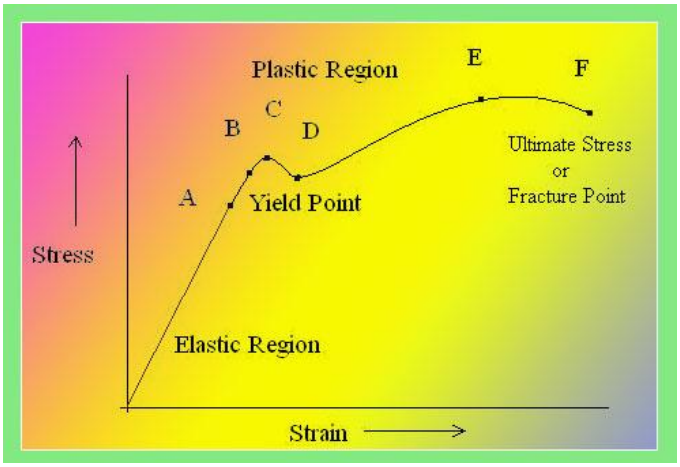
Stress – Strain Diagram for Steel:



Typical Structural Elements of a Skeletal R.C. Building:

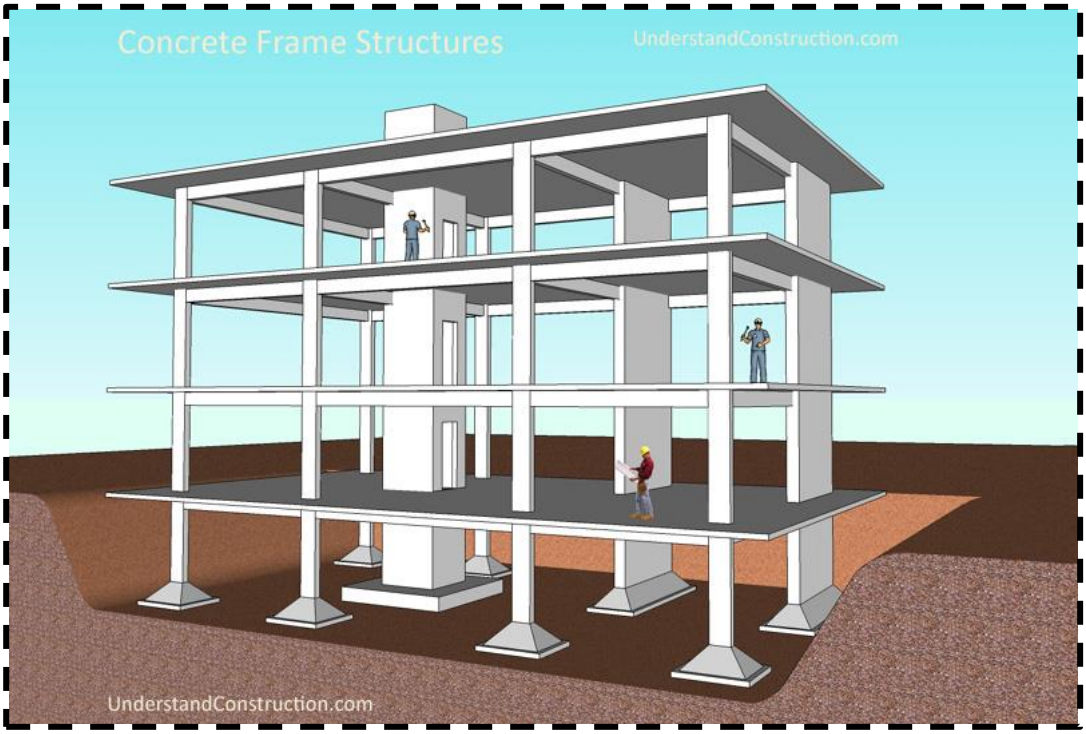
Concrete frame structures are the most common type of modern building. It usually consists of a frame or a skeleton of concrete. Horizontal members are beams and vertical ones are the columns. Concrete Buildings structures also contain slabs which are used as base, as well as roof / ceiling. Among these, the column is the most important as it carries the primary load of the building.

1- Slabs: These are the plate element and carry the loads primarily by flexure. They usually carry the vertical loads. Under the action of horizontal loads, due to a large moment of inertia, they can carry quite large wind and earthquake forces, and then transfer them to the beam.

2- Beams: These carry the loads from slabs and also the direct loads as masonry walls and their Self-Weights. The beams may be supported on the other beams or may be supported by columns forming an integral part of the frame. These are primarily the flexural members.

3- Columns: These are the vertical members carrying loads from the beams and from upper columns. The loads carried may be axial or eccentric. Columns are the most important when compared with beams and slabs. This is because, if one beam fails, it'll be a local failure of one floor but if one column fails, it can lead to the collapse of the whole structure.

4- Foundation: These are the load transmitting members. The loads from the columns and walls are transmitted to the solid ground through the foundations.


Concrete Frame Structures
UnderstandConstruction.com
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Structural Loads:

1- **Dead load:** The dead load includes loads that are relatively constant over time, including the weight of the structure itself, in addition to walls, plasterboard or carpet. The roof is also a dead load. Dead loads are also known (static loads).

Density of Some Materials that using in Construction:

Material	Density (kg/m³)
concrete	2300
Asphalt conc.	2400
Bricks	1900
Cement	1400
Clay (wet)	2080
Cement mortar	1440
Concrete (reinforced)	2400
Gypsum	1200
Sand	1650
Concrete Blocks	1400
Gravel	1800
Steel	7850
Wood(average)	400-700
Water	1000

2- **Live load:** Live loads are temporary of short duration, or a moving load. These dynamic loads may involve considerations such as impact, momentum, and vibration.

Live load for Deferent Types of Structures:

Occupancy or Use	Live Load lb/ft² (kN/m²)	Occupancy or Use	Live Load lb/ft² (kN/m²)
Air-conditioning (machine space)	200[1] (9.58)	Kitchens, other than domestic	150[2] (7.18)
Amusement park structure	100[1] (4.79)	Laboratories, scientific	100[1] (4.79)
Attic, nonresidental		Laundries	150[1] (7.18)
Nonstorage	25 (1.20)	Libraries, corridors	80[1] (3.83)
Storage	80[1] (3.83)	Manufacturing, ice	300 (14.36)
Bakery	150 (7.18)	Morgue	125 (6.00)
Exterior	100 (4.79)	Office Buildings	
Interior (fixed seats)	60 (2.87)	Business machine equipment	100[1] (4.79)
Interior (movable seats)	100 (4.79)	Files (see file room)	
Boathouse, floors	100[1] (4.79)	Printing Plants	
Boiler room, framed	300[1] (14.36)	Composing rooms	100 (4.79)
Broadcasting studio	100 (4.79)	Linotype rooms	100 (4.79)
Catwalks	25 (1.20)	Paper storage	—[4]
Ceiling, accessible furred	10[6] (0.48)	Press rooms	150[1] (7.18)
Cold storage		Public rooms	100 (4.79)
No overhead system	250[2] (11.97)	Railroad tracks	—[5]
Overhead system		Ramps	
Floor	150 (7.18)	Driveway (see garages)	
Roof	250 (11.97)	Pedestrian (see sidewalks and corridors in Table 4–1)	
Computer equipment	150[1] (7.18)	Seaplane (see hangars)	
Courtrooms	50–100 (2.40–4.79)	Rest rooms	60 (2.87)
Dormitories		Rinks	
Nonpartitioned	80 (3.83)	Ice skating	250 (11.97)
Partitioned	40 (1.92)	Roller skating	100 (4.79)
Elevator machine room	150[1] (7.18)	Storage, hay or grain	300[1] (14.36)
Fan room	150[1] (7.18)	Telephone exchange	150[1] (7.18)
File room		Theaters:	
Duplicating equipment	150[1] (7.18)	Dressing rooms	40 (1.92)
Card	125[1] (6.00)	Grid-iron floor or fly gallery:	
Letter	80[1] (3.83)	Grating	60 (2.87)
Foundries	600[1] (28.73)	Well beams, 250 lb/ft per pair	
Fuel rooms, framed	400 (19.15)	Header beams, 1,000 lb/ft	
Garages—trucks	—[3]	Pin rail, 250 lb/ft	
Greenhouses	150 (7.18)	Projection room	100 (4.79)
Hangars	150[3] (7.18)	Toilet rooms	60 (2.87)
Incinerator charging floor	100 (4.79)	Transformer rooms	200[1] (9.58)
		Vaults, in offices	250[1] (11.97)

[1]Use weight of actual equipment or stored material when greater.
[2]Plus 150 lb/ft² (7.18 kN/m²) for trucks.
[3]Use American Association of State Highway and Transportation Officials lane loads. Also subject to not less than 100% maximum axle load.
[4]Paper storage 50 lb/ft (2.40 kN/m²) of clear story height.
[5]As required by railroad company.
[6]Accessible ceilings normally are not designed to support persons. The value in this table is intended to account for occasional light storage or suspension of items. If it may be necessary to support the weight of maintenance personnel, this shall be provided for.

3- **Environmental loads**: Environmental Loads are structural loads caused by natural forces such as:

- Wind loads.
- Snow, rain and ice loads.
- Temperature changes leading to thermal expansion because thermal loads.
- Lateral pressure of soil, groundwater or bulk materials.
- Loads from fluids or floods.
- Dust loads.

4- **Other loads:** Engineers must also be aware of other actions that may affect a structure, such as:

- Foundation settlement or displacement.
- Fire.
- Corrosion.
- Explosion.
- Creep or shrinkage.
- Impact from vehicles or machinery vibration.

How Loads Flow Through a Building?

Elements of building are used to transmit and resist external loads within a building. These elements define the mechanism of load transfer in a building known as the load path. The load path extends from the roof through each structural element to the foundation. An understanding of the critical importance of a complete load path is essential for everyone involved in building design and construction.

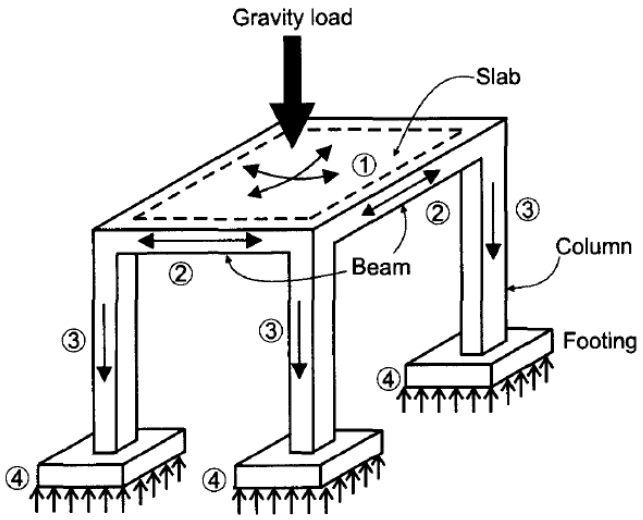
The load path can be identified by considering the elements in the building that contribute to resisting the load and by observing how they transmit the load to the next clement. Depending on the type of load to be transferred, there are two basic load paths:

- **Gravity load path**
- **Lateral load path**

Both the gravity and lateral load paths utilize a combination of horizontal and vertical structural components, as explained below

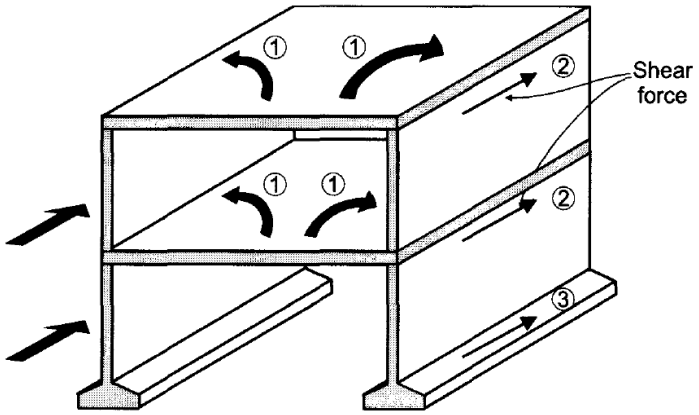
1. Gravity Load Path: Gravity load is the vertical load acting on a building structure, including dead load and live load due to occupancy or snow. Gravity load on the floor and roof slabs is

transferred to the columns or walls, down to the foundations, and then to the supporting soil beneath. Figure shows an isometric view of a concrete structure and a gravity load path.
The gravity load path depends on the type of floor slab, that is, whether a slab is a one way or a two-way system.



2. Lateral Load Path: The lateral load path is the way lateral loads (mainly due to wind and earthquakes) are transferred through a building. The primary elements of a lateral load path are as follows,

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



Text Books:

1	تصميم المنشات الخرسانية المسلحة / د.جمال عبدالواحد فرحان
2	Reinforced Concrete Structures/Dr. I.C. Syal.
3	Reinforced Concrete Structures/N. Krishna Rajo
4	Reinforced Concrete Structures/ Supramanian
5	Others

First Semester Subjects

No.	Subject
1	WORKING STRESS DESIGN METHOD (WSDM)
2	ULTIMATE STRESS DESIGN METHOD (USDM)
2-1	Design and Analysis of Singly Reinforced Beam
2-2	Design and Analysis of Doubly Reinforced Beam
2-3	Design and Analysis of (T-Beam)
2-4	Design for Shear Requirements