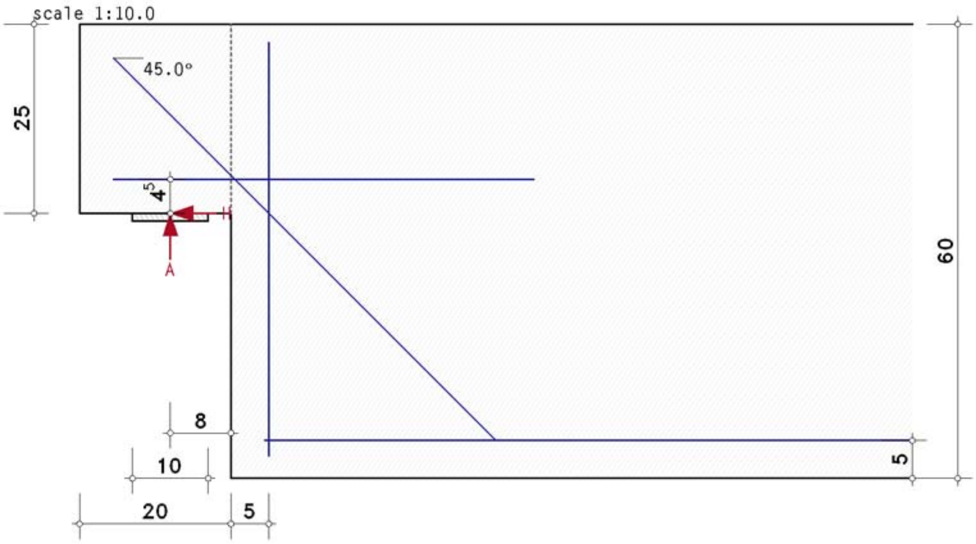
dimensioning a bearing bracket EC 2 (1.11), NA: Deutschland

1. input protocol



cross section (single bracket)
beams: b = 23.0 cm, h = 60.0 cm, center distance (design calculation): d_1 = 5.0 cm
bracket: l_k = 20.0 cm, h_k = 25.0 cm, center distance (design calculation): d_{1k} = 4.5 cm
bearing plate: l_p = 10.0 cm, b_p = 20.0 cm
material properties
concrete: C40/50, reinforcement: B500A
material safety factors
design situation: basic combination
design resistance: concrete γ_c = 1.50, reinforcement γ_s = 1.15
parameters
Load application for Δa = 8.0 cm, Δh = 0.0 cm
design method acc. to F. Leonhardt
bearing bracket, load application with variant 2
allocation number 0.58 (load percentage of vertical reinforcement)
inclination angle of transverse reinforcement 45.0°
bearing contact pressure: bearing joint of a plain/elastomeric bearing
design calculation values (ULS)
lc 1: A_{Ed} = 125.0 kN, H_{Ed} = 25.0 kN

2. note

general reinforcement rules are not taken into account.

3. design calculation

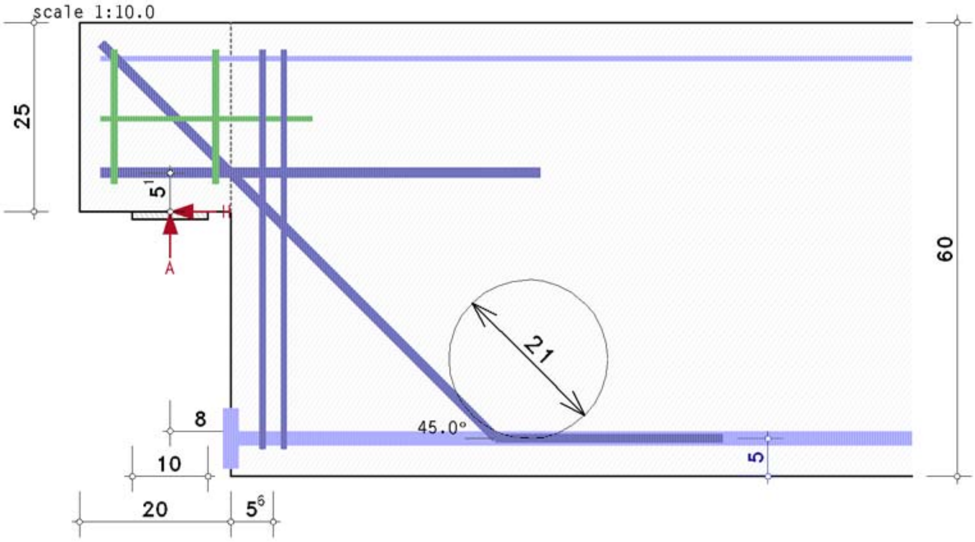
3.1. lc 1

method no longer state of the art !
design calculation values: A = A_v = 125.00 kN (Δa = 8.0 cm), H = A_h = 25.00 kN (Δh = 0.0 cm)
bearing contact pressure (plain/elastomeric bearing): σ_p = 6.25 N/mm² < $\sigma_{Rd,max}$ = 18.13 N/mm² ok
load percentage of vertical reinforcement A_V = 0.58·A = 72.50 kN
tensile reinforcement horizontal: Z_{A+H} = 114.30 kN ⇒ req $A_{s,h}$ = 2.63 cm²
vertical: Z_V = 60.90 kN ⇒ req $A_{s,v}$ = 1.40 cm²
dimensions of beam nose:
58% vertical suspension: min h_k = 5.6 cm < h_k ok
42% transverse suspension: min d_k = 4.0 cm < d_k ok
verification of compression strut: min b = 7.8 cm < b ok
tensile splitting reinforcement: $A_{sb,h}$ and $A_{sb,v}$ constructive
load percentage of transverse reinforcement A_S = 52.50 kN at α = 45.0°
tensile reinforcement transverse: Z_S = 74.25 kN ⇒ req $A_{s,s}$ = 1.71 cm²
total: $A_{s,h}$ = 2.63 cm², $A_{s,v}$ = 1.40 cm², $A_{s,s}$ = 1.71 cm² (ΣA_{st} = 5.74 cm²)

4. final result

maximum reinforcement: $A_{s,h}$ = 2.63 cm², $A_{s,v}$ = 1.40 cm², $A_{s,s}$ = 1.71 cm²

5. selected reinforcement



calculation of the required anchorage lengths: bonding conditions good

concrete cover $c_{v,v}$ = 3.6 cm

concrete cover $c_{v,h}$ = 2.8 cm

bottom reinforcement above rod reinforcement, 2Ø8, exst A_{so} = 1.01 cm²

bottom reinforcement bottom rod reinforcement, 3Ø20, exst A_{su} = 9.42 cm²

anchorage length: req l_v = 20.0 cm > exst l_v = 4.6 cm not ok !!

main reinforcement 1Ø14, D_{min} = 5.6 cm, exst $A_{s,h}$ = 3.08 cm² > req $A_{s,h}$ = 2.63 cm² ok

(U-bents, 2-shear) anchorage lengths: bracket req l_v = 16.5 cm > exst l_v = 14.2 cm not ok !!

beams l_v = 35.3 cm

transverse reinforcement 1Ø12, $D_{min,hor}$ = 4.8 cm, $D_{min,ver}$ = 21.0 cm, exst $A_{s,s}$ = 2.26 cm² > req $A_{s,s}$ = 1.71 cm² ok

(U-bents, 2-shear) anchorage lengths: bracket req l_v = 18.7 cm < exst l_v = 20.1 cm ok

beams l_v = 30.0 cm

tensile splitting reinforcement horizontal 1Ø8 (U-bents, 2-shear), exst $A_{sb,h}$ = 1.01 cm²

anchorage length: l_v = 8.0 cm ⇒ length of U-bents: l_s = 29.0 cm

tensile splitting reinforcement vertical 2Ø8 (stirrup, 2-shear), exst $A_{sb,v}$ = 2.01 cm²

vertical reinforcement 2Ø8 (stirrup, 2-shear), exst $A_{s,v}$ = 2.01 cm² > req $A_{s,v}$ = 1.40 cm² ok

anchoring horiz. 2Ø10 (U-bents, 2-shear), exst $A_{s,h1}$ = 3.14 cm²

anchoring vertical 2Ø8 (stirrup, 2-shear), exst $A_{sb,v1}$ = 2.01 cm²

center distance exst d_{1k} = 5.10 cm > clc d_{1k} = 4.5 cm !!

center distance exst e_1 = 5.60 cm > clc e_1 = 5.0 cm !!

center distance exst d_{1s} = 5.00 cm (anchoring of transverse reinforcement in the beam)

check center distance, calculation model does not correspond to the design !

design resistance not guaranteed !!

s. selected reinforcement

6. regulations

EN 1990, Eurocode 0: Grundlagen der Tragwerksplanung;
Deutsche Fassung EN 1990:2002 + A1:2005 + A1:2005/AC:2010, Ausgabe Dezember 2010
EN 1990/NA, Nationaler Anhang zur EN 1990, Ausgabe Dezember 2010

EN 1992-1-1, Eurocode 2: Bemessung und Konstruktion von Stahlbeton- und Spannbetonbauteilen -
Teil 1-1: Allgemeine Bemessungsregeln und Regeln for den Hochbau;
Deutsche Fassung EN 1992-1-1:2004 + AC:2010, Ausgabe Januar 2011
EN 1992-1-1/NA, Nationaler Anhang zur EN 1992-1-1, Ausgabe April 2013

Fritz Leonhardt, Eduard Mönnig: Vorlesungen über Massivbau, Zweiter Teil,
Sonderfälle der Bemessung im Stahlbetonbau, Dritte Auflage, Springer-Verlag, 1986

Fritz Leonhardt, Eduard Mönnig: Vorlesungen über Massivbau, Dritter Teil,
Grundlagen zum Bewehren im Stahlbetonbau, Dritte Auflage, Springer-Verlag, 1977