduces labor cost of excavation work.
- Construction of shallow foundations is simple as the depth involved in placing the foundation is less.
- Equipment required for construction of shallow foundations are simple and also less costly.
- Shallow foundations can be constructed in a short time, which also helps in reducing the cost of hiring equipment and labor.
- Construction of shallow foundations would cause lesser disturbance to geo-surface and hence good for ecology and environment.
- It helps to reduce settlement, if soil is compressive.
- No piling is required, which reduces the cost.
- There is less uncertainty in the prediction of behavior of shallow foundations and supporting soil. For deep foundations as the depth of soil involved is more, the uncertainty will be also more.

## Disadvantages Of Shallow Foundation

- There is a chance of scouring if the structure is near a river or sea. Shallow foundation cannot be used at such places.
- If subsoil water level is high and it is uneconomical to pump out the water from the pit or canal then the shallow foundation cannot be used.
- It cannot be used where the bearing capacity of top surface soil is less.
- It cannot be used when the weight of the structure is high and load of the structure is distributed unequally.

During the early stages of work, the entire footing is visible to the eye, and is therefore called an open foundation. The idea is that each footing takes the concentrated load of the column and spreads it out over a large area, so that the actual weight on the soil does not exceed the safe bearing capacity of the soil. There are several kinds of shallow footings: individual footings, strip footings and raft foundations. In cold climates, shallow foundations must be protected from freezing. This is because water in the soil around the foundation can freeze and expand, thereby damaging the foundation. These foundations should be built below the frost line, which is the level in the ground above which freezing occurs. If they cannot be built below the frost line, they should be protected by insulation: normally a little heat from the building will permeate into the soil and prevent freezing.

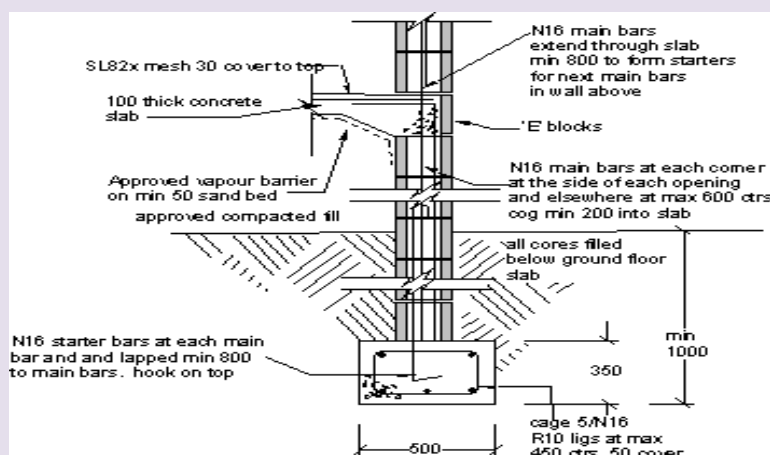
## Shallow Foundation Types

The different types of shallow foundations are:

- Spread or Isolated Footing;
- Strip Foundation;
- Mat or Raft Foundation;
- Combined Foundation.

## Wall footing

Also called strip footing, this footing is a continuous strip that supports structural and non-structural load bearing walls. Found directly under the wall, Its width is commonly 2-3 times wider than the wall above



### Isolated footing

Also called single-column footing, it is a square, rectangular, or circular slab that supports the structural members individually. Generally, each of its columns gets its footing to transmit and distribute the load of the structure towards the soil underneath. Sometimes, an isolated footing can be sloped or stepped at the base to spread greater loads. This type of footing is used when the structural load is relatively low, columns are widely spaced, and the soil's bearing capacity is adequate at a shallow depth.

### Combined footing

When more than one column shares the same footing, these are called combined footing. Utilized when the spacing of the columns is too restricted, that if isolated footing were used, they would overlap one another. Also, when property lines make isolated footings eccentrically loaded, combined footings are preferred. When the load among the columns is equal, the combined footing may be rectangular. Conversely, when the load among the columns is unequal, the combined footing should be trapezoidal.

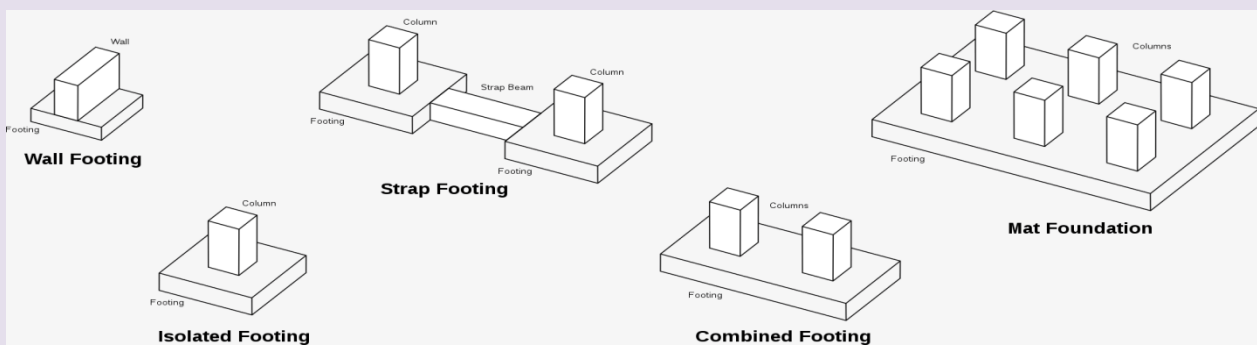


## Strap footing

A strap footing is when individual columns are connected to one another with the use of a strap beam. The general purpose of a strap footing is similar to those of a combined footing, where the spacing is possibly limited and/or the columns are adjacent to the property lines.

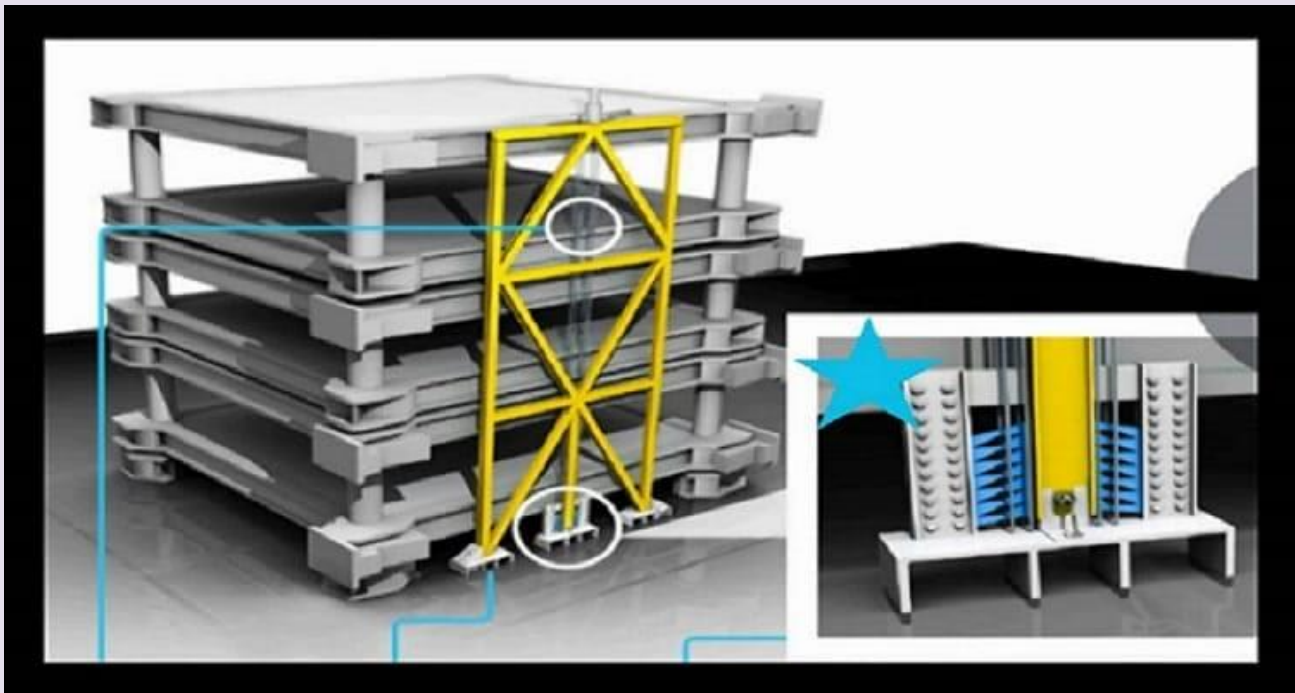
## Mat foundation

Also called raft foundation, it is a single continuous slab that covers the entirety of the base of a building. Mat foundations support all the loads of the structure and transmit them to the ground evenly. Soil conditions may prevent other footings from being used. Since this type of foundation distributes the load coming from the building uniformly over a considerably large area, it is favored when individual footings are infeasible due to the low bearing capacity of the soil.



**YOGESHWARAN.S IV YEAR-B/CIVIL**

## Advanced Earthquake Resistant Techniques



Earthquake-resistant structures are structures designed to protect buildings from earthquakes. While no structure can be entirely immune to damage from earthquakes, the goal of earthquake-resistant construction is to erect structures that fare better during seismic activity than their conventional counterparts. According to building codes, earthquake-resistant structures are intended to withstand the largest earthquake of a certain probability that is likely to occur at their location. Currently, there are several design philosophies in earthquake engineering, making use of experimental results, computer simulations and observations from past earthquakes to offer the required performance for the seismic threat at the site of interest.

These range from appropriately sizing the structure to be strong and ductile enough to survive the shaking with acceptable damage. The conventional approach to earthquake resistant design of buildings depends upon providing the building with strength, stiffness and inelastic deformation capacity which are great enough to withstand a given level of earthquake-generated force. This is generally accomplished through the selection of an appropriate structural configuration and the careful detailing of structural members, such as beams and columns, and the connections between them. But more advanced techniques for earthquake resistance is not to strengthen the building, but to reduce the earthquake-generated forces acting upon it.

Among the most important advanced techniques of earthquake resistant design and construction are:

1. Base Isolation
2. Energy Dissipation Devices

Base Isolation Method of Earthquake Resistant Design

A base isolated structure is supported by a series of bearing pads which are placed between the building and the building's foundation. A variety of different types of base isolation bearing pads have now been developed. The bearing is very stiff and strong in the vertical direction, but flexible in the horizontal direction. To get a basic idea of how base isolation works, examine Figure . This shows an earthquake acting on both a base isolated building and a conventional, fixed-base, building. As a result of an earthquake, the ground beneath each building begins to move. In Figure, it is shown moving to the left. Each building responds with

movement which tends toward the right. The building undergoes displacement towards the right. The building's displacement in the direction opposite the ground motion is actually due to inertia. The inertial forces acting on a building are the most important of all those generated during an earthquake. It is important to know that the inertial forces which the building undergoes are proportional to the building's acceleration during ground

motion. It is also important to realize that buildings don't actually shift in only one direction. Because of the complex nature of earthquake ground motion, the building actually tends to vibrate back and forth in varying directions. By contrast, even though it is too displacing, the base-isolated building retains its original,

rectangular shape. It is the lead-rubber bearings supporting the building that are deformed.

The base-isolated building itself escapes the deformation and damage, which implies that the inertial forces acting on the base-isolated building have been reduced. Experiments and observations of base-isolated buildings in earthquakes have been shown to reduce building accelerations to as little as 1/4 of the acceleration of comparable fixed-base buildings, which each building undergoes as a percentage of gravity. As we noted above, inertial forces increase, and decrease, proportionally as acceleration increases or decreases.

Acceleration is decreased because the base isolation system lengthens a building's period of vibration, the time it takes for the building to rock back and forth and then back again. And in general, structures with longer periods of vibration tend to reduce acceleration, while those with shorter periods tend to increase or amplify acceleration. Finally, since they are highly elastic, the rubber isolation bearings don't suffer any damage. But the lead plug in the middle of our example bearing experiences the same deformation as the rubber. However, it generates heat.

### Energy Dissipation Devices

The second of the major new techniques for improving the earthquake resistance of buildings also relies upon damping and energy dissipation, but it greatly extends the damping and energy dissipation provided by

lead-rubber bearings. As we've said, a certain amount of vibration energy is transferred to the building by earthquake ground motion. Buildings themselves do possess an inherent ability to dissipate, or damp, this energy. However, the capacity of buildings to dissipate energy before they begin to suffer deformation and damage is quite limited. The building will dissipate energy either by undergoing large scale movement or sustaining increased internal strains in elements such as the building's columns and beams. Both of these eventually result in varying degrees of damage. So, by equipping a building with additional devices which have high damping capacity, we can greatly decrease the seismic energy entering the building, and thus decrease building damage. Accordingly, a wide range of energy dissipation devices have been developed and are now being installed in real buildings. Energy dissipation devices are also often called damping devices. The large number of damping devices that have been developed can be grouped into three broad categories: Friction

Dampers: these utilize frictional forces to dissipate energy Metallic Dampers : utilize the deformation of metal

elements within the damper Viscoelastic Dampers : utilize the controlled shearing of solids Viscous

Dampers: utilized the forced movement (orificing) of fluids within the dampe.

## Construction Methods

1. Base-isolation is designed in buildings. It is a building designed to reduce the amount of energy that reaches the building during earthquakes. 2. Flexible joints and automatic shut off valves can be installed. Protecting

Against Earthquake Damage Prepare a Seismic Risk Map for the globe which identifies rock types, liquefaction potential, landslide potential. Extensive geological surveying has to be done to identify all active faults, including hidden faults. Earthquake Resistant Design of Structures Enact building codes to design and build earthquake-resistant structures in high seismic risk areas. wood, steel and reinforced concrete are preferred as they tend to move with the shaking ground (unreinforced concrete and heavy masonry tend to move independently and in opposition to the shaking, battering one another until the structure collapses)

## GUIDELINES FOR EARTHQUAKE RESISTANT CONSTRUCTION

In addition to the main earthquake design code 1893 the BIS (Bureau of Indian Standards) has published other relevant earthquake design codes for earthquake resistant construction Masonry structures (IS-13828 1993) • Horizontal bands should be provided at plinth, lintel and roof levels as per code • Providing vertical

reinforcement at important locations such as corners, internal and external wall junctions as per code. • Grade of mortar should be as per codes specified for different earthquake zones. • Irregular shapes should be avoided both in plan and vertical configuration. • Quality assurance and proper workmanship must be ensured at all cost without any compromise. In RCC framed structures (IS-13920) • In RCC framed structures the spacing of lateral ties should be kept closer as per the code • The hook in the ties should be at 135 degree instead of 90 degree for better anchorage. • The arrangement of lateral ties in the columns should be as per code and must be continued through the joint as well.

**DURGA.M IV YEAR-A/CIVIL**