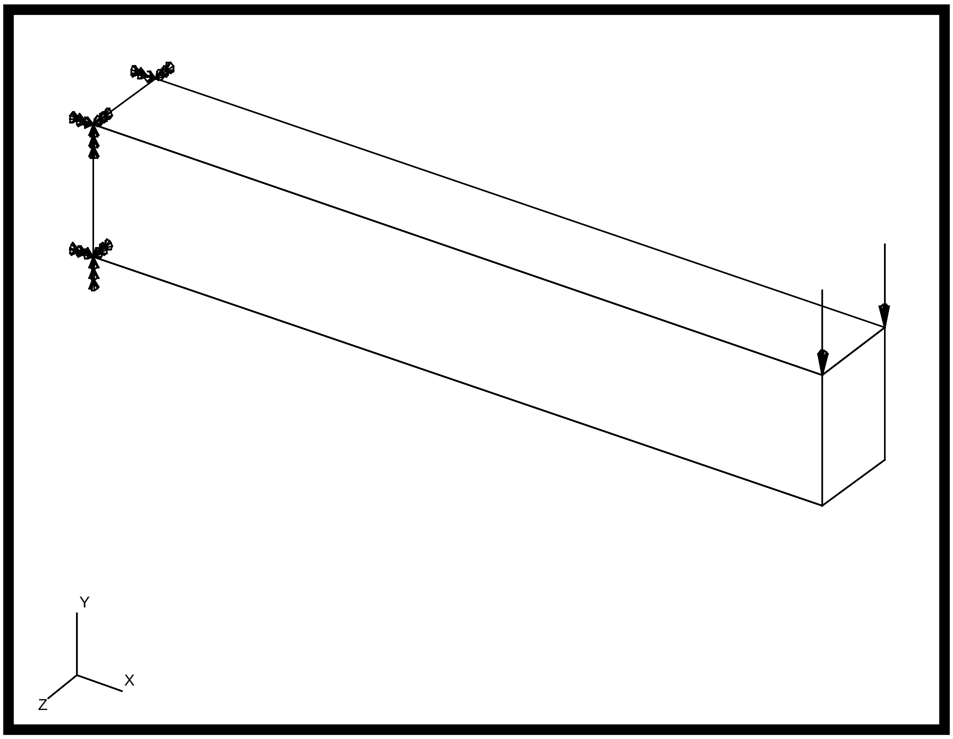
APPENDIX D

CBAR Element Shear Factor, K

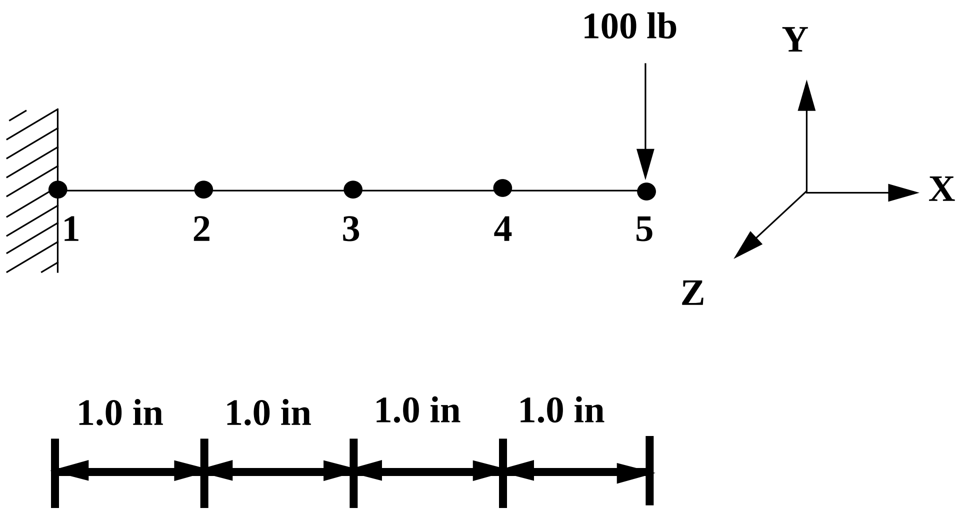


Objectives:

- Model a loaded cantilever beam with CBAR elements, including shear factors in element properties.
- Create a revised model which does not include shear factors.
- Compare both results with theory.

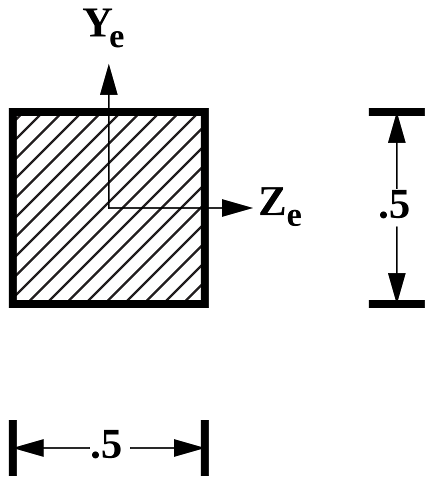
Model Description:

Illustrate the effect of the shear factor, K, on a cantilevered beam under a transverse load.



Material	=	aluminum
E	=	10.06E6 psi
ν	=	0.3

Modeling the CBAR elements with an orientaion vector of 0., 1., 0. results in the cross section:



A	=	0.25 in^2
I_1	=	I_2 = 0.0052 in^4
J	=	0.0088 in^4

Since the cross-section is square, K = 5/6 = 0.8333.

Suggested Exercise Steps:

- Open a new database.
- Create a curve and mesh it with bar elements (CBAR). Use the meshing feature so that elements and nodes (GRID) will be generated automatically by MSC/PATRAN.
- Define material (MAT1) and element properties (PBAR). Be certain to include shear factors in element property definitions.
- Apply a fixed boundary condition (SPC1) at one end of the beam and a transverse force to the free end of the beam (FORCE).
- Use the load and boundary sets to define a loadcase.
- Prepare the model for a Linear Static analysis (SOL 101 & PARAMs).
- Generate and submit input file to the MSC/NASTRAN solver.
- Create a revised MSC/NASTRAN input file without referencing shear factors in element property definitions.
- Compare both results with theory.

Results:

The shear factors Ky and Kz define the shear displacements V_{ys} and V_{zs} in the element coordinate system. The total displacement of the reference axis is

$$V_y = V_{yb} + V_{ys}$$

where V_{yb} = displacement due to bending.

From hand calculations, the predicted maximum displacement due to bending is:

$$\frac{PL^3}{3EI} = \frac{100(4)^3}{3(10.E6)(0.0052)} = 0.04102564 \text{ in}$$

The maximum displacement due to shear is:

$$\frac{VL}{AG} = \frac{100(4)}{0.833(0.25)(3.846E6)} = 0.000499 \text{ in}$$

Total displacement = 0.04102564 + 0.000499 = 0.041525 in

The following represent first, the beam modeled with shear factors, and second, the beam modeled without shear factors.

	Tip Deflection
Model w/ shear factors	-0.04153
Model w/o shear factors	-0.04103
Theory	-0.04153

Sample NASTRAN Input File:

```
ID SEMINAR, Appendix D
SOL 101
TIME 60
CEND
SEALL = ALL
SUPER = ALL
TITLE = CBAR Element Shear Factor, K
ECHO = SORT
MAXLINES = 999999999
SUBCASE 1
SUBTITLE=Default
   SPC = 2
   LOAD = 2
   DISPLACEMENT(SORT1,REAL)=ALL
   SPCFORCES(SORT1,REAL)=ALL
   STRESS(SORT1,REAL,VONMISES,BILIN)=ALL
BEGIN BULK
PARAM    POST    -1
PARAM    PATVER  3.
PARAM    AUTOSPC YES
PARAM    INREL   0
PARAM    ALTRED  NO
PARAM   COUPMASS 0
PARAM    K6ROT   0.
PARAM    WTMASS  .00259
PARAM    GRDPNT  0
PARAM,NOCOMPS,-1
PBAR     1       1       .25     .0052   .0052   .0088           + A
+     A .25      .25     .25     -.25    -.25    .25     -.25    -.25    + B
+     B .8333   .8333
CBAR     1       1       1       2       0.      1.      0.
CBAR     2       1       2       3       0.      1.      0.
```

```
CBAR    3    1    3    4    0.   1.   0.
CBAR    4    1    4    5    0.   1.   0.
MAT1    1    1.+7      .3
GRID    1         0.   0.   0.
GRID    2         1.   0.   0.
GRID    3         2.   0.   0.
GRID    4         3.   0.   0.
GRID    5         4.   0.   0.
SPCADD  2    1
LOAD    2    1.   1.   1
SPC1    1    123456 1
FORCE   1    5    0    100. 0.   -1.  0.
ENDDATA
```