FINAL EXAMINATION

Open books, notes and any other material.
Time of Examination: 3 Hours

READ following notes before starting the examination.

1. Before starting writing in the exam book **sign the exam book**.

2. **The total number of points exceeds 100 points**. However, your score may not exceed 100.

3. There will be **no credit** for correct "answers" which are not relevant to the question. Moreover a deduction may be applied for such attempt.

4. **Budget your time according to your strength**. The questions **are not in order of their difficulty**. Start and solve in order of their difficulty relative to your knowledge; start from the easiest !!!.

5. Each problem should be solved **starting a new odd page** in the exam book.

6. **Optional:** At the end of the examination, please answer a few questions on the enclosed form (on the back of this page). **Do not sign it** and submit the page **separately** from your examination, if you wish to do so. Add additional pages if you think you need it. Your feedback is very important to us. Thank you in advance.

SUCCESS TO YOU IN YOUR EXAMINATION

and

SUCCESS IN YOUR ENGINEERING LIFE.

Andrei M Reinhorn, PE PhD
Professor
Vasileios Barmpoutis, BS**,**
Teaching Assistant

Have a nice holiday and winter vacation!!

QUESTIONAIRE

Please take a few minutes and answer a few questions regarding this course. All answers will be compiled to improve the course next year.

(a) How did instructions / lectures influence your studies? (Did you follow lectures? Did you need to read in addition? Were you interested to read additionally?)

(b) In view of the project and examinations, what suggestions do you have about homeworks? (Is the format sufficient, or should it be changed? How?)

(c) Can TA and the instructor help more? (If yes, at what stage? How?)

(d) What things can "turn you on" during class presentations? (Possibly: history of previous projects from instructor career, presentation of current projects, or ____? Add your experience from similar classes.)

(e) Was grading policy well explained? Is grading policy fair? Do examinations fit the proposed policy? Do projects fit the proposed policy?

(f) How was the communication based on the Web used for the class? What information was missing? What else would you like to see on the web for this class? Any other suggestions?

Problem #1 TWO WAY SLAB (20 pts.)

Using load distribution method (based on equal deflections in in each direction), **determine the load distribution in each direction of the slab** shown below. **Note: The slab is simply supported along the side A, fixed or continuous over the supports sides B and C, and NOT supported at all (no beam along the free end.) along the side D.** The thickness of the slab is 6" and is made of regular concrete.

Show qualitatively the reinforcement in each direction.

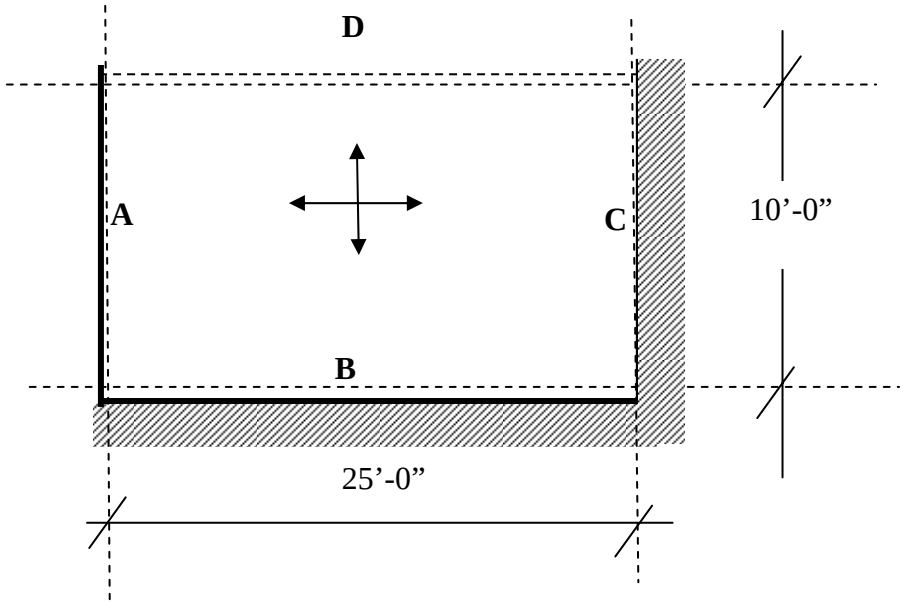

Fig 1 –Layout plan of slab for Problem 1

Problem #2 EVALUATION OF BEAMS (40 pts.)

For the 12" x 22" rectangular beam, reinforced with 8#8 at right support (in two layers), and 3#8 in midspan as shown below, determine:

a) Determine the moment capacity in each of the critical sections (midspan and right support) (15 pts).

(neglect the left support negative reinforcement and moment at left end)

b) After calculating the moments in (a), determine how much TOTAL ULTIMATE (factored) uniformly distributed load can be supported on this beam.(10 pts)

c) Assuming that the dead load is 40% of the total, determine the SERVICE live and dead loads which can be supported by the beam. (5 pts)

d) Determine the deflection due to all loads in the middle of the beam. Use center section's properties alone in the calculation of the deflections (10 points).

Data: Concrete: 5000 psi, Steel: GR60; Cover: 2" (bottom) and 4" at top (between top of beam and the centroid of reinforcement); Ec = 3000 Ksi

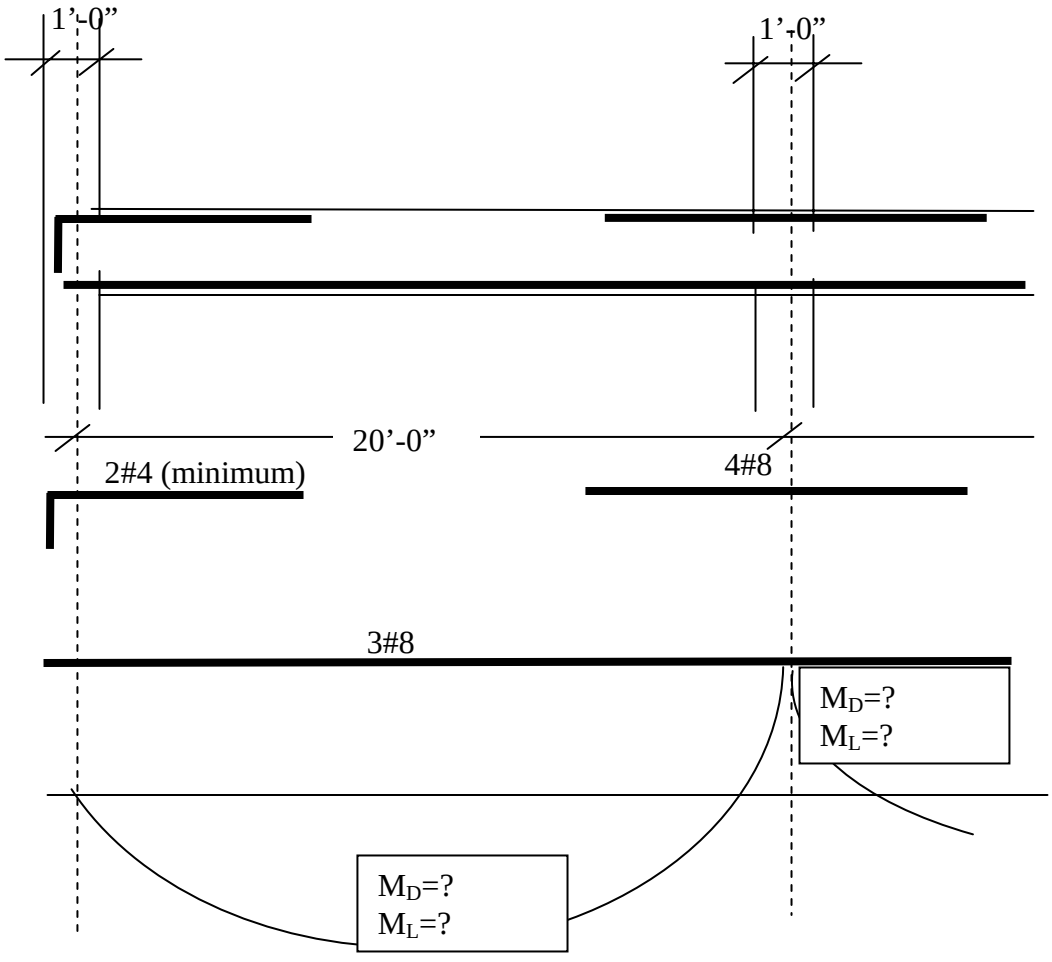

Fig 2 –Beam and moment diagram for Problem 2

Problem #3 Columns (40 pts).

1) Determine the **ULTIMATE capacity interaction diagram** for the column below defined by three points:
   a) Axial capacity without any moments (10 pts)
   b) All section in compression with zero strain at one vertex (corner) of the cross section. (10 pts)
   c) Half of the section in compression (10 pts)
2) Determine the **DESIGN capacity diagram** derived from the capacity diagram developed in (1) above. (10 pts)

Notes:

Moments should be calculated about the axes of symmetry of the section (as shown in the sketch).

Data for the column:

Concrete: ***4,000*** *psi,* ε_{cu} = ***0.003****! Steel:* ***12#8*** *of* ***GR50****; Reinforcement is* ***EQUALLY SPACED*** *around the perimeter.*

Cover of reinforcing bars form the center of the bar (including the hoops): 3.0" – from axis of reinforcement to the outside surface in all places.

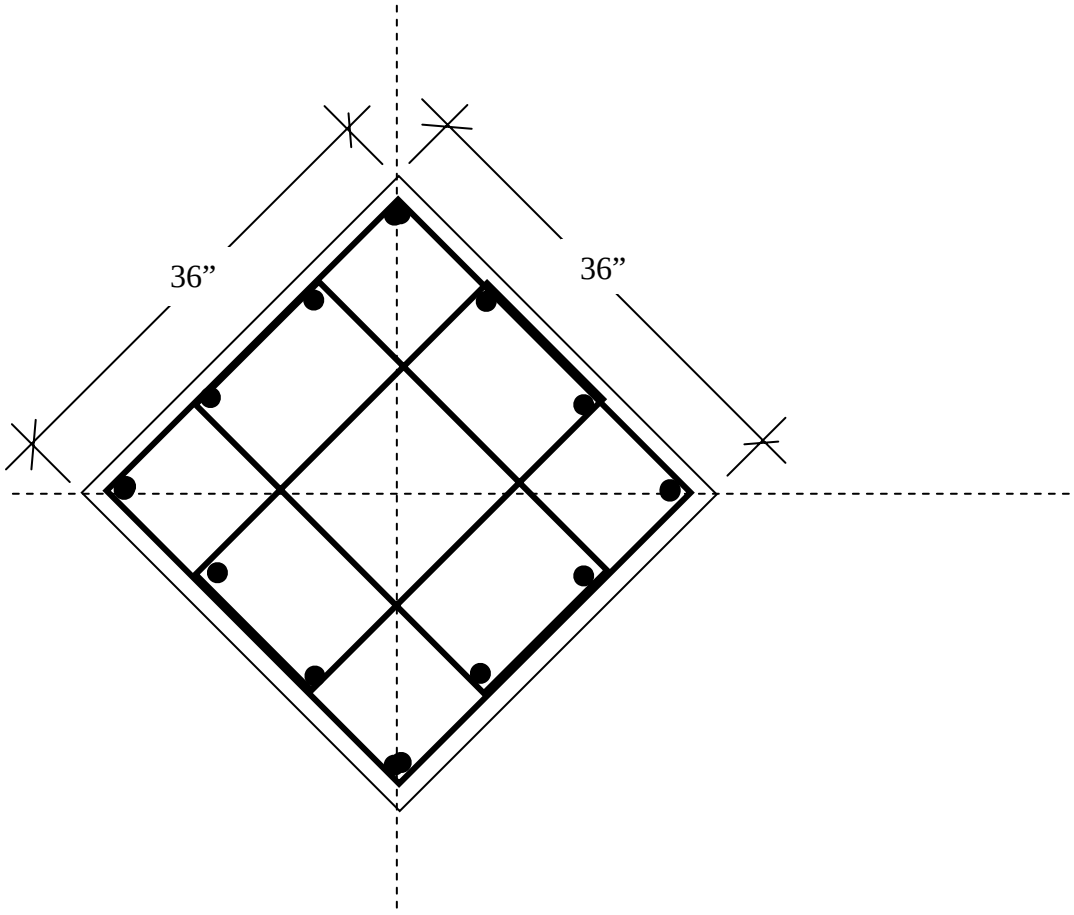

Fig 3 - Cross section of column in Problem #3

Problem #4 - CONCEPTS (20 pts.)

For the beam shown below determine and sketch the expected cracking pattern:
1) Show the cracking pattern at locations A B C and D in the sketch.
2) For extra 10 points show the cracking pattern at locations E and F.

Explain the type, the direction, and the reason for your selection of the pattern at each location.

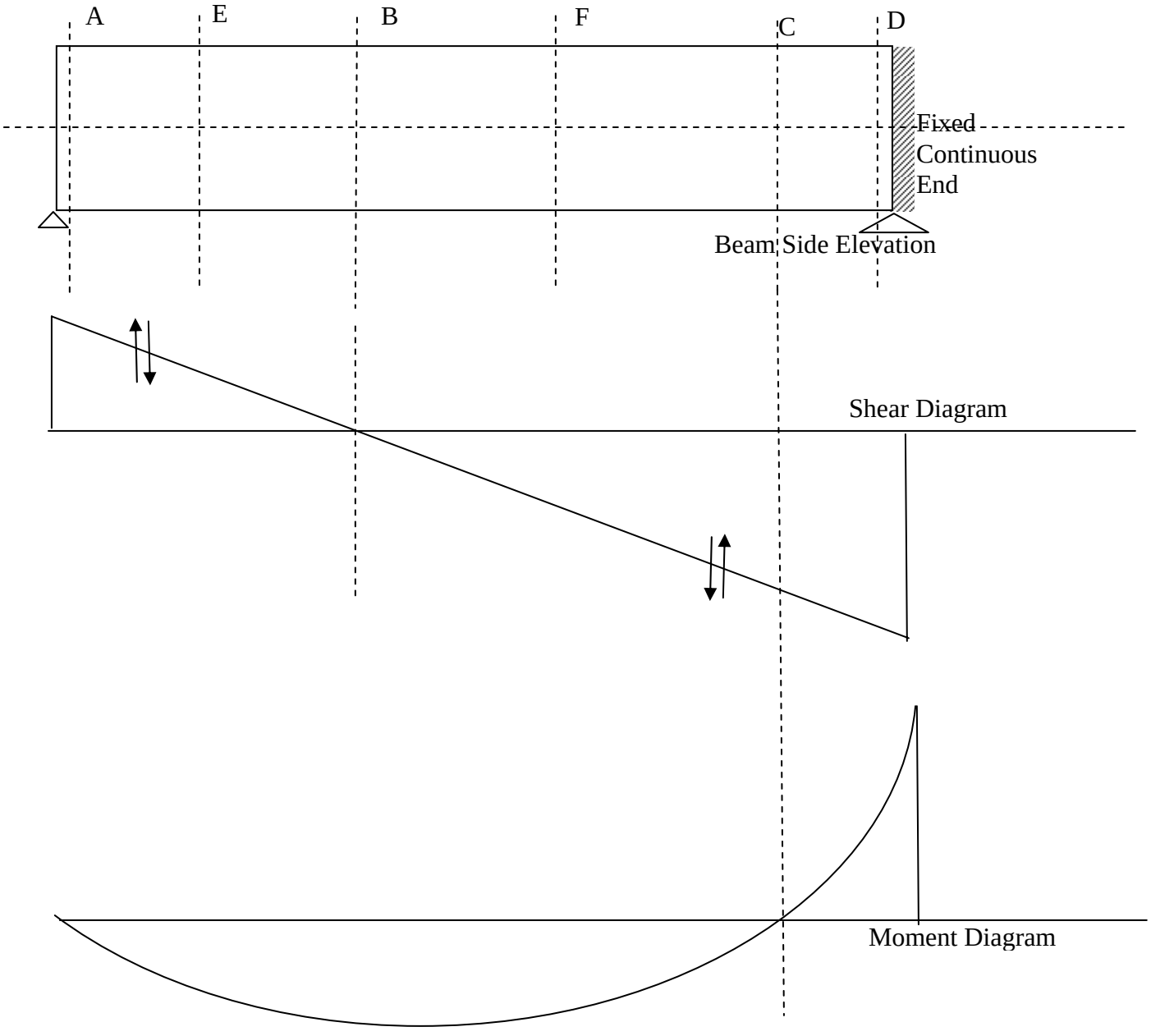

Fig 4 – Information for Problem 4