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Department of Civil Engineering

BASIC CIVIL AND MECHANICAL ENGINEERING (23ES1T01)

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UNIT-I Basics of Civil Engineering

SYLLABUS: Role of Civil Engineers in Society- Various Disciplines of Civil Engineering- Structural Engineering- Geo-technical Engineering- Transportation Engineering - Hydraulics and Water Resources Engineering - Environmental Engineering-Scope of each discipline.
Building Construction and Planning- Construction Materials- Cement - Aggregate - Bricks- Cement concrete- Steel. Introduction to Prefabricated construction Techniques
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INTRODUCTION TO CIVIL ENGINEERING:-

- Civil engineering is a professional engineering discipline that deals with the design, construction, and maintenance of the physical and naturally built environment, including public works such as roads, bridges, canals, dams, airports, sewage systems, pipelines, structural components of buildings, and railways.
- Civil engineering is traditionally broken into a number of sub-disciplines. Civil engineering is the application of physical and scientific principles for solving the problems of society, and its history is intricately linked to advances in the understanding of physics and mathematics throughout history.
- Because civil engineering is a broad profession, including several specialized sub-disciplines, its history is linked to knowledge of structures, materials science, geography, geology, soils, hydrology, environmental science, mechanics, project management and other fields.

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UNIT-1.A.

1. Explain the various contributions of civil engineers to the welfare of the society?

ANS:

1. Civil engineer will work on planning, design, construction and maintenance of projects such as roads, buildings, dams, bridges, sewages and water supply systems.
2. Civil engineering is about community service, development, and improvement.
3. Civil engineers often use theory and models to predict how a design will perform.
4. Civil engineers test their ideas on field without endangering life.
5. Civil engineers develop infrastructure for the society which is the backbone of the society.
6. Civil engineers increase the health and quality of life by developing better water supply, sewage systems, and waste water plants, to protect from natural hazards and provide health care.
7. Civil engineers improve agriculture through water management systems and distribution projects.
8. Civil engineers provide solution for the rapid and dramatic changes of transportation.
9. Structural engineers deals with connections design, analysis and construction of components to resist loads from internal and external forces.
10. As a structural engineer, you will face the challenge of analyzing and designing structures to ensure that they safely perform their purpose.
11. They must support their own weight and resist dynamic environmental loads such as hurricanes, earthquakes, blizzards, and floods.
12. Stadiums, arenas, skyscrapers, offshore oil structures, space platforms, amusement park rides, bridges, office buildings, and homes are a few of the many types of projects in which structural engineers are involved
13. Structural engineers develop new materials other than steel and cements which with stand more loads & have high strength by weight ratio which includes FRP, polymers, etc,.
14. Geotechnical engineers apply the knowledge about the behavior of soils and its composition for design of Foundations, retaining walls, earth dams, clay liners and geo synthetics for waste condiments.
15. Examples of facilities in the earth are tunnels, deep foundations, and pipelines. Highway pavements and many buildings are supported on the earth.

16. Transportation plays and essential role in the development of the society by providing trade routes and harbors air routes etc,.
17. Civil engineers plan, design, built, operate and maintain these of transport.
18. Civil engineers provide safe, efficient and convenient movement of people and goods
19. Civil engineers consider the forces and movements, weight and stress of the vehicles in motion and centrifugal forces at curves while the design the transportation.
20. The collection, storage, treatment, transmission and distribution of water played a significant role in urbanization, population growth and commercial agriculture and land use.

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2. What is the ROLE OF CIVIL ENGINEERS in society?

ANS:

A civil engineer has to conceive, plan, estimate, get approval, create and maintain all civil engineering activities.

Civil engineer has very important role in the development of the following infrastructure:

1. Measure and map the earth's surface.
2. Plan new townships and extension of existing towns.
3. Build the suitable structures for the rural and urban areas for various utilities.
4. Build tanks and dams to exploit water resources.
5. Build river navigation and flood control projects.
6. Build canals and distributaries to take water to agricultural fields.
7. Purify and supply water to the needy areas like houses, schools, offices etc.
8. Provide and maintain communication systems like roads, railways, harbors and airports.
9. Devise systems for control and efficient flow of traffic.
10. Provide and maintain solid and waste water disposal system.
11. Monitor land, water and air pollution and take measures to control them.

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3. Briefly explain Structural Engineering and its scope.

ANS:

Broad disciplines of Civil Engineering:

Civil engineering is a wide field and includes many types of structures such as residential buildings, public buildings, industrial buildings, roads, bridges, tunnels, railways, dams, canals, airports, harbours, waste water treatment plants, water supply networks and drainage networks, drainage networks etc.

According to the type of structures and activities carried out, main branches of civil engineering are classified as follows:

1. Structural Engineering
2. Geotechnical Engineering
3. Transportation Engineering
4. Environmental Engineering
5. Water resources Engineering

Structural Engineering

1. Before building a structure, it should be analyzed and designed to decide about its size to resist the possible forces coming on it.
2. The structure should be safe and at the same time its components should be as small as possible.
3. Need of tall structures and improvements in computers gave rise to matrix method and finite element method of analysis.
4. Disasters due to earthquakes have made civil engineers to study earthquake forces and build earthquake resistant structures.
5. It needs the knowledge of structural dynamics.
6. A civil engineer has to not only give a safe structure but he has to give an economical structure also.
7. Hence, there is need for studying mathematical optimization techniques.

8. All these aspects of analysis and design fall under structural engineering field.

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4. Briefly explain Geotechnical Engineering and its scope?

ANS:

Geotechnical Engineering

1. All structures have to finally transfer the load acting on them to soil safely.
2. Soil property changes from place to place. Even in the same place it may not be uniform at different depth and in different seasons.
3. Hence, a civil engineer has to properly investigate soil and decide about the safe load that can be spread on the soil. This branch of study in civil engineering is known as geotechnical engineering.
4. Apart from finding safe bearing capacity for foundation of buildings, geotechnical engineering involves various studies required for the design of pavements, tunnels, earthen dam, canals and earth retaining structures.
5. It involves study of ground improvement techniques also.

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5. Briefly explain Hydraulics, Water Resources engineering and its scope?

ANS:

Hydraulics, Water Resources Engineering

1. Water is an important need for all living beings. Study of mechanics of water and its flow characteristics is another important field in civil engineering and it is known as hydraulics.
2. Requirement of water in cities for domestic purpose and for industries is continuously increasing.
3. Rural areas need water for agricultural field also. Hence civil engineers have to look for new water resources and for storing them. This branch of civil engineering is known as water resources engineering.
4. Water stored in reservoirs by building bunds and dams should be brought to agricultural fields through canals and distributaries.
5. Study connected with this aspect is known as irrigation engineering.

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6. Briefly explain Environmental Engineering and its scope?

ANS:

Environmental Engineering

1. Apart from tackling solid and waste water disposal civil engineers have to tackle air pollution problem also. Due to industrialization air pollution is becoming a major problem.
2. It is estimated that for every tone of cement produced one tone of CO_2 is released to environment. Vehicles also produce lot of CO_2.
3. During the last one century, the environmental pollution has resulted in global warming by 4°C.
4. An environmental disaster will be unavoidable if China, India and other developing countries start consuming as much energy and materials as the West did it in its march to industrialization.
5. Hence environmental engineering is emerging as an important field of study in civil engineering.

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7. Briefly explain Transportation Engineering and its scope?

ANS:

Transportation Engineering

1. Transportation facility is another important need. Providing good and economical road links is an important duty of civil engineers.
2. It involves design and construction of base courses, suitable, surface finishes, cross drainage works, intersections, culverts, bridges and tunnels etc.

3. Railways are another important long-way transport facility.
4. Design, construction and maintenance of railway lines are parts of transportation engineering.
5. Globalization has resulted into requirement of airports and harbors.
6. For proper planning of these transport facilities, traffic survey is to be carried out.
7. Carrying out traffic survey and then planning, designing, construction and maintenance of roads, railways, bridges, tunnels, airports and harbors is known as transportation engineering.

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8. Write short note on impact of infrastructure development on the economy of the country.

ANS:

Civil engineering activities in the infrastructural development are:

(*i*) Good planning of towns and extension areas in the cities. Each extension area should be self-sufficient in accommodating offices, educational institutions, markets, hospitals, recreational facilities and residential accommodation.

(*ii*) Assured water supply.

(*iii*) A good drainage system.

(*iv*) Pollution free environnemental conditions.

(*v*) A well planned and built network of roads and road crossings.

(*vi*) Railways connect to all important cities and towns.

(*vii*) Airports and harbor of national and international standards.

(viii)Infrastructure also involves electricity supply, without assured electric supply no city town can develop.

(ix)Internet and telephones are also desirable features.

(x)Educational facility also forms part of infrastructure. Proximity of good primary and secondary schools to residential areas is desirable.

(xi)Collegiate and professional education also forms part of infrastructure of a city.

(xii)Good health care facility is a necessity. Primary health centers, specialized hospitals and doctors add to the desirable infrastructure facility.

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UNIT-1.B - Building Construction and Planning

9. What is meant by Building Construction and Planning?

ANS:

Building construction and planning is the process of constructing buildings, whether residential, commercial, or industrial, requires meticulous planning, design, and execution to ensure safety, functionality, and sustainability.

The Importance of Building Construction

1. Infrastructure Development: Building construction is at the core of infrastructure development. It includes the creation of roads, bridges, airports, and other vital facilities that connect communities and enable economic activities. The quality and efficiency of these structures have a direct impact on transportation, trade, and overall regional development.

2. Shelter and Housing: One of the primary functions of building construction is providing shelter and housing for the population. Affordable and well-designed housing is essential for a high quality of life and social well-being. It not only meets the basic human need for shelter but also fosters a sense of security and belonging.

3. Economic Growth: Construction activities stimulate economic growth by creating jobs, promoting local industries, and attracting investments. A thriving construction sector contributes to the Gross Domestic Product (GDP) and supports various related industries, such as manufacturing and real estate.

4. Environmental Considerations: In recent years, there has been a growing emphasis on environmentally friendly construction practices. Sustainable building construction focuses on reducing energy consumption, minimizing waste, and using eco-friendly materials. These practices not only conserve natural resources but also reduce greenhouse gas emissions.

The Role of Planning in Building Construction

1. Land Use and Zoning: Urban planning plays a crucial role in determining land use and zoning regulations. Proper zoning ensures that land is used efficiently and that residential, commercial, and industrial areas are appropriately segregated. Zoning also promotes mixed-use developments that can reduce traffic congestion and promote walkability.

2. Safety and Resilience: Planning involves considering the safety and resilience of buildings and infrastructure. Designing structures that can withstand natural disasters like earthquakes, floods, and hurricanes is essential for protecting lives and property. Adequate planning can also help mitigate the impacts of climate change on urban areas.

3. Aesthetics and Design: Urban planning considers the aesthetics and design of buildings and public spaces. Well-designed cities and neighborhoods enhance the quality of life, promote cultural identity, and encourage tourism. Thoughtful planning can preserve historical landmarks and promote innovative architectural designs.

4. Transportation and Accessibility: Planning encompasses transportation systems and accessibility. Efficient public transportation networks, pedestrian-friendly streets, and bicycle lanes can reduce traffic congestion, air pollution, and energy consumption. These elements contribute to a more sustainable and livable urban environment.

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10. Write about different construction materials?

ANS:

Construction materials are the materials used to construct buildings, roads, and other infrastructure. Construction materials must be strong and durable to withstand the forces of construction and use. They must also be able to resist weathering and other environmental effects.

The construction materials list includes cement, steel, sand, concrete, ready-mix concrete, binding wires, aggregates, bricks, blocks, etc. apart from these, various eco-friendly construction materials are also used in building construction.

1. Cement

Cement is a binder, a substance used for construction that sets, hardens, and adheres to other materials to bind them together. Cement is seldom used but rather to bind sand and gravel together. Cement companies produced mixed with fine aggregate to make mortar for masonry, or with sand and gravel for concrete.

2. Steel

Structural steel is a popular construction material used alongside concrete to create impressive and long-lasting buildings. Its versatility, sustainability, and flexibility are the main reasons for its use and cost-effectiveness.

Steel reinforcement bars or rebars are used to improve the tensile strength of the concrete since concrete is fragile in tension but is strong in compression. Steel is only used as rebar because of the elongation of steel due to high temperatures (thermal expansion coefficient) nearly equal to that of concrete.

3. River sand or Natural sand

The sand should be white-grey and is one of the fine-graded sands used to construct buildings. They are mainly used in concrete and masonry work. They can also be used for RCC, plastering, and other brick or block works.

4. Concrete

Concrete is the most widely used construction material in the entire world. These materials include cement, water, fine aggregate, and crushed stones or gravel. Sand and gravel or crushed stones are fine aggregate and coarse aggregate, respectively.

5. Binding wires

Binding Wire is used for tying applications in the field of construction. It is used extensively in the construction sector to tie the rebars at the joints to keep the structure intact. Binding wire is also called annealed wire and is made of mild steel.

6. Fly Ash

Fly ash is a refined powder byproduct of burning pulverized coal in electric power plants. Fly ash is a pozzolan, a substance containing aluminous and siliceous material that forms cement in the presence of

water. Fly ash can be used as prime material in many cement-based products, such as poured concrete, concrete block, and brick.

7. Aggregate – Construction Materials

Construction aggregate, or simply aggregate, is a broad category of coarse to medium-grained particulate material used in construction, including sand, gravel, crushed stone, slag, recycled concrete, and geosynthetic aggregates. Aggregates are the most mined materials in the world.

8. Bricks

A brick is a type of block used to build walls, pavements, and other elements in masonry construction. Appropriately, the term brick denotes a block composed of dried clay but is now also used informally to indicate other chemically cured construction blocks.

9. Timber (Wood)

Timber is used indoors, in the windows, cabinets, cupboards, shelves, tables, railings, etc. Timber is also popularly used in the form of plywood & raw wood. Products like ply blocks and ply boards, heavy patterned doors, and windows are made of solid wood/timber to provide strength, toughness, and durability.

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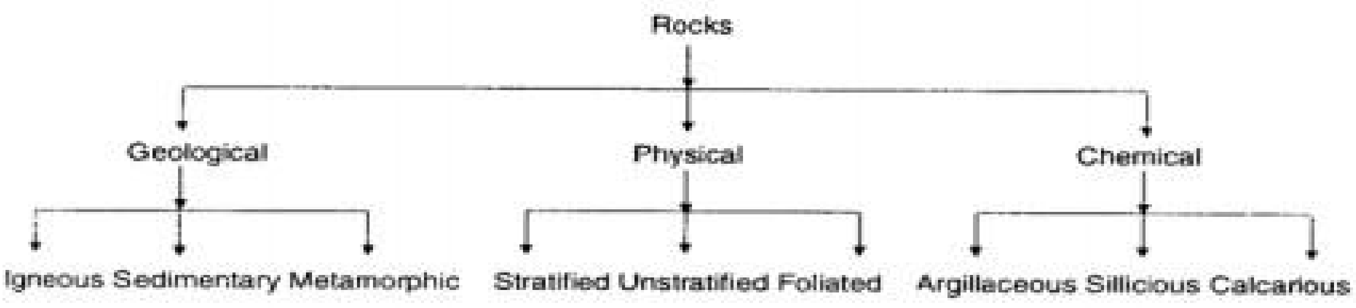
11. List out various types of classification of rocks, giving examples of each?

ANSWER

The rocks may be classified on the basis of their geological formation, physical characteristics and chemical composition as shown in Fig.



Igneous Rocks:

Igneous rocks are of volcanic origin and are formed as a result of solidification of molten mass lying below or above the earth's surface. The inner layers of the earth are at a very high temperature causing the masses of silicates to melt. This molten mass called magma is forced up as volcanic eruptions and spreads over the surface of earth where it solidifies forming basalt and trap. These are known as effusive rocks. Examples are Quartz, Monzonite

Sedimentary Rock:

These are also known as aqueous or stratified rocks. The various weathering agencies, e.g. rain, sun, air, frost, etc. break up the surface of earth. Rain water carries down these broken pieces to the rivers. As the rivers descend down to the plains, the velocity decreases gradually and the sediments (disintegrated rock pieces, sand, silt, clay, debris, etc.) in the water settle. Examples are shale, limestone, sandstone, siltstone, and conglomerate.

Metamorphic Rock:

These are formed from igneous or sedimentary rocks as a result of the action of the earth movements, temperature changes, liquid pressures, etc. The resultant mass may have a foliated structure, e.g. slate, gneiss, schist and phyallite or non-foliated structure, e.g. marble, quartzite and serpentine.

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12. Explain in detail the composition and manufacture process of good bricks using a flow chart?

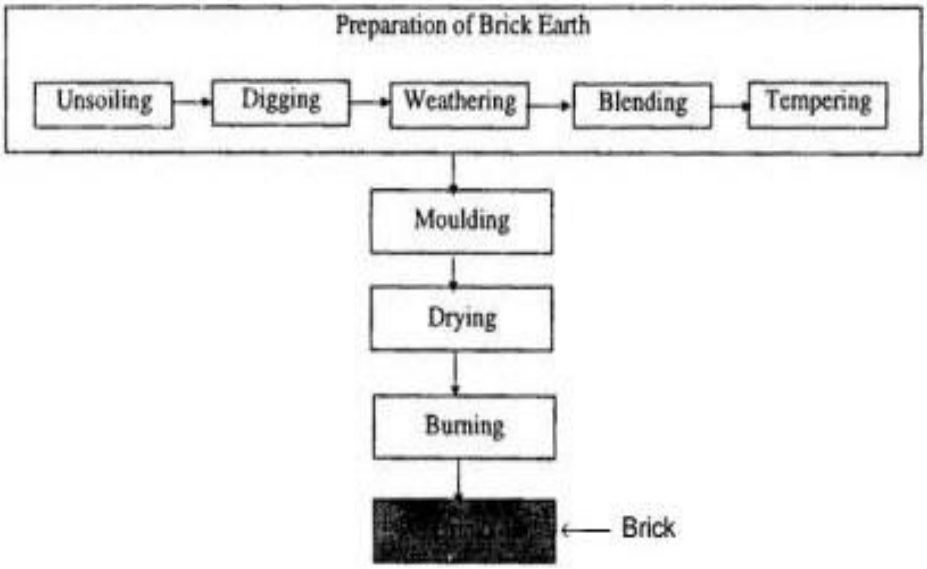
ANS:

- For the preparation of bricks, clay or other suitable earth or soil is moulded to the desired shape after subjecting it to several processes. After drying, it should not shrink and no crack should develop.
- The clay used for brick making consists mainly of silica and alumina mixed in such a proportion that the clay becomes plastic when water is added to it.

- It also consists of small proportions of lime, iron, manganese, sulphur, etc. The proportions of various ingredients are as follows:

Silica	50–60%	
Alumina	20–30%	
Lime	10%	
Magnesia	< 1%	Less than 20%
Ferric oxide	< 7%	
Alkalis	< 10%	
Carbon dioxide		Very small percentage
Sulphur trioxide		
Water		

The operations involved in the manufacture of clay bricks are represented diagrammatically in below figure.



PREPARATION OF BRICK:

It consists of the following operations.

1. Unsoiling: The soil used for making building bricks should be processed so as to be free of gravel, coarse sand (practical size more than 2 mm), lime and kankar particles, organic matter, etc. About 20 cm of the top layer of the earth, normally containing stones, pebbles, gravel, roots, etc., is removed after clearing the trees and vegetation.

2. Digging: After removing the top layer of the earth, proportions of additives such as fly ash, sandy loam, rice husk ash, stone dust, etc. should be spread over the plane ground surface on volume basis. The soil mass is then manually excavated, watered and left over for weathering and subsequent processing. The digging operation should be done before rains.

3. Weathering*:* Stones, gravels, pebbles, roots, etc. are removed from the dug earth and the soil is heaped on level ground in layers of 60–120 cm. The soil is left in heaps and exposed to weather for at least one month in cases where such weathering is considered necessary for the soil. This is done to develop homogeneity in the mass of soil, particularly if they are from different sources, and also to eliminate the impurities which get oxidized.

4. Blending: The earth is then mixed with sandy-earth and calcareous-earth in suitable proportions to modify the composition of soil. Moderate amount of water is mixed so as to obtain the right consistency for moulding. The mass is then mixed uniformly with spades. Addition of water to the soil at the dumps is necessary for the easy mixing and workability, but the addition of water should be controlled in such a way that it may not create a problem in moulding and drying. Excessive moisture content may effect the size and shape of the finished brick.

5. Tempering: Tempering consists of kneading the earth with feet so as to make the mass stiff and looks like plastic. For manufacturing good brick, tempering is done in pug mills and the operation is called pugging. The yield from a pug mill is about 1500 bricks.

6. Moulding:

It is a process of giving a required shape to the brick from the prepared brick earth. Moulding may be carried out by hand or by machines. The process of moulding of bricks may be the soft-mud (hand moulding), the stiff-mud (machine moulding) or the dry press process (moulding using maximum 10 per cent water and forming bricks at higher pressures). Fire- brick is made by the soft mud process. Roofing, floor and wall tiles are made by dry-press method. However, the stiff-mud process is used for making all the structural clay products.

a. Hand Moulding

b. Ground Moulding

c. Table Moulding

d. Machine Moulding

7. Drying:

The object of drying is to remove the moisture to control the shrinkage and save fuel and time during burning. The drying shrinkage is dependent upon pore spaces within the clay and the mixing water.

Clay products can be dried in open air driers or in artificial driers. The artificial driers are of two types, the hot floor drier and the tunnel drier. In the former, heat is applied by a furnace placed at one end of the drier or by exhaust steam from the engine used to furnish power and is used for fire bricks, clay pipes and terracotta. Tunnel driers are heated by fuels underneath, by steam pipes, or by hot air from cooling kilns. They are more economical than floor driers. In artificial driers, temperature rarely exceeds 120°C.The time varies from one to three days. In developing countries, bricks are normally dried in natural open air driers.

8. Burning of Bricks:

Kiln Burning: The kiln used for burning bricks may be underground, e.g. Bull's trench kiln or over ground, e.g. Hoffman's kiln. These may be rectangular, circular or oval in shape. When the process of burning bricks is continuous, the kiln is known as continuous kiln, e.g. Bull's trench and Hoffman's kilns. On the other hand if the process of burning bricks is discontinuous, the kiln is known as intermittent kiln.

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13. What are the different tests conducted on bricks and uses of bricks?

ANS:

The following are the required properties of good bricks:

(i) Colour: Colour should be uniform and bright.

(ii) Shape: Bricks should have plane faces. They should have sharp and true right angled corners.

(iii) Size: Bricks should be of standard sizes as prescribed by codes.

(iv)Texture: They should possess fine, dense and uniform texture. They should not possess fissures, cavities, loose grit and unburnt lime.

(v) Soundness: When struck with hammer or with another brick, it should produce metallic sound.

(vi) Hardness: Finger scratching should not produce any impression on the brick.

(vii) Strength: Crushing strength of brick should not be less than 3.5 N/mm^2. A field test for strength is that when dropped from a height of 0.9 m to 1.0 mm on a hard ground, the brick should not break into pieces.

(viii) Water Absorption: After immersing the brick in water for 24 hours, water absorption should not be more than 20 per cent by weight. For class-I works this limit is 15 per cent.

(ix) Efflorescence: Bricks should not show white patches when soaked in water for 24 hours and then allowed to dry in shade. White patches are due to the presence of sulphate of calcium, magnesium and potassium. They keep the masonry permanently in damp and wet conditions.

(x) Thermal Conductivity: Bricks should have low thermal conductivity, so that buildings built with them are cool in summer and warm in winter.

(xi) Sound Insulation: Heavier bricks are poor insulators of sound while light weight and hollow bricks provide good sound insulation.

(xii) Fire Resistance: Fire resistance of bricks is usually good. In fact bricks are used to encase steel columns to protect them from fire.

Uses of Bricks

Bricks are used in the following civil works:

(*i*) As building blocks.

(*ii*) For lining of ovens, furnaces and chimneys.

(*iii*) For protecting steel columns from fire.

(*iv*) As aggregates in providing water proofing to R.C.C. roofs.

(*v*) For pavers for footpaths and cycle tracks.

(*vi*) For lining sewer lines.

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14. What is an aggregate, Write about different types of aggregates, their uses, also discuss about different properties of aggregates?

ANS:

Aggregate is hard material made up of rock materials. It consists of many types, that include gravel, concrete, crushed rock, etc. It is used in the construction of buildings, construction of pavement surfaces, etc. These aggregates can be used for making concrete with the proper mixing of sand and cement. The properties of the aggregates will be different for different sizes of aggregates.

Aggregates can be of many types based on the different parameters. These parameters can be shape, size, strength, etc. Based on the size of the aggregates, they can broadly be classified as **1. Fine aggregate**

2. Coarse aggregate

1. Fine aggregate: This is the aggregate for which its size ranges between 4.75 mm to 0.075 mm. These are also called sand. These are the natural particles that the mining process can generate. It consists of the particle of the crushed stone or the sandy material.

2. Coarse aggregate: These aggregates have a size of more than 4.75 mm. These aggregates are used in the construction of concrete structures. Such aggregates include river gravel and stone particles made from rock stratum.

Uses of Aggregate

Aggregates have many uses in the construction of various structures. Aggregates are used to construct buildings, railway bridges, dams and other concrete structures. Using aggregates in concrete structures helps to bind the other ingredients in the concrete structures.

Aggregate enhances the strength of the concrete structures. The crushing strength of concrete is enhanced by using aggregate material. It increases the compactness of the aggregate. Its uses in concrete structures reduce the cement quantity in the concrete. Aggregates are used in different sizes in the concrete mix based on the required strength and compactness.

- Aggregates provide more strength to the concrete.
- The use of aggregates in concrete structures increases the compactness of the structures.
- The use of aggregate reduces the quantity of cement in the concrete mix.
- It also reduces the water requirement in the concrete mix.
- It reduces the shrinkage of concrete in the dry mix.
- It reduces the voids in the concrete.

Different properties of aggregates

1. Size: Aggregates come in various sizes, from fine particles smaller than 4.75mm to large rocks over 152 mm in diameter. The size of the aggregate affects its workability, durability, and strength.

2. Shape: Aggregates can be angular, rounded, or irregular in shape. Angular aggregates provide better interlocking, while rounded aggregates offer better workability. The shape of the aggregate affects the strength and durability of the resulting material.

3. Specific gravity: Specific gravity is the ratio of the weight of a substance to the weight of an equal volume of water. The specific gravity of aggregates is important for determining the weight of materials needed for a project.

4. Absorption: Aggregates have varying levels of porosity, which affects their ability to absorb water. Aggregates with high absorption rates can increase the risk of cracking and other types of damage in the resulting material.

5. Strength: The strength of aggregates is determined by their resistance to crushing and impact. The strength of the aggregate affects the strength and durability of the resulting material.
6. Durability: Aggregates must be able to withstand environmental factors such as freezing and thawing cycles, exposure to moisture, and other types of wear and tear. The durability of the aggregate affects the durability of the resulting material.
7. Cleanliness: Aggregates should be free from organic matter, clay, silt, and other types of impurities that can affect the strength and durability of the resulting material.
8. Grading: The grading of aggregates refers to the distribution of sizes within a batch. Proper grading ensures that the resulting material has the right workability, strength, and durability.

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15. Discuss about different tests on Aggregates?

ANS:

Different types of tests are carried out on the aggregate to determine its properties like strength, durability, corrosion resistance, hardness, etc. Here are some tests on aggregates mentioned below:
1. Crushing test: This test is carried out to determine the aggregate's crushing strength according to IS code 2386 (part IV) 1963. The crushing value of an aggregate indicates the resistance against the crushing of the aggregates. If the crushing value of the aggregate is on or above 35, it will be considered a weak aggregate.
2. Abrasion test: Los angles abrasion test is carried out to know the abrasion resistance of the coarse aggregate. It determines the percentage wear of the aggregate due to relative rubbing. It also indicates the hardness property of the aggregates.
3. Impact test: Aggregate may be supposed to impact load during its life cycle, so it's important to get the impact strength of the aggregate. It measures the strength of the aggregate against the impact load acting over the aggregate. It indicates the toughness of the aggregate.
4. Soundness test: This test indicates the durability of the aggregate. It also indicates the aggregate's resistance property against adverse weather conditions.
5. Shape test: This test is carried out to know the shape of the aggregate. The flakiness index and elongation index are the main important parameters to define the shape of the aggregates.

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16. What are the properties and uses of cement?

Or

Write about the various ingredients of Portland cement along with their functions?

ANS:

- Cement is broadly described as material having adhesive and cohesive property with capacity to bond the material like stone, bricks, building blocks etc.
- James Parker developed cement from clay minerals and calcium carbonate and patented as Roman cement in 1796.
- Cement is a binder, a substance that sets and hardens independently, and can bind other materials together. Cements are inorganic material that shows the cementing properties of setting and hardening when mixed with water.
- Cement is prepared from calcareous (Ca) material and argillaceous (Al + Si) material.
- Cement has property of setting and hardening under water by virtue of chemical reaction of hydrolysis and hydration.
- Cement is used for structural construction like buildings, roads, bridges, dam etc.

Properties of cement:

- It gives strength to the masonry works.
- It is an excellent binding material.
- It is easily workable
- It offers good resistance to the moisture
- It possesses a good plasticity.
- It hardens early.

Uses of cement:

- Cement mortar for masonry works

- Cement Concrete for laying floors, roofs, lintels, beams, stairs, pillars etc
- Construction of important engineering structures such as Bridges
- Culverts, Dams, Tunnels, Storage reservoirs, Docks etc
- Making Cement Pipes
- Manufacture of precast pipes, dust bins, fencing posts etc.

Composition of various ingredients of Portland cement along with their functions cement:-

The Portland cement consists of the following chemicals

- Lime - CaO- 62%
- Silica –SiO_2-22%
- Alumina - Al_2O_3 -5%
- Calcium sulphate-$CaSO_4$-4%
- Iron Oxide-Fe_2O_3-3%
- Magnesia-MgO-2%
- Sulphur-S-1%
- Alkaline and other material-1%

Portland cement is actually a chemically complex material composed of 4 major compounds (phases):

• Tricalcium silicate (Ca_3SiO_5)

• Dicalcium silicate (Ca_2SiO_4)

• Tricalcium aluminate ($Ca_3Al\ _2O_6$)

• Tetracalcium aluminoferrite ($Ca_4Al\ _2Fe_2O_{10}$)

Each contributes different properties to the cement.

Tricalcium silicate (C_3S) hydrates and hardens fairly quickly and is largely responsible for initial setting and early strength gain.

Dicalcium silicate (C_2S) hydrates and hardens slowly and is largely responsible for long-term strength gain.

Tricalcium aluminate (C_3A) hydrates and hardens the quickest, liberating a large amount of heat in the process. It is primarily responsible for setting.

Gypsum is added to portland cement to retard C_3A hydration. Without the gypsum, C_3A hydration would cause the portland cement to set almost immediately after adding water.

C_3A reacts poorly when exposed to sulfates ($MgSO_4$ and $NaSO_4$ salts) that naturally occur in groundwater, seawater, and some clayey soils. The reaction causes the concrete to expand and crack. Sulfate resistance cement has a low C_3A concentration.

Tetracalcium aluminoferrite (C_4AF) hydrates rapidly but contributes very little to setting or strength gain. Its presence allows for lower kiln temperatures in the manufacturing process, which is why ferrous materials are added to the raw ingredients.

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17. Describe the process of manufacture of cement with a neat diagram?

Or

Discuss the various ingredients of Portland cement along with their functions?

ANS:

There are four stages in the manufacture of Portland cement:

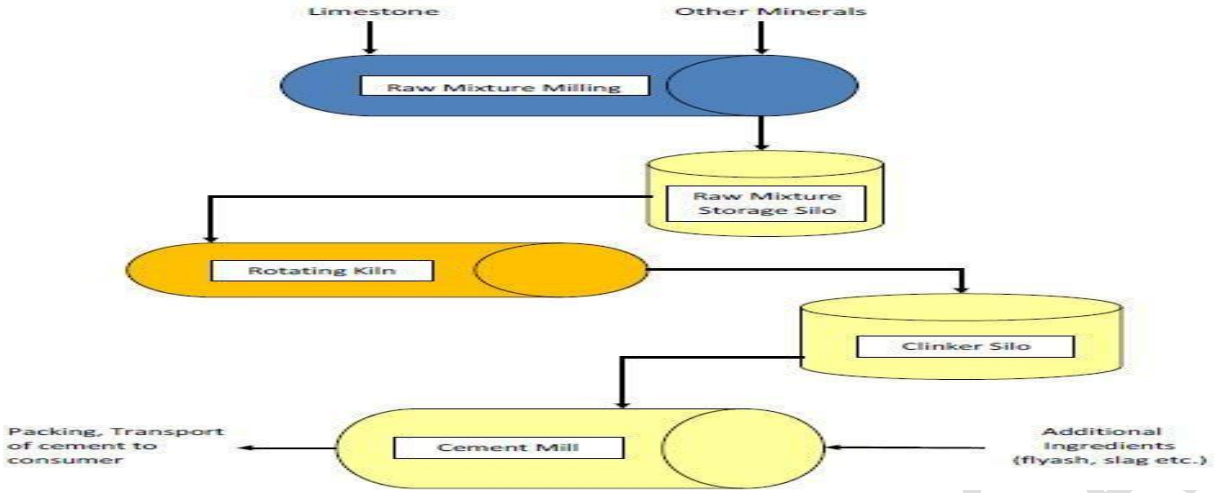
(1) Crushing and grinding the raw materials

(2) Blending the materials in the correct proportions

(3) Burning the prepared mix in a kiln

(4) Grinding the burned product, together with some 5%of gypsum

The first three processes of manufacture are known as the wet, dry, and semidry processes and are so termed when the raw materials are ground wet and fed to the kiln as slurry, ground dry and fed as a dry powder, or ground dry and then moistened to form nodules that are fed to the kiln.



1. Crushing and grinding

- All except soft materials are first crushed, often in two stages, and then ground, usually in a rotating cylindrical ball, or tube mills containing a charge of steel grinding balls.
- This grinding is done wet or dry, depending on the process in use, but for dry grinding the raw materials first may need to be dried in cylindrical, rotary dryers.
- Soft materials are broken down by vigorous stirring with water in wash mills, producing fine slurry, which is passed through screens to remove oversize particles.

2. Blending

- Finer control is obtained by drawing material from two or more batches containing raw mixes of slightly different composition.
- In the dry process these mixes are stored in "silos", slurry tanks are used in the wet process.
- Thorough mixing of the dry materials in the silos is ensured by agitation and vigorous circulation induced by compressed air.
- In the wet process the slurry tanks are stirred by mechanical means or compressed air or both.
- The slurry, which contains 35 to 45% water, is sometimes filtered, reducing the water content to 20 to 30%, and the filter cake is then fed to the kiln.
- This reduces the fuel consumption for burning.

3. Burning

- The dominant means of burning is the rotary kiln. These kilns up to 200 meters (660 feet) long and 6 meters in diameter in wet process plants but shorter for the dry process, consist of a steel, cylindrical shell lined with refractory materials.
- They rotate slowly on an axis that is inclined a few degrees to the horizontal. The raw material feed, introduced at the upper end, moves slowly down the kiln to the lower, or firing, end.
- The fuel for firing may be pulverized coal, oil, or natural gas injected through a pipe. The temperature at the firing end ranges from about 1,350 to 1,550°C (2,460 to 2,820°F), depending on the raw materials being burned.
- The burned product emerges from the kiln as small nodules of clinker. These pass into coolers, where the heat is transferred to incoming air and the product cooled.
- The clinker may be immediately grinded to cement or stored in stockpiles for later use. Modern cement plants are equipped with elaborate instrumentation for control of the burning process.
- The largest rotary kilns have outputs exceeding 5,000 tons per day.

4. Grinding

- The clinker and the required amount of gypsum are grinded to a fine powder in horizontal mills similar to those used for grinding the raw materials.
- The material may pass straight through the mill (open-circuit grinding), or coarser material may be separated from the ground product and returned to the mill for further grinding (closed-circuit grinding).

- Sometimes a small amount of a grinding aid is added to the feed material. For air-entraining cements the addition of an air-entraining agent is similarly made.
- Finished cement is pumped pneumatically to storage silos from which it is drawn for packing in paper bags or for dispatch in bulk containers.

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18. Discuss about different tests conducted on cement?

ANS:

Basically two types of tests are under taken for assessing the quality of cement. These are either field test or lab tests. The current section describes these tests in details.

1. Field test:

There are four field tests may be carried out to as certain roughly the quality of cement.There are four types of field tests to access the colour, physical property, and strength of the cement as described below.

a. Colour

- The colour of cement should be uniform.
- It should be typical cement colour i.e. grey colour with a light greenish shade.

b. Physical properties

- Cement should feel smooth when touched between fingers.
- If hand is inserted in a bag or heap of cement, it should feel cool.

c. Presence of lumps

- Cement should be free from lumps.
- For a moisture content of about 5 to 8%, this increase of volume may be much as 20 to 40 %, depending upon the grading of sand.

d. Strength

- A thick paste of cement with water is made on a piece of thick glass and it is kept under water for 24 hours. It should set and not crack.

2. Laboratory tests:

Six laboratory tests are conducted mainly for assessing the quality of cement. These are: fineness, compressive strength, consistency, setting time, soundness and tensile strength.

1. Fineness

- This test is carried out to check proper grinding of cement.
- The fineness of cement particles may be determined either by sieve test or permeability apparatus test.
- In sieve test, the cement weighing 100 gm is taken and it is continuously passed for 15 minutes through standard BIS sieve no. 9.The residue is then weighed and this weight should not be more than 10% of original weight.
- In permeability apparatus test, specific area of cement particles is calculated. This test is better than sieve test. The specific surface acts as a measure of the frequency of particles of average size.

2. Compressive strength

- This test is carried out to determine the compressive strength of cement.
- The mortar of cement and sand is prepared in ratio 1:3.
- Water is added to mortar in water cement ratio 0.4.
- The mortar is placed in moulds. The test specimens are in the form of cubes and the moulds are of metals. For 70.6 mm and 76 mm cubes, the cement required is 185gm and 235 gm respectively.
- Then the mortar is compacted in vibrating machine for 2 minutes and the moulds are placed in a damp cabin for 24 hours.
- The specimens are removed from the moulds and they are submerged in clean water for curing.
- The cubes are then tested in compression testing machine at the end of 3days and 7 days. Thus compressive strength was found out.

3. Consistency

- The purpose of this test is to determine the percentage of water required for preparing cement pastes for other tests.
- Take 300 gm of cement and add 30 percent by weight or 90 gm of water to it.

- Mix water and cement thoroughly.
- Fill the mould of Vicat apparatus and the gauging time should be 3.75 to 4.25 minutes.
- Vicat apparatus consists of a needle is attached a movable rod with an indicator attached to it.
- There are three attachments: square needle, plunger and needle with annular collar.
- The plunger is attached to the movable rod; the plunger is gently lowered on the paste in the mould.
- The settlement of plunger is noted. If the penetration is between 5 mm to 7 mm from the bottom of mould, the water added is correct, If not process is repeated with different percentages of water till the desired penetration is obtained.

4. Setting time

- This test is used to detect the deterioration of cement due to storage. The test is performed to find out initial setting time and final setting time.
- Cement mixed with water and cement paste is filled in the Vicat mould.
- Square needle is attached to moving rod of vicat apparatus.
- The needle is quickly released and it is allowed to penetrate the cement paste. In the beginning the needle penetrates completely. The procedure is repeated at regular intervals till the needle does not penetrate completely.(up to 5mm from bottom)
- Initial setting time =<30min for ordinary Portland cement and 60 min for low heat cement.
- The cement paste is prepared as above and it is filled in the Vicat mould.
- The needle with annular collar is attached to the moving rod of the Vicat apparatus.
- The needle is gently released. The time at which the needle makes an impression on test block and the collar fails to do so is noted.
- Final setting time is the difference between the time at which water was added to cement and time as recorded in previous step, and it is =<10hours.

5. Soundness

- The purpose of this test is to detect the presence of uncombined lime in the cement.
- The cement paste is prepared.
- The mould is placed and it is filled by cement paste.
- It is covered at top by another glass plate. A small weight is placed at top and the whole assembly is submerged in water for 24 hours.
- The distance between the points of indicator is noted. The mould is again placed in water and heat is applied in such a way that boiling point of water is reached in about 30 minutes. The boiling of water is continued for one hour.
- The mould is removed from water and it is allowed to cool down.
- The distance between the points of indicator is again measured. The difference between the two readings indicates the expansion of cement and it should not exceed 10 mm.

6. Tensile strength

- This test was formerly used to have an indirect indication of compressive strength of cement.
- The mortar of sand and cement is prepared.
- The water is added to the mortar.
- The mortar is placed in briquette moulds. The mould is filled with mortar and then a small heap of mortar is formed at its top. It is beaten down by a standard spatula till water appears on the surface. Same procedure is repeated for the other face of briquette.
- The briquettes are kept in a damp for 24 hours and carefully removed from the moulds.
- The briquettes are tested in a testing machine at the end of 3 and 7 days and average is found out.

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19. Explain about grades of cement with their uses?

ANSWER:

The grade indicates the strength of cement. Strength is generally measured as compressive strength. Before buying the cement, you should check the grades because it highly affects the strength of your structure.

The following are the most common grades of cement used in construction:

A) Ordinary Portland cement (OPC)

Ordinary Portland cement, or OPC, is the most common type of cement in the world. It is classified into three classes based on the compressive strength reached after 28 days of setting: 33, 43, and 53. OPC is a material that is used in mortar, concrete, stucco, and non-specialty grouts.
Given below are the OPC parameters according to Indian norms.

1. 33 Grade

Average compressive strength in N/sq millimeter is 16 for 3 days setting time, 22 for 7 days setting time, and 33 for 28 days setting time. The setting time is 30 minutes minimum and 600 minutes maximum.

2. 43 Grade

It is used for general construction uses like flooring, brickwork, and plastering.
Average compressive strength in N/sq millimeter is 23 for 3 days, 33 for 7 days, and 43 for 28 days. The setting time is 30 minutes minimum and 600 minutes maximum.

3. 53 Grade

The following are the grade's physical properties:
Average compressive strength in N/sq millimeter is 27 for 3 days, 37 for 7 days, and 53 for 28 days setting time. The setting time is 30 minutes minimum and 600 minutes maximum. Used in general construction, including bridges, multi-story structures, and highways.

B) Portland Slag Cement (PSC)

Because of its great strength and long-lasting capabilities, it is preferred over OPC in harsh conditions, such as maritime applications or wastewater treatment. It is resistant to harsh chemical reactions such as chloride and sulphate assaults, as well as corrosion..

C) Portland Pozzolana Cement (PPC)

It is known for its good corrosion resistance, fineness, durability, and great impermeability. It is favored over OPC for bridge footings, marine structures; hydraulic structures such as retaining walls and dams, and basic masonry constructions.

D) Hydrophobic Portland cement

It is more expensive than OPC and is not widely accessible in the market. It repels water well and is not impacted by excessive humidity; therefore it is used in severe weather and locations with a lot of rain. This type of cement is widely used in the building of dams, spillways, and underwater structures.

E) White cement

Among other things, cement is used to repair floors, roofs, and marble tiles. It is also used for interior and exterior decoration, such as ornamental concrete products and facing slabs, among other things. Its chemical makeup is nearly identical to that of Ordinary Portland Cement; however, it is white in colour.

F) Sulphate resisting cement

It is employed when the structure comes into contact with groundwater, dirt, the seacoast, or the ocean. In such cases, it is utilized in place of ordinary Portland cement.

G) Rapid hardening cement

This sort of cement is used to repair and expedite the construction process. It takes less time to start up and gains strength quickly.

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20. Explain the process involved in the production of concrete?

ANS:

A good quality concrete is essentially a homogeneous mixture of cement, coarse and fine aggregates and water which consolidates into a hard mass due to chemical action between the cement and water. The coarser aggregate acts as a filler. The fine aggregate fills up the voids between the paste and the coarse aggregate. The cement in conjunction with water acts as a binder. The mobility of the mixture is aided by the cement paste, fines and nowadays, increasingly by the use of admixtures.
The stages of concrete production are:
1. Batching or measurement of materials
2. Mixing
3. Compacting
4. Curing and Finishing

1. Batching

- The proportions of various ingredients are determined by proper mix design.
- A concrete mix is designed to produce concrete that can be easily placed at the lowest cost.
- Proportioning concrete is a mixture of cement, water, coarse and fine aggregates and admixtures.
- Concrete is normally mixed by machine. Machine mixing can be done on-site or be a pre-mixed concrete company.
- Pre-mixed concrete is batched (proportioned) at the plant to the job requirements. Truck mixing the materials are normally added to the trucks at batching plants and mixed for required time and speed at the plant.

2. Mixing

The mixing operation consists of rotation or stirring, the objective being to coat the surface the all aggregate particles with cement paste, and to blind all the ingredients of the concrete into a uniform mass.

The mixing may done by manually or by mechanical means like, Batch mixer, Tilting drum mixer, Non tilting drum mixer, Pan type mixer, Dual drum mixer or Continuous mixers.

Usually a small quantity of water is fed first, followed by all the solids materials.

3. Compaction

There are two methods for compaction which includes: vibration by vibrators or by tamping using tamping rods.

To achieve proper placing following rules should be kept in mind:

- ✓ The concrete should be placed in uniform layers, not in large heaps or sloping layers.
- ✓ The thickness of the layer should be compatible with the method of vibration so that entrapped air can be removed from the bottom of each layer.
- ✓ The rate of placing and of compaction should be equal.
- ✓ If you proceed too slowly, the mix could stiffen so that it is no longer sufficiently workable.
- ✓ On no account should water ever be added to concrete that is setting.
- ✓ Each layer should be fully compacted before placing the next one, and each subsequent layer should be placed whilst the underlying layer is still plastic so that monolithic construction is achieved.
- ✓ Collision between concrete and formwork or reinforcement should be avoided.
- ✓ The purpose of compaction is to get rid of the air voids that are trapped in loose concrete.

For every 1% of entrapped air, the strength falls by somewhere between 5% to 7%.

4. Curing and Finishing

Curing of concrete must be done as soon as possible after placement and finishing and must continue for a reasonable period of time, for the concrete to achieve its desired strength and durability.

Uniform temperature should be maintained throughout the concrete depth to avoid thermal shrinkage cracks. Curing assists the cement hydration reaction to progress steadily and develops calcium silicate hydrate gel, which binds aggregates leading to a rock solid mass, makes concrete denser, decreases the porosity and enhances the physical and mechanical properties of concrete.

Some other purposes of curing can be summed up as:

- Curing protects the concrete surfaces from sun and wind,
- The process of curing increase the strength of the structure,
- The presence of water is essential to cause the chemical action which accompanies the setting of concrete.
- Generally there is adequate quantity of water at the time of mixing to cause the hardening of concrete, but it is necessary to retain water until the concrete is fully hardened.

By proper curing, the durability and impermeability of concrete are increased and shrinkage is reduced. The resistance of concrete to abrasion is considerably increased by proper curing.

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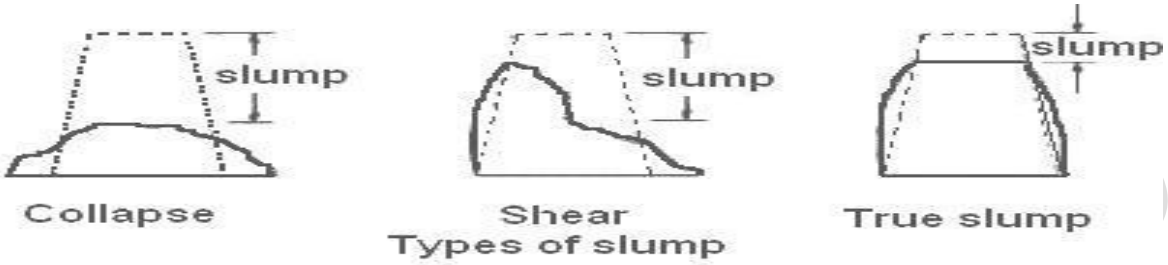
21. Discuss about different workability tests on concrete?

ANS:

There are 4 types of tests for workability. They are slump test, compacting factor test, flow test, and vee bee test

1. Slump test

The slump test result is a slump of the behavior of a compacted inverted cone of concrete under the action of gravity. It measures the consistency or the wetness of concrete. Metal mould, in the shape of the frustum of a cone, open at both ends, and provided with the handle, top internal diameter is (102 mm), and bottom internal diameter is (203 mm) with a height of 1 ft (305 mm). A 2 ft (610 mm) long bullet nosed metal rod, (16 mm) in diameter.



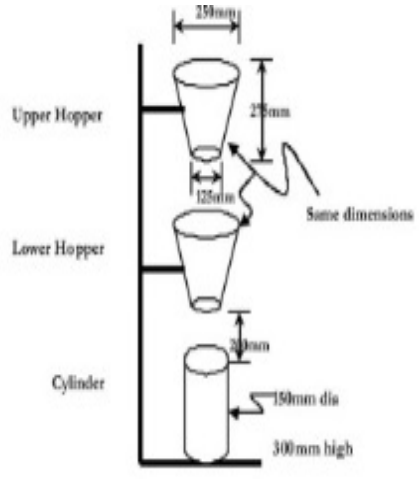
Types of slump

Apparatus Required: Compacting Factor apparatus, Trowels, Graduated cylinder, Balance and Tamping rod and iron bucket

- The test is carried out using a mould known as a slump cone or Abrams cone. This cone is filled with fresh concrete in three stages, each time it is tamped using a rod of standard dimensions.
- At the end of the third stage, concrete is struck off flush to the top of the mould. The mould is carefully lifted vertically upwards, so as not to disturb the concrete cone.
- Concrete subsides. This subsidence is termed as slump, and is measured in to the nearest 5 mm if the slump is <100 mm and measured to the nearest 10 mm if the slump is >100 mm.
- The slumped concrete takes various shapes, and according to the profile of slumped concrete, the slump is termed as true slump, shear slump or collapse slump.
- If a shear or collapse slump is achieved, a fresh sample should be taken and the test repeated.
- A collapse slump is an indication of too wet a mix.
- Only a true slump is of any use in the test. A collapse slump will generally mean that the mix is too wet or that it is a high workability mix, for which slump test is not appropriate.
- Very dry mixes having slump 0 – 25 mm are used in road making,
- Low workability mixes having slump 10 – 40 mm are used for foundations with light reinforcement, Medium workability mixes 50 - 90 for normal reinforced concrete placed with vibration,
- High workability concrete > 100 mm.

The test is carried out as per specification of IS: 1199-1959.

2. Compacting factor test:



Steps for performing the experiment:

• Keep the apparatus on the ground and apply grease on the inner surface of the cylinders.

• Measure the mass as W1 kg by weighing the cylinder accurately and fix the cylinder on the base in such a way that the central points of hoppers and cylinder lie on one vertical line and cover the cylinder with a plate.

• For each 5 kg of aggregate mixes are to be prepared with water-cement ratio by weight with 2.5 kg sand and 1.25 kg of cement and then add required amount of water thoroughly until and unless concrete appears to be homogeneous.

• With the help of hand scoop without compacting fill the freshly mixed concrete in upper hopper part gently and carefully and within two minutes release the trap door so that the concrete may fall into the lower hopper such that it bring the concrete into standard compaction.

• Fall the concrete to into the cylinder by bringing the concrete into standard Compaction immediately after the concrete has come to rest and open the trap door of lower hopper and then remove the excess concrete

above the top of the cylinder by a pair of trowels, one in each hand will blades horizontal slide them from the opposite edges of the mould inward to the center with a sawing motion.

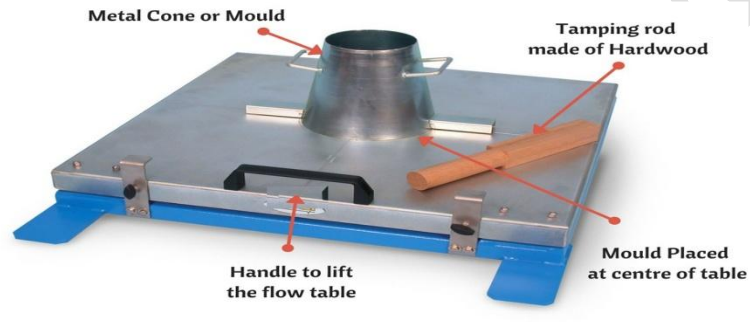
• Clean the cylinder from all sides properly. Find the mass of partially compacted concrete thus filled in the cylinder and say it W2 kg. After this refill the cylinder with the same sample of concrete in approximately 50 mm layers, by vibrating each layer heavily so as to expel all the air and obtain full compaction of the Concrete.

• Struck off level the concrete and weigh and cylinder filled with fully compacted concrete. Let the mass be W3 kg.

• Calculate compaction factor by using the formula: Compaction Factor = W2 – W1 / W3 – W1

3. Flow Table Test

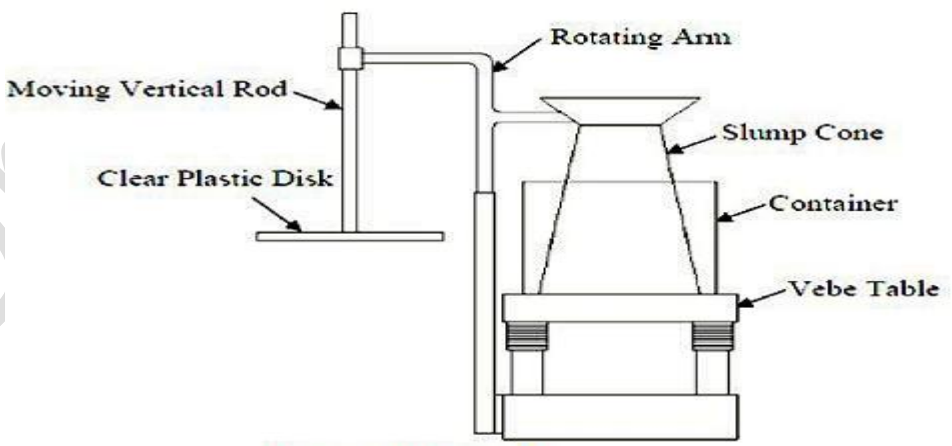
- The flow table test or flow test is a method to determine the consistence of fresh concrete.
- The flow table is wetted. The cone is placed in the center of the flow table and filled with fresh concrete in two equal layers layers.
- Each layer is tamped 10 times with tamping rod. Wait 30 seconds before lifting the cone.
- The cone is lifted, allowing the concrete to flow. The flow table is then lifted up 40mm and then dropped 15 times, causing the concrete to flow. After this the diameter of the concrete is measured.



Flow Table Test of Concrete

4. Vee-Bee Test

This test is useful for concrete having low and very low workability. In this test the concrete is moulded into a cone in a cylinder container and the entire set up is mounted on a vibrating table. When vibrator starts, concrete placed on the cone starts to occupy the cylindrical container by the way of getting re moulded. Remoulding is complete when the concrete surface becomes horizontal. The time required for completion of remoulding since start of vibrator is measured and denoted as vee-bee seconds. This provides a measure for workability. Lesser is the vee-bee seconds more is the workability.



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Dr M.S.V.K.V.PRASAD

22. What are the different grades of concrete?

ANSWER:

Concrete grades are divided into three categories:

1. Ordinary concrete grade
2. Standard concrete grade
3. High strength concrete grade

1. Ordinary concrete grade: There are three types of typical concrete grade: 10M, 15M, and 20M. Their compressive strength is relatively low and lies in the scope of 1,450 to 3,250 PSI (**Pounds per square inch)**. These are by and large used to develop asphalts, carport floors, and outer stopping that are normally non-primary.

2. Standard concrete grade: The standard concrete grade category includes concrete grades between M25 and M45. It is used to build walls, loading bays, slurry pits, high-tensile beams, concrete girders, and walls, among other things.

3. High-strength concrete grade: Concrete with more than 50 MPa is classified under the high substantial grade. Its compressive strength differs somewhere in the range of 6,525 and 9,425 PSI. The construction of high-rise buildings and structures in the vicinity of water bodies is the primary application for the high concrete grade.

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23. Discuss about manufacturing process of steel?

ANS:

The six steps that are involved in the production of steel.

Step 1 – The iron making process

The manufacturing process of steel begins by combining iron ore, lime, and coke into a blast furnace and melting it to form a mass of molten iron. Molten iron contains around 4% impurities, mainly carbon and that is responsible to turn the metal brittle and it needs to be removed.

Step 2 – Primary steelmaking

As mentioned above, there are two main processes to make steel – Oxygen Steel making (BOS) and Electric Ark Furnaces (EAF). In the BOS method, scraps of recycled steel are added to the molten iron while it is in the furnace. Then, using the Bessemer process, oxygen is forced through the liquid to cut the impurities in the molten metal substantially.

On the other hand, with the EAF method, recycled steel is introduced into an electrical ark furnace along with the molten iron and heated at 1650 degrees Celsius. This process converts the mass into high-grade steel.

Step 3 – Secondary steel making

Once the primary steel making process is completed, the newly formed molten steel is readied to convert it to the perfect steel composition. This is done either through temperature manipulation or removal of certain elements. The processes for this include degassing, stirring, ladle injection, or argon bubbling.

Step 4 – Casting

In the casting process, the hot steel is poured into cooled moulds. This causes the metal to cool quickly. Once the steel is cooled, it is then cut into required lengths as per application. Some of the shapes include blooms for sections such as beams, slabs used in plates, and billets for longer products such as pipes.

Step 5 – First forming

Here the initial shapes of slabs, blooms and billets are moulded into different shapes through hot rolling. The hot rolled products are then divided into flat products, long products, seamless tubes etc. for the last stage of processing.

Step 6 – The fabrication and finishing process

As the last step, through various secondary forming techniques including shaping, machining, jointing, and coating, the steel products are given their final shapes and properties.

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24. Write a note on different types of steel and their uses in construction activities?
ANS:
Steel is extensively used building material. The following three varieties of steel are extensively used:
(a) Mild steel
(b) High carbon steel and
(c) High tensile steel
(a) Mild Steel: It contains a maximum of 0.25% carbon, 0.055% of sulphur and 0.55% of phosphorus.
Properties of Mild Steel:
(i) It is malleable and ductile
(ii) It is more elastic
(iii) It can be magnetized permanently
(iv) Its specific gravity is 7.8
(v) Its Young's modulus is 2.1 × 105 N/mm^2
(vi) It can be welded easily
(vii) It is equally strong in tension and in compression
Uses of Mild Steel:
(i) Round bars are extensively used as reinforcement in R.C.C. works.
(ii) Rolled sections like I, T, L, C, plates etc. are used to build steel columns, beams, trusses etc.
(iii) Tubular sections are used as poles and members of trusses.
(iv) Plain and corrugated mild steel are used as roofing materials.
(v) Mild steel sections are used in making parts of many machineries.
(b) High Carbon Steel: The carbon contains in this steel is 0.7% to 1.5%.
Properties of Carbon Steel:
(i) It is more tough and elastic compared to mild steel.
(ii) Welding is difficult.
(iii) It can be magnetized permanently.
(iv) It is stronger in compression than in tension.
(v) It withstands shocks and vibrations better.
Uses of High Carbon Steel:
(i) It is used for making tools such as drills, files, chisels.
(ii) Many machine parts are made with high carbon steel since it is capable of withstanding shocks and vibrations.
(c) High Tensile Steel: It contains 0.8% carbon and 0.6% manganese. The strength of this steel is quite high.
Properties of high Tensile steel:

i. High tensile
ii. Yield strength
iii. Hardness
iv. Corrosion resistance
v. Weldability

Uses of High Tensile Steel:

i. The design and construction of trailers and trucks.
ii. Spring applications such as bungee cords.
iii. Mechanical engineering applications such as engine parts, shafts and rotors.
iv. Large scale constructions such as bridges.
v. High tensile steel wires are used in pre stressed concrete works.

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25. Discuss about Prefabricated construction Techniques briefly?
ANS:
Prefabricated modular structures are built, assembled, and conjoined together within a giant warehouse with efficient industrial practices. These structures are then transported to the desired location and laid out on a suitable foundation. With this blog, we intend to give you a peek into the different methods that modular

building companies use in order to take their precision, efficiency, and craft to greater heights to build quality structures. Here's a closer look at the popular methods of prefabricated construction:

a) Panelized Wood Framing

Long segments of specially lamented timber are converted into solid frames, which are then suitably converted into panels with the help of plywood. With the highest possible length of 72 feet, you can be sure that these frames cover enough area to act as excellent roofing panels. Not only do these roofing panels help you minimize critical construction time but these panels also add safety to the roof construction process.

b) Timber Framing

This remains an increasingly popular prefabrication construction method for timber homes because of its convenience. A timber framing panel is first built in the factory, and then transported to the location of the onsite construction. The advantage of using the timber framing method is that it aids you with the quick erection of prefabricated buildings.

c) Concrete Systems

For the sake of increased durability and improved aesthetics, you must consider the infusion of precast concrete panels to your prefabricated building. Cast in the factory, these concrete components add solidity to your structure as concrete is heavier than most materials commonly used for construction. Furthermore, you can save money if you decide to opt for concrete systems.

d) Steel Framing

Perhaps the most widely utilized commercial and residential construction material, steel remains the go-to material for most modular building companies that intend to achieve durability and strength in the structures they construct. Steel framing is essential for the creation of steel panels, which can then be used for the construction of solid buildings.

e) Modular Systems

All the necessary components are first brought to the construction site, where they are slowly connected and securely laid out, and deeply rooted in the foundation that has been prepared to support the structure. And, the result is a brand, new modular building.

Modular constructions have been gradually rising in popularity and much of this has to do with its increased efficiency while construction.

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26. List out the types of foundations?

ANSWER:

In general, all foundations are divided into two categories, - shallow and deep foundations. The terms Shallow and Deep Foundation refer to the depth of the soil at which it is placed. Generally, if the width of the foundation is greater than the depth, it is labeled as the "Shallow Foundation".

- Shallow Foundations. Made in depths as little as 3ft, shallow footings are also called spread or open footings.
- Individual Footings
- Combined Footings
- Strip Footings
- Raft or Mat Foundations
- Deep Foundations
- Pile Foundations

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27. Differentiate between ordinary concrete and reinforced concrete

ANSWER

The difference between PCC and RCC are as follows:

Ordinary concrete	Reinforced concrete
Plain Cement Concrete	Reinforced Cement Concrete
It doesn't include 'Steel'.	It includes Steel.
PCC is weak in tension loading while strong in compression loading.	RCC is strong in both.

PCC blasts on extreme loading & in an instant w/t providing any notice.	RCC provides you sufficient time to get out of the structure before the collapse.
Is a good choice for small structures	Good choice for structures that need to be of very strong
Cracks can be seen and recovered in constructions	No for cracks in construction. Cracks cannot be seen in any other strong foundation made up of RCC.

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IMPORTANT QUESTIONS

Essay Questions (10M)

1. Discuss the various disciplines of Civil engineering.
2. What are the roles of Civil engineers?
3. List out various types of classification of rocks, giving examples of each.
4. Explain the properties of aggregates
5. Explain various constituents of a good brick earth using a flow chart?
6. Explain about the various tests conducted for brick.
7. Explain about grades of cement with their uses.
8. Discuss the various ingredients of Portland cement along with their functions.
9. Explain about the various tests conducted for cement.
10. Explain about the dry process and wet process of manufacture of cement.
11. Discuss about the grades of concrete.
12. Discuss the classification of steel with uses.
13. Discuss about Pre-fabricated Structure.

Short answer questions (2M)

1. List out the classification of aggregates.
2. What is meant by grade of cement?
3. List out the types of cements.
4. What are the grades of concrete?
5. List out the types of foundations.
6. Differentiate between ordinary concrete and reinforced concrete.
7. List out the tests for aggregate

HAPPY LEARNING