List of symbols

- $a$  throat thickness of fillet weld
- $a_1$  effective length of the foundation, length of the base plate
- $a_c$  height of the column cross-section
- $a_h$  size of the anchor head
- $b$  width of angle leg, width of the base plate
- $b_{th}, b_t, b_w$  width, effective width of the foundation
- $b_s$  width of beam flange
- $b_c$  width of the column cross-section, of column flange
- $b_{eff}$  effective width
- $b_{haz}$  width of heat affected zone
- $b_p$  width of end plate
- $e$  effective width of the flexible base plate
- $c_{0}$  required concrete cover for reinforcement
- $d$  nominal diameter of the bolt
- $d_0$  diameter of the bolt hole
- $d_1, d_2$  diameter
- $d_h$  diameter of anchor head
- $e$  eccentricity, distance from bolt to edge of T-stub, from edge of the angle
- $e, e_x, e_a, e_b$  bolt distances
- $e_0$  eccentricity of the joint
- $e_1, e_2$  bolt end distance, in force direction, perpendicular to force direction
- $e_x$  distance from bolt to edge of end plate
- $f_a$  characteristic strength for local capacity in tension and compression
- $f_{ahaz}$  characteristic strength of heat affected zone
- $f_{cd}$  design value of compressive cylinder strength of concrete $f_{cd} = f_{ck} / \gamma_c$
- $f_{cd,g}$  design value of compressive cylinder strength of grout
- $f_c$  characteristic value of concrete compressive cylinder strength
- $f_j$  concrete bearing strength
- $f_o$  characteristic strength for bending and yielding in tension and compression
- $f_u$  ultimate strength
- $f_{ub}$  ultimate strength of the bolt
- $f_s$  characteristic shear strength
- $f_{shaz}$  characteristic shear strength of heat affected zone
- $f_{we,d}$  design shear resistance of the fillet weld per unit length
- $f_w$  characteristic strength of the weld metal
- $f_y$  yield stress of steel
- $f_{yav}$  average yield strength
- $f_{yb}$  yield stress of the bolt
- $f_{yc}$  yield stress of column
- $g$  length of the gap
- $g_1$  leg length of fillet weld
- $h, h_0, h_1$  height, height of concrete foundation
- $h_c$  height of column cross section
- $h_{ef}$  length of anchor embedded in the concrete
- $k$  stiffness coefficient
- $k_c$  total stiffness coefficient of the compression zone
- $k_{eff}$  total stiffness coefficient of one bolt row in tension
- $k_{eq}$  total stiffness coefficient the tension zone
- $k_i$  stiffness of component $i$
- $k_j$  stress concentration factor
- $k_\theta$  reduction factor based on material temperature
\( m, m_3 \) distance from the bolt centre to the plate
\( m_1, m_2 \) distances from bolt to web of T-stub
\( m_{pl,Rd} \) plastic bending moment resistance of the base plate per unit length
\( m_x \) distance from bolt to beam flange
\( n \) distance from bolt centre to contact with the foundation
\( p \) bolt pitch
\( p_1, p_2 \) bolt pitch; in force direction, perpendicular to force direction
\( r \) lever arm
\( r_c \) fillet radius of column
\( r_t \) theoretical resistance obtained from the design model
\( r_i \) experimentally found resistance
\( t \) thickness
\( t_0, t_1, t_2, t_w \) thickness
\( t_e \) effective thickness of partial penetration butt weld
\( t_f \) thickness of flange
\( t_{fb} \) thickness of beam flange
\( t_{fc} \) thickness of column flange
\( t_g \) thickness of grout
\( t_h \) thickness of anchor head
\( t_p \) thickness of plate thickness, of end plate
\( t_{ic} \) thickness of column flange
\( t_w \) thickness of the column web
\( t_{wa} \) thickness of the washer
\( t_{wc} \) thickness of column web
\( w_1, w_2 \) distance between bolts
\( x, y, z \) axes
\( z \) lever arm
\( z_c \) lever arm of compression zone
\( z_{cb} \) lever arm of compression zone at bottom of the joint
\( z_{ct} \) lever arm of compression zone at top of the joint
\( z_{eq} \) equivalent lever arm
\( z_t \) lever arm of tension zone

\( A \) area, surface area of the member per unit length
\( A_0 \) area
\( A_b \) total area of bolt, unthreaded part
\( A_c \) area of the column
\( A_{eff} \) effective area; of the flexible base plate, of the cross-section
\( A_g \) area of the gross section
\( A_h \) bearing area of the bolt head
\( A_{net} \) net area
\( A_s \) net area of the bolt, in thread
\( A_s \) shear area
\( B_e \) effective length
\( B_{ld} \) design resistance of bolt in tension
\( C_{0s}, C_f \) constant values
\( C_{0s}, C_{tr}, C_{s}, C_k \) efficiency parameter
\( C_{f,ld} \) friction coefficient
$E$  Young’s modulus of steel

$F$  force

$F_{b,Rd}$  design bearing resistance

$F_{c,b,Rd}$  design resistance in compression in bottom zone of the joint

$F_{c,fb,Rd}$  design resistance of beam flange in compression

$F_{c,Rd}$  design resistance in compression

$F_{c,t,Rd}$  design resistance in compression in top zone of the joint

$F_{c,wc,Rd}$  design resistance of column web in compression

$F_{el}$  elastic limit

$F_{exp,fy/fum}$  resistance for the structural members obtained from the tests to failure

$F_{o,Rd}$  pull-out resistance

$F_{p,Cd}$  design preloading force

$F_{p,Rd}$  pull-through resistance

$F_{Rd}$  design resistance

$F_{Sd}$  applied force

$F_{t,Rd}$  design tension resistance

$F_{t,Sd}$  tensile force

$F_{tep,Rd}$  design resistance of end plate in bending

$F_{t,fc,Rd}$  design resistance of column flange in bending

$F_{t,wb,Rd}$  design resistance of beam web in tension

$F_{t,wc,Rd}$  design resistance of column web in tension

$F_{t,i,Rd}$  resistance of the $i$-th bolt row in tension

$F_{v,Rd}$  design shear resistance

$F_{v,Sd}$  shear force

$F_{w,Rd}$  resistance of the weld per unit length

HAZ  Heat Affected Zone

$I$  second moment of inertia

$I_b$  second moment of inertia of beam

$I_c$  second moment of inertia of column

$\bar{S}_{ini}$  relative initial stiffness

$K_{el,20^\circ C}, K_{el,20^\circ C}$  elastic and plastic stiffness of the component, at ambient temperature

$L, L_1$  length, beam span

$L_b$  length of beam

$L_f$  free length of the anchor bolt

$L_{b,lim}$  maximal bolt length, when anchor bolt may be exposed to prying

$L_{be}$  embedded length of the anchor bolt

$L_{bf}$  length of anchor bolt above the concrete foundation

$L_c$  length of column

$L_{eff}$  effective length of a T-stub

$L_{eq}$  equivalent length of the anchor bolt

$L_w$  length of fillet weld
L_{w,eff}  
M  
M'  
M_{j,Rd}  
M_{j,ult,d}  
M_{j,ult,ecp}  
M_{pl,Rd}  
N  
N_0, N_1, N_2  
N_{1y}  
N_{pl,Rd}  
N_{sd}  
N_{u,Rd}  
Q  
R_d  
R_{sy}  
S_j  
S_{j,sec}  
S_{j,ini}  
S_{j,ini}  
S_{j,ini}  
V  
V_{G,Ed}  
V_{M,Ed}  
V_{pl,Rd}  
V_{sd}  
V_{wp, Rd}  
W_{ext}  
W_{int}  

\alpha  
\alpha_b  
\alpha_d  
\beta  
\beta, \beta_3, \beta_3  
\beta_j  
\beta_{lw}  
\beta_w  
\delta  
\delta_c  
\delta_{b,c}  
δ_{c} \quad \text{deformation of components in compression zone at top of the joint}
δ_{d} \quad \text{deformation capacity}
δ_{t} \quad \text{deformation of components in tension zone}
Δ\theta \quad \text{temperature interval}
Δt \quad \text{time interval}
ε \quad \text{strain}
ϕ \quad \text{joint rotation}
ϕ_{pl} \quad \text{plastic rotation capacity}
ϕ_{p} \quad \text{available plastic rotation}
γ \quad \text{partial safety factor}
γ_{M} \quad \text{partial safety factor for the resistance}
γ_{M,bi} \quad \text{partial safety factor for fire}
γ_{M0} \quad \text{partial safety factor for steel}
γ_{M\theta} \quad \text{partial safety factor of bolted connections}
γ_{Mw} \quad \text{partial safety factor for weld}
γ_{\theta\theta} \quad \text{partial safety factor of slip resistance}
γ_{M\theta,ser} \quad \text{partial safety factor of slip resistance at serviceability}
γ_{M3} \quad \text{partial safety factor of net section at bolt holes}
θ \quad \text{temperature}
θ_{0} \quad \text{temperature of the lower beam flange at mid span}
θ_{1}, \theta_{2}, \theta_{i} \quad \text{angle between diagonal and the chord}
σ \quad \text{normal stress}
σ_{//} \quad \text{normal stress parallel to the axis of the weld}
σ_{\perp} \quad \text{normal stress perpendicular to the axis of the weld}
τ \quad \text{shear stress}
τ_{//} \quad \text{shear stress (in the critical plane of the throat) parallel to the weld axis}
τ_{\perp} \quad \text{shear stress (in the critical plane of the weld) perpendicular to the weld axis}
η \quad \text{stiffness modification coefficient}
λ_{1}, λ_{2} \quad \text{dimensions of the T-stub}
\bar{λ} \quad \text{relative slenderness}
\mu_{0} \quad \text{degree of utilization}
\mu \quad \text{stiffness ratio}
ρ_{\text{HAZ}} \quad \text{heat affected zone (HAZ) softening factor}
ψ \quad \text{shape factor}

\* \text{in prEN 1993-1-8: 2003 are the partial safety factors for prediction of the resistance simplified:}
γ_{M0} \quad \text{partial safety factor of steel}
γ_{M1} \quad \text{partial safety factor of stability}
γ_{M2} \quad \text{partial safety factor of connectors (bolts, rivers, pins, welds, weld, plates in bearing)}
γ_{M3} \quad \text{partial safety factor of hybrid connections, or under fatigue loading}
γ_{M4} \quad \text{partial safety factor of an injection bolt}
γ_{M5} \quad \text{partial safety factor of joints in hollow section lattice girder}
γ_{M6,ser} \quad \text{partial safety factor of pins at serviceability limit state}
γ_{M7} \quad \text{partial safety factor of high strength bolts}
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