STUDY AND ANALYSE THE EXCESSIVE CAMBER DEVELOPMENT IN PRECAST PRESTRESSED SLAB PANELS

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Degree of Master of Science in Structural Engineering

Department of Civil Engineering

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Abstract

In Prestressed concrete, the initial compression is applied to the concrete before applying any external load so that stress from external loads is counteracted in a favourable way. Camber in precast prestressed slab panels can be defined as the upward deflection that is caused due to the moment caused by the eccentric prestressing force. Excessive camber development in precast prestressed slab panels can lead to several problems such as needing extra amount of topping concrete meaning extra cost and extra dead load. In addition, cracking of top surface of slab leads to durability problems. Therefore, accurate prediction of camber is essential to minimize these problems. The objective of this research is to identify the causes for the difference between design and actual camber and to propose suggestions to minimize excessive camber in precast prestressed slab panels.

To achieve the research objective, a literature review was carried out to identify camber calculation methods in precast prestressed slabs and to identify the reasons for difference between calculated and actual camber. Then did manual calculations for designing of sample precast prestressed slab panel. Electronic strain gauges were installed to high strength strands to measure the strain developed in the strands during stressing and destressing processes and obtained the data logger readings. Then comparative analysis of literature review findings, theoretical calculations and practical observations were done, and the conclusion was derived based on above analysis results. From the recalculation process by using the material properties and parameters obtained by experimental data, it is shown that it is adequate to use 5 number of strands instead of 6 number of strands.

From the experimental values obtained from concrete cylinder tests, the actual Modulus of Elasticity in concrete used is lower than the values considered in design. When the Modulus of Elasticity of concrete decreases, the upward deflection also increases. Because of excessive camber development we had to put extra amount of topping concrete thickness to maintain the minimum topping concrete layer thickness of 75 mm and to maintain levelled floor surface. This increases extra 5.27% of topping concrete material cost.

Stress releasing process of strands was done one by one and is not symmetrical. Therefore, the stress at strands varies during the releasing process. Due to this reason, there can be a twist in the precast prestressed slab panel and the camber value also varies along a cross section considered. Therefore, it is suggested to release all strands simultaneously.

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A	=	Cross section area of precast prestressed slab
A_{ps}	=	Area of prestressing strands
b	=	Width of the precast prestressed slab
E_{ci}	=	Elastic modulus of concrete
E_s	=	Elastic modulus of prestressing strands
e	=	Eccentricity of prestressing strands
f_{cu}	=	Characteristic compressive strength of concrete
f_{pu}	=	Characteristic strength of prestressing strands
f_{max}	=	Maximum permissible stress in concrete at service condition
f_{min}	=	Minimum permissible stress in concrete at service condition
f_{maxt}	=	Maximum permissible stress in concrete at transfer condition
f_{mint}	=	Minimum permissible stress in concrete at transfer condition
I	=	Second moment of area of precast prestressed slab
M_0	=	Moment due to self-weight of slab
M_s	=	Moment at serviceability limit state
P_j	=	Jacking force
P_i	=	Initial prestress force
P_e	=	Effective prestress force
P_{sr}	=	Loss due to steel relaxation
P_{sc}	=	Loss due to creep of concrete
P_{ss}	=	Loss due to shrinkage of concrete
V_{co}	=	Design ultimate shear strength of uncracked section
V_{cr}	=	Design ultimate shear strength of cracked section
V_c	=	Critical shear strength of concrete section
Z_1	=	Section modulus at bottom of precast prestressed slab
Z_2	=	Section modulus at top of precast prestressed slab
α	=	Loss ratio
δ_{ps}	=	Deflection due to prestress force
δ_{sw}	=	Deflection due to self-weight of slab
γ_m	=	Partial factor of safety for material strength