TNPSC

BASED ON DIPLOMA NEW SYLLABUS

THE HANDBOOK OF PDF STUDY MATERIAL

CIVIL ENGINEERING

CODE: 443

ENGLISH MEDIUM

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1. Stress and Strain

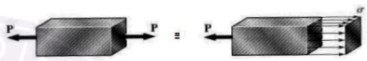
Theory at a Glance (for IES, GATE, PSU)

1.1 Stress (σ)

When a material is subjected to an external force, a resisting force is set up within the component. The internal resistance force per unit area acting on a material or intensity of the forces distributed over a given section is called the stress at a point.

- It uses original cross section area of the specimen and also known as engineering stress or conventional stress.

Therefore, $\sigma = \frac{P}{A}$



- *P is* expressed in *Newton* (N) and *A*, original area, in square meters (m^2), the stress σ will be expresses in N/ m^2. This unit is called *Pascal (Pa).*
- As *Pascal* is a small quantity, in practice, multiples of this unit is used.

1 kPa = 10^3 Pa = 10^3 N/ m^2 (kPa = Kilo Pascal)

1 MPa = 10^6 Pa = 10^6 N/ m^2 = 1 N/mm^2 (MPa = Mega Pascal)

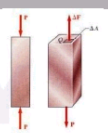
1 GPa = 10^9 Pa = 10^9 N/ m^2 (GPa = Giga Pascal)

Let us take an example: A rod 10 mm × 10 mm cross-section is carrying an axial tensile load 10 kN. In this rod the tensile stress developed is given by

$$(\sigma_t) = \frac{P}{A} = \frac{10\,kN}{(10\,mm \times 10\,mm)} = \frac{10 \times 10^3\,N}{100\,mm^2} = 100\,N/mm^2 = 100\,MPa$$

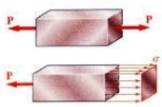
- The resultant of the internal forces for an axially loaded member is normal to a section cut perpendicular to the member axis.
- The force intensity on the shown section is defined as the normal stress.

$\sigma = \lim_{\Delta A \to 0} \frac{\Delta F}{\Delta A}$ and $\sigma_{avg} = \frac{P}{A}$



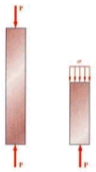
- **Tensile stress (σ_t)**

If σ > 0 the stress is tensile. i.e. The fibres of the component tend to elongate due to the external force. A member subjected to an external force tensile P and tensile stress distribution due to the force is shown in the given figure.



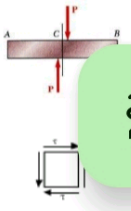
- **Compressive stress (σ_c)**

If σ < 0 the stress is compressive. i.e. The fibres of the component tend to shorten due to the external force. A member subjected to an external compressive force P and compressive stress distribution due to the force is shown in the given figure.



- **Shear stress (τ)**

When forces are transmitted from one part of a body to other, the stresses developed in a plane parallel to the applied force are the shear stress. **Shear stress acts parallel to plane of interest. Forces *P* is applied transversely to the member *AB as shown. The* corresponding internal forces act in the plane of section *C* and are called *shearing* forces. The corresponding average shear stress** $(\tau) = \frac{P}{Area}$



1.2 Strain (ε)

The deformation per unit length *(dimensionless)* is known as strain.

Bending Moment and Shear Force Diagram

Theory at a Glance (for IES, GATE, PSU)

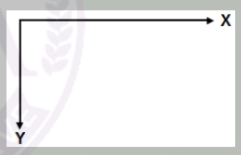
4.1 Shear Force and Bending Moment

At first we try to understand what shear force is and what is bending moment?

We will not introduce any other co-ordinate system. We use general co-ordinate axis as shown in the figure. This system will be followed in shear force and bending moment diagram and in deflection of beam. Here downward direction will be negative i.e. negative Y-axis. Therefore downward deflection of the beam will be treated as negative.

We use above Co-ordinate system

Some books fix a co-ordinate axis as shown in the following figure. Here downward direction will be positive i.e. positive Y-axis. Therefore downward deflection of the beam will be treated as positive. As beam is generally deflected in downward directions and this co-ordinate system treats downward deflection is positive deflection.



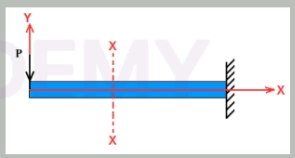
Some books use above co-ordinate system

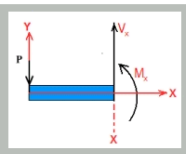
Consider a cantilever beam as shown subjected to external load 'P'. If we imagine this beam to be cut by a section X-X, we see that the applied force tend to displace the left-hand portion of the beam relative to the right hand portion, which is fixed in the wall. This tendency is resisted by internal forces between the two parts of the beam. At the cut section a resistance shear force (V_x) and a bending moment (M_x) is induced. This resistance shear force and the bending moment at the cut section is shown in the left hand and right hand portion of the cut beam. Using the three equations of equilibrium

$\sum F_x = 0$, $\sum F_y = 0$ and $\sum M_i = 0$

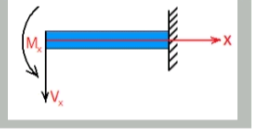
We find that $V_x = -P$ and $M_x = -P.x$

In this chapter we want to show pictorially the

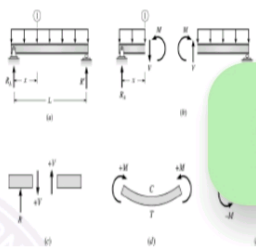




variation of shear force and bending moment in a beam as a function of 'x' measured from one end of the beam.



Shear Force (V) ≡ equal in magnitude but opposite in direction to the algebraic sum (resultant) of the components in the direction perpendicular to the axis of the beam of all external loads and support reactions acting on either side of the section being considered.



Bending Moment (M) equal in magnitude but opposite in direction to the algebraic sum of the moments about (the centroid of the cross section of the beam) the section of all external loads and support reactions acting on either side of the section being considered.

What are the benefits of drawing shear force and bending moment diagram?

The benefits of drawing a variation of shear force and bending moment in a beam as a function of 'x'

Trusses (Pin jointed frames)

I. Basic concepts.

The truss is a frame structure which will continue to perform as a geometrically unchangeable system, even when all of its rigid joints are conventionally replaced by perfect hinges. The trusses are used for the same purposes as beams and girders, but the spans they cover are much larger.

In trusses all the members are subjected either to direct extension (tension) or compression. That ensures better utilization of the materials, the stress diagram for each of these members is constant.

The trusses can be space framed structures in which the elements are situated in several planes. However, the design of the three dimensional trusses can be reduced to the case of several plane systems.

Here we are going to examine two dimensional (plane) trusses for which all the elements and loads are situated in one plane.

The span of a truss is the distance between its supports. The lower and upper longitudinal members form the upper and lower chords of the truss. The members connecting both the chords are called the web members. They are subdivided into verticals and diagonals. The distance between two adjacent joints measured along the horizontal is usually called a panel (Fig. 1).

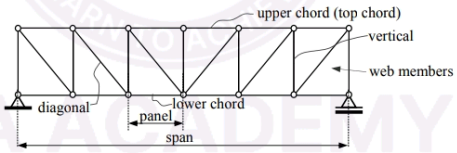


Figure 1 A truss with parallel chords

The following five criterions may serve as a basis for the classification of trusses:

1) The shape of the upper and lower chords;
2) The type of the web;
3) The conditions of the supports;
4) The purpose of the structure;
5) The level of the floor (lane, road)

According to the first criterion, the trusses can be classified into trusses with parallel chords (Fig. 1), polygonal and triangular trusses or trusses with inclined chords (Fig. 2).

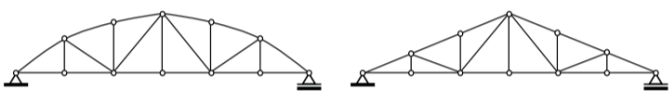


Figure 2 Polygonal and triangular trusses

The second criterion (type of the web) permits to subdivide the trusses into those with triangular patterns (Fig. 3a), those with quadrangular patterns (Fig. 3b) formed by vertical and diagonals, those with the web members form a letter K (Fig. 3c). Finally, trusses formed by superposition of two or more simple grids (Fig. 3d,e).

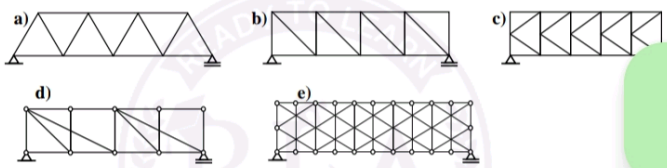


Figure 3 Trusses according to the type of the web

The third criterion permits to distinguish between the ordinary end-supported trusses (Fig. 4a), the cantilever trusses (Fig. 4b), the trusses cantilevering over one or both supports (Fig. 4c), and finally descent or arched trusses (Fig. d,e).

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4. Euler's and Rankin's Formula for...
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5. Effective Length for Different E...
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7. Combined Stresses due to Direc...
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8. Stability of Earth Retaining Wall...
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CANTILEVER BEAM

AIM: -To determined young's modulus of elasticity of material of cantilever beam

OBJECT:-To find the values of bending stresses and young's modulus of elasticity of the material of a cantilever beam and carrying a concentrated load at the end.

APPARATERS:

1. Deflection of beam apparatus
2. Pan
3. Weights
4. Beam of different cross-sections and material (say wooden and Steel beams)

THEORY:

The beam which has one end is fixed and another end is free is called cantilever beam. For the cantilever beam the bending moment is zero at free end and maximum at fixed end. When the cantilever beam is subjected to a load at free end the beam will bend in convexity downwards. The deflection at free end is maximum and at fixed end is zero.

When the cantilever beam is subjected to a load at free end then the maximum bending moment is given by

`M= WL

Where W =Load acting on the beam

L= length of the beam

When the cantilever beam is subjected to a load at free end then the deflection is given by

$$\delta = \frac{WL^3}{3EI}$$

for diameter or depth of beam (d)

S.NO	M.S.R.	V.C.R.	M.S.R+(V.C.R.X L.C.)
			Average=

RETAINING WALLS

RETAINING WALL

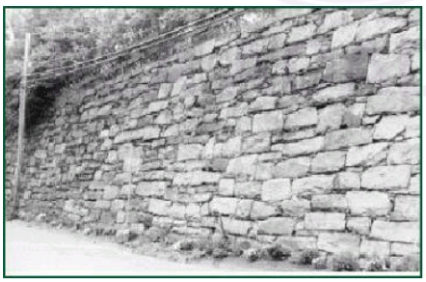
2.5. Retaining walls are structures used to retain earth or water or other materials such as coal, ore, etc; where conditions do not permit the mass to assume its natural slope. The retaining material is usually termed as backfill. The main function of retaining walls is to stabilize hillsides and control erosion. When roadway construction is necessary over rugged terrain with steep slopes, retaining walls can help to reduce the grades of roads and the land alongside the road. Some road projects lack available land beside the travel way, requiring construction right along the toe of a slope. In these cases extensive grading may not be possible and retaining walls become necessary to allow for safe construction and acceptable slope conditions for adjacent land uses. Where soils are unstable, slopes are quite steep, or heavy runoff is present, retaining walls help to stem erosion. Excessive runoff can undermine roadways and structures, and controlling sediment runoff is a major environmental and water quality consideration in road and bridge projects. In these situations, building retaining walls, rather than grading excessively, reduces vegetation removal and reduces erosion caused by runoff. In turn, the vegetation serves to stabilize the soil and filter out sediments and pollutants before they enter the water source, thus improving water quality.

In this section you will learn the following
Gravity walls
Semi Gravity Retaining Wall

Flexible walls
Special type of retaining walls

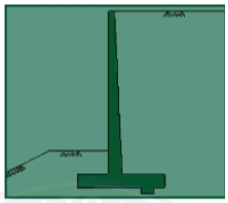
Different Types of Retaining Structures On the basis of attaining stability, the retaining structures are classified into following: 1. **Gravity walls :**

Gravity walls are stabilized by their mass. They are constructed of dense, heavy materials such as concrete and stone masonry and are usually reinforced. Some gravity walls do use mortar, relying solely on their weight to stay in place, as in the case of dry stone walls. They are economical for only small heights.



. **Semi Gravity Retaining Wall**

These walls generally are trapezoidal in section. This type of wall is constructed in concrete and derives its stability from its weight. A small amount of reinforcement is provided for reducing the mass of the concrete.This can be classified into two:



- Cantilever retaining wall
- Counter fort retaining wall

Cantilever retaining wall
Fig 6.3.Semi Gravity Retaining Wall

This is a reinforced concrete wall which utilises cantilever action to retain the backfill. This type is su
retaining backfill to moderate heights(4m-7m). In cross section most cantilevered walls look like "L"
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for diameter or depth of beam (d)

S.NO	M.S.R.	V.C.R.	M.S.R+(V.C.R.X L.C.)
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4.1.4. END CONDITIONS OF COLUMN

The following end conditions of columns are important:

(a) Both the ends hinged [Fig. 4.2(i)]
(b) Both the ends fixed [Fig. 4.2(ii)]
(c) One end fixed and other end hinged [Fig.4.2(iii)]
(d) One end fixed and other free [Fig.4.2(iv)]

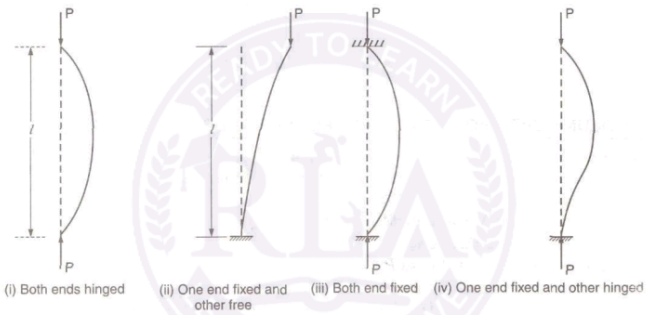
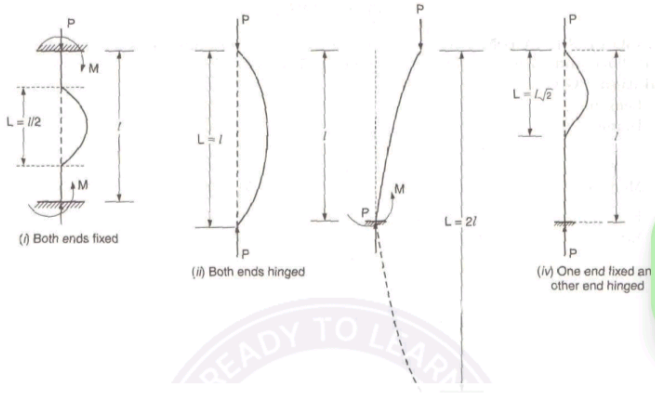


Fig.4.2

4.1.5 EQUIVALENT LENGTH OR EFFECTIVE LENGTH

Equivalent length is the length of the long column which is actually involved in bending. Equivalent length of a column is also defined as the distance between adjacent point of inflexion*.The equivalent length of a column is obtained by multiplying it with some constant factor 'C'. The constant factor 'C' depends on end conditions of the column. If l is the actual length of a column, then its equivalent length, $L = c \times l$
Hence, in case of column with:

(a) Both ends fixed, equivalent length, $L = \frac{l}{2}$
(b) Both ends hinged, $L = l$
(c) One end fixed and other end free, $L = \frac{2l}{\sqrt{2}}$
(d) One end fixed and other hinged, $L = \frac{l}{\sqrt{2}}$



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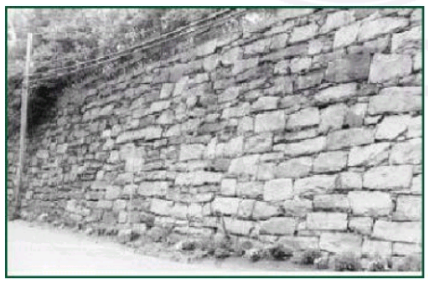

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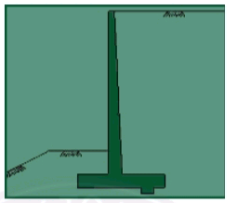

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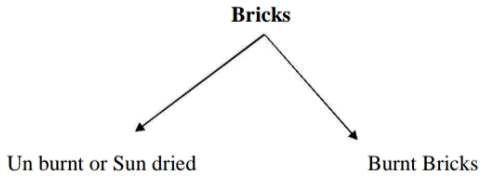
One of the oldest building material brick continues to be a most popular and leading construction material because of being cheap, durable and easy to handle and work with. Clay bricks are used for building-up exterior and interior walls, partitions, piers, footings and other load bearing structures. A brick is rectangular in shape and of size that can be conveniently handled with one hand. Brick may be made of burnt clay or mixture of sand and lime or of Portland cement concrete. Clay bricks are commonly used since these are economical and easily available. The length, width and height of a brick are interrelated as below:

Length of brick = 2 × width of brick + thickness of mortar Height of brick = width of brick

Size of a standard brick (also known as modular brick) should be 19 × 9 × 9 cm and 19 × 9 × 4 cm.

When placed in masonry the 19 × 9 × 9 cm brick with mortar becomes 20 × 10 × 10 cm. However, the bricks available in most part of the country still are 9" × " × 3" and are known as field bricks. Weight of such a brick is 3.0 kg. An indent called frog, 1–2 cm deep, as shown in Fig. 5, is provided for 9 cm high bricks. The size of frog should be 10 × 4 × 1 cm. The purpose of providing frog is to form a key for holding the mortar and therefore, the bricks are laid with frogs on top. Frog is not provided in 4 cm high bricks and extruded bricks.

CLASSIFICATION OF BRICKS



The bricks used in construction works are burnt bricks and they are classif into the following four categories:

- First Class Bricks
- Second Class Bricks
- Third Class Bricks
- Fourth Class Bricks

Topic 3 Aggregates

Aggregates are the important constituents in concrete. They give body to the concrete, reduce shrinkage and effect economy. the aggregates occupy 70–80 per cent of the volume of concrete, their impact on various characteristics and properties of concrete

Aggregates can be classified as

(i) Normal weight aggregates,
(ii) Light weight aggregates and
(iii) Heavy weight aggregates.

In this chapter the properties of normal weight aggregates will only be discussed.

Normal weight aggregates can be further classified as natural aggregates and artificial aggregates.

Natural - Sand, Gravel, Crushed Rock such as Granite, Quartzite, Basalt, Sandstone

Artificial - Broken Brick, Air-cooled Slag. Fly ash, Bloated clay

Aggregates can also be classified on the basis of the size of the aggregates as coarse aggregate and fine aggregate.

Source

Almost all natural aggregate materials originate from bed rocks. There are three kinds of rocks, namely,

(i) Igneous,
(ii) Sedimentary and
(iii) Metamorphic.

Igneous rocks - Igneous rocks are formed by the cooling of molten magma or lava at the surface of the crest (trap and basalt) or deep beneath the crest (granite).

Sedimentary rocks - The sedimentary rocks are formed originally below the sea bed and subsequently lifted up.

Metamorphic rocks - Metamorphic rocks are originally either igneous or sedimentary rocks which are subsequently metamorphosed due to extreme heat and pressure.

Physical Properties

The physical properties of aggregates are those that refer to the physical structure of the particles that make up the aggregate.

- Absoprtion, Porosity, and Permeability
- Surface Texture
- Strength and Elasticity
- Density and Specific Gravity

- Aggregate Voids
- Hardness
- Particle Shape
- Coatings

Fine Aggregate - Sand and/or crushed stone.

< 4.75 mm.

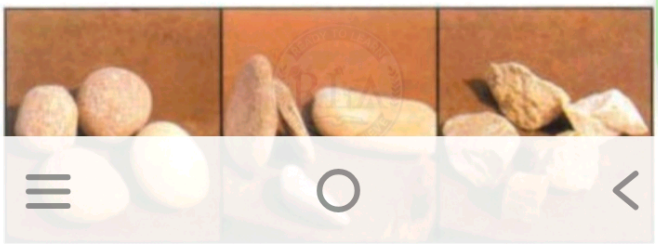
F.A. content usually 35% to 45% by mass or volume of total aggregate.

Coarse Aggregate - Gravel and crushed stone.

>4.75 mm.

Typically, between 9.5 and 37.5 mm.

Shape - The shape of aggregates is an important characteristic since it affects the workability of concrete.



PLASTIC:

Plastics are a wide range of synthetic or semi-synthetic materials that use polymers as a main ingredient. Their plasticity makes it possible for plastics to be moulded, extruded or pressed into solid objects of various shapes. This adaptability, plus a wide range of other properties, such as being lightweight, durable, flexible, and inexpensive to produce, has led to its widespread use. Plastics typically are made through human industrial systems. Most modern plastics are derived from fossil fuel-based chemicals like natural gas or petroleum; however, recent industrial methods use variants made from renewable materials, such as corn or cotton derivatives.

Properties of Plastics

- They are light in weight and is chemically stable.
- Easily moulded into different shapes and sizes.
- Good insulation and low thermal conductivity.
- Good impact resistance and they do not rust.
- Good transparency and wear resistance.
- Poor dimensional stability and can be easily deformed.
- Low processing cost.

Different Types of Plastic

Plastics are of Two Types:

1. Thermoplastics
2. Thermosetting Plastic

Thermoplastics:

The term 'thermoplastic' refers to plastics that do not undergo any chemical changes when subjected to high temperatures. These plastics do not undergo any changes in their chemical structures and chemical compositions when subjected to heat and can be changed into a soft state and remoulded multiple times.

Examples: Polystyrene, Teflon, Acrylic, Nylon, etc.

Thermosetting Plastics:

They are also known as thermosets, and are plastics that can be moulded only once and d change shape on applying heat. These plastics can only be moulded once and they cann softened on further heating. These plastics undergo degradation and become damaged v exposed to a large amount of heat.

Examples: Vulcanized rubber, Bakelite, Polyurethane, Epoxy resin, Vinyl ester resin, etc.

Uses of Plastics

Plastics are highly durable, lightweight and most importantly can be moulded into any form or shape. These properties account for the largest usage of plastics. plastics are extremely versatile

CONSTITUENTS OF CONCRETE (CEMENT AND AGGREGATE)

Concrete is a mixture of

- Cement (11%),
- Fine aggregates (26%),
- Coarse aggregates (41%)
- water (16%)
- air (6%).

Cement --Powder
Cement + Water --Cement Paste

Cement Paste + Fine Aggregate (FA) --Mortar
Mortar + Coarse Aggregate (CA) --Concrete

Portland cement, water, sand, and coarse aggregate are proportioned and mixed to produce concrete suited to the particular job for which it is intended. Concrete a composite man-made material is the most widely used building material in the construction industry. It consists of a rationally chosen mixture of binding material such as lime or cement, well graded fine and coarse aggregates, water and admixtures (to produce concrete with special properties). In a concrete mix, cement and water form a paste or matrix which in addition to filling the voids of the fine

aggregate, coats the surface of fine and coarse aggregates and binds them together. The matrix is usually 22-34% of the total volume. Freshly mixed concrete before set is known as wet or green concrete whereas after setting and hardening it is known as set or hardened concrete.

PROPORTIONING OF CONCRETE

Process of selection of relative proportions of cement, sand, coarse aggregate water, so as to obtain a concrete of desired quality is known as the proportio concrete. It is observed that if a vessel, as shown in figure below is taken and fi with stones, of equal size, the voids to the extent of about 45 % are formed.

This result is independent of the size of the stones. It is interesting to note that if sand is taken in place of stones, the same result will be obtained. The result can be

Topic 9 Admixture

Admixtures are artificial or natural materials added to the concrete besides cement, water and aggregate to enhance the properties of concrete for applications in concrete works during casting or setting or service stage with special requirements.

To improve the properties of the concrete required. It can be divided in two groups that is:

1. Chemical Admixture
2. Mineral Admixture

Functions of Admixture

- To improve workability of fresh concrete
- To improve durability by entrainment of air
- To reduce the water required
- To accelerate setting & hardening, thus to produce high early strength
- To aid curing
- To impart water repellent / water proofing property
- To cause dispersion of the cement particles when mixed with water
- To retard setting • To improve wear resistance (hardness)
- To offset / reduce shrinkage during setting & hardening
- To cause expansion of concrete and automatic prestressing of steel
- To aerate mortar / concrete to produce a light-weight product
- To impart colour to concrete
- To offset or reduce some chemical reaction
- To reduce bleeding
- To reduce the evolution of heat

Types of chemical admixtures

- Water reducing Admixture
- Set-controlling chemicals
- Air Entraining
- Viscosity modifying agents
- Corrosion Inhibitors
- Alkali-Aggregate Reaction Inhibiting
- Shrinkage Reducing

Water reducing admixture

Types and Examples	Normal water reducers	High range water reducers	
	Lignosulphonates	Polysulphonates	polycarboxylates
	Hydroxycarboxylic acids	Sulphonated naphthalene formaldehyde	poly acrylates

	Carbohydrates	Sulphonated melamine formaldehyde	monovinyl alcohols
	Corn syrup, dextrin, Sugar		
Dosage Between	0.3 to 0.5 %	0.7 to 1 %	
Problems	High retardation and air entrainment	excessive retardation, lack of early strength	

Water reducing admixture

- Work on the principle of Dispersion
- Portland cement being in fine state will have a tendency to flocculate in wet concrete, these flocculation entraps certain amount of water used in the mix. When its used, they get adsorbed on the cement particles, creates particle to particle repulsive forces which overcome the attractive forces.
- This repulsive force is called Zeta Potential, which depends on the base, solid content, quantity of plasticizer used. When cement particles are deflocculated, the water trapped inside the flocs gets released & now available to fluidify the mix.

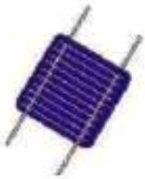
Set-controller admixtures

- Accelerator (It will increase the rate of dissolution of calcium ions and silicates.) • Reta (It will impede the dissolution of calcium and aluminate)
- Added to increase/decrease the rate of hydration of concrete mix which then lead to the increases/decreases in the rate of development of strength and heat evolution.
- To shorten/longer the setting time,
- Disadvantages is possible cracking due to heat evolution & possibility of corrosion of embedded reinforcement and it may promote bleeding.

SOLAR ENERGY

ABOUT SOLAR CELL:

Solar power or electricity from the solar system is obtained from solar photovoltaic (PV) cells. The PV cell looks like as;



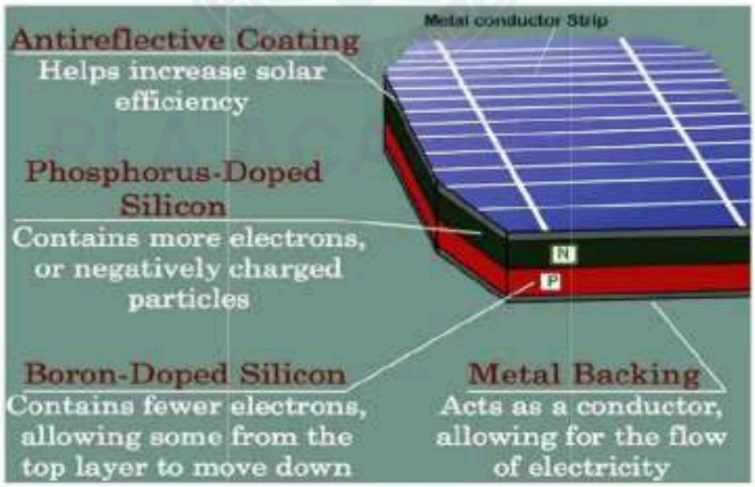
→ The PV cell made from the silicon material, which is semiconducting material.

→ It is called the photovoltaic (PV) cells because in Greek language phos means light, and volt, a measurement unit named for Alessandro Volta (1745-1827), a pioneer in the study of electricity. Therefore, it's called photovoltaic.

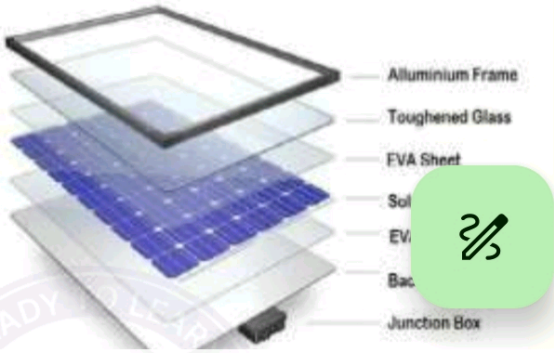
→ Solar cells are small devices, which can convert sunlight into electricity.

→ One cell has 0.5 to 0.6 volt. So to get higher voltage, no. of cells connected in series to get higher voltage.

The main layers of a solar cell are;



SOLAR MODULE:



A PV module consists of a number of series connected solar cells (typically 36 connected in series) encapsulated into a single, long-lasting, stable unit.

Chapter -8

Roofs

A roof may e defined as the upper most part of the building provided as a structural covering, to protect the building from external weather exposure such as rain, sun, wind, etc. Basically, a roof consists of structural elements, which support roof coverings. The structural element may be trusses, beam, slabs, shells or domes. The roof coverings may be corrugated metal sheets, reinforced concrete slab, tiles, etc. Roof covering material is laid over network of frames. The availability of the materials and the climate of the place governs the particular type of roof. The roofs may be classified as follows:

Types of Roofs

The General types of roofs are

1. ***Pitched/slopping roofs***
2. ***Flat roofs***
3. ***Dome roofs***
4. ***Shell roofs.***

The selection of the type of roof depends upon the shape or plan of the building, climatic conditions of the area and type of constructional materials available. Pitched roofs have sloping top surface. They are suitable in those areas where rainfall/snowfall is very heavy. Buildings with limited width and simple shape can generally be covered satisfactorily by pitched roofs. Buildings irregular in plan, or with long spans, present awkward problems in the design of a pitched roof, involving numerous valleys, gutters and hips. Buildings of large area, such as factories, require internal gutters in the valleys when covered by a series of parallel- pitched roofs.

1. <u>Sloping or Pitched Roof</u>

Pitched roof is is a type of roof which slopes in one or more directions. It is the most common form of roof and is generally regarded as the cheapest alternative for covering a structure. Pitched roof is almost always constructed in wood or steel. The different shape can be provided to the pitched roofs. The various shapes, which can be given to roofs of this type, depend on the area covered, materials available, type of lighting and ventilation needed inside, available appliance etc. In pitched roofs a slope of less than 1 in 3 is generally not considered satisfactory from drainage point of view in areas of heavy snowfall, steeper slopes(1:1.5 or1:1) incidence of snow load on the roof

Forms of Pitched Roof

Sloping roofs are basically of the following forms:

Building Construction :Roofs

Shed roof: It is the simplest type and slopes only in one direction .It is used for smaller span and is also known as lean to roof. At the upper ends, the rafters are nailed to the wooden wall plate, which may be of stone, brick or steel. At the lower end the rafters are notched and nailed to the wooden post plate.

Gable roof: It slopes in two directions and is commonly used. It is formed by a pair of inclined rafters with their upper ends nailed to a common ridge piece and their low ends. Notched and nailed to the wooden wall plates embedded in masonry on the top of the wall on either end. Gable roofs slope in two directions but there is a break is slope.

Hip roof: It slopes in four directions such that the end formed by intersection of slopes results in triangular and/ or trapezoidal form.

Butterfly roof: It slopes in two directions and intersects at the centre of the span and will have common drainage system.

Gambrel roof. This type of roof slopes in two directions but there is break in slopes.

Mansard roof. This type of roof slopes in all the four directions but there is break in slopes.

North light roof. This type of roof is commonly used in factories to admit sufficient light through panels fixed on the steep sloping sides of the roof.

Pyramid roof: It is similar to hip roofs, slopes in four directions and the intersections of slop pyramid

Important Elements and Terms of Pitched Roof

Some of the important elements of pitched roofs are:

Span: It is the clear distance between the supports of beam, roof truss, or an arch.

Rise: It is the vertical distance between the top of the ridge and the wall plate.

Pitch: It is the inclination of the sides of a roof to the horizontal or is expressed either in degrees or as ratio of rise to span.

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1. INTRODUCTION

Rural roads play an important role in the overall development of rural areas as access to social and economic infrastructure and services are the sine qua non of rural development. In an indirect way, rural roads influence the process of growth through changes in socio-economic attitudes of people by facilitating the dissemination of knowledge and reduction of inequalities leading to better quality of life.

Rural roads are very essential to:

- promote and sustain agricultural growth
- improve basic health and hygiene
- provide access to schools and other educational opportunities
- provide access to economic opportunities
- create employment opportunities
- enhance democratic processes and bring people into national mainstream
- enhance local skills
- reduce vulnerability and poverty
- act as infrastructure multiplier

Rural Connectivity is perceived as one of the major components in increasing the agricultural output and earning capacity of the rural population. Improved rural connectivity will lead to marked improvement in the quality of life, by way of better educational facilities, improved health services, improved attendance of teachers as well as students etc. Accessibility also leads to improvement in governance and provision of other utility and emergency services.

1.1. IRC CLASSIFICATION OF ROADS

1) National Highways (NH)
2) State Highways (SH)
3) Major District Roads (MDR)
4) Other District Roads (ODR)
5) Village Roads (VR)

1.1.1. National Highways (NH)

The National Highways Network of India, is a network of highways that is managed and maintained by Government of India. These highways measure over 70,934 km (44,076 mi) as of 2010, including over 1,000 km (620 mi) of limited-access Expressways.

The National Highways Authority of India (NHAI) is the nodal agency responsible for building, upgrading and maintaining most of the national highways network. It operates under the Ministry of Road Transport and Highways. The NHAI often uses a public-private partnership model for highway development, maintenance and toll-collection.

5.1.10 FACTORS TO BE CONSIDERED FOR SELECTION OF AN IDEAL SITE FOR BRIDGE

1. On either sides of waterway must be easily communicated between the roads.
2. Straight and well defined embankments both on upstream and downstream sides of the bridge.
3. Availability of men and material easily.
4. Minimum width of water course at crossing.
5. Uniform and steady flow with non silting and non scouring velocities.
6. Good foundations at reasonable depths.
7. Right angled crossing of stream.

8. Waterway should be straight for reasonable length in both upstream and d
   for smooth navigation.
9. Construction should be economical.
10. Maintenance cost should be low.

5.1.11 ALIGNMENT

1.6 ROAD ARBHORICULTURE AND LIGHTING

Tree planting or arboriculture is the most important component of highway landscaping. Planting may be functional, or for aesthetic effects, but in either case the objective should be to help restore the unity of the landscape. Functional planting applies to such problems as protection of slopes against erosion, screening of unsightly views, reducing headlight glare, providing shade in summer and so on. In most cases, such planting also improves the appearance of the road and enhances the natural landscape, planting for aesthetic effects is also by and large functional but goes beyond that to blend the road into the surrounding countryside and enhance the overall beauty. The trees on both side of road break the monotony of the driving and act as sound barrier.

Roadside planting of trees may be in the form of avenues, groups or groves. Where conditions are favourable, for example in groves, fruit bearing trees may be preferred.

In the design and development of arboriculture, certain restrictions imposed by engineering, traffic and safety requirements should be kept in view.

Some of these are:

a) Position of trees on either side should be fixed taking into account the ultimate development of the roadway with regard to future widening.
b) Trees should be planted beyond 1 m back from the ultimate edge of the roadway so that they are not a safety hazard or affect the required sight distances.
c) Considerations of sight distance and safety, being of primary importance, these should in no case be subordinated to aesthetics.
d) Shrubs and trees should be planted clear of roadside drains and other drainage structures so that their root system do not interfere with efficient working of the drainage facilities.

To facilitate systematic execution of operations involved in roadside arboriculture, it will be advisable to prepare a detailed work plan including necessary drawings for field use. These should cover the scope and extent of the proposed activities, pattern, type and location of plantings, plant species to be used etc. and should be simple enough to be easily followed by field crews.

Tree plantation is the most effective, economical and useful remedy for control of environmental pollution. Besides, it is the cheapest way of landscape improvement. Trees have innumerable direct and indirect benefits of supplying timber and fuel at maturity. During their life time, they supply fodder, fruits, seeds, help in controlling soil erosion and

water conservation, offer shade and are oxygen producing industries to combat ever increasing air pollution. Big foliage trees also help in reducing noise and dust pollution.

1.6.1. OBJECTIVES OF TREE PLANTATIONS

i. To provide for aesthetic enhancement of the project corridors
ii. To reduce the impacts of air pollution and dust, as trees and shrubs are known to
natural sink for air pollutants.
iii. To provide much needed shade on glaring hot roads during summer.
iv. To reduce the impact of ever increasing noise pollution caused due to increas
number of vehicles.
v. To arrest soil erosion at the embankment slopes.
vi. Prevention of glare from the headlight of incoming vehicles.
vii. matic amelioration,
viii. Moderating the effect of wind and incoming radiation

UNIT-5 (HARBOUR NGINEERING)

Water Transport Harbors and ports, Types of Harbours; Harbours - layouts, shippin glanes, anchoring, location identification; Littoral transport with erosion and deposition; sounding methods; Dry and Wet docks, components and operational Tidal data and analyses. Inland waterways: advantages and disadvantages;Development in India. Inland water operation.

Water transportation

The water transportation can further be subdivided into two categories:

- inland transportation and
- Ocean transportation. InlandWater transportation
  - Inland Water transportation is either in the form of river transportation orcanal transportation.
  - Ocean Water transportation is adopted for trade and commerce.
  - It is estimated that about 75 per cent of international trade is carried outby shipping.
  - The development of navy force is intended for national defense.
  - Ocean water transportation has an limitation and it possesses high flexibility.

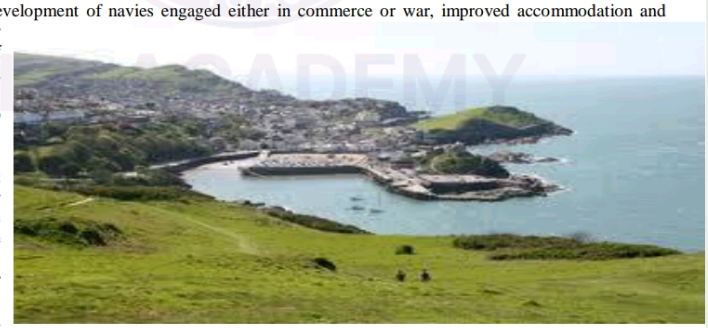
Definitions Harbours:

- A harbour can be defined as a sheltered area of the sea in which vessels could belaunched, built or taken for repair; or could seek refuge in time of storm; or provide for loading and unloading of cargo and passengers.

Harbours are broadly classified as:

- **Natural harbours**
- Semi-natural harbours
- Artificial harbours.Natural harbours:

- Natural formations affording safe discharge facilities for ships on sea coasts, in the form of creeks and basins, are called natural harbours.
- With the rapid development of navies engaged either in commerce or war, improved accommodation and facilities for repairs, storage of cargo and connected amenities had to be provided in natural harbours.
- The size and draft of present day vessels have necessitated the works improvement for natural harbours.
- The factors such as local geographical features, growth of population, development of the area, etc. have made the natural harbours big and attractive. Bombay and Kandla are, examples of natural harbours



Semi-natural harbours:

- This type of harbour is protected on sides by headlands protection and it requires man-made protection only at the entrance.
- Vishakhapatnam is a semi-natural harbour

Fig. 1: Aerial view of Akko; looking N-E

Artificial harbours:

- Where such natural facilities are not available, countries having a seaboard had to create or construct such shelters making use of engineering skill and methods, and such harbours are called artificial or man made harbours.

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Pressure and Pressure Measurement

Introduction

- A matter exists in nature, either in the solid state or the fluid state. The fluid state is further divided into the liquid and the gaseous states.
- The two classes of fluids i.e. gases and liquids also exhibit quite different characteristics.
- Practically all fluids (liquids as well as gases) are compressible.
- Gases can be compressed much readily under the action of external pressure, hence considered as compressible. On the other hand under ordinary conditions liquids are quite difficult to compress and therefore they may for most purposes be regarded as incompressible.

Fluid

❑ Definition of a Fluid

- A fluid may be defined as a substance which is capable of flowing.
- It has no definite shape of its own, but conforms to the shape of the containing vessel.
- A liquid is a fluid, which possesses a definite volume, which varies only slightly with temperature and pressure. Since under ordinary conditions liquids are difficult to compress, they may be for all practical purposes regarded as incompressible.

❑ Types of a Fluids

- The fluids are also classified as ideal fluids and real fluids.
- Ideal fluids are those fluids which have no viscosity and surface tension and they are incompressible. As such for ideal fluids no resistance is encountered as the fluid moves. However, in nature the ideal fluids do not exist and therefore, these are only imaginary fluids. The fluids which have low viscosity such as air, water etc., may however be treated as ideal fluids.
- Real fluids are those fluids which are actually available in nature. These fluids possess the properties such as viscosity, surface tension and compressibility and therefore a certain amount of resistance is always offered by these fluids when they are set in motion.

Difference in behaviour of Fluids w.r.to Solids

Solids	Fluids
They cannot flow	They can flow
They have their own shape	They have no definite shape
Spacing between molecules is less	Spacing between molecules is more
Require less space	Require more space
Density is more	Density is less
Specific gravity is more	Specific gravity is less

AIM:

To determine the hydraulic coefficients (Coefficient of Discharge C_d, Coefficient of Velocity C_v, and Coefficient of Contraction C_c) for a sharp edge orifice.

Apparatus:

1. Hydraulic bench
2. Orifice tank with a sharp edge orifice
3. Measuring tank
4. Stopwatch
5. Vernier caliper or micrometer
6. Scale or ruler
7. Pitot tube (for velocity measurement)
8. Manometer

Theory:

The flow through an orifice can be characterized by three hydraulic coefficients:

- **Coefficient of Discharge (Cd)**: The ratio of the actual discharge to the theoretical discharge.
- **Coefficient of Velocity (Cv)**: The ratio of the actual velocity of the jet at the vena contracta to the theoretical velocity.
- **Coefficient of Contraction (Cc)**: The ratio of the area of the jet at the vena contracta to the area of the orifice.

These coefficients are related by the equation: $Cd=Cc \cdot Cv$

Procedure:

1. **Measurement of Orifice Diameter:**
   - Measure the diameter of the sharp edge orifice using a vernier caliper or micrometer.
   - Record the diameter (d).
2. **Setup:**
   - Fill the orifice tank with water to a certain height.
   - Ensure that the orifice is submerged and there is a steady flow of water through the orifice.
3. **Determination of Coefficient of Discharge (Cd):**

- Measure the height (h) of the water level above the center of the orifice.
- Collect water in the measuring tank for a known period using the stopwatch.
- Measure the volume of water collected (V) and the time taken (t).
- Calculate the actual discharge (Q_{actual}) using the formula:
  $Q_{actual} = \frac{V}{t}$
- Calculate the theoretical discharge ($Q_{theoretical}$) using the formula:
  $Q_{theoretical} = A \cdot \sqrt{2gh}$
  where A is the area of the orifice and g is the acceleration due to gravity.
- Determine C_d using the formula:
  $C_d = \frac{Q_{actual}}{Q_{theoretical}}$

4. **Determination of Coefficient of Velocity (Cv):**

- Use a Pitot tube to measure the velocity of the jet at the vena contracta.
- Measure the velocity head (h_v) using the manometer attached to the Pitot tube.
- Calculate the actual velocity (v_{actual}) using the formula:
  $v_{actual} = \sqrt{2gh_v}$
- Calculate the theoretical velocity ($v_{theoretical}$) using the formula:
  $v_{theoretical} = \sqrt{2gh}$
- Determine C_v using the formula:
  $C_v = \frac{v_{actual}}{v_{theoretical}}$

Water Resources Engineering – I

Introduction:

A water wells is a hole or shaft, usually vertical, excavated in the earth for bringing ground water to the surface.

Uses of wells are for irrigation purpose, livestock watering, industrial supplies, geothermal or ground-source energy, construction, dewatering, brine mining, water injection to oil reservoirs, aquifer clean up, river support and artificial recharge of aquifers. Wells also used extensively for monitoring water levels and groundwater quality.

Types of Water Wells:

Diverse geological formations require different types of wells for tapping ground water for irrigation and water supply. The choice of type of well for irrigation is influenced by the size of farm holdings and the relative preference given to private, cooperative and public wells.

There are two broad classes of Wells:

1. Dug well / Open wells
2. Tube wells

1. **Dug Well or Open Well:**

   Open wells have been the major means of domestic water supply throughout the span of the recorded history of mankind. They are also used extensively in small-scale irrigation. Compared to tube wells, open wells are shallow and usually used to tap water table aquifers

   - Larger diameter (3' to 4')
   - Curbing material is usually concrete crocks with loose joints.

- Water enters well through loose casing joints.
- Low well yield
- Highly vulnerable to contamination

Types of Open wells:

- Unlined wells
- Wells with pervious lining
- Wells with impervious lining
- Dug-cum-Bore wells

2. **Tube Wells:**

Tube well is a hole drilled in the ground for the purpose of extracting ground water. Tube wells are classified on the basis of the entry of water into the well, the method of construction, the depth and the type of aquifer tapped.

Classification based on Entry of water:

1) Screen wells

   Several types of well screens are used to suit the specific requirements of the aquifer and economic status of the farmer.

   - Openings in the form of slots which are continues and uninterrupted around the circumstance of the screen.
   - Close spacing of slot openings to provide the maximum percentage of open area.
   - V-shaped slot openings that widen inward

Name

1. Types Survey.pdf
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2. Chain Surveying.pdf
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3. Compass Surveying.pdf
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4. Levelling.pdf
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5. Contour Surveying.pdf
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6. Theodolite Surveying.pdf
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7. Trignometrical Levelling.pdf
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8. Tachemetry.pdf
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9. Field Work – Simple Problems
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10. Curves.pdf
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11. Global Positioning System (GPS...
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12. Remote Sensing.pdf
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13. Photogrammetric Surveying.pdf
Modified Jun 30

14. Hydrographic Surveying.pdf
Modified Jun 30

15. Total Station.pdf
Modified Jun 30

16. Geographical Information Syst...
Modified Jun 30

17. Fundamental of Remote Sensin...
Modified Jun 30

18. Photogrammetry.pdf
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19. Image Interpretation and Analy...
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Introduction:

- Surveying is defined as "taking a general view of, by observation and measurement determining the boundaries, size, position, quantity, condition, value etc. of land, estates, building, farms mines etc. and finally presenting the survey data in a suitable form". This covers the work of the valuation surveyor, the quantity surveyor, the building surveyor, the mining surveyor and so forth, as well as the land surveyor.

- Another school of thought define surveying "as the act of making measurement of the relative position of natural and manmade features on earth's surface and the presentation of this information either graphically or numerically.

The process of surveying is therefore in three stages namely:

(i) Taking a general view

This part of the definition is important as it indicates the need to obtain an overall picture of what is required before any type of survey work is undertaken. In land surveying, this is achieved during the reconnaissance study.

(ii) Observation and Measurement

This part of the definition denotes the next stage of any survey, which in land surveying constitutes the measurement to determine the relative position and sizes of natural and artificial features on the land.

(iii) Presentation of Data:

The data collected in any survey must be presented in a form which allows the information to be clearly interpreted and understood by others. This presentation may take the form of written report, bills of quantities, datasheets, drawings and in land surveying maps and plan showing the features on the land.

Types of Surveying

On the basis of whether the curvature of the earth is taken into account or not,surveying can be divided into two main categories:

Plane surveying: is the type of surveying where the mean surface of the earth is considered as a plane. All angles are considered to be plane angles. For small areas less than 250 km^2 plane surveying can safely be used. For most engineering projects such as canal, railway, highway, building, pipeline, etc constructions, this type of surveying is used. It is worth noting that the difference between an arc distance of 18.5 km and the subtended chord lying in the earth's surface is 7mm. Also the sum of the angles of a plane triangle and the sum of the angles in a spherical triangle differ by 1 second for a triangle on the earth's surface having an area of 196 km^2.

Geodetic surveying: is that branch of surveying, which takes into account the true shape of the earth (spheroid).

Classification of surveying

Introduction

For easy understanding of surveying and the various components of the subject, we need a deep understanding of the various ways of classifying it.

Objective

To enable the students have understanding of the various ways of classifying surveying

Classification Of Surveying

Surveying is classified based on various criteria including the instruments used, purpose

the area surveyed and the method used.

Classification on the Basis of Instruments Used.

Based on the instrument used: surveys can be classified into:

i) Chain tape surveys

ii) Compass surveys

iii) Plane table surveys

CONTOURING

While introducing surveying, it was mentioned that showing natural and manmade features on land in a plan is topographic surveying. Instead of showing the features only in their

plan view if their positions in elevation are also shown, it will enhance the value or topographic map. The various methods tried to show the relative vertical positions of features in a plan are shading, spot heights, hatching and contour lines, of all these methods commonly used method is by drawing contour line in the plan.

A contour line is a imaginary line which connects points of equal elevations. Such lines are drawn on the plan of the area. Since the water in a still lake is a level surface, it represents a contour line Fig, shows a lake with water surface at a level of 110 m. in the plan represents a contour line RL 110 m. if water level goes down by 5 m, of water shows, contour line of RL 105 m. when periphery of water surface in various levels are down, it becomes contour map of ground level of the lake.

While conducting surveying, if levels of various points on the ground are also taken, it is possible to draw ground features in the plan as well as draw the contour lines of different elevations. The field and office work involved in drawing contour lines is called contouring.

Unit 1: Photogrammetry

Unit Structure

1.0. Learning objectives

After studying this unit you will be able to explain:

- About digital photogrammetry.
- Learners will acquire skill to work upon DEM, DTM and ortho photos.
- Learners will be equipped with knowledge to study further digital photogrammetry needs, applications and advancement in remote sensing field.

1.1. Introduction to Digital Photogrammetry

- Photogrammetry as a science is among the earliest techniques of remote sensing.
- The word photogrammetry is the combination of three distinct Greek words: 'Photos' -light; 'Gramma' -to draw; and 'Metron' –to measure. The root words originally signify "measuring graphically by means of light."
- The fundamental goal of photogrammetry is to rigorously establish the geometric relationship between an object and an image and derive information about the object from the image.
- For the laymen, photogrammetry is the technological ability of determining the measurement of any object by means of photography.

1.2. Why Digital Photogrammetry?

- With the advent of computing and imaging technology, photogrammetry has evolved from analogue to analytical to digital (softcopy) photogrammetry.
- The main difference between digital photogrammetry and its predecessors (analogue and analytical) is that it deals with digital imagery directly rather than (analogue) photographs.
- Digital photogrammetry invovles processing of imagery of all types, inclu passive (e.g., optical sensing) or active (e.g., radar imaging), and taken any platform (e.g., airborne, satellite, close range, etc.).
- The unique advantages of Digital Photogrammetry in terms of precision and accuracy offers opportunities for automation of DEM/DTM and integration of images acquired on a multi-platform and multi-sensor basis.

1.3. Techniques of photogrammetry

Name

1. Sources of Water.pdf
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2. Conveyance of Water.pdf
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3. Treatment of Water.pdf
Modified Jun 30

4. Quality and Test of Water.pdf
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5. Distribution System.pdf
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6. Sewers- Collection and Convey...
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7. Sewer Appurtenances - Drainag...
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8. Effluent Treatment Plants.pdf
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9. Treatment and Disposal of Se
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- 6. Sewers- Collection and Convey...
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- 7. Sewer Appurtenances - Drainag...
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- 9. Treatment and Disposal of Sew...
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- 10. Solid Waste Management.pdf
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- 11. Environmental Pollution Control...
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- 12. Air Pollution.pdf
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- 13. Soil Pollution.pdf
  Modified Jun 30
- 14. Noise Pollution.pdf
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SOURCES OF WATER

All the sources of water can be broadly divided into

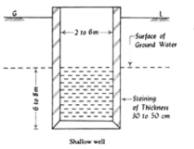
1. **Surfaces sources**
2. **Sub surface sources**

The **surface sources** further divided into

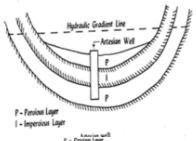
i. **Streams**
ii. **Rivers**
iii. **Ponds**
iv. **Lakes**
v. **Impounding reservoirs etc.**

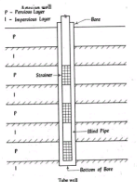
The sub**surface sources** further divided into

(i) **Infiltration galleries**
(ii) **Infiltration wells**
(iii) **Springs etc**

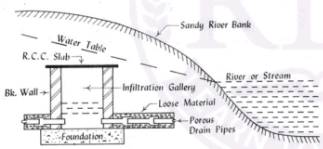


Shallow well

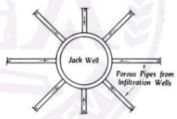




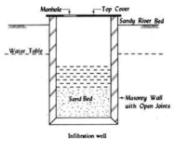
Tube well



Infiltration gallery



Plan of jack well with connections from infiltration wells



Infiltration well

Types of Intake structures

Depending upon the source of water the intake works are classified as following

- **Lake Intake**
- **Reservoir Intake**
- **River Intake**
- **Canal Intake**

WATER DEMANDS

- While designing the water supply scheme for a town or city, it is necessary to determine the total quantity of a water required for various purposes by the city.
- As a matter of fact the first duty of the engineer is to determine the water demand of the town and then to find suitable water sources from where the demand can be met.
- But as there are so many factors involved in demand of water, it is not possible to accurately determine the actual demand.
- Certain empirical formulae and thumb rules are employed in determining the water demand, which is very near to the actual demand.

TYPES OF WATER DEMANDS

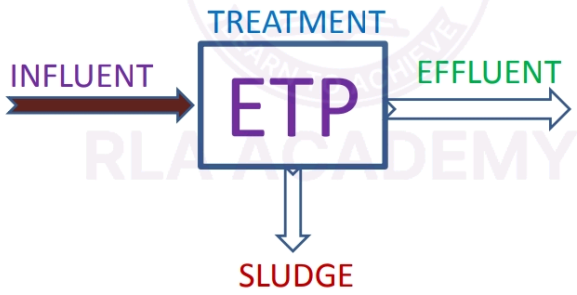
- **Domestic water demand**
- **Industrial demand**
- **commercial demand**
- **Demand for public use**
- **Fire demand**
- **Loses and wastes**

DOMESTIC WATER DEMAND

As per IS:1172-1963, under normal conditions, the domestic consumption of water in India is about 135litres/day/capita. But in developed countries this figure may be 350

What is an ETP?

- **ETP (Effluent Treatment Plant)** is a process design for treating the industrial waste water for its reuse or safe disposal to the environment.
- **Influent: Untreated** industrial waste water.
- **Effluent: Treated** industrial waste water.
- **Sludge: Solid part** separated from waste water by ETP.



Need of ETP

- To **clean industry effluent** and recycle it for further use.
- To **reduce the usage of fresh/potable** water in Industries.
- To **cut expenditure** on water procurement.
- To **meet the Standards** for emission or discharge of environmental pollutants from various Industries set by the Government and **avoid hefty penalties**.
- To **safeguard environment** against pollution and contribute in sustainable development.

Design of ETP

The design and size of the ETP depends upon:

- Quantity and quality of the industries discharge effluent.
- Land availability.
- Monetary considerations for construction, operation & mainten
- **Area dimension depends on:**
  - Quality of wastewater to be treated
  - Flow rate

5.1.11 NOISE POLLUTION

Noise Definition:

Noise is defined as "unwanted **sound**" or "**wrong sound",** in the wrong place, at the wrong time. The noise is measured in terms of "**decibel**"- **(dB).**

Properties:

Noise has **two** important properties.

1. **Loudness**
2. **Frequency**

1. Loudness

It depends upon the amplitude of the vibrations which initiated the noise. The loudness of the noise is measured in decibel (dB). When we say that a sound is 60 dB, it means that it is 60 dB more intense than the smallest distinguishable noise.

Acceptable noise levels (dB).

Building Type	Room Details	Noise Level (dB).
Residential	Bed Room	25
Commercial	Living Room	40
	Office	35-45
	Conference	40-45
	Restaurance	40-60
Industrial	Workshop	40-60
	Laboratory	40-50
Educational	Class Room	30-40
	Library	35-45
Hospitals	Wards	20-30

2. Frequency

It is denoted as **hertz(Hz)**, One Hz is equal to **one wave per second**. The human ear can bear frequencies from about 20 to 20,000 Hz, but this range is reduced with age and other subjective factors. The range of vibrations below 20 Hz is infra-audible and those above 20,000 Hz are ultra-sonic. Many animals (e.gogs) can hear sounds inaudible to the human ear.

Sometimes noise is expressed in psycho-acoustic terms the phon. The phon is a psycho-acoustic index of loudness.

The base **instruments** used in studies on noise are

1. The **sound level meter** which measures the intensity of sound in dB or dB (A)
2. The "**octave band frequency analyzer**" which measures the noise in octave bands. The resulting plot shows the "sound spectrum" and indicates the characteristics of the noise, whether it is mainly high – pitched or of variably pitched.
3. The **audiometer** which measures the hearing ability. The zero line at the top in the audiogram represents normal hearing. Noise-induced hearing loss shows a characteristics dip in the curve at the 4000 Hz frequency.

5.1.12 SOURCES OF NOISE:

The sources of noise may be divided into the following groups.

1. **Domestic Noise**
   It includes the operating of radio, television, record player, etc. with high volume. It also include the use of vacuum cleaner for a long time.
2. **Public Noise.**
   It includes the operation of loud speakers with high volume during the festivals, social functions, religious functions, etc.
3. **Traffic Noise.**

Name

1. Systems of Taking out Quantitie...
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2. Trade and Group systems.pdf
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3. Material Requirement for Differ...
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4. Preparation of Data for Works.p...
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5. Report Writing.pdf
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6. Valuation of Buildings and Prop...
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7. Fixation of Rents.pdf
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8. Approximate Estimates.pdf
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9. Detailed Estimate and Abstra
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9. Detailed Estimate and Abstract ...
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10. CMDA Rules and Regulations.p...
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11. Building-By -Laws.pdf
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METHODS OF TAKING OUT QUANTITIES:

The quantities like earth work, foundation concrete, brickwork in plinth and super structure etc., canbe workout by any of following two methods:

a) Long wall - short wall method

b) Centre line method.

c) Partly centre line and short wall method.

a) Long wall-short wall method:

In this method, the wall along the length of room is considered to be long wall while the wall perpendicular to long wall is said to be short wall. To get the

length of long wall or short wall, calculate first the centre line lengths of individual walls. Then the length of long wall, (out to out) may be calculated after adding half breadth at each end to its centre line length. Thus the length of short wall measured into in and may be found by deducting half breadth from its centre line length at each end. The length of long wall usually decreases from earth work to brick work in super structure while the short wall increases. These lengths are multiplied by breadth and depth to getquantities.

b) Centre line method:

This method is suitable for walls of similar cross sections. Here the total centre line length is multiplied by breadth and depth of respective item to get the total quantity at a time. When cross walls or partitions or verandah walls join with mainall, the centre line length gets reduced by half of breadth for each junction. such junction or joints are studied caefully while calculating total centre line length.The estimates prepared by this method are most accurate and quick.

c) Partly centre line and partly cross wall method:

This method is adopted when external (i.e., alround the building) wall is of one thickness and the inte walls having different thicknesses. In such cases, centre line method is applied to external walls and long wall-short wall method is used to internal walls. This method suits for different

2.1.9 Valuation of Property

The valuation of the building is mainly depends on its type, materials used in construction, durability, site conditions, size and shape, present market rates of materials, labour and land, etc.,. The valuation may also depends on the height of building, type of roofs, wall thickness, type of foundations, plinth level, etc.,.

Buildings constructed in commercial areas or market have high value than those constructed in residential areas. Buildings constructed in approved lands or developed areas has high value as compared to buildings of unapproved lands or undeveloped areas. The buildings of the area with facilities like electricity, water supply and sanitary arrangements will have high value. The buildings constructed on free-hold lands will have high value than constructed on lease-hold lands. The value of the building mainly depends on the net income which it can fetch if rented. The valuation also depends on the demand for purchase, if purchasers are more the value will be increased.

2.1.10 Methods of valuation of buildings

The following are the various methods used to determine the valuation of buildings :

1 Rental method
2 Cost based method (Present value)
3 Profit based method
4 Capital value comparison method

1 Rental method :

In this method the net income fetched by the property is worked out deducting all the outgoing expenditures as described earlier. The valuation of the building on the basis of the rent is taken as about 200 times the rent per month of the building, and on this allowing cost of depreciation depending on life of the building.

If the building is rented one, then on its market value, its valuation can be calc
But no hard and fast rules can be laid down for the market value of the building,
will depend on the locality in which the building has been constructed, the purp
which it was built, and the purpose for which it could be utilized in that locality.

2 Cost based method (Present value) :

In this method the actual cost of construction of the building or purchase cost is taken into account. After suitable depreciation and considering other points, the present valuation is determined.

i.e., Present value $V = P(1-p)^n$

here, P - Original cost p – *rate of depreciation*]

Introduction

1.1 Introduction

The term building in Civil Engineering parlance is used to mean a structure having various components like foundations, walls, columns, floors, roofs, doors, windows ventilators, stairs, lifts, various type of surface finishes etc. As a Civil Engineer is mainly concerned with the construction of buildings, it is essential for him to acquire good knowledge of construction of various components of a building.

1.2 Type of Building

National building code of India (SP : 7-1970) defines the building as any structure for whatsoever purpose and of whatsoever materials constructed and every part there of whether used as human habitation or not and includes foundations, plinth, walls, floors, roofs, chimneys, plumbing and building services, fixed platforms, verandah, balcony cornice or projection, part of a building or any thing affixed there to or any wall enclosing or intended to enclose any land or space and signs and outdoor display structures tents, shamianas and tarpaulin, shelters are not considered as a building.

As per national building code of India, buildings are classified into nine groups based on occupancy as follows:

Group A	:	Residential buildings
Group B	:	Educational buildings
Group C	:	Institutional buildings
Group D	:	Assembly buildings
Group E	:	Business buildings
Group F	:	Mercantile buildings
Group G	:	Industrial buildings
Group H	:	Storage buildings
Group I	:	Hazardous buildings

1.3 Structural System of Building

Building is an assemblage of two or more components which are interrelated and compatible. Each component is essential for the required performance of a building. Building components like walls, floors, roofs, windows and doors are interrelated and compatible with each other. The required performance of the building as a whole imposes restrictions on the components.

The simplest building system consists of only two components, floor and an enclosure. Floor is a flat horizontal surface, on which human- activities take place. An enclosure extends over and around the floor giving shelter to living being from weather.

A load bearing wall is one which rests on the foundation taken deep into the subsoil. It takes superimposed load. i.e. the load transmitted from slabs and beams. It transmits the load of the superstructure on the subsoil on which it rests. The entire wall should be taken deep into the ground where the enlarged footings provide enough stability for it. Also stress transmitted is considerably reduced because of increase in width of footings.

A partition wall is an internal screen wall which rests above the floor level; to create a room or enclosure. It may not be anchored deep into the soil and may; not take any load of superstructure.

According to structural system there are three types of buildings:

(1) Load bearing structure (2) Framed structure (3) Composite structure

1.3.1 Load bearing structure

The system of building comprising of slabs, beams and load bearing walls is known as a load structure. Most of the residential buildings are small in size and are up to three storey are generally con as load bearing structures.

As shown in figure below loads from the slab roof or trusses and floors are transmitted through the firm soil below the ground. In load bearing structures walls of the upper floors have less thickness th walls of lower floors, so compared to upper floors, the carpet area at lower floors will be less. Such type of structures are most suited for buildings up to three storey and where hard strata of soil is available. Generally for individual residential bungalow, tenement, low rise flats, temples and rural buildings load bearing structure system is adopted.

Name

1. Reinforced Cement Concrete St...
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2. Analysis and Design of Singly an...
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2. Deformation of Elastic Bar due t...
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3. T-Beam Sections.pdf
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4. Cantilever, Simply Supported, C...
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5. One Way and Two Way Slabs.pdf
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6. Lintels.pdf
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7. Sunshade.pdf
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8. Staircases.pdf
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9. Rectangular and Circular Short ...
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10. Basics of Retrofitting.pdf
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11. Steel Structure.pdf
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12. Design of Tension and Compre...
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13. Different Forms of Tension Me...
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14. Design Strength of Single Angl...
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15. Design of Ties using Angles an...
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16. Design of Simple Beams.pdf
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17. Web Design Strength in Benc
Modified Jun 30

18. Shear – Limiting Deflection of ...

Introduction

Reinforced concrete, as a composite material, has occupied a special place in the modern construction of different types of structures due to its several advantages. Due to its flexibility in form and superiority in performance, it has replaced, to a large extent, the earlier materials like stone, timber and steel. Further, architect's scope and imaginations have widened to a great extent due to its mouldability and monolithicity. Thus, it has helped the architects and engineers to build several attractive shell forms and other curved structures. However, its role in several straight line structural forms like multistoried frames, bridges, foundations etc. is enormous.

Concrete

Concrete is a product obtained artificially by hardening of the mixture of cement, sand, gravel and water in predetermined proportions.

Depending on the quality and proportions of the ingredients used in the mix the properties of concrete vary almost as widely as different kinds of stones.

Concrete has enough strength in compression, but has little strength in tension. Due to this, concrete is weak in bending, shear and torsion. Hence the use of plain concrete is limited applications where great compressive strength and weight are the principal requirements and where tensile stresses are either totally absent or are extremely low.

Properties of Concrete

The important properties of concrete, which govern the design of concrete mix are as follows

(i) Weight

The unit weights of plain concrete and reinforced concrete made with sand, gravel of crushed natural stone aggregate may be taken as 24 KN/m^3 and 25 KN/m^3 respectively.

(ii) Compressive Strength

With given properties of aggregate the compressive strength of concrete depends primarily on age, cement content and the water cement ratio are given Table 2 of IS 456:2000. Characteristic strength are based on the strength at 28 days. The strength at 7 days is about two-thirds of that at 28 days with ordinary portland cement and generally good indicator of strength likely to be obtained.

(iii) Increase in strength with age

There is normally gain of strength beyond 28 days. The quantum of increase depends upon the grade and type of cement curing and environmental conditions etc.

(iv) Tensile strength of concrete

The flexure and split tensile strengths of various concrete are given in IS 516:1959 and IS 5816:1970 respectively when the designer wishes to use an estimate of the tensile strength from compressive strength, the following formula can be used

$$\text{Flexural strength, } f_{cr}=0.7\sqrt{f_{ck}}\ \text{N/mm}^2$$

(v) Elastic Deformation

The modulus of elasticity is primarily influenced by the elastic properties of the aggre and to lesser extent on the conditions of curing and age of the concrete, the mix proportions and the type of cement. The modulus of elasticity is normally related to the compressive characteristic strength of concrete

$E_c=5000\sqrt{f_{ck}}$ N/mm^2

What is Lintel?

A lintel is a beam placed across the openings like doors, windows etc. in buildings to support the load from the structure above. The width of lintel beam is equal to the width of wall, and the ends of it is built into the wall. Lintels are classified based on their material of construction.

Horizontal lintels are easy to construct as compared to arches.

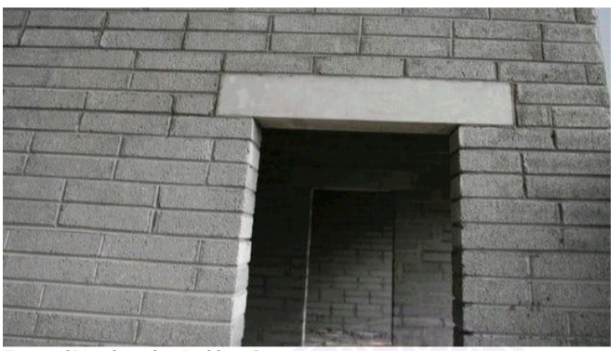
Bearing of Lintel

The bearing provided should be the minimum of following 3 cases.

10 cm

Height of beam

$1/10^{th}$ to $1/12^{th}$ of span of the lintel.



Types of Lintel used in Building Construction

Lintels are classified based on the material of construction as:

1. Timber Lintel

In olden days of construction, Timber lintels were mostly used. But now a days they are replac several modern techniques, however in hilly areas these are using. The main disadvantages wi are more cost and less durable and vulnerable to fire.

If the length of opening is more, then it is provided by joining multiple number of wooden piec help of steel bolts which was shown in fig (a). In case of wider walls, it is composed of two wood kept at a distance with the help of packing pieces made of wood. Sometimes, these are strengthened by the provision of mild steel plates at their top and bottom, called as flitched lintels.

UNIT-1

DESIGN OF BEAMS

1.1 Introduction

A structure refers to a system of connected parts used to support forces (loads). Buildings, bridges and towers are examples for structures in civil engineering. In buildings, structure consists of walls floors, roofs and foundation. In bridges, the structure consists of deck, supporting systems and foundations. In towers the structure consists of vertical, horizontal and diagonal members along with foundation.

A structure can be broadly classified as (i) sub structure and (ii) super structure. The portion of building below ground level is known as sub-structure and portion above the ground is called as super structure. Foundation is sub structure and plinth, walls, columns, floor slabs with or without beams, stairs, roof slabs with or without beams etc are super-structure. Many naturally occurring substances, such as clay, sand, wood, rocks natural fibers are used to construct buildings. Apart from this many manmade products are in use for building construction. Bricks, tiles, cement concrete, concrete blocks, plastic, steel & glass etc are manmade building materials.

1.2 Objectives

1. To understand various design philosophies.
2. To understand the necessity of reinforcement in RC structure.
3. To understand the stress block parameter of RC beam section.
4. To understand the necessity of partial safety in design of RC member.

1.3 Advantages Disadvantages of RC members

Advantages

- It has high tensile and compressive strength.
- It is more durable and may long up to 100 years.
- It imparts ductility.
- Raw materials used for construction of RC buildings are easily available and can be transported.
- Overall cost for constructing a building using RC proves to be economical compared to steel and pre-stressed structures.
- RC components can be moulded to any desired shape , if formwork is designed properly.

- If RC structures are properly designed then it can resist the earthquake forces.

Disadvantage

- Tensile strength of RC member is about $1/10^{th}$ of its compressive strength **1.4**

Materials required for RC member

a. Concrete

Concrete is a product obtained artificially by hardening of the mixture of cement, sand, gravel and water in predetermined proportions. Depending on the quality and proportions of ingredients used in the mix the properties of concrete vary almost as widely as different k of stones. Concrete has enough strength in compression, but has little strength in tension. to this, concrete is weak in bending, shear and torsion. Hence the use of plain concrete is limited applications where great compressive strength and weight are the principal requirements and where tensile stresses are either totally absent or are extremely low.

Properties of Concrete

1. **Grade of concrete**

Deflection of Beams

Introduction:

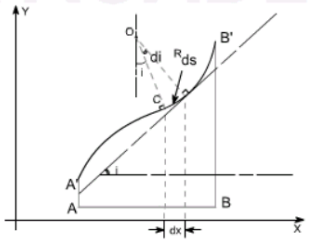
In all practical engineering applications, when we use the different components, normally we have to operate them within the certain limits i.e. the constraints are placed on the performance and behavior of the components. For instance we say that the particular component is supposed to operate within this value of stress and the deflection of the component should not exceed beyond a particular value.

In some problems the maximum stress however, may not be a strict or severe condition but there may be the deflection which is the more rigid condition under operation. It is obvious therefore to study the methods by which we can predict the deflection of members under lateral loads or transverse loads, since it is this form of loading which will generally produce the greatest deflection of beams.

Assumption: The following assumptions are undertaken in order to derive a differential equation of elastic curve for the loaded beam

1. Stress is proportional to strain i.e. hooks law applies. Thus, the equation is valid only for beams that are not stressed beyond the elastic limit.
2. The curvature is always small.
3. Any deflection resulting from the shear deformation of the material or shear stresses is neglected.

It can be shown that the deflections due to shear deformations are usually small and hence can be ignored.



Consider a beam AB which is initially straight and horizontal when unloaded. If under the action of loads the beam deflect to a position A'B' under load or infact we say that the axis of the beam bends to a shape A'B'. It is customary to call A'B' the curved axis of the beam as the elastic line or deflection curve.

In the case of a beam bent by transverse loads acting in a plane of symmetry, the bending moment M varies along the length of the beam and we represent the variation of bending moment in B.M diagram. Futher, it is assumed that the simp bending theory equation holds good.

$$\frac{\sigma}{y} = \frac{M}{I} = \frac{E}{R}$$

If we look at the elastic line or the deflection curve, this is obvious that the curvatu at every point is different; hence the slope is different at different points.

To express the deflected shape of the beam in rectangular co-ordinates let us take two axes x and y, x-axis coincide with the original straight axis of the beam and the y – axis shows the deflection.

Name

1. Planning of a Project.pdf
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2. Factors to be Considered.pdf
Modified Jun 30

3. Project Report.pdf
Modified Jun 30

4. Organization Structure of Const...
Modified Jun 30

5. Construction Planning.pdf
Modified Jun 30

6. CPM and PERT Networks.pdf
Modified Jun 30

7. Contracts.pdf
Modified Jun 30

8. Tenders and Tender Documents...
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10. Supervision and Quality Cor
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- 10. Supervision and Quality Contr...
  Modified Jun 30
- 11. Safety Measures in Constructio...
  Modified Jun 30
- 12. Labour Legislations.pdf
  Modified Jun 30
- 13. Banking Practice.pdf
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- 14. Cash Flow Diagrams.pdf
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- 15. Financial Management.pdf
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- 16. Ethics in Engineering.pdf
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- 17. Disaster Management.pdf
  Modified Jun 30
- 18. Types of Natural Calamities.pdf
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- 19. Causes – Preparedness.pdf
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- 19. Causes – Preparedness.pdf
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- 20. Response and Recovery.pdf
  Modified Jun 30
- 21. Use of Computers.pdf
  Modified Jun 30
- 22. Application of CAD Softwares....
  Modified Jun 30
- 23. Project Management Software...
  Modified Jun 30
- 24. Use of MS Word.pdf
  Modified Jun 30
- 25. Use of MS Excel.pdf
  Modified Jun 30
- 26. Use of MS Powerpoint.pdf
  Modified Jun 30
- 27. Application of Design & Analysi...
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Project

Once a project is selected for execution, the structural project planning approach prescribes that the project gets planned in detail prior to the actual start of the project.

Project planning consists of two main stages: Risk Management and Project Scheduling.

The goal of the risk management stage is to identify project risks and take the necessary precautions.

The goal of project scheduling is to make a detailed schedule of all the tasks that need to performed, with specific time frames and resource allocations.

Risk Management

In projects, there is always some uncertainty about the schedule, the costs and the quality of the end product.

Project management is to some extent risk management which tries to systematically manage this uncertainty in order to increase the likelihood of meeting project objectives

Risk management deals with uncertainty, which comes in two flavours:

Known unknowns: Identified potential problems. One doesn't know exactly what will happen, but one is aware of the risks and their potential to damage the project. One can prepare for these risks.

Unknown unknowns: These relate to problems that arrive unexpectedly and cannot be anticipated. However, good project managers still expect these to happen.

All project management activities can be considered as managing risk, but the risk management process is a specific set of activities performed consciously to identify and manage risks on the project.

There is a difference between project risk and business risk.

Business risk relates to creating the right project output. Business risk is seldom the responsibility of the project manager, but rather of the project owner.

Project risk relates to making sure the project produces the promised results within budget and on time. This is the responsibility of the project manager.

Risk Management Framework

A possible risk management framework consists of 5 main steps:

Identify Risks: Find all the factors that threaten project objectives.

Analyse and prioritize: Assess each risk in terms of its possible damage and likelihood of occurrence.

Develop a response: Create strategies for reducing the possible damage and/or probability risk will occur.

Establish reserves: Set aside additional funding for the project that will be used for known and unknown risks.

Continuous risk management: Implement strategies and monitor the effects of these changes the project.

Identify the risks

Organize brainstorm sessions with stakeholders to gather potential risks. Generate a list as big as

7. QUALITY CONTROL, MONITORING AND SUPERVISION

7.1 QUALITY CONTROL

Quality is defined as:

- Degree of goodness
- Conformance to requirements
- Zero defects
- Fitness for purpose
- Consistent conformance to expectation
- Doing things right the first time
- Quality is the totality of characteristics of an entity that bears on its ability to satisfy stated and implied needs

Quality Control concerns the operational means to fulfill the quality requirements. It detects the non-conformity and verifies the conformity. Quality control includes the following stages:

- Incoming goods, services and information
- In-process
- End product

Facts and Misconceptions regarding Quality

- Quality is not grade
- Quality costs more, but lack of quality costs even more
- Quality is a means of achieving project success. It is not the goal in itself
- Process quality is more than product quality
- Quality standards do not demand the best quality, they establish the minimum requirements to be achieved
- Quality does not happen by accident, it has to be properly planned and implemented

7.2 QUALITY MANAGEMENT

- Quality Control
- Quality Assurance
- Total Quality Management

Quality management includes Quality Assurance (QA) and Quality Control (QC) as well as other concepts of quality planning, quality policy and quality improvement. Total Quality Management (TQM) develops these concepts as a long-term global management strategy and the participation of all members of the organization for the benefit of the organization itself, its members, its customers and society as a whole.

Client and Quality

- What does the client want ? The client's brief and commitment is most essential
- Due to his unique requirements and constraints, the client has to provide clear instructions, timely decisions and assist the project management team
- Continual effort to achieve better and improved quality performance is vital

Conflict Leads to:

Quality management tools and techniques:

- Process sequence flow chart - to know where the process
- ally chart/check sheets - to know how often what goes wrong
- istogram - to obtain meaningful pictures of data
- Pareto analysis - to find the vital few from the trivial many

I. Introduction to Disasters

1. Introduction

Disasters disrupt progress and destroy the hard-earned efforts. Often pushes the nation in quest for progress, back by several decades. Efficient management of disaster rather than mere response to their occurrence has received increased attention. India is vulnerable in varying degrees to a large number of natural as well as man-made disasters. 59% of land mass is prone to earthquake of moderate to very high intensity. Over 40 million hectares (12% of land) is prone to floods and river erosion. 5700km, out of 7516km coast line is prone to cyclones and tsunamis. 68% of cultivable area is vulnerable to drought and hilly areas are at land slide risk.

Vulnerability to disaster, emergencies of chemical, biological and nuclear origin also exists. Disaster risk can be related to expanding population, rapid urbanization, and industrialization, development in high risk zones, environmental degradation and climate change. The national policy enacted Disaster Management Act in 2005, envisages capacity building on various aspects of disaster management at different levels. It includes measures for disaster prevention, mitigation, preparedness, response and reconstruction.(Dr. Ramachandran)

India with its varied geographical, geological and climatic conditions is prone to different types of disasters. 5700km /7516km coastal line is prone to cyclones and tsunamis, 40 million hectare (12%) of land is prone to flood and river erosion, 58% of land prone to earthquakes, 68% of cultivable land is vulnerable to drought by nion availability of river water. All hill areas at risk of land slide. Apart from this, we have radiological and nuclear radiation and environmental degradation due to abnormal dumping of greenhouse gases in the atmosphere by the use of fossil fuel for most of energy generation activities and transportation. Foundations to risk reductions are

- Planning in advance
- Robust design methodology, to withstand higher level of risk and technological adoption such as tsunami warning system and Polari metric radar.
- Implementing it in right time to reduce risk
- Ensuring safety and security in case of disaster in separate incident or in a combination of multiple disasters. (Dr.APJ Abdul Kalam)

Disaster management is an important topic of discussion after 2001 Bhuj earth quake and 2004 Tsunami. In R&D GOI has implemented warning system for tsunami and storm surges. Tsunsmi vulnerability assessment, climate disaster resilience index, drought assessment and coastal chronic disasters such as shoreline erosion using satellite remote sensing data are carried out during last decade. DM is introduced in school curriculum. Networking of universities in Asia has helped in higher education in DM. various case studies done by many organizations in the past decade. It aimed to provide disaster education, training and capacity building. Tsunami impact studies along Chennai coast and Andaman Islands

After 26.12.2004, Indian Ocean tsunami event inundation mapping of tsunami water was carried out along Chennai coast in TN and assessment through field survey and micro paleontological investigation along islands. A quantitative assessment at Chennai was made by interating thematic details from satellite data. The study reveals that parameters such as shore bathymentry, land evaluation, nature of water waves, manmade protection measures play a vital role in controlling the effect of tsunami. They mapped the shore as low, moderate and high risk zone. It is useful for local govt, revenue, highways and town planning departments. Under the ministry of earth science, a national program on early warning system for tsunami was made. Several cities and towns along coast are facing fury of climate change and floodi the lowlying area. Chennai with high population is more vulnerable to climate disasters.

The **Disaster Management Act, 2005**, (23 December 2005) No. 53 of 2005, passed by the Rajya Sabha, the upper house of the Parliament of India on 28 November, by the Lok Sabha, the lower house of the Parliament, on 12 December 2005. It received t assent of The President of India on 9 January 2006. The Disaster Management Act, 2005 has 11 chapters and 79 sections. The Act extends to the whole of India. The Act provides for "the effective management of disasters and for matters connected therewith or incidental thereto."

Nati Authority

UNIT – I

Conventional Software Management: The waterfall model, conventional software Management performance.

Evolution of Software Economics: Software Economics, pragmatic software cost estimation.

Improving Software Economics: Reducing Software product size, improving software processes, improving team effectiveness, improving automation, Achieving required quality, peer inspections.

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1. Conventional software management

Conventional software management practices are sound in theory, but practice is still tied to archaic (outdated) technology and techniques.

Conventional software economics provides a benchmark of performance for conventional software management principles.

The **best** thing about software is its **flexibility**: It can be programmed to do almost anything.

The **worst** thing about software is also its **flexibility**: The "almost anything" characteristic has made it difficult to plan, monitors, and control software development.

Three important analyses of the state of the software engineering industry are

1. Software development is still highly unpredictable. Only about **10%** of software projects are delivered **successfully** within initial budget and schedule estimates.
2. Management discipline is more of a discriminator in success or failure than are technology advances.
3. The level of software scrap and rework is indicative of an immature process.

All three analyses reached the same general conclusion: The success rate for software projects is very low. The three analyses provide a good introduction to the magnitude of the software problem and the current norms for conventional software management performance.

1.1 THE WATERFALL MODEL

Most software engineering texts present the waterfall model as the source of the "conventional" software process.

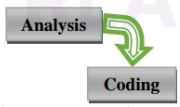
1.1.1 IN THEORY

It provides an insightful and concise summary of conventional software management

Three main primary points are

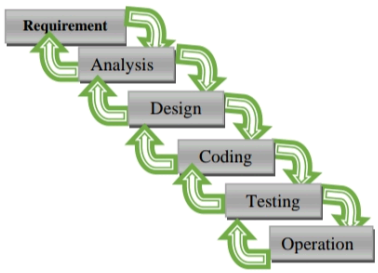
1. There are two essential steps common to the development of computer programs: **analysis** and **coding.**

   Waterfall Model part 1: The two basic steps to building a program.



Analysis and coding both involve creative work that directly contributes to the usefulness of the end product.

2. In order to manage and control all of the intellectual freedom associated with software development, one must introduce several other "overhead" steps, including system requirements definition, software requirements definition, program design, and testing. These steps supplement the analysis and coding steps. Below Figure illustrates the resulting project profile and the basic steps in developing a large-scale program.



3. The basic framework described in the waterfall model is risky and invites failure. The testing phase that occurs at the end of the development cycle is the first event for which timing, storage, input/output transfers, etc., are experienced as distinguished from analyzed. The resulting design changes are likely to be so disruptive that the software requirements upon which the design is based are likely violated. Either the requirements must be modified or a substantial design change is warranted.

Five necessary improvements for waterfall model are:-

1. **Program design comes first**. Insert a preliminary program design phase between the so requirements generation phase and the analysis phase. **By this technique, the program de assures that the software will not fail because of storage, timing, and data flux (continuo change).** As analysis proceeds in the succeeding phase, the program designer must impose on the analyst the storage, timing, and operational constraints in such a way that he senses the consequences. If the total resources to be applied are insufficient or if the embryonic(in an early stage of development) operational design is wrong, it will be recognized at this early stage and the iteration with re ents and preliminary design can be done before final design, coding and test commence. How is this program design procedure implemented?

Application of Design & Analysis Softwares

1. Definition & Introduction

- Design & Analysis Software: Computer programs enabling civil engineers to model, design, analyze, and optimize structures and systems (buildings, bridges, infrastructure).
- In Construction Management, these tools support planning, execution tracking, cost estimation, scheduling, and resource allocation.
- Enhances accuracy, efficiency, and productivity across all phases—from conceptual design to project closeout.

2. Key Concepts & Theory

1. Finite Element Method (FEM)

Mathematical technique dividing complex structures into discrete "elements" enabling structural, thermal, or dynamic analysis.

2. Building Information Modeling (BIM)

A 3D collaborative database-driven model of built components, integrating geometry, spatial relationships, and metadata for improved coordination.

3. Structural Analysis

Simulation of stresses, deflection, natural frequencies. Software evaluates load paths under static, dynamic, wind, seismic forces.

4. Scheduling & Planning

Critical Path Method (CPM) / Program Evaluation and Review Technique (PERT) with Gantt charts for time management, cost-loading, resource leveling.

5. Cost Estimation & Quantity Take-off

2D/3D drafting software extracts quantities, applies rate databases for BOQ generation and financial forecasting.

3. Relevant Formulas (Commonly Embedded in Software)

Beam bending:

- $M = EI \cdot \kappa$
- $\kappa = M / (EI)$; M = bending moment, E = modulus, I = moment of inertia

Critical Path Duration:

- ES / EF / LS / LF / Float = LS−ES

Load Combinations (IS 875):

- WL + DL + (LL or EL)

Fundamental Natural Frequency:

- $\omega_1 = (\pi / L^2) \cdot \sqrt{(EI / m)}$

4. Diagrams (Describe Textually)

FEM Mesh

A cantilever beam broken into triangular/quadrilateral elements with red nodes and blue outlines.

BIM Coordination Overlay

Architectural, structural, MEP models in different colors; IFC clash detection alerts highlig
in red.

Gantt Chart & CPM Network

Horizontal timeline bars; nodes represent events; critical path highlighted in red.

5. Important Tables

Software	Purpose	Key Features
ETABS	Structural modeling &	FEM load combos