MODULE : 08

Types of Structures, Structural Constraints and static Indeterminacy.

Structure:-

" A combination of members or elements connected together in such a way to serve useful purpose."

OR

"Combination of structural elements for useful purposes"

For example:-

A building is structure in which there is different structural elements for e.g walls, slabs, column etc due to which that structural enable to carry the load of chairs, tables, desk and people.

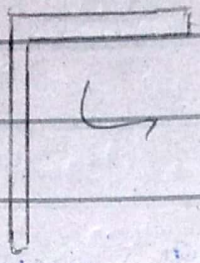
Types of structures according to Construction:-

(a) Regid Frame structure:-

In this case the members are joined together by regid joint. It

may be welded may be nailed or joined together by concrete.

Figure:-



↳ Rigid frame structure.

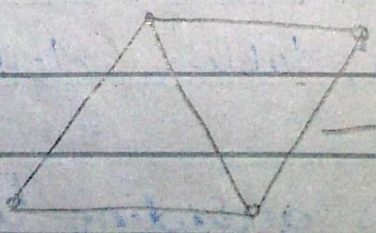
(b) Truss or Pin Connected structure:-

A structure in which the member are joined together by "Pin".

OR

"A structure in which the members are joined together to form a triangular shape."

Figure:-



↳ Truss structure.

↳ Beam that is rigid frame structure can subject vertical load. It may also

binding moment or may not take.

While Pin support / structure does not take binding moment. e.g. : Slap.

-That is why we not give load on truss not on middle but at joint.

↳ Which transfer into member in form of compression and Tension.

(*) On rigid structure, each member may have tension, compression and binding moment

→ While member of truss have tension and compression not binding moment.

→ The member of truss is also called two truss member.

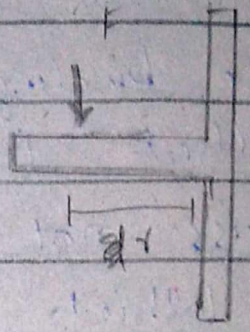
i.e If forces (two) are applied at two points i.e same in magnitude, Collinear and opposite direction.

So This type of member is called two force member. So in truss each member has two forces acting.

While the member of rigid or frame structure has subjected to 3 forces.

So called '3' force member.

Binding moment :-



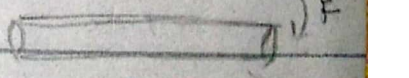
Consider a cantilever beam if force is applied downward that will create moment as;

$M = r \times F$.

As this torque or force tries to create binding so that is why called binding moment.

twisting moment :-

When force are apply in such away so that to they are equal in mag. & opposite in direction for e.g as shown in fig. on opposite end.



↳ The moment along the axis of member is called twisting moment.

Structural Member:-

The members, elements or things from which the structure is made is called structural member.

Fore.g:-

Examples of structural members are slab, beam, walls, column, etc.

1. Beam:-

↳ Beam is flexure member of structure.

(*) It is subjected to transverse loading and gravity loading.

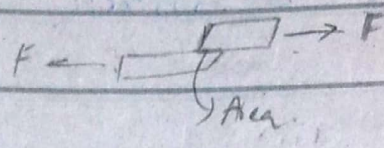
↳ These loads create shear and bending moment. They are design for shear & bending Mo..

(*) In beam, we put stirrup that is for vertical loading or transverse. While the horizontal reinforcement (longitudinal bar) are for tension. and tension is produce due to bending moment.

Shear force:-

It the cross sectional area that

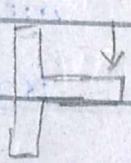
resist, the applied force, is parallel to applied force is called shear force.



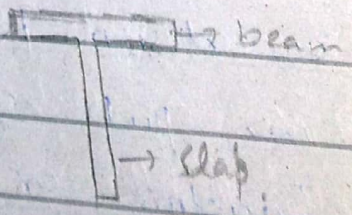
Axial force:-

Of cross sectional area is perpendicular to applied then applied force will be axial force,

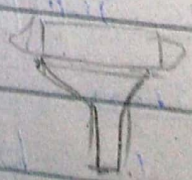
-That may be compression or tension



Drop Panel:-

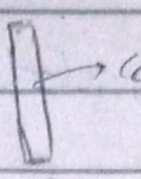


Column Capital:-



Column:-

A vertical ~~load~~ member that is only subjected to compression is called column.



Strut:-

A compressive member of structure is called strut. or

A structural piece designed to resist pressure in direction of its length.

Beam Column:-

A structural member subjected to compression as well as flexure is called beam column.

Grid:-

A network of beam intersecting each other at right angles and subjected to vertical load is called grid.

Spring can also act as ~~rel.~~ cable i.e to show the tension in it.

Cable:-

Cables are suspended at their end that are subjected to tension along the axis of cable.

They do not subjected to compression.

~~Cable~~ Arches:-

Opposite of cable → subject to compression

↳ Build on upper of door or building.

↳ Can be subjected to compression.

Plates & Slab:-

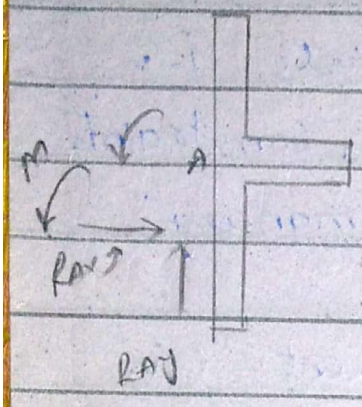
Plates are 3-D flat structural components usually made of metal that are often found in roofs and floor of structures usually made of metal.

While in case of reinforcement we call plate as slab.

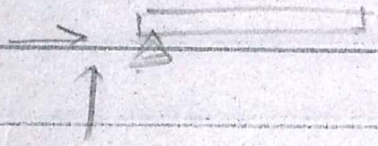
Static Determinacy:-

When the number of unknown reactions are equal to number of equations called determinate problem or determinant problems.

But if the number of unknown are more than the number of equations called indeterminant problems.



↳ Determinant Problem as 3 unknown & 3 eqns.

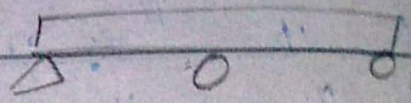


↳ Unstable or Improper constraint.

→ Over constraint.
Indeterminant problem ↴

Because to be in equilibrium one roller and one Pin support is enough but where two pins & one roller supports are supplied. So over constraint.

" If a system is over constraint and how much it is over constraint is called static indeterminacy "

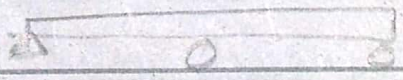
For Example:- 

Here 4 unknown & we have 3 eqns so over constraint and how much degree is over constraints i.e 4-3=1. → So 1 degree over constraints This is called Static determanacy.

(*) Constraint → A support that give reaction or resist us.

* Reduntant Constraint:-

If a system is over constraint we call it reduntant constraint.

 → Reduntant Constraint

Even if we have roller support the body will be in equilibrium but it redistribute the load.

Improper Constraint:-

If we have a heavy plank and some one want to take it from one

place to other. If he pick it from centre may be he can do mean he can move it but if he take through one hand → on one side so it will be difficult for him and become improper constraints.

↳ Not enough support.