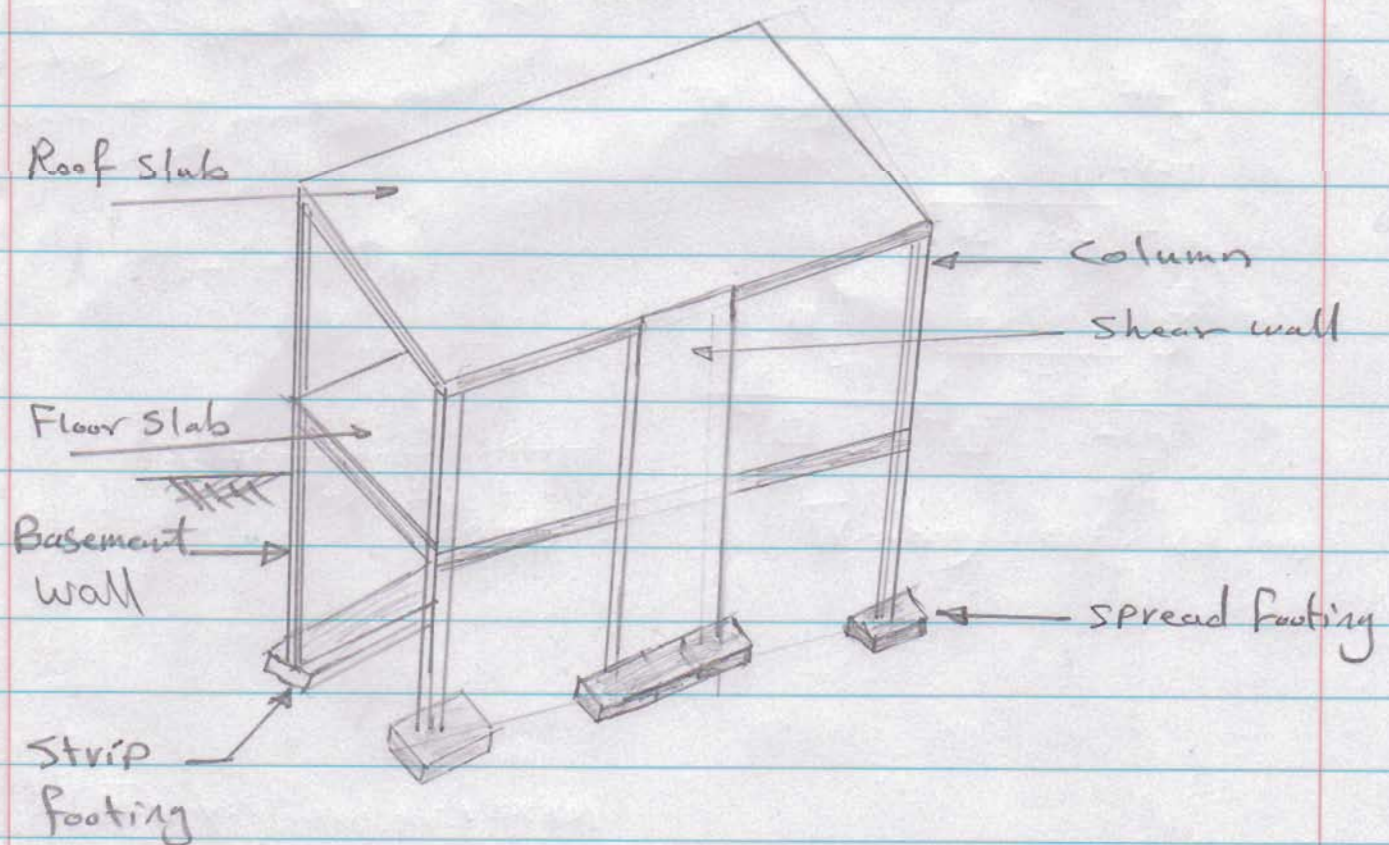


- Structural Components

Reinforced concrete buildings consist of several structural components or (members), such as ;

- Floor and roof systems
- Beams
- walls
- Columns
- Foundations

These structural components can be classified into horizontal components (floors, roofs, and beams) and vertical components (columns and walls). According to another classification, the part of the building above ground is called the superstructure, while the part below ground is called the sub-structure.



The most common floor and roof systems are listed below :-

- **Slab-beam and girder** : The slabs are supported by beams, which are in turn supported by girders. A girder is a large beam that carries loads from the beams framing into it. Beams around the outside edges of the floor are called spandrel beams.

- **Slab band** : This is usually a uniform slab with a thickened slab portion along the column lines parallel to the longer spans.

- **Flat slab** : This is a system without beams, where a slab is supported by round or square columns. In this system, the design may also require a flared cone-shaped cap on the top of the column, called the **capital**, and a thickened slab above it, called the **drop panel**.

- **Flat plate** : This is similar to the flat slab, except that there are no drop panels or capitals.

- **Slab with beams** : The beams frame into columns and support floor or roof slabs. They provide moment interaction with the columns.

• **Joist Floor (Pan joist)** : This system consists of a series of closely spaced joists (similar to small beams), spanning in one or two directions, topped by a reinforced concrete slab cast integrally with the joists, and beams spanning between the columns perpendicular to the joists.

• **Waffle slab** : This is a two-way reinforced concrete joist floor. Waffles are hollow spaces between the joists.

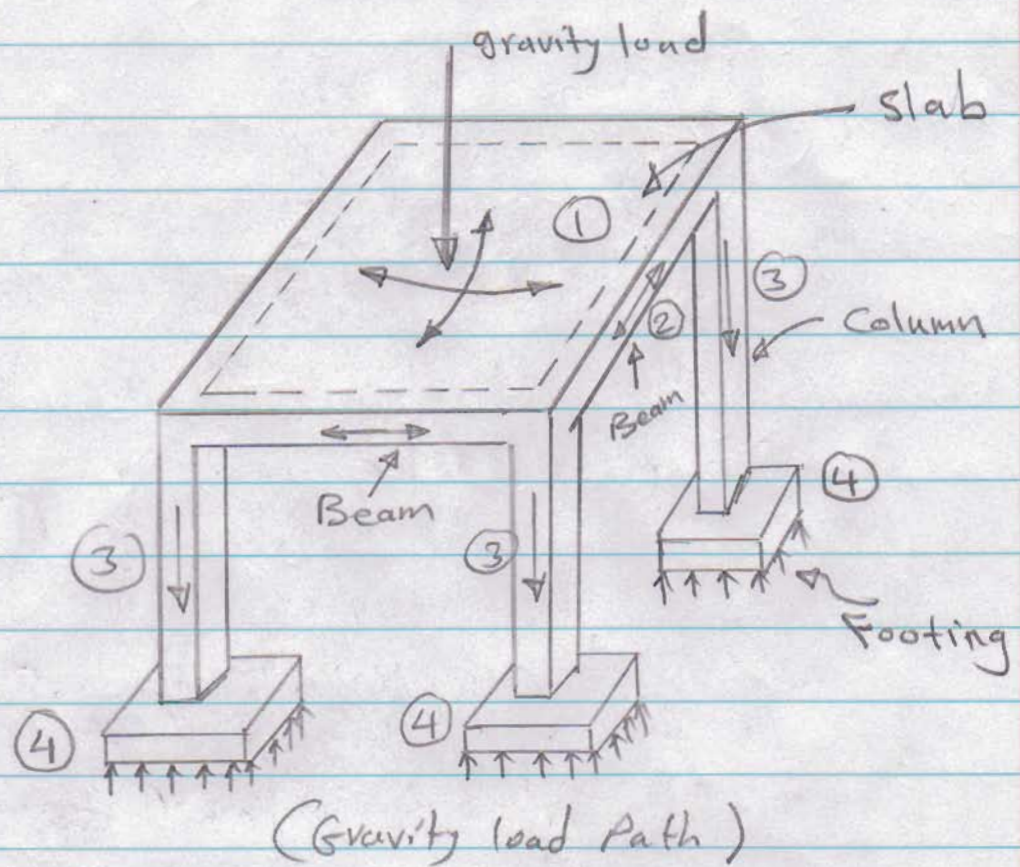
Notes :-

① Beams transmit the loads from the floors to the vertical supports (columns). Beams are usually cast monolithically with the slab and are subjected to bending and shear.

② Columns are vertical components that support a structural floor system. Columns are usually subjected to combined axial and bending.

③ Walls provide the vertical enclosure for a building. Bearing walls carry gravity loads only, whereas shear walls have a major role in carrying lateral loads due to wind and earthquakes.

(4) Foundations transmit the weight of the superstructure to the supporting soil.

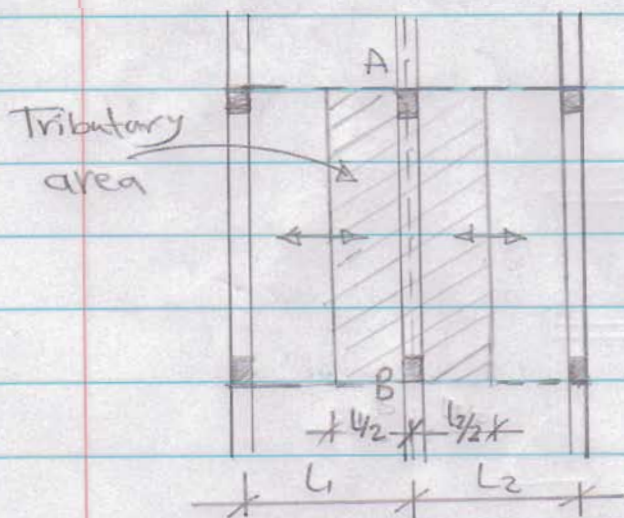


- Load paths :

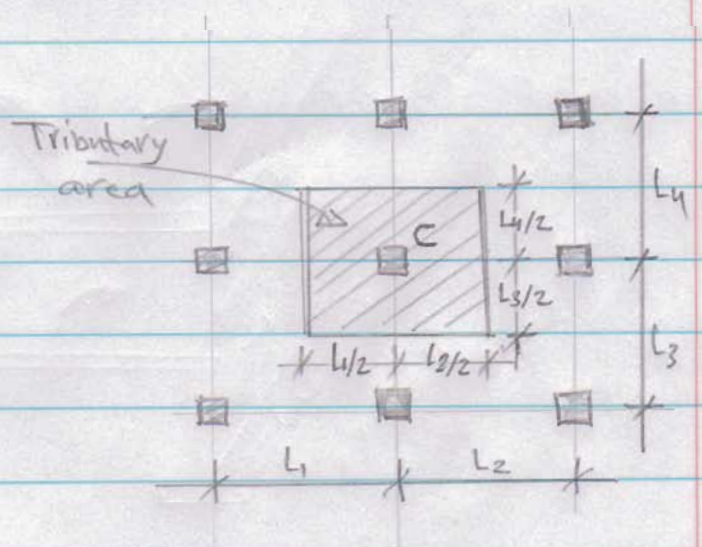
- Gravity load path: The gravity load path is vertical in direction (mainly due to dead load and live load). The gravity load acts on a slab (1), which transfers the load to the beams (2), which in turn transfer the load to the columns (3) and then down to the foundations (4).

The gravity load path depends on the type of floor slab, that is, whether a slab is a one-way or two-way system. In the one-way system, the effect of external loads is transferred primarily in one direction. The load path in a two-way system transfers in two perpendicular directions.

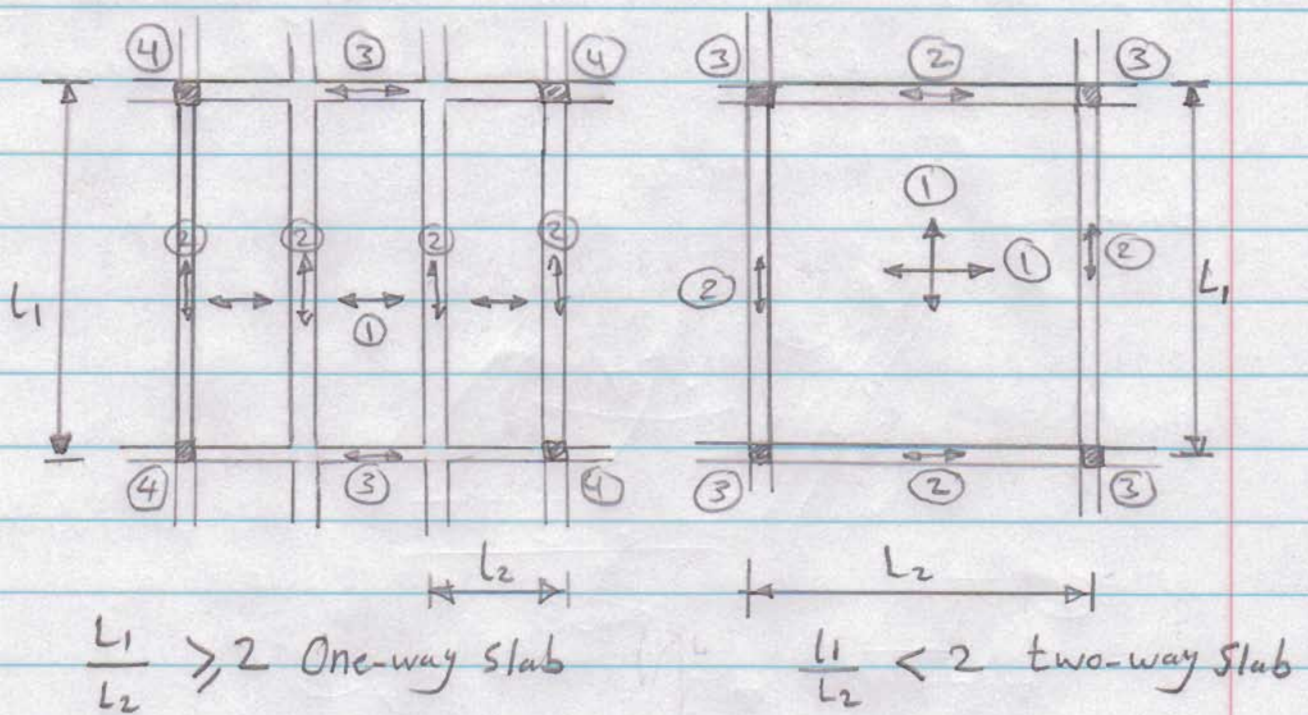
- Tributary area: The tributary area is related to the load paths and is used to determine the loads that beams, girders, columns, and walls carry. The tributary area for a beam or a girder supporting a portion of the floor is the area enclosing the member and bounded by the lines located approximately half way between the lines of support (columns or walls), as shown below. For example, a tributary area for the reinforced concrete beams AB that is a part of the one-way floor system is shown hatched in figure. A typical column has a tributary area bounded by the lines of zero shear, that is, the lines corresponding to zero shear forces in the slabs, beams, or girders, the zero-shear locations are determined by the analysis. For buildings with a fairly regular column spacing, the zero-shear locations may be approximated to be halfway between the lines of support.



Tributary area for beams

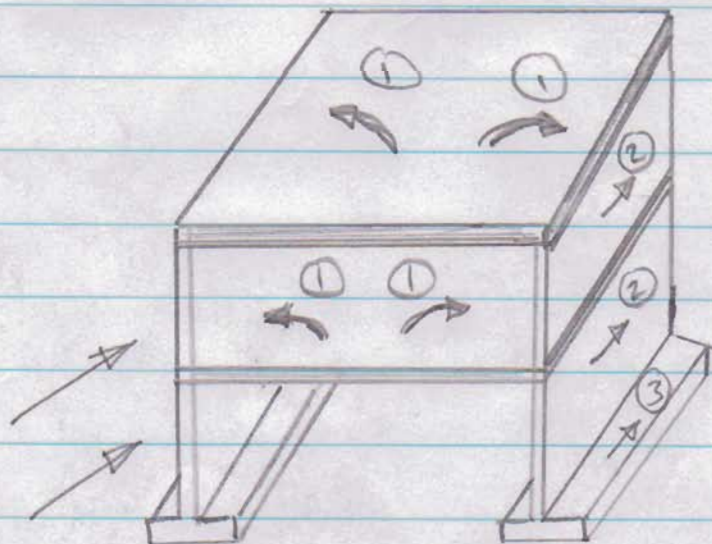


Tributary area for columns



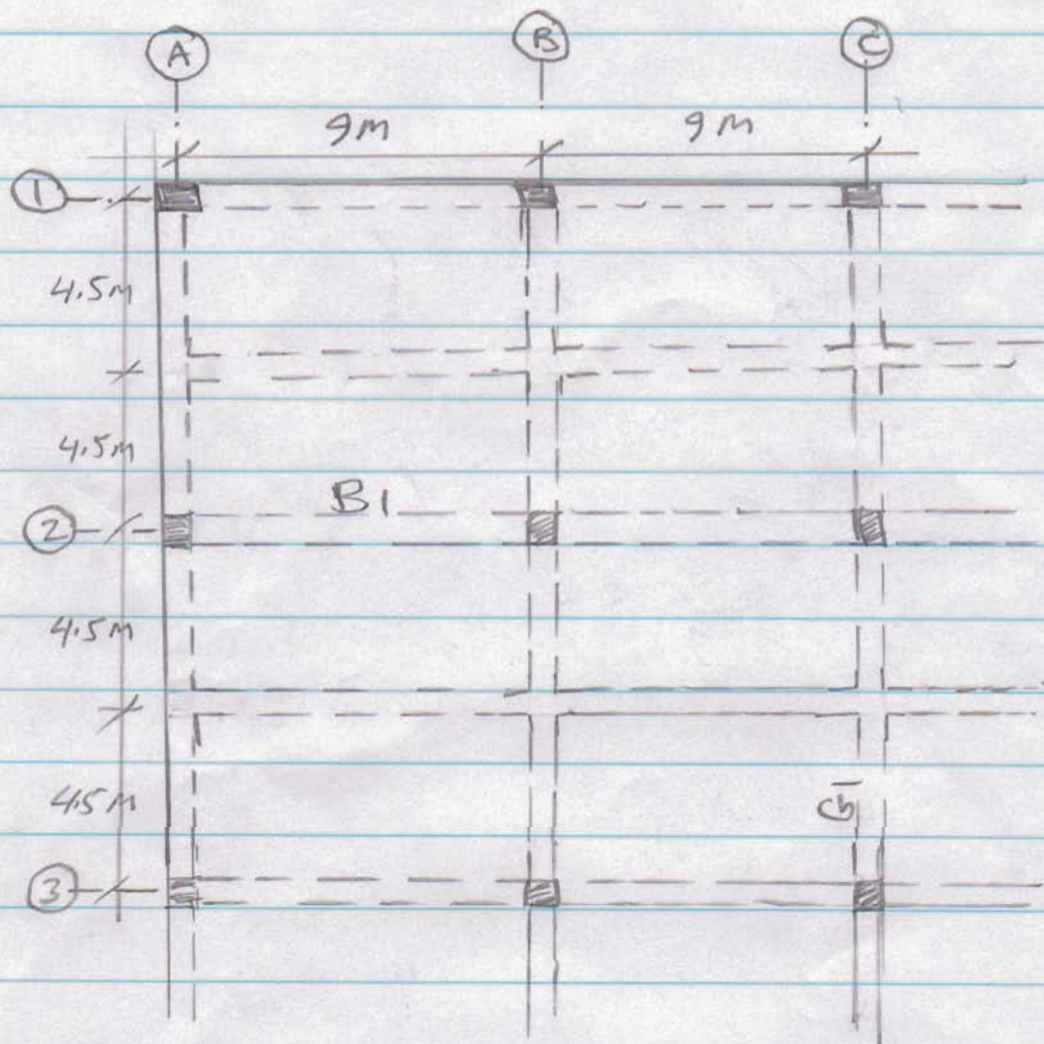
- Lateral Load Path: The way is lateral (Mainly due to wind and earthquakes). The primary elements are as follows;

- Vertical components: shear walls and frames.
- Horizontal components: roofs, floors, and foundations



(Lateral Load Path)

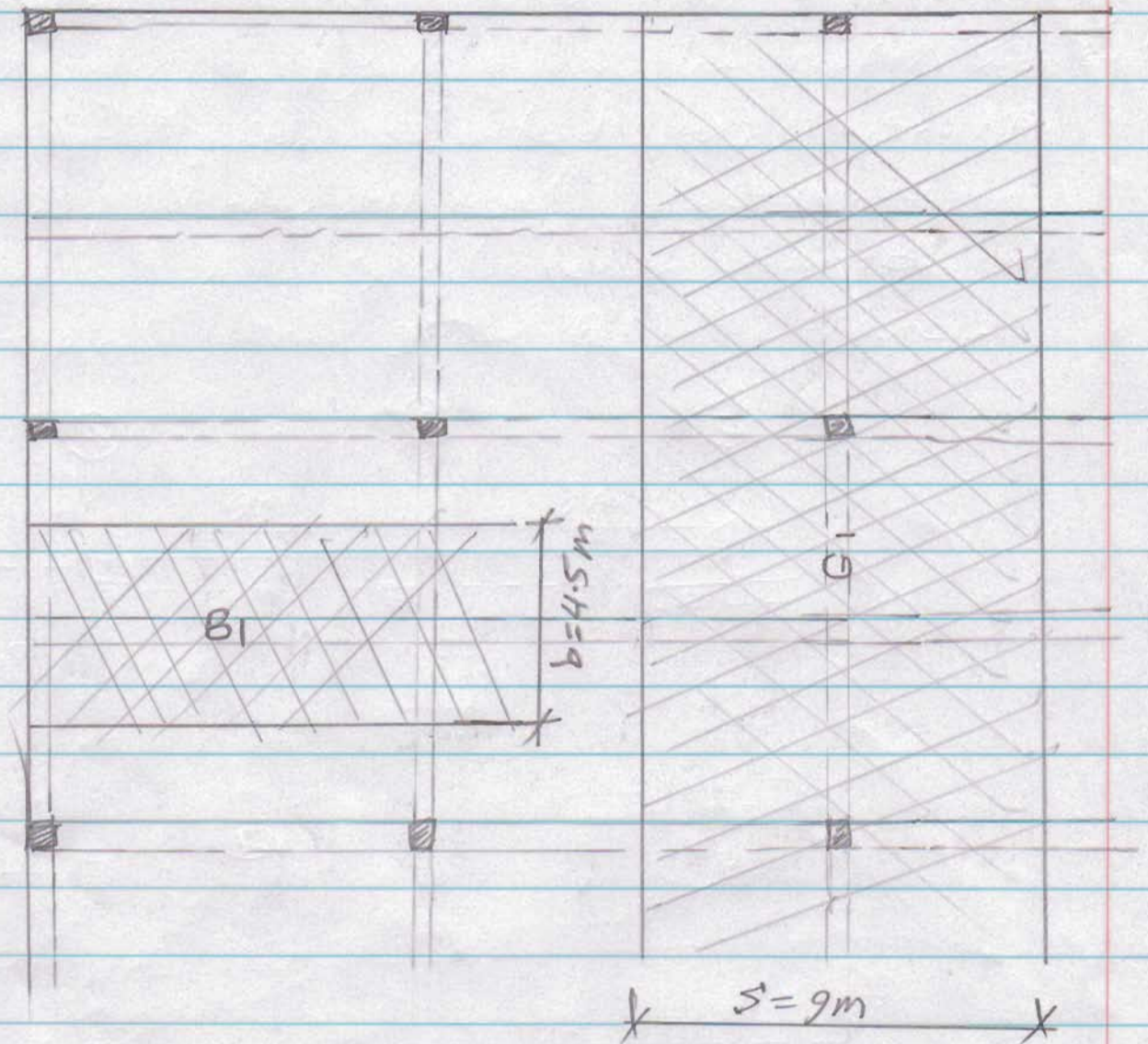
Example: A partial floor plan of R.C. building is shown in the figure below. The roof is subjected to a total uniform area load (w) of 15.0 kPa (including the floor self weight). Determine the uniform load on the typical interior beam B1 and the typical interior girder G1 in the figure.



Solution:

a) Load on a typical interior beam B1

$$W_{B_1} = w \times b = 15 \times 4.5 = 67.5 \text{ kN/m}$$



b) Load on a typical interior girder G_1

$$W_{G_1} = w \times s = 15 \times 9 = 135 \text{ kN/m}$$