INVESTIGA TION OF NERDC COMPOSITE FLOOR SLAB SYSTEM

A Thesis Submitted in Partial Fulfillment of the Requirements for the Degree of Master of Engineering in Structural Engineering Design

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Abstract

NERD composite floor slab system is widely used in Sri Lanka to construct concrete floors specially by the low and middle income families. The system has considerable advantages over the traditional construction methods. One of the major drawback of this cost effective slab system is the unavailability of sound theoretical basis for the structural behavior of the system. Even though the slab system is used in this country over the past twenty years, this drawback has not yet been fulfilled. The aim of this research is to fill this timely needed gap by investigating the structural behavior of this slab system and optimize the system.

The proposed method of structural analysis using first principle and the subsequent spread sheet calculation is presented. The spread sheet can be used to select the depth of the prestressed beam required, if the customer knows the imposed load and the span of the slab. According to the results of the spread sheet analysis, the present detailing of prestressed beams is to be changed. The new detailing can be implemented at the existing licensed prestressing yards in operation all over Island without much difficulties.

The slab is presently constructed as unpropped construction. However it was identified '. that, by constructing as a propped construction, the moment carrying capacity can be increased significantly. However, by using props, the advantage "bottom space is available to use on the following day" will be lost. The customer can decide whether to use propped or unpropprd construction by considering the advantages and disadvantages of the method selected.

The most important outcome of this research is the discovery of under utilization of strength of prestressing wires. The strength of wires cannot be fully utilized until the facilities available at the rural yards are improved up to the required standard. The capital investment to improve the facilities of the prestressing yards can be recovered

very quickly as one third of the cost of prestressing steel can be saver by fully utilizing the strength of the prestressing steel.

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NOTATION

E_s = Young's modulus of the steel tendon

A_{ps} = Cross sectional area of the prestress steel

L = Initial length of the tendon

e = Elongation

f_{cu} = Characteristic strength of concrete

f_{ci} = Concrete strength at transfer

$E_{c,28}$ = Static modules of elasticity at 28 days

$E_{c,t}$ = Modules of elasticity of concrete at transfer

K_o = Constant closely related to the modules of elasticity of the aggregate

$f_{cu,28}$ = Characteristics cube strength at 28 days

$f_{cu,t}$ = Characteristics cube strength of the age of t

f_{co} = concrete stress

f_y = tensile stress of steel

Δf_{ps} = change in the stress in steel

P_j = Jacking force

P_e = Effective prestress force

P_i = Initial prestress force

A = Cross sectional area of the prestress beam

I =Second moment of area

M_d = Moment due to dead weight of prestress beam

Φ = Creep coefficient for the period considered

$I_{beam,na}$ = Second moment of area of the beam about neutral axis

$I_{comp.\ na}$ = Second moment of area of the composite section about neutral axis

Z_b = Section modulus of the beam section below neutral axis

Z_t = Section modulus of the beam section above neutral axis

w_i = Imposed load

w_d = Dead weight of prestress beam

w_{ds} = Dead weight of insitu concrete

$Z_{b.\ comp}$ = Section modulus of the composite section below neutral axis

$Z_{t.comp}$ = Section modulus of the composite section above neutral axis

M_d = Moment due to Dead weight of prestress beam

$M_{d,avg}$ = Average Moment due to Dead weight of prestress beam

M_{ds} = Moment due to Dead weight of insitu concrete

$M_{i\,max}$ = Maximum moment due to imposed load

$f_{a\,max}$ = Allowable compressive stress

$f_{a\,min}$ = Allowable tensile stress

$f_{a\,maxt}$ = Allowable compressive stress at transfer

$f_{a\,mint}$ = Allowable tensile stress at transfer

ε_{cc} = creep strain in concrete

n = modular ratio between steel and concrete

V_h = horizontal shear force

b = width of the insitu topping(compression zone)

h = depth of the insitu topping above the interface

b_i = contact width at the interface

l = beam length between the point of maximum and zero moments

L_b = length of the prestress beam

V_h = horizontal shear force

$(v_h)_{avg}$ = average horizontal design shear stress

v_h = design shear stress

A_h =area of interface steel

H =overall depth

d =effective depth

v =design shear stress at a cross section

v_c = design concrete shear stress