# SYMBOL AND NOTATION

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|---|---|---|
| $\alpha$ | = | Concrete stress block area parameter |
| $\gamma$ | = | Concrete stress block centroid parameter |
| $\alpha_{re}$ | = | Preloaded stress block area parameter |
| $\gamma_{re}$ | = | Preloaded stress block centroid parameter |
| $\varepsilon_a$ | = | Strain value of tangential intersection line with initial curve slope |
| $\varepsilon_c$ | = | Concrete strain |
| $\varepsilon_{cm}$ | = | Maximum concrete strain |
| $\varepsilon_{cc}$ | = | Concrete strain at peak stress of confined concrete |
| $\varepsilon_0$ | = | Concrete strain at peak stress (0.002) |
| $\varepsilon_{pl}$ | = | Concrete plastic strain |
| $\varepsilon_{ro}$ | = | Concrete residual strain when receiving partial unloading |
| $\varepsilon_s$ | = | Steel reinforcement strain, usually used for bottom reinforcement |
| $\varepsilon_{un}$ | = | Unloading strain |
| $\varepsilon_{s'}$ | = | Top reinforcement strain of reinforced concrete beam |
| $\varepsilon_{sr}$ | = | Repair rebar strain |
| $\lambda$ | = | Modification factor of lightweight concrete |
| $\varphi$ | = | Beam curvature |
| $A_b$ | = | Area of rebar for length development calculation |
| $A_s$ | = | Cross section area or rebar for bottom reinforcement |
| $A_s'$ | = | Cross section area of rebar for top reinforcement |
| $A_{sr}$ | = | Cross section area of repair rebar |
| $b''$ | = | Width of confined concrete core measured to outside of stirrups |
| $C_c$ | = | Resultant of compression force by concrete stress block |
| $C_s$ | = | Resultant of compression force by top steel reinforcement |
| $C$ | = | Total compression force of beam cross section |
| $e$ | = | Exponential number |
| $d$ | = | Distance from top fiber of beam to center of bottom steel reinforcement |
| $d_b$ | = | Diameter of rebar for length development |
| $d_r$ | = | Distance from top fiber of beam to center of repair rebar |
| $d'$ | = | Distance from top fiber of beam to center of top steel reinforcement |
| $E$ | = | Material elasticity |
| $E_S$ | = | Elasticity value of steel reinforcement |
| $E_r$ | = | Elasticity of concrete during reloading |
| $E_c$ | = | Elasticity value of concrete |
| $f_c$ | = | Concrete stress |
| $f'_c'$ | = | 28days concrete strength tested on cylindrical specimens |
| $f'_{cc}'$ | = | Maximum concrete stress of confined concrete |
| $f_s$ | = | Steel reinforcement stress, usually used for bottom rebar reinforcement |
| $f_{s'}$ | = | Top steel reinforcement stress |
| $f_{sr}$ | = | Repair rebar steel reinforcement stress |
| $f_{new}$ | = | Concrete stress of reloaded concrete with the same strain of its unloading strain |
| $f_{ro}$ | = | Concrete stress of partially unloaded concrete |
| $f_r$ | = | Tensile strength of concrete (rupture modulus) |
| $l_d$ | = | Required length development of steel reinforcement |

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|---|---|---|
| $\Delta l$ | = | Length of calculated steel reinforcement |
| $K_u$ | = | Unloading constant |
| $kd$ | = | Distance from top fiber of beam section to beam neutral axis |
| $S_L$ | = | Clear distance between ribs of deformed rebar |
| $H_L$ | = | Depth of ribs of deformed rebar |
| $u$ | = | Bond strength between concrete and rebar in elastic region |
| $u_f$ | = | Bond strength between concrete and rebar in yield and strain hardening region |
| $T$ | = | Total tension force of beam cross section |
| $T_s$ | = | tension force created by bottom reinforcement |
| $T_{sr}$ | = | Tension force create by repair rebar |
| $Z$ | = | Confinement parameters of concrete confined by stirrups or hoops |