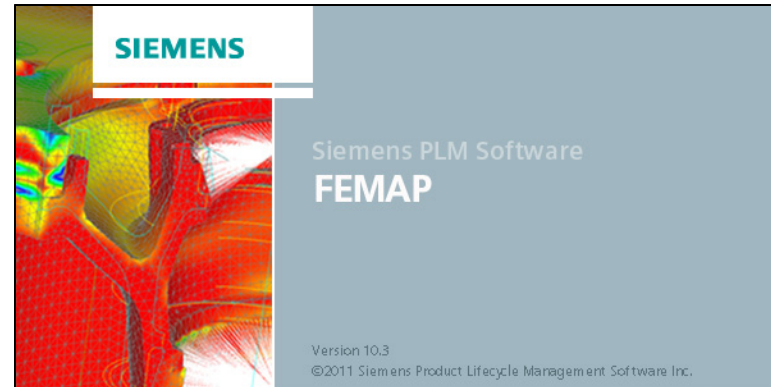# Seminar Outline

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

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Model Check

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

Model Check

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
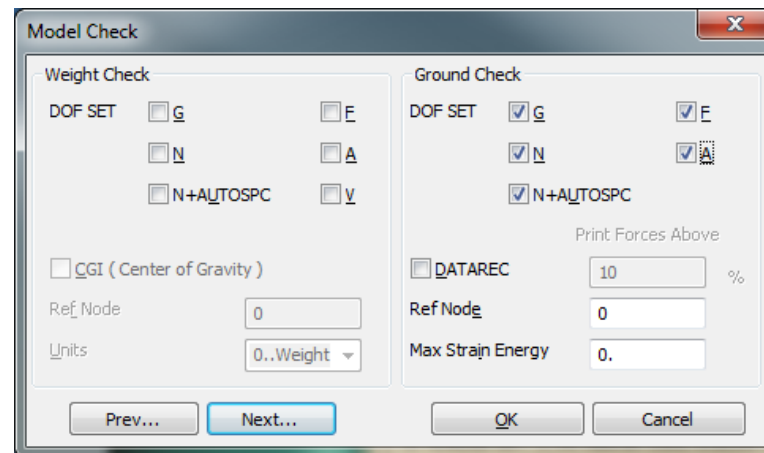
15.3 Strain Energy Output

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.
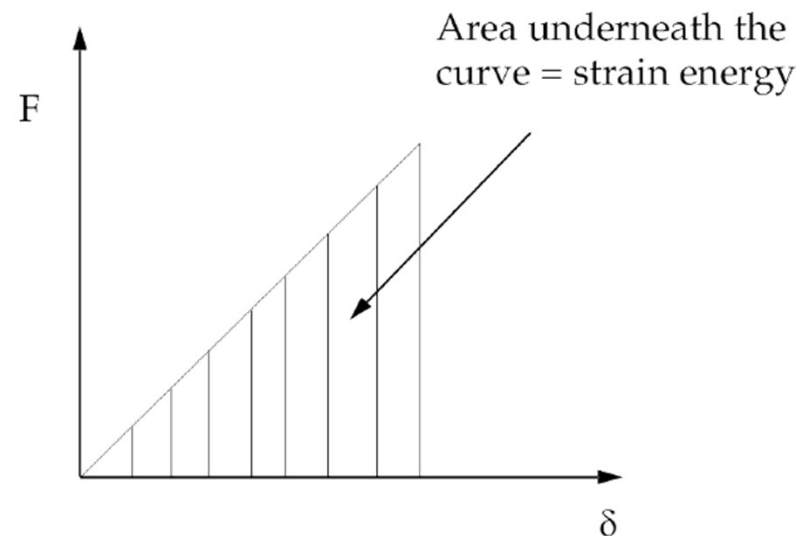
Area underneath the curve = strain energy

Figure 15-9. Load Deflection Curve

Model Check

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;
```

Model Check

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.
```

Model Check

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.
```

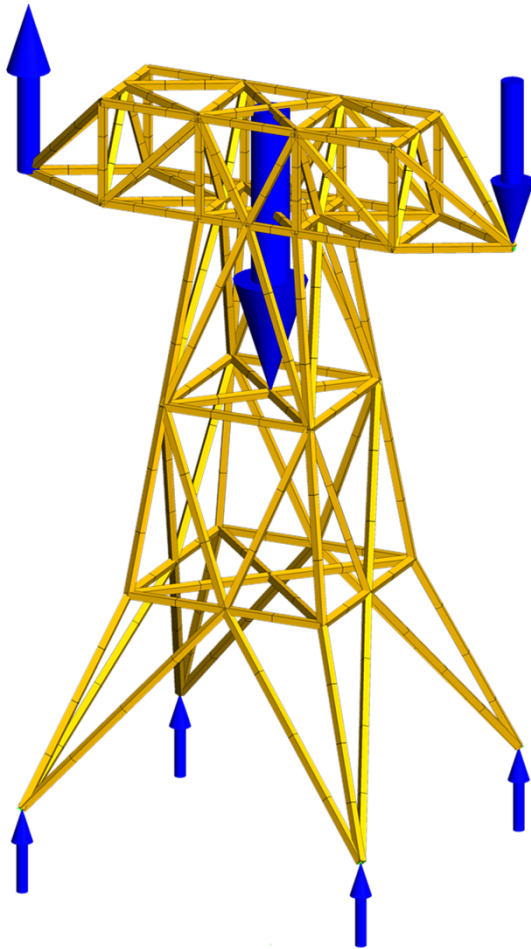# Model Check

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              2.000000E+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:
        1. CONSTRAINTS WHICH PREVENT RIGID-BODY MOTION.
```

Model Check

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 GROUNDCHECK 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.
```

Model Check

GFXArrow Object API