LIST OF SYMBOLS

$[\boldsymbol{A}]$	Coefficient matrix
A	Cross sectional area of the crack, normal to flow direction x
a_0	A constant which takes into account the residual opening in sinusoidal CMOD relation
a_1, a_2, a_3, a_4	Four of the six displacement constant of a triangular finite element
B	Width of dam at foundation level
B'	Width of dam at crack location other than foundation level
b	Crack opening at any distance x from the crack mouth and time t
$\langle b \rangle$	Mean value of mechanical aperture b
b_c	A constant in exponential CMOD relation
b_H	Hydraulic aperture
b_0	Amplitude in sinusoidal CMOD relation
b_m	Crack mouth opening displacement (CMOD)
b_{max}	Maximum value CMOD
b_{mr}	Residual crack mouth opening displacement
b'_{mr}	Increased residual crack opening due dead storage in dam reservoir
$\dot{b_m}$	Crack mouth opening displacement rate (CMODrate)
c	Constant in CMOD rate relation
C	A constant in power spectrum function
C_0	A constant in sine hyperbolic CMOD rate equation
C_2, C_3	Constants in momentum equations for laminar and turbulent flow respectively

$[\boldsymbol{D}]$	Coefficient matrix in linear strain-stress relation resulting from plane strain formulation
D	Structural size used in size effect law (SEL)
D_h	Hydraulic radius of the crack which is equal to $2b$
d	Separation distance between two reference planes used to measure crack aperture
dA	Infinitesimal area of control volume
$\left(\frac{dp}{dx}\right)_l$	Laminar pressure gradient
$\left(\frac{dp}{dx}\right)_t$	Turbulent pressure gradient
E	Elastic Modulus of concrete
$E^{'}$	Young modulus equal to$E$ for plain stress and $E/(1-{\nu_0}^2)$ for plane strain
E_T	Total energy of crack propagation
dV	Infinitesimal volume element of control volume
$\{\boldsymbol{F}\}$	Force vectors
F_i	Force in direction of i
F_s	Factor of safety in sliding (FSS)
$F(t)$	Uplift force at any time t
$F_H(t)$	Horizontal hydrostatic force at upstream face of the dam.
f	Wave number of power spectra
$f_{ij}^{m_0}(\theta)$	Trigonometric function for crack deformation mode m_0 and stress σ_{ij}
$f_0(b_m)$	Function of b_m used in sine hyperbolic CMOD rate equation
G	Crack driving force
g	Acceleration due of gravity
H	Water depth at full reservoir level (FRL)
H_p	Pressure head

H_z	Hurst exponent
$\sum H_0$	Summation of horizontal forces acting on the dam
h	Depth of crack location from full reservoir level (FRL)
H_T	Total head
J	Hydraulic gradient
k	A constant in exponential CMOD relation
k_0	A constants used in sine hyperbolic CMOD rate equation
$[\boldsymbol{k}]$	Stiffness matrix
K	Hydraulic conductivity of crack
K_I	Stress intensity factor (SIF) for opening mode of the crack
K_{IC}	Fracture toughness
$(K_I)_P$,$(K_I)_M$	SIF in opening mode for prototype and model
K_{max}	Maximum SIF in cyclic loading
K_{min}	Minimum SIF in cyclic loading
ΔK_d	Difference of maximum and minimum SIF values in cyclic loading
K_n	Normal stiffness of crack wall
L	Crack length
L_H	Crack length at dam foundation level
L_h	Crack length at level h below FRL
L_P ,L_M	Crack length for prototype and model
L_s	Stagnation length during closing phase of crack mouth
$L_{sp.}$	Saturation length
L_{spH}	Saturation length in crack located at foundation level
L_{sph}	Saturation length in crack located at level h below FRL.
L_t	Transition length, where laminar flow changes to turbulent flow

L_{tu}	Upstream transition length during closing phase of crack mouth
L_{td}	Downstream transition length during closing phase of crack mouth
m	Mass of water in control volume
m_0	Modes of crack deformation
N	Number of cycles in fatigue loading
$\boldsymbol{n}$	Outward unit normal vector on surface of control volume
n	Exponent in Louis (1969) momentum equation
n_0	Exponent in CMOD rate relation
$P(f)$	Power spectrum function of wave number$f$
p	Pressure as function space and time
p_m	Reservoir pressure at crack mouth
p_s	Stagnation pressure
$\{\boldsymbol{q}\}$	Nodal displacement vectors
Q	Discharge through the crack
Q_m	Discharge at crack mouth
R	Crack resistance force
R_0	Ratio of maximum and minimum SIF values in cyclic loading
R_e	Reynolds number
T	Time period of one opening-closing of crack walls
T_0	Fracture transmissivity
$\mathbf{U}$	Displacement vector
U	Strain energy
u_j	Component form of displacement vector
$(u_j\,, v_j)$	Horizontal and vertical displacement of a node j of triangular finite element

u_0	One of the six displacement constant of a triangular finite element
$\boldsymbol{v}$	Water velocity vector
v_0	One of the six displacement constant of a triangular finite element
v_x, v_y	Velocity of fluid in x and y directions respectively
v	One dimensional velocity of water in crack
$\sum V_0(t)$	Summation of vertical forces acting on the dam (including uplift forces)
w	Depth of fracture
W	Weight of the dam
W_s	Work required to create new fracture surfaces
z	Location of crack
z_0	Parameter for correlation length used in crack aperture measurement
$z_1(x,y)$,$z_2(x,y)$	Surface height functions used to measure the fracture aperture in $x-y$ plane
Π	Potential energy of crack propagation
α	An exponent in power spectrum function
$\{\boldsymbol{\sigma}\}$	Stress tensor
σ_b	Standard deviation of mechanical aperture b
σ_{br}	Crack bridging stress in sine hyperbolic CMOD rate equation
σ_N	Nominal strength used in size effect law (SEL)
σ_u	Uniform boundary stress acting on the boundary for calculation of SIF
σ_{uP} ,σ_{uM}	Uniform boundary stress acting on the boundary for calculation of SIF for prototype and model respectively
σ_{ij}	Stresses in the direction of $j$on plane normal to i
δ_{ij}	Kronecker delta

ρ	Density of water
ε	Average asperity height or absolute roughness of crack walls
$\boldsymbol{\epsilon}$	Strain tensor
μ,λ	Lame constants
λ_0	Ratio of crack lengths of prototype and model
μ_0	Friction coefficient in sliding
ϵ_{ij}	Indicial form of strain tensor
γ	Unit weight of water
ω	Circular frequency of crack opening- closing cycle
ω_0	Numerical correction factor that takes into account loading conditions, boundary conditions, and specimen geometry in calculation of SIF
ω_{0P}	Numerical correction factor used in calculation of SIF for prototype and model respectively
θ	Phase angle in sinusoidal CMOD relation
ν	Kinematic viscosity of water
ν_0	Poisson ratio