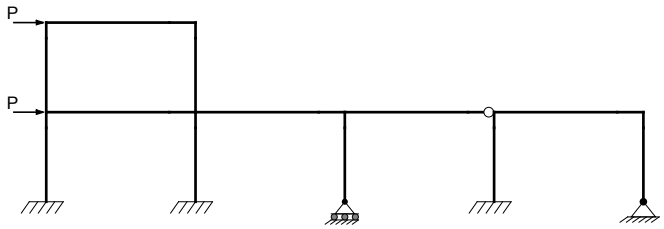
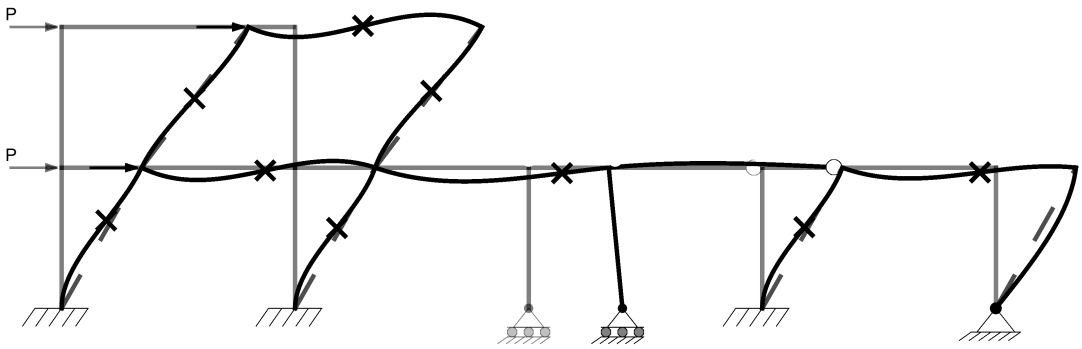
1. (30 points)
For the frame shown below, sketch the deformed shapes and indicate the location of all inflection points.
You do NOT need to indicate a numeric estimate for the location of inflection points.
Assume EI is within a factor of at most 2 between between all members.
Note:
- You must first draw the figure as shown below and then sketch the deformed shape on that figure.
- You must show chords of the deformed shape as DASHED or DOTTED lines.



Solution:

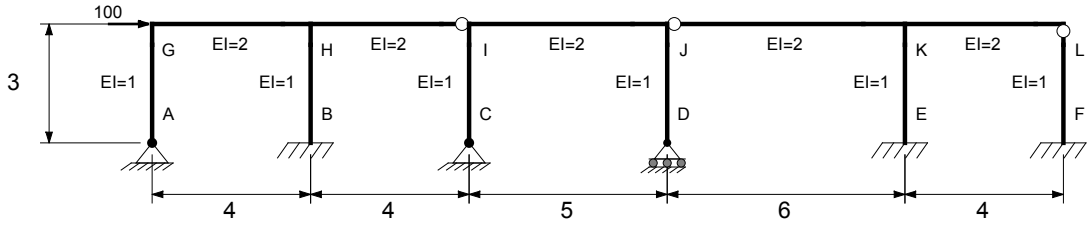


Each error in a member except inflection point: - 3 points (up to max 30 points)
Each error in inflection point (missing or inappropriate): - 2 points (up to max -8 per figure)
Each fixed connection not 90 degrees: - 2 points per figure
If any connection rotated beyond vertical that shouldn't: - 5 points (total -5 points)
On second floor, if beam not perpendicular to column and leads to beam errors
then -4 points for connection and beams

Node moving up or down (not staying at same level as initial) - 5 points
Discontinuity between bays (ie. one span doesn't follow rest): - 5 points per floor

Each other major connection error: - 5 points (up to 2 total for connections or -10 points)

2. (70 points) Referring to the structure below, indicate in a table on your answer sheet the shear in the columns and the moments at the ends of each column.
Note:
- You must also show calculations and they MUST be in tabular form.
- You do NOT need to draw the figure. You do NOT need to show the results on a figure.
- Results for beams are NOT needed. A sketch of the deformed shape is NOT needed.
- Use approximate analysis but the shears and moments in most columns must have errors less than 30% for a full grade.
- There is an internal hinge at I on beam HI
- There is an internal hinge at J on beam JK
- There is an internal hinge at L on column FL
- Supports A and C are hinges, supports B, E and F are fixed and support D is a roller



Solution:

20 points

Approximate analysis of a side loaded building						
Preliminary calculations						
Floor = 1						
column	1	2	3	4	5	6
stiffness factor at top	2.250	4.500	1.800	0	3.750	0
stiffness factor at bottom	0	∞	0	0	∞	∞

50 points

Iteration number = 1							
Floor = 1							
column number	1	2	3	4	5	6	
shear stiffness	0.083	0.384	0.078	0	0.374	0.111	1.031
relative shear stiffness	0.081	0.372	0.076	0.000	0.363	0.108	1
shear	8.083	37.230	7.607	0.000	36.302	10.777	100
Internal moment at top	24.249	52.906	22.822	0.000	51.050	0.000	
Internal moment at bottom	0.000	−58.785	0.000	0.000	−57.857	−32.332	

Stiffness factor error: 1 error -4, otherwise: -5 per column
Propagated error from stiffness factor, shear stiffness,has NO PENALTY if results are consistent
except if shear stiffness is zero when it shouldn't or nonzero when it should
then penalty applies on target columns

shear stiffness: -4 per error; max points removed - 16
relative shear stiffness: - 2 per error ; max points removed - 8
shear force: - 2 per error ; max points removed - 8
Internal moments (top and bottom): -2 points per error; max points can be removed - 16

If factor 1.5 not used in adjusting stiffness factors then NO PENALTY because results within tolerance

If column 6 is wrongly set to zero then -10 total (no other penalty if all rest correct)