WORKSHOP 12

The Effect of Multiple Coordinate System

Objectives:

- Create a cantilever beam model
- Assign different coordinate systems as refference and displacement coordinate system
- Run an MSC.Nastran Linear Static analysis
- Modify reference and displacement coordinate system
- Compare the analysis results

Model Description:

The goal of this example is to examine the effect of different coordinate systems. A linear static analysis of a cantilever beam will be performed using multiple coordinate systems.

We will examine the following 3 cases

Case 1

Ref. coord. = ϕ

Disp. coord. = ϕ

Case 2

Ref. coord. = 99

Disp. coord. = ϕ

Case 3

Ref. coord. = 99

Disp. coord. = 99

Question:

For case 3, the displacement vectors have been shifted to T1 column. However, are the values correct? What about the SPC force ?

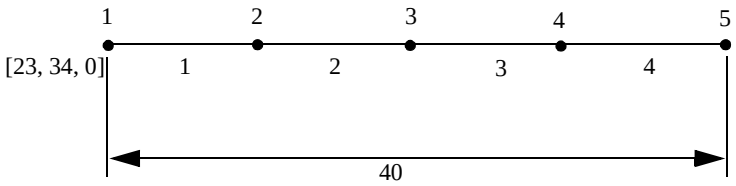

Figure 12.1 - Grid Coordinates and Element Connectivities

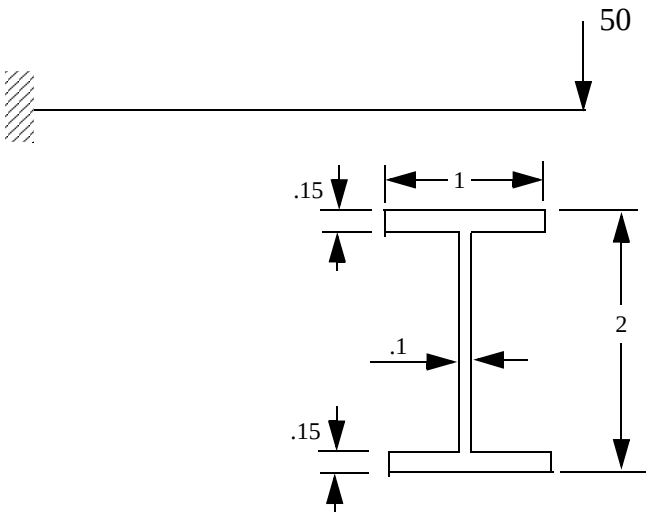

Figure 12.2 - Loads and Boundary Conditions

Suggested Exercise Steps:

- Define a local coordinate system 99
  Origin
  Point on Axis 3
  Poin of plane 1-3
- Generate a finite element representation of the cantilever beam. (i.e., The nodes (GRID) and element connectivitives (CBAR).
- Use the basic coordinate system, coord. ϕ, as the reference and displacement coordinate systems.
- Define material (MAT1) and the element (PBAR) properties.
- Apply the fix boundary constraints (SPC1) at the left tip.
- Apply the concentiated force of 50lbs (FORCE) at the free end.
- Prepare the model for linear static analysis (SOL 101).
- Review the results.

```
SOL 101
CEND
ECHO = NONE
SUBCASE 1
   SPC = 1
   LOAD = 1
   DISPLACEMENT=ALL
   SPCFORCES=ALL
   STRESS=ALL
BEGIN BULK
PARAM    POST    -1
$
PBARL    1       1               I
  +      A
+      A 2.      1.      1.      .1      .15     .15
$
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               23.     34.     0.
GRID     2               33.     34.     0.
GRID     3               43.     34.     0.
GRID     4               53.     34.     0.
GRID     5               63.     34.     0.
$
SPC1     1       123456  1
$
FORCE    1       5       0        50.    0.     -1.     0.
$
ENDDATA
```

Case 1

D I S P L A C E M E N T V E C T O R

POINT ID.	TYPE	T1	T2	T3	R1	R2	R3
1	G	0.0	0.0	0.0	0.0	0.0	0.0
2	G	0.0	-3.150556E-02	0.0	0.0	0.0	-5.868709E-03
3	G	0.0	-1.133143E-01	0.0	0.0	0.0	-1.006064E-02
4	G	0.0	-2.286586E-01	0.0	0.0	0.0	-1.257580E-02
5	G	0.0	-3.607706E-01	0.0	0.0	0.0	-1.341419E-02

F O R C E S O F S I N G L E - P O I N T C O N S T R A I N T

POINT ID.	TYPE	T1	T2	T3	R1	R2	R3
1	G	0.0	5.000000E+01	0.0	0.0	0.0	2.000000E+03

S T R E S S E S I N B A R E L E M E N T S (C B A R)

	ELEMENT ID.	SA1	SA2	SA3	SA4	AXIAL STRESS	SA-MAX	SA-MIN	M.S.-T
		SB1	SB2	SB3	SB4		SB-MAX	SB-MIN	M.S.-C
0	1	6.707096E+03	-6.707096E+03	-6.707096E+03	6.707096E+03	0.0	6.707096E+03	-6.707096E+03	
		5.030322E+03	-5.030322E+03	-5.030322E+03	5.030322E+03		5.030322E+03	-5.030322E+03	
0	2	5.030322E+03	-5.030322E+03	-5.030322E+03	5.030322E+03	0.0	5.030322E+03	-5.030322E+03	
		3.353548E+03	-3.353548E+03	-3.353548E+03	3.353548E+03		3.353548E+03	-3.353548E+03	
0	3	3.353548E+03	-3.353548E+03	-3.353548E+03	3.353548E+03	0.0	3.353548E+03	-3.353548E+03	
		1.676774E+03	-1.676774E+03	-1.676774E+03	1.676774E+03		1.676774E+03	-1.676774E+03	
0	4	1.676774E+03	-1.676774E+03	-1.676774E+03	1.676774E+03	0.0	1.676774E+03	-1.676774E+03	
		3.050034E-11	-3.050034E-11	-3.050034E-11	3.050034E-11		3.050034E-11	-3.050034E-11	

```
SOL 101
CEND
ECHO = NONE
SUBCASE 1
   SPC = 1
   LOAD = 1
   DISPLACEMENT=ALL
   SPCFORCES=ALL
   STRESS=ALL
BEGIN BULK
PARAM    POST    -1
$
PBARL    1       1               I
  +      A
+      A 2.      1.      1.      .1      .15     .15
$
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       99      0.      0.      0.
GRID     2       99      0.      0.      10.
GRID     3       99      0.      0.      20.
GRID     4       99      0.      0.      30.
GRID     5       99      0.      0.      40.
$
SPC1     1       123456  1
$
FORCE    1       5       0        50.    0.      -1.     0.
$
CORD2R   99              23.     34.     0.      24.     34.     0.
  +      B
+      B 23.     35.     0.
ENDDATA
```

Case 2

D I S P L A C E M E N T V E C T O R

POINT ID.	TYPE	T1	T2	T3	R1	R2	R3
1	G	0.0	0.0	0.0	0.0	0.0	0.0
2	G	0.0	-3.150556E-02	0.0	0.0	0.0	-5.868709E-03
3	G	0.0	-1.133143E-01	0.0	0.0	0.0	-1.006064E-02
4	G	0.0	-2.286586E-01	0.0	0.0	0.0	-1.257580E-02
5	G	0.0	-3.607706E-01	0.0	0.0	0.0	-1.341419E-02

F O R C E S O F S I N G L E - P O I N T C O N S T R A I N T

POINT ID.	TYPE	T1	T2	T3	R1	R2	R3
1	G	0.0	5.000000E+01	0.0	0.0	0.0	2.000000E+03

0 SUBCASE 1

S T R E S S E S I N B A R E L E M E N T S (C B A R)

	ELEMENT ID.	SA1	SA2	SA3	SA4	AXIAL STRESS	SA-MAX	SA-MIN	M.S.-T
		SB1	SB2	SB3	SB4		SB-MAX	SB-MIN	M.S.-C
0	1	6.707096E+03	-6.707096E+03	-6.707096E+03	6.707096E+03	0.0	6.707096E+03	-6.707096E+03	
		5.030322E+03	-5.030322E+03	-5.030322E+03	5.030322E+03		5.030322E+03	-5.030322E+03	
0	2	5.030322E+03	-5.030322E+03	-5.030322E+03	5.030322E+03	0.0	5.030322E+03	-5.030322E+03	
		3.353548E+03	-3.353548E+03	-3.353548E+03	3.353548E+03		3.353548E+03	-3.353548E+03	
0	3	3.353548E+03	-3.353548E+03	-3.353548E+03	3.353548E+03	0.0	3.353548E+03	-3.353548E+03	
		1.676774E+03	-1.676774E+03	-1.676774E+03	1.676774E+03		1.676774E+03	-1.676774E+03	
0	4	1.676774E+03	-1.676774E+03	-1.676774E+03	1.676774E+03	0.0	1.676774E+03	-1.676774E+03	
		3.050034E-11	-3.050034E-11	-3.050034E-11	3.050034E-11		3.050034E-11	-3.050034E-11	

```
SOL 101
CEND
ECHO = NONE
SUBCASE 1
   SPC = 1
   LOAD = 1
   DISPLACEMENT=ALL
   SPCFORCES=ALL
   STRESS=ALL
BEGIN BULK
PARAM    POST    -1
$
PBARL    1       1               I
  +      A
+      A 2.      1.      1.      .1      .15     .15
$
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       99      0.      0.      0.      99
GRID     2       99      0.      0.      10.     99
GRID     3       99      0.      0.      20.     99
GRID     4       99      0.      0.      30.     99
GRID     5       99      0.      0.      40.     99
$
SPC1     1       123456  1
$
FORCE    1       5       0        50.    0.     -1.     0.
$
CORD2R   99              23.     34.     0.      24.     34.     0.
  +      B
+      B 23.     35.     0.
ENDDATA
```

Case 3

D I S P L A C E M E N T V E C T O R

POINT ID.	TYPE	T1	T2	T3	R1	R2	R3
1	G	0.0	0.0	0.0	0.0	0.0	0.0
2	G	-3.651206E-01	0.0	0.0	0.0	-6.960557E-02	0.0
3	G	-1.326860E+00	0.0	0.0	0.0	-1.193238E-01	0.0
4	G	-2.686346E+00	0.0	0.0	0.0	-1.491548E-01	0.0
5	G	-4.244705E+00	0.0	0.0	0.0	-1.590984E-01	0.0

F O R C E S O F S I N G L E - P O I N T C O N S T R A I N T

POINT ID.	TYPE	T1	T2	T3	R1	R2	R3
1	G	5.000000E+01	0.0	0.0	0.0	2.000000E+03	0.0

S T R E S S E S I N B A R E L E M E N T S (C B A R)

	ELEMENT ID.	SA1 / SB1	SA2 / SB2	SA3 / SB3	SA4 / SB4	AXIAL STRESS	SA-MAX / SB-MAX	SA-MIN / SB-MIN	M.S.-T / M.S.-C
0	1	-3.977461E+04	-3.977461E+04	3.977461E+04	3.977461E+04	0.0	3.977461E+04	-3.977461E+04	
		-2.983096E+04	-2.983096E+04	2.983096E+04	2.983096E+04		2.983096E+04	-2.983096E+04	
0	2	-2.983096E+04	-2.983096E+04	2.983096E+04	2.983096E+04	0.0	2.983096E+04	-2.983096E+04	
		-1.988730E+04	-1.988730E+04	1.988730E+04	1.988730E+04		1.988730E+04	-1.988730E+04	
0	3	-1.988730E+04	-1.988730E+04	1.988730E+04	1.988730E+04	0.0	1.988730E+04	-1.988730E+04	
		-9.943652E+03	-9.943652E+03	9.943652E+03	9.943652E+03		9.943652E+03	-9.943652E+03	
0	4	-9.943652E+03	-9.943652E+03	9.943652E+03	9.943652E+03	0.0	9.943652E+03	-9.943652E+03	
		-3.617480E-10	-3.617480E-10	3.617480E-10	3.617480E-10		3.617480E-10	-3.617480E-10	