CIE 429 – Reinforced Concrete Design
Final Examination

- Time: 3hrs
- Open books, notes, old exams…etc.
- Start each problem on a new page and mark the proper problem #.
- Please write and draw as neat as you possibly can.
- The exam offers you 120 points…same as the midterm exam. You will be graded up to 100 points. If you get a 110, then it is a 100.
- If the final exam grade is higher than the midterm grade, then the final grade will be considered as the score for both examinations.
- Do not pass materials during the exam…this means no cheating.
- Please fill out the questionnaire before leaving the exam.

Problem 1:

Determine the ultimate and design capacity of the tied column shown for two possible conditions of failure:

(a) Axial Compression only (13)

(b) And when the Compression block covers half of the area of the column. (Assume that the compression block extends over the entire compression strain area.) (13)

Comment of the difference between case (a) and case (b).

(Moments should be expressed in terms of the centerline. Reinforcing bars are equally spaced.)

![Diagram of a circular column with multiple bars labeled with specifications.]

Figure P1
Problem 2: 30 points

Figure P2 shows the cross-section of a water channel to be made entirely of reinforced concrete.

Without any computations:

1) Show the expected line of stress for the hydrostatic pressure.  (2)
2) Show the expected moment diagram for the channel under the same condition.  (5)
3) Show the expected shear diagram for the same structure.  (5)
4) Show the schematic for the tension reinforcement (using short lines) wherever steel is required within the cross-section.  (3)
5) Show detailed reinforcement in the cross-section and detailed bars next to the cross section. (How should it be constructed?)  (10)

Note: Show all reinforcement in item 5 including transverse reinforcement if any.

Problem 3: 20 points

Show the arrangement of reinforcing bars in the slab shown on the floor plan. (Typical reinforcement only.) Indicate shrinkage reinforcement if necessary.  (20)
Problem 4: 40 points

The beam shown below is part of a floor system. Determine:

i. From the moment diagram, determine the distributed service dead load and live load, which act on the beam. (6)

ii. Determine the customary design moments using customary ACI load factors for bending. Draw a new moment diagram. (7)

iii. Redistribute the design moments using 10% reduction of the moments over the supports. Show the "redistributed" diagram. (7)

iv. Using information about the equivalent moment of inertia considering the mid-section properties and conditions only \( I_m = I_m \), determine the deflection due to the live load only. (20)

Good Luck! Budget your time wisely.

\[ f_c = 3000 \text{ psi} \]
\[ f_y = (60) \text{ ksi} \]