

**ADVANCED CONSTRUCTION TECHNIQUES  
&  
EQUIPMENTS**

**TH-3**  
**6<sup>th</sup> SEM CIVIL  
ENGG.**

**Under SCTE&VT,Odisha**

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LECTURE NOTE  
ON

ADVANCED CONST.

TECHNIQUES & EQUIP.  
(ACT & E)

SEM:- 6<sup>TH</sup>

SUB:- TH-3

## → Earthquake Resistance Construction :-

### Introduction :-

Earthquake causes ground motion in random way both horizontally & vertically.

→ The structure due to the ground vibrates & initial internal forces in them, it is therefore essential to ensure.

(i) Stability

(ii) Strength

(iii) Serviceability

→ The random earthquake ground motion which cause the structure which vibrate can be resolved in any 3 mutually perpendicular direction.

### Cause of Earthquake :-

Large amount of heat was generated by the friction & slowly the earth cool down & the heavier & denser material sink to the center & the lighter one rise to the top.

→ The differentiated earth, consist of 4 elements

(a) The inner core of radius 1290 km.

(b) The outer core thickness 220 km

(c) The mantle of thickness 2900 km

(d) The crust of thickness 15 to 40 km

→ The inner core is solid & consist of heavy metal where the crust consist of light metal.

→ The inner core is liquid in form & mantle has the ability to flow.

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Saturday

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→ The temp<sup>n</sup> is estimated 25,000°C & the pressure 4 million in the atmosphere.

### 10 Formation of Earthquake :-

→ Rock are made of elastic material & show elastic strain energy is stored in them. During the deformation the occurs deep to tectonic plates action that occurs in the earth.

→ But the material contained in rock is very brittle when the rock along a weak region in the earth crust reaches their strength, a sudden moment takes place, this sudden vibration is known as "Earthquake".

### 3 Types of Earthquake :-

4 → Most Earthquake in the world occurs along the boundaries of tectonic plate, are called "inter plate earthquake". Ex:- 1897 in Assam earthquake

5 → A no of earthquake also occurs within the plate itself away from the plate boundaries. It is known as "intraplate Earthquake".

6 Ex:- 1993 Ludhiana earthquake.

7 → In both types of earthquake the slive or vibration generated is along both vertically & horizontally.

Notes

## Seismic Waves :-

- 9 → Lateral strain energy released during an earthquake travels as seismic waves in all
- 10 directions through the earth layers.
- These waves are two types :-
- 11 (a) Body waves
- (b) Surface waves
- 12 → Body wave consist of primary waves & Secondary waves
- 1 → In primary waves material particles undergo the direct energy. (P. waves)
- 2 → In case of secondary waves the energy transmission is done. (S. waves)
- 3 → P. waves are fastest followed in sequence by Secondary wave, the primary waves & Secondary
- 4 waves are the viceversa.

## Measuring Instrument :-

- 5 → The instrument that measures earthquake shaking, a Seismograph has 3 components :-
- 6 The Sencer, the recorder & the timer.
- 7 → A pen attached on the tip of an oscillating simple pendulum marks on a chart paper that is held on a drum, rotating at a constant speed.

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## Ground motion characteristics:-

- Shaking of ground on the Earth's surface is a net consequence of motion caused by seismic waves generated by energy released at each material point within the 3 dimensional volume that ruptures at the fault.
- These waves arrive at various instant of times have different amplitude & carry different levels of energy. Thus the motion at any side on ground is random in nature with its amplitude & direction varying at the time.

## Earthquake terminology:-

- (i) Focus & epicenter:-  
The point on the fault where slip starts the focus & the point vertically above this on the surface of the earth is the epicenter.
- The depth of focus from the epicenter called as "focal depth".
- It is an important parameter in determining the damaging potential of an earthquake.
- A no. of smaller size earth quake takes place before & after a big earthquake.

Notes

## Magnitude of earthquake =

- 9 → It is a quantitative measure of the actual size of the earthquake.
- 10 → Magnitude of earthquake is a no which is a measure of energy release in an earthquake.
- 11 → An increase in magnitude (M) by 1.0 times higher wave form amplitude & about 31 times
- 12 higher energy released.

## Seismic Zone of India =

- 1 Based on the levels of destruction during damaging
- 2 past earthquakes seismic zone maps for a country are prepared.
- 3 → The seismic zone maps are revised from time to time.

	Town	Seismic zone factor
4	Ahmedabad	0.10
5	Ajmer	0.10
	Amritsar	0.24
6	Bangalore	0.10
	Bikaner	0.10
7	Bhopal	0.10
	Bhubaneswar	0.16
	Bokaro	0.16
	Chandigarh	0.24
	Chennai	0.16
	Cuttack	0.16

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Thursday

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	Darejiling	0.24
	Derradeen	0.24
	Delhi	0.24
10	Grangtok	0.24
	Goa	0.16
11	Gohati	0.36
	Hydrabad	0.10
12	Jaipur	0.10
	Jamshedpur	0.10
1	Jodhpur	0.10
	Kanpur	0.16
2	Kanchipuram	0.16
	Kolkata	0.16
3	Kota	0.10
	Lakho	0.16
4	Mumbai	0.16
	Maisur	0.10
5	Nasik	0.16
	Nainital	0.24
6	Pune	0.16
	Roorkee	0.24
7	Roskela	0.10
	Vishakapatnam	0.10

Notes

## Seismic effect on building:-

- 9 (i) Max<sup>m</sup> Considered Earthquake (MCE) :-  $\rightarrow$ 
  - $\rightarrow$  It is the most severe earthquake effects considered
  - 10 by the Indian Standard.
- 11 (ii) Design basis earthquake (DBE) :-  $\rightarrow$ 
  - $\rightarrow$  It is the earthquake that can be expected to
  - 12 occur at least once during the design life of the structure.
  - 1  $\rightarrow$  Earthquake causes shaking of the ground so a building resting on it will experience motion at
  - 2 its base.
  - $\rightarrow$  The roof has tendency to stay in the original
  - 3 position but the base of the building moves with the ground.
  - 4  $\rightarrow$  This gives rise to inertia force on the roof element.
  - 5  $\rightarrow$  Earthquake causes shaking of the ground in all the 3 direction such as  $x$ ,  $y$  &  $z$  direction.

— 0 —

09

JANUARY

Construction & Earth

PART-C

Saturday

Moving equipment

Week 02 • 009/357

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### Planning of Construction Equipment :-

- Modern highway construction project are complex in nature & success of a project depends on proper & scientific planning.
- Before starting any project its planning is done with great care as the efficiency of the whole project involves all the equipments.
- Planning of construction project involves deciding extrics, mechanism, Equipment planning & excusion planning etc.

### Selection of construction equipment :-

- Proper selection of equipment for a highway construction project is a vital importance for its speedy economical completion.
- Selection of equipment for the project is one of the key discussion in planning & executing a construction project.
- It depends upon,
  - (i) use of availability of equipment
  - (ii) scope of work to be carried out
  - (iii) size of equipment
  - (iv) availability of spare part
  - (v) suitability of local labourer.

10 Sunday

Notes

## Equipment :-

Some of the earth moving equipments are tractor, bulldozer, dragline, roller etc.

## Tractor :-

These are available in all size almost any job for which they are used. They are divided into 2 categories.

(a) crawler tractor

(b) wheel tractor

## (a) Crawler Tractor :-

→ These types of tractors are widely used most uneven & rough surface.

→ It moves in an endless chain & the speed of the tractor is less than the wheel tractor.

→ These are usually rated by weight & power.

→ The crawler tractor are adopted for

Scrapers.  
→ Average speed of crawler tractor is 5 to 6 km. per hour & max<sup>m</sup> is 11.5 km per hour.

## (b) Wheel tractor :-

→ The main advantages of wheel tractor over a crawler tractor is the higher speed but the pulling effort for wheel tractor is less than the crawler tractor.

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- It is generally used in smooth & even surface.
- It is divided into 2 categories,
  - (1) two wheel tractor
  - (2) four wheel tractor

### (1) Two wheel tractor →

- Now a days two wheel tractor are not used because of less rolling resistance.

### (2) Four wheel tractor →

- Due to better standing & steering property it keeps more confidence to the driver.
- Less tendency to bounce on rough roads, it can be driven at greater speed.

### Bulldozer →

- It is largely employed for excavating & moving the earth.
- It consist of a blade mounted at the front of a tractor which may either be wheel mounted.
- The blade width may be 2 to 8.5m & the height of blade may be 0.6 to 2.0m.
- These are important tools in excavation plant for rapid digging & dumping.

Notes

## Classification of Bulldozer :-

From the basis of blade direction,

(i) Blade bulldozer :-

These are mountain with blades perpendicular to the direction of travel.

(ii) Angle bulldozer :-

These are mountain with the blade set an angle of  $65^\circ$  with the direction of travel.

→ It is used for cutting the embankment.

## On the basis of mounting :-

(a) wheel tractor mountain bulldozer

(b) crawler tractor mountain bulldozer

## Advantages of cable controlled :-

→ It is easy to repair the control.

→ Its installation is simple & easy.

→ It is simple in operation.

→ It can be used for bigger capacity machine.

## Advantages of hydraulic controlled :-

→ position of blade can be maintained more accurately.

Comparison bet <sup>n</sup> crawler & wheel bulldozer	crawler bulldozer	wheel bulldozer
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→ Less speed.

→ Most compact

→ Greater speed

→ Less compact

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JANUARY

Thursday

Week 03 • 014/352

→ Can travel over muddy surface.

→ Gives less operation.

→ Can't travel in muddy surface.

→ Give more operation.

### Operation of bulldozer :=

→ Operation = Capacity of blades  $\times$  no. of phase per hour

### Uses of bulldozer :=

→ To construct temporary roads throo difficult areas.

→ To clear floor of borrowpits.

### Output bulldozer :=

Output = Capacity of blades  $\times$  no. of phase per hour

### Power Shovels :=

These are used primarily to excavate the earth & load the tractor.

→ They are capable of excavating all type of earth except solid rock.

→ These are available in size ranging from 0.5 to 5 m<sup>3</sup>.

→ Size of Shovel is indicated by size of dipper expressed in m<sup>3</sup>.

Notes

## Types of power Shovels :-

- crawler mounted
- Truck mounted
- wheel mounted

## Draglines :-

These are used to excavate the earth & load into the trucks.

→ They are used to deposit the excavated earth on the banks.

→ The constructional advantages of the machine is it can dig & dump over large distance than a shovel can do.

→ Power Shovel upto capacity of  $1.9m^3$ , but in case of dragline its capacity upto  $5.9m^3$ .

→ In many projects draglines may have advantages over the power shovel.

→ The output of dragline is only about 70-80% of that of power shovel of the same size & capacity.

## Types of drag line :-

- (i) crawler mounted
- (ii) wheel mounted
- (iii) truck mounted
- (iv) walking drag lines

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### Walking draglines:-

- 9 These draglines have a exception of long reach & hence they have Sweeted bore chain
- 10 removal of material boom other.
- The soil having poor bearing capacity walking dragline are used
- working operation of machine is quite simple

### Advantages of dragline:- (Operation)

- 1 → A dragline can successfully do the under water digging work.
- 2 → The range of working of a drag line is more than that of a power sovels.
- 3 → It is most suitable for remodeling the irrigation channels & drains.

### Disadvantages:-

- 5 → A dragline has less digging force as compared to power sovels.
- 6 → The operation of the drag line is less than that of a power sovel working capacity!

### Uses of drag line:-

- 17 Sunday → TO dig soft or middium & hard materials.
- Where digging is at or well below ground level where material are to be lifted from a pit.

Notes

## Roller :-

- The roller is one of the essential equipment required for road construction.
- 10 → It is used for compaction of soil & road macadam.
- 11 → It can be following types,
  - (a) Smooth wheel roller
  - (b) Pneumatic wheel roller

### (a) Smooth wheel roller :-

- 1 → It may have either two axial wheels or 3 axial wheels. Rollers are very heavy & are useful for heavy rolling. These are generally used in heavy construction.
- 2 → Two wheel rollers are also called tandem roller.
- 3 → The rollers having weight 8 to 10 tons are most common rolling equipment used in road construction.
- 4 → It is diesel power.
- 5 → The dia & the width of front roll is around 100cm to 105cm & rear roll is 145cm to 150cm respectively.
- 6 → The rolling width is 2m.
- 7 → The compacting efficiency of smooth field roller depend upon the weight, wide & dia of the wheel.

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→ The smooth wheeled roller are efficiently compacting the granular soil such as gravel & crushed stone.

### 10 (b) Pneumatic type roller :-

This type of roller consist of a box mounted on 2 axle, the rear axle has more wheels than front.

12 → Generally there are 4 wheels in front & 5 in rear.

### 1 Vibratory Compactor :-

→ In vibratory compactor vibrations are induced in the soil during compaction.

→ The compaction are available in variety form when the vibration is maintained on a drum the compaction factor is more.

→ This roller are available both as pneumatic & smooth wheel type.

→ These are suitable for compacting granular soil with thickness of layer about 30cm.

5 → Another form of a vibratory compactor is vibrating plate compactor.

7 → Hand operated plate are also available.

→ The depth of the vibrating plate is limited to small depth.

→ It can compact the soil to a very high max<sup>m</sup> dry density.

Notes

### Gradability =

It is defined as max<sup>m</sup> slope expressed as percentage,

$$K = \frac{1160 \times T \times h}{W \times R} - \frac{N}{4}$$

Where,

$K$  = gradeability

$T$  = Rated engine torque (Kg/cm)

$W$  = gross weight in Kg

$N$  = Rolling resistance (Kg/ton)

$R$  = revolution per min

$h$  = total gear reduction

### Owing of Operating Cost of equipment

- cost of equipment deliver to the owner.
- Demand of such equipment at the end of its useful life.
- No of years it is used.
- State of maintainans & repair
- Servicity of the condition under which it is used.
- Following cost should be consider for overciving the total cost of weighing equipment.
  - (a) Depreciation
  - (b) Investment
  - (c) maintainans requires
  - (d) opperation cost

(a) Depreciation →

- The term cost depreciation is used to indicate process of allocating period during which there are benefit from the depreciation equipment.
- Method employed to work out the cost depreciation is the straight line method constant percentage method.

Straight line method

In this method it is assume that a proper loss its value by the same amount every year.

$$D = \frac{P - S}{n}$$

where,

D = Average annual depreciation

n = life of property in year

P = original cost.

S = Salvage value.

$$D = \frac{P - S}{n} \quad (\text{where } n = 1)$$

### Constant percentage method :-

→ In this method it is assumed that a property will lose its value by a constant percentage of its value at the beginning of every year.

Where,

$P$  = Constant value

→ The value of the property at the end of 1st year,  $P = (1 - P)$

~~The value of the property~~

### Shrinking fund method :-

→ In this method the depreciation of a property is assumed to be equal to the annual shrinking fund.

→ If 'A' be the annual shrinking fund B, C, D are represent the interest of the shrinking fund on the subsequent year.

Where,

$$D = \frac{S \times i}{(1+i)^n - 1}$$

Where,

$S$  = amount of single fund

$D$  = Annual instalment required.

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$i$  = Rate of interest

$n$  = no of years required to create the single fund.

Pro-1 A construction equipment was purchased in 12,000 RS only. Assuming its salvage value at the end of 6 year to be 3000, determine the amount of depreciation for the year by straight line method.

Sol<sup>n</sup>

$$n = 6 \text{ year}$$

$$P = 12,000$$

$$S = 3000$$

$$D = \frac{P-S}{n} = \frac{12000 - 3000}{6} = 1500 \text{ RS.}$$

Soil reinforcement technique  $\rightarrow$

At present soil reinforcement technique is well excavating on each side used in various applications such as improving bearing capacity, drainage control etc.

Necessity of soil reinforcement  $\rightarrow$

24 Sunday It is used for improving bearing capacity of soil, shear strength of soil & permeability etc.

Notes

### Introduction :-

- A no of wires connecting various accessories for the distribution of electrical ~~energy~~ energy from the supply board to the no of consumers in case of electrical consuming device. Such as lamps, fans, & another domestic uses of consumer is known as "wiring system".
- In ordinary house service fuse is called service "cutout".
- The point at which the consumer wiring is connected into cutout is known as "point of commencement" of supply by the consumer.

### illumination :-

- It is the branch of electricity which tells us about the system of lightening & the various kinds of light is called "illumination".

### Types of lightening sources :-

- The system of lightening sources may be classified as,

- direct lightening
- Semi-direct lightening
- Indirect lightening
- Semi-indirect lightening
- General lightening

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Wednesday

Week 05 • 027/339

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### (a) Direct lightning →

→ It is the simplest & mostly used system of lightning in which 90% of total light fall direct on the surface and the connection is D.C current.

### (b) Semi direct lightning →

In this system of lightning 60% light fall directly on the surface so it is called semi-direct lightning. It is connected by the D.C shunt.

### (c) Indirect lightning →

In this system 10% of light fall on the ground.

### (d) Semi indirect lightning →

In this system 60% of light doesn't fall on the ground.

### (e) General lightning →

In this system 50% of light fall on the ground & 50% of light rebase outward.

Notes

## Measurement of lightening →

9 Light → It is a kind of energy which radiate light weight either by source of Sun, moon etc.

11 Luminous flux → The total quantity of light emitted by the source of light per second is called luminous flux.

→ It is denoted by " $\Phi$ " & its unit is lumen.

→

$$\Phi = \frac{Q}{T}$$

3 Luminous flux ( $\Phi$ ) =  $4\pi I$   
Where,

4  $I$  = luminous intensity

$Q$  = Total quantity of light

5  $T$  = Time frame

## Luminous intensity :-

6 The luminous flux emitted by a source of light per unit of solid angle in a particular direction is called luminous intensity.

7 → It is denoted by " $I$ " & its unit is candle power.

## Candle power :-

The no of luminous flux keeps out by the source of lightening unit by a solid angle

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Week 02 • 029/037

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In a particular direction, is known as candle power.

### Fuse :-

It is the simplest & cheapest used for interrupting the electrical circuit, under over current magnitude as it is used for over loads or CKT protection in high voltage up to 60kV.

→ In normal operating condition when the current flowing through the circuit is within safe limit the heat developed in the fuse element carrying heavy loads.

→ When some fault such as short circuit occurred or when load connected in a circuit exceeds its capacity the fuse ends at its limiting value.

### Advantages of fuse :-

- It is the cheapest form of protection.
- It should not need more maintenance.
- The min<sup>m</sup> time operation can be made.
- The smaller size of fuse element impose a current limiting effect under short circuit condition.

Notes

## Disadvantages of fuse :-

- If heavy load is provided the fuse should not carry the load.

## Types of fuse :-

- Supply main fuse :-**
  - This fuse is provided by the fixed just after the service meter & sill.
  - The sill can be broken only by the supply authority in case of blowing out of fuse for the purpose of replacement.
  - The rating on supply main fuse will be calculate as per load current of the consumer.

### (b) Consumer main fuse :-

- This is another fuse of rating slightly less than that of supply main fuse provided by the supplier & placed after the consumer main switch.

### (c) Sub circuit fuse :-

- The total wiring system divided into no. of sub-circuit & branch circuit.
- A separate fuse is provided for each branch circuit is called "Sub circuit fuse".

(c) Point fuse:-

In good quality indoor wiring of building every light & power point is provided with its indivisual fuse known as point fuse.

Types of wiring :-

(a) C.T.S :- Cotton/PVC toughened / sitted wiring

The C.T.S is provided with insulation which is not water or proof.

→ Over the installation of the conductor & top rubber sheets is provided for additional, installation & protection against wear & tear & moisture etc.

→ This type system is suitable for damp circuit but cannot sustain much heat & it is not suitable for outdoor wiring, it should not be exposed to direct sunlight areas.

(b) Conduit wiring :-

In this system of wiring single installations are used.

→ The wires are run in steel if a good protection terms in a mechanical type.

→ This type of wiring is used for industries.

### (C) Concealed conduit wiring:-

- 1 This system is same as conduit wiring except that the conduit are covered with a sheet type material, i.e. known as concealed material.
- 2 → The cost of this material is not economic.

### Earthing & their uses:-

- 1 As the earth protection are zero bore all purpose any electrical appliances when connected to earth with a zero potential are said to be earthen.
- 2 → The voltage of this earthen applying is higher there is no risk.

#### uses:-

- 1 → To maintain the line voltage & current.
- 2 → To protect the buildings for atmospheric lightning.

### Mechanical Services:-

#### Lift:-

These are known as vertical transportation system.

- 1 → A lift is defined as appliances designed to transport persons or materials bet<sup>n</sup> two or more levels in a vertical direction by means of platform.

- The 1st safety unit of lift is designed by American Scientist 1853.
- The development of lift was fullfilled necessities to encourage in the construction of highest building.
- Since lift are possible source of accident building special care should be taken in case of designing the lift.

### 1 Escalator:-

- It is a power inclined continuous stairway used for rising & lowering passenger.
- It consist of Escalator, track, track of the escalator then step treads, lining.
- It share the effort required for ascending & descending.
- It ~~steps~~ brings a continuous one waiting as it required in case of lift is eliminated, hence it is commercially very beneficial.

### 7 Elevator:-

- These are defined as moving steps running bet<sup>n</sup> floors.
- Elevator moves bet<sup>n</sup> the different shape while the step moves this arrangement helps in moving large no. of people at a time

without conflict.

## Types of Elevator :-

### (a) Hospital Elevator :->

Hospital bed elevator generally transport patient are not well enough to sit up even in wheel chair.

### (b) Residential elevator :->

These are intend to move passengers up & down stairs in a multitable residence are quite similar to those used in large public building.

-> It can be built either inside or outside of the home.

### (c) Stairway elevator :->

These are generally installed in homes where someone in the family has problems with movability.

### (d) Dump wateries elevator :->

These are small freighted elevator installed to carry objects rather than people.

### (e) Agricultural Elevator / Application :->

#### (i) Bucket Elevator :-

This is used to move crops have been newly harvested.

-> These are manufactured in such a way that they can move heavy loads quite easily.

## (ii) Industrial Elevator :-

The most common type industrial elevators are hoist elevator & inclined elevator.

## Methods of ventilation :-

It is divided in 2 methods.

(a) Natural ventilation

(b) Artificial / Mechanical ventilation

### (a) Natural Ventilation :-

The system is useful for small building & it can not be adopted for big office, theaters, auditoriums etc.

→ In this system of ventilation this is used for doors, windows, ventilators, skylight.

-ht to make the room proper venti-  
-lated.

→ The important point to remembered in concept with natural ventilating system are fans etc.

### Prefabrication :-

It is the assembly of precise components of structure is a factory or other manufacturing & transporting complete assemblies or sub-assemblies to the construction site where the structure is

located.

9 → It is frequently used when fabrication of a section of machine or any structure which is movable.

10 → It is the lifted from the main manufacture-  
11 -ring site to the another site.

12 **History:** →

→ Fabrication has been used since ancient time.

1 → It is claimed that the world's oldest time where the road ways of the sewer track construction in england around 3800 BC.

2 → At this century Australia has a large no. of prefabricated house.

3 → The method was widely used in the construction of fabricated houses in the 20<sup>th</sup> century.

4 **The process and theory of prefabrication:** →

5 The conventional method of a building is to transport the brick, cement, sand, steel, aggregate etc.

6 → In prefabrication construction only foundation are constructed, in this way while section of walls pillars are fabricated in a factory & transported to the site. & it is lifted into place by a crane & bolted together.

Sunday 07

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→ Prefabrication is use in the manufacture of ships, large size of culverts & all types of vehicles & machines where sections previously assemble but the bind point of manufacture at a another place, where instead before being delivered fore final deposition.

→ The Theory behind the method is that time & the cost is saved.

→ If similar construction task can be grounded assemble line technics can be improved in prefabrication where skilled labourer is available.

→ It avoid to transport so many skilled labourer to the construction site & the other site of construction such as basic of power, basic of water & hazardous environment are avoided.

→ Against this advantages must be weighed the cost of transporting fabricated section & lifting them into particular position as they will usually taken difficult to handed then the material & of which they are made.

Notes

## Current uses: →

- 9 → Pre-fabrication technique are used in the construction of permanent blocks & housing developments with repeated housing units.
- 10 → The technique is also used in office blocks, the factory buildings etc.
- 11 → Pre-fabricated steel & glass section are widely used for the exterior building.
- 12 → Pre-fabricated has become widely used in the space craft with components. Such are wings often being manufactured in different countries & delivered to the final assemble site.
- 1 → → Radio towers or radars for mobile phone & other services often consist of multiple pre-fabricated section.
- 2 → Pre-fabricated bridge elements & system of bridge design & construction of this terms are not satisfied by the pre-fabricated structure.
- 3 → It can also help minimize the impact on traffic from bridge.

## Advantages: →

- High capacity
- Factory made products

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- Shorten construction time
- Independent of adverse weather condition during construction.
- Opportunities for good architecture.
- Healthy building.
- Reduced energy consumption.
- Cost effective sol<sup>n</sup>.
- Safety in construction
- Increase in the quality of construction.
- Reduction of construction waste.

### Disadvantages:-

- Leaks can form at joints in prefabricated components.
- Transportation cost may be higher.
- Large fabricated sol<sup>n</sup> require heavy duty cranes & precise measurement & handling to place in position.
- Skilled laborer & supervision is required.
- Large groups of building from the type of prefabricated elements tend to look drab & monotonous.

Notes

## Classification of prebabrication:-

The prebabrication is classibied as follows:-

- (i) Small prebabrication
- (ii) medium prebabrication
- (iii) Large prebabrication
- (iv) Open prebabrication
- (v) clasled System of prebabrication
- (vi) Partial System of prebabrication
- (vii) Total system of prebabrication

## Pre-fabrication Element:-

Flooring / roofing System:->

- > This system consist of R.C plonice supported over a partially pre-cast R.C joist.
- > The joists are supported with the main beam through channels which are provided at the necessary spacing.

## Precast Beam:-

- > Reinforcement are prepared for 300mm on either side to provide better connection with another beam.
- > Shear keys are provided at either face of the column to get better & arrange channel sec<sup>n</sup> are provided at a regular spacing to connect the joists.

### Precast columns:-

- 9 → The special types of columns are used to hold the wall panel in position.
- 10 → These types of special column having high load carrying capacity of moment
- 11 carrying capacity.

### Precast wall panel:-

- 12 Cellular condition of 75mm. thick blocks are sandwiched by a layer M25 grade concrete bore thickness of 37.5mm on either face.
- 1 → A min<sup>m</sup> area of reinforcement is provided on the side face concrete, doors & windows frames are simultaneously while casting the wall panels.

### Modular Co-ordination:-

- 5 → It may be applied to the design, manufacture & assembly of building its connect & installation. It also affects the work positioning & dimensioning during construction.
- 6 → The concept of modular co-ordination based on the used of modules (basic modules & multi modules).
- 7 → A reference system to define co-ordination spaces & zones for building elements with

the reference system.

- 9 → Rules for sizing building components in order to determine their work size.
- 10 → The objective of implementing modular co-ordination is to improve production, installation through the reduction of wastages in the productive process to improve quality in the construction industry.
- 11 → Modular Co-ordination in an imp. factory in application of industrialized building system by way of standardization of components & dimension. Such as reduce time of production & installation of components achieving repeatability & able to construction of building at lower cost.

### 4 Building Configuration! =

- 5 → IS 1893-2002 has recommended building configuration system in Sec<sup>3</sup> for the better performance of building earthquakes.
- 6 → An imp. features in building configuration is regular & symmetry in horizontal & vertical planes.
- 7 → Seismic behaviour of irregular should placed better form regular shapes because their a symmetric can present local deformation due to the presence of excessive openings.

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- Both effects give origin to undesired concentration in some resisting member of the building.
- On the contrary the ideal rectangular or square plan structurally symmetric within enough in plane stiffness in its diaphragm presents ideal behaviour, because it has the same displacement at every point in the slab.
- Therefore the building shaped like a box, such as rectangular both plan & elevation is inherently strong a building within wings.

### Lateral Load Resisting Structures:-

- The first step in architectural planning of a building is to select the lateral load resisting system.
- The load resisting system must be of closed loop, so that it is able to transfer all the forces acting either vertically or horizontally to the ground.
- BIS has approved 3 major types of lateral force resisting system.
- These consist of moment resisting building frame system bearing wall system & dual system.

Notes

## Building characteristics :-

- 9 → The following assumption shall be made in the earth quake resistant design of
- 10 Structure.
- Earthquake cause impulsive ground motions
- 11 which are complex & irregular in character, changing in period & amplitude each lasting
- 12 for a small duration.
- Earthquake is not likely to occur simulta-
- 1 -neously with wind or max<sup>m</sup> flood or max<sup>m</sup> sea waves.
- 2 → The value of elastic modulus of material wherever required may be taken as for
- 3 static analysis unless a more definite value is available for use in such condi-
- 4 -tion.

## Effect of irregularities on performance of R.C Building :-

- 5 → The most imp. cause of damage of R.C build-
- 6 -ing earthquake is the irregular building configuration.
- A building that lacks symmetry & has discon-
- 7 -tinuity in geometry mass or load resisting elements is called as irregular building.
- The irregularity or discontinuity in a building result in obstruction of flow inertia force & cause lot of damage to the building.

- building.
- The irregularity or discontinuity in a building result in obstruction of flow inertia force & cause lot of damage to the building.
  - The irregularities in a building are 2 types:-
    - (a) Vertical irregularities
    - (b) Horizontal irregularities.

### (a) Vertical Irregularities

These irregularities are as a result of sudden change of strength & geometry mass over the height to the building.

#### (i) Irregularities in Strength & Stiffness →

→ It is commonly seen that in multistoreyed R.C building the ground storey is made 'staked' & open.

→ This is done to have space for configuration resulting following centres / halls etc.

This configuration resulting follows.

(ii) This ground storey is flexible as compared to upper storeys which are stiffer because of presence of in-fill walls, Thus the upper storeys move as a single unit together most of the horizontal displacement of the building occurs in ground storey. This type of building is called as "Soft Storey building".

(ii) The strength of the open ground storey is less as compared to the upper storey, thus it is also called as weak storey.

(ii) Vertical Discontinuity:-

→ One of the major cause of damage in R.C buildings during load & transposed strong earth quake is the discontinuity in the path at load transposed (flow of internal force).

→ The structure should have a complete & continuous path for transfer of seismic force i.e.

Floor → Beams → columns → walls → foundation → ground.

(iii) Vertical geometric irregularities:-

The ex. of vertical geometric irregularity when the horizontal dimension of the building in any storey is more than 150% of that an adjacent storey then the building is said to have this.

(b) Horizontal irregularities:-

This is caused due to

- (a) A Symmetrical plan shapes.
- (b) Re-entrant corners
- (c) Non-parallel system
- (d) Cut-out.

(i) All anchorages should be closely viewed regularly so as to ascertain their bearing capacity of load.

→ The chain shouldn't dropped from a height but should be lowered gradually.

→ The lifting should be carried out smoothly without sudden shocks.

**Additional Strengthening measures in masonry Building :-**

All masonry buildings should be strengthened in horizontal as well as vertical direction for improving the earthquake resistance.

(a) Horizontal Reinforcement

(b) Vertical Reinforcement

**Horizontal Reinforcement :-**

→ The horizontal reinforcement of wall is required for imparting them horizontal reinforcement helps in preventing shrinkage & temp. cracks.

→ It also help in tying the walls together in the exterior wall horizontal reinforcement helps in preventing shrinkage & temp. cracks.

(i) Lintel band :-

This is the most imp. band & provided at lintel level in all load bearing & all cross wall.

Sunday 21

(ii) Plinth band :-

It should be provided in those case where

the soil is soft or uneven as hilly areas.

(iii) Rest band:-

It is a band provided immediately below the roof or floor.

(iv) Gable Band:-

It is a band which is provided at the top of gable masonry below the purlins.

(b) Vertical Reinforcement:-

It is also provided in walls to improve the seismic resistance of buildings.

Retrofitting of Structures:-

Sources of weakness in R.C frame buildings:-

→ Damage survey reports of past earthquake reveal the following main sources of weakness R.C moment resistance frame buildings.

→ Discontinuous load path.

→ Lack of deformation compatibility of structure member.

→ quality of workmanship & poor quality of material.

## Structural Damage due to discontinuous load path:-

- 9 → Every structure must have 2 load resisting systems.
- 10 → Vertical load resisting system for transferring the vertical load to the ground.
- 11 → Horizontal load resisting system for transfer the horizontal load to vertical load system.
- 12 → It is imperative that the seismic forces should properly connected by the horizontal bracing system & properly transferred into vertical central resisting system.
- 1 → Any discontinuity in this load path may cause one of the major contributions to structural damage during strong earthquakes.
- 2 → It must be ensured that each member both horizontal & vertical load resisting system must be strong & not during earthquake.
- 3 → Therefore, all the structural & non-structural elements must have sufficient strength & should be well connected to the structural system to be well connected to the structural system so that the load path must be complete & sufficient strong.

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## Structural damage due to lack of deformation

The main problems in the structural members amount of ductility & the inability to redistributed load in order to safety with the deformation imposed upon in response to seismic load.

→ The most common region of failure may be in columns, beams, walls & beam-column joints:

→ It is to consider the consequences of member failure.

→ It is adequate strength & ductility of the structural members can & will result in local or complete failure of the system.

## Retrofitting

It is defined as the process of increasing seismic resistance of a weak or damaged building by suitable techniques.

## Need for retrofitting

As discussed above the need of retrofitting & strengthening is to increase the available seismic resistance of the weak or earthquake damaged.

Notes

## Global Retrofitting methods:-

- 9 Adding Shear Walls / Infill wall / Bearing:-  
 It is used for increasing the lateral strength of R.C building.  
 → Steel bracing may be used for increasing strength & stiffness of the building.
- 10
- 11

## 12 Non-conventional method:-

### Seismic Base Isolation:-

- 1 This is a non-conventional & costly method for increasing the ~~base~~ seismic resistance of the R.C.C building.

- 2 It is also a non-conventional & costly method for controlling seismic damage in buildings & improving their seismic ~~damage~~ ~~buildings~~ performance.
- 3
- 4

## 5 Other points of natural ventilation:-

- The efficiency of roof ventilators depends on their location, wind direction & height of buildings.
- 6
- The location, size & type of window play a great role in imparting natural ventilation to the room.
- All these functional requirement should be properly co-related while deciding the location of window in a room.

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- The velocity of wind creates pressure difference bet<sup>n</sup> the inside & out side surface of a room.
- Hence if the ~~conclude~~ velocity of wind is more there will more pressure difference & this will result in the increase of rate of air change in the room.
- This type of ventilation depends on the direction of wind & it is very difficult to control the entry of air containing smoke, dust etc.

### Artificial ventilation:-

- In this system of ventilation some mechanical arrangement is adopted to provide enough ventilation to the room.
- This system has become popular due to relative change in motion regarding ventilation.
- This system is costly.
- This system is adopted for big offices, banks, industrial plants, theatres, auditoriums.

### System of ventilation:-

following are 5 systems of the artificial ventilation.

Notes

(a) Exhaust System

(b) Supply

(c) Combination of exhaust & supply system

(d) plenum process

(e) Air-conditioning.

(a) Exhaust System:-

→ In this system the partial vacuum is created inside of the room.

→ The extraction of air from inside set up the current of fresh air from outside to inside, and thus it becomes possible to provide fresh air to the room through doors & windows.

→ The fans are installed at suitable places in the outside wall & they are connected to different rooms.

→ This system is useful for removing smoke, dust, radon etc. from kitchen, industrial plants etc.

(b) Supply System:-

→ This system is just reverse of exhaust system & it consists in supplying fresh air to the room by installing input fans in outside walls.

→ This system is used for ventilating rooms where unused quantity of heat or radon is used.

- not proceeded
- (c) Combination of exhaust & supply system:-
- This system is the combination of the above two systems.
  - The exhaust fans & input fans are installed at cause a current of fresh air from outside to inside of the room.
  - The combination of both the systems gives better results.

- (d) Plenum process:-
- This system is mostly used in cold countries & comprises a complete ventilation & heating unit.

- (e) Air conditioning:-
- This is the most effective system of artificial ventilation.
  - This system is used to indicate the sense of controlling or conditioning air w.r.t (with respect to) humidity, temp., movement air, odour etc.

- (f) Cold water distribution in high rise building:-
- The cold water is supplied to the outlet at main pressure.

- The only storage requirement is a small capacity cistern to heat the hot water storage tank.

- The main advantage is that the drinking

water is available from all cold water outlets.

→ For efficient operation, a high pressure water supply is essential, particularly at period of peak demand.

→ The storage cistern, supplying the hot water cylinder.

→ The maintenance valves should be fitted isolated each section of pipe work.

→ With every outlet the pressure of back siphonage must be considered.

→ Back siphonage can occur when there is a high demand on the main.

02

MARCH

Wednesday

Week 10 • 06/2004

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→ Negative (-ve) pressure can draw water back into the main from submerged inlet.

### Hot water supply:-

- The hot water from the boiler, mixes directly with the water in the cylinder.
- It is used in a soft water in the boiler must be rest free.
- This system is not suited to hard water, when heated, the calcium precipitates, to line the boiler & primary pipe work.
- If a lower rail is fitted there may be supplied from the primary & return pipes.

### Material used for waste & discharge system:-

Material	Application	Joining
① Cast-iron	→ Some 50mm above vents discharge stage	→ Lead, caulking with molten fibers, Leads coal chemical tanking
② Galvanised Steel	→ waste pipe	→ BSPT Sere welded
③ Copper	→ waste pipe & traps	→ Compression, capillary Silver Solder.

Notes

(4) Lead → water pipes & discharge stock → Soldered or lead welded

(5) ABS → upto 50mm waste & ventilating pipes & traps → Push fitting Seal & Compression fitting.

(6) Polypropylene → upto 50mm waste & ventilating pipes & traps → Push fitting

Layout for Hot water Supply:-

The sequence of unit to be installed in the lay out water supply project starting from the source of water to the distributor as follows:-

- 5 → Location on intakes
- plain Sedimentation tanks.
- 6 → Coagulation Sedimentation tanks.
- filters units.
- 7 → water softening & other miscellaneous plant
- Disinfection plant
- Storage of clear water in under ground & over head Reservoir.
- Distribution of water.