1/3

FACULTY OF ENGINEERING AND ARCHITECTURE
AMERICAN UNIVERSITY OF BEIRUT
Department of Civil & Environmental Engineering

CE622 – Prestressed Concrete
Exam II (Optional) – Spring 2009-2010

Prof. M. Harajli

Time = 1 ½ hrs
Allowed a two-page summary
Use of Programmable Calculators is not allowed

Problem No. I (15%) – *(Learning Outcome 1)*

(i) List three of the most important advantages of prestressed concrete.

(ii) List the methods used for prestressing concrete members and the type of construction application for each.

Problem No. II (40%)– *(Learning Outcome 2)*

Given a pre-tensioned simply supported member as shown in the figure below.

Section Properties: $A_c = 2550\ \text{cm}^2$; $y_{top} = 50$ cm; $y_{bottom} = 40$ cm; $I_g = 1,994,750\ \text{cm}^4$; eccentricity at midspan $e = 30$ cm.

Loading: $W_g = 1.4$ T/m; $W_s = 1.0$ T/m

Reinforcement and Material Properties: A_{ps} = 14 strands of ½ in -7 wire strands Grade 270 (14.0 cm^2); $f_{pu} = 18900\ \text{kg/cm}^2$; $f_{pi} = 0.65 f_{pu}$; $f_{pe} = 0.55 f_{pu}$; $f'_c = 420\ \text{kg/cm}^2$; f'_{ci} (7 days) = 300 kg/cm.^{2}

Allowable concrete stresses: $\sigma_{ci} = -0.6 f'_{ci}$; $\sigma_{ti} = 3\sqrt{f'_{ci}\,(psi)}$; $\sigma_c = -0.60 f'_c$; $\sigma_t = 6\sqrt{f'_c\,(psi)}$. Allowable compression stress under sustained load (Dead Load) $\sigma_c = -0.45 f'_c$

1. What is the magnitude of the uniformly distributed live load W_{LL} that the beam can support before developing flexural tension cracks.

2. What is the maximum uniformly distributed live load that the beam can support such that the beam satisfies both of (i) the allowable concrete stress requirements under service load, and (ii) the ultimate flexural strength requirements of the ACI code.

3/3

Problem No. III (15%)– *(Learning Outcome 2)*

A post-tensioned simply supported concrete beam has the following cable characteristics: span length = 50 m; prestressing is carried out from both sides simultaneously; cable profile is parabolic with eccentricity at midspan e_m = 50 cm, and eccentricity e_s at support = 0.0 cm. E_{ps} = 2.0 x 10^6 kg/cm^2; jacking stress = 0.74 f_{pu} ; f_{pu} = 18900 kg/cm^2 (Grade 270); curvature friction coefficient μ = 0.25/rad.

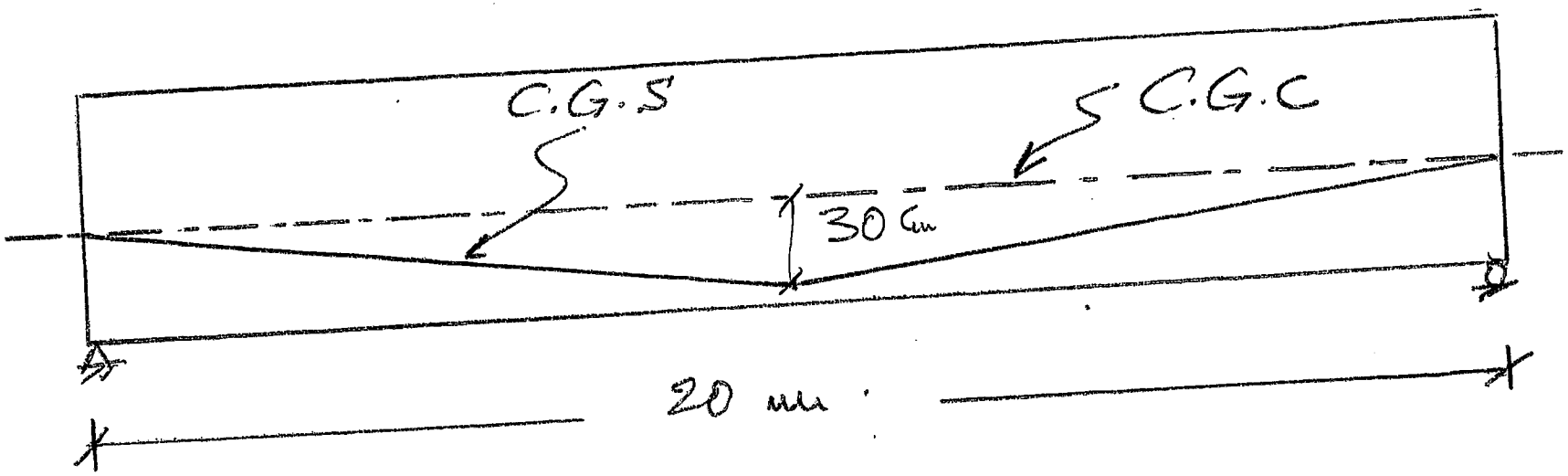
Assuming the stress profile between the midspan and the support is linear (i.e. not exponential), and if the measured elongation of the cables at the prestressing end = 15.5 cm, estimate the wobble friction coefficient k (1/m).

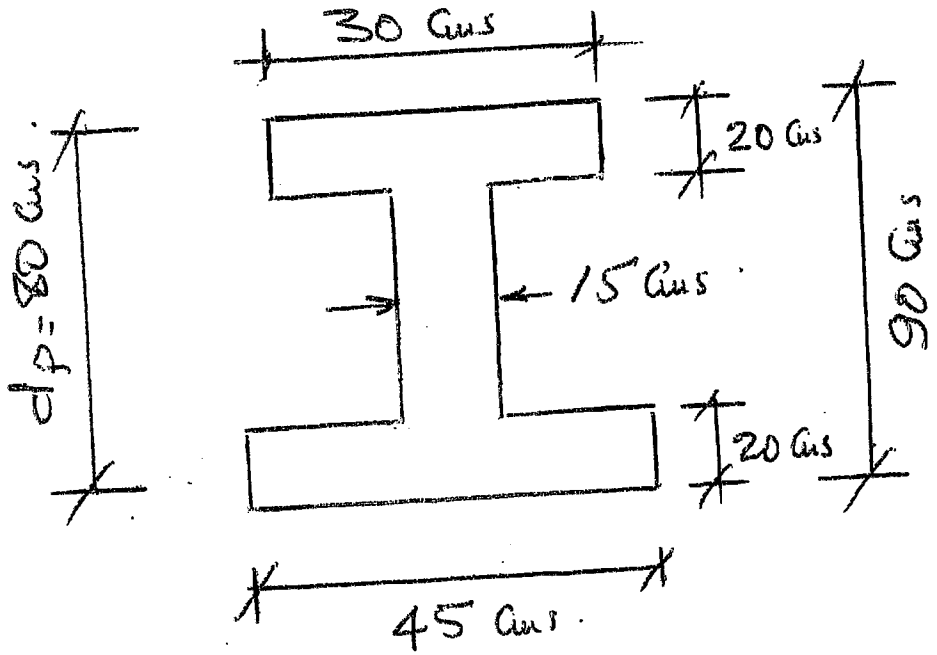
Problem No. IV(30%) – *(Learning Outcome 4)*

A prestressed concrete rectangular beam has the following properties: span length = 10 m, b = 30 cm, h = 60 cm, f'_c = 320 kg/cm^2, superimposed dead load = 1.5 T/m, and live load LL = 0.5 T/m. The profile of the prestressing steel is horizontal with an eccentricity e = 20.0 cm.

(i) Calculate the effective force in the prestressing steel if the deflection at midspan under service dead load (DL) (superimposed plus self-weight) is to be zero.

(ii) Assuming the prestressing force in Q. (i) is determined to be F = 100 tons, estimate the concrete stresses in the top and bottom fibers at midspan under (a) (DL), and (b) under application of full service load (DL + LL).


C.G.S
C.G.C
30 Cm
20 mts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