STRENG s.r.o.
STRUCTURAL ENGINEERING & (RE-) CONSTRUCTION

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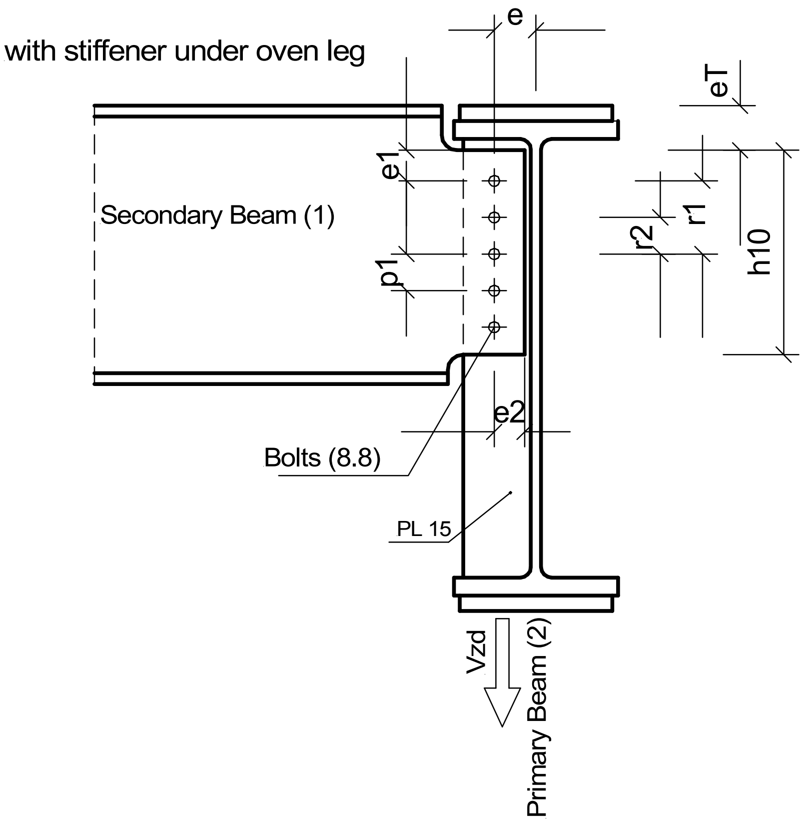
Fin Plate Connection



IPE450 O ⇒ 2x IPE750x222

Input Data:

Material / Section / Geometry:

Steel Grade Stahl =	S235
Bolts:	
Size Schr =	M 20
Number of Bolts n =	5
Connection Type VB =	SLS
Bolt Grage FK =	8.8
Drilled Hole Clearance Δd =	2,0 mm
Beams:	
Secondary Beam Typ1 =	IPEo
Size NH1 =	450
Primary Beam Typ2 =	IPE
Size NH2 =	750x222
Fin Plate (= Stiffener under oven leg):	
Width b_p =	100 mm
Thickness d_p =	15 mm

Project:	Customer:	Date: 01.12.2009

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Bolt Spacing:
vertical e_1 = 45 mm
vertical p_1 = 60 mm
horizontal e_2 = 50 mm
Distance to Beam Axis e = 65 mm
h_b = (n-1)*p_1 = 240 mm

Cut of upper and lower Flange:
Length a_T = 136 mm
Hight e_{To} = 73 mm
Hight e_{Tu} = 48 mm

Internal Forces:

Design Value - Index "d"
Reaction V_d = 275,00 kN
Moment M_d = V_d*e/10 = 1787,50 kNcm
r_1 = 0,12 m
r_2 = 0,06 m
I_p = $2*(r_1^2+r_2^2)$ = 0,036000 m^2
H_d = r_1* 0,01*M_d / I_p = 59,58 kN
F_{sd} = $\sqrt{((V_d/n)^2+H_d^{\,2})}$ = 81,08 kN

Material:

$f_{y,k}$ = TAB("Stahl/DIN"; f_{yk}; Bez=Stahl)/10 = 24,00 kN/cm²
f_{uk} = TAB("Stahl/DIN"; f_{uk}; Bez=Stahl)/10 = 36,00 kN/cm²
Partial Safety Factors (acc. to the Slovak NAD):
Safety Factor for Bolts γ_{Mb}= 1,45
Safety Factor for Welding γ_{Mw}= 1,50
Safety Factor for Section γ_{M0}= 1,15

$f_{y,d}$ = $f_{y,k}$ / γ_{M0} = 20,87 kN/cm²
σ_{Rd} = $f_{y,k}$ / γ_{M0} = 20,87 kN/cm²
τ_{Rd} = $f_{y,k}$ / ($\sqrt{(3)}$ * γ_{M0}) = 12,05 kN/cm²
Factor β_w = WENN(Stahl = "S235" ; 0,8; 0,9) = 0,80
$\tau_{W,R,d}$ = f_{uk}/ (β_w * γ_{Mw}) = 30,00 kN/cm²
$f_{y,b,k}$ = TAB("Stahl/Schr"; f_{ybk}; FK=FK)/10 = 64,00 kN/cm²
$f_{u,b,k}$ = TAB("Stahl/Schr"; f_{ubk}; FK=FK)/10 = 80,00 kN/cm²

d = TAB("Stahl/Schr"; d; SG=Schr) = 20,0 mm
Hole Diameter d_0 = d+Δd = 22,0 mm
α_a = TAB("Stahl/Schr"; α_a; FK=FK; VB=VB) = 0,60
A_{Sp} = TAB("Stahl/Schr"; A_{sp}; SG=Schr) = 2,45 cm²
A_{Sch} = TAB("Stahl/Schr"; A_{sch}; SG=Schr) = 3,14 cm²

Section Characteristics / Geometry:

Secondary Beam (1):
Hight h_1 = TAB("Stahl/"Typ1; h; NH=NH1)/10 = 45,60 cm
Web Thickness t_{w1} = TAB("Stahl/"Typ1; s; NH=NH1)/10 = 1,10 cm

Relevant Thickness for Bearing Capacity:
t = MIN(d_p;t_{w1}*10) = 11,00 mm

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Output Data:

Bolt Spacing Check acc to 6.5.1:

$1,2*d_0/e_1$	=	0,59 < 1
$e_1/MAX(12*t;150)$	=	0,30 < 1
$1,5*d_0/e_2$	=	0,66 < 1
$e_2/MAX(12*t;150)$	=	0,33 < 1
$2,2*d_0/p_1$	=	0,81 < 1
$p_1/MIN(14*t;200)$	=	0,39 < 1

Bolt Shear Capacity and Check:

for Shear in Thread $F_{vs,Rd}$= $0,6*f_{u,b,k}*A_{Sp}/\gamma_{Mb}$ = 81,1 kN

F_{sd} / $F_{vs,Rd}$ = **1,00 < 1,0**

Bolt Bearing Capacity and Check:

α= $MIN(e_1/(3*d_0);p_1/(3*d_0)-0,25;f_{u,b,k}/f_{uk};1)$ = 0,659

$F_{b,Rd}$= $2,5*\alpha*f_{uk}*d*t/\gamma_{Mb}/100$ = 89,99 kN

$F_{sd}/F_{b,Rd}$ = **0,90 < 1**

Web Shear Check:

τ = $V_d / (t_{w1}*(h_1-((e_{To}+e_{Tu})/10)))$ = 7,46 kN/cm²

τ / τ_{Rd} = **0,619 < 1,0**

End Plate Shear Check:

In an Verticalsection of the Holesrow.

A = $(h_1-((e_{To}+e_{Tu})/10) - n*0,1*d_0)*t_{w1}$ = 24,75 cm²

τ = V_d/A = 11,11 kN/cm²

τ / τ_{Rd} = **0,922 < 1,0**

Stress Analysis in Cut out Section and Check:

Characteristics of the Remaining Section:

h_{10} =	$h_1 - (e_{To}+e_{Tu})/10$	=	33,50 cm
A =	$t_{w1}*h_{10}$	=	36,85 cm²
a_d =	$h_{10}/2$	=	16,75 cm
a_z =	$h_{10} - a_d$	=	16,75 cm
I_{y1} =	$t_{w1}*h_{10}^3/12$	=	3446,24 cm4
S_{y1} =	$t_{w1}*a_d^2/2$	=	154,31 cm³
M_{1d} =	$V_d*(a_T -e_2)/10$	=	2365,00 kNcm
max.σ =	$M_{1d}*a_d/I_{y1}$	=	11,49 kN/cm²
max.σ / σ_{Rd}		=	**0,551 < 1,0**
max.τ =	$V_d*S_{y1}/(I_{y1}*t_{w1})$	=	11,19 kN/cm²
max.τ / τ_{Rd}		=	**0,929 < 1,0**
σ_v =	$\sqrt{}(max.\sigma^2 + 3*max.\tau^{2)}$	=	22,53 kN/cm²
σ_v / σ_{Rd}		=	**1,080 < 1,0**

The section (1) is adequate, local plastification is allowed.