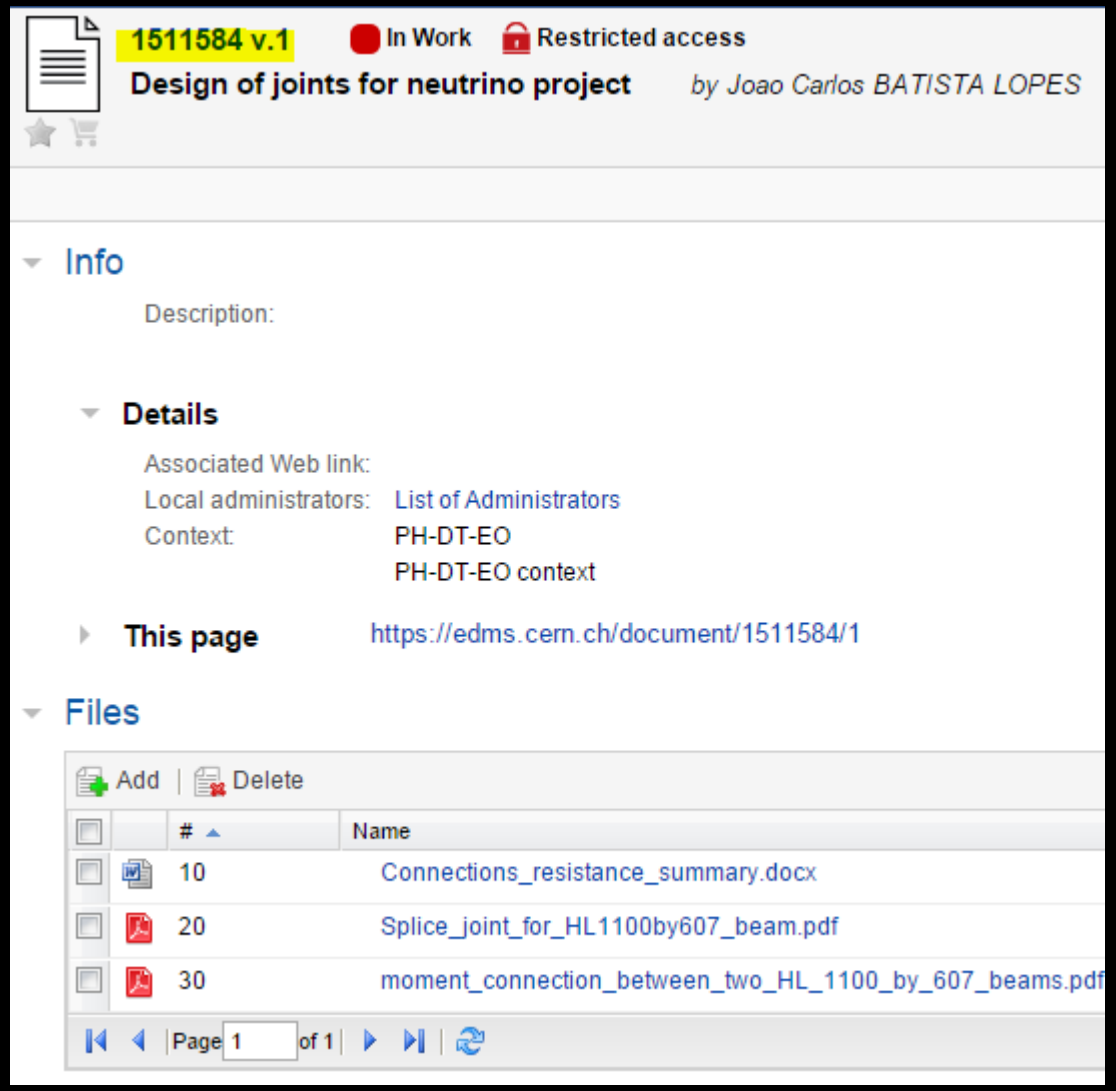
Design of the joints for neutrino project

jcbl

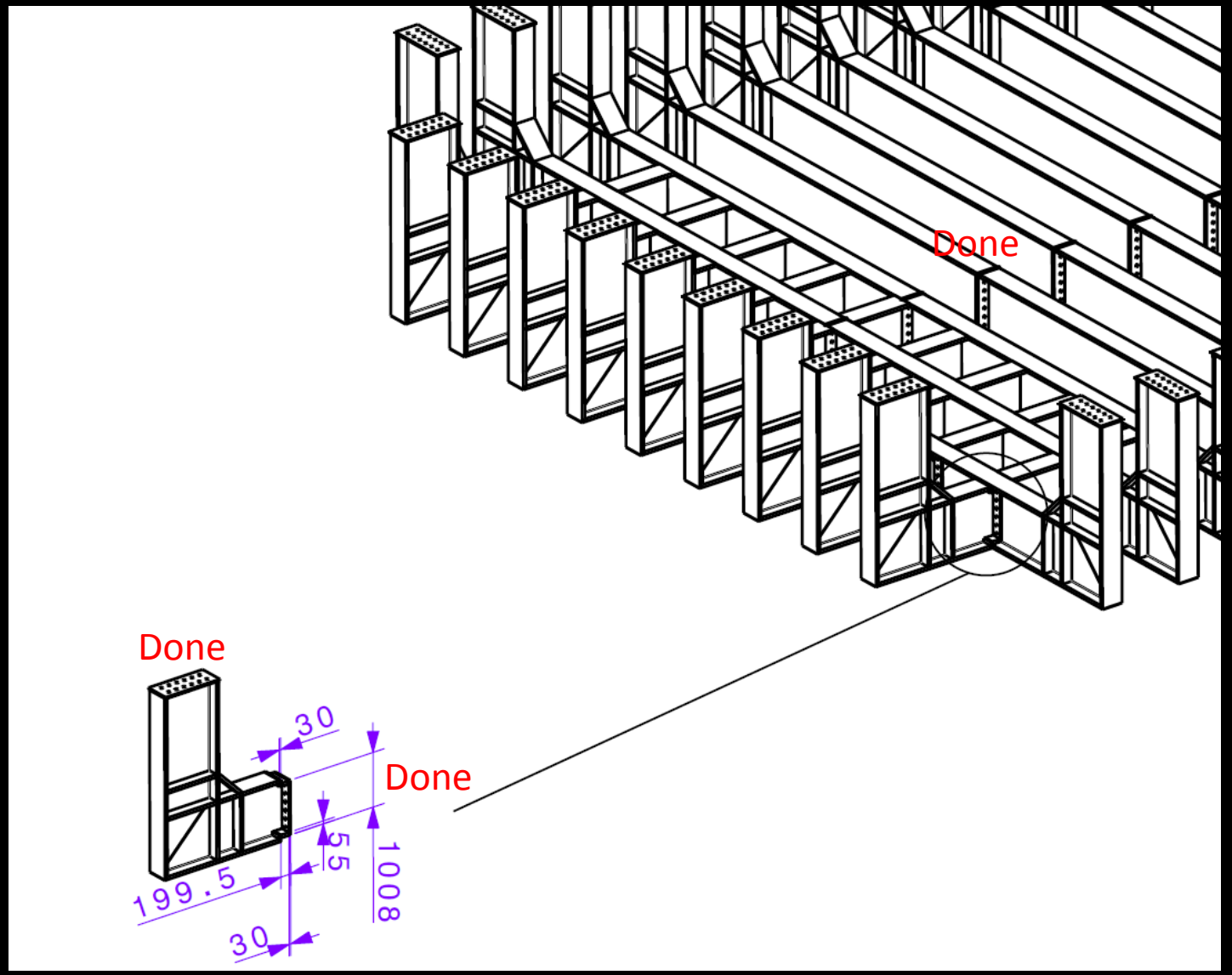
18/5/2015



Document status: In work

Contents:

- Analytical calculations (EC3 compliance)
- FEA (stress compliance with ASME)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30
55
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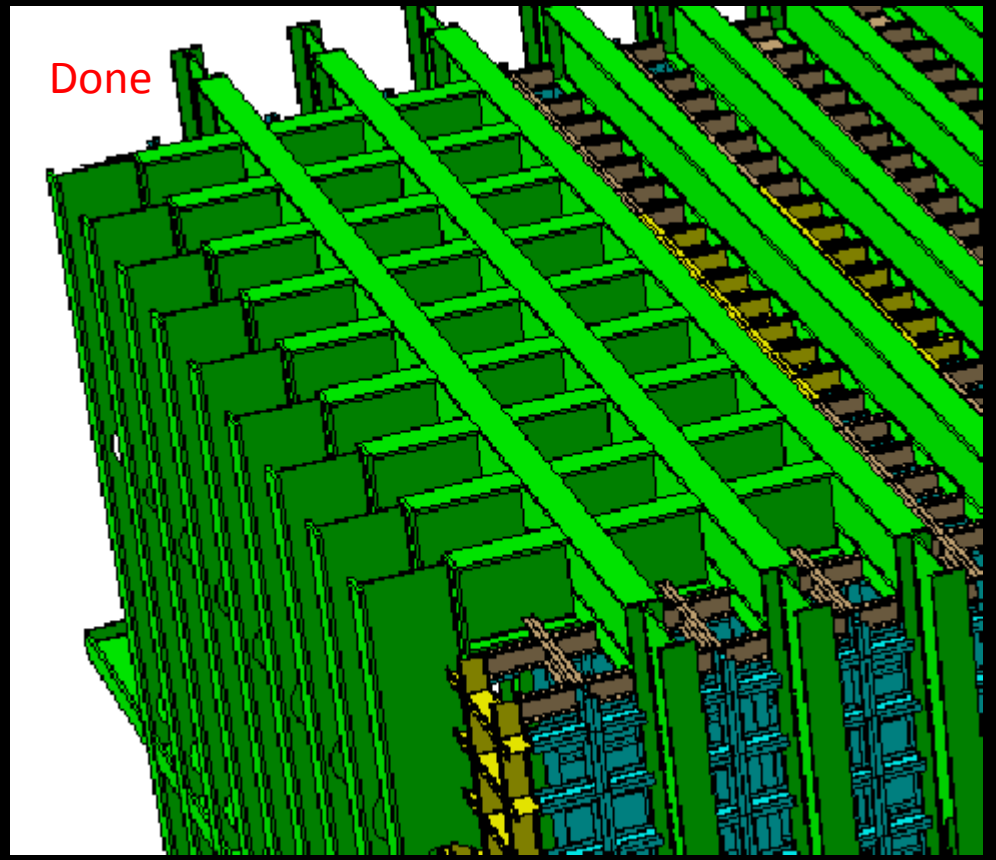
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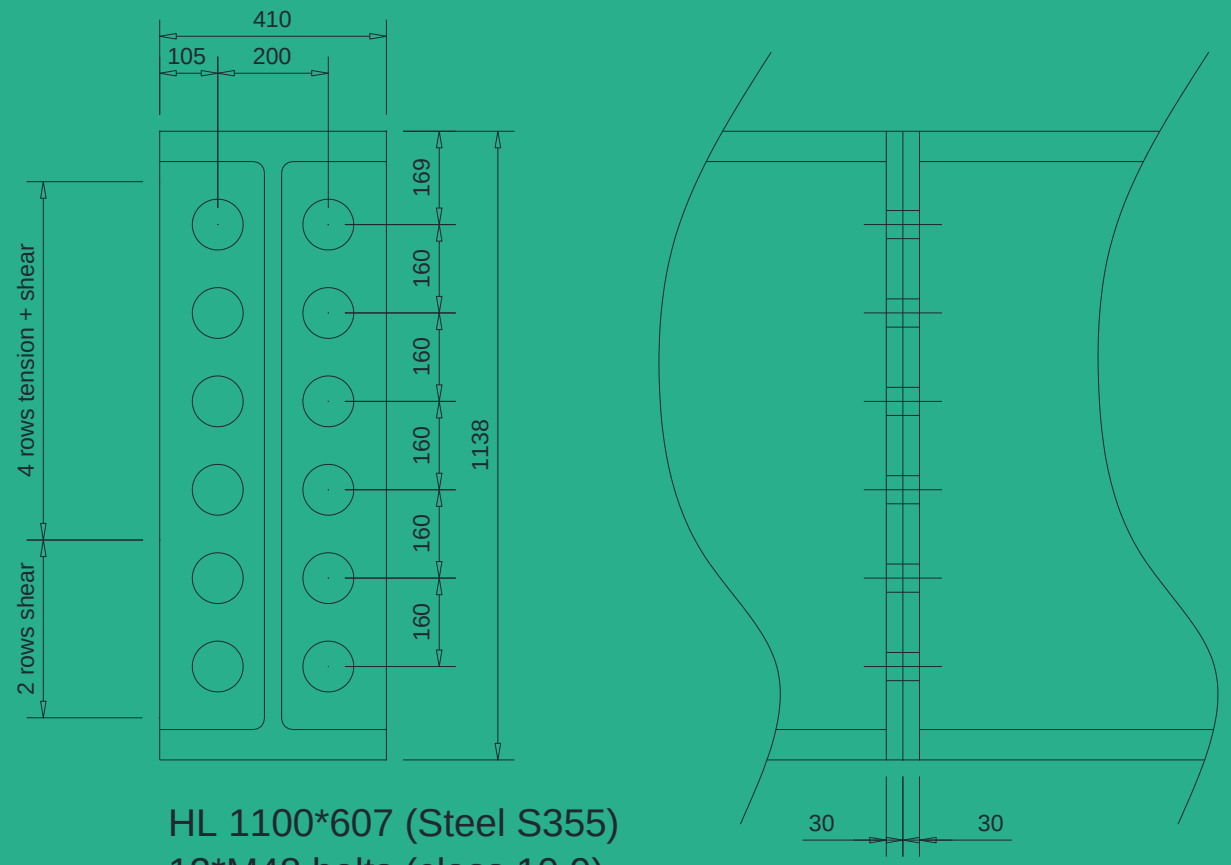
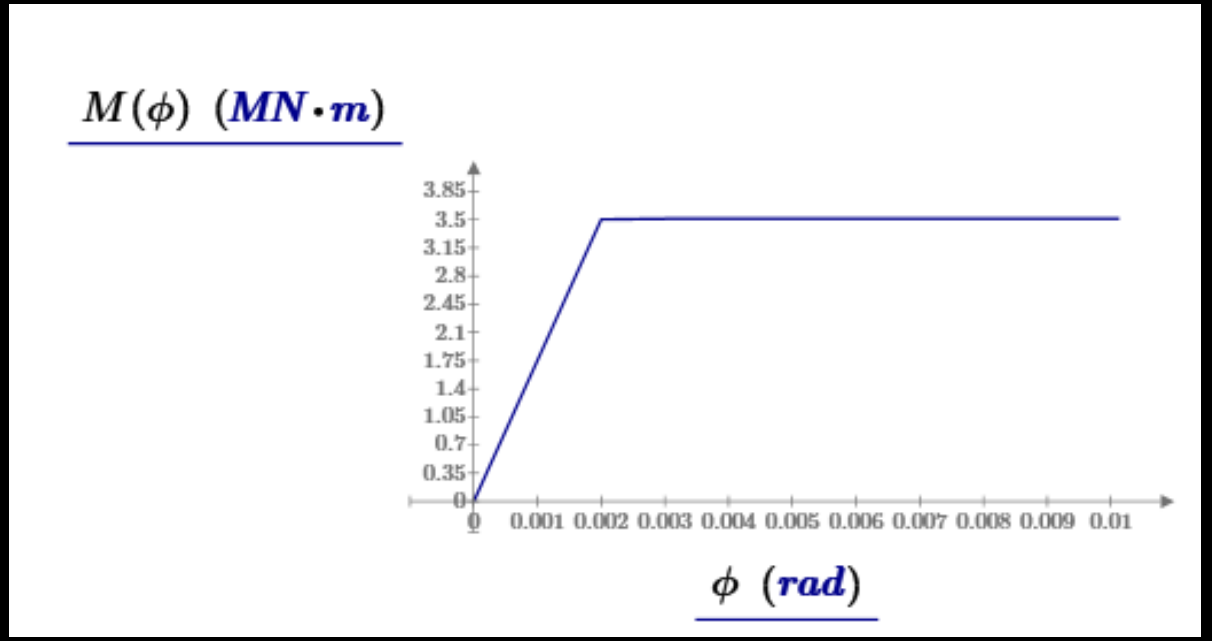
Splice 1 geometry



HL 1100*607 (Steel S355)
12*M48 bolts (class 10.9)
tp=30 mm (Steel S 355)



Splice 1 capacity

- *Compression components*

Beam flange and web in compression: $F_{c.fb.Rd} = 9.805\ MN$

- *Tension components*

$F_{t1.Rd} = 1.567\ MN$

$F_{t2.Rd} = 1.343\ MN$

$F_{t3.Rd} = 1.396\ MN$

$F_{t4.Rd} = 1.195\ MN$

$F_{t.total.Rd} := F_{t1.Rd} + F_{t2.Rd} + F_{t3.Rd} + F_{t4.Rd} = 5.502\ MN$

- *Connection capacity*

Moment resistance $M_{j.Rd} = 2.726\ MN \cdot m$

Shear resistance $V_{j.Rd} = 1.347\ MN$

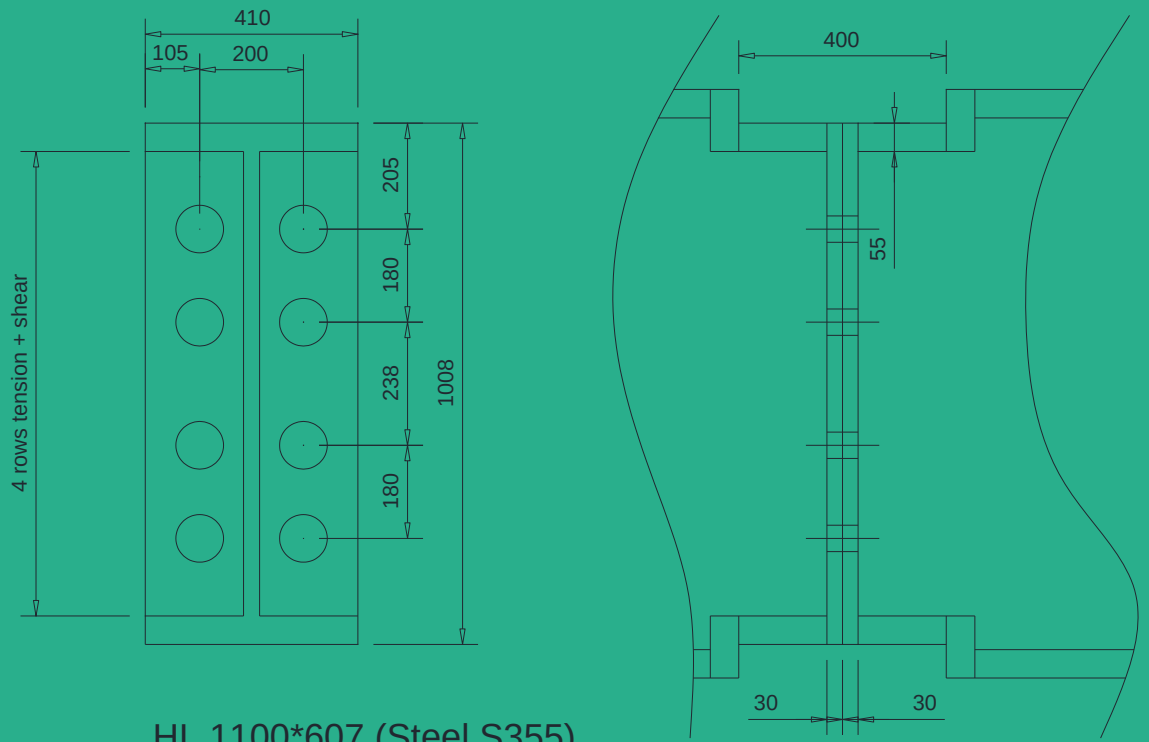
Initial rotation stiffness $S_{j.ini} = 2145.939\ MN \cdot \frac{m}{rad}$

Idealized rotation stiffness (for design) $S_j = 1072.969\ MN \cdot \frac{m}{rad}$

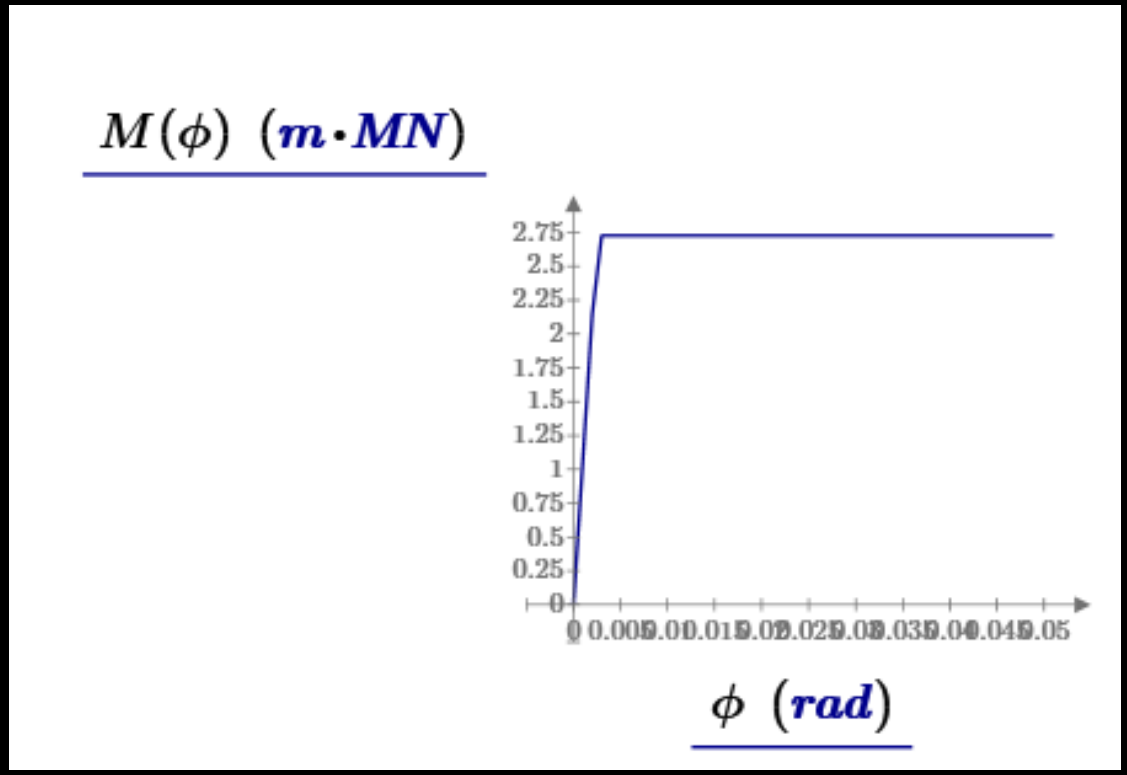
Minium rigidity for rigid joint $S_{j.rigid} = 1706.601\ MN \cdot \frac{m}{rad}$

maximum rigidity for pinned joint $S_{j.pinned} = 106.663\ MN \cdot \frac{m}{rad}$

Splice 2 geometry



HL 1100*607 (Steel S355)
8*M48 bolts (class 10.9)
tp=30 mm (Steel S 355)



Splice 2 capacity

- *Compression components*

Beam flange and web in compression: $F_{c.fb.Rd} = 9.805\ MN$

- *Tension components*

$F_{t1.Rd} = 1.909\ MN$

$F_{t2.Rd} = 1.909\ MN$

$F_{t3.Rd} = 1.858\ MN$

$F_{t4.Rd} = 1.636\ MN$

$F_{t.total.Rd} := F_{t1.Rd} + F_{t2.Rd} + F_{t3.Rd} + F_{t4.Rd} = 7.313\ MN$

- *Connection capacity*

Moment resistance $M_{j.Rd} = 3.572\ MN \cdot m$

Shear resistance $V_{j.Rd} = 1.347\ MN$

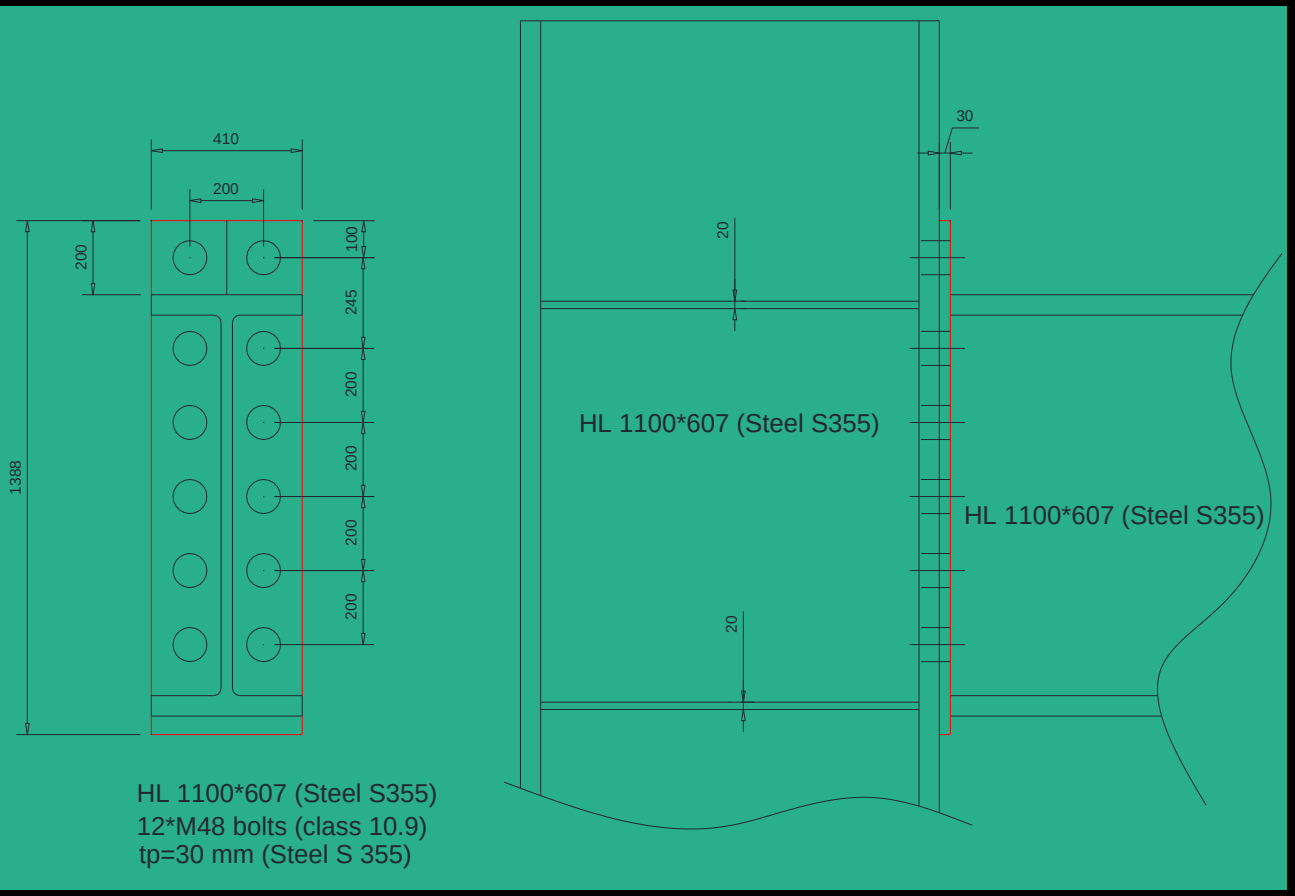
Initial rotation stiffness $S_{j.ini} = 3029.423\ MN \cdot \frac{m}{rad}$

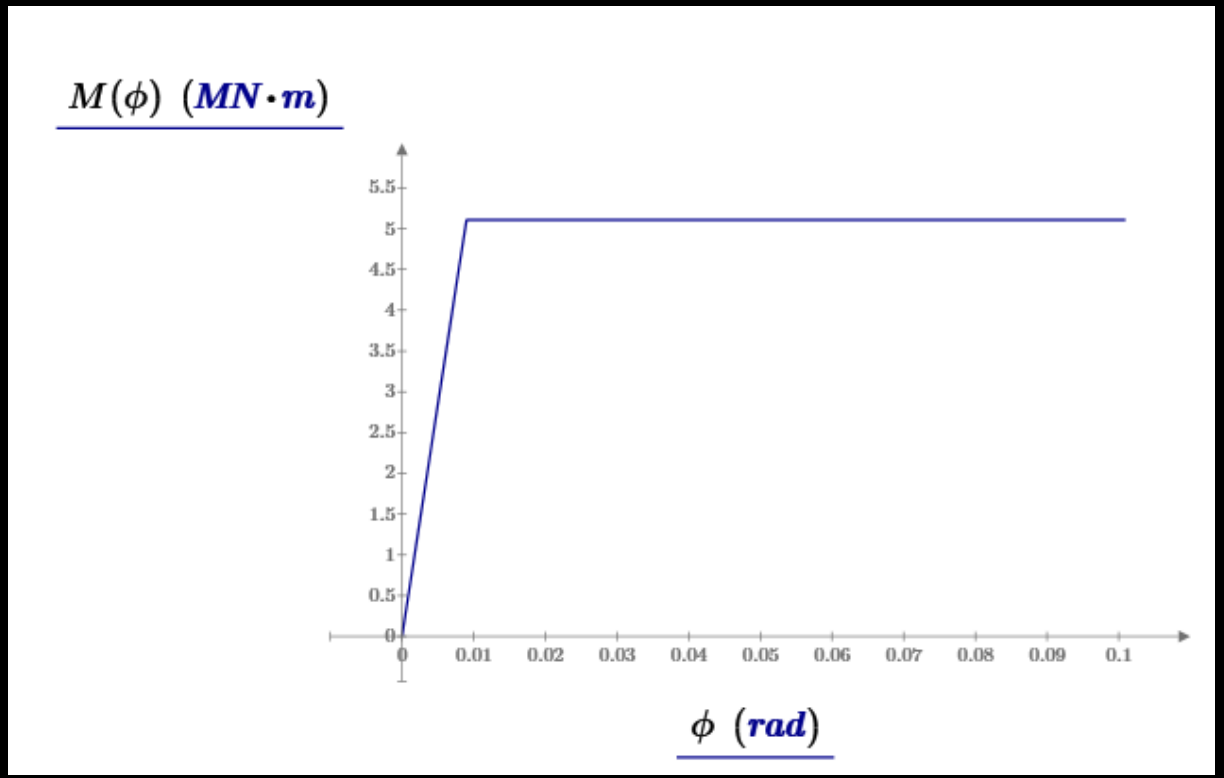
Idealized rotation stiffness (for design) $S_j = 1514.711\ MN \cdot \frac{m}{rad}$

Minium rigidity for rigid joint $S_{j.rigid} = 1706.601\ MN \cdot \frac{m}{rad}$

maximum rigidity for pinned joint $S_{j.pinned} = 106.663\ MN \cdot \frac{m}{rad}$

Moment connection geometry





Moment connection capacity

- *Shear components*

Column web in shear: $V_{w.Rd} = 7.565\ MN$

- *Compression components*

Column web in transverse compression: $F_{c.wc.Rd} = 12.156\ MN$

Beam flange and web in compression: $F_{c.fb.Rd} = 13.771\ MN$

- *Tension components*

$F_{t1.Rd} = 1.026\ MN$

$F_{t2.Rd} = 1.558\ MN$

$F_{t3.Rd} = 1.348\ MN$

$F_{t4.Rd} = 1.227\ MN$

$F_{t5.Rd} = 1.558\ MN$

$F_{t6.Rd} = 0.395\ MN$

$$F_{t.total.Rd} := F_{t1.Rd} + F_{t2.Rd} + F_{t3.Rd} + F_{t4.Rd} + F_{t5.Rd} + F_{t6.Rd} = 7.113\ MN$$

- *Connection capacity*

Moment resistance $M_{j.Rd} = 5.107\ MN \cdot m$

Shear resistance $V_{j.Rd} = 2.02\ MN$

Initial rotation stiffness $S_{j.ini} = 1138.074\ MN \cdot \frac{m}{rad}$

Idealized rotation stiffness (for design) $S_j = 569.037\ MN \cdot \frac{m}{rad}$

Minium rigidity for rigid joint $S_{j.rigid} = 6297.451\ MN \cdot \frac{m}{rad}$

maximum rigidity for pinned joint $S_{j.pinned} = 393.591\ MN \cdot \frac{m}{rad}$

Joint classification

$$Joint_{classification} := \left\| \begin{array}{l} \text{if } S_j \le S_{j.pinned} \\ \quad \text{“Pinned”} \\ \text{else if } S_j \ge S_{j.rigid} \\ \quad \text{“Rigid”} \\ \text{else} \\ \quad \text{“Semi–rigid”} \end{array} \right\| = \text{“Semi–rigid”}$$