APPENDIX-A

NOTATION

A constant in the equation of stress strain for concrete.

A_0 semi-major axis of an ellipse.

A_1 area of an individual web bar.

A_s area of main longitudinal tensile reinforcement.

A_s' area of compression reinforcement.

A_w area of hanging steel (Uhlmann's design method).

a shear span between the line of application of the load and that of the support reaction.

B_0 semi-minor axis of an ellipse.

β_f moment capacity enhancment factor.

B constant in the equation of stress strain for concrete.

b width of beam section.

C_1, C_2, C_3 numerical coefficients (Robins and Kong's formula).

C_1' compressive force due to plain concrete in compression.

C_2' compressive force due to steel bar in compression.

C_3' compressive force due to fibrous concrete in compression.

C cohesion of concrete.

D overall depth of beam.

d effective depth of beam.

d' distance from the centroid of the compression reinforcement to the centroid of the tension reinforcement.

e eccentricity of an ellipse.

E_c tangent modulus that is the initial modulus of elasticity of concrete.

E_s modulus of elasticity of steel.

F_s force in the steel reinforcement (Varghese and Krishnamoorthy's formula).

f_c cube compressive strength of concrete.

f_c' cylinder compressive strength of concrete.

f_r modulus of rupture strength of concrete.

f_s stress in tension reinforcement.

f_s' stress in compression reinforcement.

f_t cylinder splitting tensile strength of concrete.

f_t' direct tensile strength of concrete.

f_y yield stress of reinforcement.

$g = \frac{M_{cr}}{Vd}$ in Rangan's formula.

$h_f D$ depth of fibrous concrete in section.

k a constant in Ramakrishna and Ananthanarayana's formula; in Uhlmann's design method K is a function of D/L.

k ratio of depth of neutral axis to effective depth of beam.

K_b interfacial born stress coefficient.

k_u ratio of depth of neutral axis to effective depth at ultimate load.

k_1 ratio of average concrete stress to maximum concrete stress at ultimate load.

k_2 ratio of depth to resultant of compressive stress and depth to neutral axis at ultimate load.

k_3 ratio of maximum concrete stress at ultimate load to cylinder strength f_c.

L span of beam.

L_0 clear span, measured face to face of supports.

l_a lever arm of internal forces.

M applied moment at a section.

M_{cr} critical moment at shear failure.

M_{FL} ultimate flexural strength of deep beam.

M_{HFL} ultimate flexural strength of deep beam (half depth condition)

m modulus ratio = $\frac{E_s}{E_0}$

N_1, N_2 numerical constants in the equation of strain in web steel.

n total number of web bars, including main longitudinal bars.

P total applied load.

$P_s' = 2v_s bD$

P_s'' modified P_s' according to de Paiva and Siess.

$p = \frac{A_s}{bd}$

$p' = \frac{A_s'}{bd}$

$p_t = \frac{A_s}{bD} + A_v(1 + si)/bD$ in Laupa, Siess and Newmark's formula.

R radius of curvature.

r ratio of maximum compressive stress of concrete to the maximum tensile stress of concrete

r' ratio of flexural compressive strength to direct compressive strength.

SCF strain compatibility factor.

T total tensile force.

T_1 tensile force due to steel bar.

T_2 tensile force due to fibrous concrete.

t_f tensile strain capacity enhacement factor.

V applied shear force at a section.

V_f volume fraction of fibre with respect to that of matrix.

V_m volume fraction matrix = $1 - V_f$

V_u ultimate shear.

V_{uc} ultimate shear carried by concrete.

V_{uf} resistance offered by fibre towards shear.

V_{us} shear carried by web reinforcement.

v total shear stress $\left(= \frac{V}{bd}\right)$

v_c permissible shear stress carried by concrete.

v_s nominal shearing stress in Laupa, Siess, Newmark's formula.

W_c Observed inclined cracking load.

W_c' theoretical inclined cracking load.

W_u measured ultimate load.

W_y yield load.

X clear shear span distance between load blocks at support and loading points.

Y depth, measured from the top of the beam, at which an individual web bar intersects the line joining the inside edge of the bearing block at support with the outside edge of that at loading point (Robins and Kong's formula).

α angle between a web bar and the line described in the definition of y (Robins and Kong's formula), also is a rotation factor as defined.

α_i inclination of inclined web reinforcement to the horizontal.

α_c ratio of depth to centroid of compression steel to effective depth of beam.
θ inclination to horizontal of line joing support point to nearest load point.
ψ angle of internal friction.
σ stress in concrete.
σ_c stress in concrete in flexure.
σ_{mu} compressive strength of concrete in flexure.
σ_u crushing strength of concrete prism.
$\in$ strain in concrete.
$\in_{cu}$ strain in concrete at ultimate load.
$\in_{mc}$ strain correspond to the compressive strength of concrete.
$\in_{mu}$ strain correspond to the modulus of rupture of concrete.
$\in_{mul}$ strain in matrix at ultimate load.
$\in_s$ strain in steel.
$\in_y$ yield strain in steel.
μ ductility ratio $\frac{\nabla_u}{\nabla_y}$
∇_u ultimate deflection.
∇_y yield deflection.