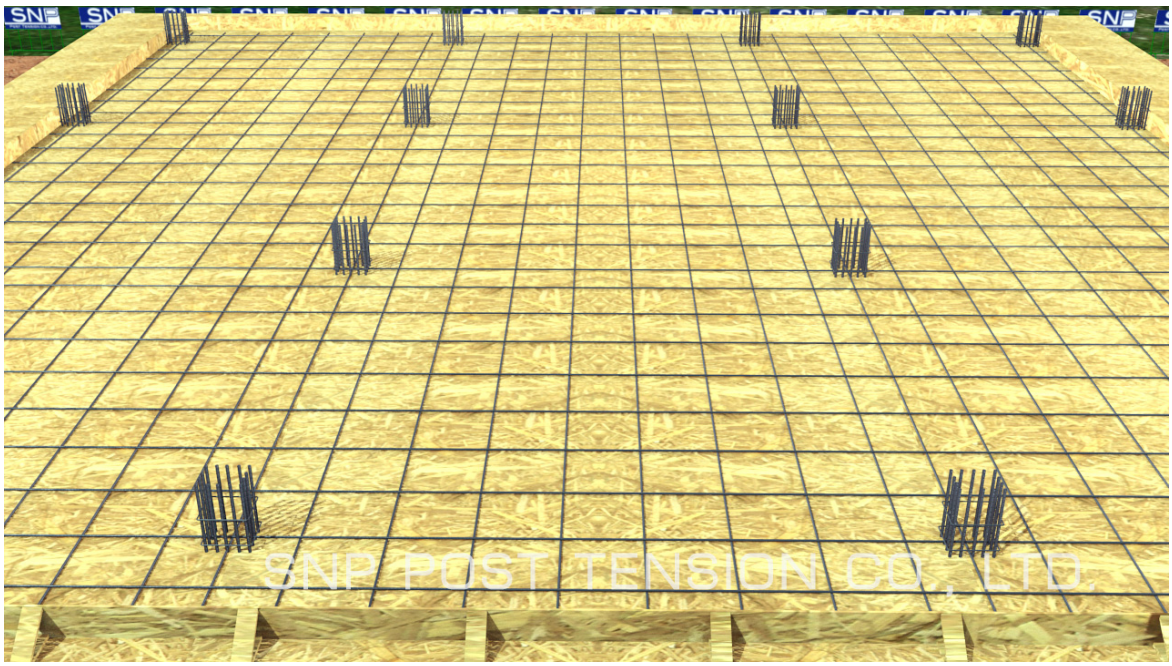
# Bottom Reinforcement for Post-Tensioned Slab




Bottom reinforcement will be discussed in this Chapter, particularly the use of Wire mesh, to provide more details and modify some points in the Chapter of “Reinforcement for Post-Tensioned Slab”.

The minimum bonded reinforcement intercepts positive moment is discussed in the Section 4 of "Reinforcement for Post-Tensioned Slab" Chapter, and is divided into 2 cases as follow:

**Case 1: Tensile stress of bottom fiber at mid-span exceed $0.53\sqrt{fc'}$**

If the tensile stress at bottom fiber occurred from positive moment at mid-span exceeds $0.53\sqrt{fc'}$, a minimum reinforcement, $As_{min} = \frac{N_c}{0.5fy}$, shall be provided (ACI 318-19, Section 8.6.2.3).

**8.6.2.3** For prestressed slabs, a minimum area of bonded deformed longitudinal reinforcement, $A_{s,min}$, shall be provided in the precompressed tension zone in the direction of the span under consideration in accordance with Table 8.6.2.3.

**Table 8.6.2.3—Minimum bonded deformed longitudinal reinforcement $A_{s,min}$ in two-way slabs with bonded or unbonded tendons**

| Region | Calculated $f_t$ after all losses, psi | $A_{s,min}$, in.$^2$ | |
|---|---|---|---|
| Positive moment | $f_t \le 2\sqrt{f'_c}$ | Not required | (a) |
| | $2\sqrt{f'_c} < f_t \le 6\sqrt{f'_c}$ | $\frac{N_c}{0.5f_y}$ | (b)[1],[2] |
| Negative moment at columns | $f_t \le 6\sqrt{f'_c}$ | $0.00075A_{cf}$ | (c)[2] |

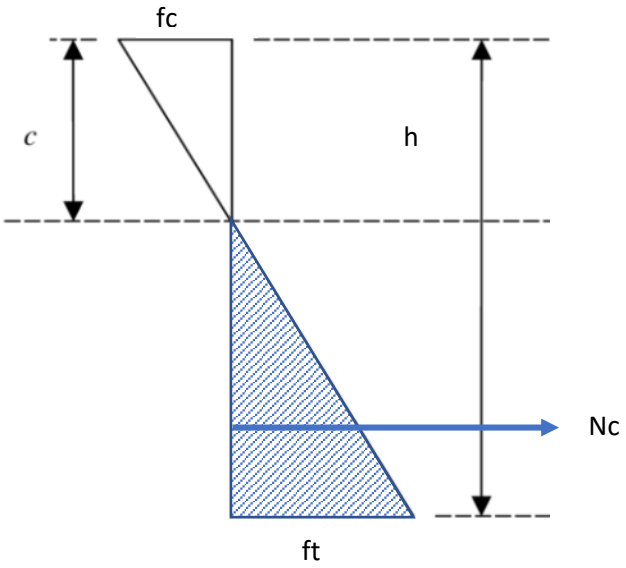
[1]The value of $f_y$ shall not exceed 60,000 psi

the bonded prestressed reinforcement located within the area used to determine $N_c$ for positive moment, or within the width of slab defined in 8.7.5.3(a) for negative moment.

- $2\sqrt{fc'}\ in\ psi = 0.53\sqrt{fc'}\ in\ ksc\ \ and\ \ 6\sqrt{fc'}\ in\ psi = 1.59\sqrt{fc'}\ in\ ksc$

As shall be provided at the center of positive moment areas, and the length of the reinforcement shall not be less than In/3. Where In is the clear span (ACI318-19, Section 8.7.5.5.1).

According to the ACI318-19 provision, fy shall not exceed 4200 ksc, and Nc is the total tensile forces occurred in the uncracked homogenous section.




The value of Nc is calculated by multiplying the area of highlighted similar triangle with the width of the design strip, which shall first get started with the finding of C value in the top similar triangle. Depending on the theory of similar triangle, $\frac{c}{fc} = \frac{h}{fc+ft}$. When the value of C is known, it will lead to calculate the area of the highlighted triangle, which is: $\frac{1}{2}$(ft) (h-c). Then multiply this area with the width of the design strip to get the Nc value.

**Case 2: Tensile stress of bottom fiber at mid-span is less than $0.53\sqrt{fc'}$**

In case tensile stress at bottom fiber is less than $0.53\sqrt{fc'}$ or equal to zero, ACI318-19 suggested that the minimum reinforcement shall not be provided. However, in real construction, particularly in Thailand, the reinforcement conforming to EIT 1009-34 is used which is the provision of unboned post-tensioned slab system. This standard suggested that at positive moment areas, if the tensile stress in the concrete section occurred from service loads is less than $0.53\sqrt{fc'}$, bonded reinforcement shall be provided not less than 0.001 of the concrete section and this reinforcement shall be placed near the bottom surface of concrete where the tensile stress occurred.

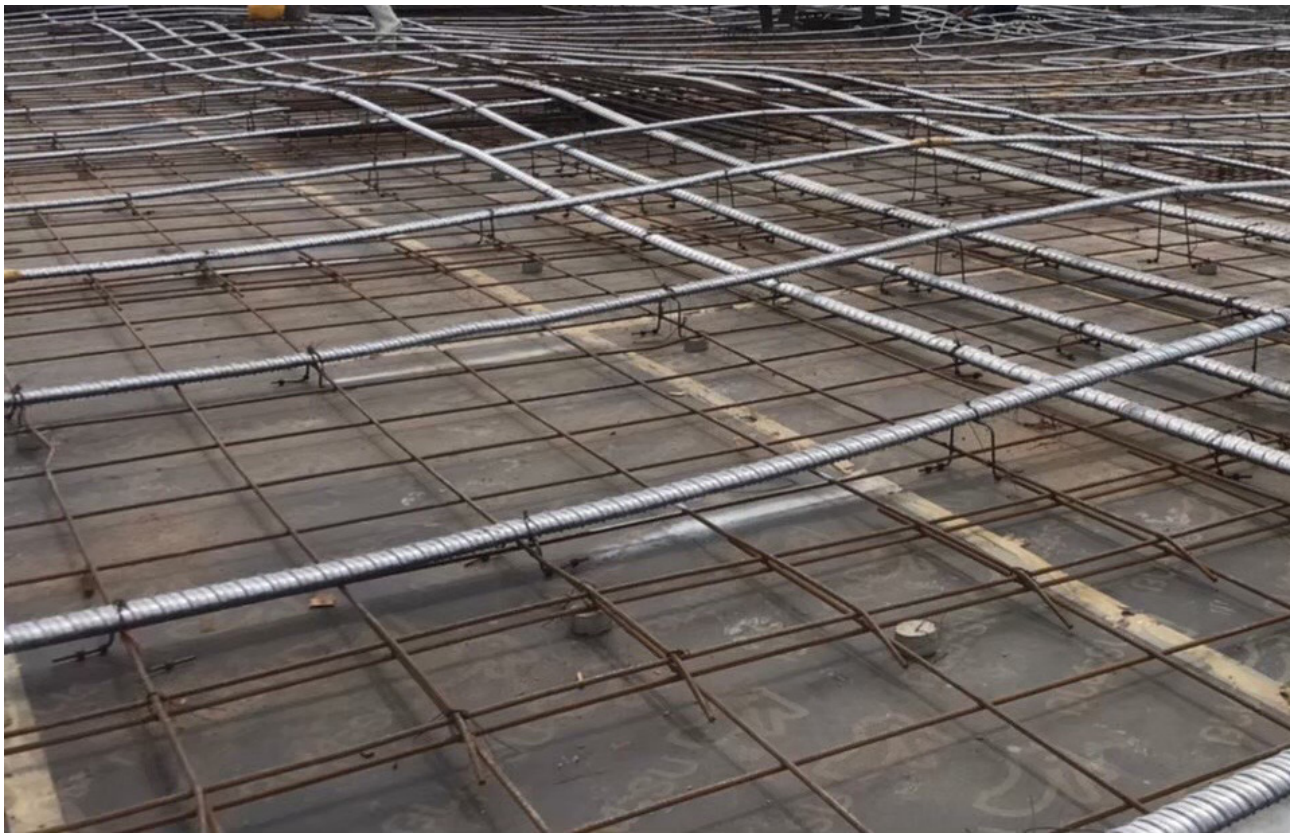
Example:

Slab thickness = 0.23 m ➔ As = 0.001 x 100 x 23 = 2.30 $cm^2$. Therefore, use DB12mm (SD40) will get DB12mm@0.50m in both directions.

If wire mesh is used instead of deformed bar (SD40), ACI318-19 provides some specifications as shown in the Table 20.2.2.4(a) and the Section 20.2.1.7.

**Table 20.2.2.4(a)—Nonprestressed deformed reinforcement**

| Usage | Application | | Maximum value of $f_y$ or $f_{yt}$ permitted for design calculations, psi | Applicable ASTM specification | | | |
|---|---|---|---|---|---|---|---|
| | | | | Deformed bars | Deformed wires | Welded wire reinforcement | Welded deformed bar mats |
| Flexure; axial force; and shrinkage and temperature | Special seismic systems | Special moment frames | 80,000 | A706[2] | Not permitted | Not permitted | Not permitted |
| | | Special structural walls[1] | 100,000 | | | | |
| | Other | | 100,000[3] [4] | A615, A706, A955, A996, A1035 | A1064, A1022 | A1064, A1022 | A184[5] |



The allowable Wire mesh shall be conformed to ASTM A1064. It is shown that the TIS standard for Wire mesh conforms to TIS 737-2549 for general deformed bar properties, TIS 747-2531 for cold-drawn steel wire for concrete reinforcement and TIS 943-2533 for cold-drawn deformed steel wire for concrete reinforcement, in which all of these standards are referenced from ASTM A496 and ASTM A497. In the present, ASTM specifies to use ASTM A1064 instead of ASTM A82, A185, A496 and A497, respectively.

**Specifications Covering Welded Wire Reinforcement**

| U.S. and Canadian Specification | Title |
|---|---|
| ASTM A1064* | Standard Specification for Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete |
| * - Formerly known as: ASTM A82, ASTM A185, ASTM A496, ASTM A497 | |
| ASTM A1022 | Standard Specification for Deformed and Plain Stainless Steel Wire and Welded Wire for Concrete Reinforcement |

Moreover, ASTM A1064 specified about the strength of Wire mesh for both plain and deformed wires as the following:

**TABLE 6 Tension Test Requirements—Plain Wire for Welded Wire Reinforcement**

| | Size W 1.2 [MW 7.7] and Larger | Smaller than Size W 1.2 [MW 7.7] |
|---|---|---|
| Tensile strength, min, ksi [MPa] | 75 [515] | 70 [485] |
| Yield strength, min, ksi [MPa] | 65 [450] | 56 [385] |
| Reduction of area, min, % | 30[A] | 30[A] |

[A] For material testing over 100 ksi [690 MPa] tensile strength, the reduction of area shall be not less than 25 %.

**TABLE 10 Tension Test Requirements—Deformed Wire (Material for Welded Wire)**

| | psi [MPa] min |
|---|---|
| Tensile strength | 80 000 [550] |
| Yield strength | 70 000 [485] |

Example of the calculation of using Wire mesh instead of general rebars by using deformed wire can be calculated as below:

For slab thickness is equal to 0.23 m ➔ As = 0.001(4000/4850)(100)(23) = 1.897 $cm^2$ ➔ Use Wire mesh Dia8mm, spacing 0.25m.