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fib Model Code for Concrete Structures 2010


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Commission 9, Reinforcing and prestressing materials and systems

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Task Group 9.9, Manual for prestressing materials and systems
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Task Group 9.11, Testing the bond capacity of tendon anchorages
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SAG 5, New Model Code

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SAG 6, Composite steel-concrete construction

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SAG 7, Assessment and interventions upon existing structures

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SAG 8, fib Sustainability initiative

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SAG 9, Revision of partial safety factors

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Notations

Meaning of roman capital letters

A area
C torsional moment of inertia; serviceability constraints
D fatigue damage factor; diffusion coefficient
E modulus of elasticity; earthquake action; load (action) effect
F action in general; local loading
G permanent action; shear modulus
H horizontal component of a force
I second moment of a plane area
J creep function
K (permeability) coefficient
M bending moment; coefficient of water absorption; safety margin
N axial force
P force
Q variable action
R resistance; strength (resisting load effect); reaction at a support; resultant
S static moment of a plane area
T torsional moment; temperature
V shear force, volume
W modulus of inertia
X material or soil properties in general; reaction or force in general, parallel to x axis
Y reaction or force in general, parallel to y axis
Z reaction or force in general, parallel to z axis
NOTE: Roman capital letters can be used to denote types of material, e. g. C for concrete, LC for lightweight concrete, S for steel, Z for cement.

Meaning of roman lower case letters

a deflection; distance; acceleration
b width
c concrete cover
d effective height; diameter (see also h)
e eccentricity; sets of loads (actions)
f strength
g distributed permanent load; acceleration due to gravity; limit state function
h total height or diameter of a section; thickness
i radius of gyration
j number of days
k all coefficients with dimension
l span; length of an element
m bending moment per unit length or width; mass; average value of a sample
n normal (longitudinal, axial) force per unit length or width
p prestressing
q distributed variable load
r radius; resistance variables; resistance function
s spacing; standard deviation of a sample
t time; torsional moment per unit length or width; thickness of thin elements
u perimeter
v velocity; shear force per unit length or width
w width of a crack
x coordinate; height of compression zone
y coordinate; height of rectangular diagram coordinate; lever arm

Use of Greek lower case letters

alpha	α	angle; ratio; coefficient
beta	β	angle; ratio; coefficient
gamma	γ	safety factor; density; shear strain (angular strain)
delta	δ	coefficient
epsilon	ε	strain
zeta	ζ	coefficient
eta	η	coefficient
theta	θ	rotation
lambda	λ	slenderness ratio; coefficient
mu	μ	relative bending moment; coefficient of friction; mean value of a whole population
nu	ν	relative axial force; Poisson's ratio
xi	ξ	coefficient; ratio
pi	π	mathematical use only
rho	ρ	geometrical ratio of reinforcement; bulk density
sigma	σ	axial stress; standard deviation of a whole population
tau	τ	shear stress
phi	φ	coefficient
chi	χ	coefficient
psi	ψ	coefficient; ratio
omega	ω	mechanical ratio of reinforcement

Mathematical symbols and special symbols

S sum
Δ difference; increment (enlargement)
Ø nominal diameter of a reinforcing bar or of a cable
′ (single prime) compression (only in a geometrical or locational sense)
e base of Naperian logarithms
exp power of the number e
π ratio of the circumference of a circle to its diameter
n number of ...
w/c water/cement ratio
< smaller than
> greater than

General subscripts

a support settlement; additional; accidental load
b bond; bar; beam
c concrete; compression; column
d design value
e elastic limit of a material
f forces and other actions; beam flange; bending; friction
g permanent load
h horizontal; hook
i initial
j number of days

k	characteristic value
l	longitudinal
m	mean value; material; bending moment
n	axial force
o	zero
p	prestressing steel
q	variable load
r	cracking
s	ordinary steel; snow; slab
t	tension;* torsion;* transverse
u	ultimate (limit state)
v	shear; vertical
w	wind; web; wire; wall
x	linear coordinate
y	linear coordinate; yield
z	linear coordinate
1, 2, 3	particular values of quantities
cc	conventional asymptotic value
*	When confusion is possible between tension and torsion, the subscripts tn (tension) and tr (torsion) should be used.

Subscripts for actions and action effects

a(*A*)	support settlement; accidental action
cc	creep of concrete
cs	shrinkage of concrete
ep	earth pressure
ex	explosion; blast
g(*G*)	permanent load
im	impact
lp	liquid pressure
m(*M*)	bending moment
n(*N*)	axial force
p(*P*)	prestress
q(*Q*)	variable load
s(*S*)	snow load
t(*T*)	torsion; temperature
v(*V*)	shear
w(*W*)	wind load

Subscripts obtained by abbreviation

abs	absolute
act	acting
adm	admissible, permissible
cal	calculated, design
crit (or *cr*)	critical
ef	effective
el (or *e*)	elastic
est	estimated
exc	exceptional
ext	external
fat	fatigue
inf	inferior
int	internal
lat	lateral
lim	limit
max	maximum
min	minimum
nec	necessary
net	net
nom	nominal
obs	observed
pl	plastic
prov (or *pr*)	provisional (stage of construction); provided
red	reduced
rel	relative; relaxation
rep	representative
req	required
res	resisting, resistant
ser	serviceability
tot	total
var	variable

Notation list

Roman lower case letters

$1/r$	curvature of a section of an element
$1/r_{(g)}$	curvature due to *g*
$1/r_{(g+q)}$	curvature due to *g* and *q*
$1/r_{0\,(g+\,q)}$	instantaneous (elastic) curvature due to *g* and *q*
$1/r_I$	curvature of an uncracked concrete section (state I)
$1/r_{Ir}$	curvature in state I under cracking moment
$1/r_2$	curvature of a cracked concrete section (state II)
$1/r_{2r}$	curvature in state II under cracking moment
$1/r_{ts}$	tension stiffening correction for curvature
a	geometrical quantity in general; deformation; deflection
a_d	design values of geometrical quantity
a_0	elastic deflection (calculated with rigidity $E_c\,I_e$)
b	breadth of compression zone or flange, width of concrete section
b_f	width of FRP section; width of flange
b_{red}	reduced width of web
b_x	smaller side dimension of a rectangular section
b_y	greater side dimension of a rectangular section
b_w	width of web
c	concentration of a substance in a volume element; concrete cover; coefficient for shear resistance due to adhesive bond
c_r	coefficient for shear resistance due to aggregate interlock
c_1	column dimension parallel to the eccentricity of the load
c_2	column dimension perpendicular to the eccentricity of the load
c_{min}	minimum concrete cover
c_{nom}	nominal value of concrete cover (= c_{min} + tolerance)
d	effective depth to main tension reinforcement
d'	effective depth to compression reinforcement
d_{max}	maximum aggregate size
e	load eccentricity
e_0	first order eccentricity (= M_{Ed}/N_{Ed})
e_{01}	smaller value of the first order eccentricity at one end of the considered element
e_{02}	greater value of the first order eccentricity at one end of the considered element
e_{tot}	total eccentricity
f	strength
f_{bd}	design bond strength
$f_{bd,0}$	basic design bond strength
f_{bpd}	design bond strength for prestressing tendon

f_c cylinder compressive strength of concrete
f_{lc} cylinder compressive strength of lightweight aggregate concrete
f_c^* cylinder compressive strength of concrete under triaxial loading (confined strength), reduced concrete strength due to transverse tension
f_{cc} cylinder compressive strength of concrete under uniaxial stress
f_{cd}^* design compressive strength of concrete under triaxial loading (confined strength), reduced design concrete strength due to transverse tension
f_{cd} design value of f_c
$f_{cd,fat}$ design fatigue reference strength of concrete under compression
$f_{c,\,imp,\,k}$ characteristic compressive strength under high rates of loading
f_{ck} characteristic value of compressive strength of concrete
$f_{ck,c}$ value of f_{ck} of confined concrete
$f_{ck,cube}$ characteristic value of cube compressive strength of concrete
$f_{ck,fat}$ characteristic value of fatigue reference compressive strength
$f_{ck,ft}$ characteristic value of concrete compressive strength after freeze-thaw attack
f_{cm} mean value of compressive strength of concrete
$f_{cm,sus}(t,t_0)$ mean value of compressive strength of concrete at time t when subjected to a high sustained compressive stress at an age at loading t_0
f_{ct} axial tensile strength of concrete
f_{ctd} design value of f_{ct}
$f_{ct,\,imp,\,k}$ characteristic tensile strength under impact loading
f_{ctk} characteristic value of f_{ct}
$f_{ctk,\,is}$ characteristic measured in-situ tensile strength
$f_{ctk,\,max}$ upper bound value of the characteristic tensile strength of concrete
$f_{ctk,\,min}$ lower bound value of the characteristic tensile strength of concrete
$f_{ctk,\,sus}$ characteristic tensile strength of concrete under sustained loading
f_{ctm} mean value of axial tensile strength of concrete
$f_{ct,fl}$ flexural tensile strength (at T = 20°C)
$f_{ctm,fl}$ mean flexural tensile strength (at T = 20°C)
$f_{ct,sp}$ splitting tensile strength of concrete
$f_{ctm,sp}$ mean splitting tensile strength of concrete
f_d design value of material or product property; design value of strength
f_f tensile strength of non-metallic reinforcement
f_{fad} design anchorage bond strength for non-metallic reinforcement
f_{fbd} design value of tensile stress in non-metallic reinforcement limited by bond to concrete
f_{fbm} mean value of tensile stress in the non-metallic reinforcement limited by bond to concrete
f_{fd} design tensile strength of non-metallic reinforcement
f_{fk} characteristic value of tensile strength of non-metallic reinforcement
f_{Fts} serviceability residual strength (post-cracking strength for serviceability crack opening) for fibre-reinforced concrete
f_{Ftsd} design value of post-cracking strength for serviceability crack opening for fibre-reinforced concrete
f_{Ftu} ultimate residual strength (post-cracking strength for ultimate crack opening) for fibre-reinforced concrete
f_{Ftud} design value of post-cracking strength for ultimate crack opening for fibre-reinforced concrete
f_k characteristic value of material or product property; characteristic value of strength
f_L Limit of Proportionality
f_{Lk} characteristic value of Limit of Proportionality
f_{lck} characteristic value of compressive strength of lightweight aggregate concrete
f_{lcm} mean value of compressive strength of lightweight aggregate concrete
$f_{lctk,\,max}$ upper bound value of the characteristic tensile strength of lightweight aggregate concrete
$f_{lctk,\,min}$ lower bound value of the characteristic tensile strength of lightweight aggregate concrete
f_{lctm} mean value of axial tensile strength of lightweight aggregate concrete
$f_{p0.1}$ 0.1% proof strength of prestressing steel
$f_{p0.2}$ 0.2% proof strength of prestressing steel
$f_{p0.1k}$ characteristic 0.1% proof strength of prestressing steel
$f_{p0.2k}$ characteristic 0.2% proof strength of prestressing steel
f_{pt} tensile strength of prestressing steel; UTS (Ultimate Tensile Strength) of prestressing steel
f_{ptd} design tensile strength of prestressing steel
f_{ptk} characteristic value of tensile strength of prestressing steel; characteristic value of UTS (Ultimate Tensile Strength) of prestressing steel
f_{py} tensile yield stress of prestressing steel
f_{pyd} design value of tensile yield stress of prestressing steel
f_{pyk} characteristic value of tensile yield stress of prestressing steel
f_r relative (or projected) rib area
$f_{R,j}$ residual flexural tensile strength of fibre reinforced concrete corresponding to Crack Mouth Opening Displacement ($CMOD$) = $CMOD_j$
f_{R1k} characteristic residual strength of fibre reinforced concrete significant for serviceability conditions
f_{R3k} characteristic residual strength of fibre reinforced concrete significant for ultimate conditions
$f_{sp,\theta}$ proportional limit of reinforcing steel at temperature θ
$f_{sy,\theta}$ maximum stress of reinforcing steel at temperature θ
$f_{0.2}$ 0.2% proof strength of reinforcing steel
$f_{0.2k}$ characteristic value of 0.2% proof strength of reinforcing steel
f_t tensile strength of reinforcing steel
f_{tk} characteristic value of tensile strength of reinforcing steel
f_{tm} mean value of tensile strength of reinforcing steel
f_y yield strength of reinforcing steel in tension
$f_{y,act}$ actual yield strength of reinforcing steel in compression
f_{yc} yield strength of reinforcing steel in compression
f_{ycd} design yield strength of reinforcing steel in compression
f_{yd} design yield strength of reinforcing steel in tension
f_{yk} characteristic value of yield strength of reinforcing steel in tension
f_{ym} mean value of yield strength of reinforcing steel in tension
g_d design value of distributed permanent load
h overall depth of member, total height; notional size of a member ($2\,A_c/u$; u: perimeter in contact with the atmosphere)
h_b depth of beam

h_f depth of flange
h_{key} height of shear key in joint interface
h_{sp} distance between the notch tip and the top of the specimen
Δh_w height of water column
i radius of gyration
k plasticity number; unintentional angular displacement
k_a effectiveness coefficient of anchorage system
k_b shape factor
k_{bl} bond length calibration factor
k_c coefficient
k_d effectiveness factor dependent on the reinforcement detail
k_l stress–strength ratio
k_m coefficient of confinement from transverse reinforcement
k_n displacement factor for repeated constant amplitude loading
k_t displacement factor for permanent load
l design span, effective span, length of an element, thickness of a penetrated section
Δl change in distance between two measuring points
l_0 design lap length, effective length (of columns); distance between measuring points
l_b design anchorage length; design lap length
l_{bp} basic anchorage length of bonded pretensioned reinforcement
l_{bpd} design anchorage length of bonded pretensioned reinforcement
l_{bpt} transmission length of bonded pretensioned reinforcement
$l_{b,min}$ minimum anchorage length; minimum lap length
l_{cs} characteristic length (fracture parameter)
l_p development length for bonded prestressing reinforcement
Δl_{pl} residual elongation after unloading
$l_{p,max}$ length over which the slip between prestressing steel and concrete occurs
$l_{s,max}$ length over which the slip between steel and concrete occurs
l_t transmission length
m moment per unit width (out-of-plane loading); mass of substance flowing; degree of hydration; moisture content
n number of bars, number of load cycles; force per unit width (in-plane loading)
n_b number of anchored bars or pairs of lapped bars in the potential splitting surface; number of bars in the bundle
n_{Ri} number of cycles leading to failure at stress levels $S_{i,min}$ and $S_{i,max}$, respectively
n_{Si} number of cycles applied at constant minimum and maximum stress levels $S_{i,min}$ and $S_{i,max}$, respectively
n_t number of legs of confining reinforcement crossing a potential splitting failure surface at a section
p local gas pressure; overall steel ductility parameter
p_m mean pressure
p_{tr} transverse pressure perpendicular to the bar axis; mean compressive stress perpendicular to the potential splitting failure surface at the ultimate limit state
q_d design value of distributed variable load
r radius
s slip (relative displacement between steel and concrete cross-sections), shear slip (at interfaces); spacing of bars; coefficient which depends on the strength class of cement
s_m slip at maximum bond stress
$s_{n,t}$ slip due to permanent or repeated loading
s_{max} maximum bar spacing
s_r distance between cracks; radial spacing of layers of shear reinforcement
$s_{r,m}$ mean spacing between cracks
s_t longitudinal spacing of confining reinforcement
s_u ultimate slip
t time, age, duration; thickness of thin elements
t_0 age at first loading
t_1 age of the concrete when its temperature returns to ambient temperature
t_f thickness of non-metalic reinforcement
t_{eq} equivalent time interval for calculation of relaxation losses
t_{p1} mean duration of a heating cycle
t_R reference period
t_s concrete age at the beginning of shrinkage or swelling
t_T temperature adjusted concrete age
u length of a perimeter; component of displacement of a point
u_0 length of the periphery of the column or distribution area of load
u_1 length of the control perimeter for punching
u_{ef} length of the perimeter of A_{ef}
u_n length of the control perimeter for punching outside a slab zone with shear reinforcement
v shear force per unit width (out-of-plane loading), component of displacement of a point
w crack width; component of displacement of a point
w_c crack width for $\sigma_{ct} = 0$
w_k calculated characteristic crack width
w_{lim} nominal limit value of crack width
w_u maximum crack opening accepted in structural design: its value depends on the ductility required
x depth of compression zone; distance; parameter
$x_c(t)$ carbonation depth at the time t
x_d design value of parameter x
z internal lever arm

Greek lower case letters

α coefficient; reduction factor; inclination of reinforcement crossing an interface; sum of the angular displacements
α_e modular ratio ($= E_s/E_c$)
$\alpha_{e,p}$ modular ratio ($= E_p/E_c$)
$\alpha_{e,sec}$ secant modular ratio ($= E_{s,sec}/E_{c,sec}$)
α_{fl} conversion factor ($= f_{ctm}/f_{ctm,\,fl}$)
α_i unintended inclination of compressive members
α_{im} unintended inclination of group of vertical prestressing members
α_p coefficient of thermal expansion of prestressing reinforcement
α_{spl} conversion factor ($= f_{ctm}/f_{ctm,\,spl}$)
α_{sT} coefficient of thermal expansion for steel
α_T coefficient of thermal expansion in general

α_1 coefficient representing the influence of reinforcement provided

α_2 coefficient representing the influence of passive confinement from cover

α_3 coefficient representing the influence of passive confinement from transverse reinforcement

β coefficient characterizing the bond quality of reinforcing bars, coefficient for the compressive strength of a strut across an interface

β_c coefficient for the compressive strength of a strut across an interface

$\beta_{bc}(t,t_0)$ coefficient to describe the development of basic creep with time after loading

$\beta_{dc}(t,t_0)$ coefficient to describe the development of drying creep with time after loading

$\beta_{cc}(t)$ coefficient to describe the development of strength of concrete with time

$\beta_{c,sus}(t,t_0)$ coefficient to describe the decrease of strength with time under sustained load

$\beta_E(t)$ coefficient to describe the development of modulus of elasticity of concrete with time

$\beta_{lcc}(t)$ coefficient to describe the development of strength of lightweight aggregate concrete with time

γ safety factor

γ_c partial safety factor for concrete material properties

γ_{cb} partial safety factor for bond

$\gamma_{c,fat}$ partial safety factor for concrete material properties under fatigue loading

γ_d partial safety factor for partial factors for model uncertainties

γ_f partial safety factor for the tensile strength of non-metallic reinforcement

γ_F partial safety factor for actions; partial safety factor for fibre reinforced concrete

γ_G partial safety factor for permanent actions

γ_m partial safety factor for material properties

γ_M partial safety factor for material properties, model uncertainties and geometrical uncertainties

γ_Q partial safety factor for variable actions

γ_{Rd} partial safety factor associated with the uncertainty of the model and geometrical uncertainties

γ_s partial safety factor for the material properties of reinforcing and prestressing steel

$\gamma_{s,fat}$ partial safety factor for the material properties of reinforcing and prestressing steel under fatigue loading

γ_{Sd} partial safety factor accounting for model uncertainty

δ shear displacement

δ_{jj} node displacement

ε strain

ε_c concrete compressive strain

ε_c^* concrete compressive strain under triaxial stress

ε_{cbs} concrete basic shrinkage strain

ε_{cds} concrete drying shrinkage strain

ε_{cm} average concrete strain within $l_{s,max}$

ε_{c1} concrete strain at maximum compressive stress

$\varepsilon_{c1,imp}$ impact concrete strain at maximum load

$\varepsilon_{cc}(t)$ concrete creep strain at concrete age $t > t_0$

$\varepsilon_{ci}(t_0)$ stress dependent initial strain of concrete at the time of first loading

ε_{cf} strain at maximum stress due to repeated loads

$\varepsilon_{cn}(t)$ stress independent strain at a concrete age t

$\varepsilon_{cs}(t)$ shrinkage or swelling strain at concrete age t

$\varepsilon_{c\varsigma}(t)$ stress dependent strain at concrete age t

ε_{ct} concrete tensile strain

$\varepsilon_{cT}(t)$ thermal strain at a concrete age t

ε_{clim} ultimate strain of concrete in compression

ε_{pd0} strain of prestressed reinforcement corresponding to P_{d0}

ε_f strain of non-metallic reinforcement

ε_{fu} strain of non-metallic reinforcement at maximum force in tension

ε_{fuk} characteristic value of strain of non-metallic reinforcement at maximum force in tension

ε_{lc1} lightweight aggregate concrete strain at maximum compressive stress

ε_{lclim} ultimate strain of lightweight aggregate concrete in compression

ε_{pu} strain of prestressing steel at maximum force

ε_{puk} characteristic value of strain of prestressing steel at maximum force

ε_r strain at the onset of cracking

ε_s steel strain

ε_{s1} steel strain in uncracked concrete

ε_{s2} steel strain in crack

ε_{sm} mean steel strain

$\Delta\varepsilon_{sr}$ increase of steel strain due to crack formation in the section

ε_{sr1} steel strain at the point of zero slip under cracking forces

ε_{sr2} steel strain in the crack under cracking forces (σ_{ct} reaching f_{ctm})

ε_{sT} thermal strain of steel

ε_{su} strain of reinforcing steel at maximum load

$\Delta\varepsilon_{ts}$ increase of strain by the effect of tension stiffening

ε_u limit strain value; strain of reinforcing steel at maximum force

ε_{uk} characteristic value of reinforcing steel strain at maximum force

ε_{yd} design yield strain of reinforcing steel ($= f_{yd}/E_s$)

ε_v transverse contraction

ζ ratio of bond strength of prestressing steel and high-bond reinforcing steel

η viscosity of gas

η_1 coefficient representing the type of reinforcing bar being anchored or lapped

η_2 coefficient representing the position of the bar during casting

η_3 coefficient representing the bar diameter

η_4 coefficient representing the characteristic strength of steel reinforcement being anchored or lapped

η_{p1} coefficient representing the type of prestressing tendon

η_{p2} coefficient representing the casting position of the tendon

θ angle between web compression and the axis of a member; rotation

θ_f angle between inclined compression in a flange and the axis of the member

κ coefficient

κ_1 coefficient for axial force in interface connectors

κ_2 coefficient for dowel action resistance of interface connectors

λ slenderness ratio ($= l_0/i$)

μ coefficient of friction; relative bending moment
ν_c Poisson's ratio of concrete
ν_s Poisson's ratio of steel
ξ creep induced stress redistribution after modification of restraint conditions
ρ ratio of (longitudinal) tensile reinforcement ($= A_s/(bd)$); density
$\rho_{s,ef}$ effective reinforcement ratio ($= A_s/A_{c,ef}$)
ρ_t relaxation after t hours
$\rho_t(T)$ relaxation after t hours at temperature T
ρ_{100} relaxation after 100 hours
ρ_{1000} relaxation after 1000 hours
ρ_w ratio of web reinforcement ($= A_{sw}/(b_w\, s_w \sin \alpha)$)
σ stress
σ_1, σ_2, σ_3 principal stresses
σ_c concrete compressive stress
σ_{cd} design concrete compressive stress
σ_{ct} concrete tensile stress
$\sigma_{c,c}$ compressive stress of confined concrete
$\sigma_{c,\,max}$ maximum compressive stress
$\sigma_{c,min}$ minimum compressive stress
$\sigma_{ct,\,max}$ maximum tensile stress
σ_f stress in non-metallic reinforcement
σ_n (lowest) compressive stress resulting from normal force acting at the interface
$\sigma_{p0}(x)$ initial stress in prestressing steel at a distance x from anchorage device
$\sigma_{p0,max}$ maximum tensile stress in prestressing steel at tensioning
σ_{pcs} stress in prestressing steel after all losses (including creep and shrinkage)
σ_{pd} tendon stress under design load
$\Delta\sigma$ stress range relevant to fatigue of reinforcement
$\Delta\sigma_{Rsk}(n)$ stress range relevant to n cycles obtained from a characteristic fatigue strength function
σ_s steel stress
σ_{sd} steel stress to be anchored by bond over the distance l_b
σ_{s2} steel stress in the crack
σ_{se} steel stress at the point of zero slip
σ_{sr2} steel stress in the crack under cracking load (σ_{ct} reaching f_{ctm})
$\Delta\sigma_{Es}$ steel stress range under the acting loads
τ_0 bond stress according to the bond stress–slip curve
τ_a ultimate shear capacity due to adhesion or interlocking
τ_b local bond stress
$\tau_{b,m}$ bond stress modified in case of bar yielding, transverse pressure and cracking parallel to the bar axis and cyclic loading
τ_{bmax} maximum value of bond stress
τ_{Ed} design interface shear stress
τ_{Rdi} design value of interface shear strength
τ_u ultimate shear friction capacity
$\tau_{u,split}$ peak value of bond strength in a splitting failure
$\varphi\,(t,t_0)$ creep coefficient
φ_0 basic creep coefficient
$\varphi_{0,\,dc}$ drying creep coefficient
$\varphi_{0,\,k}$ nonlinear notional creep coefficient
φ_l basic creep coefficient for lightweight aggregate concrete
$\Delta\varphi_{T,trans}$ transient thermal creep coefficient which occurs at the time of the temperature increase
χ aging coefficient in the evaluation of creep structural effects
$\psi(t,t_0)$ relaxation coefficient
ω_c mechanical reinforcement ratio

Roman capital letters

A total area of a section or part of a section (enclosed within the outer circumference)
A_1 section area in state I (taking into account the reinforcement)
A_b area of single bar
A_c area of concrete cross section or concrete compression chord
$A_{c,ef}$ effective area of concrete in tension
A_{core} effectively confined area of cross-section in compression
A_d design value of accidental action
A_{Ed} design value of seismic action
A_{Ek} representative value of seismic action
A_k area enclosed by the centrelines of a shell resisting torsion
A_p area of prestressing steel
A_s area of reinforcement
A_s' area of compression reinforcement
A_{sh} area of hoop reinforcement for torsion
A_{sl} area of longitudinal reinforcement
A_{sp} cross sectional area of prestressing steel
A_{st} area of transverse reinforcement; cross sectional area of one leg of a confining bar
A_{sw} area of shear reinforcement
$A_{s,cal}$ calculated area of reinforcement required by design
$A_{s,min}$ minimum reinforcement area
AF amplification factor
C serviceability constraints
C_0 initial chloride content of concrete
C_f aggregate effectivity factor
$C_{S,\Delta x}$ chloride content at a depth of Δx
D fatigue damage; diffusion coefficient; deformation
D_{app} apparent diffusion coefficient of a substance in concrete
D_{eff} effective diffusion coefficient of a substance in concrete
D_{lim} limiting fatigue damage
D_{RCM} rapid chloride migration coefficient
E modulus of elasticity; load (action) effect; cumulative leaching
E_c modulus of elasticity of concrete
E_{ci} tangent modulus of elasticity of concrete at an age of 28 days
$E_{ci}(t_0)$ tangent modulus of elasticity of concrete at the time of loading t_0
$E_{ci}(t)$ tangent modulus of elasticity of concrete at an age $t \neq 28$ days
$E_{c,1}$ secant modulus from the origin to the peak compressive stress
$E_{c,imp}$ modulus of elasticity of concrete for impact loading
E_d design action-effect
E_f modulus of elasticity for non-metallic reinforcement
E_{lc} modulus of elasticity for lightweight aggregate concrete
E_{lci} tangent modulus of elasticity of lightweight aggregate concrete at concrete age of 28 days
E_p modulus of elasticity of prestressing steel
E_s modulus of elasticity of reinforcing steel
$E_{s,\theta}$ modulus of elasticity of reinforcing steel at temperature θ