Support strut verification

The support strut verification and dimensioning of sliding reinforcement is done according to the article 6.5 of the EN1992-1-1.

Effective support stress for intermediate supports:

$$\sigma_{c\theta} = \frac{F_z}{b_s \times h_s}$$

$$\sigma_{Rdmax} = k_1 \times \nu' \times fcd$$

Effective support stress for edge supports:

$$\sigma_{c\theta} = \frac{F_z}{b_s \times a_2 \times \sin(\Theta)}$$

$$\sigma_{Rdmax} = k_2 \times \nu' \times fcd$$

The design values for the compressive stresses within nodes may be determined by [§6.5.4 4 from EN 1992-1-1]:

$$\sigma_{Rdmax} = k_1 \times \nu' \times fcd$$

where :

σ_{Rdmax} is the maximum stress which can be applied at the edges of the node

$$\nu' = 1 - \frac{fck}{250} \text{ [§6.5.2.(2)from EN 1992 − 1 − 1]:}$$

$$\nu' = 1 - \frac{fck}{250} = 1 - \frac{25}{250} = 0.9$$

The value of k_1 for use in a Country may be found in its National Annex. The recommended value is 1,0. [§6.5.4.(4a) Note from EN 1992-1-1]

The value of k_2 for use in a Country may be found in its National Annex. The recommended value is 0.85. [§6.5.4.(4b) Note from EN 1992-1-1]

In this example, the support stresses in the edge supports will be verified because it is about a single span beam:

$$\sigma_{Rdmax} = k_2 \times \nu' \times fcd = 0.85 \times 0.9 \times 16.67 = 12.75 \frac{MN}{m^2}$$

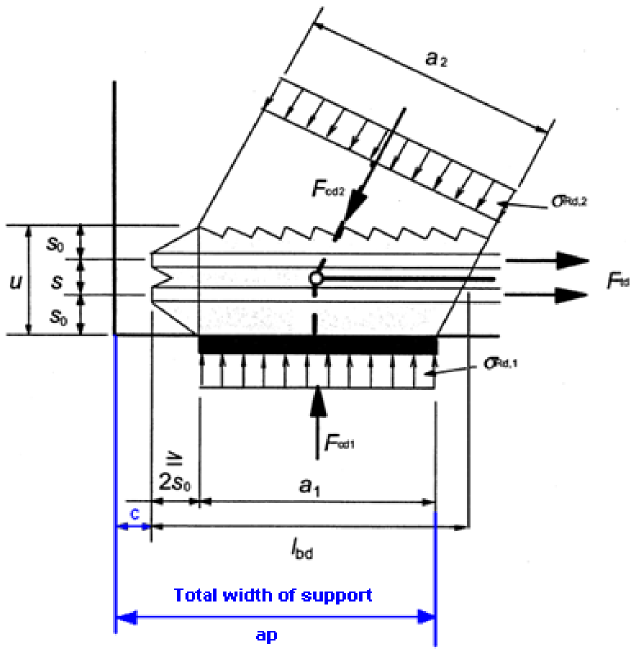
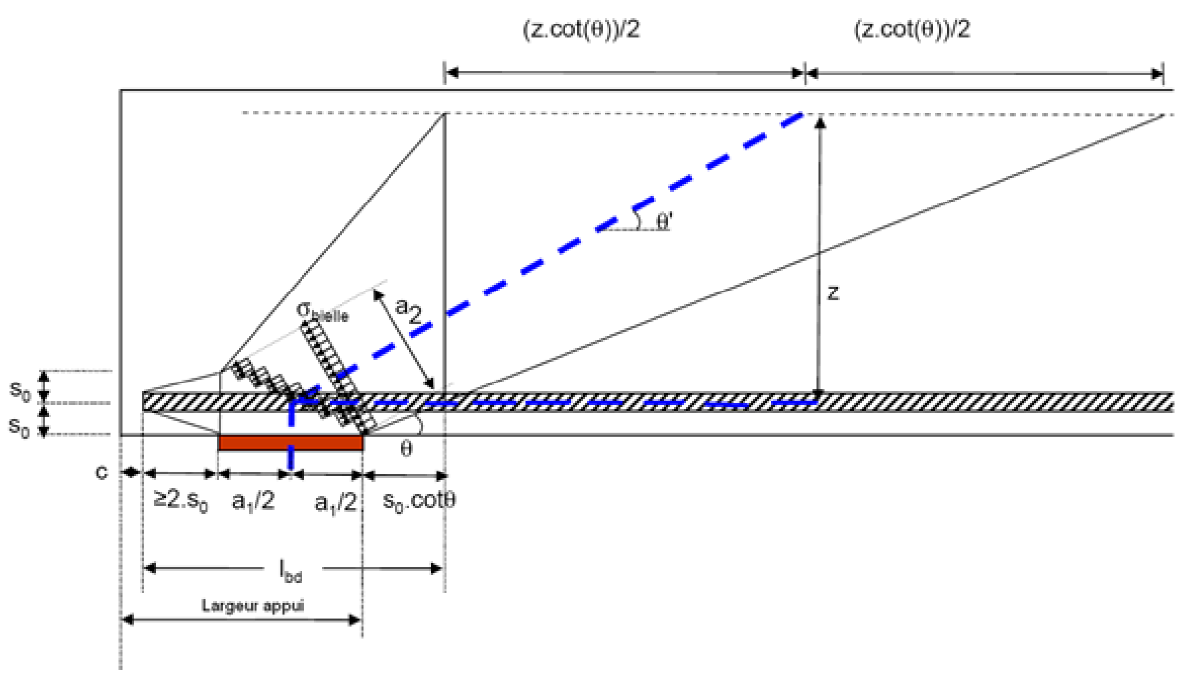


Figure 6.27: Compression tension node with reinforcement provided in one direction

The schema corresponds to the balance of a node solicited by:

- A compressive force, F_{cd2}, which corresponds to the force in the compressed strut
- A tension force, F_{td} , that corresponds to the tensile force in the reinforcement
- A compressive force, F_{cd1}, which corresponds to the support reaction

In most of the cases the longitudinal reinforcement in the support is disposed on a single layer and the following schema can be considered:

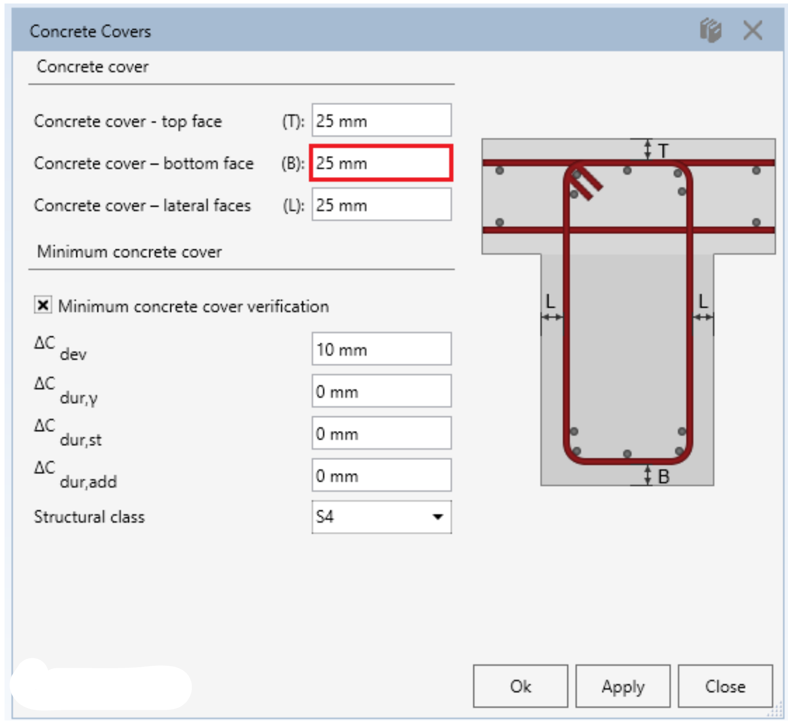


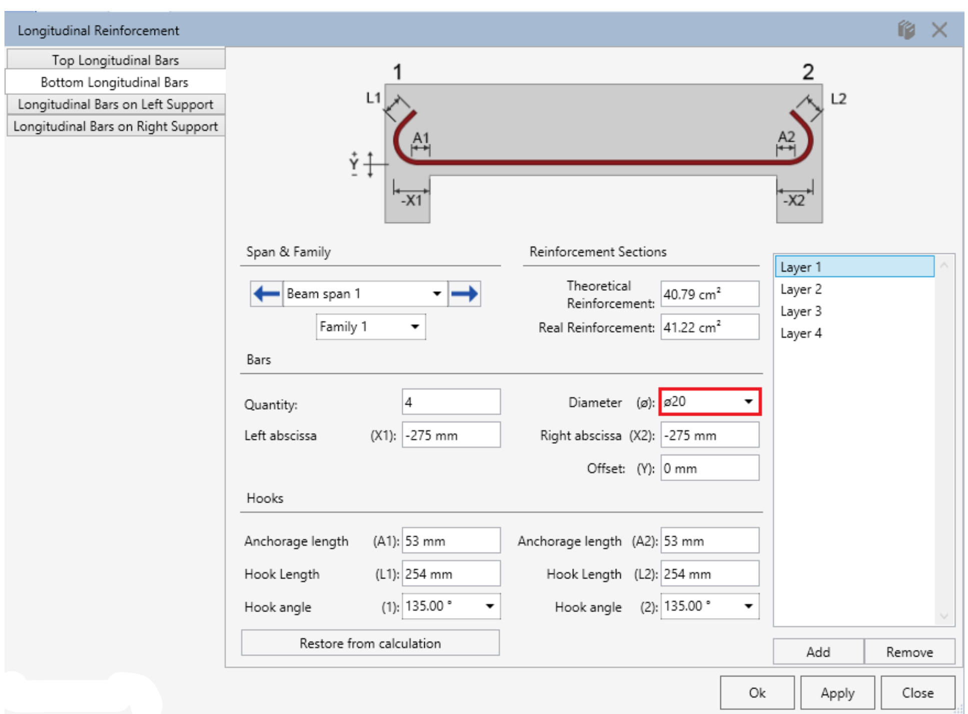
There are two significant widths:

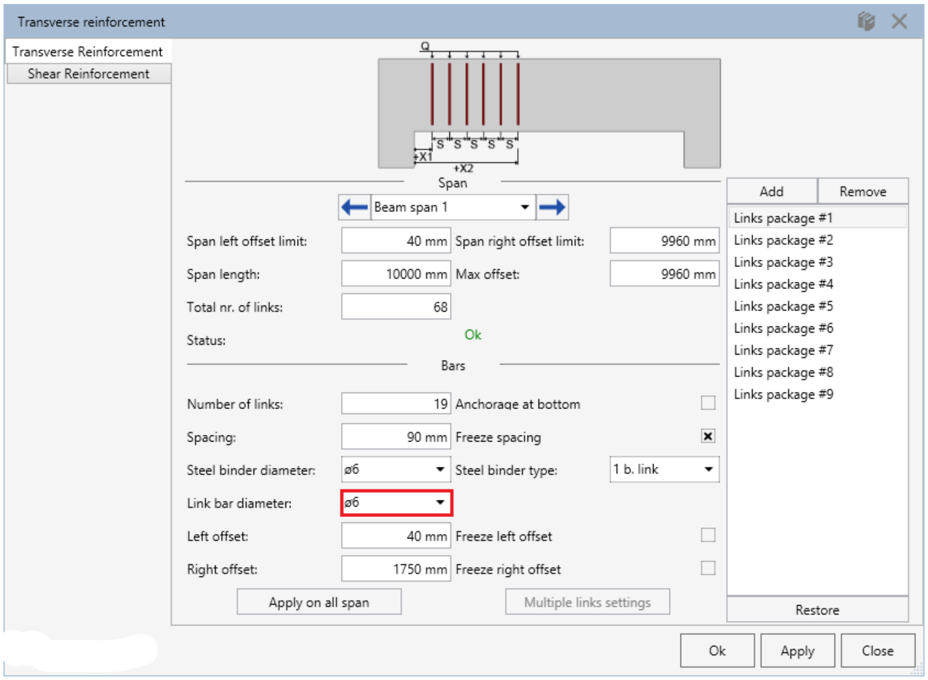
a_1 represents the effective width of the support

a_2 represents the width of the compressed strut

The bottom cover of the beam, the longitudinal and transversal diameters are the following:







$a_1 = b_{support} - c - 2 \times s_0$

For bars anchored with hooks in supports the program does not considers the term s_0 when calculating a_1. The above relation will be applied only for the case in picture 6.27 from the article 6.5.4 (4b) EN1992-1-1(straight bars).

$a_1 = b_{support} - c = 300 - 25 = 275 \text{ mm}$

The inclination angle of the strut :

$$\cot\theta' = \frac{\frac{a_1}{2} + s_0 \times \cot\theta + z \times \frac{\cot\theta}{2}}{z} = \frac{a_1}{2 \times z} + \frac{s_0 \times \cot\theta}{z} + \frac{\cot\theta}{2}$$

$$s_0 = 25 + 6 + \frac{20}{2} = 41 \text{ mm}$$

$$d = 950 - 25 - 6 - 10 = 909 \text{ mm}$$

$$z = 0.9 \times d = 0.9 \times 909 = 818 \text{ mm}$$

$$\cot\theta' = \frac{a_1}{2 \times z} + \frac{s_0 \times \cot\theta}{z} + \frac{\cot\theta}{2} = \frac{275}{2 \times 818} + \frac{41 \times \cot 45°}{818} + \frac{\cot 45°}{2} = 0.718215$$

$$\theta' = \arctan\left(\frac{1}{0.718215}\right) = 54.31°$$

$$a_2 = 2 \times s_0 \times \cos\theta' + a_1 \times \sin\theta' = 2 \times 41 \times \cos 54.31 + 275 \times \sin 54.31 = 271 \text{ mm}$$

$$\sigma_{c\theta} = \frac{V_{Ed}}{b_w \times a_2 \times \sin(\theta')} = \frac{478.79 \times 10^{-3}}{0.35 \times 0.271 \times \sin(54.31)} = 6.22 \frac{MN}{m^2} \leq \sigma_{Rdmax} = 12.75 \frac{MN}{m^2}$$

Span	Section	Abscissa	Position	M_{Ed}	M_{cqc}	M_{fq}	M_{qp}	V_{Ed}	T_{Ed}
		(mm)		(kN·m)	(kN·m)	(kN·m)	(kN·m)	(kN)	(kN·m)
1	Left Support	0	Top	-190.48	-135.57	-110.71	-100.76	478.79	0.00
			Bottom	72.90	51.88	42.37	38.56	0.00	0.00
1	Right Support	10000	Top	-190.48	-135.57	-110.71	-100.76	0.00	0.00
			Bottom	72.90	51.88	42.37	38.56	-478.79	0.00
1	MInf	5000	Top	0.00	0.00	0.00	0.00	0.00	0.00
			Bottom	1269.88	903.81	738.05	671.74	0.00	0.00
1	VInf	10000	Top	-190.48	-135.57	-110.71	-100.76	0.00	0.00
			Bottom	72.90	51.88	42.37	38.56	-478.79	0.00

If the relation is not satisfied the program will automatically generate strut reinforcement for edge supports.

Note: In the case of intermediate supports if the relation $\sigma_{c\theta} \leq \sigma_{Rdmax}$ is not satisfied there will appear an error message informing the user that the admissible stress is exceeded, the strut reinforcement is not generated automatically.