มหาวิทยาลัยสงขลานครินทร์
คณะวิศวกรรมศาสตร์

สอบปลายภาคการศึกษาที่ 1 **ปีการศึกษา 2553**

วันที่ 4 ตุลาคม 2553 **เวลา 13.30 - 16.30 น.**

วิชา 221-414 Prestressed Concrete **ห้องสอบ S 817**

ชื่อ-สกุล..... .....**รหัส**.....

คำชี้แจง

1.ข้อสอบทั้งหมดมี 5 ข้อใหญ่ คะแนนรวม 100 คะแนน ดังแสดงในตารางข้างล่าง

2.ข้อสอบมีทั้งหมด 14 หน้า (รวมปก) ผู้สอบต้องตรวจสอบว่ามีครบทุกหน้าหรือไม่ (ก่อนลงมือทำ) ห้ามฉีกหรือแกะข้อสอบออกจากเล่ม

3.ให้ทำหมดทุกข้อลงในกระดาษคำถามนี้ หากไม่พอให้ใช้หน้าว่างด้านซ้ายมือ

4.ไม่อนุญาตให้นำเอกสารใดๆ เข้าห้องสอบได้

5.อนุญาตให้ใช้เครื่องคิดเลขได้ทุกชนิด

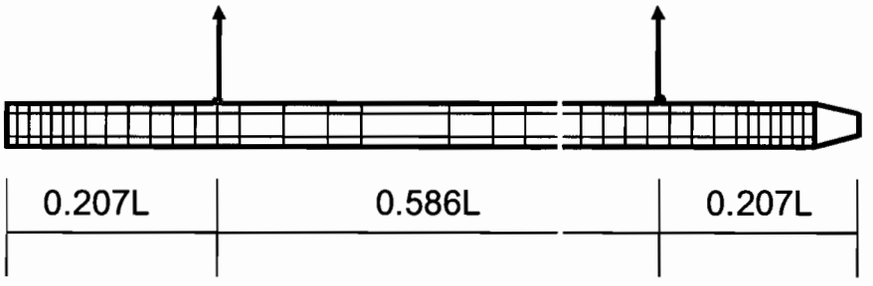
6.ห้ามหยิบ หรือยืมสิ่งของใดๆ ของผู้อื่นในห้องสอบ

7.อนุญาตให้ตอบด้วยดินสอดำได้ (ควรใช้ชนิด B)

ตารางคะแนน

ข้อที่	คะแนนเต็ม	ได้
1	20	
2	20	
3	20	
4	20	
5	20	
รวม	**100**	

(20 point) Problem 1: Design of a square prestressed concrete pile with cross section (30×30 cm). The length of a concrete pile is equal to 20 m (assume total losses 20% Relative Humidity = 75%) and Impact factor 30%. Do not design for stirrup



Compressive strength of concrete:

Minimum compressive strength at service $f_c^{'} = 400\ ksc$

Minimum compressive strength at transfer $f_{ci}^{'} = 0.7f_c^{'} = 280\ ksc$

Prestressing tendon:

PC.wire Diameter 7 mm: As = 0.3848 cm^2 $f_{pu} = 16{,}000\ ksc$

Permissible tensile stress of prestress tendons: $f_{pi} = 0.7f_{pu} = 11{,}200\ ksc$

Allowable stress of concrete at transfer load

Extreme fiber stress in compression: $0.6f_{ci}^{'}$ Extreme fiber stress in tension: $0.795\sqrt{f_{ci}^{'}}$

Allowable stress of concrete at service load (for transportation and driven)

Extreme fiber stress in compression: $0.45f_c^{'}$ Extreme fiber stress in tension: $1.59\sqrt{f_c^{'}}$

Allowable axial load on the pile = $(0.33f'_c - 0.27f_{pc})A_C$ and **Ultimate load on the pile** = $(0.85f'_c - 0.6f_{pc})A_C$

Losses using EIT code:

$SH = 1200 - 11RH$ $\qquad ES = E_s\varepsilon_{ES} = \frac{E_s f_c}{E_c} = \frac{E_s P_i}{E_c A_c} = r\frac{P_i}{A_c} = nf_{cs}$

$CR = 12f_{cir} - 7f_{cds}$ $\qquad RE = 1270 - 0.4ES - 0.2(SH + CR)$

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Determine

1.1 Minimum number of steel PC wires

1.2 Check top and bottom fiber stresses at transfer and service load

1.3 Safety factor of axial bearing load

1.4 Check total losses using EIT code.

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Problem 4 (20 point): The concrete I beam is prestressed with tendons (bonded) having area 2,350 mm^2. The effective prestress force after all losses is 11,200 kg. The eccentricity of the prestress tendon (ordinary stress-relieved tendons) is 115 mm above the bottom of the beam. Determine the ultimate resisting moment of the section and Check the reinforcement index following ACI code.

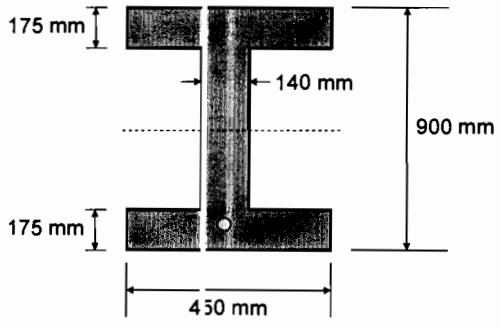
Compressive strength of concrete:

$$f_c^{'} = 490\ ksc$$

Prestressing tendon:

$$f_{py} = 16{,}000\ ksc$$

$$f_{ps} = 19{,}000\ ksc$$



Steel stress f_{ps} at flexural failure (if f_{pe} is not less than $0.5f_{pu}$)

Members with bonded tendons but without tension or compression reinforcement

$$f_{ps} = f_{pu}\left(1 - \frac{\gamma_p}{\beta_1}\frac{\rho_p f_{pu}}{f_c^{'}}\right)$$

γ_p = 0.40 for f_{py}/f_{pu} not less than 0.85 (ordinary stress-relieved tendons)

$$\beta_1 = 0.85 - 0.0008\,(f_c^{'} - 300) \geq 0.65$$

Check the reinforcement index

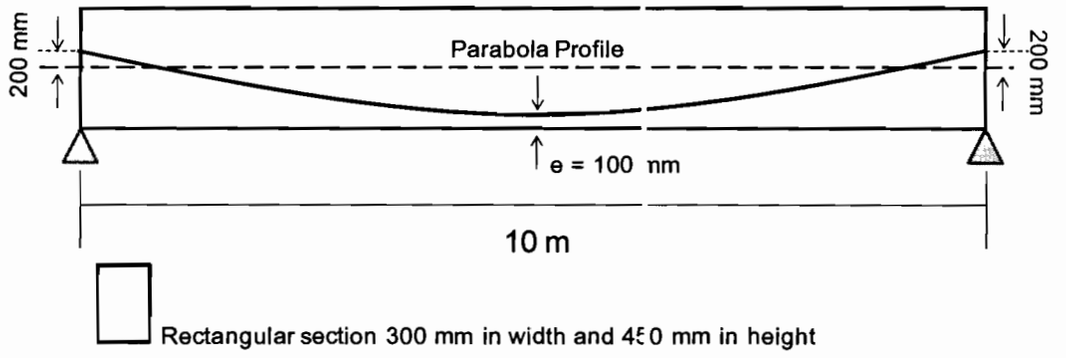
$$\omega_{pw} = \frac{\rho_{pw} f_{pu}}{f_c^{'}} \leq 0.36\beta_1$$

$$\rho_{pw} = \frac{A_{pw}}{b_w d_p}$$

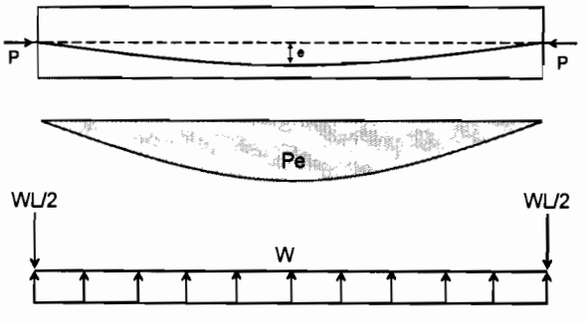
The compression force in the web part is equal to the tension force with the steel area A_{pw}.

$$A_{pw} f_{ps} = 0.85 f_c^{'} b_w a$$

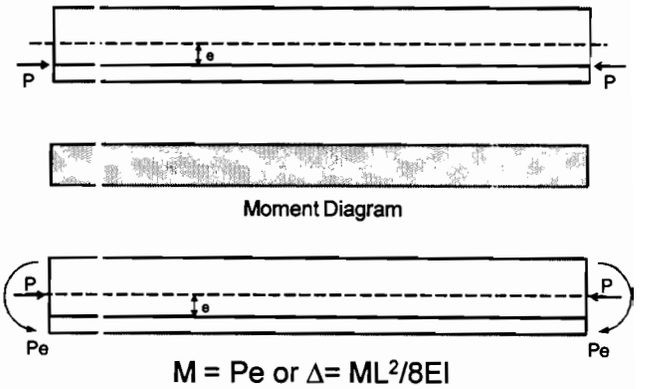
Problem 5 (20 point):: A concrete beam of 10 m simple span is pc sttensioned with 780 mm^2 of high tensile steel to an effective prestress of 9650 ksc. Assuming (E_c = 280,000 ksc E_s = 1.9(10^6) ksc) and f'_c = 380 ksc Modulus of rupture $2.0(f'_c)^{0.5}$



Rectangular section 300 mm in width and 450 mm in height



M = Pe or M = $WL^2/8$
W = $8Pe/L^2$
Δ = $5WL^4/384EI$



M = Pe or Δ= $ML^2/8EI$

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5.1 Compute the deflection at midspan due to the effective prestress and the beam's own weight.

5.2 Determine cracking moment of the prestressed concrete beam

5.3 Determine the additional uniform load can carry on the prestressed concrete beam before beam cracking.

5.4 Compute the total deflection before cracking due to the prestress, beam's own weight and additional uniform load

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