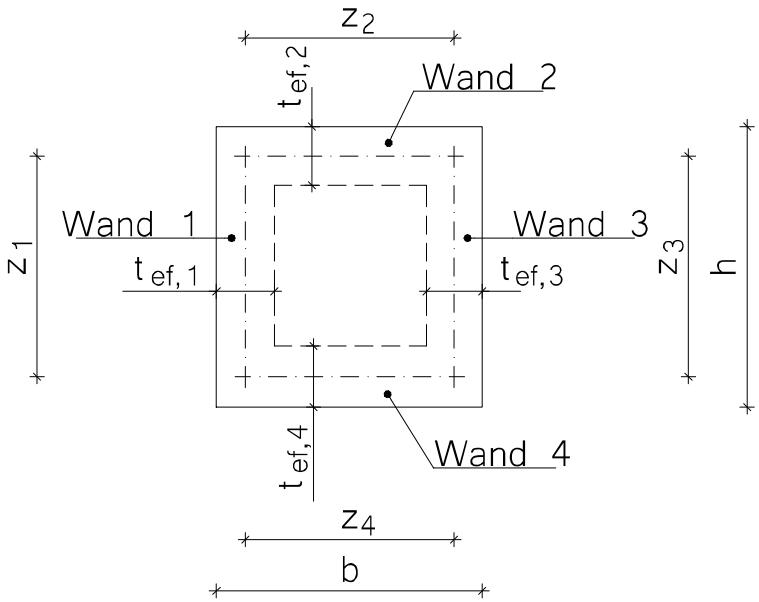
Berekening wringing en dwarskracht van rechthoekige betondoorsnede
NEN-EN 1992-1-1 artikel 6.2 en 6.3

Geometrie



Hoogte h =	800	mm
Breedte b =	500	mm
Diameterhoofdwapening d_{hoofd} =	12	mm
Dekking c_{nom} =	35	mm
Diameterbeugels $d_{beugels}$ =	8	mm

$A_{beugel} = 1/4 * \pi * d_{beugels}^2 = 50$ mm²
$d = h - c_{nom} - d_{beugels} - 1/2 * d_{hoofd} = 751$ mm
$z = 0{,}9 * d = 0{,}9 * 751 = 676$ mm
$A = b * h = 500 * 800 = 400000$ mm²
$u = b + h + b + h = 500 + 800 + 500 + 800 = 2600$ mm
$t_{ef} = \frac{A}{u} = \frac{400000}{2600} = 154$ mm

De minimale waarde voor t_{ef} is:

$t_{ef,grens} = 2 * (c_{nom} + d_{beugels} + 1/2 * d_{hoofd}) = 98$ mm
$t_{ef} = MAX(t_{ef}; t_{ef,grens}) = 154$ mm
$t_{ef,1} = t_{ef} = 154$ mm
$t_{ef,2} = t_{ef} = 154$ mm
$t_{ef,3} = t_{ef} = 154$ mm
$t_{ef,4} = t_{ef} = 154$ mm

$z_1 = h - 1/2 * t_{ef,4} - 1/2 * t_{ef,2} = 646$ mm
$z_2 = b - 1/2 * t_{ef,1} - 1/2 * t_{ef,3} = 346$ mm
$z_3 = z_1 = 646$ mm
$z_4 = z_2 = 346$ mm

$A_k = z_1 * z_2 = 646 * 346 = 223516$ mm²
$u_k = z_1 + z_2 + z_3 + z_4 = 646 + 346 + 646 + 346 = 1984$ mm

Materialen

Beton		=	C28/35
f_{ck}		=	28 N/mm²
f_{cd} =	f_{ck} / 1,5	=	19 N/mm²
f_{yd} =	500 / 1,15	=	435 N/mm²

Belasting

T_{Ed} =		50 kNm
V_{Ed} =		60 kN

Controle betondrukdiagonalen

ν =	$0{,}6*\left(1-\frac{f_{ck}}{250}\right)$	=	0,53
$T_{Rd,max}$ =	$\nu * 1{,}0 * f_{cd} * A_k * t_{ef} * 10^{-6}$	=	347 kNm
$V_{Rd,max}$ =	$1/2 * 1{,}0 * b * z * \nu * f_{cd} * 10^{-3}$	=	1702 kN
Toetsing =	$T_{Ed} / T_{Rd,max} + V_{Ed} / V_{Rd,max}$	=	0,18 ≤ 1,00

Berekening benodigde langswapening voor wringing

$$\Sigma A_{sl} = \frac{u_k * T_{Ed}}{f_{yd} * 2 * A_k} * 10^6 = 510 \text{ mm}^2$$

Beugelwapening

Benodigde beugelwapening wand 2 en 4 is:

$$\tau_{t,2} = \frac{T_{Ed} * 10^6}{2 * A_k * t_{ef,2}} = \frac{50 * 10^6}{2 * 223516 * 154} = 0{,}73 \text{ N/mm}^2$$

$$V_{Ed,2} = \tau_{t,2} * t_{ef,2} * z_2 = 0{,}73 * 154 * 346 = 39 * 10^3 \text{ N}$$

maximale hoh afstand van de beugels in wand 2 en 4 is:

$$s_2 = \frac{A_{beugel}}{V_{Ed,2}} * z_2 * f_{yd} = \frac{50}{39000} * 346 * 435 = 193 \text{ mm}$$

Benodigde beugelwapening wand 3 (torsie en dwarskracht gecombineerd)

$$\tau_{t,3} = \frac{T_{Ed} * 10^6}{2 * A_k * t_{ef,3}} = \frac{50 * 10^6}{2 * 223516 * 154} = 0{,}73 \text{ N/mm}^2$$

$$V_{Ed,3} = \tau_{t,3} * t_{ef,3} * z_3 + V_{Ed} * \frac{1}{2} * 10^3$$

$$= 0{,}73 * 154 * 646 + 60 * \frac{1}{2} * 10^3 = 103 * 10^3 \text{ N}$$

maximale hoh afstand van de beugels in wand 3 is:

$$s_3 = \frac{A_{beugel}}{V_{Ed,3}} * z_1 * f_{yd} = 136 \text{ mm}$$

De maximale hoh afstand van de beugels is:

s = MIN(s_2; s_3) = 136 mm