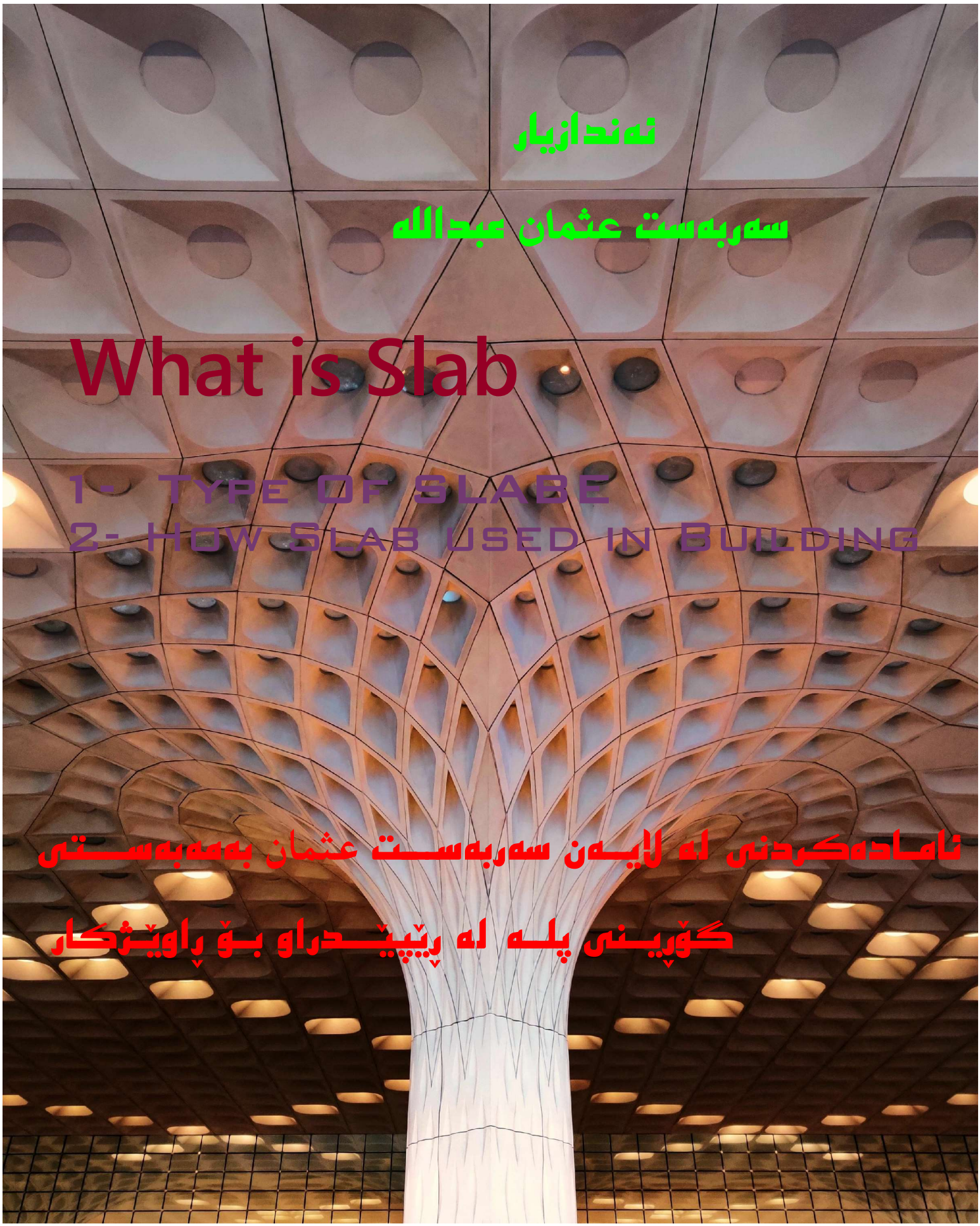

ئەندازیار

سەربەست عثمان عبدالله

What is Slab

1- Type of Slabe

2- How Slab used in Building

ئامادەکردنی لایەن سەربەست عثمان بەمەبەستی

گۆڕینی پلە لە پێڕەوی بۆ ڕاوێژکار

Concrete slabs in buildings

Introduction

A slab is a structural element, made of concrete, that is used to create flat horizontal surfaces such as floors, roof decks, and ceilings. A slab is generally several inches thick and supported by beams, columns, walls, or the ground.

Concrete slabs can be prefabricated off-site and lowered into place or maybe poured in-situ using formwork. If reinforcement is required, slabs can be pre-stressed or the concrete can be poured over rebar positioned within the formwork.

There are several different types of slabs, including:

What is a slab in construction

In the context of construction, a slab refers to a flat, horizontal, and typically reinforced concrete element used to form floors, ceilings, and roofs. Slabs are one of the essential components of a building structure and provide a solid, stable base for supporting other building elements such as walls, columns, and beams

Types of slab in construction

The different types used in construction projects depend on various factors, including the span of the slab, the loads it will be subjected to, and the available materials and resources. However, there are several types of slabs including:

1) One-way slabs on beams

These slabs are supported by parallel beams that transfer the load to columns. These slabs are designed to resist loads in one direction only, and the reinforcement is provided in the direction perpendicular to the beams.

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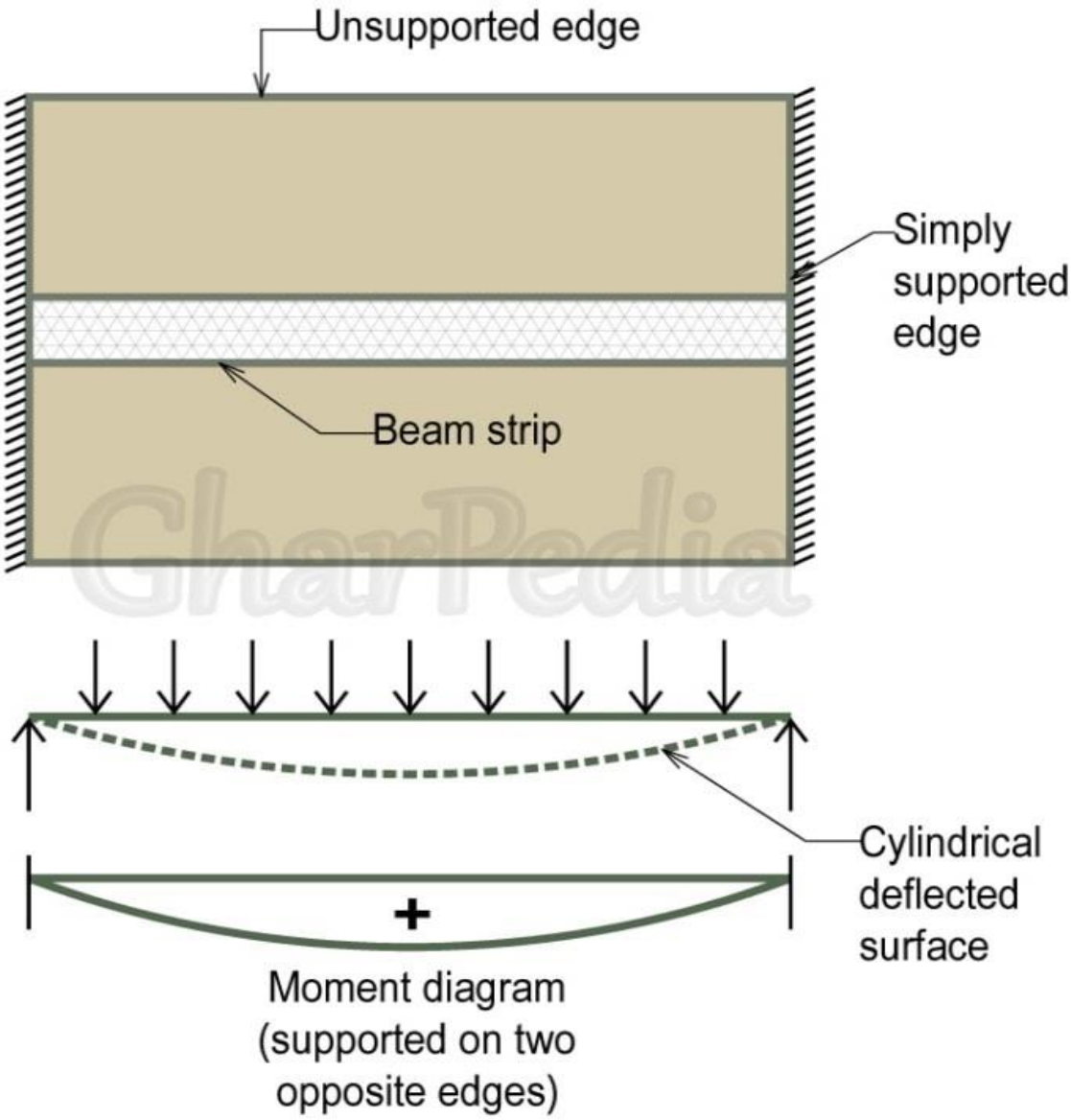

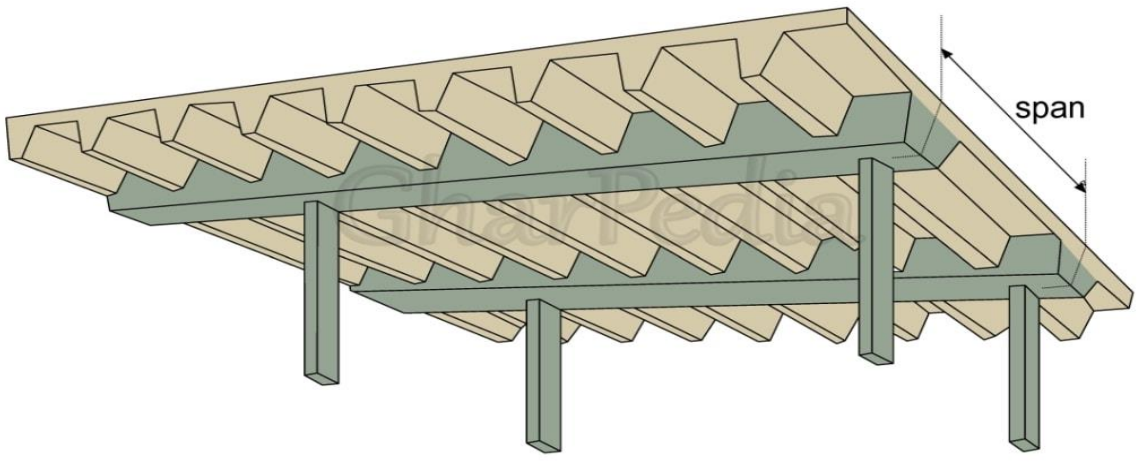

The direction (shorter side of slab) in which load is transferred is known as span. A one-way slab is designed for the spanning direction alone as it bends in only one direction.

The main tension reinforcing bars therefore run parallel (spaced uniformly) to the shorter span and are usually placed at the bottom of slab.

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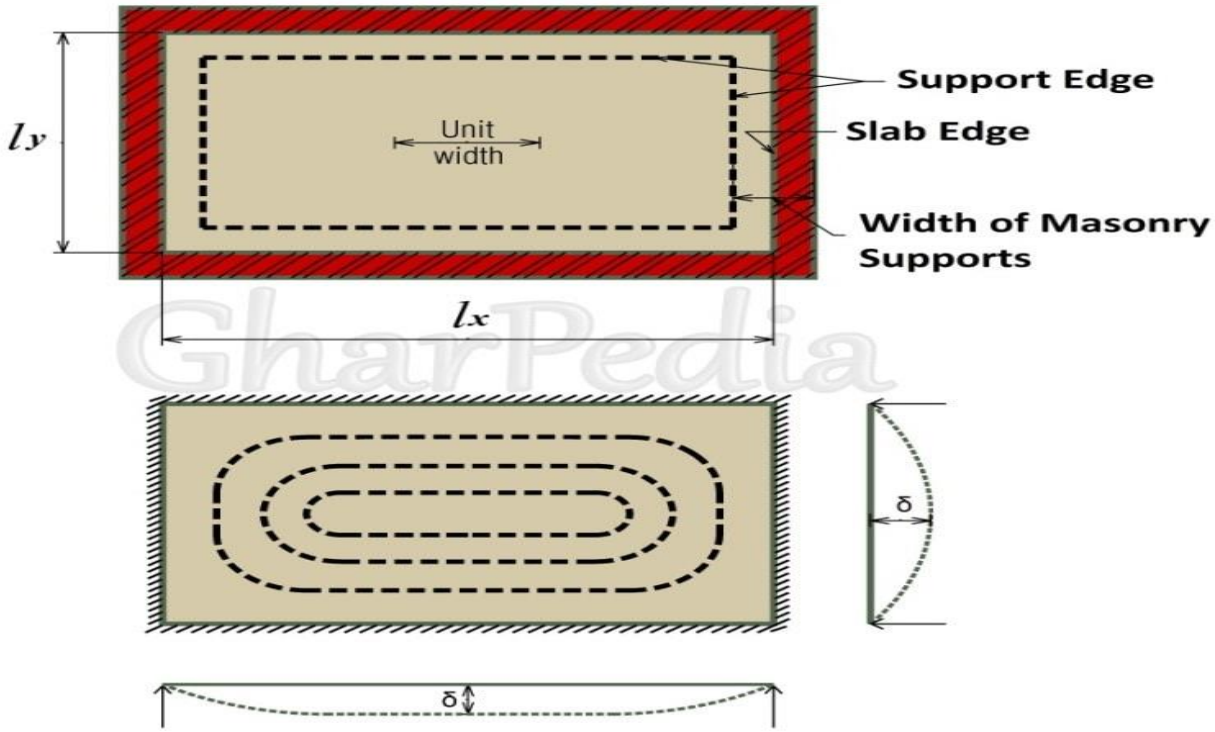
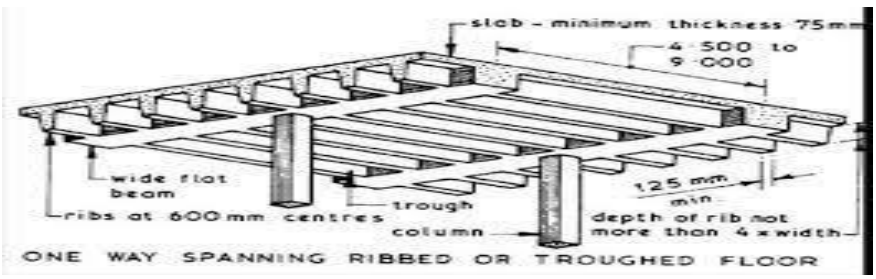
In the transverse direction (a longer direction), a minimum amount of reinforcement is provided to take care of the temperature and shrinkage effects in that direction. This **steel reinforcement** is called the distribution steel or secondary reinforcement. This steel also helps in distributing the load. I.e. the point load which has a tendency to punch through the slab. The distribution steel also aids in distributing the load transversely over a larger width, thus offsetting the local effect
like **plastic shrinkage cracks** due to temperature and shrinkage. Even when a slab is supported on all four sides, the behavior of slab is expected to be as one-way slab only as evident from the



2) One-way joist slab (ribbed slab)

This type of slab consists of a series of small reinforced concrete T-beams, spaced at regular intervals, and supported by columns or walls. The T-beams act as ribs, providing extra stiffness and reducing the amount of concrete required. The spa



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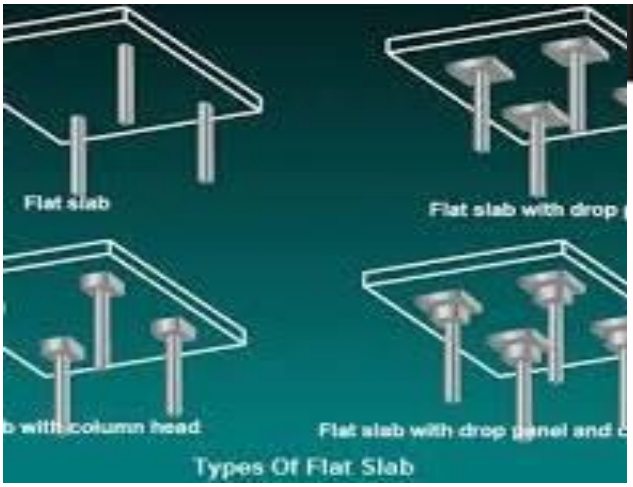
lightweight concrete or hollow blocks, reducing the overall weight of the structure

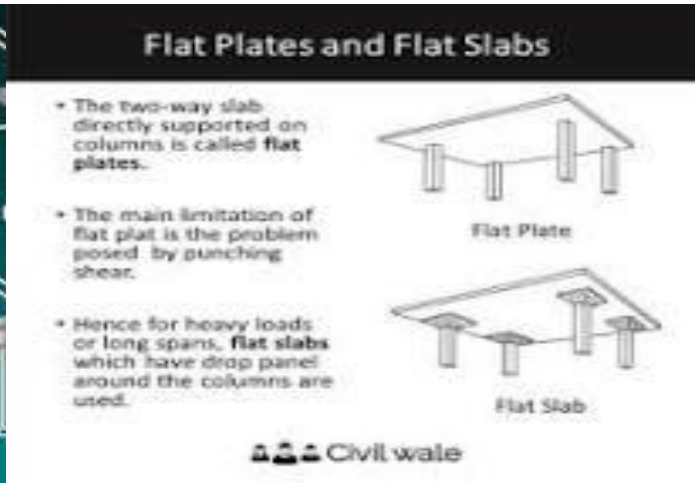
- ## 3) Flat plates

- A flat plate slab is a one-way or two-way reinforced concrete slab supported directly on columns or walls. The slab is usually thin and has no beams or ribs. The reinforcement is provided in both directions to resist the loads. Flat plate slabs are simple and economical to construct.

4)Flat slab

Flat slab is a reinforced concrete slab supported directly by concrete columns without the use of beams. Flat slab is defined as one sided or two-sided support system with sheer load of the slab being concentrated on the supporting columns and a square slab called 'drop panels'. Drop panels play a significant role here as they augment the overall capacity and sturdiness of the flooring system beneath the vertical loads thereby boosting cost effectiveness of the construction. Usually the height of drop panels is about two times the height of slab





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Flat Slabs are considered suitable for most of the construction and for asymmetrical column layouts like floors with curved shapes and ramps etc. The advantages of applying flat slabs are many like depth solution, flat soffit and flexibility in design layout. Even though building flat slabs can be an expensive affair but gives immense freedom to architects and engineers the luxury of designing. Benefit of using flat slabs are manifold not only in terms of prospective design and layout efficacy but is also helpful for total construction process especially for easing off installation procedures and saving on construction time. If possible, try to do away with drop panels as much as possible and try to make the best use of thickness of flat slabs. The reason is to permit the benefits of flat soffits for the floor surface to be maintained, ensure drop panels are cast as part of the column. **To utilize the slab thickness to optimum level, the essential aspects that should be kept in mind are:**

1. Procedure related to design
2. Presence or absence of holes
3. Significance of deflections
4. Previous layout application experience

Types of Flat Slab Construction

Following are the types of flab slab construction:

- Simple flat slab
- Flat slab with drop panels
- Flat slab with column heads
- Flat slab with both drop panels and column heads

Uses of Column Heads

- It increase shear strength of slab
- It reduce the moment in the slab by reducing the clear or effective span

Uses of Drop Panels

- It increase shear strength of slab
- It increase negative moment capacity of slab
- It stiffen the slab and hence reduce deflection

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Advantages of Flat Slabs

It is recognized that Flat Slabs without drop panels can be built at a very **fast pace** as the framework of structure is simplified and diminished. Also, speedy turn-around can be achieved using an arrangement using early striking and flying systems. Flat slab construction can deeply **reduce floor-to –floor height** especially in the absence of false ceiling as flat slab construction does act as limiting factor on the placement of horizontal services and partitions. This can prove gainful in case of lower building height, decreased cladding expense and pre-fabricated services. In case the client plans changes in the interior and wants to use the accommodation to suit the need, flat slab construction is the perfect choice as it offers that **flexibility** to the owner. This flexibility is possible due to the use of square lattice and absence of beam that makes channelling of services and allocation of partitions difficult.

Thickness of flat slab

Thickness of flat slab is another very attractive benefit because thin slab provides the advantage of increased floor to ceiling height and lower cladding cost for the owner. However, there is profound lower limit to thickness of slab because extra reinforcements are needed to tackle design issues. Besides this, added margin must be provided to facilitate architectural alterations at later stages.

Types of Flat Slab Design

Multitudes of process and methods are involved in designing flat slabs and evaluating these slabs in flexures. Some of these methods are as following:

- The empirical method
- The sub-frame method
- The yield line method
- Finite –element analysis

5- CONVENTIONAL SLAB

Conventional slab

This type of slab is supported with beams and columns, with the load transferred to those elements. A conventional slab is classified as either:

- One-way: Supported by beams on two opposite sides, carrying the load in one direction.
- Two-way: Supported by beams on all four sides, carrying the load along with both directions.

The main difference between flat slab & conventional slab-beam system is that the one is directly supported on the column while another system has a beam for support. The load is transferred directly from slab to column in the flat slab. In

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conventional slab-beam system, the load is transferred from slab to beam and ultimately beam to the column

Flat Slab System

Conventional Slab - Beam System

CONVENTIONAL SLAB AND IT'S TYPES

In This Article We Are Going To Cover What Is Conventional Slab And Types Of Conventional Slab Briefly.

- What Is Conventional Slab
- When We Use Conventional Slab
- Where We Use Conventional Slab
- Types Of Conventional Slab
- Two Way Slab Details
- One Way Slab Details

What Is Conventional Slab

Slab Which Is Supported With Beams And Columns Is Called Conventional Slab.

In This Kind Of Slab The Thickness Of Slab Is Small Where As Depth Of Beam Is Large And Load Is Transferred To Beam And From Beams To Columns.

It Requires More Formwork When Compared With The Flat Slab, And There Is No Need Of Providing Column Caps In Conventional Slab.

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The Thickness Of Conventional Slab Is 4 or 10 cm. 5 To 6 Inches Is Recommended If The Concrete Will Receive Occasional Heavy Loads. Such As Motor Homes Or Garbage Trucks.

- **Normally It Is Square In Shape And Has A Length Of 4 meter.**

Reinforcement Is Approved In Conventional Slab And The Bars Which Are Set In Horizontal Are Called Main Reinforcement Bars And Bars Which Are Set In Vertical Are Called Distribution Bars.

- **These Types Of Slabs Are Used In Constructing Floors Of Multi Storeyed Building.**

Types Of Slabs

1. One Way Slab
2. Two Way Slab

ONE WAY SLAB

One Way Slab Is A Slab Which Is Supported By Beams On The Two Opposite Sides To Carry The Load Along Direction.

The Ratio Of Longer Span (L) To Shorter Span (B) Is Equal Or Grater Than 2, Considered As One Way Slab Because This Slab Will Bend In One Direction. (i.e In The Direction Along Its Shorter Span)

$$\frac{LongerSpan}{ShortSpan} \geq 2$$

However Minimum Reinforcement Knows As Distribution Steel It Is Provided Along The Longer Span Above The Main Reinforcement To Distribute The Load Uniformly And To Resist Temperature And Shrinkage Stresses.

In Generally Length Of Slab Is 4 meter. But In One Way Slab One Side Length Is meter And Other Side Length Is More Than 4 meter.

In One Way Slab Main Reinforcement Is Provided In Shorter Span And Distribution Reinforcement Is Provided In Longer Span.

Generally All The Cantilever Slabs Are One Way Slab. **Chajjas And Verandhs** Are Practical Example Of One Way Slab.

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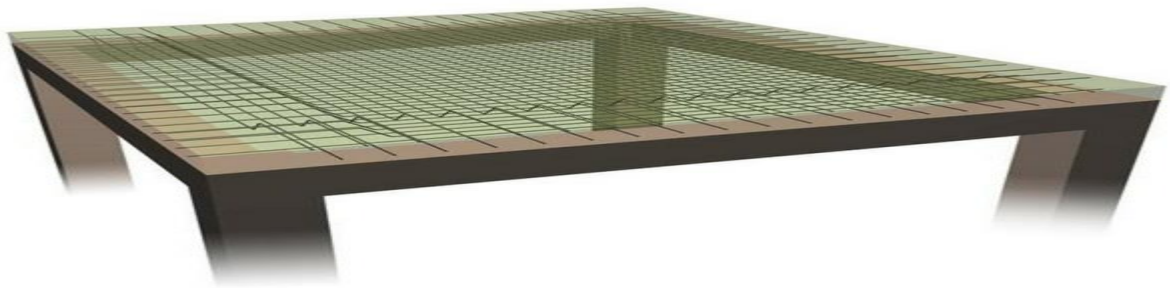
Two Way Slab



Two Way Slab

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Two Way Slab Is A Slab Supported By Beams On All The Four Sides And The Loads Are Carried By The Supported Along Both Directions Non As Two Way Slab.

In Two Way Slab The Ratio Of Longer Span (L) To Shorter Span (B) Is Less Than 2.

$$\frac{LongerSpan}{ShorterSpan} = \frac{\mathrm{l}}{\mathrm{b}} < 2$$

The Slabs Are Likely To Bend Along The Two Spans In This Load Is Transferred In Both The Directions To The Four Supporting Edges And Hence Distribution Reinforcement Is Provided In Both The Directi

6) Hollow-core ribbed slab

Hollow core slabs are typically used in the construction of floors in multi-storey buildings, in both simple and complex designs of residential, commercial, educational, healthcare and industrial buildings, because of their versatility in spanning capabilities

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HOLLOW CORE RIBBED SLAB

Hollow Core Ribbed Slab Is One The Type Of Concrete Slab, We Will Cover How This Types Slab Are Drives And Where We Use This Kind Of Slab.Process Of Casting Hollow Ribbed Slab also Cover.

benefits of HOLLOW CORE slab

- Reduce weight on your building or structure.
- Sound insulation
- Fire resistant
- Fast to install
- No additional formwork

Hollow Core Ribbed Slabs Derives Their Name From The Voids Or Core Which Run Through The Units.

The Cores Can Function As Service Ducts And Significantly Reduced The Self-Weight OF Slab And Maximizing Structural Efficiency.

Units Are Generally Available In Standards 1200 mm Width And Depths From 110 mm To 400 mm. (Their Is Total Freedom In Length Of Unit)

This Kind Of Slab Is Used Where Construction Has To Be Done Fast.

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These Kind Of Slab Are Pre-Cast Slab Which Are Ready Made.

The Hollow Core Ribbed Slab Have Between Four And Six Longitudinal Cores Running Through Them.

The Primary Purpose Of The Cores Being To Decrease The Weight And Material Within The Floor Yet To Maintain Maximal Strength.

Further To Increase The Strength Slabs Are Reinforced With 12 mm Diameter Steel Strand, Running Longitudinally.

Hollow Core Ribbed Slab
By Using Tower Cranes Hollow Slabs Are Inserted Between The Beams.

The Gaps Between The Slab Is Filled With Screed.

Screed Is Concrete Material Generally We Use 20 mm Aggregates In Concrete Whereas In Screed We Use Baby Chips As Aggregates. (Small Broken Stones)

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7) Waffle slab (grid slab)

This type of slab contains square grids with deep sides, resembling a waffle shape, often used where large spans are required without the interference of columns. Waffle slabs can be capable of supporting a greater load than conventional slabs.

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What is Waffle Slab or Ribbed Slab

A waffle slab or ribbed slab is a structural component that is plain on its top and contains a grid-like system on its bottom surface. The top of the ribbed slab is normally thin, and the bottom grid lines are generally ribs that are laid perpendicular to each other with equal depth. The waffle slab has two directional reinforcements.

All the ribs are directed from column heads or beams. The depth of ribs maintained is as same as depth of column head or beam. Because of the ribs and double reinforcement, it is more stable and recommended for larger span slabs or foundations.

Characteristics of Waffle Slabs

- Waffle slabs are generally suitable for flat areas.
- The volume of concrete used is much less compared to others.
- The reinforcement in the waffle slab is provided in the form of mesh or individual bars.
- Separate excavation for beams is not required in case of waffle slab.
- The bottom surface of the slab looks like a waffle which is obtained by using cardboard panels or pods etc.

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- The thickness of the waffle slab recommended is 85 to 100 mm while the overall depth of the slab is limited to 300 to 600 mm.
- The width of beams or ribs provided in the waffle slab is generally 110 to 200 mm.
- The spacing of ribs recommended is 600 to 1500 mm.
- Reinforced waffle slabs can be constructed for span up to 16 meters while beyond that length prefabricated waffle slab is preferable.
- Waffle slab is good against shrinkage and it is lower than stiffened rafts and footing slabs.
- Waffle slab requires only 70% of concrete and 80 % of steel from the concrete and steel used for stiffened raft.

Waffle Slab Construction Procedure

The construction of waffle slabs can be done in three ways as follows.

- In-situ
- Precast
- Prefabricated

In-situ waffle slabs are constructed by pouring concrete into the site or field with proper arrangements. In case of precast waffle slab, slab panels are cast somewhere and they are joined together with proper reinforcement, and concrete is filled.

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The third case, prefabricated waffle slab is costlier than the other two methods. In this case, reinforcement is provided in the slab panels while casting with some tension. Hence, they do not need internal reinforcement on the site.

To construct a waffle slab in situ conditions, formwork should be necessary to support the slab. However, some special tools are required for the formwork in case of a waffle slab.

Formwork tools required in the construction of waffle slab are:

- Waffle pods
- Horizontal supports
- Vertical supports
- Wall connectors
- Cube junctions
- Hole plates
- Clits
- Steel bars

Horizontal support and vertical supports are arranged first and they are fixed in position by the connectors. At the edges, wall connectors are used to provide connection between the wall and the slab. The horizontal beam supports are

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connected by small beam connectors which form square-like shape in which pods are going to be placed.
The pods are generally made of plastic and they are available in different sizes and different shapes. The size selection of the pod depends upon the requirement and span length. For longer spans large number of pods are required. The same size should be used for one complete slab.
Similarly, beam connectors and cube junctions are also available in different sizes based on the suitability of pod sizes.

Cube junctions are used to fix the corners of pods with the framework. After fixing the formwork, reinforcement is placed in the two directions of the slab and then concrete is poured in the gaps which are called ribs after hardening. A thin concrete slab is provided on the top and after its hardening pods and frameworks are removed from the bottom. Thus, the waffle-like shape appears at the bottom surface.

Benefits of Waffle Slab Construction

- Waffle slabs are used for larger span slabs or floors and used when there is a limited requirement for a number of columns.

- The load-carrying capacity of a waffle slab is greater than the other types of slabs.

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- They provide good structural stability along with aesthetic appearance. Hence, it is constructed for airports, hospitals, temples, churches, etc.

- It has good vibration control capacity because of two directional reinforcement. So, it is useful for public buildings to control vibrations created by the movements of crowd.

- Waffle slabs are lightweight and require less amount of concrete, hence it is economical.

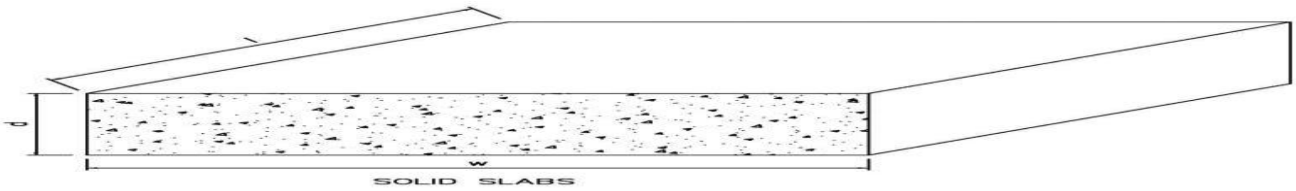
- Construction of waffle slab is easy and quick with good supervision.

- The concrete and steel volume required is small, hence, light framework is enough for waffle slab.

- Several services like lighting, plumbing pipes, electrical wiring, air conditioning, insulation materials, etc. can be provided within the depth of the waffle slab by providing holes in the waffle bottom surface. This system is called a Holedeck

8) Solid slab raft

Solid Slabs are fully customizable concrete slabs of varying width, length and thickness. Solid Slabs can be designed and produced with mild reinforcing or by adding prestressing strands. They can be used in a variety of applications such as bridges, piers, building floors, roof systems, detention vault lids and boat launches. Solid Slabs can be cast with specialty inserts for lifting, mounting or connecting hardware. They can be produced with smooth, broom or raked finishes.



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This is a type of shallow foundation, typically formed by a reinforced concrete slab that covers a wide area, often the entire footprint of a building. It spreads the load imposed by a number of columns, walls, and so on, over a large area, and can be considered to 'float' on the ground in a similar way to a raft floating on water. It is often used for lightly-loaded buildings on weak or expansive soils such as clays or peat.

For more information, see Types of raft foundation.

Foundations provide support for structures, transferring their load to layers of soil or rock that have sufficient bearing capacity and suitable settlement characteristics to support them.

Very broadly, foundations can be categorised as shallow foundations or deep foundations:

- Shallow foundations are typically used where the loads imposed by a structure are low relative to the bearing capacity of the surface soils.
- Deep foundations are necessary where the bearing capacity of the surface soils is not adequate to support the loads imposed by a structure and so those loads need to be transferred to deeper layers with higher bearing capacity.

Raft foundations are a type of shallow foundation. They are typically formed by reinforced concrete slabs that cover a wide area, often the entire footprint of a building. They spread the load imposed by a number of columns, walls, and so on, over a large area, and can be considered to 'float' on the ground in a similar way to a raft floating on water. Also known as mat foundations, they are often used for lightly-loaded buildings on weak or expansive soils such as clays or peat.

There are several different types of raft foundation, which are selected depending upon the structural system and loads to be supported.

9) Flat raft mats

This is a reinforced concrete slab of uniform thickness covering the whole bearing area. This can be used when columns are positioned at equal distance with equal loads distributed on the foundation. Two steel meshes are generally used as reinforcement, one placed at the bottom of the slab and the other at the top, to counteract upward and downward bending forces.

Flat raft mats are commonly used for the construction of small dwellings.

Generally, top soil is removed and a 50-75 mm-thick blinding layer of concrete spread to provide a base. It is on this base that the concrete raft is cast. With the blinding dry, the damp proof membrane is laid to protect the raft from rising moisture causing damage. The reinforcement is positioned and the concrete poured and consolidated.

In terms of finishing, it can be poured to ground level or left just below the surface. A 50 mm-thick layer of concrete can be spread over the raft to raise the level, providing a smooth finish for floor coverings to be

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laid. Alternatively, if the floor needs to be raised above ground, a raised floor may be constructed on top of the raft surface.

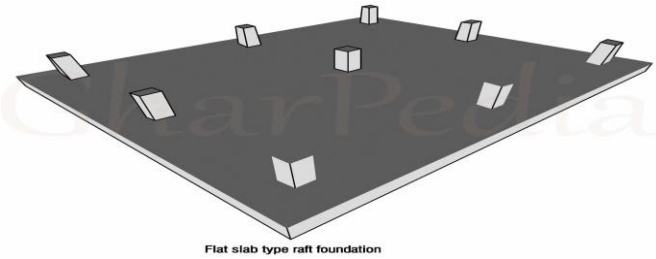
When to use raft foundations

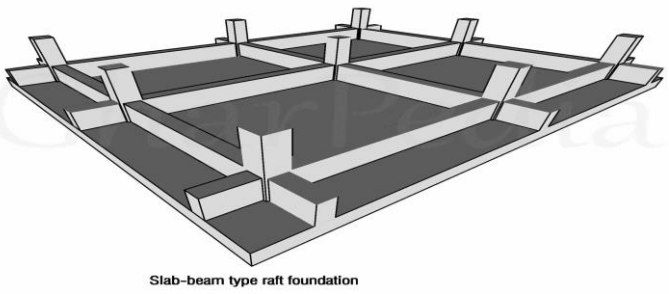
In the past, raft foundations have been widely used in the construction of commercial buildings such as warehouses or supermarkets. However, over the last few decades they are increasing in popularity as a simple and inexpensive solution for domestic construction projects, such as extensions and conservatories.

Raft foundations are suitable where a building's footprint is reasonably small, and the structural load requirements are not onerous. They are also suitable for basement constructions where the foundation slab can receive direct **live loads** depending on the use of the building. On sites where the soil conditions are poor or access for large excavation plant is limited, raft foundations can again prove to be an excellent solution.

There are three types of loads which must be considered when designing concrete slabs:

1. Dead load of the slab:
   (Dead Load: Self weight of the slab= Mass / Weight of the slab i.e. Density *Area.)
2. Live load of the slab:
   (Weight of Humans (Living Beings), Furniture etc. = Refer IS 875 for load condition in various types of buildings.)
3. Floor finish load:
   (Load acting due to plaster, painting, tiles etc.)


Flat slab type raft foundation


Slab-beam type raft foundation

10) Composite slab

Composite slabs are typically constructed from reinforced concrete cast on top of profiled steel decking, (re-entrant or trapezoidal). Slabs are most commonly made of concrete because of its mass and stiffness which can be used to

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reduce the floor's deflections and vibrations, and achieve the necessary fire protection and thermal storage. Steel is often used as the supporting system underneath the slab due to its superior strength-weight and stiffness-weight ratio and ease of handling.

Composite construction dominates the non-residential multi-storey building sector. This has been the case for over thirty years. Its success is due to the strength and stiffness enhancement that can be achieved with an efficient use of materials.
The reason why composite construction is often so efficient can be expressed in one simple way - concrete is good in compression and steel is good in tension. Structurally, when these two materials work together then their strengths can be exploited to result in a highly efficient and lightweight design. The reduced self-weight of composite elements has a knock-on effect by reducing the forces in those elements supporting them, including the foundations. Composite construction is robust and does not require tight tolerances, making the system quick to construct. The floor depth reductions that can be achieved using composite construction can also provide significant benefits in terms of the costs of services and the building envelope.
The scope of this article is to cover a number of different basic types of composite beams, composite slabs, composite columns and composite connections.

11) Hardy slab:

- A Hardy slab, also known as a profiled steel sheet slab, is a composite slab made of a steel sheet and a concrete topping. The steel sheet acts as a formwork during construction and as a tensile reinforcement after the **concrete** has hardened. The composite slab has a high strength-to-weight ratio..

WHAT IS HARDY SLAB

This type of slab is built with hardy bricks which is made of hollow bricks and concrete. These bricks are used to fill thick slab areas, which saves the amount of concrete, thus reducing the slab's weight. These types of the slab are commonly found in Dubai and China. This slab is used in areas where the temperature is very high. The thickness of the slab is increased to withstand the temperature from above the slab. The heat coming from the walls is counteracted by using special bricks that contain thermocol.

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TYPES OF HARD SLAB

One way - Hardy Slab
Two way - Hardy slab

APPLICATION OF HARDY SLAB

We can use this type of slab where the temperature is very high. its thickness is increased to resist temperature. The heat coming from the walls is counteracted by the use of special bricks with thermacol.

ADVANTAGES OF HARDY SLAB

1. Improved insulation for sound and heat.
2. The amount of concrete reduced below the neutral axis to reduce the slab weight
3. Simplicity of construction, especially when all beams are concealed beams.
4. Advanced insulation for heat and sound.

DISADVANTAGES OF HARDY SLAB

1. If not handled properly, brick units can be damaged during transport.
2. It's not suitable for small spans.
3. Repair and strengthening is difficul

12) Bubble deck slab

- Bubble deck slab is a type of two-way concrete slab that has hollow plastic balls or bubbles incorporated into the slab. These plastic balls are made from recycled materials and are placed in a matrix pattern within the slab. The bubbles reduce the amount of concrete required in the slab, making it lighter and more cost-effective. The voids created by the bubbles can also be used for services such as electrical and plumbing conduits.

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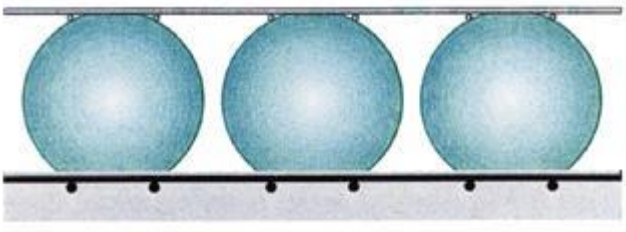
Bubble deck Type A is a combination of constructed and unconstructed elements. A 60 mm thick concrete layer and part of the finished depth are precast and brought on-site with the bubbles and steel reinforcement unattached.



The bubbles are then supported by temporary stands on top of the precast layer and held in place by interconnected steel mesh. This type of bubble deck is optimal for new construction projects where the designer can determine the bubble positions and steel mesh layout

13) Precast slab

- Precast slabs are **precast concrete** elements that are manufactured in a factory and transported to t4he construction site. These slabs can be one-way or two-way and can have a variety of shapes and sizes. Precast slabs are usually supported by beams or walls and are connected to each other by jointing systems.

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