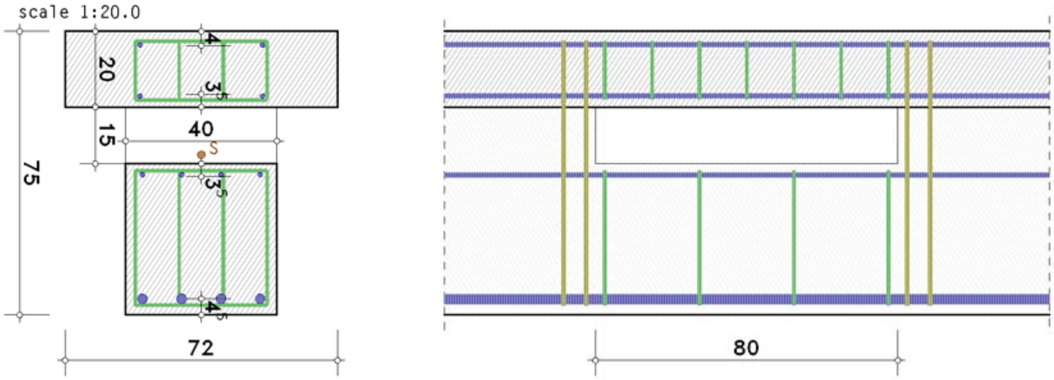
POS. 7: HEFT 599, 4.4.2, BSP.1

dimensioning of a beam recess EC 2 (1.11), NA: Deutschland 4H-EC2AB Version: 2/2024-1a

1. input protocol

visualisation of the selected reinforcement



cross section
T-beam: $h = 75.0$ cm, $b = 40.0$ cm, $h_p = 20.0$ cm, $b_p = 72.0$ cm
recess: $e_o = 20.0$ cm, $e_u = 40.0$ cm, $l_A = 80.0$ cm
axis distances (calculation): $d_{o,o} = 3.8$ cm, $d_{u,o} = 3.4$ cm, $d_{o,u} = 3.4$ cm, $d_{u,u} = 4.3$ cm
material properties
concrete acc. to EC 2, 3.1.7(1): C30/37, $\varepsilon_{c2} = -2.00‰$, $\varepsilon_{cu2} = -3.50‰$, $f_{cd} = 17.00$ N/mm²
reinforcement acc. to EC 2, 3.2.7(2a): B500A, $\varepsilon_{ud} = 25.0‰$, $f_{yd} = 434.78$ N/mm², $f_{td} = 456.52$ N/mm², $E_s = 200000.0$ N/mm²
parameters
design method acc. to Heft 599, DAfStb
moment zero crossing in the centre of recess
shear force distribution determined from the effective belt stiffnesses
shear design: compression strut angle minimum

1.1. design calculation values

lc 1: $M_{y,Ed} = 504.00$ kNm, $V_{z,Ed} = 168.00$ kN

1.2. durability and concrete cover

bottom: minimum strength class, concrete cover
due to reinforcement corrosion XC1 ⇒ C16/20, $c_{nom} = 20$ mm, $c_{nom,b} = 20$ mm, $c_{nom,l} = 13$ mm
⇒ $c_{nom} = 20$ mm $\leq c_v = 20$ mm ok
minimum concrete quality C16/20 with $f_{ck} = 16.0$ N/mm² $<$ 30.0 N/mm² ok
above: minimum strength class, concrete cover
due to reinforcement corrosion XC1 ⇒ C16/20, $c_{nom} = 20$ mm, $c_{nom,b} = 20$ mm, $c_{nom,l} = 6$ mm
⇒ $c_{nom} = 20$ mm $\leq c_v = 20$ mm ok
minimum concrete quality C16/20 with $f_{ck} = 16.0$ N/mm² $<$ 30.0 N/mm² ok

2. note

general reinforcement rules are not taken into account.

3. recess

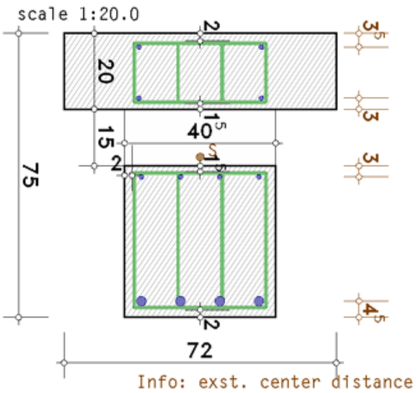
3.1. lc 1

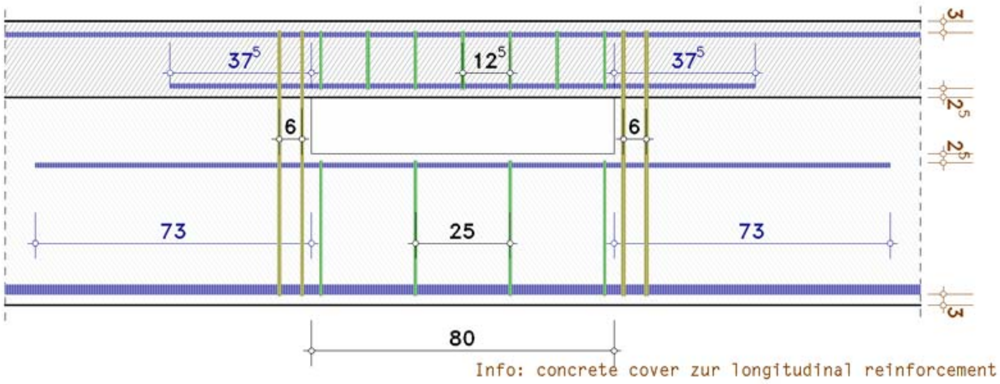
design calculation values in centre cut: $N_{Ed} = 0.00$ kN, $M_{Ed} = 504.00$ kNm, $V_{Ed} = 168.00$ kN
shear force distribution: 43.7% of shear force acts in the compression chord (= top chord)
above the recess
design calculation values in top chord: $N_{Ed,o} = -746.3$ kN, $V_{Ed,o} = 73.5$ kN, $M_{Ed,o} = \pm 29.4$ kNm
longitudinal reinforcement in top chord designed
shear design:
design resistance without shear reinforcement $V_{Rdc} = 110.83$ kN, max. design resistance of compression strut $V_{Rd,mx} = 279.32$ kN
$|V_{Ed,o}| < V_{Rdc}$ ⇒ minimum reinforcement: $a_{sb,o} = 6.67$ cm²/m
below the recess
design calculation values in bottom chord: $N_{Ed,u} = 746.3$ kN, $V_{Ed,u} = 94.5$ kN, $M_{Ed,ul} = 79.4$ kNm, $M_{Ed,ur} = 155.0$ kNm
longitudinal reinforcement in bottom chord: $A_{so,u} = 2.56$ cm², $A_{su,u} = 18.73$ cm²
shear design:
design resistance without shear reinforcement $V_{Rdc} = 5.27$ kN, max. design resistance of compression strut $V_{Rd,mx} = 823.65$ kN
$V_{Rdc} < |V_{Ed,u}| < V_{Rd,mx}$ ⇒ shear reinforcement in bottom chord $a_{sb,u} = 6.73$ cm²/m
suspended reinforcement: $T_{v,l} = 168.2$ kN ⇒ $A_{s,l} = 3.87$ cm², $T_{v,r} = 179.8$ kN ⇒ $A_{s,r} = 4.13$ cm², distribution width 22.5 cm
total: $A_{so,o} = 0.00$ cm², $A_{su,o} = 0.00$ cm², $a_{sb,o} = 6.67$ cm²/m, $A_{so,u} = 2.56$ cm², $A_{su,u} = 18.73$ cm²
$a_{sb,u} = 6.73$ cm²/m, $A_{s,l} = 3.87$ cm², $A_{s,r} = 4.13$ cm², $\rho = 0.58\%$

4. final result

maximum reinforcement: $A_{so,o}$ = 0.00 cm², $A_{su,o}$ = 0.00 cm², $a_{sb,o}$ = 6.67 cm²/m, $A_{so,u}$ = 2.56 cm²
$A_{su,u}$ = 18.73 cm², $a_{sb,u}$ = 6.73 cm²/m, $A_{s,l}$ = 3.87 cm², $A_{s,r}$ = 4.13 cm², ρ = 0.58%

5. selected reinforcement





above the recess
concrete cover to stirrup reinforcement:
above c_{vo} = 2.0 cm > c_{nom} = 2.00 cm ok
bottom (to recess) c_{vi} = 1.5 cm, lateral c_{vr} = 2.0 cm
longitudinal reinforcement above 2Ø12, exst A_s = 2.26 cm²
exst A_s = 2.26 cm² > req A_s = 0.00 cm² ok
bottom 2Ø12, exst A_s = 2.26 cm²
exst A_s = 2.26 cm² > req A_s = 0.00 cm² ok
anchorage length from recess edge left/right 37.4/37.4 cm
stirrup reinforcement Ø8/12.5 cm (4-cut), exst a_{sb} = 16.08 cm²/m > req a_{sb} = 6.67 cm²/m ok
center distance above exst d_1 = 3.60 cm < clc d_1 = 3.8 cm ok
bottom exst d_1 = 2.90 cm < clc d_1 = 3.4 cm ok

below the recess
concrete cover to stirrup reinforcement:
above (to recess) c_{vi} = 1.5 cm, lateral c_{vr} = 2.0 cm
bottom c_{vu} = 2.0 cm > c_{nom} = 2.00 cm ok
longitudinal reinforcement above 4Ø12, exst A_s = 4.52 cm²
exst A_s = 4.52 cm² > req A_s = 2.56 cm² ok
anchorage length from recess edge left/right 73.0/73.0 cm
bottom 4Ø25, exst A_s = 19.63 cm²
exst A_s = 19.63 cm² > req A_s = 18.73 cm² ok
stirrup reinforcement Ø8/25.0 cm (4-cut), exst a_{sb} = 8.04 cm²/m > req a_{sb} = 6.73 cm²/m ok
center distance above d_v = 3.00 cm ⇒ exst d_1 = 2.90 cm < clc d_1 = 3.4 cm ok
bottom d_v = 4.00 cm ⇒ exst d_1 = 4.30 cm = clc d_1 = 4.3 cm ok

suspended reinforcement
Bügel left 2Ø10/6.0 cm (4-cut), exst A_s = 6.28 cm² > req A_s = 3.87 cm² ok
Bügel right 2Ø10/6.0 cm (4-cut), exst A_s = 6.28 cm² > req A_s = 4.13 cm² 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

Josef Hegger et. al.: Bewehren nach Eurocode 2
Deutscher Ausschuss für Stahlbeton, Heft 599, Beuth Verlag GmbH, 2013