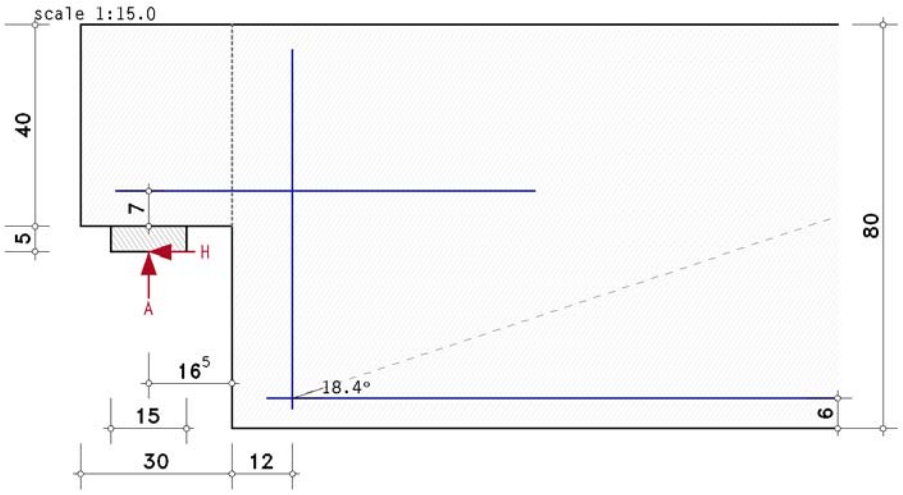
POS. 15: HEFT 599, 5.5

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

1. input protocol



cross section (single bracket)
beams: b = 30.0 cm, h = 80.0 cm, center distance (design calculation): d_1 = 6.0 cm
bracket: l_k = 30.0 cm, h_k = 40.0 cm, center distance (design calculation): d_{1k} = 7.0 cm
bearing plate: l_p = 15.0 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 = 16.5 cm, Δh = 5.0 cm
design method acc. to EC 2-1-1, 6.5
bearing bracket, load application with variant 1
bearing contact pressure: dry bearing joint
from shear design of beam: compression strut angle Θ = 18.4° (minimal)
design calculation values (ULS)
lc 1: A_{Ed} = 250.0 kN

1.1. durability and concrete cover

vertical: minimum strength class, concrete cover
due to reinforcement corrosion XC1 ⇒ C16/20, c_{nom} = 20 mm, $c_{nom,l}$ = 24 mm ⇒ c_{nom} = 24 mm < c_v = 42 mm ok
minimum concrete quality C16/20 with f_{ck} = 16.0 N/mm² < exst f_{ck} = 40.0 N/mm² ok
horizontal: minimum strength class, concrete cover
due to reinforcement corrosion XC1 ⇒ C16/20, c_{nom} = 20 mm, $c_{nom,l}$ = 24 mm ⇒ c_{nom} = 24 mm < c_v = 25 mm ok
minimum concrete quality C16/20 with f_{ck} = 16.0 N/mm² < exst f_{ck} = 40.0 N/mm² ok

2. note

general reinforcement rules are not taken into account.

3. design calculation

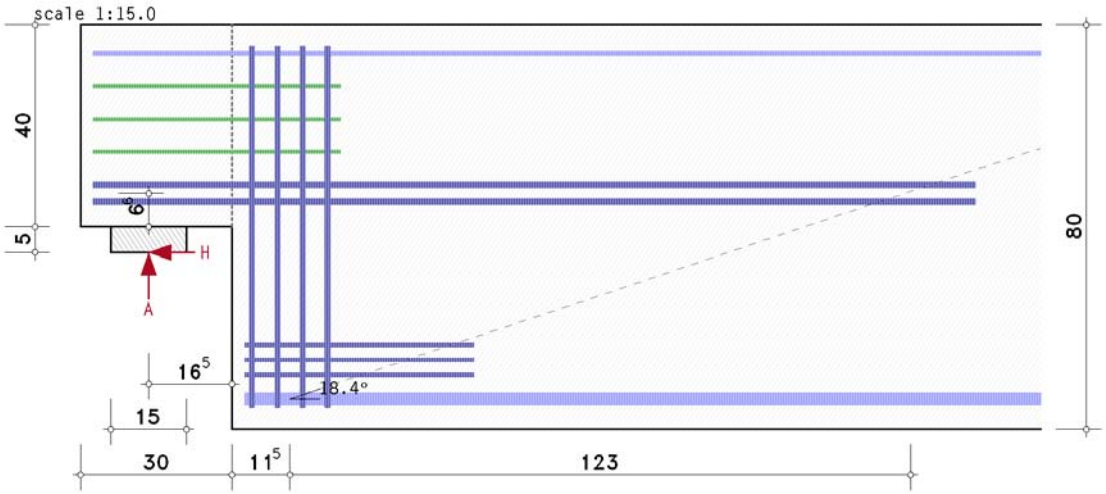
3.1. lc 1

note (dry bearing joint): H < 0.2·A ⇒ H = 0.2·A = 50.00 kN !!
design calculation values: A = A_v = 250.00 kN (Δa = 16.5 cm), H = A_h = 50.00 kN (Δh = 5.0 cm)
bearing contact pressure (dry bearing joint): σ_p = 8.33 N/mm² < $\sigma_{Rd,max}$ = 9.07 N/mm² ok
tensile reinforcement horizontal: Z_{A+H} = 333.83 kN ⇒ req $A_{s,h}$ = 7.68 cm²
vertical: Z_V = 250.00 kN ⇒ req $A_{s,v}$ = 5.75 cm²
anchoring of $A_{s,h}$ at z_3 = 123.0 cm for Θ = 18.4°
verification of compression strut: x = 6.96 cm < perm x = 0.4·d = 12.0 cm ok
tensile splitting reinforcement: horizontal stirrup reinforcement ($A_{sb,v}$ constr.) for $\Delta a/h$ = 0.21 ≤ 0.5 (compact bracket)
⇒ req $A_{sb,h}$ = 0.3·$A_{s,h}$ = 2.30 cm²
anchoring of bottom reinforcement: Z_{h1} = 375.00 kN ⇒ req $A_{s,h1}$ = 8.63 cm²
total: $A_{s,h}$ = 7.68 cm², $A_{s,v}$ = 5.75 cm², $A_{s,h1}$ = 8.63 cm², $A_{sb,h}$ = 2.30 cm² (ΣA_{st} = 13.43 cm²)

4. final result

maximum reinforcement: $A_{s,h}$ = 7.68 cm², $A_{s,v}$ = 5.75 cm², $A_{s,h1}$ = 8.63 cm², $A_{sb,h}$ = 2.30 cm²

5. selected reinforcement



calculation of the required anchorage lengths: bonding conditions good

concrete cover	$c_{v,v}$ = 4.2 cm > $c_{nom,v}$ = 2.40 cm ok
concrete cover	$c_{v,h}$ = 2.5 cm > $c_{nom,h}$ = 2.40 cm ok
bottom reinforcement above	rod reinforcement, 2Ø10, exst A_{so} = 1.57 cm²
bottom reinforcement bottom	rod reinforcement, 4Ø25, exst A_{su} = 19.63 cm²
	anchorage length: req l_v = 32.4 cm > exst l_v = 17.0 cm ⇒ anchoring $A_{s,h1}$ req. !!
main reinforcement	1. Lage:2Ø14, D_{min} = 5.6 cm, exst $A_{s,h}$ = 6.16 cm²
(U-bents, 2-shear)	2. Lage:2Ø14, D_{min} = 5.6 cm, exst $A_{s,h}$ = 6.16 cm², d_v = 3.4 cm
	exst $A_{s,h}$ = 12.32 cm² > req $A_{s,h}$ = 7.68 cm² ok
	anchorage lengths: bracket req l_v = 12.0 cm < exst l_v = 16.1 cm ok
	beams l_v = 25.8 cm
tensile splitting reinforcement	horizontal 3Ø8 (U-bents, 2-shear), exst $A_{sb,h}$ = 3.02 cm² > req $A_{sb,h}$ = 2.30 cm² ok
	anchorage length: l_v = 18.0 cm ⇒ length of U-bents: l_s = 49.0 cm
vertical reinforcement	4Ø10 (stirrup, 2-shear), exst $A_{s,v}$ = 6.28 cm² > req $A_{s,v}$ = 5.75 cm² ok
anchoring horiz.	3Ø10 (U-bents, 4-shear), exst $A_{s,h1}$ = 9.42 cm² > req $A_{s,h1}$ = 8.63 cm² ok
	anchorage length: req l_v = 13.5 cm < exst l_v = 17.0 cm ok
	lap length l_v = 45.4 cm
center distance	exst d_{1k} = 6.60 cm < clc d_{1k} = 7.0 cm ok with minimum bar distance each layer
center distance	exst e_1 = 11.50 cm < clc e_1 = 12.0 cm ok with bar distance d_h = 5.00 cm > min d_h = 3.0 cm ok

design resistance ensured

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

Frank Fingerloos, Gerhard Stenzel: Konstruktion und Bemessung von Details nach DIN 1045,
Betonkalender 2007 T.2, Verlag Ernst & Sohn, 2007