King Fahd University of Petroleum & Minerals
DEPARTMENT OF CIVIL ENGINERING

CE 511
Advanced Structural Analysis

(3-0-3)

Prerequisite: Graduate Standing
ICS 101 (Computer Programming)
or equivalent

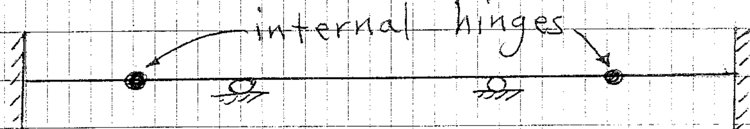
Subject	No. of Lectures
Introduction	1
Indeterminacy	1
Review of Some Undergraduate Topics (Seminars)	3
Flexibility Method of Analysis: Planar Structures	2
Stiffness Method of Analysis: (1) Planar Orthogonal Structures	14
Midterm Exam (take home) (2) Planar Non-Orthogonal Structures (3) Three-Dimensional Structures Stability of Planar Structural Systems	4
Energy Methods	2
Introduction to the Finite Element Method	1
Introduction to Structural Dynamics	2
Final Exam (in class)	

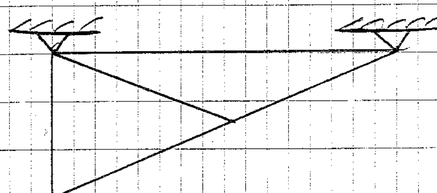
Grading Policy:

Seminars + Homework	40%
Term Project (Computer Program)	20%
Midterm Exam	20%
Final Exam	20%

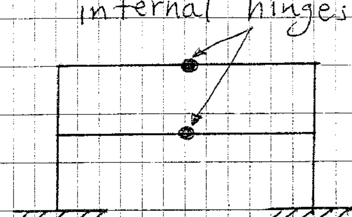
HW # 1 Spring,

State the degree of static indeterminacy and the degree of kinematic indeterminacy for the structures shown.

① 

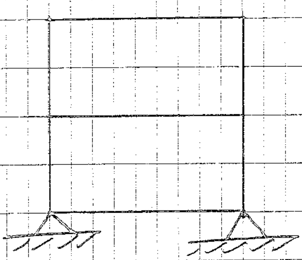
② 

plane truss

③ 

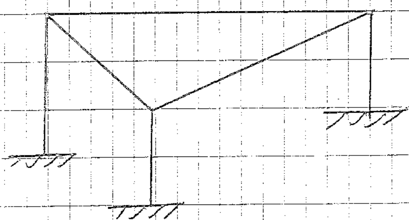
plane frame

④



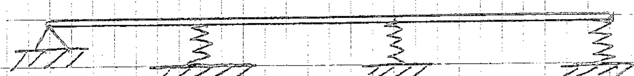
Plane frame

⑤



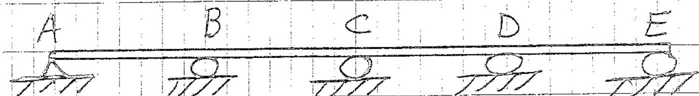
Space frame

⑥



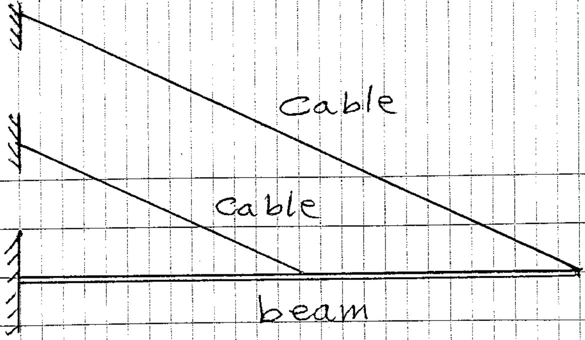
beam on elastic foundations

⑦

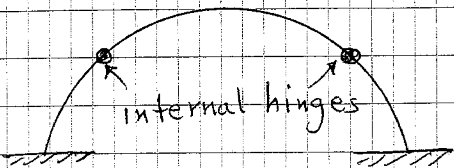


beam with settlements at A, B and C

(8)

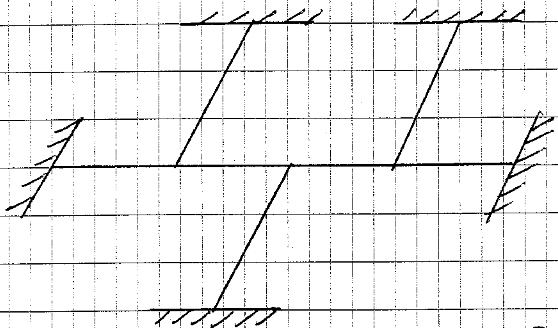


(9)



arch

(10)

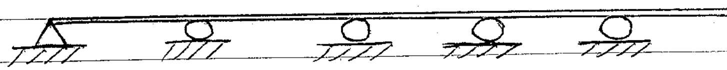


plane grid

HW #2

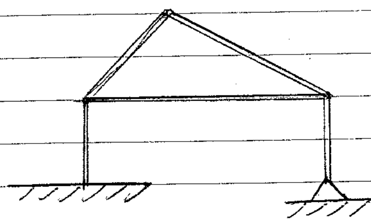
State the degree of static indeterminacy and the degree of kinematic indeterminacy for the structures shown;

(1)



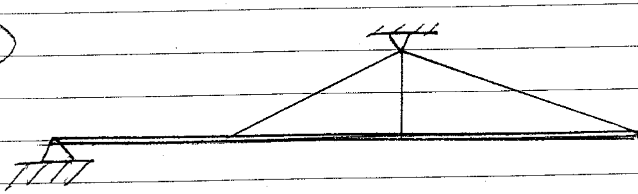
beam

(2)



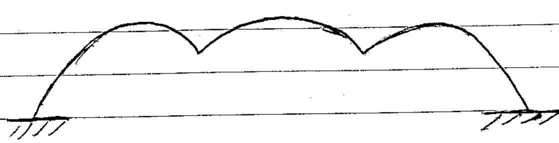
plane Frame

(3)



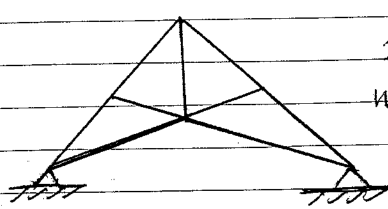
beam supported by cables

(4)



2-D arch

(5)



2-D truss neglect joint rotations

Spring,

HW #3

Obtain a computer program which can do matrix inversion. Invert a 4x4 matrix (at least)

HW #4

$$[I] = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

$$[A] = \begin{bmatrix} 6 & 7 & 8 & 9 \\ -5 & -4 & -3 & 0 \\ 4 & 5 & 6 & 7 \\ 0 & 1 & 2 & 0 \end{bmatrix}$$

$$[B] = \begin{bmatrix} 4 & 3 & 2 & 1 \\ 8 & 7 & 6 & 5 \\ -1 & -2 & 3 & 4 \\ 5 & -6 & -7 & 8 \end{bmatrix}$$

Write a computer program to determine:

① $[C] = [A] + [B]$

② $[E] = [I] * [A]$

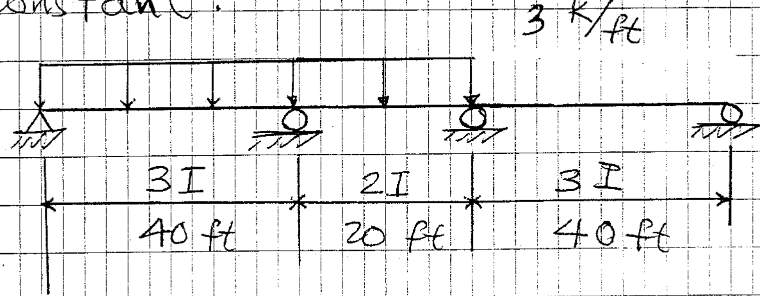
③ $[H] = [A] * [B]$

④ $[P] = [C]^T$

Output all results

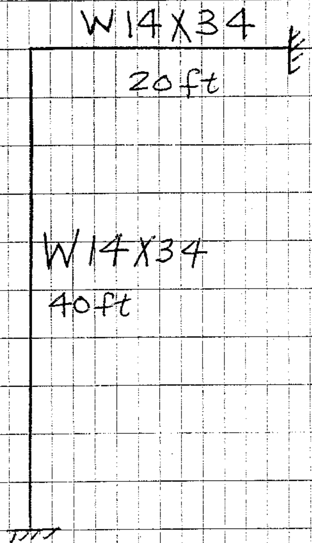
HW # 5

Analyze the beam shown using the Flexibility Method. E & I are constant.



HW # 6

The steel frame shown was erected in Riyadh when the temperature was 42°F. Calculate all reactions when the temperature becomes 122°F using the Flexibility Method.



$E = 29 \times 10^{6}$ Psi

$\alpha = 6.5 \times 10^{-6}$ IN/IN °F

$I = 340$ IN^4

$A = 10$ IN^2

HW #7

Spring [illegible]

① Write a computer program to generate the member stiffness matrix (axial deformation neglected).

② Run a case where:

$E = 1$ K/ft²

$I = 1$ ft⁴

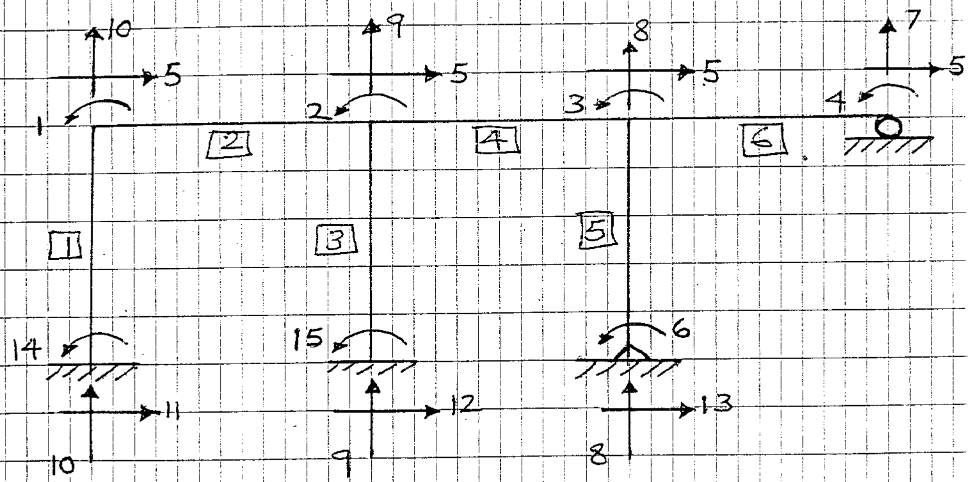
$L = 10$ ft

Output all results using the "F" format.

HW # 8

① Write a computer program to generate the total (structure stiffness matrix for orthogonal planar frames and beams.

② Run the frame shown



L = 10 ft for all

E = 1 K/ft^2 for all

I = 1 ft^4 for all

Output all results.

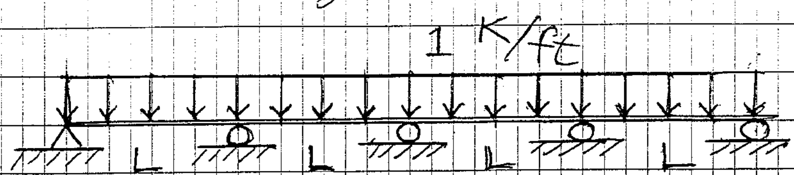
HW # 9

Using the Stiffness Method analyze the beam shown completely, i.e. calculate:

1. The unknown nodal displacements
2. All reactions
3. The shears and moments for all ends of members.

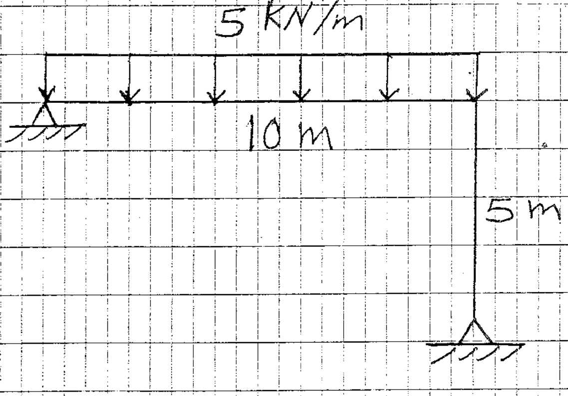
Let $E = 1\ k/ft^2$ for all
$I = 1\ ft^4$ for all
$L = 10\ ft$ for all

Show results on complete and clear drawings.



HW # 10

Using the stiffness method analyze the frame shown completely. E & I are constant.



HW # 11

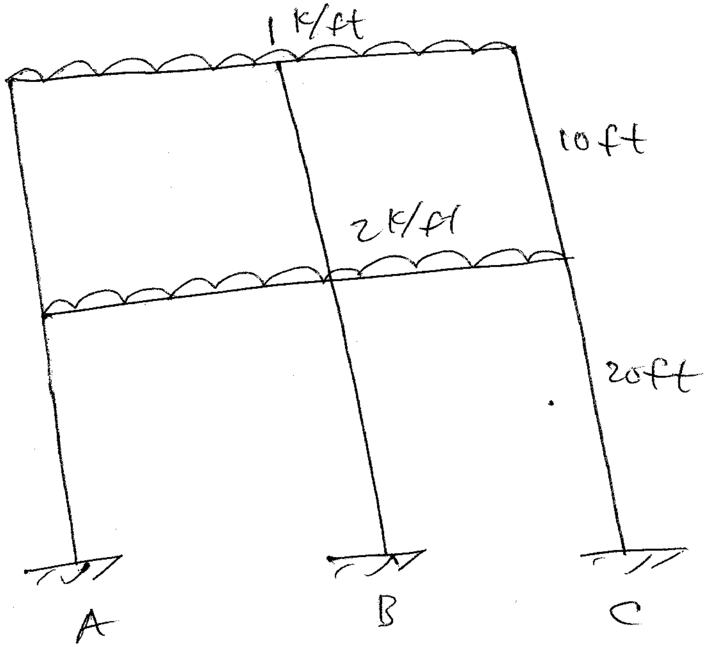
Solve problem 5-1 in handouts.

HW #12

Solve problem 6-23 in handouts

HW # 13

Using your developed program Solve the following problem. Draw all final member end actions



I = 288 IN4

E = 30000 Ksi

Support B Settles 2 IN.