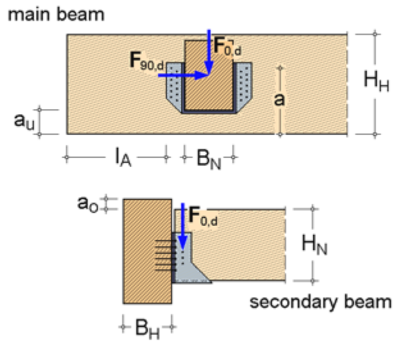
POSITION 1: BS-SIMPSON

4H-HOLZ joist hanger connection

(4H-HLZ72 Version: 10/2012-1j) (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 = 190.0 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 $f_{1,k}$ = 7.595 N/mm² $R_{ax,k}$ = 0.760 kN $R_{ax,d}$ = 0.467 kN
secondary beam $f_{1,k}$ = 7.595 N/mm² $R_{ax,k}$ = 0.760 kN $R_{ax,d}$ = 0.467 kN

nail anchorage capacities (shear), simplified method, without consideration of rope effect
main beam $f_{h,k}$ = 18.935 N/mm² $R_{la,k}$ = 1.156 kN $R_{la,d}$ = 0.841 kN
secondary beam $f_{h,k}$ = 18.935 N/mm² $R_{la,k}$ = 1.156 kN $R_{la,d}$ = 0.841 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 $\gamma_{M,Holz,main\ beam}$ = 1.30 $\gamma_{M,Holz,secondary\ beam}$ = 1.30 $\gamma_{M,steel}$ = 1.10
$\gamma_{M,calc,main\ beam}$ = 1.10 $\gamma_{M,calc,secondary\ beam}$ = 1.10

transversely load-carrying capacity ($R_{2,d}$) (1)
e_N = 110.00 mm R = 67.50 mm
$F_{2,d}$ = 1.50 kN $R_{2,d}$ = 4.58 kN $F_{2,d}/R_{2,d}$ = 0.33 ≤ 1.00 verification successful

load-carrying capacity for load towards base plate ($R_{1,d}$) (2)
$F_{1,d}$ = 4.50 kN $R_{1,d}$ = 13.46 kN $F_{1,d}/R_{1,d}$ = 0.33 ≤ 1.00 verification successful

load-carrying capacity for load away from base plate ($R_{1a,d}$) (3)
$F_{1a,d}$ = 0.00 kN $R_{1a,d}$ = 11.77 kN $F_{1a,d}/R_{1a,d}$ = 0.00 ≤ 1.00 verification successful

verification of interaction (4 + 5)
$(F_{1,d}/R_{1,d})^2 + (F_{2,d}/R_{2,d})^2$ = 0.22 ≤ 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)
Für a/H_H = 0.594 ≤ 0.7 ist ein verification of splitting capacity erf. Acc. to DIN EN 1995-1-1:2010-12/NA/A1:20
NCI zu 8.1.4 the following requirement should be satisfied: **$F_{V,Ed}$ / $F_{90,Rd}$ ≤ 1.0**
$F_{V,Ed}$ design value of the force component perpendicular to grain
$F_{90,Rd}$ design splitting capacity of the beams
$F_{90,Rd} = k_s * k_r * (6.5 + 18. * a^2/H_H^2) * (t_{ef} * H_H)^{0.8} * f_{t,90,d} * k_g$
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 $f_{t,90,d}$ = 0.246 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

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

Selected Design Parameters of the National Annex

Germany

DIN EN 1995-1-1 (EC5)

Chapter	Value	Meaning
2.3.1.2(2)P	use table NA.1	Association of action effects to classes of duration of load
2.4.1		Partial safety factors
Tab. 2.3	γ_M = 1.30	solid wood
	γ_M = 1.30	glue laminated timber
	γ_M = 1.30	LVL, plywood, OSB
	γ_M = 1.30	particleboards
	γ_M = 1.30	hard fibreboards
	γ_M = 1.30	medium fibreboards
	γ_M = 1.30	MDF-fibreboards
	γ_M = 1.30	soft fibreboards
	γ_M = 1.30	connections
	γ_M = 1.25	metal plate fasteners
	γ_M = 1.30	steel in connections
	γ_M = 1.30	gypsum board, etc.
3.1.3	use table NA.4	modification coefficients
8.3.2	use table NA.15	f_{ax} , f_{head} for profiled nails
8.3.1.2	use NA.11	penetration depths > 4 d
8.5.3 (2)	threaded rods acc. to NAD	allow threaded rods
6.3.3 (7)	lat. tors. buckl. acc.to NAD	verifification of lateral torsional buckling
8.2.4 (1)	simplified method acc.to NAD	fastener

Rissfaktor

Rissfaktor k_{cr} zur Festlegung der effektiven Querschnittsbreite bei der Ermittlung der Schubspannungen aus Querkraft

k_{cr} = 2.0/fv,k für coniferous timber
k_{cr} = 0.67 für hardwood
k_{cr} = 2.5/fv,k für glue laminated timber
k_{cr} = 1.0 sonst