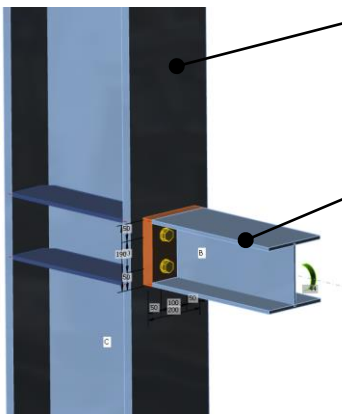


Verification example Flush Moment End-Plate

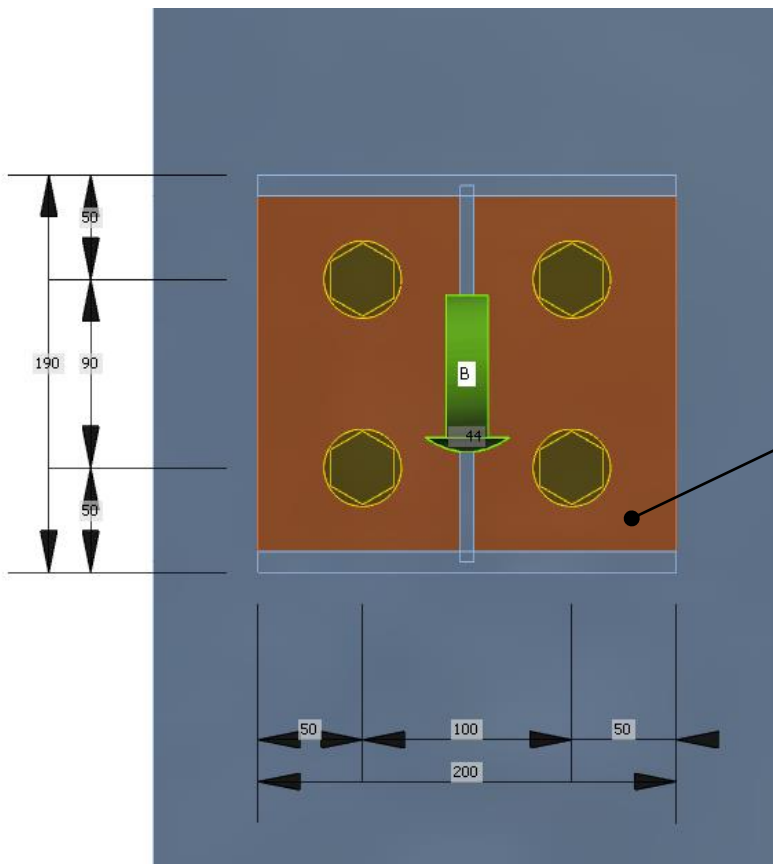
Type of connection: Flush Moment End-Plate connection
Unit system: Metric
Designed acc. to: AISC 360-10 - Design Guide 16 – LRFD
Investigated: Bolts, End-plate
Materials: Steel A36, Bolts A490M

Geometry:



Profile:
HEB 500

Profile:
HEA 200



End-Plate
thickness:

$t_p = 35\text{mm}$

Bolts:

M20 – A490M

Applied forces:

$M = 44 \text{ kNm}$

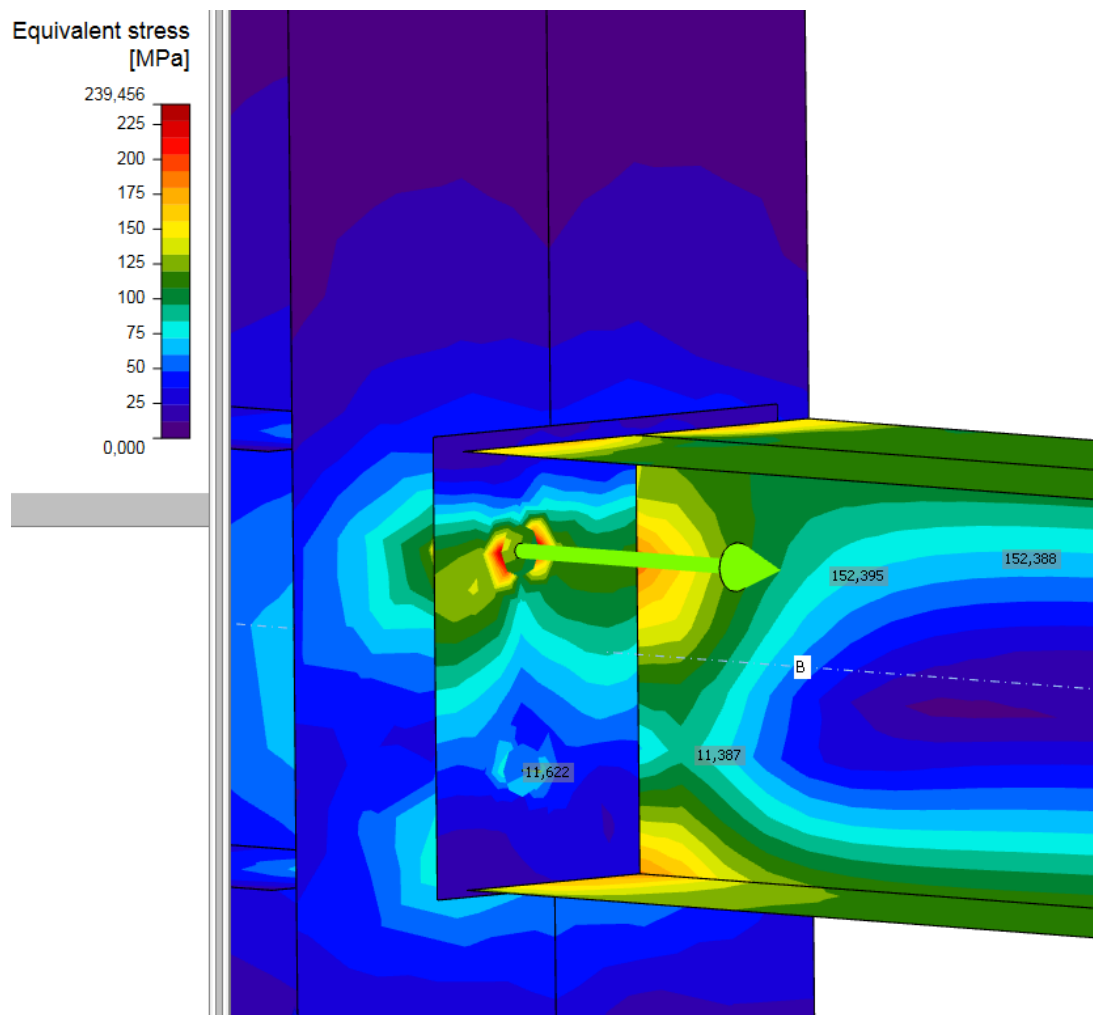
$V = 0 \text{ kN}$

$N = 0 \text{ kN}$

Procedure:

For the purpose of verification, it is considered that design is determined by bolt rupture with no prying actions. Therefore the design procedure (acc. DG16) is used.

IDEA StatiCa Connection – results



The tension force in upper bolt is **$F_t = 152.4 \text{ kN}$**

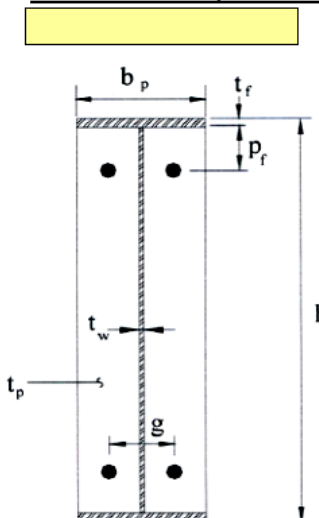
The ultimate tensile strength of M20 – A490M is **$F_{nt} = 183.8 \text{ kN}$**

acc. Table J3-2 and Eq. J3-1

The unit check: $152.4/183.8 = \mathbf{0.83} = \mathbf{83\%}$

AISC 360-10 and Design Guide 16 – results

Flush connection (AISC Steel design guide 16) - no prying actions



$h =$	190	mm
$t_w =$	6,5	mm
$t_f =$	10	mm
$t_p =$	35	mm
$b_p =$	200	mm
$g =$	100	mm
$p_f =$	40	mm

Plate and beam steel: **A36**

$E =$	200	GPa
$f_y =$	250	MPa
$f_u =$	400	MPa
$\Phi_b =$	0,9	
$\Phi_b f_y =$	225,0	MPa
$\Phi =$	0,75	
$\gamma_r =$	1,25	

Full capacity of profile? **No** (Area computed + 4% radii)

Moment $M_{yd} =$ **44,0** kNm

Moment $M_{zd} =$ kNm

Axial force $N_d =$ kN

Shear force $V_{zd} =$ kN

$M_u = M_{yd} + 0,5N_d(h_{p,or-t}) + M_{zd} h_t / (b_p + g) =$ **44** kNm

Added to M

AISC steel design guide 16 - 4.2.3

Max unit check: **0,89 OK**

End-Plate Yield

$$\phi M_n = \phi_b M_{pl} = \phi_b F_y A_g$$

$$Y = \frac{b_p}{2} \left[h_f \left(\frac{l}{p_f} + \frac{l}{s} \right) \right] + \frac{2}{g} [h_f (p_f + s)]$$

Note: Use $p_f = s$, if $p_f > s$

$$s = \frac{1}{2} \sqrt{b_p g} \quad \phi_b = 0.90$$

Bolt Rupture No Prying Action

$$\phi M_n = \phi M_{np} = \phi [2(P_t) d_1] \quad \phi = 0.75$$

Plate thickness check

$\Phi M_n =$	236 kNm	>	$1,11 Y M_u =$	61 kNm	0,26 OK
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Bolts check

Bolts	4xM 20	Class	A490M	$d_{B0} =$	24	mm	($d_b + 2$ mm)	
Shear plane in thread?	Yes	$f_y =$	780	$F_{nt} =$	245	kN	tension force per 1 bolt	
Pretension (fully tightend):		$T_b =$	179	kN	$F_{nv} =$	144	kN	shear force per 1 bolt

$\Phi M_n =$ 50 kNm > $M_u =$ 44 kNm **0,89 OK**

The resulting force in one bolt is: $F_t = M_u / (2 d_1) = 44 \text{ kNm} / (2 \times 0.135\text{m}) = \mathbf{163 \text{ kN}}$

The unit check: **89%**

Comparison:

The results show that the force computed using CBFEM by IDEA StatiCa is slightly lower than using standard approach in AISC Design Guide. The difference is around 6-7%

The check of end-plate is hardly comparable, since the IDEA StatiCa is based on FEM analysis. However in both cases the thickness of the end-plate is satisfactory and doesn't determine the check of connection.