

Design of Reinforced Concrete One-Way Slabs as per ACI 318- 19 Code

An Online Continuing Education Course for Engineers

Course Number: C-1030

Credit: 1 Hour / 1 PDH / 1 CPD

Design of Reinforced Concrete One-Way Slabs as per ACI 318-19 Code

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Introduction

A one-way slab is a type of concrete slab in which loads are transferred in one direction to the supporting beams and columns. Therefore, the bending occurs in only one direction. The design of a one-way slab is simple and can be carried out easily.

The ACI 318-19 provides several requirements regarding slab thickness, concrete cover, and reinforcement ratio, which facilitate the design process. For instance, the ACI 318-19 specifies a minimum slab thickness that satisfies deflection.

The designer can select smaller slab thicknesses but needs to check the deflection of the slab to make sure that it does not exceed the maximum allowable deflection. The procedure of designing a one-way slab is like that of a rectangular beam.

Slabs are used to provide flat, useful surfaces. A reinforced concrete slab is a broad, flat plate, usually horizontal, with top and bottom surfaces parallel or nearly so. Slabs may be supported by reinforced concrete beams, masonry or reinforced concrete walls, structural steel members, columns, and continuously by the ground.

One-way Floor System

- In this system, the applied load acting on the slab is transferred in one direction to the supporting beams, then to the supporting columns.

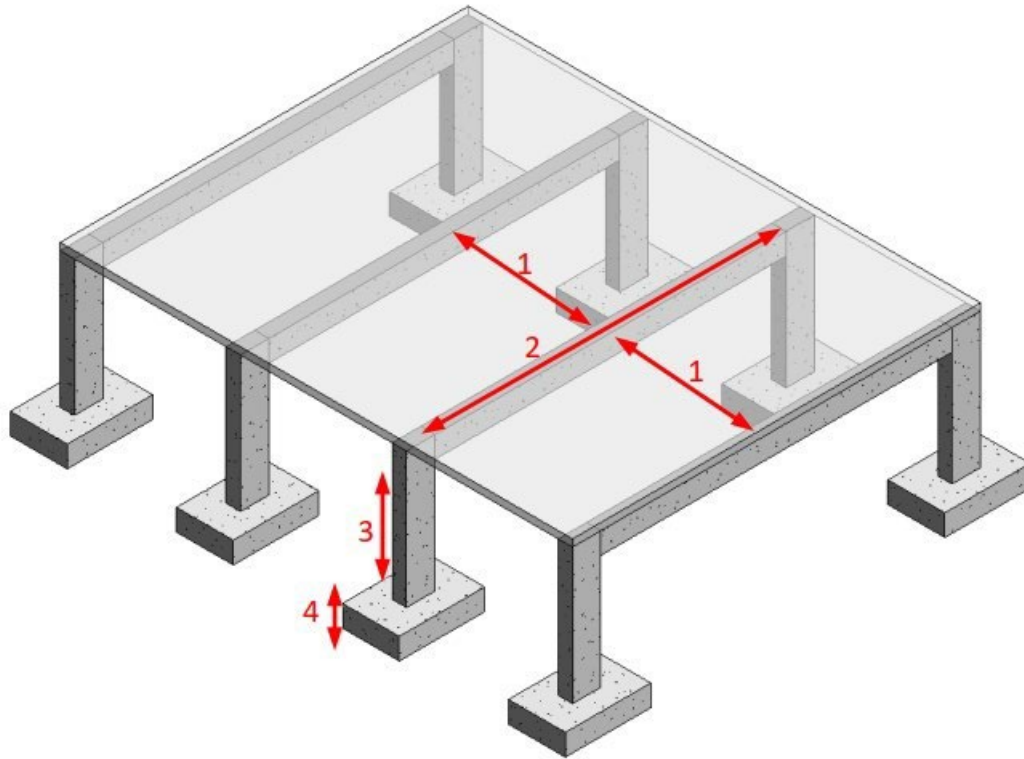


Figure 1- One-way floor system

- For large column spacing, the load may be transferred from the slab to the floor beams, then to larger beams (usually called the girders), and in turn to the supporting columns.

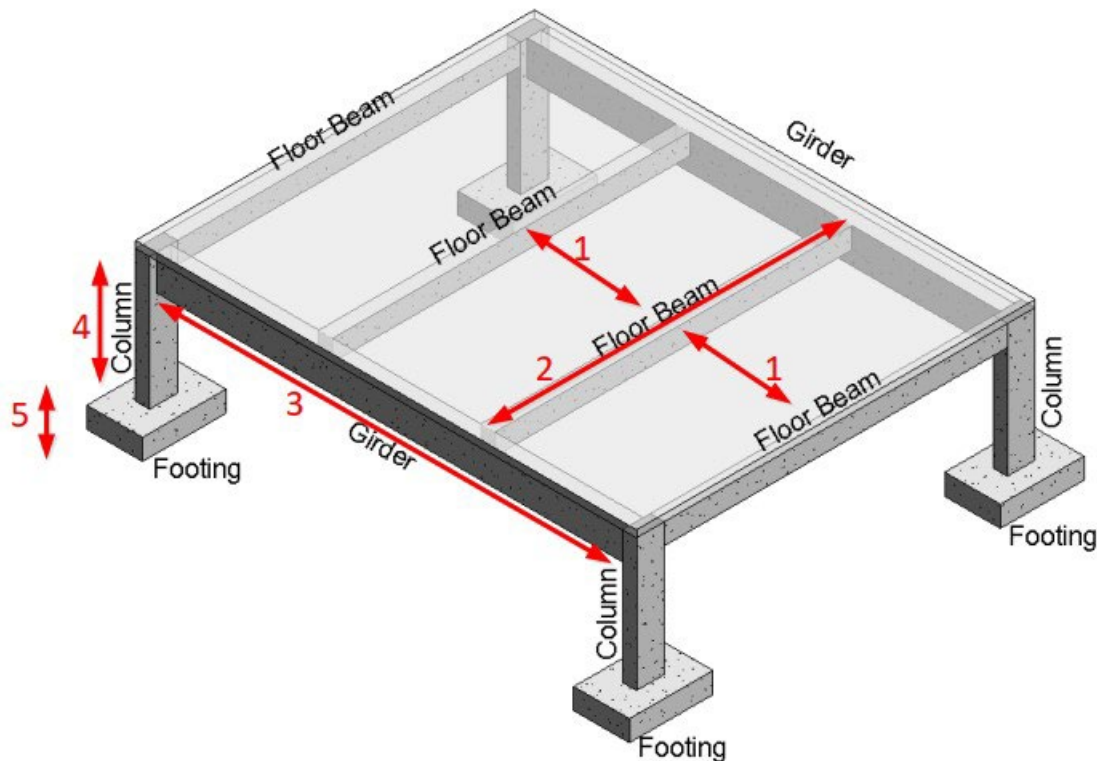


Figure 2- Slab-beam-girder one-way system

How to Differentiate a One-way Slab from a Two-way Slab

When a rectangular slab is supported on all four sides, but the ratio of the longer side, L , to the shorter side, S , is 2 or more, $L/S \geq 2.0$, then, the slab will act as a one-way slab, with bending primarily occurring in the short direction. The main reinforcement is placed in the shorter direction, which is the span, while shrinkage reinforcement is provided in the longer direction to limit cracking. When the slab is supported on only two sides, the load will be transferred to these sides regardless of its ratio of longer span to shorter span, and it will be classified as a one-way slab.

Behavior of One-way Slab

The structural action of a one-way slab can be visualized in terms of the deformed shape of the loaded surface. The deflected shape of a rectangular slab, simply supported along its two opposite long edges and free of any support along the two-opposite short edges is shown in Figure 3. The deflected shape is shown by solid lines.

Bending moments are the same in all strips (S) spanning in a short direction between supported edges whereas there is no bending moment in the long strips (l) parallel to the supported edges. The surface is approximately cylindrical.

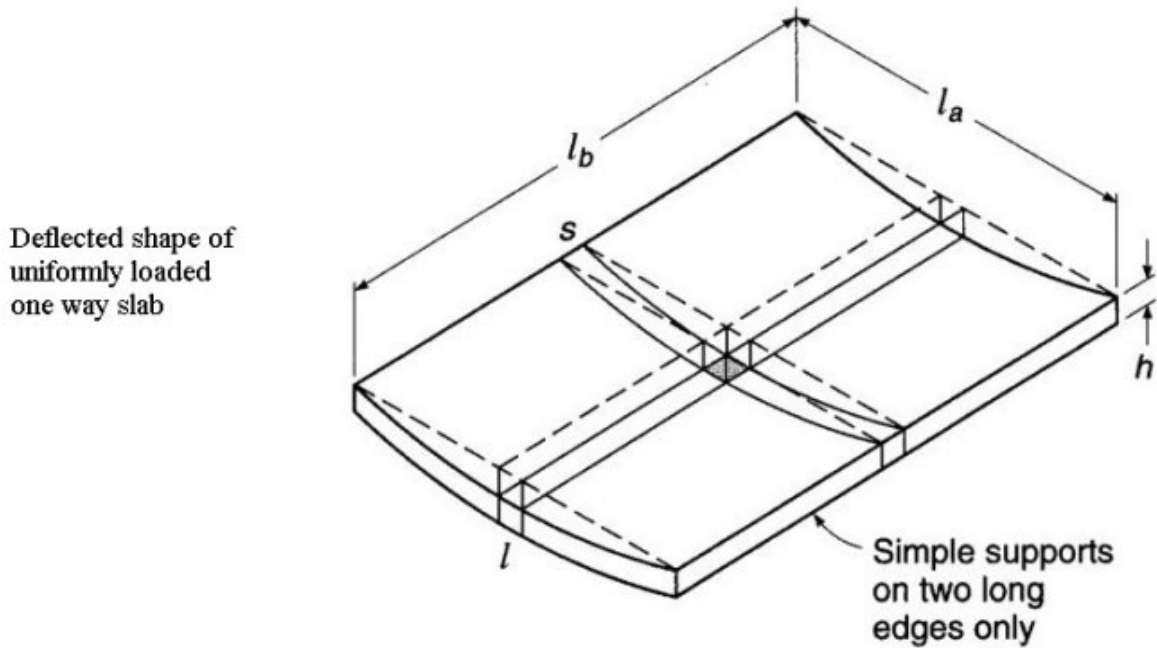
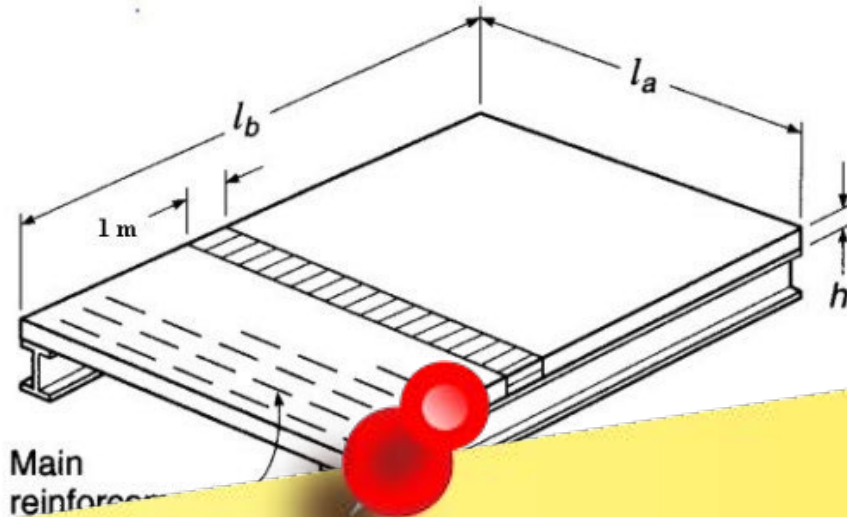


Figure3 - Deflected Shape of One-ways Slab Due to Uniformly Distributed Load

Unit strip Basis for Flexural Design

For the purpose of analysis and design, a unit of the slab is cut out at right angles to the supporting beams, shown in Figure 4, which may be considered as a rectangular beam of unit width, with depth (h) equal to the slab thickness and the span (l) equal to the distance between supporting edges.



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C. Tra ... perpendicular to the direction of
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D. Preliminary thickness of one-way slabs and beams can be determined using ACI 318-19 code provisions (Minimum thickness of slabs and beams).