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STRENGTHENING OF R.C DEEP BEAMS USING CFRP,GFRP

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Statement

This thesis is submitted to Faculty of Engineering, Ain Shams University, Cairo Egypt, for the degree of Master of Science in Structural Engineering.

The work included in this thesis was carried out by the author in the Department of Structural Engineering, Ain Shams University, from October 2015 to September 2018.

No part of this thesis has been submitted for a degree or qualification at any other University or Institute.

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LIST OF SYMBOLS

V=Applied shear

V_{cz} = Shear in the compression zone

V_d = Dowel action

v_a = The vertical component of aggregate interlock stresses

V_S = Additional vertical force

h = Depth of the beam.

l_e= Effective span length

b =Width of beam

fy_h = Yield strength of horizontal steel

fy_v = Yield strength of vertical steel

ρ_h = Reinforcement ratio of horizontal steel

ρ_t = Reinforcement ratio of total horizontal tensile steel

ρ_v = Einforcement ratio of transverse steel

m = Compression ratio

a = Shear span

f_{ce} ,$f\bar{c}$= Strength of concrete

Θ_s = The smallest angle between the compressive strut and the adjoining tensile ties

ε_s = The tensile strain in the tie

ε_1 = The principal tensile strain

F_{nn} = Compression strength of nodal zones

A_{nz} = The smaller of (a) the area of the face of the nodal zone perpendicular to the load acting on that face, and (b) the area of a section through the nodal zone perpendicular to the line of action of the resultant force on the section

f_{cen} = The effective compressive strength of the concrete in the nodal zone

B_n = A factor that depends on the node classification

V_f = Shear resistance contribution of the FRP

V_s = Steel stirrups contribution

V_c = Concrete shear resistance

β = The inclination angle of the FRP

s_f = The width of the FRP

d=d_f = The depth to the shear reinforcement

A_f = The area of the FRP reinforcement

n= The total number of FRP sheets

t_f=The thickness of the FRP

E_f = The FRP modulus of elasticity

ε_{fe} = The effective strain that is the maximum strain that can be achieved in the FRP reinforcement system

K_v = Strain-reduction coefficient

k_1 . k_2 = Two modification factors

$lt,_{max}$ = The anchorage length required to develop full anchorage capacity

f_{ctm} = The tensile strength of the concrete

ε_{fd} = The design ultimate strain capacity of the FRP reinforcement

ε_{fu}*= Maximum strain in the FRP

γ_f = Material strength reduction factor of FRP shear reinforcement

LIST OF FIGURES