Advanced FEMAP Programming with Applications to Structural Analysis

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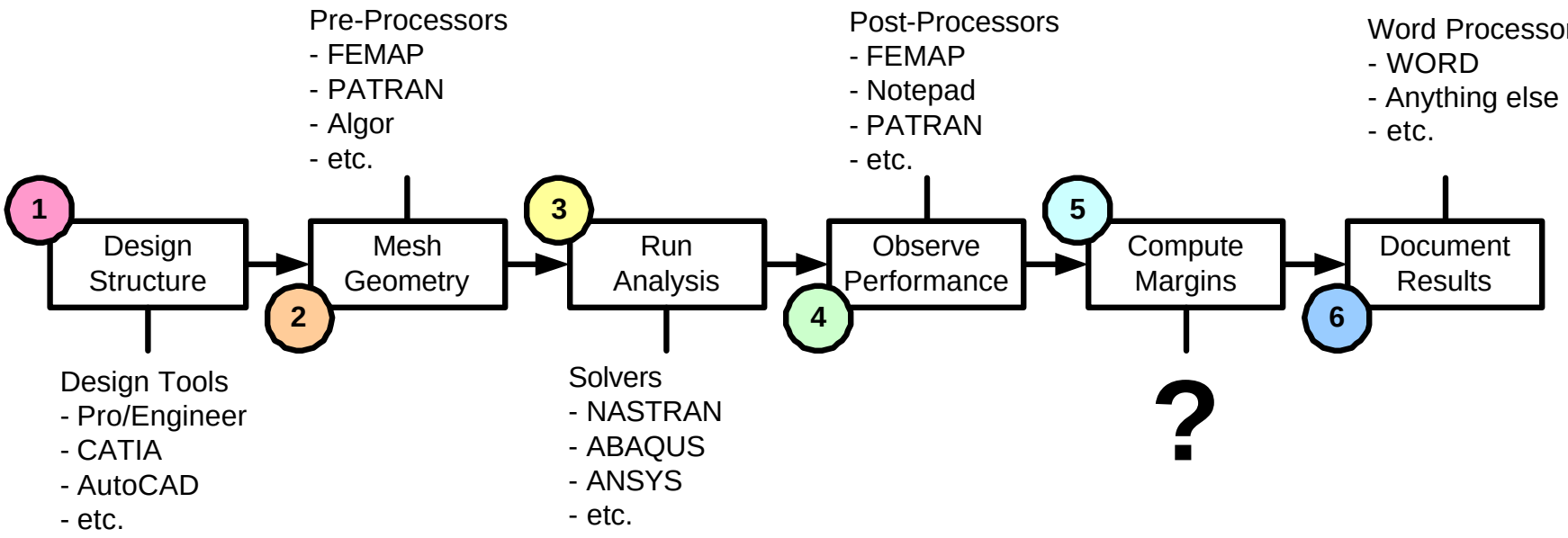
FEMAP®

FEMCI

SWALES AEROSPACE

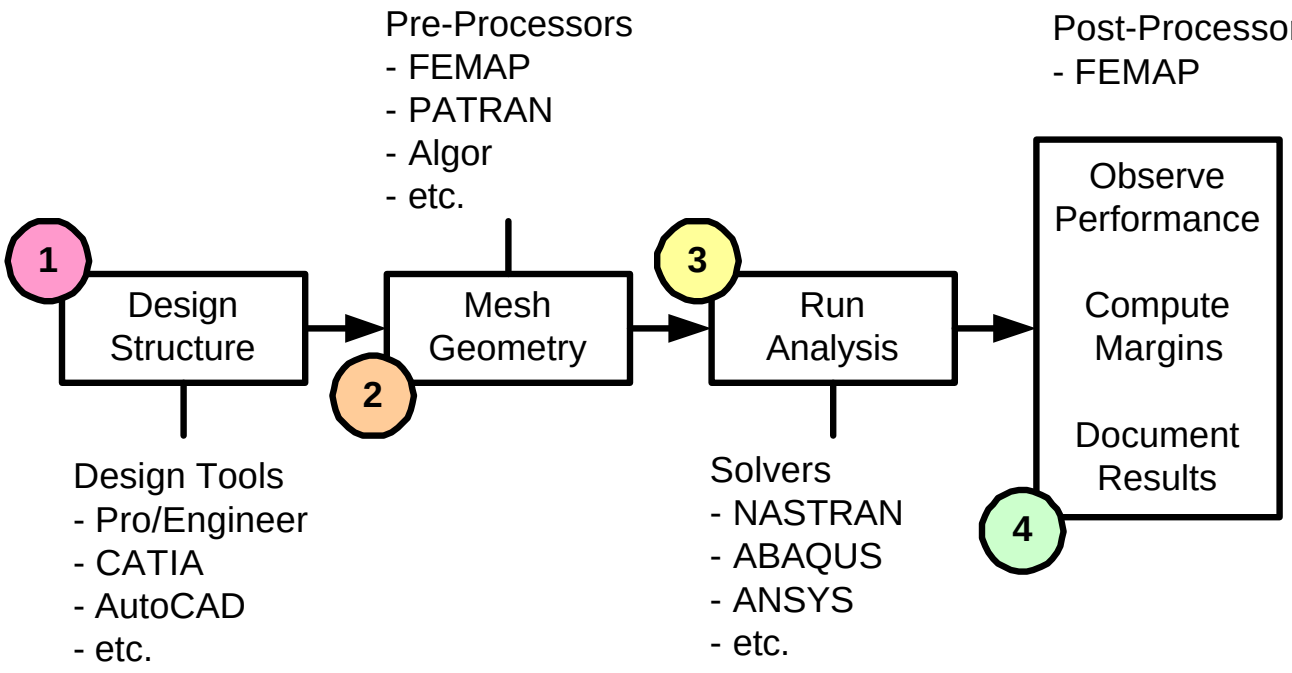
Typical Analysis Process

Six “Easy” Steps



Simplified Analysis Process

- Now only FOUR steps
  - Use FEMAP to Control External Software



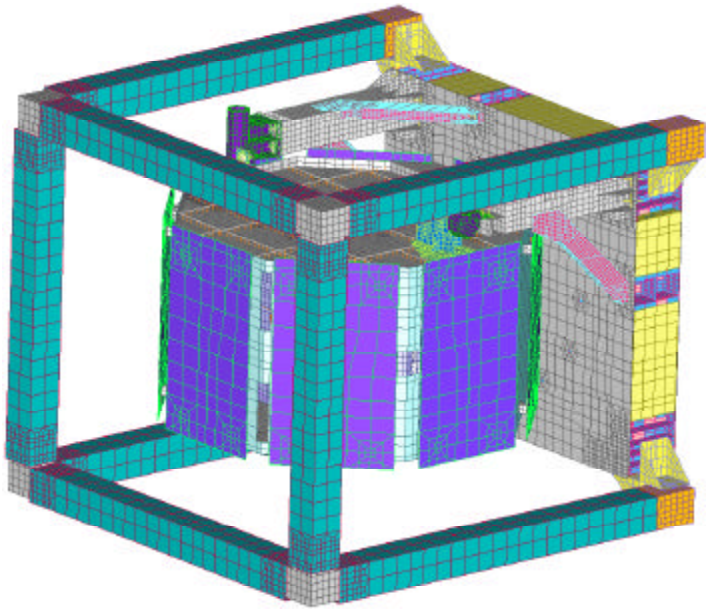
FEMAP's Programming Capabilities

- Old Versions of FEMAP
  - Advanced Programming Interface (API)
    - Add more functionality to FEMAP
    - Interface with other VB driven programs
      - But **NOT** vice-versa
- New to FEMAP v8.1
  - Object Linking and Embedding (OLE)
    - Objects that define FEMAP processes
    - Two-way communication with OLE programs

Example 1: Organizing a FEMAP Model

- Use EXCEL to Control FEMAP
  - Renumber Entities
    - Nodes, Elements, Properties, Materials, etc.
      - By layer, color, group, etc.
    - Extract Model Information
      - Mass, Volume, CG, Layer/Group/Color Name, etc.
- Output Model Information
  - All Information Displayed in a Formatted Table
  - Can Be Easily Transferred to a Stress Report

Example 1: Organizing a FEMAP Model



FEA Model

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feDocument, Build 1.11 BETA

Click to Document FEMAP Model

INSTRUCTIONS

1. Load your FEMAP model file BEFORE executing this routine
2. Verify that your model is in FEMAP v8.1 format
3. Make sure that only ONE instance of FEMAP is running
4. Make sure that your model file does NOT have any stored OUTPUT information
5. Organize your model into discrete layers
6. Specify the following parameters:

Renumber Model [Yes] < Renumber Model Nodes/Elements?

Start ID [1] < Renumber Start ID (min = 1)
ID Increment [1000] < ID increment between layers (min = 1)

Renumber Properties [Yes] < Renumber Model Properties?
Renumber Materials [Yes] < Renumber Model Materials?

G Factor [386.4] < Factor to apply to mass/force entries

Generate Groups [No] < Generate Groups from Layers?

Save Model [No] < Save FEMAP Model File

7. Make sure that this is what YOU want to do - **there is NO UNDO!**

Questions? Send email to: wmcgill@swales.com

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Example 1: Sample EXCEL Output

Model File Information

Renumbers Node, Elements

FEM Model Details, Page 1

Model File: Z:\wmcgill\ST5\2113-187\ST5_Models\st5_machine_r1\st5_machine_finalmodels\st5_machine_allup_spacecraft_GSE2.MOD

Table 1: Node, Element, Mass, and CG Information

Description	Layer ID	Node Range			Element Range			Nodes	Elements	S Mass (pounds)	NSM (pounds)	Total Mass (pounds)	Volume (in^3)	XCG (in)	YCG (in)	ZCG (in)
DS Honeycomb Facesheet	1	1	-	3937	1	-	3707	3936	3706	4.23	0.22	4.44	43.08	-0.31	-9.52	-0.51
DS Honeycomb Core	2	4000	-	7366	4000	-	7916	3366	3916	2.23	0.00	2.23	884.22	-0.45	-9.53	-0.61
DS Stanchion Inserts	3	8000	-	8669	8000	-	10200	669	2200	2.40	0.00	2.40	24.51	0.76	-9.15	0.37
DS Brace Inserts	4	11000	-	11304	11000	-	11792	304	792	0.76	0.00	0.76	7.76	1.13	-9.38	0.22
DS Interface Inserts	5	12000	-	12504	12000	-	12432	504	432	1.63	0.00	1.63	16.60	-0.31	-9.53	-0.51
DS Potting Material	6	13000	-	12504	13000	-	13904	0	904	1.22	0.00	1.22	52.68	-0.17	-9.53	-0.46
DS Stanchions	9	14000	-	17700	14000	-	17761	3700	3761	5.60	0.00	5.60	57.09	2.65	-3.94	1.78
DS Braces	10	18000	-	20760	18000	-	20672	2760	2672	1.64	0.00	1.64	16.75	2.42	-5.11	1.51
DS Fasteners	11	21000	-	20760	21000	-	21063	0	63	0.00	0.00	0.00	0.00	0.00	0.00	0.00
DS Mechanisms	12	22000	-	23636	22000	-	23548	1636	1548	2.22	0.14	2.36	15.59	-0.06	1.23	3.56
GSE Spider	36	78000	-	80066	78000	-	79332	2066	1332	9.59	0.00	9.59	97.77	-0.33	3.65	-0.51
					Totals			56580	56470	90.03	16.65	106.68	1798.39	-0.06	1.38	-0.20

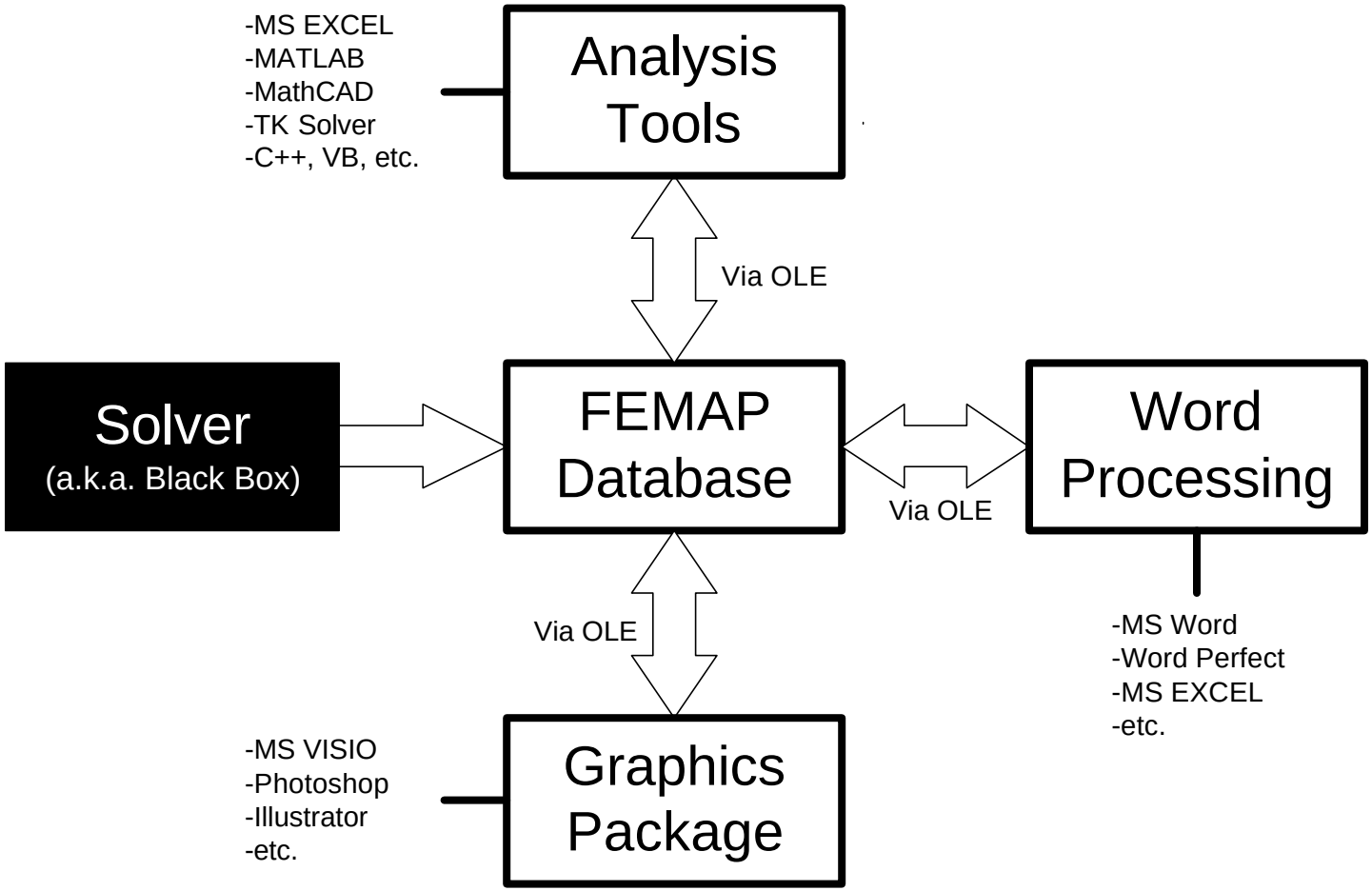
Includes Layer Names

Sorts by Layer ID

Reports CG Information

Provides Model Summary
(# Nodes, Elements, Total Mass, etc.)

Post-Processing Tasks

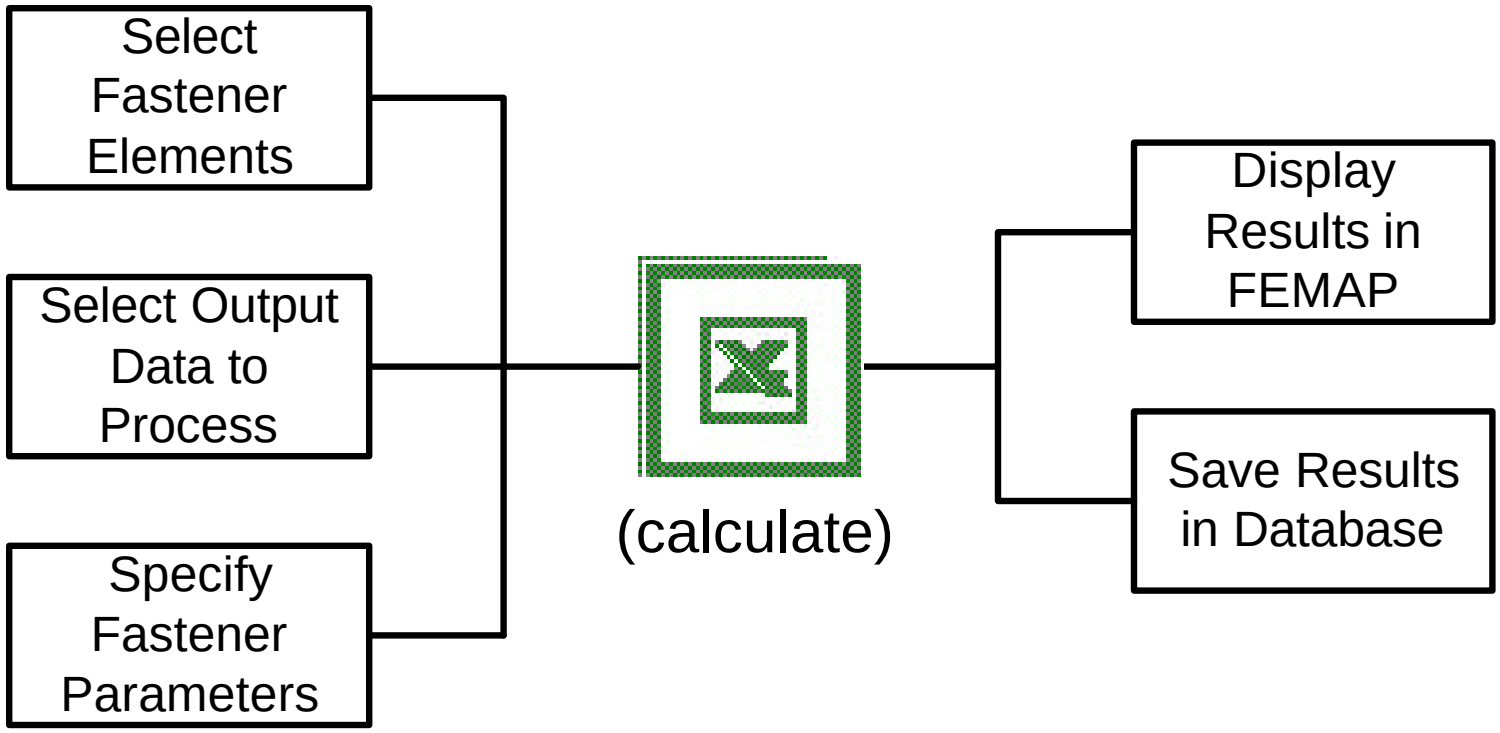


The FEMAP Database

- Can store any form of information
  - This includes analysis results from external software
  - Results can be retrieved and formatted as a MS Word document
- Database can be manipulated by external software
  - So long as it is OLE compatible
  - Demonstrated in the previous example

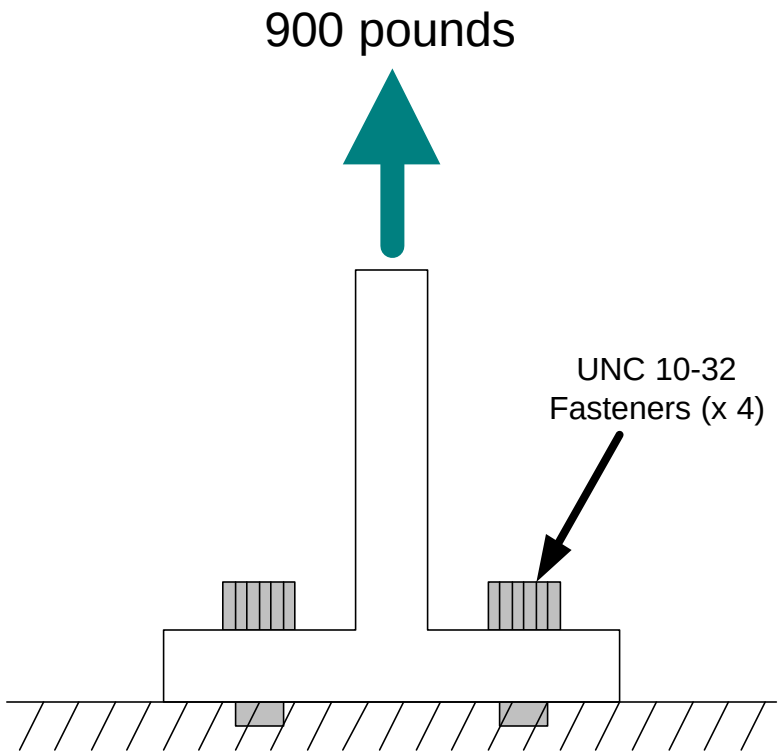
Example 2: Fastener Analysis

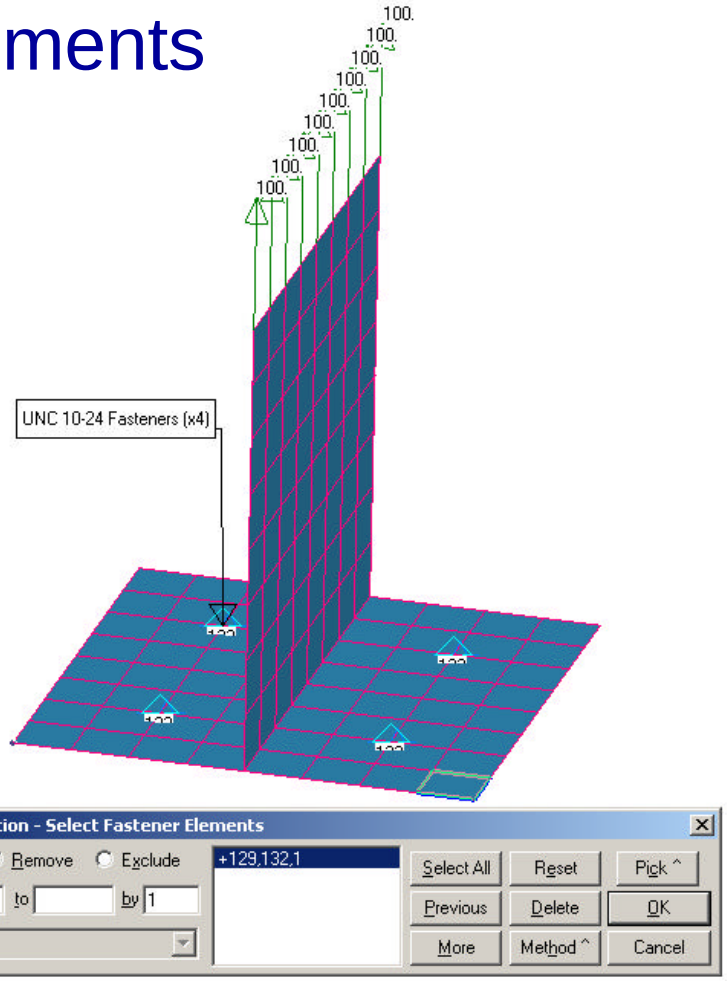
Analyze Fasteners for Tension Failure



Example 2: Screen Shots

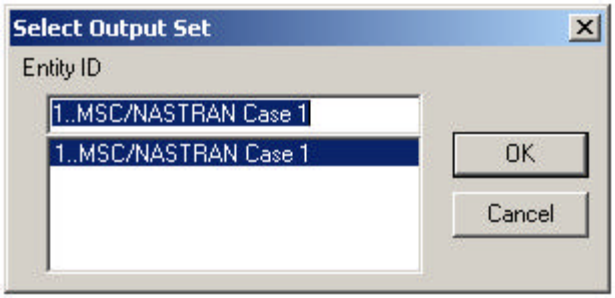
Step 1: Select Fastener Elements



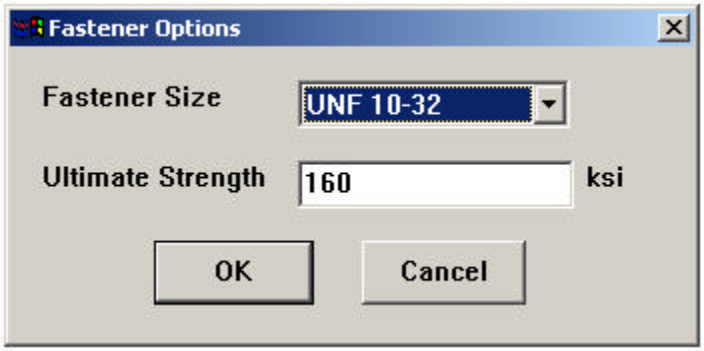


Example 2: Screen Shots (cont'd)

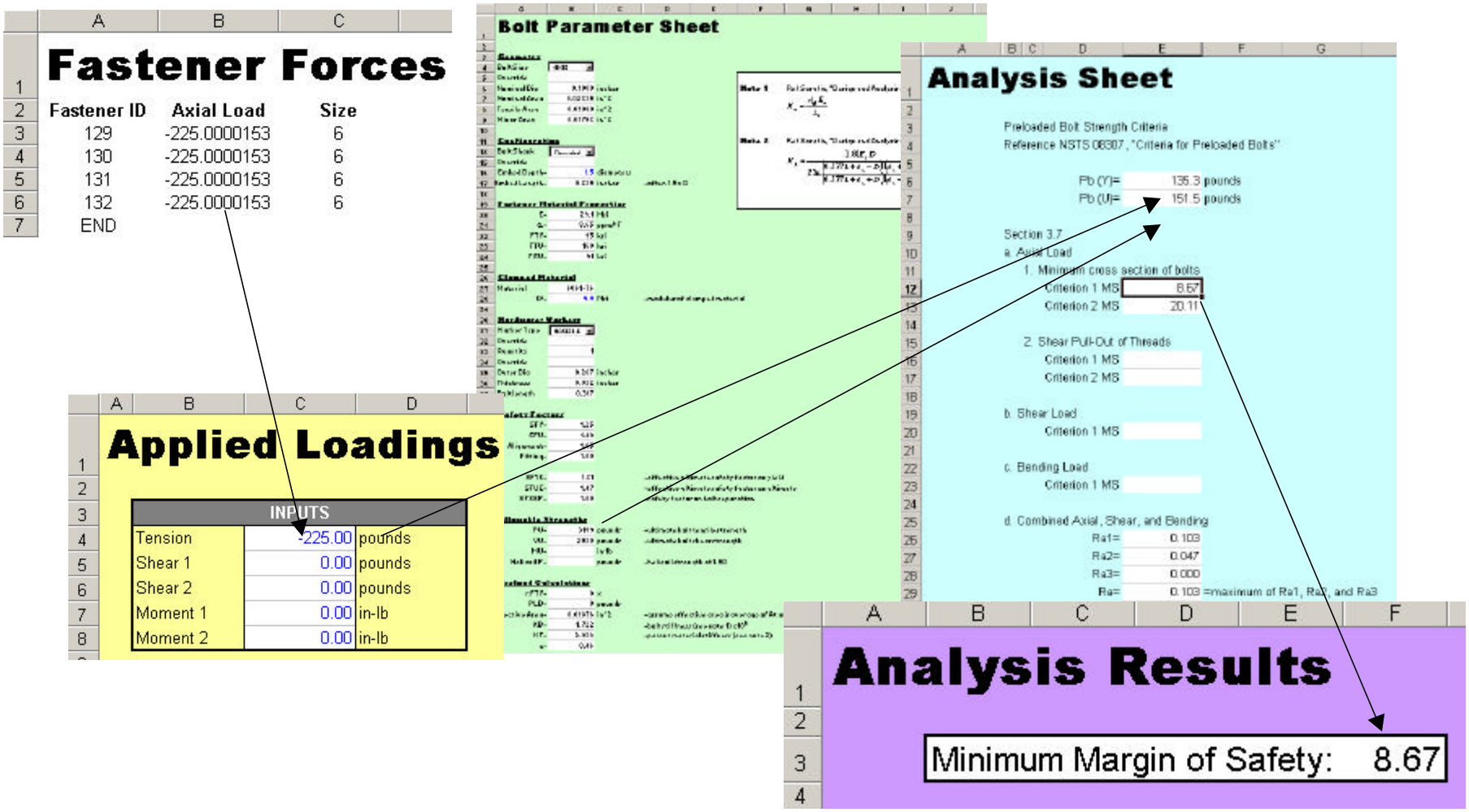
Step 2: Select Output Set



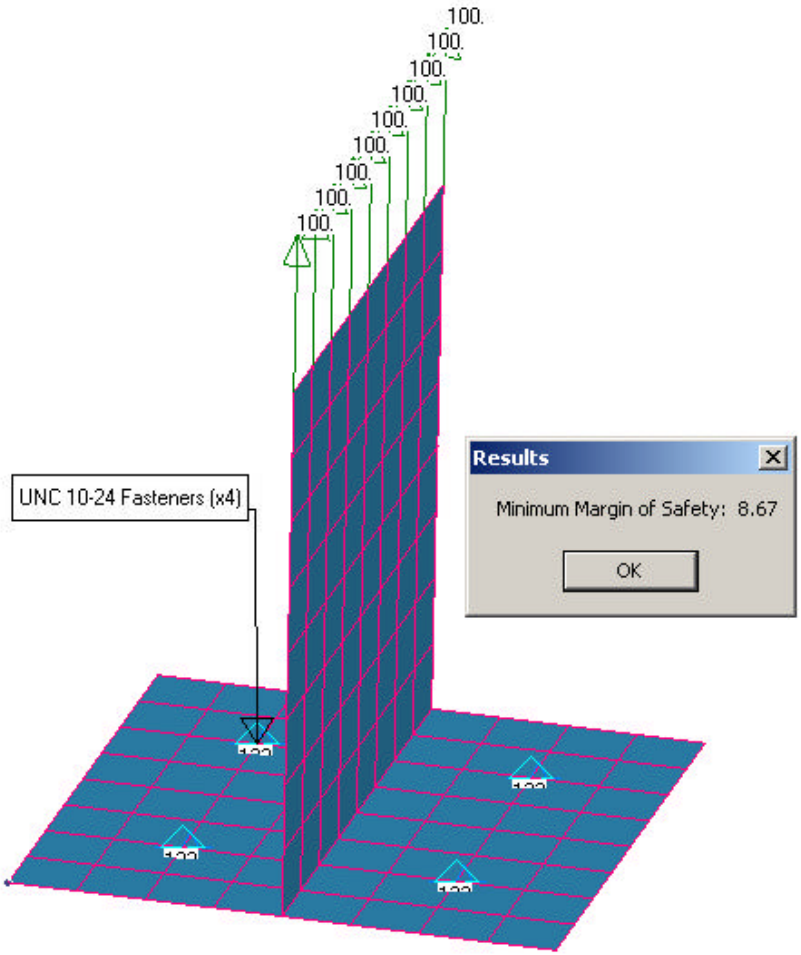
Step 3: Specify Fastener Options



Example 2: Crunch Numbers in EXCEL



Example 2: Display Analysis Output



Process Can Be
Extended to Virtually
any Analysis Task

'How Can I Do These Cool Things?

IF (you are a FEMAP User…) IS TRUE THEN

- Step 1: Upgrade to FEMAP v8.1
- Step 2: Play Around with Visual Basic for Applications
  - Very, Very Simple Compared to C++, FORTRAN
- Step 3: Review the FEMAP Programmers Manual
  - Copy from FEMAP Install CD or Download from EDS
- Step 4: Use the "Help" Files of OLE Compatible Software
  - Here is where you can find examples on how to use the specific OLE interface objects for each program
- Step 5: Come up with Cool Ideas
  - R.O.T.: There is ALWAYS something that needs to be simpler

ELSE

- Become a FEMAP User (LOOP)

END IF

Future Possibilities

- Buckling Analysis according to Bruhn
  - Algorithm to Identify a Representative Stress to Compare to Buckling Allowables
- Store Element Information within FEMAP Database
  - Examples
    - Fastener sizes represented by springs
    - Idealized BC information for QUADs that make up a panel
  - Recover This Information As Needed for Analysis
- Automated Documentation of Model with Screen Shots according to Layer or Group
- Expand Element, Property, and Material Database
  - Add Unsupported/Custom Element and Property Types
- Anything Else…