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## WORKSHOP PROBLEM 7

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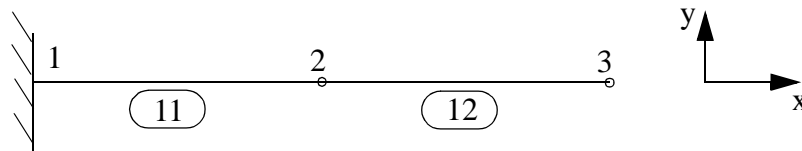
# *Calculating Element Strain Energy*

### Objectives:

- Calculate the element strain energy per mode due to element stiffness generated from DMIG input.

### Procedure:

1. Submit the following cantilever beam model consisting of two bar elements. This is a planar problem retaining only the 2 and 6 degrees of freedom. Review the strain energy output.



2. Comment out “cbar, 11” from the input file for modification and replace the stiffness with the following equivalent DMIG matrix. A k2gg=stiff Case Control command is required.
3. Write a dmap to calculate the strain energy generated by the DMIG entries.
4. Put the strain energy calculation inside a subdmap.
5. Use the MESSAGE module to format the strain energy output, mode by mode.

**Hints:**

- The DMIG stiffness matrix is saved as k2jj. This datablock needs to be saved inside the SEMG1 module to be retrieved later on.
- The strain energy datablock is called ONRGY1 and is printed inside the SEDRCVR module.
- Other possible useful modules:
  - DBSTORE
  - DBFETCH
  - SMPYAD
  - PARAML

**Equivalent DMIG matrix:**

dmig	stiff	0	6	1	0		
\$							
\$DMIG	NAME	GJ	CJ		G1	C1	A1
\$							
dmig	stiff	1	2		1	2	29988.
	1	6	149940.		2	2	-29988.
	2	6	149940.				
dmig	stiff	1	6		1	6	999600.
	2	2	-149940.		2	6	499800.
dmig	stiff	2	2		2	2	29988.
	2	6	-149940.				
dmig	stiff	2	6		2	6	999600.

## Input File for Modification:

### wkshp7.dat

```

$
$ wkshp7a.dat - baseline bar model
$
id bar stiff
sol 103
time 10
cend
title = two bar example
spc = 100
disp = all
method = 100
ese = all
echo = punch
$
begin bulk
CBAR 11 1 1 2 99
CBAR 12 1 2 3 99
CONM2 21 2 1.5
CONM2 22 3 1.5
EIGRL 100 2
GRDSET 1345
GRID 1 0. 0. 0.
GRID 2 10. 0. 0.
GRID 3 20. 0. 0.
GRID 99 10. 0. 100.
MAT1 1 3.+7 .32
PARAM WTMASS .00259
PBAR 1 1 1.0 .0833 .0833 .1667
SPC1 100 123456 1
ENDDATA

```

## Solution Input File:

### soln7.dat

```

$
$  wkshp7.dat
$  replace bar # 11 using dmig
$
id dmig stiff
sol 103
diag 8
COMPILE SEMG1
ALTER 'add.*k2jj' $
CALL DBSTORE K2JJ,,,,/0/0/'          '/0 $
COMPILE SEDRCVR
ALTER 'OFP.*ONRGY1'(1,-1) $
CALL STRNENRG UG // $
$
COMPILE STRNENRG
SUBDMAP STRNENRG UG // $
$
TYPE      PARM,,I,N,NUMMODES,NVALS $
TYPE      PARM,,RS,N,REX$
TYPE      PARM,,RS,Y,TINY
$
$  DMIG Processing
$
CALL DBFETCH /K2JJ,,,,/0/0/0/0/0 $
PARAML  K2JJ//'PRESENCE'////S,N,NOK2JJ $
$
IF (NOK2JJ <> -1) THEN
  matprn k2jj // $
    SMPYAD      UG,K2JJ,UG,,,/ESEK2JJ/3////1/0/0/ $
  $
matprn esek2jj// $
  PARAML      ESEK2JJ//'trailer'/1/S,N,NVALS $
  $
  NUMMODES = 1 $
  DO WHILE (NUMMODES <= NVALS) $
    PARAML ESEK2JJ//'DMI'/NUMMODES/NUMMODES/S,N,REX $
    REX = 0.5 * REX $
    MESSAGE //'-----' $
    MESSAGE //'MODE Number '/NUMMODES $
    MESSAGE //'Strain Energy of DMIG'/REX $
    MESSAGE //' ' $
    MESSAGE //'-----' $
    NUMMODES = NUMMODES + 1 $
  ENDDO
ENDIF $ NOK2JJ
RETURN
END $
cend
title = two bar example

```

```

subtitle = replace one bar with dmig
spc = 100
disp = all
method = 100
k2gg = stiff
ese = all
$
begin bulk
cbar      12      1      2      3      99
conm2     21      2      1.5
conm2     22      3      1.5
dmig      stiff  0      6      1      0
$
$DMIG     NAME      GJ      CJ      G1      C1      A1
$
dmig      stiff     1      2      1      2      29988.
           1      6      149940.  2      2      -29988.
           2      6      149940.
dmig      stiff     1      6      1      6      999600.
           2      2      -149940.  2      6      499800.
dmig      stiff     2      2      2      2      29988.
           2      6      -149940.
dmig      stiff     2      6      2      6      999600.
eigr1     100      3
grdset
grid      1      0.      0.      0.
grid      2      10.     0.      0.
grid      3      20.     0.      0.
grid      99     10.     0.      100.
mat1      1      3.+7    .32
param     wtmass   .00259
pbar      1      1      1.0    .0833  .0833
spc1     100     123456  1
enddata

```

Partial Output with CBAR,11:

Compare the results obtained in the .f06 file with the results below:

```

REAL EIGENVALUES
MODE NO.  EXTRACTION ORDER  EIGENVALUE          RADIANS          CYCLES          GENERALIZED MASS          GENERALIZED STIFFNESS
1      1            1      2.192585E+05          4.682505E+02          7.452438E+01          1.000000E+00          2.192585E+05
2      2            2      9.705066E+06          3.115295E+03          4.958146E+02          1.000000E+00          9.705066E+06

ELEMENT STRAIN ENERGIES
ELEMENT-TYPE = BAR
MODE 1
* TOTAL ENERGY OF ALL ELEMENTS IN PROBLEM = 1.096293E+05
TOTAL ENERGY OF ALL ELEMENTS IN SET -1 = 1.096293E+05
*

ELEMENT-ID          STRAIN-ENERGY          PERCENT OF TOTAL          STRAIN-ENERGY-DENSITY
11          9.833312E+04          89.6961          9.833312E+03
12          1.129614E+04          10.3039          1.129614E+03
SUBTOTAL          1.096293E+05          100.0000

TWO BAR EXAMPLE
0

ELEMENT STRAIN ENERGIES
ELEMENT-TYPE = BAR
MODE 2
* TOTAL ENERGY OF ALL ELEMENTS IN PROBLEM = 4.852533E+06
TOTAL ENERGY OF ALL ELEMENTS IN SET -1 = 4.852533E+06
*

ELEMENT-ID          STRAIN-ENERGY          PERCENT OF TOTAL          STRAIN-ENERGY-DENSITY
11          2.579659E+06          53.1611          2.579659E+05
12          2.272874E+06          46.8389          2.272874E+05
SUBTOTAL          4.852533E+06          100.0000

TWO BAR EXAMPLE
1
    
```



```

ROW
1) -3.2047D+05 5.1593D+06
THE NUMBER OF NON-ZERO TERMS IN THE DENSEST COLUMN = 2
THE DENSITY OF THIS MATRIX IS 100.00 PERCENT.
***-----
***MODE NUMBER 1
***STRAIN ENERGY OF DMIG 9.833312E+04
***
***-----
***MODE NUMBER 2
***STRAIN ENERGY OF DMIG 2.579659E+06
***
***-----
1 TWO BAR EXAMPLE P
REPLACE ONE BAR WITH DMIG
0

ELEMENT STRAIN ENERGIES
ELEMENT-ID 12
ELEMENT-TYPE = BAR 1
MODE 1
* TOTAL ENERGY OF ALL ELEMENTS IN PROBLEM = 1.129613E+04
TOTAL ENERGY OF ALL ELEMENTS IN SET -1 = 1.129613E+04
*
STRAIN-ENERGY 100.0000 PERCENT OF TOTAL STRAIN-ENERGY-DENSITY
1.129613E+04 100.0000 1.129614E+03
SUBTOTAL 100.0000
1 TWO BAR EXAMPLE
REPLACE ONE BAR WITH DMIG
0

ELEMENT STRAIN ENERGIES
ELEMENT-ID 12
ELEMENT-TYPE = BAR 2
MODE 2
* TOTAL ENERGY OF ALL ELEMENTS IN PROBLEM = 2.272874E+06
TOTAL ENERGY OF ALL ELEMENTS IN SET -1 = 2.272874E+06
*
STRAIN-ENERGY 100.0000 PERCENT OF TOTAL STRAIN-ENERGY-DENSITY
2.272874E+06 100.0000 2.272874E+05
SUBTOTAL 100.0000
1 TWO BAR EXAMPLE
REPLACE ONE BAR WITH DMIG
0
    
```