Chapter 3

Structural Description

After completing the process of the architectural project explanation of all the details, we must move to the construction phase of the study for the project, in order to choose the appropriate structural system for each element in the building, in order to provide all requirement and design all elements necessary for the system. So that it is taking into account the loads affecting the types of elements, showing how to deal with them and work to resist them, so we must know these structural elements in detail, in order to be customized and analyzed accurately.

3.1 The purpose of structural design

The purpose of structural design is to find the building is available where all safety requirements, in order to resist all the forces that affect the building in different forms, such as loads of dead and live or external forces such as earthquakes, wind and landing in the soil. When designing any element of these it should be taken in consideration the following standers:

1.Safety: is the essential element that must be provided in the design, so choosing the

appropriate element of each region to resist loads that affecting them.

2. Economy: must be supplied when working on the selection of appropriate materials, and sufficient for its desired purpose and appropriate quantity, with lowest cost and highest quantity.

3.Serviceability: work to avoid any external failures, such as the decline in soil or any cracks in the external shape, or anything that works to increase this failure.

4.Architectural side: work to take into account the architectural elements in the building and try to keep it as much as possible.

3.2 Theoretical studies of the structural elements of the building

The most important step that should work out of the project before starting the structural design, working on a comprehensive study of the project in terms of its size the nature of its work, how to estimate the loads that effect on the building, choose items that are exposed to these loads, and identify system construction, which used to resist these loads.

3.3 Types of Loads

Loads are the base of design process, so they must have great consideration is specialty, identifying and study.

Accurately, so differing building from another depends on the architectural design, project site, materials used in construction and other influences, therefore loads can be classified as follow:

1.Basic loads:

The loads which must be taken into account in the structural design of the building in all cases, it includes: Dead load, Live load and Environmental loads.

2.Secondary loads:

The loads that should be take into account in the design in some buildings, depending on the nature of the building and other influences, it includes: Shrinkage load, Thermal load, Snows load, Dynamic load, Seismic load.

3.3.1 Dead Load

Dead load includes loads that are relatively constant over time, including the weight of the structure itself, and immovable fixtures such as walls, plasterboard or carpet. Roof is also a dead load. Dead loads are also known as permanent loads.

Designer can also be relatively sure of the magnitude of dead loads as they are closely linked to density and quantity of the construction materials. These have a low variance, and the designer is normally responsible for specifying these components.

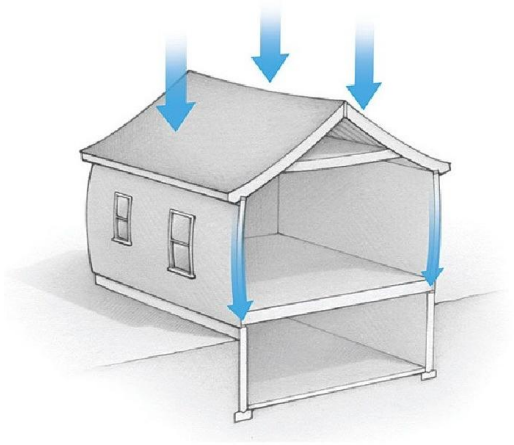

Figure 3.1 Dead Load.

Table 3.1: Specific Density of the Materials Used

Num.	Density (KN/m^3)	Material
1	24.5	Tiles
2	22	Mortar
3	17	sand
4	22	plaster
5	9	block
6	25	Reinforcement concrete

3.3.2 Live load

Live load is imposed loads which are temporary, of short duration, or moving.These dynamic loads may involve consideration such as impact, momentum, vibration, slosh dynamic of fluids, fatigue, etc. Live loads, sometimes also referred to as probabilistic loads include all the forces that are variable within the object's normal operation cycle not including construction or environmental loads.

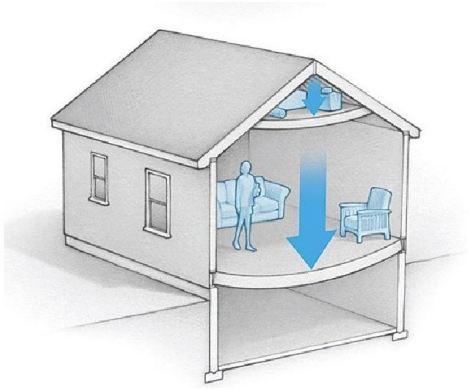

Figure 3.2 Live Load.

Table 3.2: Live Loads (Ref.: Jordan Code)

Num.	Live load (KN/m^2)	Use
1	5.0	Store
2	5.0	Parking
3	5.0	Theaters and terraces
4	4.0	Stairs
5	2.4	Offices

3.3.3 Environmental loads

The loads arising from the changes in the environmental such as seismic, wind and snow.

3.3.3.1 Seismic load:

Loads caused by earthquakes. Buildings should be designed to withstand minor earthquakes because they can occur almost anywhere. During an earthquakes the ground can move both horizontal and vertically in any direction. This exerts tremendous horizontal loads on members.

Figure 3.3Seismic Load.

3.3.3.2 Wind load:

The forces that affect horizontally on the building appear especially in high-rise buildings, and its designed on the basis of wind speed and height of the building, and the amount of buildings surrounding the building.

Figure 3.4 Wind Load.

3.3.3. 3 Snow load:

The building must be designed to resist snow loads and to be taken into account the design and it depends on the height of the building and the area of this building.

Figure 3.5 Snow loads.

The following table shows the relationship between the height of the building and carry snow that we take him in the case of design.

Table 3.3: Loads of Snow by Sea Level (Ref.: Jordan Code)

Building height above sea level	The value of load in surface (KN/m^2)
250 >h 500 >h >250 1500 >h >500	0 (h-250)/800 (h-400)/320

3.4 Practical Tests

Before you begin the process of design and construction, should work some of necessary tests at the site, especially on the soil, and work to see the quality of the rocks in the region, and work to deviate place waterfalls ground water and its impact on the building, and work to resolve the problems if available of these problems, as soil test.

3.5 Structural Elements

There are many structural elements used in the buildings as the slab, beam, column, stairs, the shear wall and foundations.

3.5.1 The Slabs

Is an element which transfers the loads that are exposed to other structural elements such as column, beam, wall. They many factor to select type of slabs:

1. The distance between the spaces and columns.
2. The desired function of the space.
3. Cost.
4. Ease of implementation and duration available for building.

And In our project, we will use different types including:

3.5.1.1 Rib Slab:

In general, this type is most commonly used in our project, this contains the steel bars use to transfer the loads, and block and the concrete between this block and the topping of all, and we have two types of this:

- One way ribbed slab.
- Two way ribbed slab.

One way ribbed slab are used when it is intended to cover areas without bridges falling , was the use of these tiles in all floors of this project , to light weight and effectiveness.

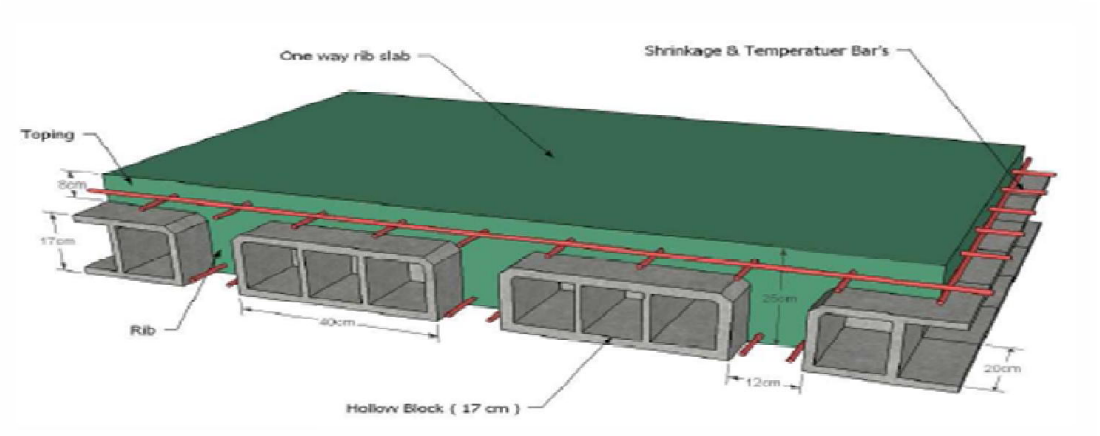

Figure 3.6 One Way Rib Slab.

Two way rib slabbed is the type use when the length of the two direction in the space approximately is equals, and we used in this type bar of steel in two direction to transfer the load.

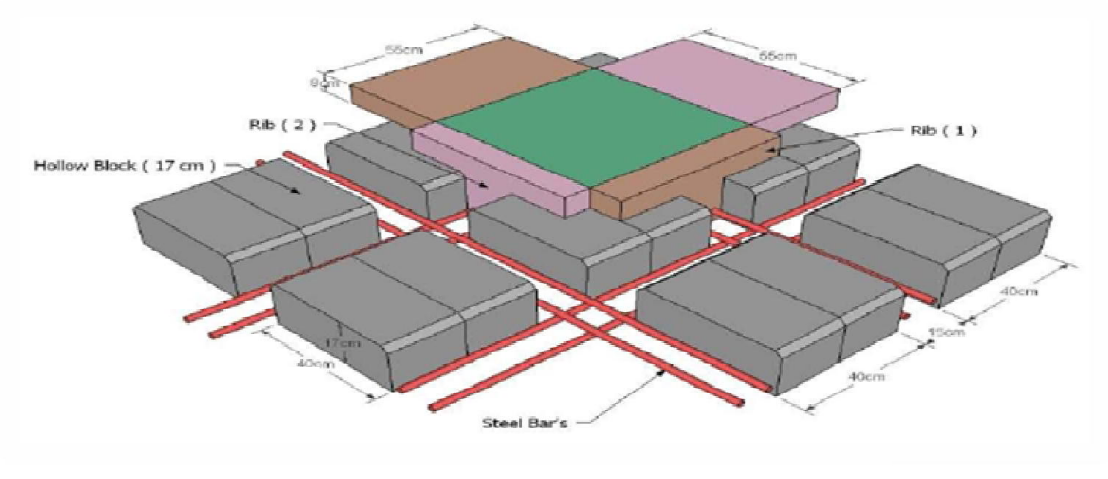

Figure 3.7 Two Way Rib Slab.

3.5.1.2 Solid Slab:

We use this method when the height of the spaces is important, and we don't have problem when show the drop beam and this transfer the load to the beam to the column, and we have two types one way and two way, and the difference between two types is the direction of transfer load.

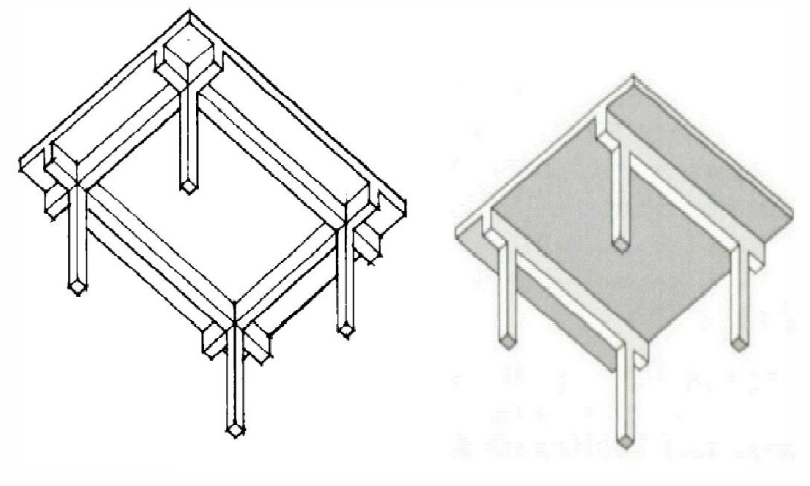

Figure 3.8 Solid Slabs

3.5.2 Beams

Use this element to transfer the load from the slab to the column, and have the type as hidden beam when have the same thickness of slab and drop beam when have different thickness.

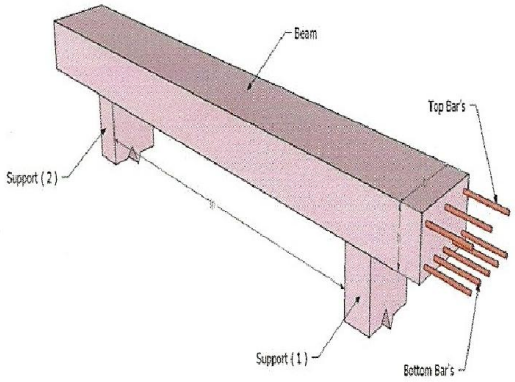

Figure 3.9 Hidden Beam.

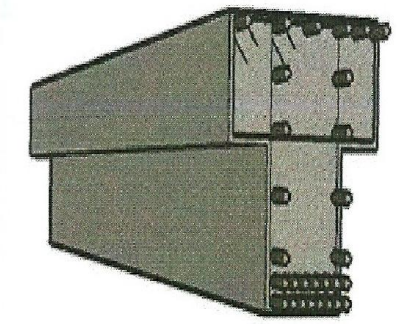

Figure 3.10 Drop Beam.

3.5.3 Columns

The element is use to transfer the load from the slab to the foundation, and it helps in the stability of the building, and when design we will know the type design if short or slender column.

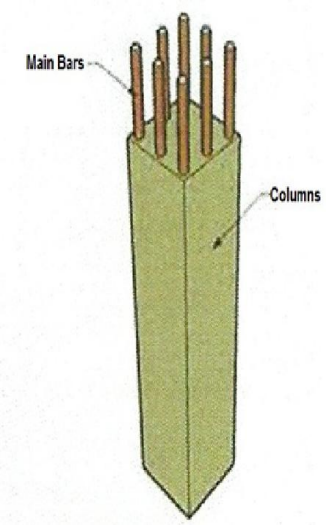

Figure 3.11 Square Column.

Figure 3.12 Circular Column.

3.5.4 Shear Wall

Shear wall is the important element structure because use to resist the vertical and horizontal load; Shear wall is a type of structural system that provides lateral resistance to the building or structure. It resist loads as the wind and earthquake. When design this wall, we use two layer steel to give it more strength.

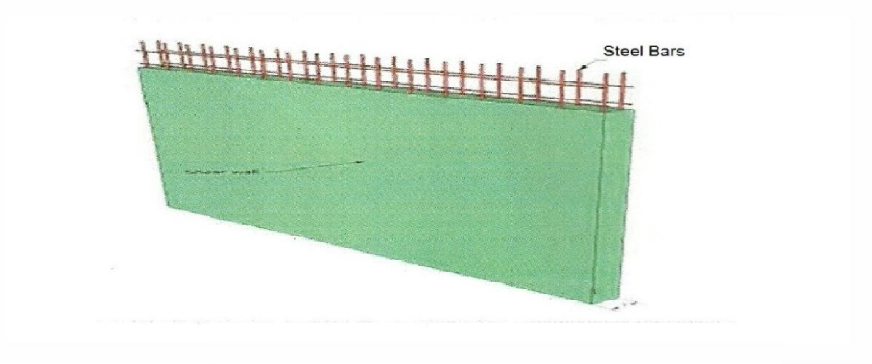

Figure 3.13 Shear wall.

3.5.5 The Foundations

The first element we implemented on the ground, but is the last element we design, because all loads are transmitted to it whether the basic load as dead or live load or secondary load. So is the basic element, which receives all the loads and distributed it to the soil.

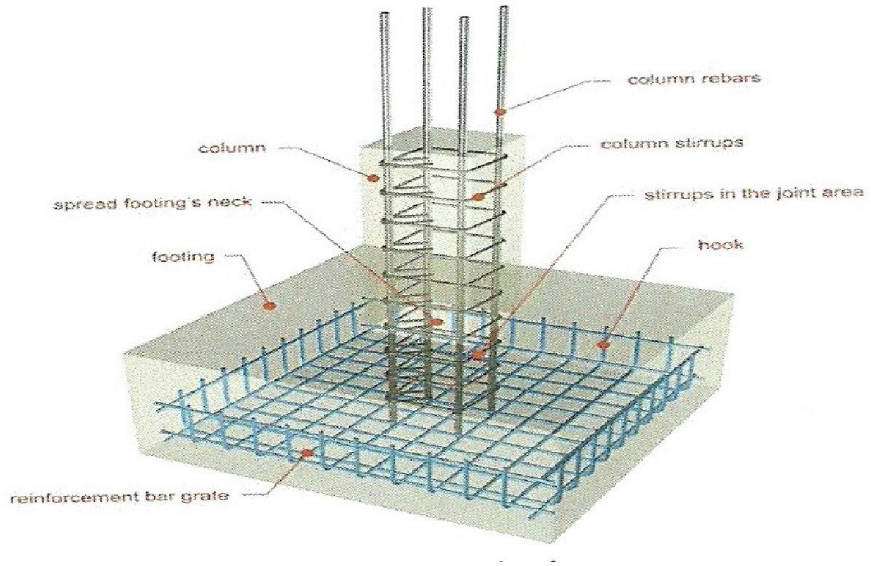

Figure 3. 14 Isolated Footing.

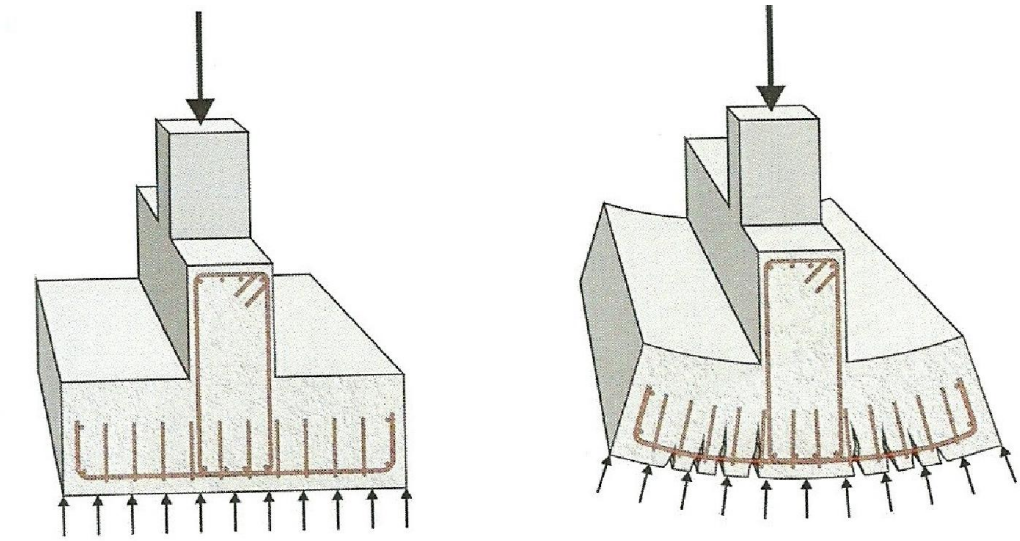

Figure 3.15 Strip Footing.

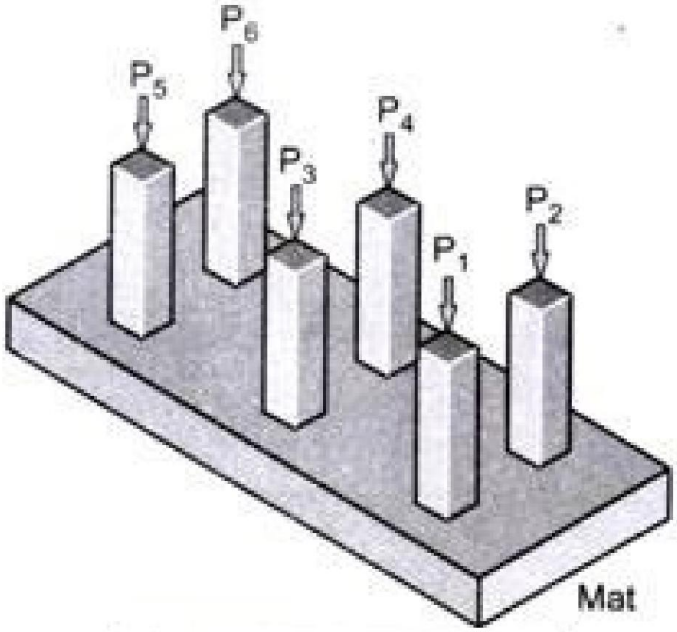

Figure 3.16 Mat Footing.

3.5.6 Stairs

The stairs is a vertical transmission element between the layers, and we used the one way solid slab in the landing.

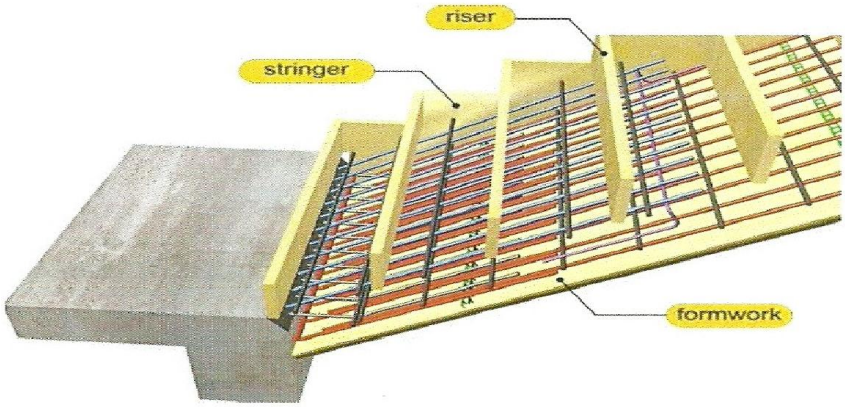

Figure 3.17 Stairs.

3.5.7 Expansion joints

Is a spacer which are used in order to avoid getting any expansion or other effects that may impair the building, where the building is separated entirely, and the building is separated after increasing distanced (35-45) m.

When you use joints must take into account the vast spaces of the building:

1. 40m areas with high humidity.
2. 36m areas with normal humidity.
3. 32m areas with medium humidity.
4. 28m with dry areas.

- We don't have any expansion joint.