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King Mongkut's University of Technology Thonburi
Midterm Examination

Semester 1 Academic Year 2017

CVE 444 Prestressed Concrete Design — 4rd Year Undergraduate Student
Date of Examination: September 25, 2017 — Time 13.00-16.00 AM.

Instruction:

1. There are 4 questions, 13 pages (including this page). Answer all questions.
2. Write your name at all pages and answer in the examination paper. If the provided space is not enough, use the back side of the paper.
3. Books, notes, and calculators are allowed in the examination room

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Examiners : Dr. Raktipong Sahamitmongkol
Tel. 02-470-9312

This examination paper has been approved by the Department of Civil Engineering

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Assoc. Prof. Dr. Sutat Leelataviwat
Head of the Civil Engineering Department

Student Name:_____**I.D. Number**_____

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Problem 1: A simply-supported prestressed concrete is subjected to the superimposed dead load of 20 kN/m and live load of 60 kN/m. The span length is 12 m. The cross-section is rectangular with 300-mm width and 1000-mm height. The profile of prestressing tendon is parabolic and its eccentricity is 450 mm below the concrete centroid at midspan section.

Determine the top and bottom stress of the midspan section at the stress transfer and at the service condition by

1) Elastic stress analysis (15 marks)

2) Load Balancing method (10 marks)

Note: Density of concrete can be assumed as 24 kN/m^3 and the effectiveness ratio is assumed as 0.90. If any other necessary parameter is not given, assume suitable value explicitly in the calculation.

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Problem 2: A simply-supported prestressed concrete member is to be designed according to allowable stress recommended by ACI318-05. A rectangular cross-section is preferred. All loads are uniformly distributed. The moments at midspan due to superimposed dead load and live load are 60 kN·m and 200 kN·m, respectively. The concrete strength at prestress transfer and at service load is 40 MPa and 60 MPa, respectively. The eccentricity can be varied along the span.

Note: Density of concrete can be assumed as 24 kN/m^3 and the effectiveness ratio is assumed as 0.90. If any other necessary parameter is not given, assume suitable value explicitly in the calculation.

1) Determine minimum top cross-sectional modulus (S_t) and minimum top cross-sectional modulus (S_b) when self-weight is ignored. (5 Marks)

2) If the depth of cross-section is fixed at 600 mm, determine a suitable width of cross-section if the self-weight is also considered. (10 marks)

3) With the obtained size of rectangular cross-section, determine the required prestressing force and eccentricity at midspan (10 marks)

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Problem 3: Rectangular prestressed concrete section with a width of 200 mm and height of 550 mm is prestressed with the initial prestress of 1,300 kN. The eccentricity at midspan is 150 mm. Five 7 wire strands with 17.78-mm diameter are installed by bonded system. The yielding strength and breaking strength of each strand are 318.0 kN and 353.2 kN, respectively. The effectiveness ratio is 0.85 and the 28-day compressive strength of concrete is 65 MPa.

Determine the flexural capacity of the cross-section by equation recommended by ACI318-05 (25 marks)

Note: If any other necessary parameter is not given, assume suitable value explicitly in the calculation.

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Problem 4: A prestress concrete beam, 200 mm wide and 300 mm deep, is prestressed with wires (area = 320 mm^2) located at a constant eccentricity of 50 mm and carrying an initial stress of 1000 N/mm2. The span of the beam is 10 m. Calculate the percentage loss of stress in wires if the beam is pre-tensioned with constant eccentricity (25 Marks)

Use the following data (if necessary):

$E_s = 210\ kN/mm^2$, $E_c = 35\ kN/mm^2$

Relaxation of streel stress = 5 percent of the initial stress

Shrinkage of concrete = 300×10^{-6} for pre-tensioning only

Creep coefficient = 1.6

Slip at anchorage = 1 mm

Friction coefficient = 0.0015 (for wobble effect)