

List of symbols

a	throat thickness of fillet weld
a_l	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_0, b_l, b_w	width, effective width of the foundation
b_b	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
c	effective width of the flexible base plate
c_{\varnothing}	required concrete cover for reinforcement
d	nominal diameter of the bolt
d_0	diameter of the bolt hole
d_0, d_l, 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_l, 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
$f_{a,haz}$	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_{ck}	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_v	characteristic shear strength
$f_{v,haz}$	characteristic shear strength of heat affected zone
$f_{vw,d}$	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_{ya}	average yield strength
f_{yb}	yield stress of the bolt
f_{yc}	yield stress of column
g	length of the gap
g_l	leg length of fillet weld
h, h_0, h_l	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_{θ}	reduction factor based on material temperature

m, m_x	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_e	theoretical resistance obtained from the design model
r_t	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
$z_{c,b}$	lever arm of compression zone at bottom of the joint
$z_{c,t}$	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_v	shear area
B_e	effective length
$B_{t,Rd}$	design resistance of bolt in tension
C_0, C_1	constant values
C_e, C_T, C_X, C_K	efficiency parameter
$C_{f,d}$	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
$F_{t,ep,Rd}$	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
$F_{v,max}$	maximum shear force obtained in a test
$F_{v,Rd}$	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
$\bar{S}_{j,ini}$	relative initial stiffness
$K_{i,e,20^{\circ}C}, K_{i,pl,20^{\circ}C}$	elastic and plastic stiffness of the component, at ambient temperature
L, L_l	length, beam span
L_b	length of beam
L_b	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

$L_{w,eff}$	effective length of fillet weld
M	bending moment
M'	bending moment per unit length
$M_{j,Rd}$	moment resistance of joint
$M_{j,ult,d}$	predicted ultimate bending moment of joint
$M_{j,ult,exp}$	experimental ultimate bending moment resistance of joint
$M_{pl,Rd}$	plastic bending moment resistance of member
M_{Sd}	applied bending moment
M_w	bending moment carried by the weld
N	normal force
N_0, N_1, N_2	axial force
N_{Iy}	axial force of the chord corresponding to the plastification
$N_{pl,Rd}$	resistance of cross section
N_{Sd}	applied axial force
$N_{u, Rd}$	design ultimate resistance of the cross-section
Q	prying force
R_d	resistance of the connection
R_{fy}	plastic resistance of the connected dissipative member
S_j	stiffness of joint
$S_{j,sec}$	joint secant stiffness
$S_{j,ini}$	initial stiffness of joint
$S_{j,ini}$	initial stiffness of the joint
V	volume of the member per unit length
$V_{G,Ed}$	shear force due to the non seismic actions
$V_{M,Ed}$	shear force due to the resisting moments at the end sections of the beam
$V_{pl,Rd}$	plastic resistance to the shear force
V_{Sd}	design shear effort
$V_{wp,Rd}$	design resistance of column web panel in shear
W_{ext}	external energy
W_{int}	internal energy
α	reduction factor of bearing resistance
α_b	factor for bearing resistance
α_d	factor of end distance and pitch for bearing resistance
β	transformation parameter for shear loading
β, β_2, β_3	reduction factors
β_j	joint coefficient
β_{Lw}	reduction factor for long welds
β_w	correlation factor
δ	deformation, beam deflection at midspan, component deformation
δ_c	deformation of components in compression zone
$\delta_{b,c}$	deformation of components in compression zone at bottom of the joint

$\delta_{i,c}$	deformation of components in compression zone at top of the joint
δ_{Cd}	deformation capacity
δ_t	deformation of components in tension zone
$\Delta\theta$	temperature interval
Δt	time interval
ε	strain
ϕ	joint rotation
ϕ_{pl}	plastic rotation capacity
ϕ_p	available plastic rotation
γ	*partial safety factor
γ_M	*partial safety factor for the resistance
$\gamma_{M,fi}$	*partial safety factor for fire
γ_{M0}	*partial safety factor for steel
γ_{Mb}	*partial safety factor of bolted connections
γ_{Mw}	*partial safety factor for weld
γ_{Ms}	*partial safety factor of slip resistance
$\gamma_{Ms,ser}$	*partial safety factor of slip resistance at serviceability
γ_{M2}	*partial safety factor of net section at bolt holes
θ	temperature
θ_0	temperature of the lower beam flange at mid span
$\theta_1, \theta_2, \theta_i$	angle between diagonal and the chord
σ	normal stress
$\sigma_{//}$	normal stress parallel to the axis of the weld
σ_{\perp}	normal stress perpendicular to the axis of the weld
τ	shear stress
$\tau_{//}$	shear stress (in the critical plane of the throat) parallel to the weld axis
τ_{\perp}	shear stress (in the critical plane of the weld) perpendicular to the weld axis
η	stiffness modification coefficient
λ_1, λ_2	dimensions of the T-stub
$\bar{\lambda}$	relative slenderness
μ_0	degree of utilization
μ	stiffness ratio
ρ_{haz}	heat affected zone (HAZ) softening factor
ψ	shape factor

* in prEN 1993-1-8: 2003 are the partial safety factors for prediction of the resistance simplified:

γ_{M0}	partial safety factor of steel
γ_{M1}	partial safety factor of stability
γ_{M2}	partial safety factor of connectors (bolts, rivets, pins, welds, weld, plates in bearing)
γ_{M3}	partial safety factor of hybrid connections, or under fatigue loading
γ_{M4}	partial safety factor of an injection bolt
γ_{M5}	partial safety factor of joints in hollow section lattice girder
$\gamma_{M6,ser}$	partial safety factor of pins at serviceability limit state
γ_{M7}	partial safety factor of high strength bolts

Indexes

20°C	ambient temperature
a	structural steel
b	bearing; bolt
c	calculation
cr	critical
d	design value
e	elastic
E	Young's modulus
f	failure, furnace
fi	fire design
HAZ	Heat Affected Zone
i	component
j	joint
m	member
max	maximum
min	minimum
pl	plastic
Rd	design resistance
Sd	design loading
t	time, duration on fire exposure
ten, t	tension
v	shear
w	weld
y	yield