Yonsei University
Dept. of Civil & Environment Engineering
2019. 06. 11

Final Term Exam

Structural Behavior of Concrete

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Name :
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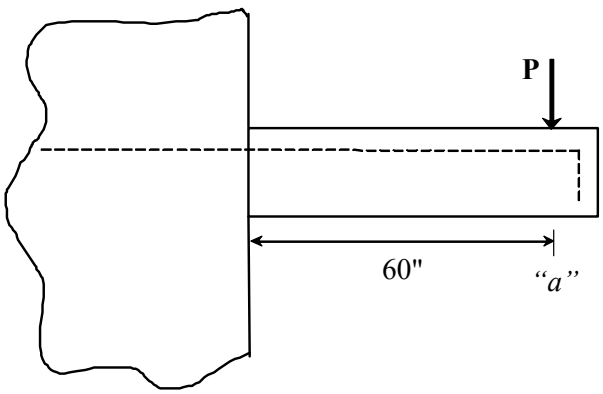
The Total point is 120 points.

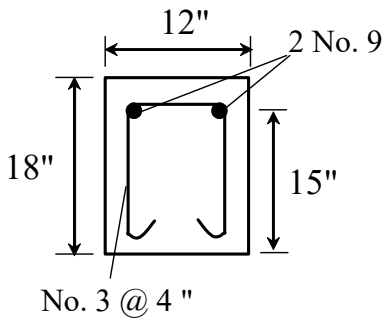
Problem 1 : Point (40)

A weightless cantilever beam attached to a massive anchorage block is shown. Material and cross-sectional properties are given below. The beam is subjected to a load history described as follows :

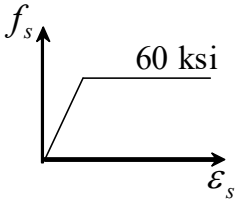
(a) The beam sits for one year after construction without applied load.
(b) At age one year, a concentrated load of P=15kips is applied at point "a".
(c) The load P=15kips is maintained on the beam for five years.
(d) The load P is increased to failure.

Plot the complete relation between deflection and time. Indicate as well as possible the shape of the curves describing the relation. Indicate deflection values at times of 1 year and time of 6 years. Indicate the deflection at failures.





Recommendation : Do not apply ACI deflection calculation methods directly.



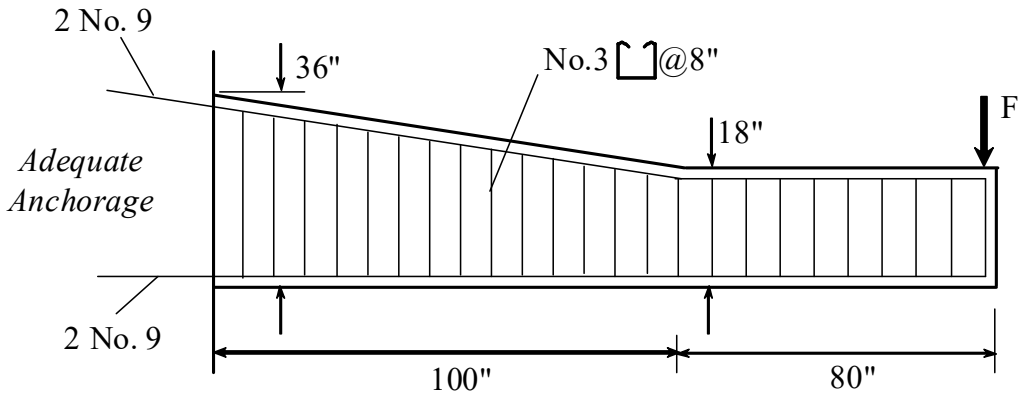
$f'_c = 4\ ksi$ $\quad I_g = 5800\ \text{in}^4$ $\quad I_{cr} = 2100\ \text{in}^4$ ($kd = 5.12$ in)

$M_{cr} = 300\ k{\cdot}in$ $\quad M_y = 1600\ k{\cdot}in$ $\quad \epsilon_{sh} = 0.0007$

$C_t = 2.0$ $\quad E_c = 3600\ ksi$ $\quad \rho = 0.011$, $n = 8.0$

Problem 2 : Point (40)

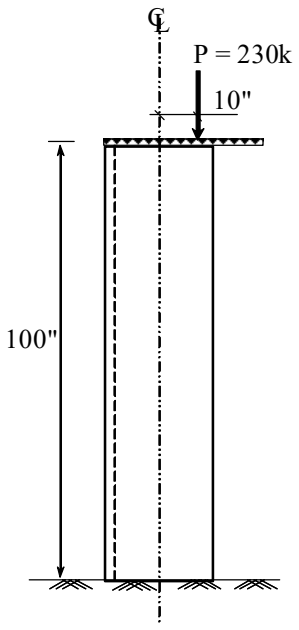
A cantilever beam has been constructed upside down as shown below. You have been hired to determine the theoretical load F at failure. Assume the beam to be weightless. (Normal weight concrete, $E_c = 3605\,ksi$, $E_s = 29000\,ksi$, $f_{ck} = 4000\,psi$, $f_y = 60000\,psi$)



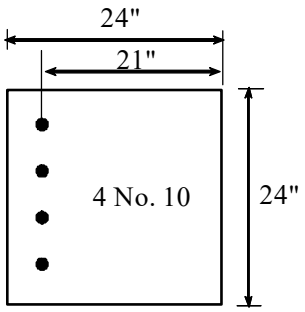
Problem 3 : Point (40)

A structure consists of a vertical reinforce concrete member supporting a rigid platform on which a concentrated load is placed. Assume "typical" normal-weight aggregated concrete having $f'_c = 4000\,\text{psi}$. Grade 60 steel.

Assume the load is placed at age of 1 year. Calculate the horizontal deflection at the load point at age of ten years. The reference point for zero deflection is the position at the time of casting. Do not use the ACI empirical equation s for deflection calculations. Hint ; $\epsilon_c = 0.0005$



Elevation



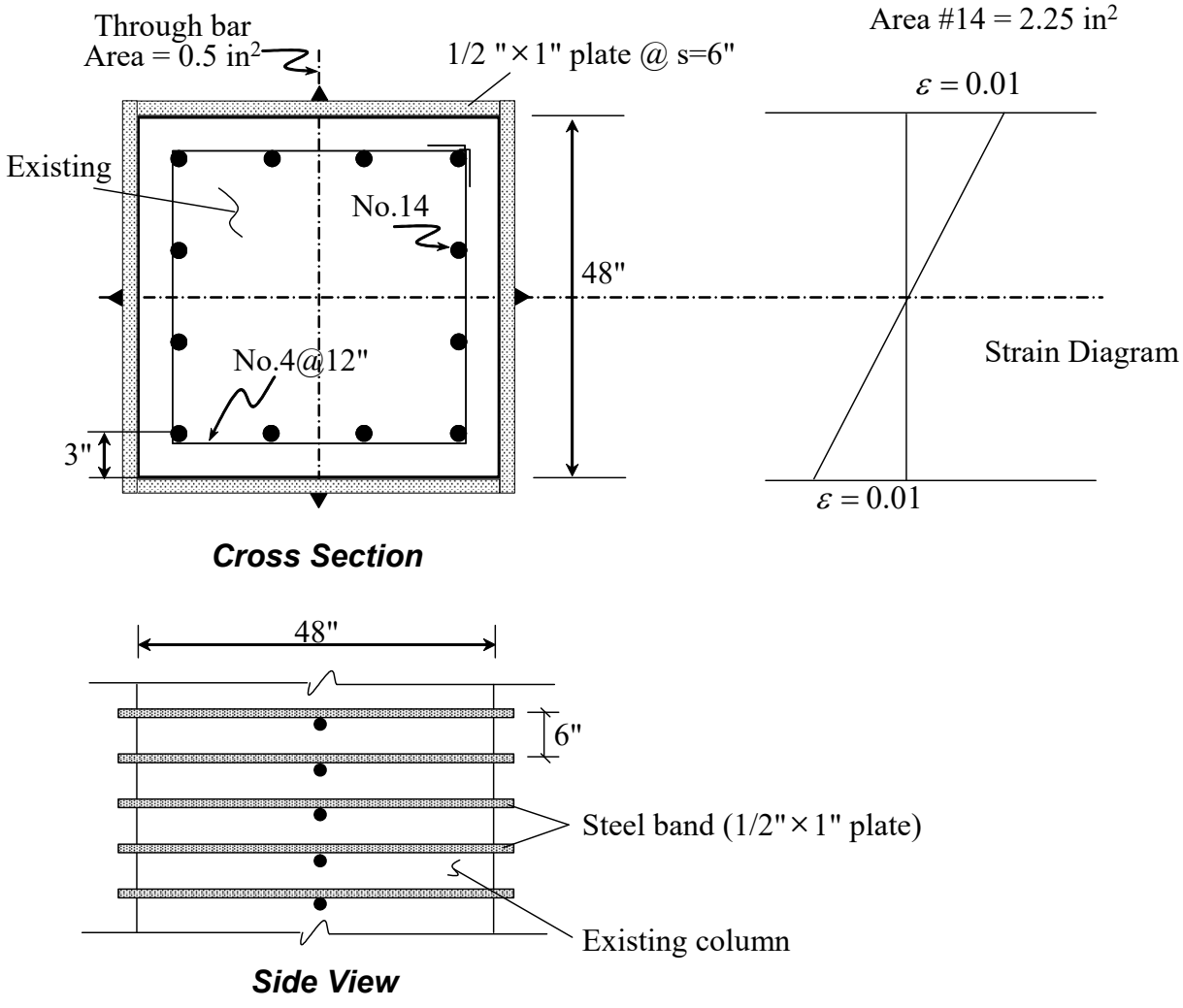
Cross Section

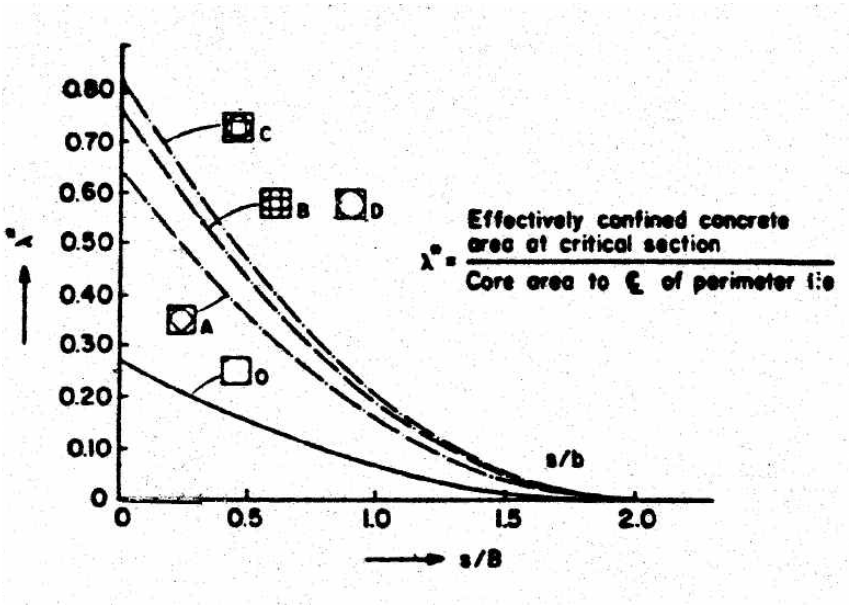
- Area No.10 = 1.27 in^2
- $\varepsilon_{c\max} = 0.0005$

Problem 4 : Point (40)

An existing bridge column has $f'_c = 4000$ psi and Grade 40 reinforcement (assume $f_y = 45000$ psi and no strain hardening). Existing ties comprise No.4 perimeter hoops at 12-in. spacing as shown. A proposed retrofit consists of steel bands and through bars having $f_y = 50000$ ksi and spacing of 6 inches.

As proof that you understand how to calculated behavior of this column, calculate the axial load corresponding to the strain condition shown below.





Effectively confined concrete area as a function of tie spacing and core size for various square steel configurations

bar #	d_b (in)	A_b (in^2)
3	3/8	0.11
4	4/8	0.20
5	5/8	0.31
6	6/8	0.44
7	7/8	0.60
8	1	0.79
9	1.12	1.00
11	1.44	1.56