SUPERMETAL STRUCTURES
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No DOCUMENT / DOCUMENT No	REV.
C2919-SK MC 001	1

NOTES DE CALCUL / DESIGN BRIEF
GTAA Pier F

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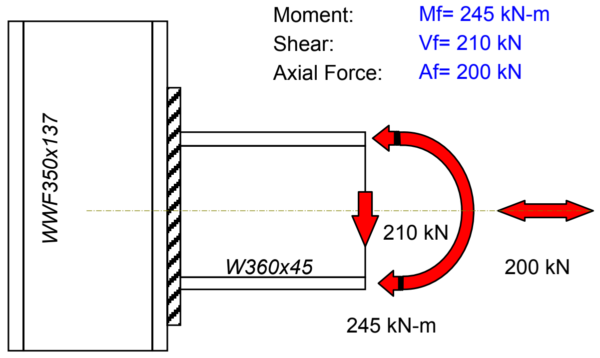
Préparé par/ Prepared by: Marc Robitaille P.E, S.E

BOLTED MOMENT CONNECTION

LIMIT STATE DESIGN (S16.1-01)

DESIGN FORCES



Moment: Mf= 245 kN-m
Shear: Vf= 210 kN
Axial Force: Af= 200 kN

Slip critical conn.

25 mm
1 in.
TYPE A490
CLASS A
FILETS incl

DESIGN VALUES

Vr=	148.0 kN
Vs=	71.6 kN
Tr=	264 kN
Ab=	507 mm²
Fu=	1035 MPa

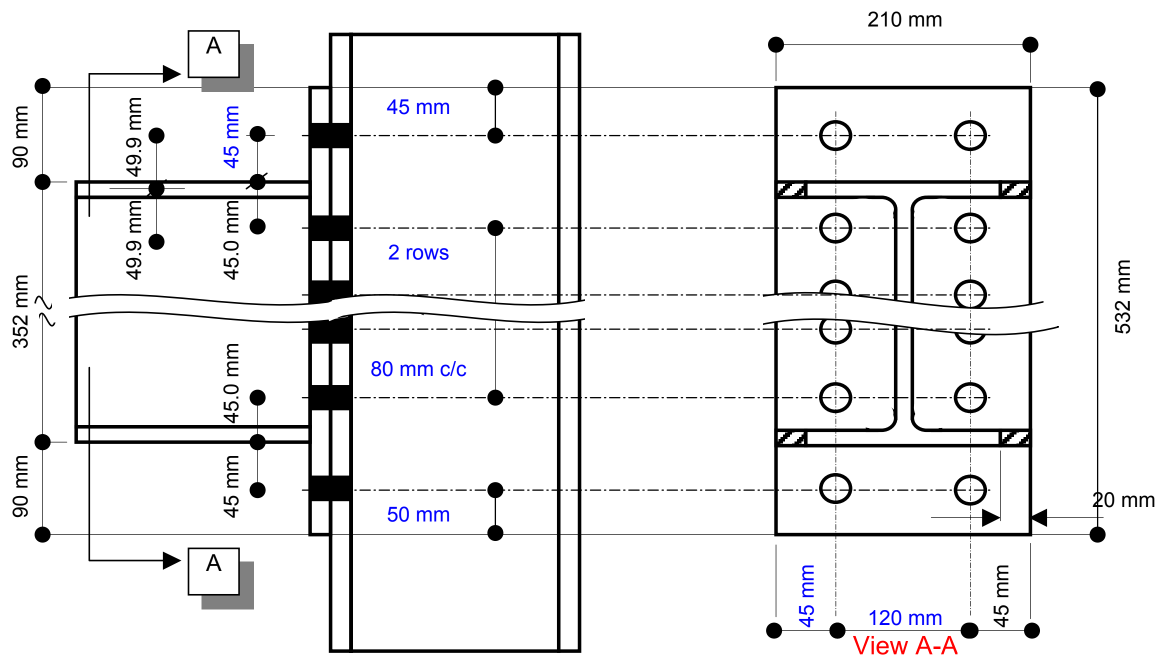
BEAM

W360x45
Fy= 350 MPa
db= 352 mm
bb= 171 mm
tb= 9.8 mm
wb= 6.9 mm
kb= 22.0 mm
Area= 5730 mm²

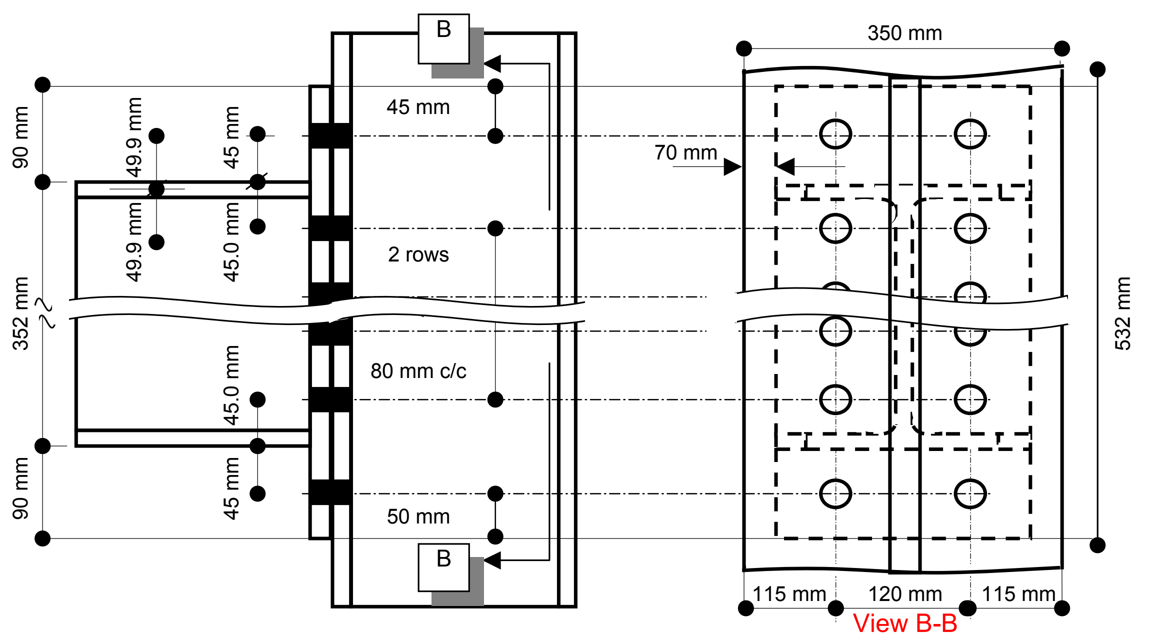
COLUMN

WWF350x137
Fy= 350 MPa
dc= 350 mm
bc= 350 mm
tc= 20.0 mm
wc= 11.0 mm
kc= 29.0 mm

END PLATE CONNECTION GEOMETRY



COLUMN FLANGE CONNECTION GEOMETRY



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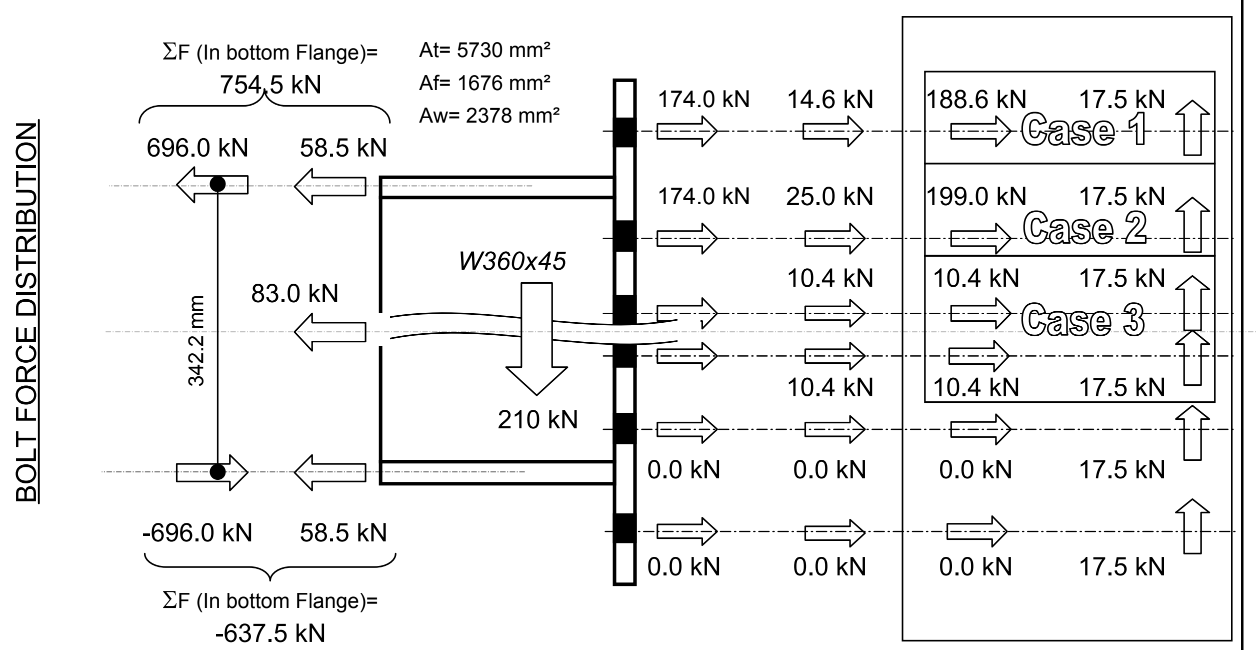

No Bolt Axial Force Due to Flange Force

Bolt Group Verification

The maximum factored tension force per bolt: B_u = 199.0 kN < 264 kN **o.k.**

The maximum factored shear force per bolt: Vser = 13.0 kN < 71.6 kN **o.k.**

Ultime resistance Verification:
- V_f/V_r = n/a
- T_f/T_r = n/a
- $(V_f/V_r)^2+(T_f/T_r)^2$ = n/a

Slip resistance Interaction $(V_{ser}/V_s)+1.9(T/(AbFu))$= 0.902 **o.k.** C.F = 1.35

Weld Design

For electrodes: E480XX

Unit factored resistance on Base metal: 202 MPa
Unit factored resistance on Weld metal: 215 MPa

Beam flanges to end-plates welds:

Minimum Filet size: 6.0 mm
Filet size required: 11.93 mm

Use D= 12 mm

Beam web to end-plates welds:

We will use the required weld size to develop the maximum bending stress (0.9Fy) in web near the tension flange. This filet will be placed from both sides of beam web from inside face of beam flange to centerline of inside bolt holes plus two bolt diameter.

$D = 0.9*F_y*w_b/2*0.202$ = 5.38 mm

Use D= 6 mm

The factored shear is to be resisted by weld between the inner row of the tension and compression bolts plus 2 row diameter for each rows.

Eff. Length of weld: 332 mm
Minimum Filet size: 6.0 mm
Maximum Filet size: 5.02 mm
Filet size required: 2.08 mm

Use D= 6 mm

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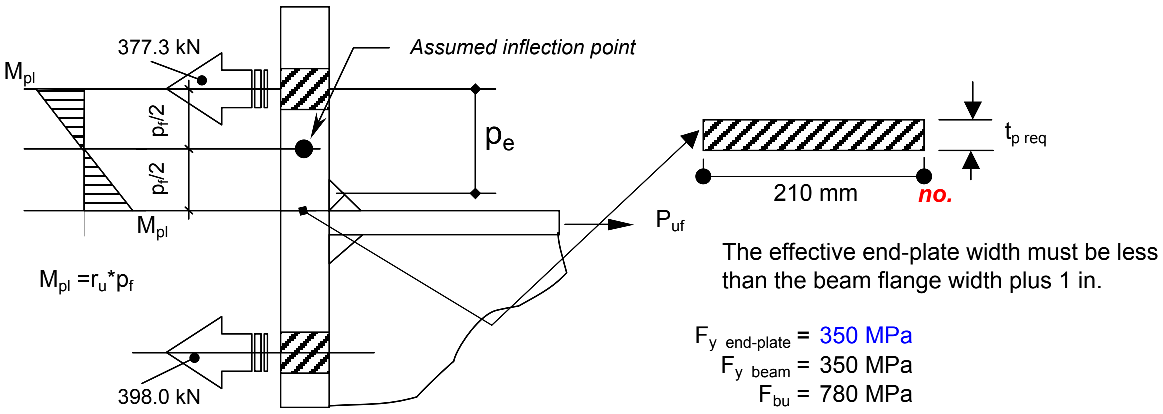
End-plate Design

This Design procedure is based on the work of Krishnamurthy (1978a) on wich prying action forces are considered negligible and the tension flange force is considered to be distributed equally to the four tension bolts. Possible local yielding of the tension flange and tension area of the web is neglected. The required end-plate thickness is determined using the tee-stub analogy.



The effective end-plate width must be less than the beam flange width plus 1 in.

$F_{y\ end\text{-}plate}$ = 350 MPa
$F_{y\ beam}$ = 350 MPa
F_{bu} = 780 MPa
F_{bt} = 390 MPa
F_b = 263 MPa
F_{avg} = 350 MPa

P_{uf} =	Factored beam flange force =	754.5 kN
α_m =	$C_aC_b(A_f/A_w)^{1/3}(p_e/d_b)^{1/4}$ =	1.194
C_a =	$1.2[1.29(F_{avg}/F_{bu})^{2/5}(F_{bt}/F_b)^{1/2}]$ =	1.369
C_b =	$(b_f/b_p)^{1/2}$ =	0.934
b_f =	beam flange width =	171 mm
b_p =	effective end-plate width =	196 mm
A_f =	area of beam tension flange =	1676 mm²
A_w =	area of beam web, clear of flanges =	2378 mm²
p_e =	effective pitch =	30.27 mm
p_f =	distance from centerline of bolt to nearer surface of tension flange.	45 mm
w_t =	fillet weld throat size =	8.48 mm
d_b =	nominal bolt diameter =	25 mm

The critical moment in the end-plate is given by: $M_{eu} = (\alpha_m * P_{uf} * p_e)/4$ = **6817 kN-mm**

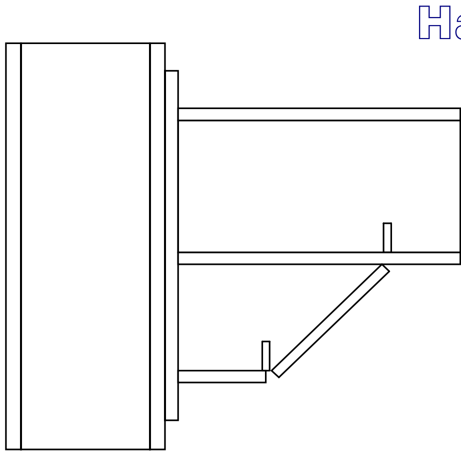
The required end-plate thickness is then determined as: $t_{p\ req} = [(4*M_{eu})/(\phi F_y b_p)]^{1/2}$ = **21.0 mm**

Use t_p = 22 mm

Verification of the shear yielding of the end-plate: $\phi R_n = 2*\phi(0.60F_yA_g)$ = 1746 kN

o.k.

Haunch Design



If the maximum factored tension force per bolt is higher than the tension capacity of the selected bolt, we can increase the depth of the moment connection and by doing so we reduce the applied tension force per bolt. In some cases with a haunch we can avoid the column stiffening wich result in a lower cost for the overall connection.

Design calc. using a haunch: STD bolted MC

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