NOTES
STATIC ANALYSIS

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Introduction

That a building is stable means that all external loads/actions can be lead through the building components and the forcetransmitting joints down to foundations and down to loadbearing soil.

The direction of external loads/actions can be divided into two main directions:

- Vertical downwards: Deadload, imposed action, snow- and wind actions
  Vertical upwards: Wind load (suction)

- Horizontal direction: Wind load and mass action

To gain an insight into how the forces are transferred through the building components, it si important to do a composition of forces at an early stage.
To ensure the stability of the building, it is important to set up function requirements for each building component.

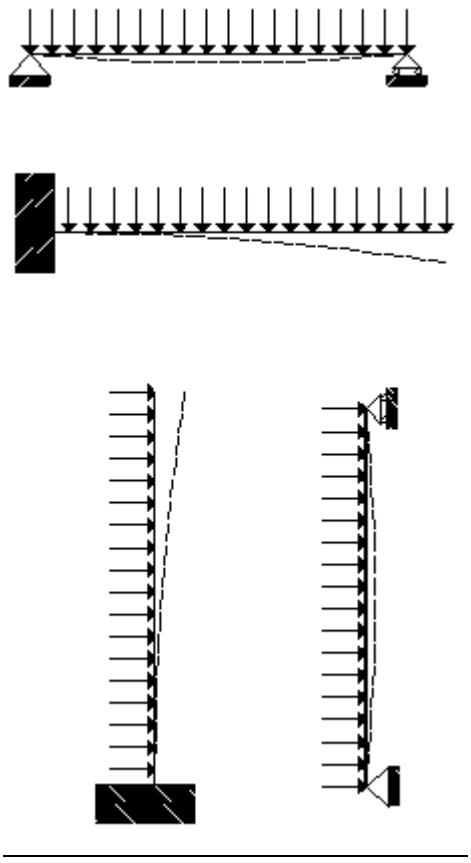
The terms and mode of operation for each individual function requirement will be described in the following.

CONTENT

Beam function: (BEF)
-the ability to transfer forces/loads perpendiculary on a longitudinal axix

Characteristic:

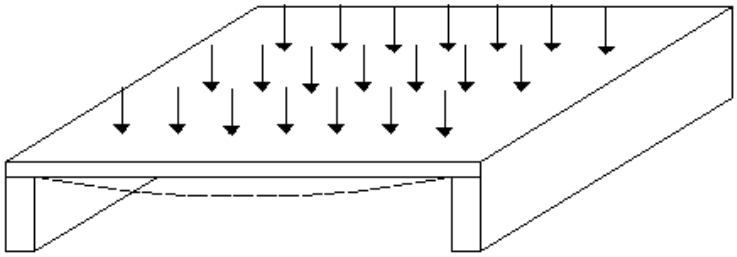
- The load/force is applied perpendiculary to the center line of the building component.
- The load/force causes bending and shear stress in the building component.
- The load/force will cause deflection.

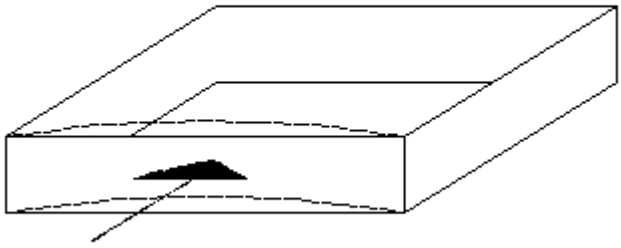


Slab function: (SLF)
-the ability to transfer forces/loads perpendiculary on a plane surface

Characteristic:

- The load/force is applied perpendiculary to the plane of the building component.
- The load/force causes bending and shear stress in the building component.
- The load/force will cause deflection.





Column function: (COF)
-the ability to transfer forces/loads parallel to or exactly in a longitudinal axix.

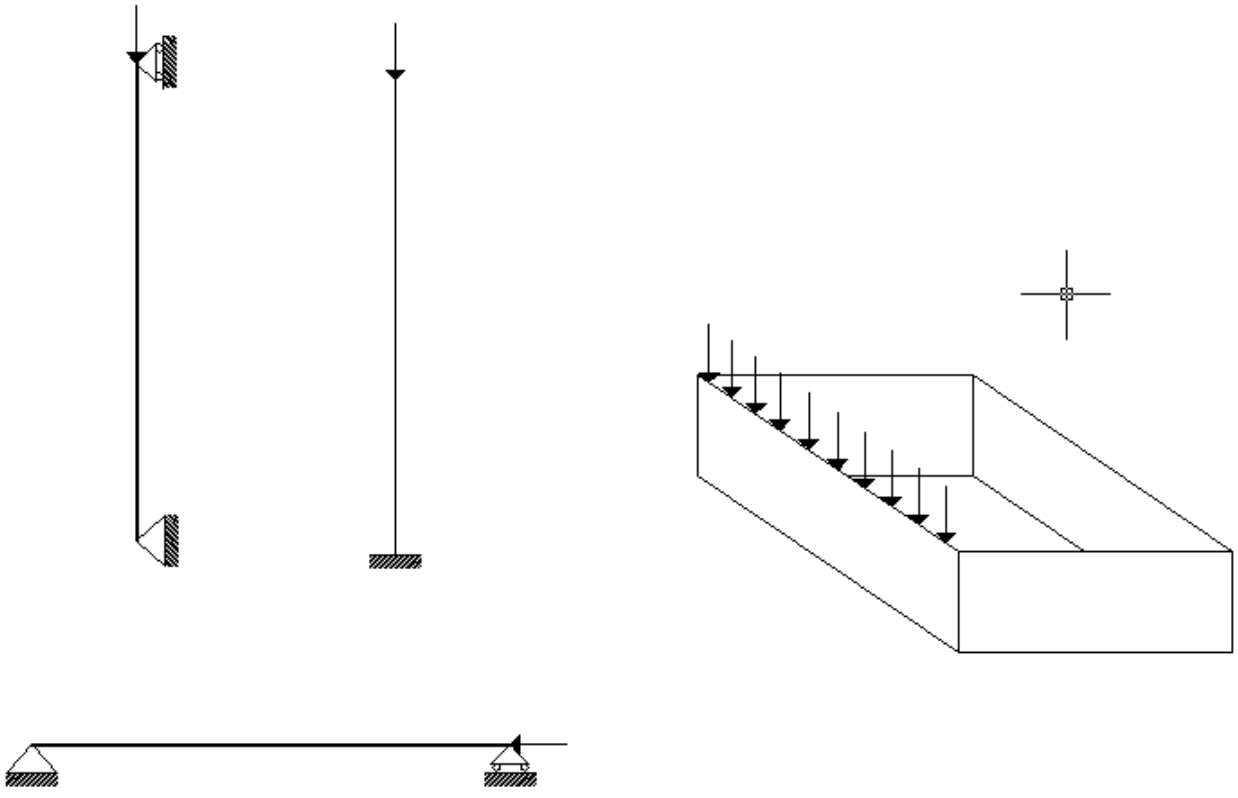
Characteristic:

- The load/force is in theory applied in the center of the building component.

- The load/force causes compressive stress in the building component.

- Theoretically a force placed in the centerline will not cause bending stress or deflection.

NOTE!
Loads/forces applied parallel to the centerline (with an eccentricity = e) will cause combined stress (bending and compressive stress) resulting in more complex bearing capasity issues.

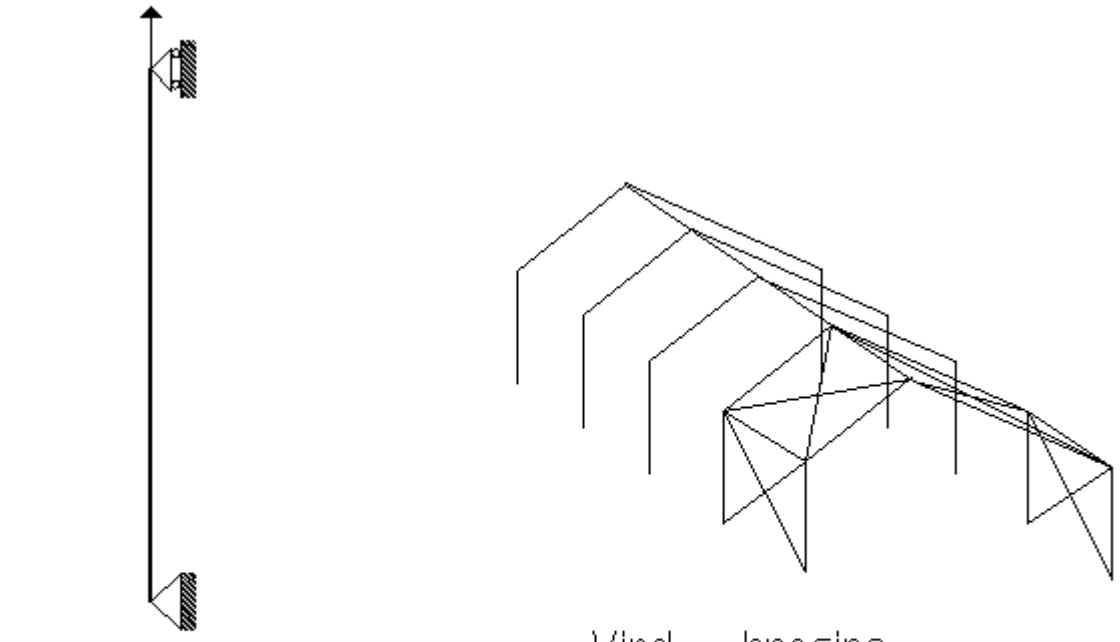


Tie rod function: (TRF)
-the ability to transfer forces/loads exactly in a longitudinal axix.

Characteristic:

- The load/force is in theory applied in the center of the building component.

- The load/force causes tensile stress in the building component.

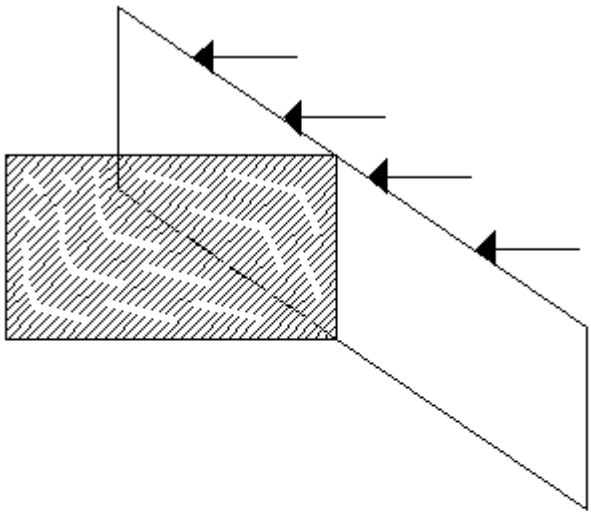


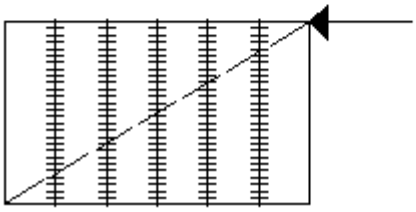
Shear function: (SHF)
-the ability to transfer forces/loads in a longitudinal axix together with a simultaneous displacement of the forces in the same plane.

Characteristic:

- The load/force is applied in the plane of symetry of the building component.
- Action- and reaction lines are parallel but not positioned in the same axix.
- The load/force will cause shear stress in the building component.
- The load/force will not (in practice) cause deflection.

NOTE!
If precast concrete wall components are calculated to achieve stability against shear forces, some wall components must be anchored to the foundation or the component-joints must be cast with concrete (keyed shear joints).



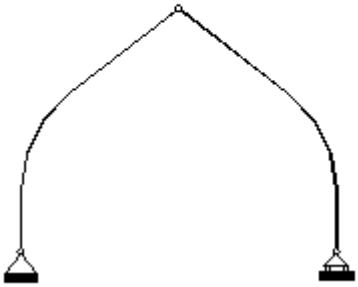


Portal frame construction (PFC)

-the ability to transfer forces/loads perpendiculary on a longitudinal axix and then throug the frame post as a kind of column-beamfunction down to the foundation.

2-Charniere portal frame with moment-rigid corners.

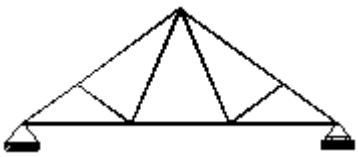
2-Charniere arc.



3-Charniere portal frame with (round) moment-rigid corners.

Triangle constructions (TRC)

-the ability to transfer forces/loads perpendiculary on a longitudinal axix together with forces/loadsand in a longitudinal axix (because of the internal structure where the different components works as struts and tie rods).



Truss construction where stability is achieved through struts and tie rods.

The practical use of the static analysis

After having put up alle the requirements of the building components, it is important to check following:

Building component

- Is the building component capable of fulfilling the function
- Is it necessary to calculate it?
- Could it be looked up in a catalogue?
- Could it be estimated?

The force-transmitting joint

- What happends in the joint. Is it affected to compressive stress, tensile stress or shearstress?
- Is it necessary to calculate it?
- Could it be looked up in a catalogue?
- Could it be estimated

The static analysis is normally containing an isometric sketch (or real 3D) one for each situation:

- Vertical loads
- Horizontal loads applied on facades
- Horizontal loads applied on gables

For each situation you describe how forces are lead to foundation (loadbearing soil) and it can be combined with sketches showing the forcetransmitting joints.