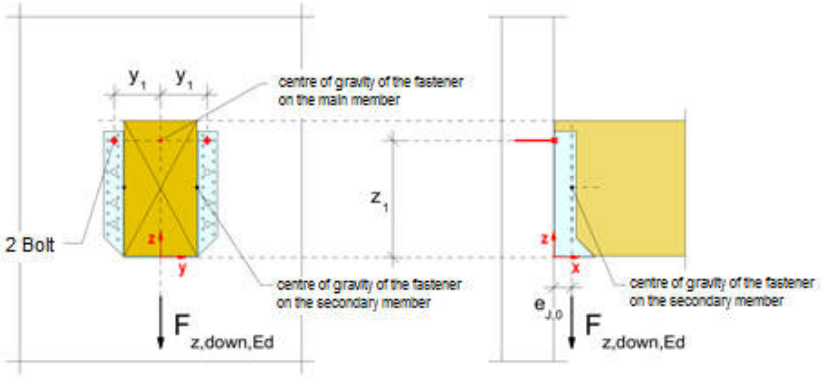
Determination of the bolt loads for GH joist hangers

For joist hangers to ETA-08/0264, equations are given in the following, with which it is possible to determine the most highly loaded bolt in the main member joint. The allowable actions here are forces in the Y-direction, with lever arms $e_{J,0}$ and $e_{J,90}$, as well as forces in the Z-direction with lever arm $e_{J,0}$. The values y_i, z_i, $e_{J,0}$, $e_{J,90}$ as well as the fastener centre of gravity on the main member joint and the fastener centre of gravity on the secondary member joint, depend on the selected joist hanger, the secondary member dimensions and the selected number of bolts used. These values must therefore be determined individually. The embedment verification of the joist hanger is to be provided separately for bolt force $F_{v,y,Ed}$ and $F_{v,z,Ed}$.

$e_{J,90}$	distance in Z-direction of force $F_{y,Ed}$ to the fastener centre of gravity of the secondary member joint.
$e_{J,0}$	distance in the Y-direction between the row of nails on the secondary member joint and the surface of the main member.
$F_{ax,Ed}$	resulting tensile load of the bolt.
$F_{v,Ed}$	resulting shear load on the bolt.
$F_{v,y,Ed}$	shear load of the bolt in y-direction
$F_{v,z,Ed}$	shear load of the bolt in z-direction

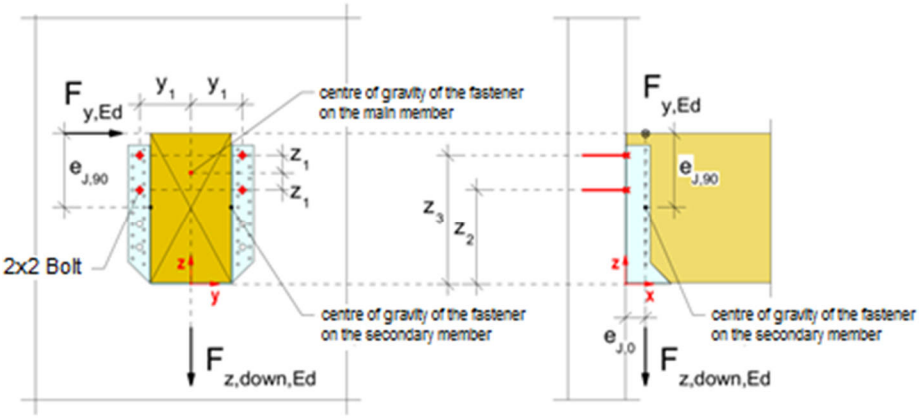
Use case 1: 2 bolts with $F_{y,Ed}$ and $F_{z,Ed}$



$$F_{v,Ed} = F_{v,z,Ed} = \frac{F_{z,Ed}}{2}$$ for $F_{z,Ed}$

$$F_{ax,Ed} = \frac{F_{z,Ed} \cdot e_{J,0}}{2 \cdot z_1}$$ for $F_{z,Ed}$

Use case 2: 2x2 bolts with $F_{y,Ed}$ and $F_{z,Ed}$

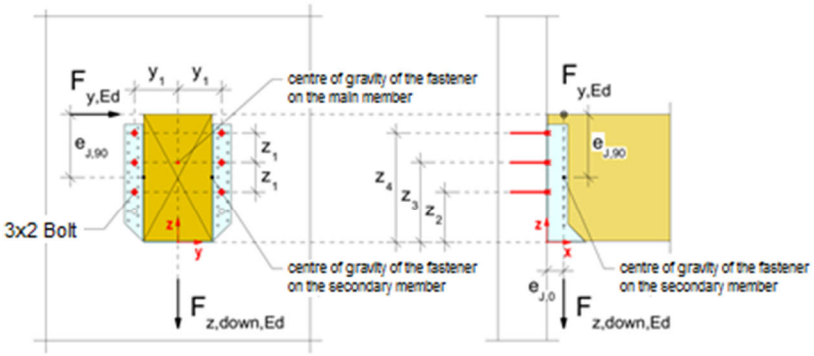


$$F_{v,Ed} = F_{v,z,Ed} = \frac{F_{z,Ed}}{4}$$ for $F_{z,Ed}$

$$F_{v,Ed} = \sqrt{F_{v,y,Ed}^2 + F_{v,z,Ed}^2} = \sqrt{\left(\frac{F_{y,Ed}}{4} + \frac{F_{y,Ed} \cdot e_{J,90} \cdot z_1}{4 \cdot (z_1^2 + y_1^2)}\right)^2 + \left(\frac{F_{z,Ed}}{4} + \frac{F_{y,Ed} \cdot e_{J,90} \cdot y_1}{4 \cdot (z_1^2 + y_1^2)}\right)^2}$$ for $F_{y,Ed}$ and $F_{z,Ed}$

$$F_{ax,Ed} = \frac{F_{z,Ed} \cdot e_{J,0} \cdot z_2}{2 \cdot (z_2^2 + z_3^2)}$$ for $F_{z,Ed}$

Use case 3: 3x2 bolts with $F_{y,Ed}$ and $F_{z,Ed}$



$$F_{v,Ed} = F_{v,z,Ed} = \frac{F_{z,Ed}}{6}$$ for $F_{z,Ed}$

$$F_{v,Ed} = \sqrt{F_{v,y,Ed}^2 + F_{v,z,Ed}^2} = \sqrt{\left(\frac{F_{y,Ed}}{6} + \frac{F_{y,Ed} \cdot e_{J,90} \cdot z_1}{4 \cdot z_1^2 + 6 \cdot y_1^2}\right)^2 + \left(\frac{F_{z,Ed}}{6} + \frac{F_{y,Ed} \cdot e_{J,90} \cdot y_1}{4 \cdot z_1^2 + 6 \cdot y_1^2}\right)^2}$$ for $F_{y,Ed}$ and $F_{z,Ed}$

$$F_{ax,Ed} = \frac{F_{z,Ed} \cdot e_{J,0} \cdot z_3}{2 \cdot (z_2^2 + z_3^2 + z_4^2)}$$ for $F_{z,Ed}$