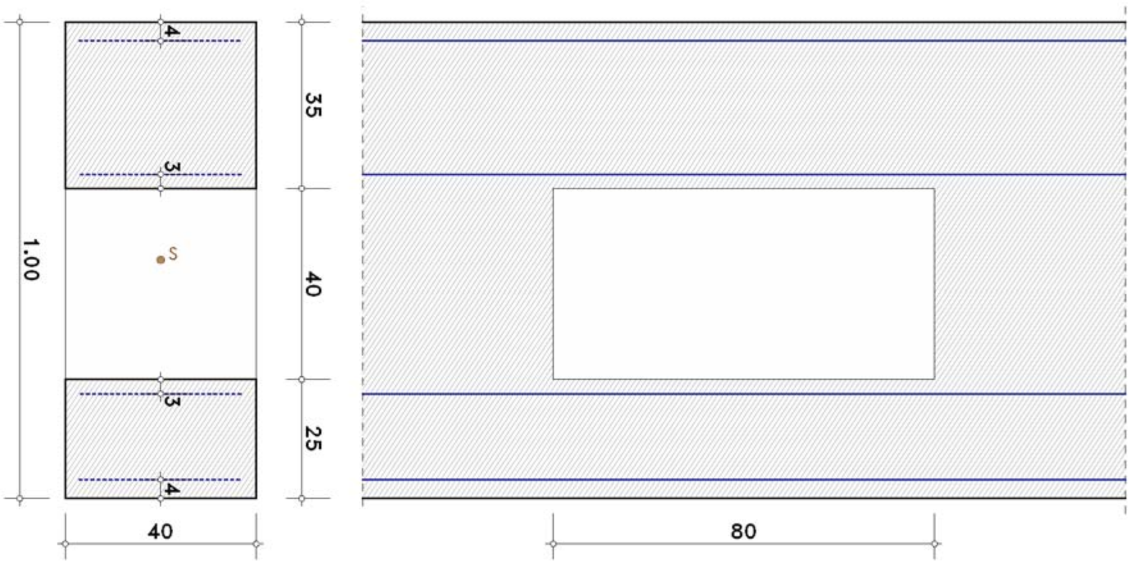
POS. 15: HEFT 459, 4.8

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

1. input protocol



cross section
rectangle: h = 100.0 cm, b = 40.0 cm
recess: e_o = 35.0 cm, e_u = 25.0 cm, l_A = 80.0 cm
axis distances (calculation): $d_{o,o}$ = 4.0 cm, $d_{u,o}$ = 3.0 cm, $d_{o,u}$ = 3.0 cm, $d_{u,u}$ = 4.0 cm
material properties
concrete acc. to EC 2, 3.1.7(1): C30/37, ε_{c2} = -2.00‰, ε_{cu2} = -3.50‰, f_{cd} = 17.00 N/mm²
reinforcement acc. to EC 2, 3.2.7(2a): B500A, ε_{ud} = 25.0‰, f_{yd} = 434.78 N/mm², f_{td} = 456.52 N/mm², E_s = 200000.0 N/mm²
parameters
base reinforcement: top chord above $A_{so,0}$ = 0.00 cm², bottom chord bottom $A_{su,0}$ = 6.00 cm²
design method acc. to Heft 459, DAfStb
shear force distribution determined from the gross belt stiffnesses
shear design: compression strut angle minimum

1.1. design calculation values

lc 1: $M_{y,Ed}$ = 168.00 kNm, $V_{z,Ed}$ = -330.00 kN

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} = 168.00 kNm, V_{Ed} = -330.00 kN
shear force distribution: 73.3% of shear force acts in the compression chord (= top chord)
above the recess
design calculation values in top chord: $N_{Ed,o}$ = -240.0 kN, $V_{Ed,o}$ = -241.9 kN, $M_{Ed,ol}$ = 104.6 kNm, $M_{Ed,or}$ = -88.9 kNm
longitudinal reinforcement in top chord: $A_{so,o}$ = 4.48 cm², $A_{su,o}$ = 5.73 cm²
shear design:
design resistance without shear reinforcement V_{Rdc} = 83.07 kN, max. design resistance of compression strut $V_{Rd,mx}$ = 579.18 kN
$V_{Rdc} < |V_{Ed,o}| < V_{Rd,mx} \Rightarrow$ shear reinforcement in top chord: $a_{sb,o}$ = 10.48 cm²/m
below the recess
design calculation values in bottom chord: $N_{Ed,u}$ = 240.0 kN, $V_{Ed,u}$ = -88.1 kN, $M_{Ed,ul}$ = 38.1 kNm, $M_{Ed,ur}$ = -32.4 kNm
longitudinal reinforcement in bottom chord: $A_{so,u}$ = 6.23 cm², $A_{su,u}$ = 7.17 cm²
shear design:
design resistance without shear reinforcement V_{Rdc} = 23.94 kN, max. design resistance of compression strut $V_{Rd,mx}$ = 275.40 kN
$V_{Rdc} < |V_{Ed,u}| < V_{Rd,mx} \Rightarrow$ shear reinforcement in bottom chord $a_{sb,u}$ = 3.75 cm²/m
suspended reinforcement: $A_{s,l} = A_{s,r} = A_{s1}+A_{s2}$ = 15.43 cm²
anchoring the chord reinforcement: T_{v1} = 241.9 kN $\Rightarrow$ A_{s1} = 5.56 cm², distribution width 32.5 cm
transmission of the anchoring forces: T_{v2} = 429.0 kN $\Rightarrow$ A_{s2} = 9.87 cm², distribution width 90.0 cm
total: $A_{so,o}$ = 4.48 cm², $A_{su,o}$ = 5.73 cm², $a_{sb,o}$ = 10.48 cm²/m, $A_{so,u}$ = 6.23 cm², $A_{su,u}$ = 7.17 cm²
$a_{sb,u}$ = 3.75 cm²/m, A_{s1} = 5.56 cm², A_{s2} = 9.87 cm², $A_{s,l} = A_{s,r}$ = 15.43 cm², ρ = 0.59%

4. final result

maximum reinforcement: $A_{so,o}$ = 4.48 cm², $A_{su,o}$ = 5.73 cm², $a_{sb,o}$ = 10.48 cm²/m, $A_{so,u}$ = 6.23 cm²
$A_{su,u}$ = 7.17 cm², $a_{sb,u}$ = 3.75 cm²/m, A_{s1} = 5.56 cm², A_{s2} = 9.87 cm², $A_{s,l}$ = $A_{s,r}$ = 15.43 cm²
ρ = 0.59%
incl. base reinforcement: $A_{so,o}$ = 4.48 cm², $A_{su,o}$ = 7.17 cm²

design resistance ensured

5. 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

Hermann U. Hottmann, Kurt Schäfer: Bemessen von Stahlbetonbalken und -wandscheiben mit Öffnungen,
Deutscher Ausschuss für Stahlbeton, Heft 459, Beuth Verlag GmbH, 1996