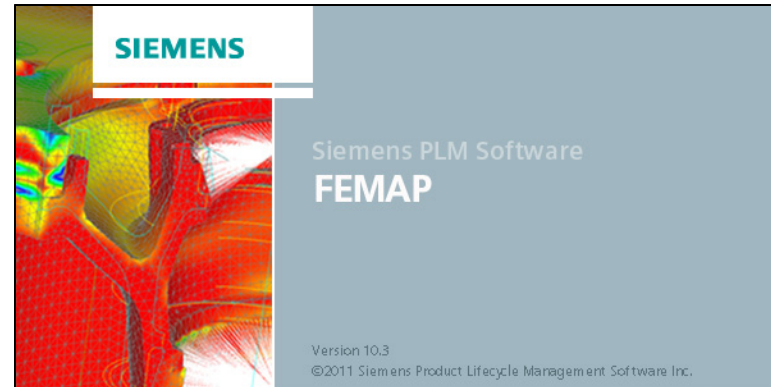


Seminar Outline

- Model Check with NX Nastran
 - Ground Check
 - DOF Sets
 - Strain Energy
 - Debugging
- GFX API
 - What is a GFX Object?
 - Using the API



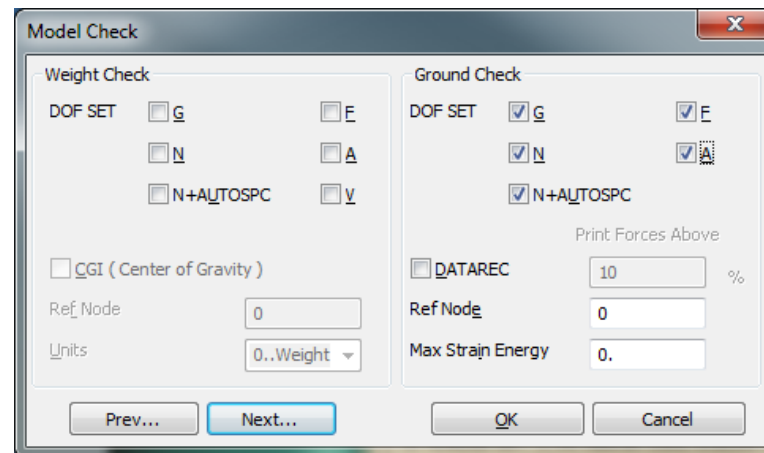


GROUNDCHECK

Performs grounding check analysis on stiffness matrix to expose unintentional constraints by moving the model rigidly.

Ground Check – DOF Sets

SET Keyword	DOF Set	Description
G	g-set	before single point, multipoint constraints, and rigid elements are applied
N	n-set	after multipoint constraints and rigid elements are applied
N+AUTO	n-set with AUTOSPC	same as the n-set with the rows/columns in the stiffness matrix corresponding to degrees-of-freedom constrained by the PARAM,AUTOSPC operation zeroed out
F	f-set	after single point, multipoint constraints, and rigid elements are applied
A	a-set	after static condensation



15.3 Strain Energy Output

Frequently you are faced with the decision of modifying your structure in order to meet stringent design criteria. In most instances, your objective is to maximize the benefits with minimal changes. The element strain energy output is an excellent tool for identifying areas of modification that will reap the most benefits for design changes.

The element strain energy is basically the elastic energy stored in the structural element. As an example, if you hold onto one end of the spring and push slowly on the other end starting from rest, the load deflection curve looks something like [Figure 15-9](#) for small deflections.

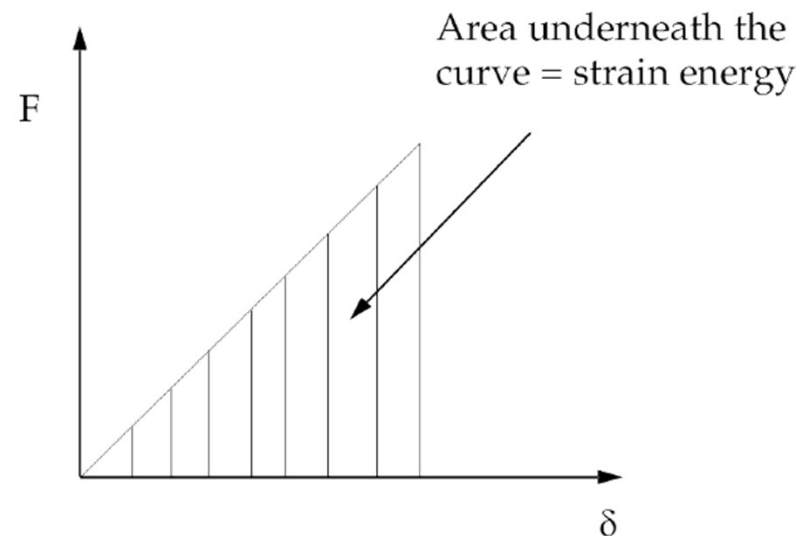


Figure 15-9. Load Deflection Curve

DOF Sets – G-SET

Before SPCs, MPCs, RBEs

```

*** USER INFORMATION MESSAGE 7570 (GPWG1S)
RESULTS OF RIGID BODY CHECKS OF MATRIX KGG      (G-SET) FOLLOW:
PRINT RESULTS IN ALL SIX DIRECTIONS AGAINST THE LIMIT OF 2.814220E-02
      DIRECTION      STRAIN ENERGY      PASS/FAIL
      -----
      1      2.582965E-09      PASS
      2      4.401954E-09      PASS
      3      7.174094E-09      PASS
      4      2.878377E-04      PASS
      5      1.076575E-05      PASS
      6      2.921340E-04      PASS
SOME POSSIBLE REASONS MAY LEAD TO THE FAILURE:
1. CELASI ELEMENTS CONNECTING TO ONLY ONE GRID POINT;
2. CELASI ELEMENTS CONNECTING TO NON-COINCIDENT POINTS;
3. CELASI ELEMENTS CONNECTING TO NON-COLINEAR DOF;
4. IMPROPERLY DEFINED DMIG MATRICES;
  
```

DOF Sets – N-SET

After MPCs, RBEs

*** USER INFORMATION MESSAGE 7570 (GPWG1S)
 RESULTS OF RIGID BODY CHECKS OF MATRIX KNN (N-SET) FOLLOW:
 PRINT RESULTS IN ALL SIX DIRECTIONS AGAINST THE LIMIT OF 8.820000E+00

DIRECTION	STRAIN ENERGY	PASS/FAIL
-----------	---------------	-----------

1	2.582965E-09	PASS
2	4.401954E-09	PASS
3	7.174094E-09	PASS
4	2.914140E-04	PASS
5	1.076575E-05	PASS
6	2.876637E-04	PASS

SOME POSSIBLE REASONS MAY LEAD TO THE FAILURE:

1. MULTIPOINT CONSTRAINT EQUATIONS WHICH DO NOT SATISFY RIGID-BODY MOTION;
2. RBE3 ELEMENTS FOR WHICH THE INDEPENDENT DEGREE-OF-FREEDOM CANNOT DESCRIBE ALL POSSIBLE RIGID-BODY MOTIONS.

DOF Sets – N+AUTOSPC-SET After AUTOSPC

*** USER INFORMATION MESSAGE 7570 (GPWG1S)
 RESULTS OF RIGID BODY CHECKS OF MATRIX KNN+AUTO (N+AUTOSPC-SET) FOLLOW:
 PRINT RESULTS IN ALL SIX DIRECTIONS AGAINST THE LIMIT OF 8.820000E+00

DIRECTION	STRAIN ENERGY	PASS/FAIL
-----	-----	-----
1	2.582965E-09	PASS
2	4.401954E-09	PASS
3	7.174094E-09	PASS
4	2.914140E-04	PASS
5	1.076575E-05	PASS
6	2.876637E-04	PASS

SOME POSSIBLE REASONS MAY LEAD TO THE FAILURE:

1. MPC EQUATIONS WHICH DO NOT SATISFY RIGID-BODY MOTION;
2. RBE3 ELEMENTS FOR WHICH THE INDEPENDENT DOF CANNOT DESCRIBE ALL POSSIBLE RIGID-BODY MOTIONS;
3. PARAM,AUTOSPC HAS OVER-CONSTRAINED THE MODEL.

DOF Sets – F-SET

After SPCs

```

*** USER INFORMATION MESSAGE 7570 (GPWG1S)
RESULTS OF RIGID BODY CHECKS OF MATRIX KFF      (F-SET) FOLLOW:
PRINT RESULTS IN ALL SIX DIRECTIONS AGAINST THE LIMIT OF 2.814220E-02
      DIRECTION      STRAIN ENERGY      PASS/FAIL
      -----
      1      2.0000000E+06      FAIL
      2      2.0000000E+06      FAIL
      3      2.0000000E+06      FAIL
      4      5.0850000E+10      FAIL
      5      4.4100000E+10      FAIL
      6      5.0850000E+10      FAIL
SOME POSSIBLE REASONS MAY LEAD TO THE FAILURE:
1. CONSTRAINTS WHICH PREVENT RIGID-BODY MOTION.
  
```


DOF Sets – A-SET

After Static Condensation (super elements)

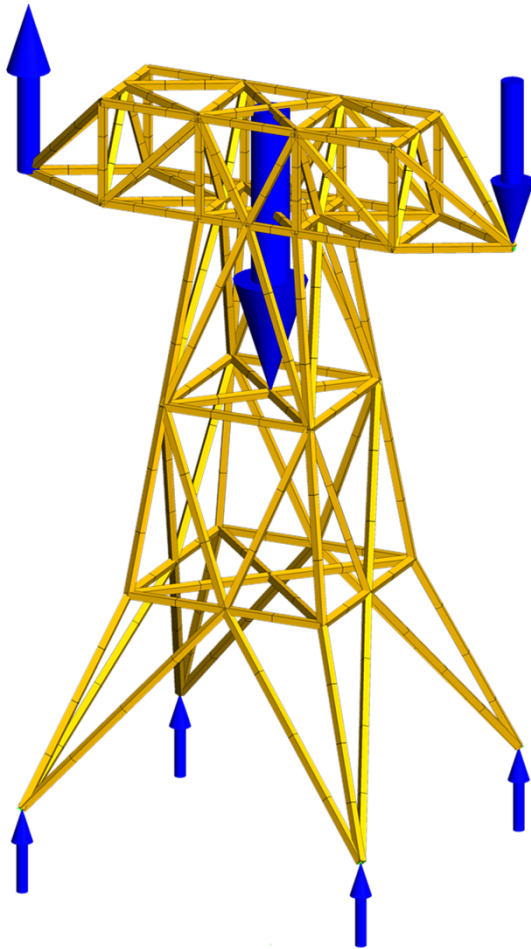
```
*** USER INFORMATION MESSAGE 7570 (GPWG1S)
RESULTS OF RIGID BODY CHECKS OF MATRIX KAA1      (A-SET) FOLLOW:
PRINT RESULTS IN ALL SIX DIRECTIONS AGAINST THE LIMIT OF 2.814220E-02
      DIRECTION      STRAIN ENERGY      PASS/FAIL
      -----      -
      1      2.000000E+06      FAIL
      2      2.000000E+06      FAIL
      3      2.000000E+06      FAIL
      4      5.085000E+10      FAIL
      5      4.410000E+10      FAIL
      6      5.085000E+10      FAIL
```

SOME POSSIBLE REASONS MAY LEAD TO THE FAILURE:

IF THE MODEL HAS PASSED THE PREVIOUS CHECKS FOR THE G-SET AND N-SET,
 THEN:

1. THE MODEL IS NOT INTENDED TO BE FREE-FREE WHICH INDICATES THAT THE MODEL IS PROPERLY CONSTRAINED TO GROUND;
2. THE REFERENCE GRID POINT (GRID=GID ON THE GROUNDHECK COMMAND) IS LOCATED TOO FAR FROM THE MODEL'S CENTER OF GRAVITY. IT IS RECOMMENDED THAT THE REFERENCE GRID POINT BE LOCATED AS CLOSE AS POSSIBLE TO THE MODEL'S CENTER OF GRAVITY OF THE MODEL (SEE THE GRID POINT WEIGHT GENERATOR OUTPUT);
3. PARAM,AUTOSPC,YES CONSTRAINS NEAR-SINGULAR DEGREES-OF-FREEDOM. WHEN A FINITE ELEMENT MODEL WITH AUTOSPC FAILS THE A-SET CHECK, IT IS NOT EVIDENT THAT GROUNDING HAS OCCURRED. THE USE OF PARAM,SNORM WILL NOT ELIMINATE THE SPURIOUS FAILURE.

GFXArrow Object API



```

API Programming
1 'www.PredictiveEngineering.com
2 'All Rights Reserved, 2013
3 'Predictive Engineering Assumes No Responsibility For Results Obtained From API
4 '-----
5 'This API was originally coded for FEMAP v11.0.1
6 'Written by Adrian Jensen
7 'This API will create vectors with the GFXArrow Object
8
9 Sub Main
10 Dim App As femap.model
11 Set App = feFemap()
12
13 App.feAppMessage(FCM_ERROR,"Generate GFX ArrowsMeasure")
14
15 'option: delete previous gfx elements
16 Dim delPrevGFX As Long
17 delPrevGFX = App.feAppMessageBox(3,"Do you want to delete all previous graphic elements?")
18
19 Dim ar As femap.GFXArrow, txt As femap.text
20 Set ar = App.feGFXArrow
21 Set txt = App.feText
22
23 Dim GFXSet As femap.Set
24 Set GFXSet = App.feSet
25 GFXSet.ID = 1
26
27 If delPrevGFX = FE_CANCEL Then
28 Exit Sub
29 ElseIf delPrevGFX = FE_OK Then
30 ar.DeleteAll(True,1) 'delete arrows
31 App.feGFXSelect(GFXSet.ID,True,True)
32
33 App.feViewRegenerate()
34 End If
35
36 Do 'infinite loop - user presses cancel to get out
37 Dim vecLength As Double, vecBase As Variant, vecDir As Variant
38 If App.feVectorPick("Select Vector for GFX Arrow",False,vecLength,vecBase,vecDir) = FE_CANCEL Then
39 Exit Sub
40 End If
41
42 'ar.ID = GFXSet.Count+1
43 ar.ID = ar.NextEmptyID
44 ar.style = 1
45 ar.lengthmode = GAM_ABSOLUTE
46
47 'Vector Colors: 4=red; 14=orange; 24=yellow; 20=green; 100=blue
48 ar.color = 20
49
50 ar.x = vecBase(0)
51 ar.y = vecBase(1)
52 ar.z = vecBase(2)
53 ar.dX = vecDir(0)*vecLength
54 ar.dY = vecDir(1)*vecLength
55 ar.dZ = vecDir(2)*vecLength
56 ar.Length = Sqr(ar.dX^2+ar.dY^2+ar.dZ^2)
57
58 ar.Put(ar.ID)
59 GFXSet.Add(ar.ID)
60 App.feGFXSelect(GFXSet.ID,True,True)
61
62 App.feViewRegenerate() 'regenerate active view so as to display textboxes
63 Loop
64 End Sub
    
```