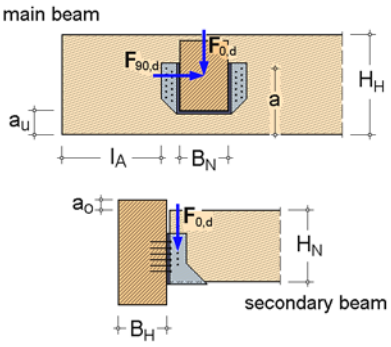
POSITION 1: BS-SIMPSON

4H-HOLZ joist hanger connection

(4H-HLZ72 Version: 1/2012-1a) (principle sketch)



calculation bases:
DIN EN 1995-1-1:2010-12 (EC5) /NA:2010-12,
BAZ Z-9.1-225 und ETA-04/0013

sizes of main and secondary beam (single-sided)
H_H = 320 mm B_H = 240 mm a_O = 50 mm
H_N = 220 mm B_N = 120 mm a_U = 50 mm
w = 189 mm a = 190 mm $l_A < H_H$

service class 2

species/timber grade
main beam: coniferous timber, timber grade C24
secondary beam: coniferous timber, timber grade C24

internal forces and factors

$F_{0,d}$	force perpendicular to the base plate
$F_{90,d}$	force parallel to the base plate
$N_{,d}$	normal force in secondary beam

combinations of internal forces (design values)

LK-Nr.	KLED	$F_{0,d}$	$F_{90,d}$	$N_{,d}$	k_{mod}
1	medium-term	4.50 kN	1.50 kN	---	0.80

connection method joist hanger with outer plates
make BS-Simpson 120x157.5, basic form 440
joist hanger size width b = 120.0 mm height h = 157.5 mm steel plate thickness t = 2.0 mm
nails CNA ribbed nails 4,0x35
d_n = 4.0 mm l_n = 35.0 mm d_k = 8.0 mm l_g = 25.0 mm M_{yk} = 6.6 Nm

verifications

combination of internal forces 1 (design values)

LK-Nr.	KLED	$F_{0,d}$	$F_{90,d}$	$N_{,d}$	k_{mod}
1	medium-term	4.50 kN	1.50 kN	---	0.80

nail anchorage capacities (withdrawal)
main beam $f_{1,k}$ = 6.125 N/mm² $R_{ax,k}$ = 0.613 kN $R_{ax,d}$ = 0.377 kN
secondary beam $f_{1,k}$ = 6.125 N/mm² $R_{ax,k}$ = 0.613 kN $R_{ax,d}$ = 0.377 kN
nail anchorage capacities (shear)
main beam $f_{h,k}$ = 18.935 N/mm² $R_{1a,k}$ = 1.309 kN $R_{1a,d}$ = 0.952 kN $d_{R,k}$ = 0.153 kN
secondary beam $f_{h,k}$ = 18.935 N/mm² $R_{1a,k}$ = 1.309 kN $R_{1a,d}$ = 0.952 kN $d_{R,k}$ = 0.153 kN
joist hanger load-carrying capacities (full nailing)
number of nails n_H = 26 n_N = 14
form factors k_{H1} = 40.40 k_{H2} = 36.70
material safety factors $\gamma_{M,timber}$ = 1.30 $\gamma_{M,steel}$ = 1.10 $\gamma_{M,calc}$ = 1.00
transversely load-carrying capacity ($R_{2,d}$) (1)
e_N = 110.00 mm R = 67.50 mm
$F_{2,d}$ = 1.50 kN $R_{2,d}$ = 4.27 kN $F_{2,d}/R_{2,d}$ = 0.35 ≤ 1.00 verification successful
load-carrying capacity for load towards base plate ($R_{1,d}$) (2)
$F_{1,d}$ = 4.50 kN $R_{1,d}$ = 12.97 kN $F_{1,d}/R_{1,d}$ = 0.35 ≤ 1.00 verification successful
load-carrying capacity for load away from base plate ($R_{1a,d}$) (3)
$F_{1a,d}$ = 0.00 kN $R_{1a,d}$ = 12.08 kN $F_{1a,d}/R_{1a,d}$ = 0.00 ≤ 1.00 verification successful
verification of interaction (4 + 5)
$(F_{1,d}/R_{1,d})^2 + (F_{2,d}/R_{2,d})^2$ = 0.24 ≤ 1.00 verification successful
$(F_{1a,d}/R_{1a,d})^2 + (F_{2,d}/R_{2,d})^2$ verification not required
verification of splitting capacity (6)
For a/H_H = 0.594 ≤ 0.7 verif. of splitting capacity is required. Acc. to DIN 1052:2008-12, par. 11.1.5 the following requirement should be satisfied: **$F_{90,d} / R_{90,d} \le 1.0$**
$F_{90,d}$ design value of the force component perpendicular to grain
$R_{90,d}$ design splitting capacity of the beams
$R_{90,d} = k_s * k_r * (6.5 + 18.*a^2/H_H^2) * (t_{ef} * H_H)^{0.8} * f_{t,90,d}$
a = 190.0 mm H_H = 320.0 mm a/H_H = 0.594 a_r = 189.0 mm t_{ef} = 33.0 mm
h_1 = 130.0 mm k_s = 1.527 k_r = 1.893 l_{Ag} = 189.0 mm k_g = 0.648
$f_{t,90,k}$ = 0.400 N/mm² $f_{t,90,d}$ = 0.320 N/mm² $F_{90,d}$ = 4.50 kN $R_{90,d}$ = 9.80 kN
$F_{90,d} / R_{90,d}$ = 4.50 / 9.80 = 0.46 ≤ 1.0 verification successful

verifications

LK1: all verifications successful.

references and comments

The clear distance l_A of the connector to the end of the main beam is less than the height of the m. b. Acc. to par. 11.1.5 (8) DIN 1052:2008-12 tension stresses perpendicular to grain at the end of the beam are to be absorbed by reinforcements.

summary

maximum utilization max U = 0.46
decisive load combination 1, verification 6