EN1740 Computer Aided Visualization and Design

Spring 2012

4/10/2012

Brian C. P. Burke

Last Time:

- Finish Top-Down Design
- Form Project Groups

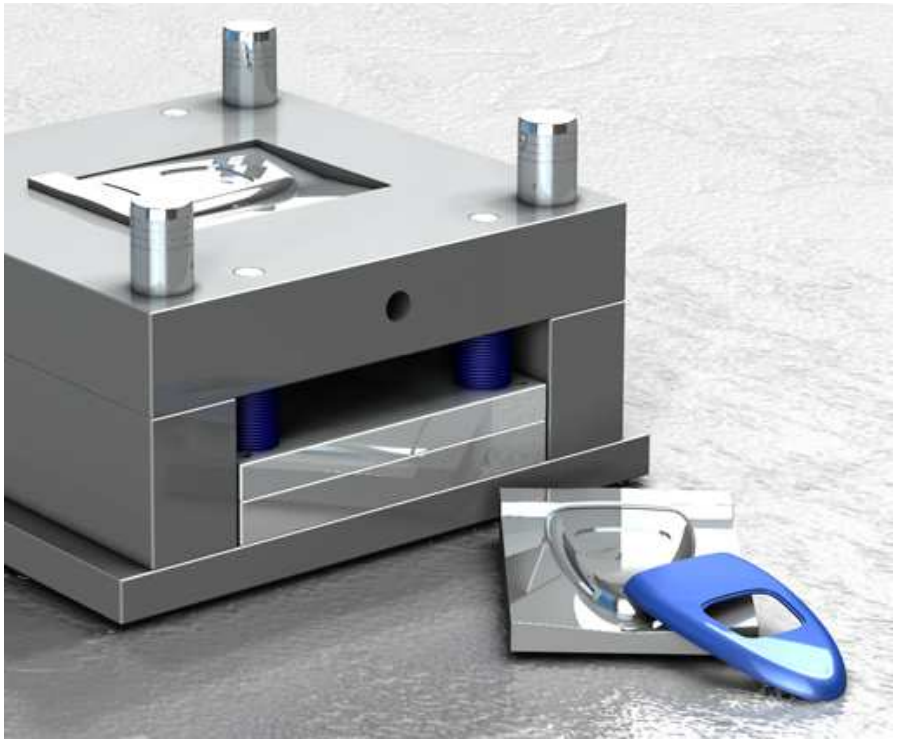
Tonight:

- Rendering
- Design Analysis
  - Clearance/Interference Checking
  - Sensitivity/Feasibility/Optimization

Additional Reading For Next Time – The second half of Chapt. 4 (pg 96-112) as well as Chapt. 6,
Please read Chapt. 8

Rendering

Photo Quality Images of CAD models

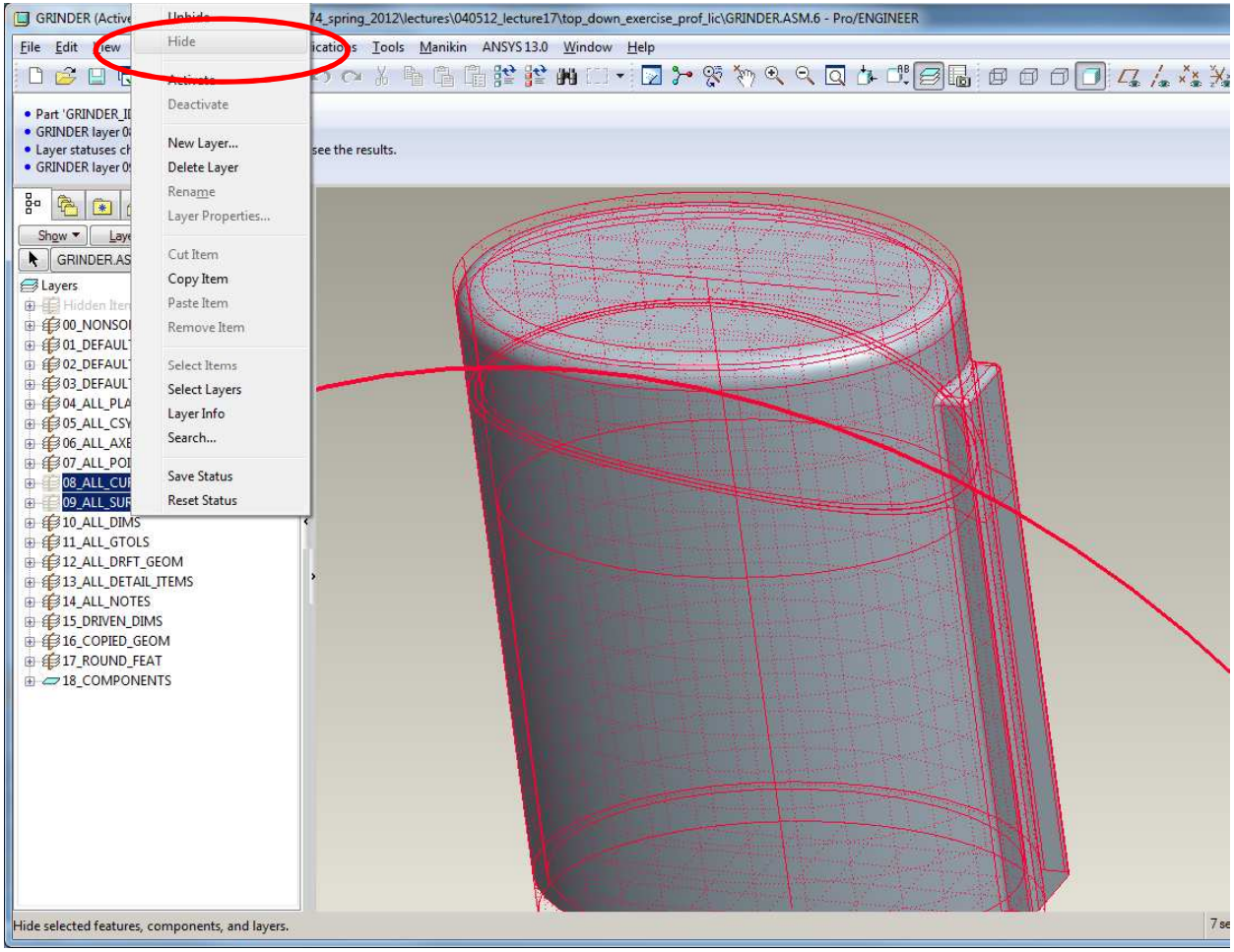


http://www.ptc.com/product/creo/advanced-rendering-extension

EXERCISE – Rendering

Blank Surface and Curve Layers

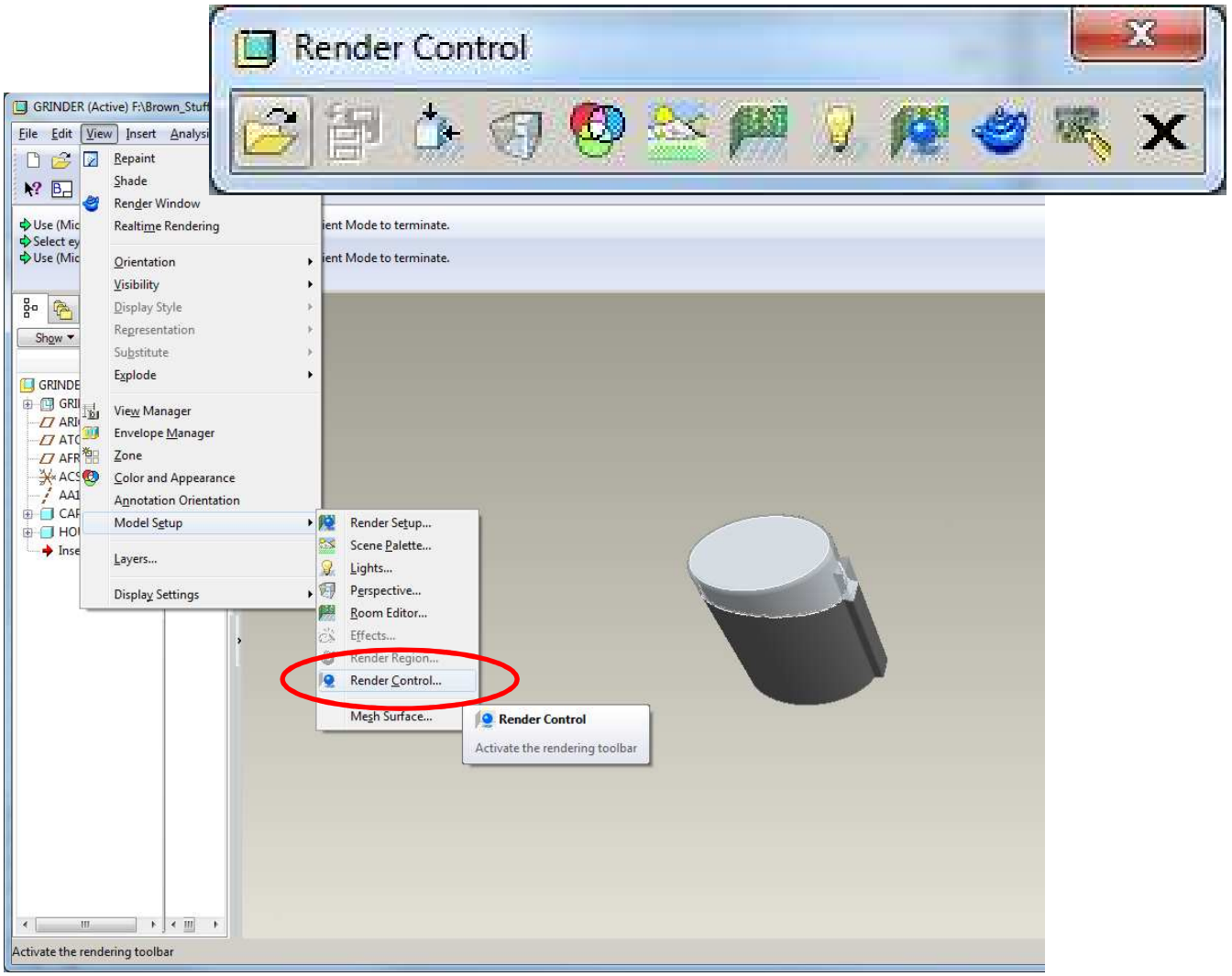
- Click Show above model tree and select ‘Layer Tree’
- Highlight the ‘All Curves’ and ‘All Surfaces’ Layers
- RMB > Hide
- RMB > Save Status



EXERCISE – Rendering

Render Controls

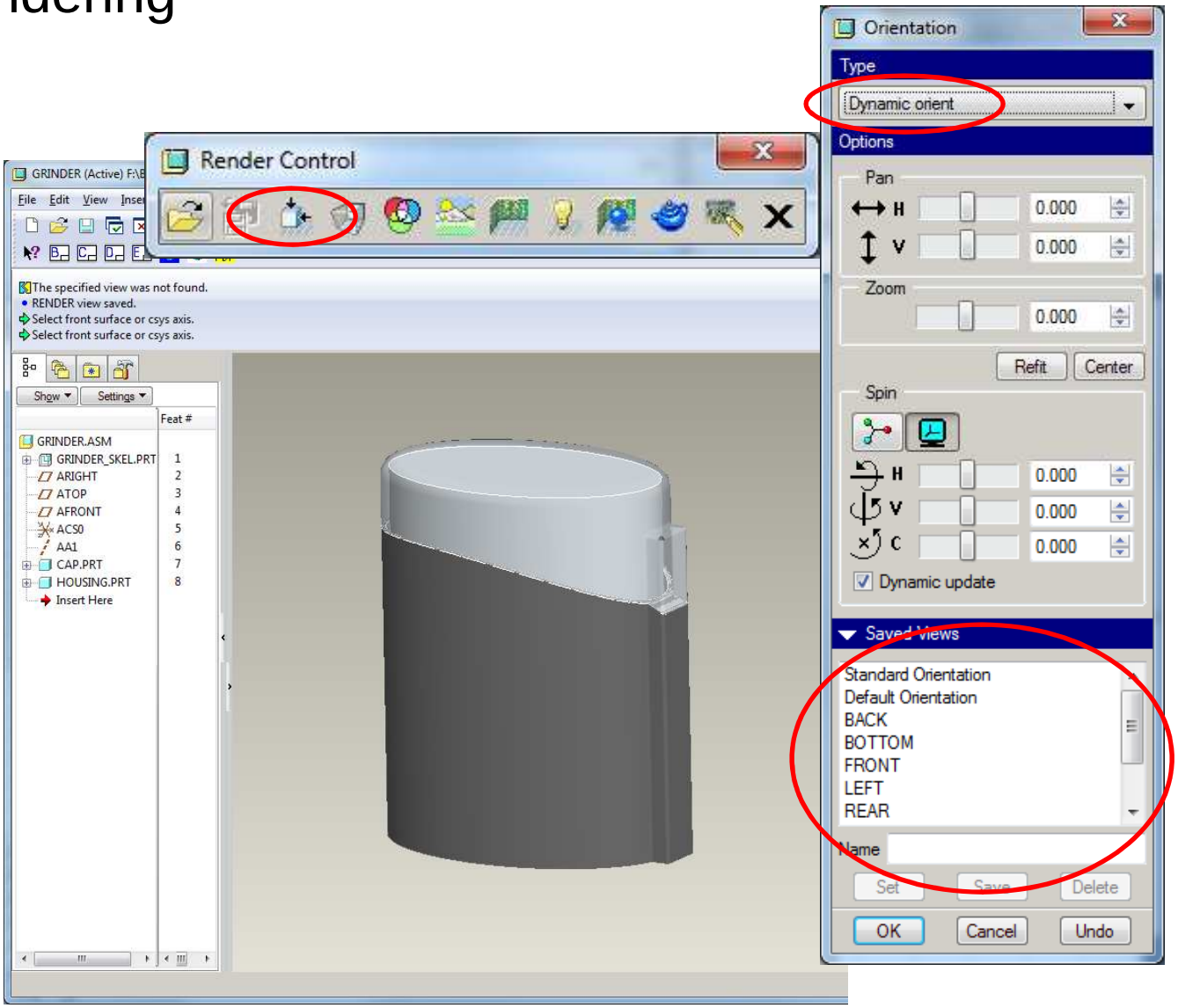
- One-stop shop for all things related to rendering
- View > Model Setup > Render Control



EXERCISE – Rendering

Orientation

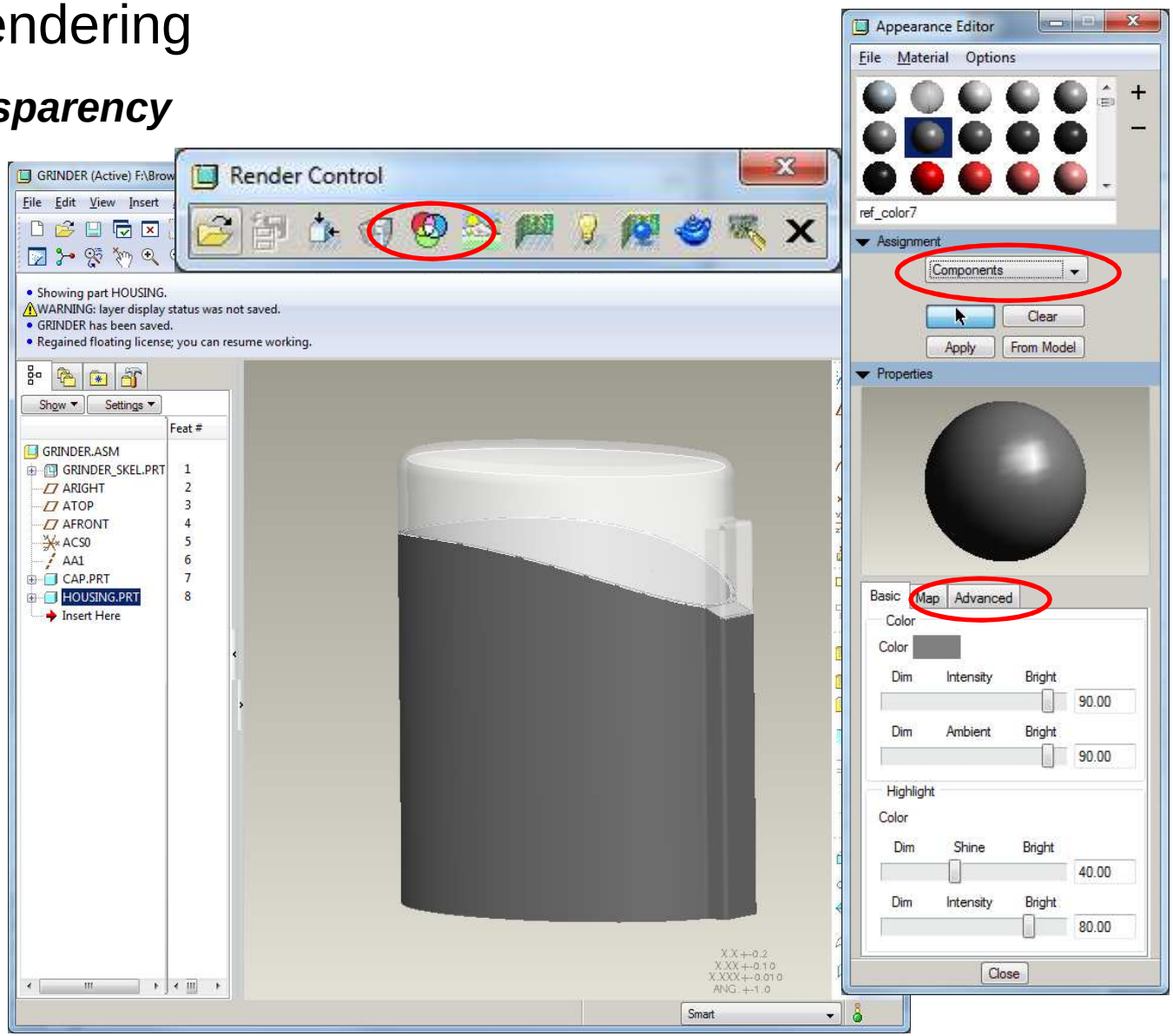
- Save an orientation so the model can be put back in the same place for updates
- Use Dynamic Orientation
- Remember to Save with a name you'll remember



EXERCISE – Rendering

Set Colors and Transparency

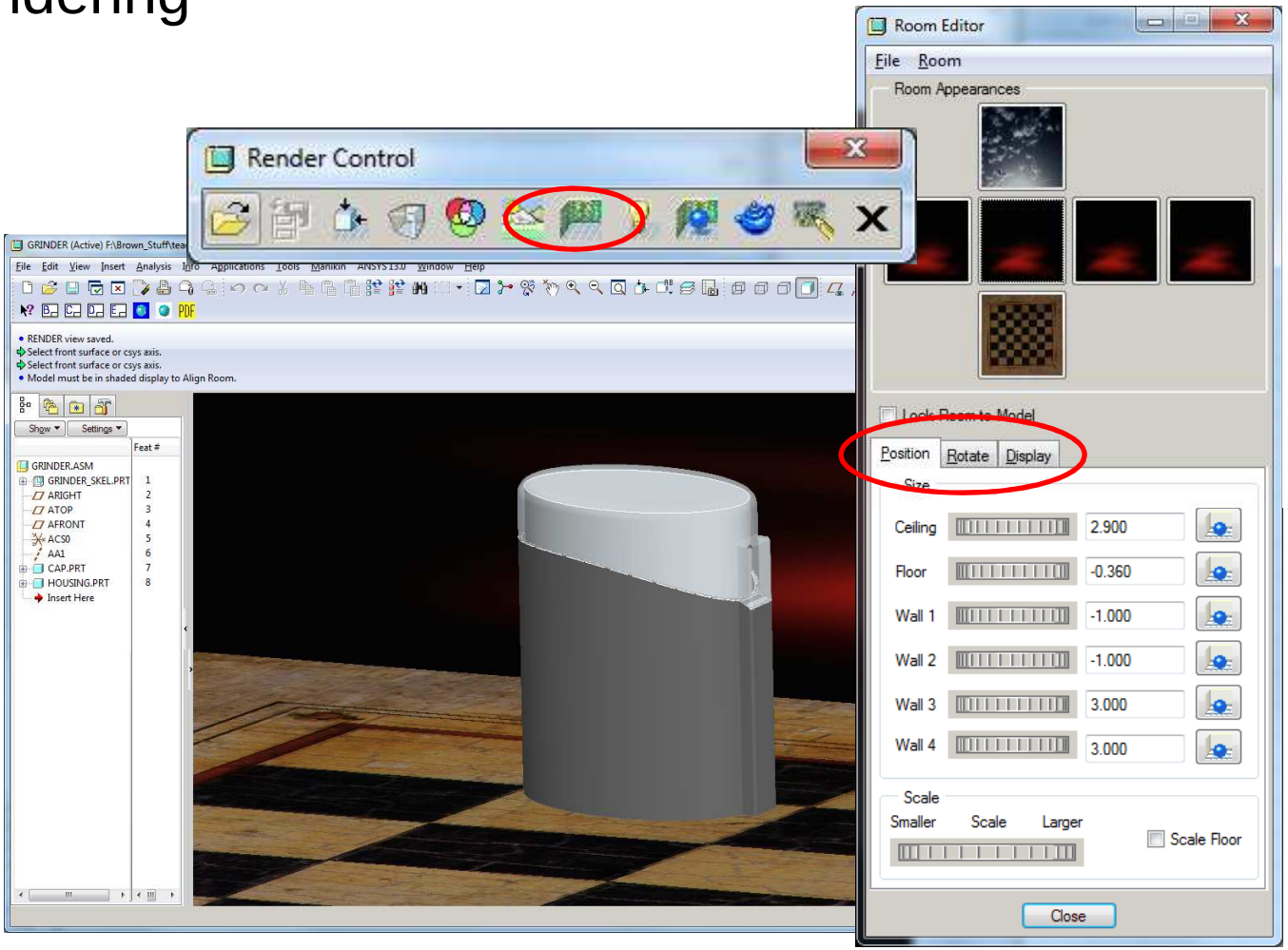
- View > Color and Appearance (or from tool bar)
- From the drop down, select Components
- Select Component
- Select Component and click Apply
- See Advanced tab for transparency



EXERCISE – Rendering

Room Editor

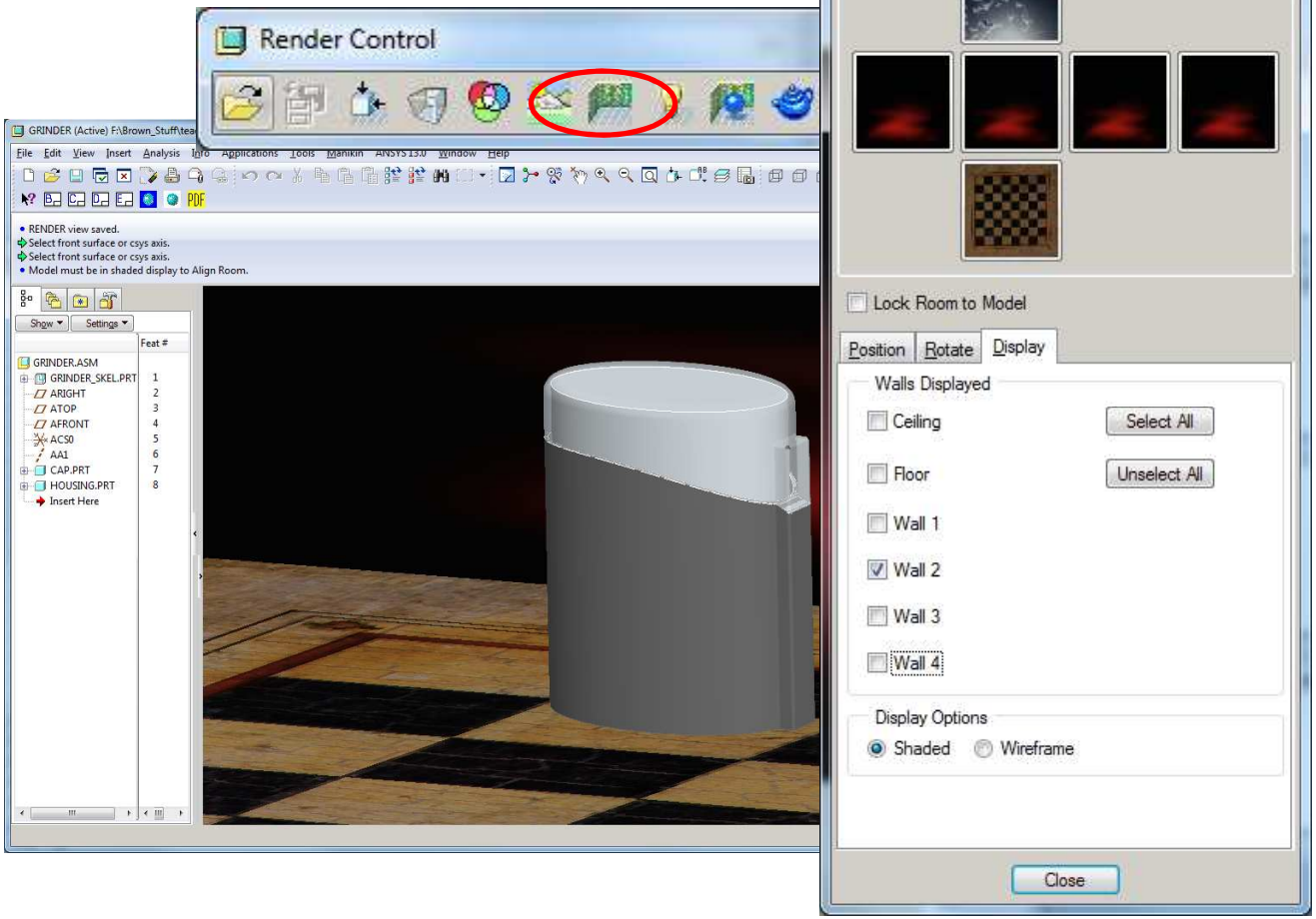
- Set the stage – create a scene for the model
- Using the Position, Rotate and Display tabs orient the model to the space
  - Note: 'Align against…shaded model' tool is quite helpful



EXERCISE – Rendering

Room Editor (cont.)

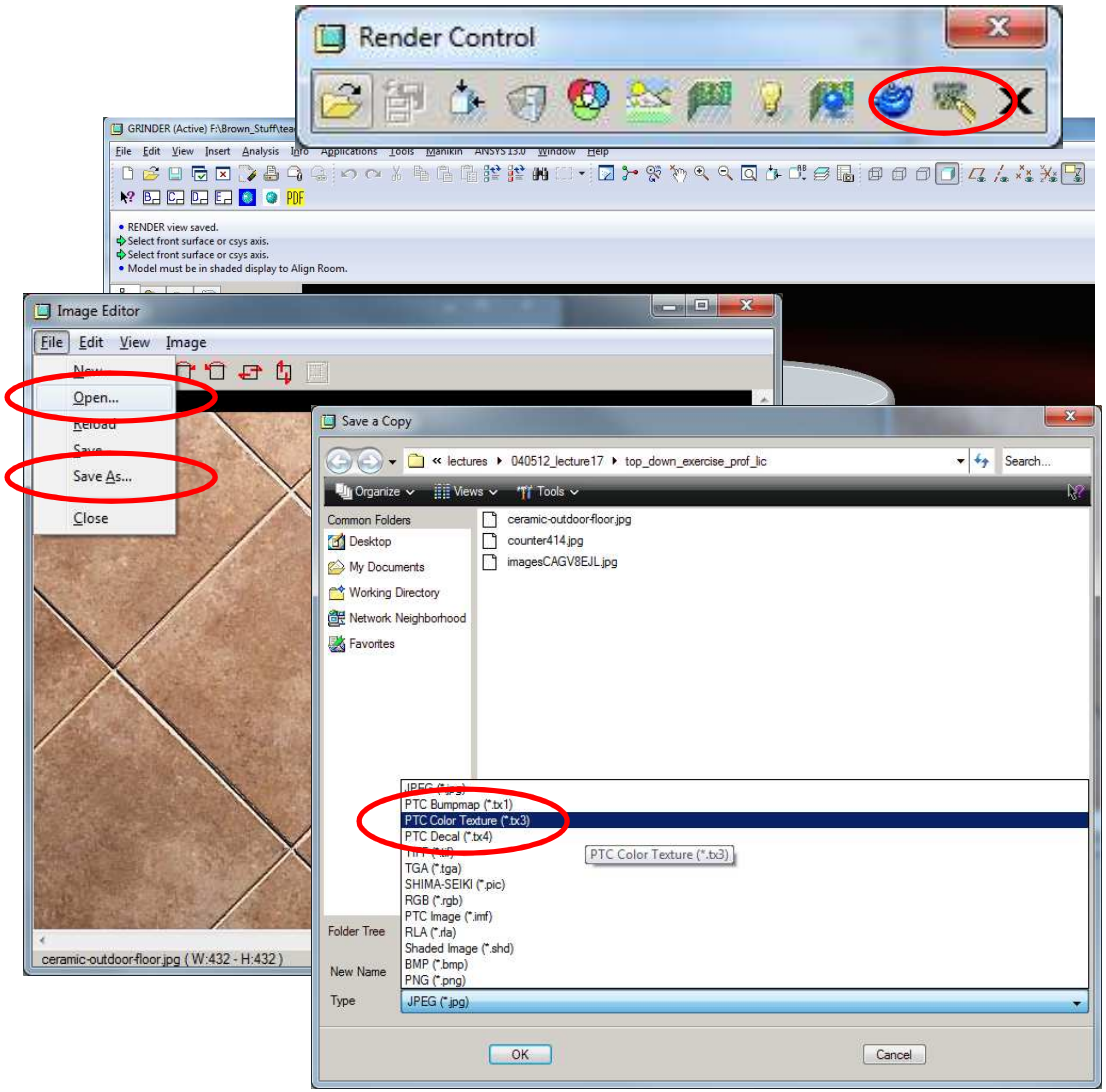
- On display tab, uncheck everything but the Floor and Wall 2



EXERCISE – Rendering

Room Editor (cont.)

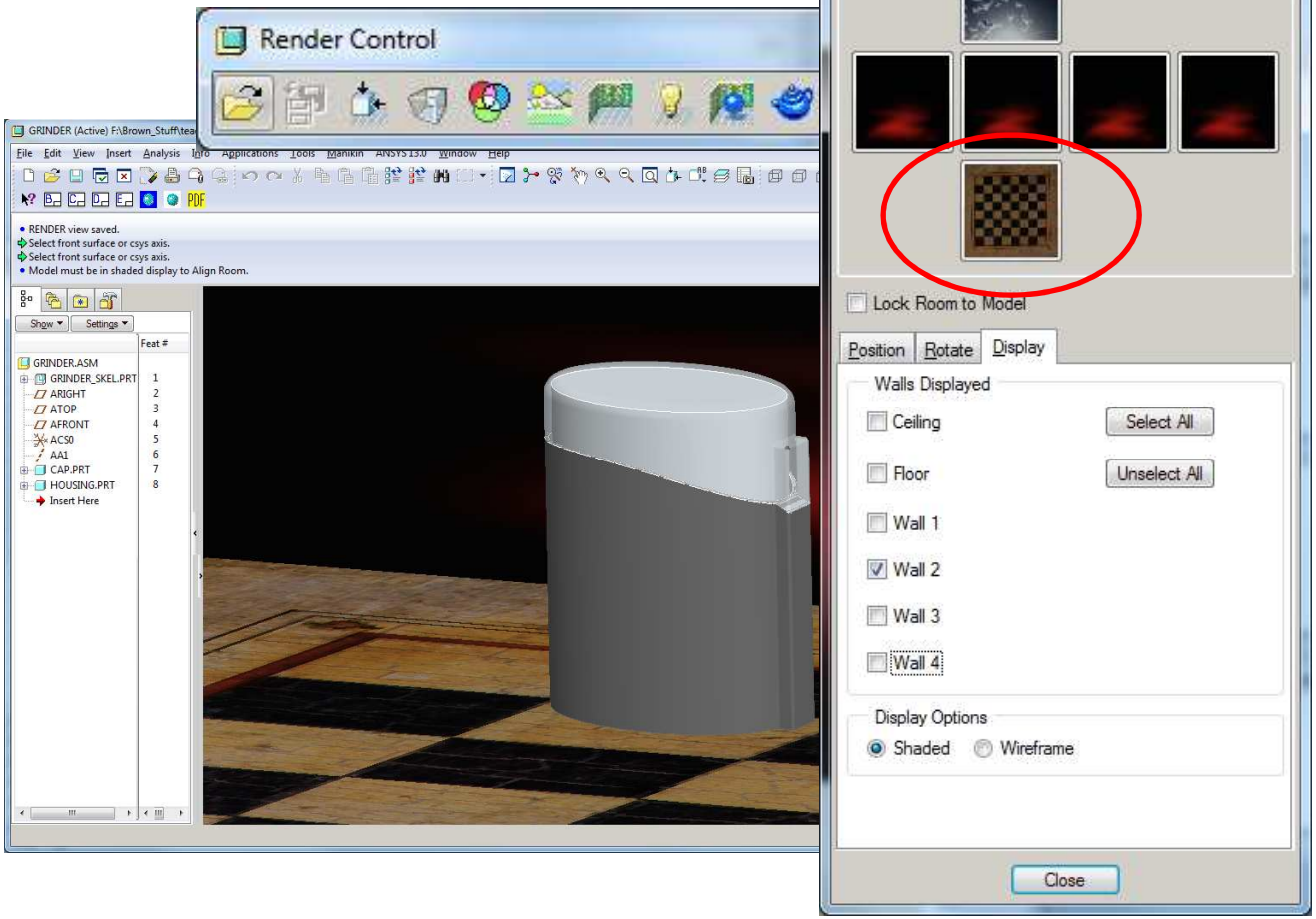
- Click the image editor
- In the Image Editor open the ceramic tile and wood grain images
- Save each of these images as a PTC Color Texture (*.tx3)



EXERCISE – Rendering

Room Editor (cont.)

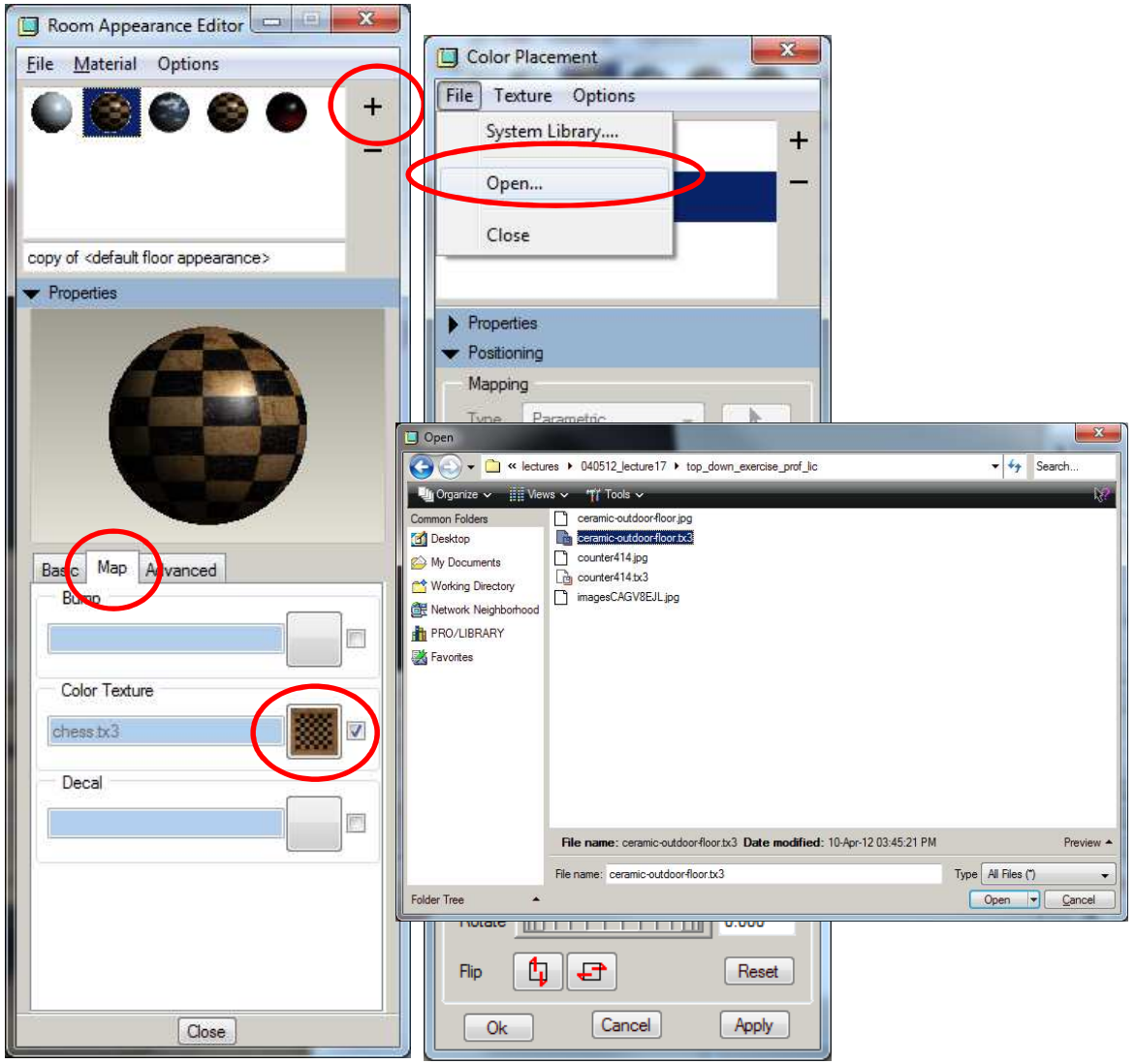
- Back to Room Editor
- Double click on the textures applied to each wall to edit
- This will launch Room Appearance Editor



EXERCISE – Rendering

Room Editor (cont.)

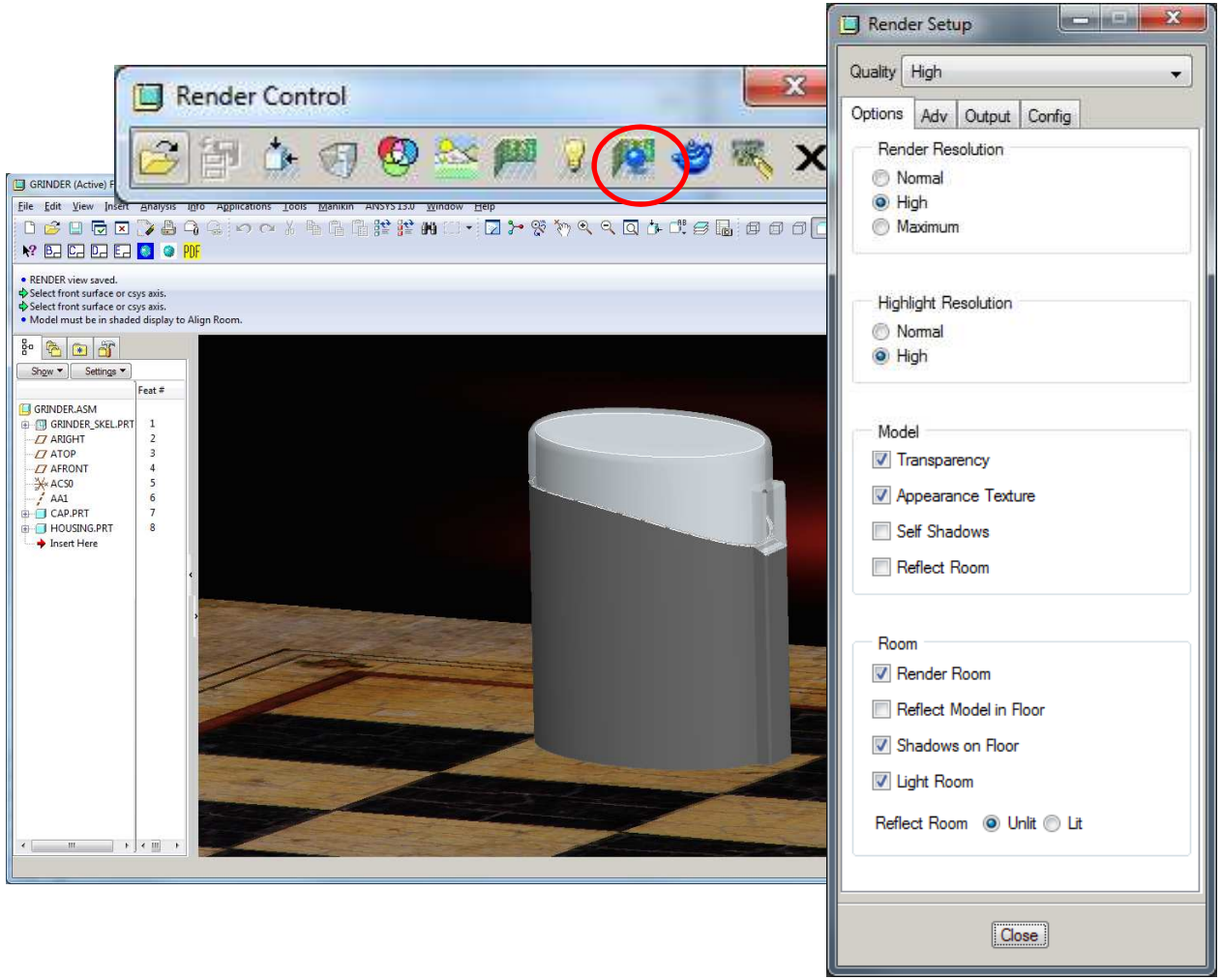
- Set up new textures for the floor and wall 2
  - Create a new appearance
  - Click the Map tab
  - Click on the Color Texture
  - From the Color Placement dialog open the textures just created
  - Assign accordingly



EXERCISE – Rendering

Render Settings

- There are a ton of options, for now:
  - Quality to High
  - Set Render Resolution to High
  - Select ‘Shadows on Floor’ and ‘Light Room’



EXERCISE – Rendering

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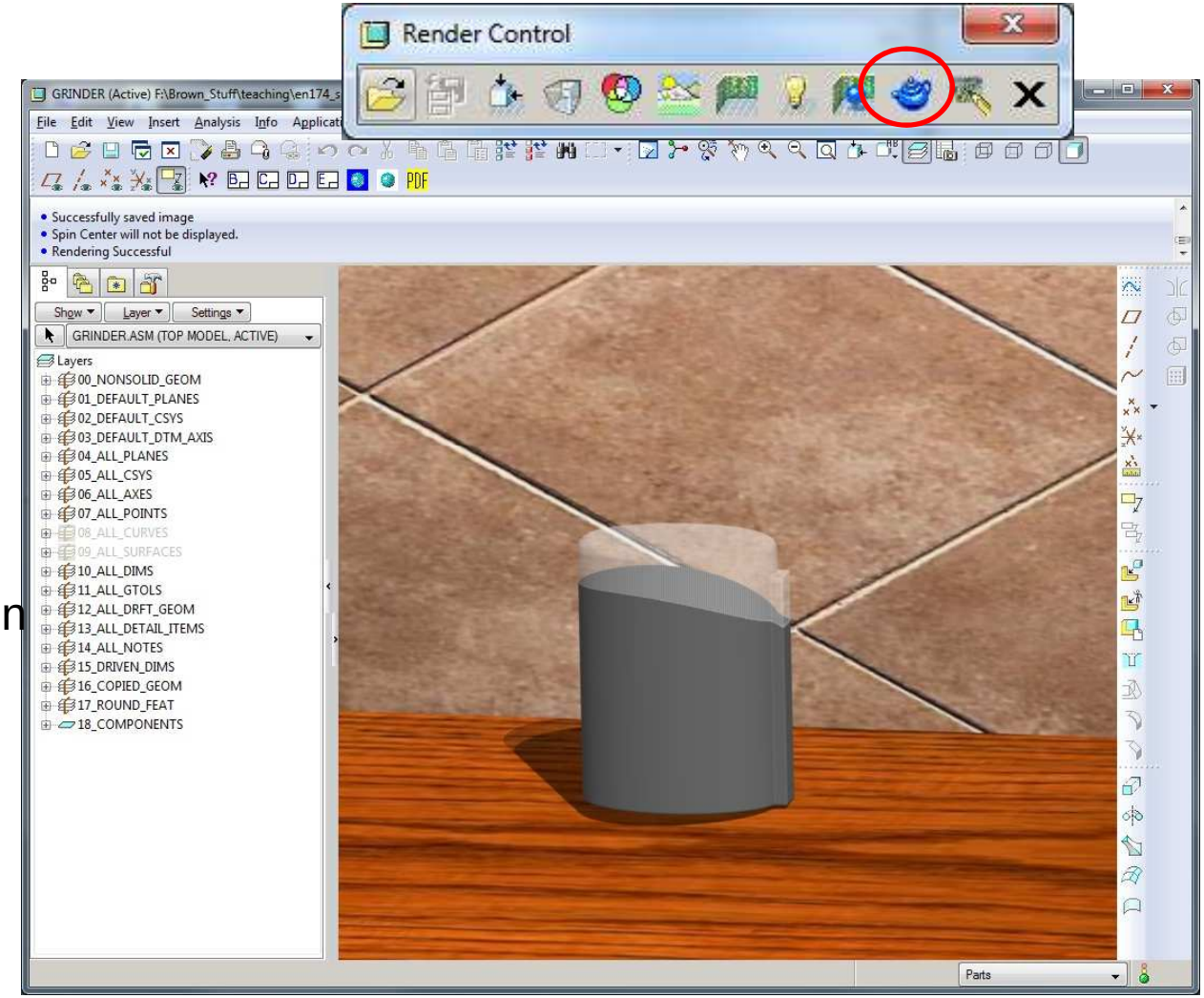


Design Analysis

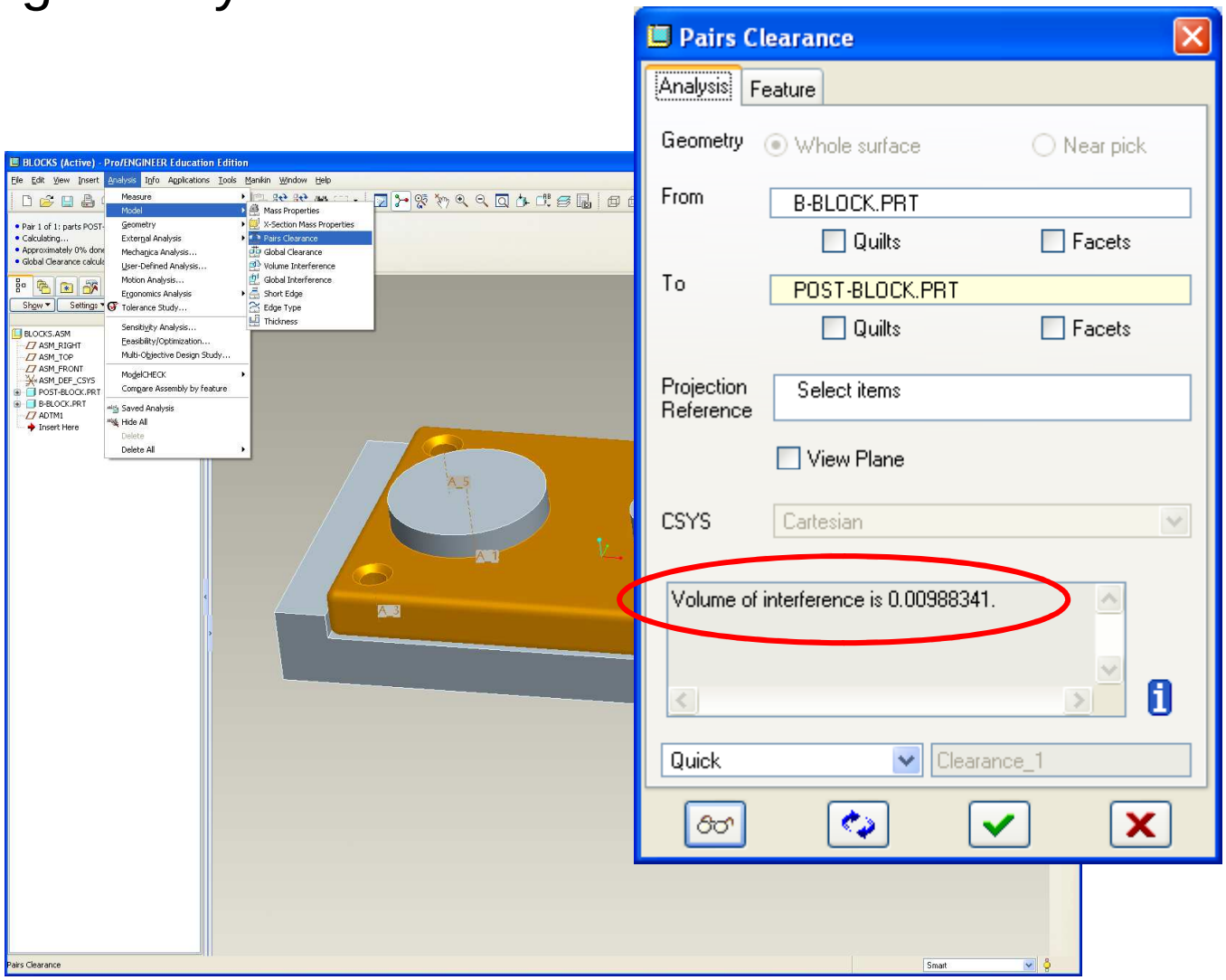
Clearance/Interference Checking

- One of the most basic design requirements is that parts fit together
- Due to manufacturing variation, a certain amount of nominal clearance must be specified to assure that this is possible
- Pro/E has a number of ways to evaluate this (Note: *None of these I would consider exceptionally good)*
  - Pairs Clearance – Measures clearance between features, surfaces, quilts, parts or sub-assemblies
  - Global Clearance – Highlights parts and sub-assemblies not meeting a minimum clearance specification
  - Global Interference – Calculates volume of interference between all parts and sub-assemblies

EXAMPLE - Design Analysis

Pairs Clearance

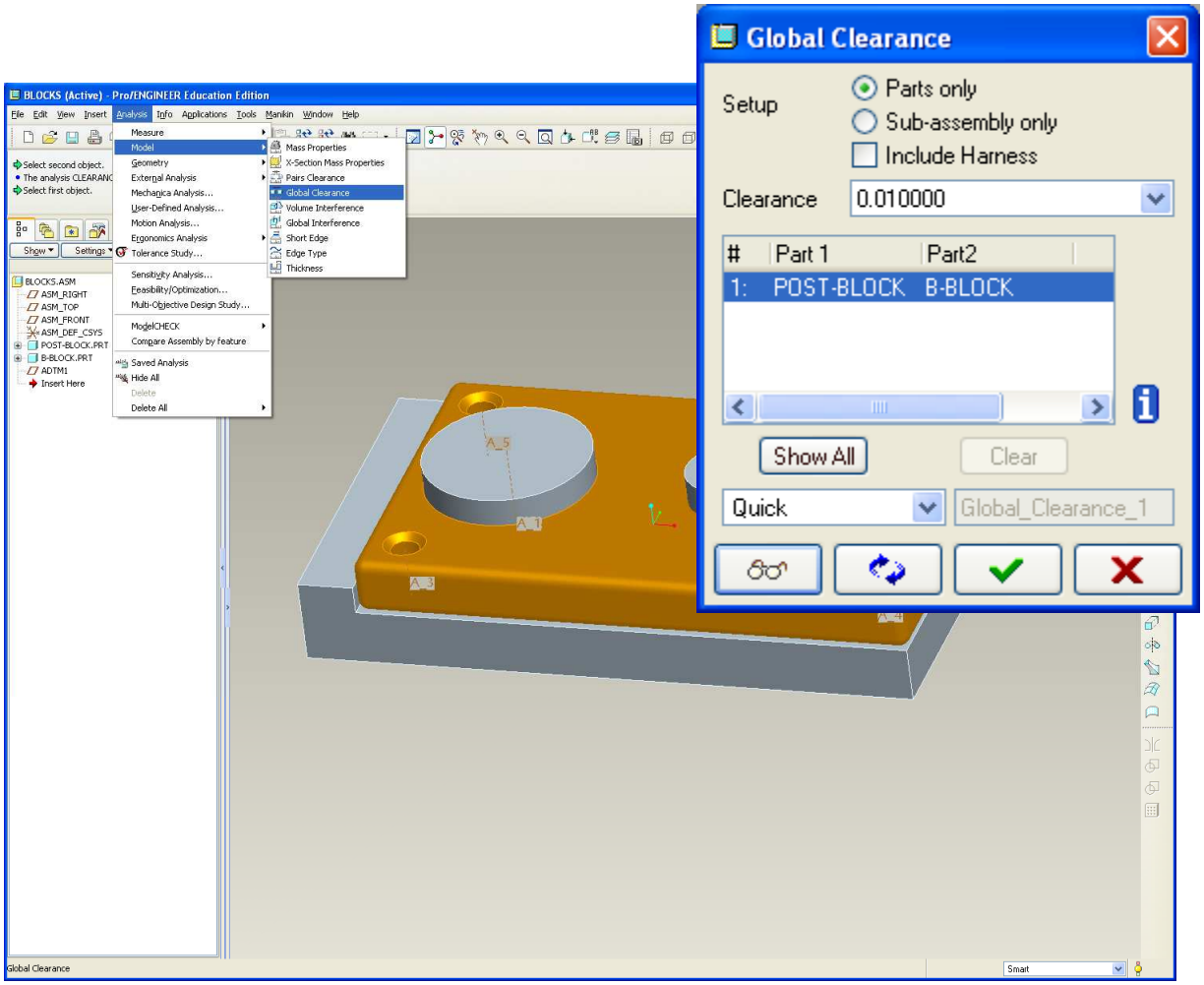
- Analysis > Model > Pair Clearance
- Select feature part or sub-assembly
- Click goggles to show result
- Feature can be saved



EXAMPLE - Design Analysis

Global Clearance

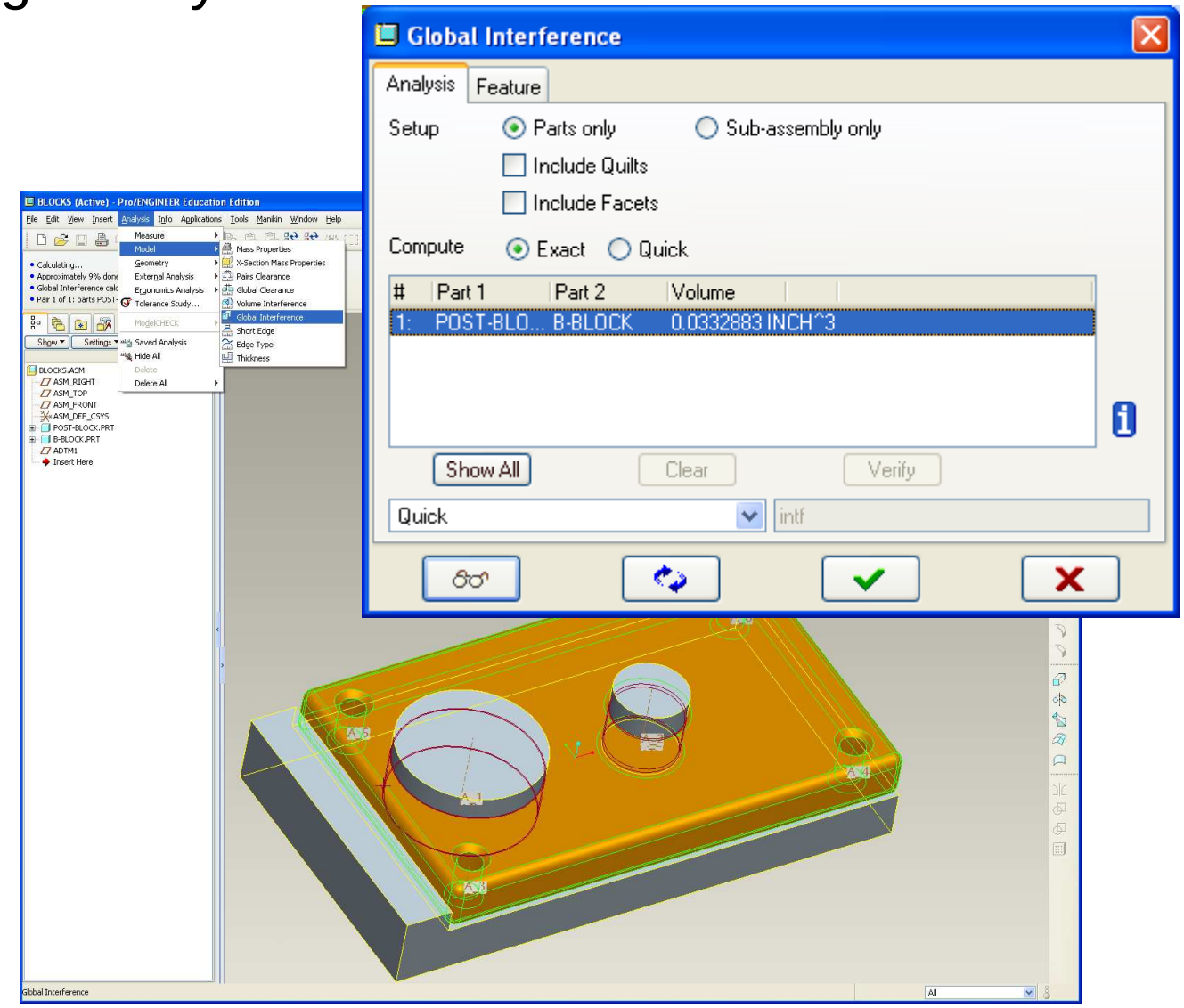
- Analysis > Model > Global Clearance
- Specify minimum clearance value
- Click goggles to show result
- System specifies all parts not meeting minimum clearance
- ***Not smart enough to filter out assembly constraints***



EXAMPLE - Design Analysis

Global Interference

- Analysis > Model > Global Interference
- Specify Parts only or Sub-assembly only
- Click goggles to show result
- System calculates total interference volume
- ***Graphics windows highlights all interferences***



Design Analysis

Clearance/Interference Checking

Summary:

- *No simple tool to ensure clearances are all correct*
- *Old fashion method => grab a high-lighter and mark on the prints corresponding dimensions from mating parts.*

Design Analysis

Sensitivity, Feasibility and Optimization Studies

- ***These are the basis for most quantitative design activities***
  - ***Sensitivity – Influence of a variable on design objective***
  - ***Feasibility – Given a design objective vary one or more variables to get a solution***
  - ***Optimization – Given a design objective vary one or more variables to get the best solution***
- ***Above functions are described in the language of Pro/E***
- ***These are very standard design activities that should be available in all CAD packages***

Design Analysis

Analysis Features and Relations

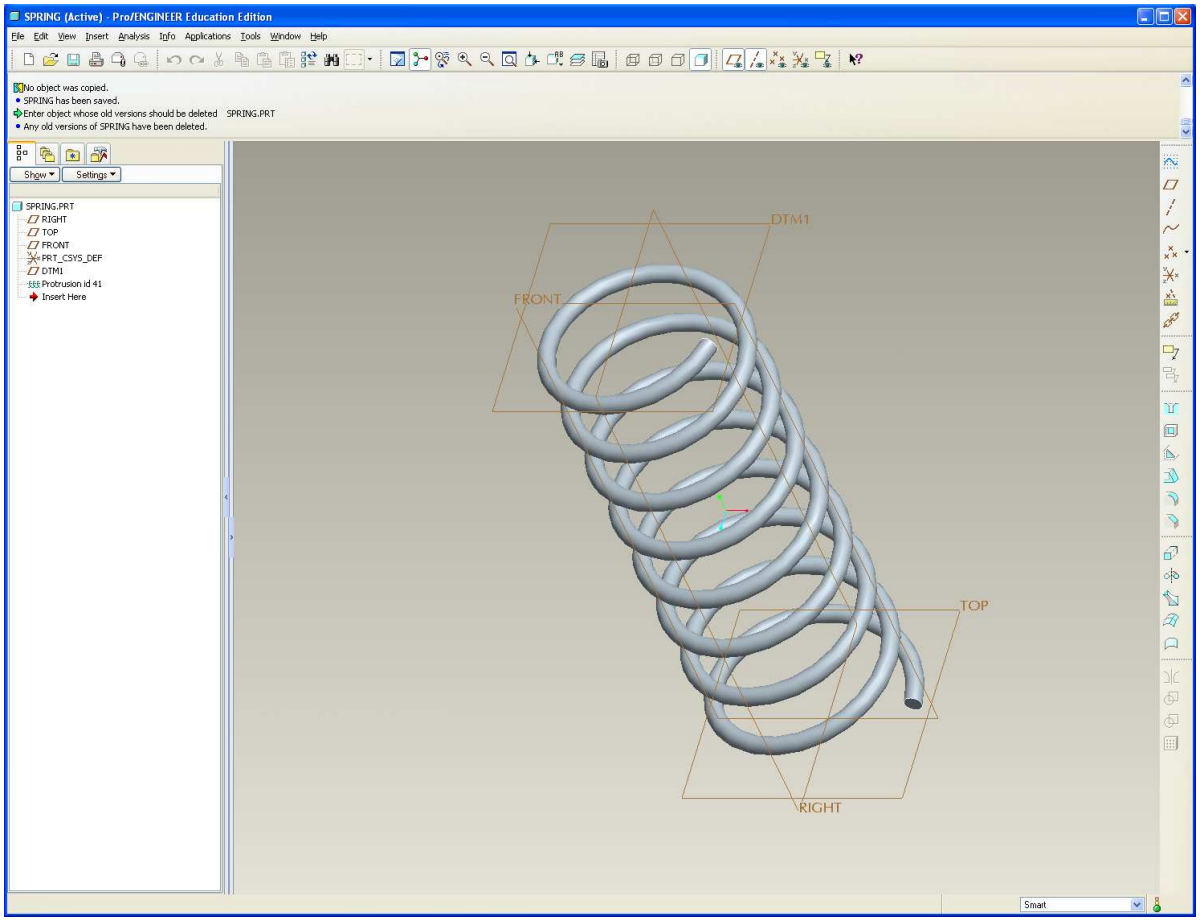
- Pro/E allows for calculations using part dimensions and properties
  - Parameters are set values inputted by user
  - Relations are used to define calculations
  - Analysis features can be used to update Relations as a result of a component or assembly change

- ***Relations can also be used to drive part dimensions, but this is not always a best practice in group work***

EXERCISE - Design Analysis

Sensitivity, Feasibility, Optimization, Analysis Features and Relations

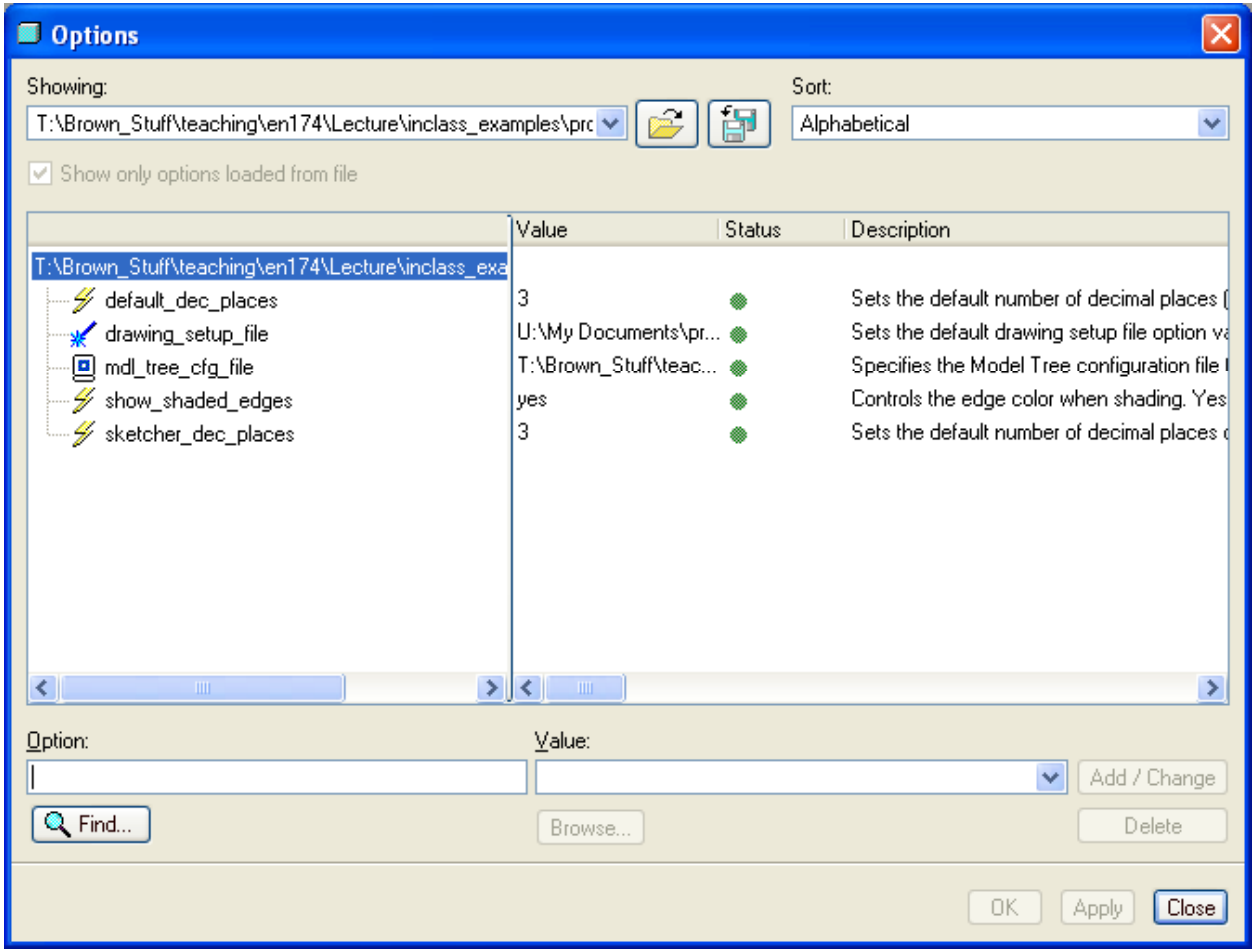
- Using a spring model, we'll explore how to use Pro/E's Design Analysis functions
  - Sensitivity to show effect of wire dia. on rate
  - Feasibility to find design to under yield stress
  - Optimization to minimize volume



EXERCISE - Design Analysis

Sensitivity, Feasibility, Optimization, Analysis Features and Relations

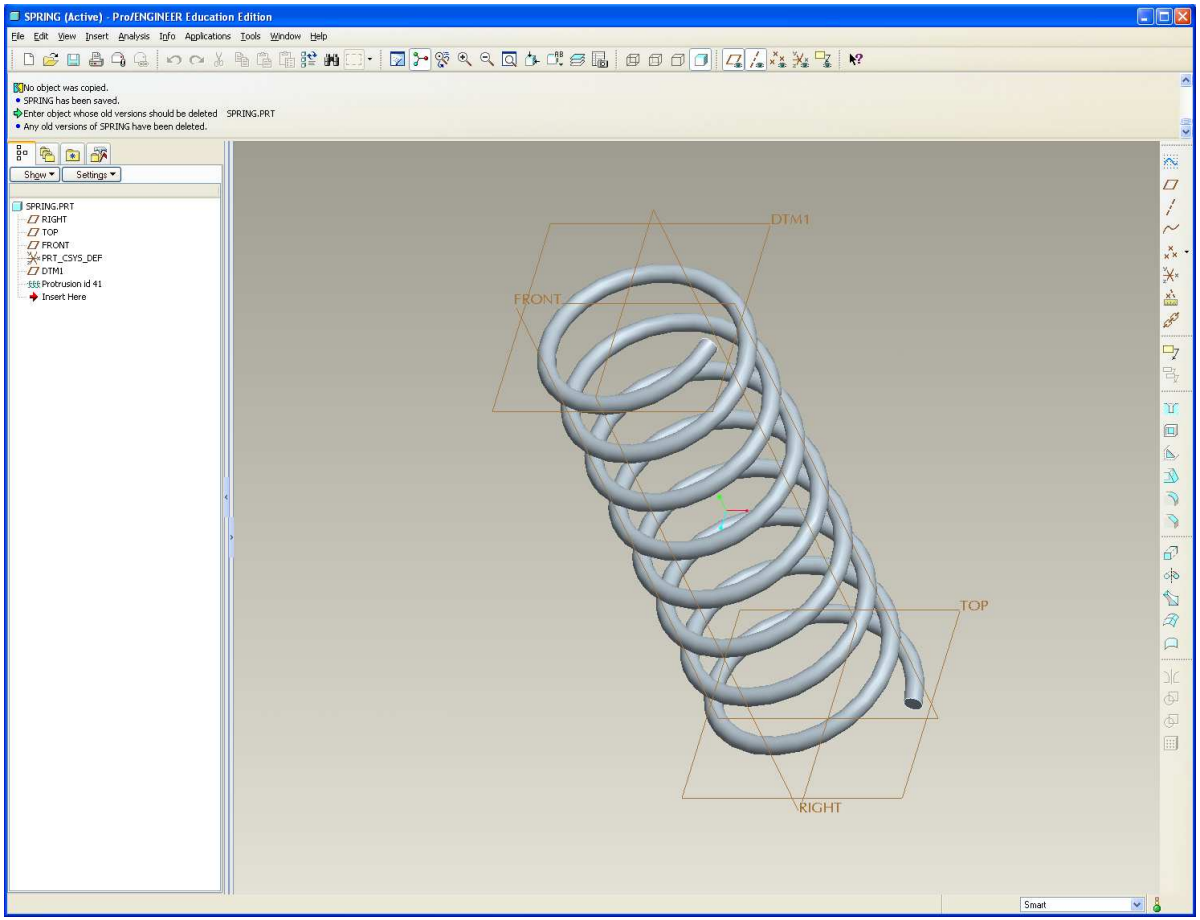
- BEFORE WE DO ANYTHING….we're going to set preference for the model tree
  - Make sure that your config.pro points to model tree config file
  - Set parameter for mdl_tree_cfg_file in Options dialog



EXERCISE - Design Analysis

Sensitivity, Feasibility, Optimization, Analysis Features and Relations

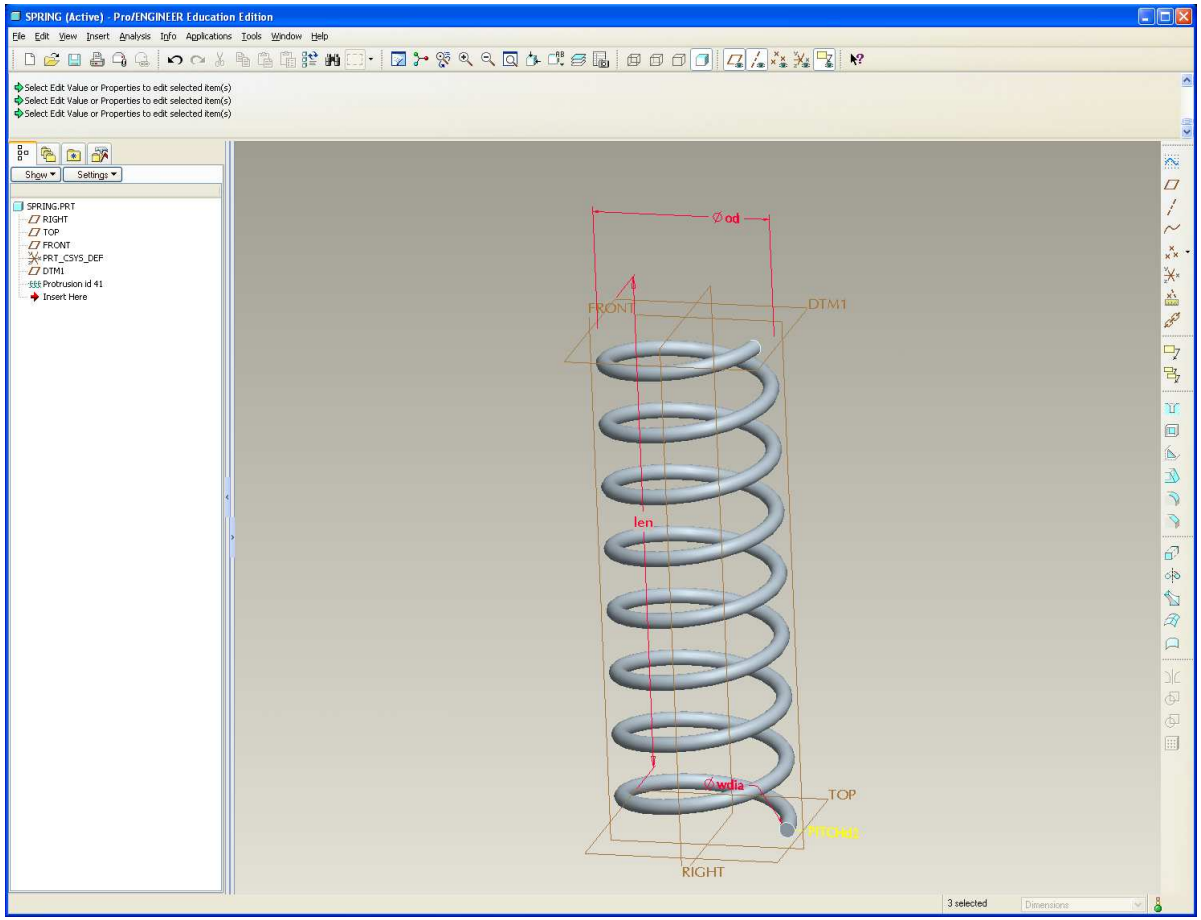
- Download from Supporting Materials page *spring.prt*
- Open part and take a look
  - Open ends, not ground
  - Constant pitch
  - Constant OD



EXERCISE - Design Analysis

Sensitivity, Feasibility, Optimization, Analysis Features and Relations

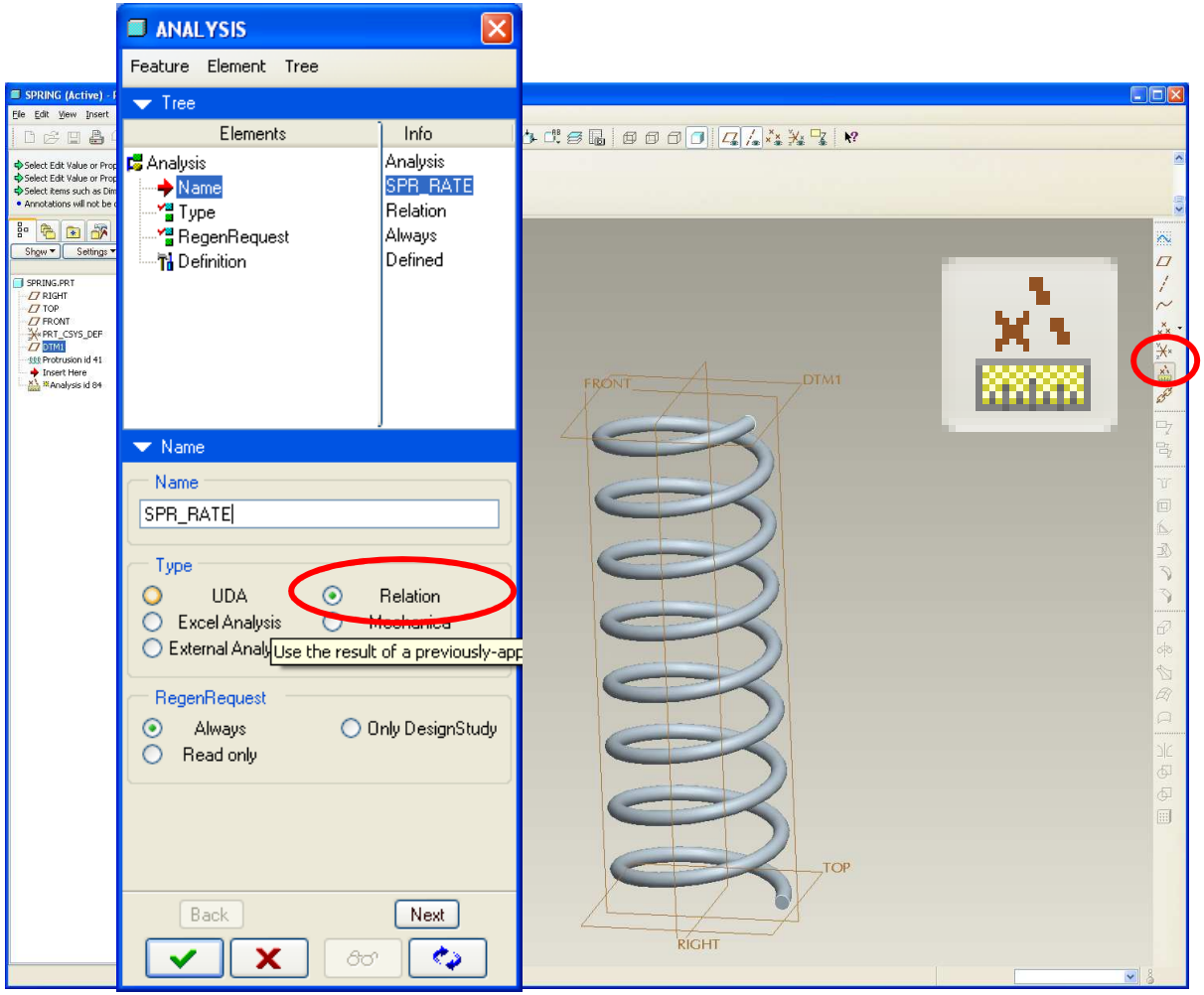
- Rename dimensions
  - od for Outside Diameter
  - len for Overall Length
  - wdia for Wire Diameter
  - pitch for Pitch
- RMB on dimension
- Properties
- Dimension Text Tab
- Dimension Name
- ***May have to turn on Annotations to see Helical Sweep dim's***



EXERCISE - Design Analysis

Sensitivity, Feasibility, Optimization, Analysis Features and Relations

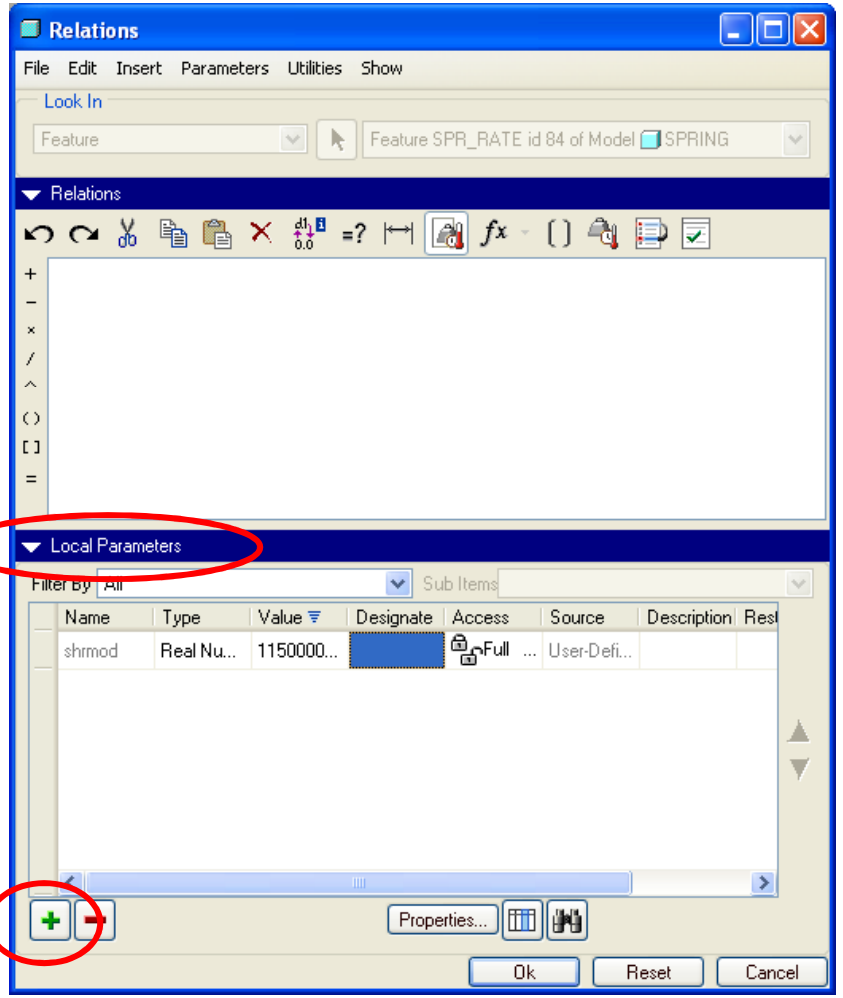
- Create an Analysis Feature
- Name feature SPR_RATE
  - ***NOTE: Must hit return in dialog for changes to take effect***
- Select Relation
- Click Next



EXERCISE - Design Analysis

Sensitivity, Feasibility, Optimization, Analysis Features and Relations

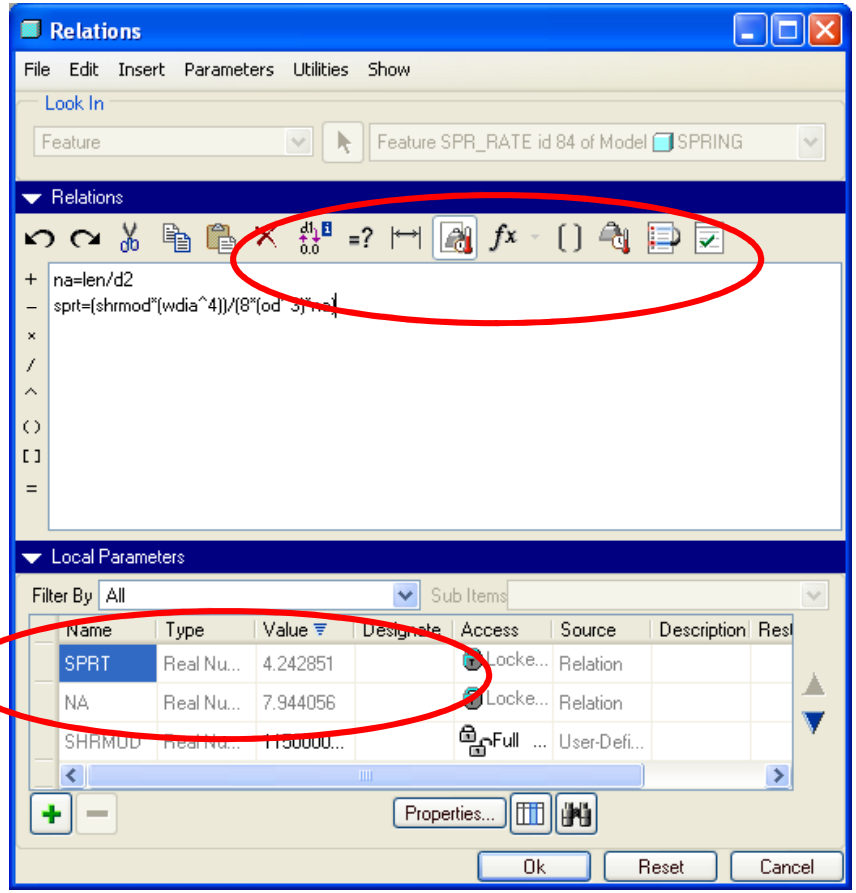
- Relations dialog box is launched
- Expand the Local Parameters section
- Create a parameter called *shrmod* for Shear Modulus and enter a value of 11.5e6



EXERCISE - Design Analysis

Sensitivity, Feasibility, Optimization, Analysis Features and Relations

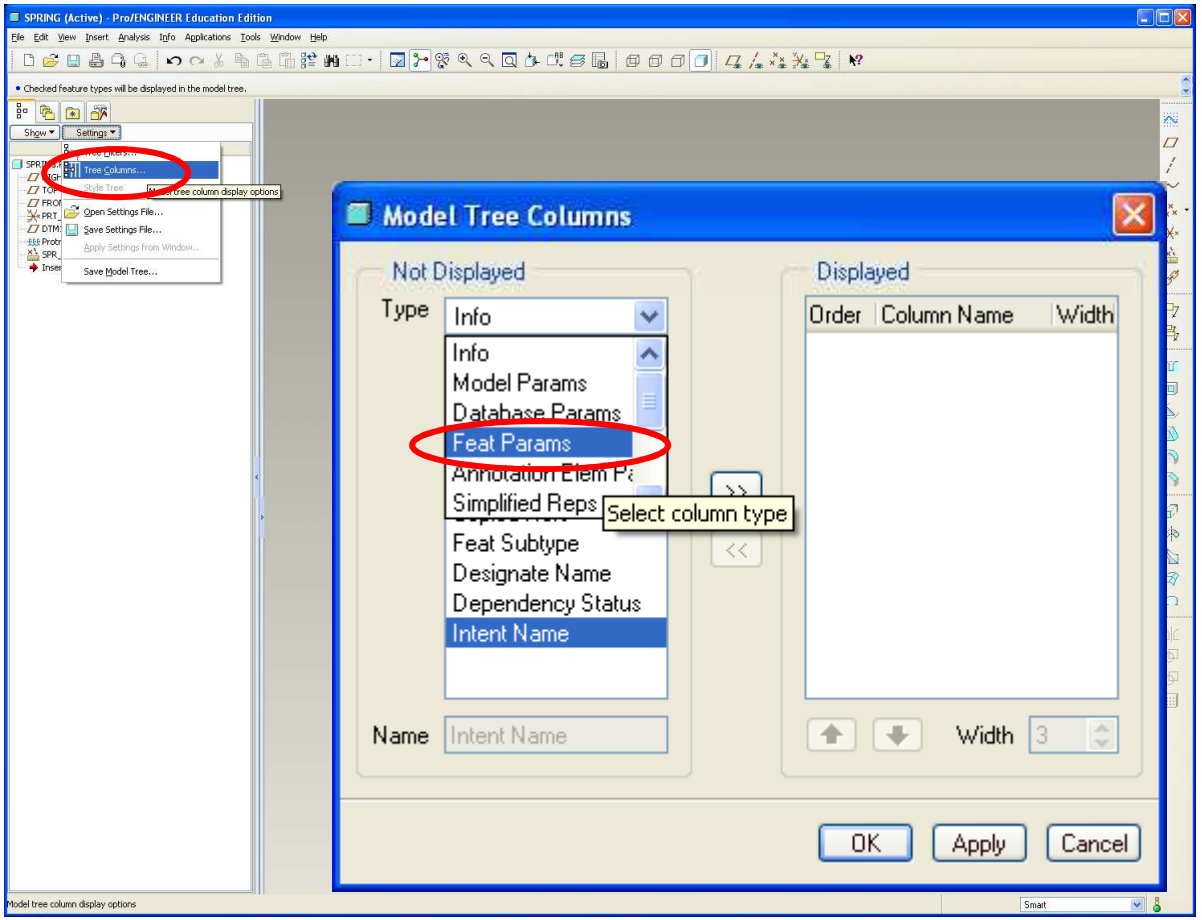
- Write a relation to estimate the spring rate
  - Number of coils N=L/p
  - Spring rate $k=Gd^4/8D^3N$
  - *USE DIMENSION NAMES FOR VARIABLES*
- Select Execute/Verify icon
- Ans: k=4.24
- Click OK
- Click Check



EXERCISE - Design Analysis

Sensitivity, Feasibility, Optimization, Analysis Features and Relations

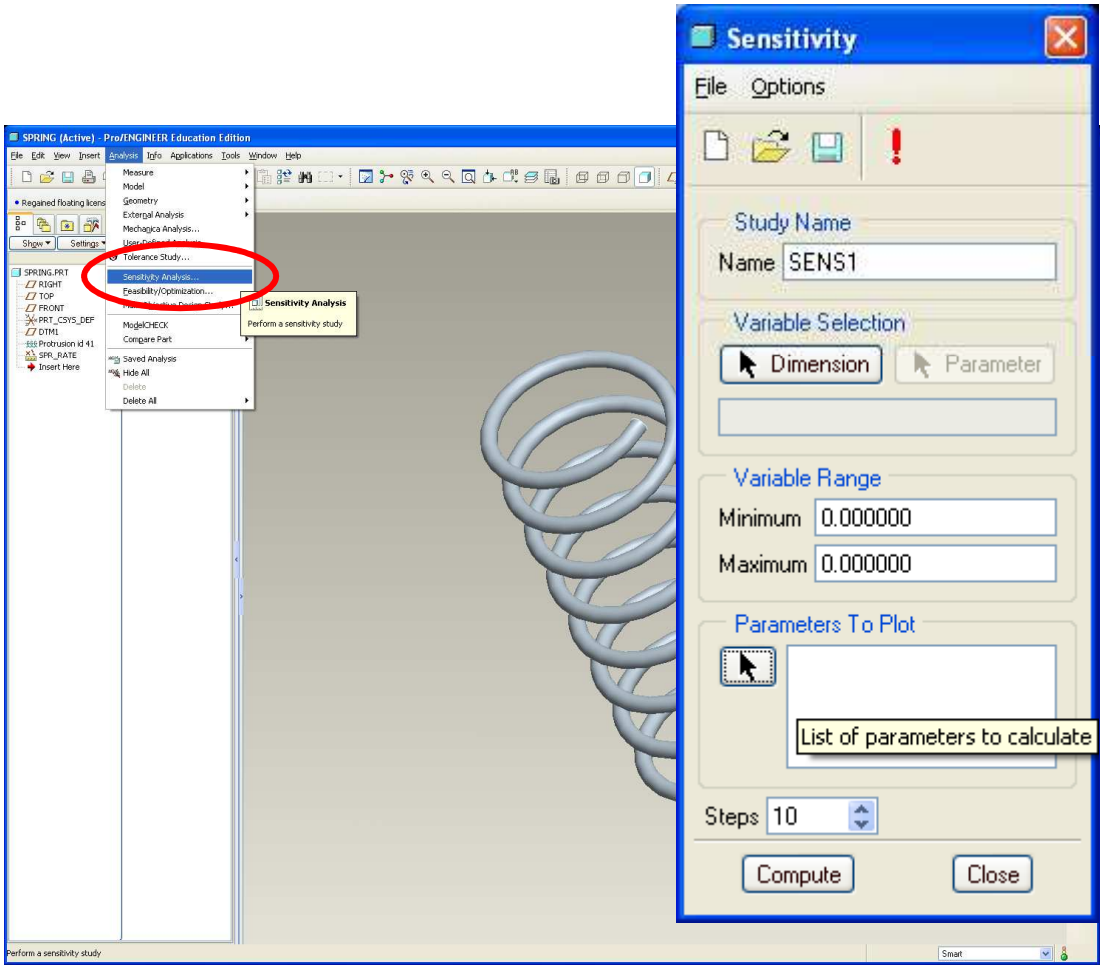
- Add the result to the model tree
  - From the model tree, click Settings > Tree Columns
  - From Type select Feat Params
  - Type sprt in Name and press Enter
  - Click OK
  - Notice the 4.24lb/in is listed in the model tree
- Save Tree settings in start-up directory



EXERCISE - Design Analysis

Sensitivity, Feasibility, Optimization, Analysis Features and Relations

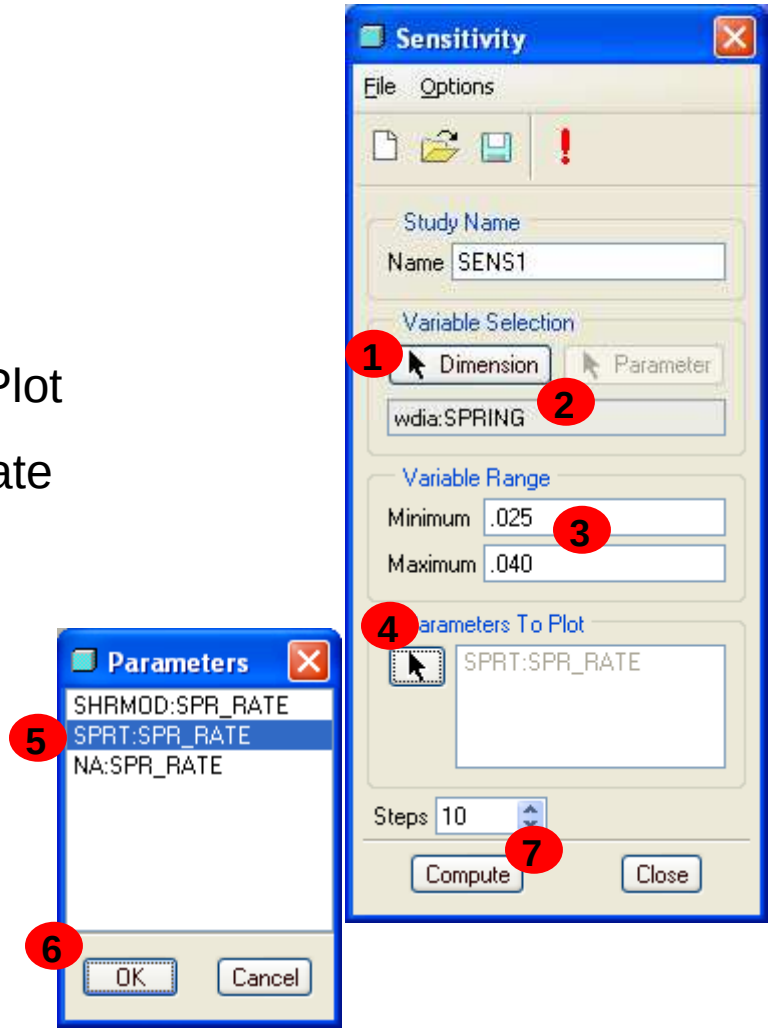
- ***Perform a Sensitivity Analysis***
  - Evaluate the effect of wire diameter on stiffness
  - Analysis > Sensitivity Analysis



EXERCISE - Design Analysis

Sensitivity, Feasibility, Optimization, Analysis Features and Relations

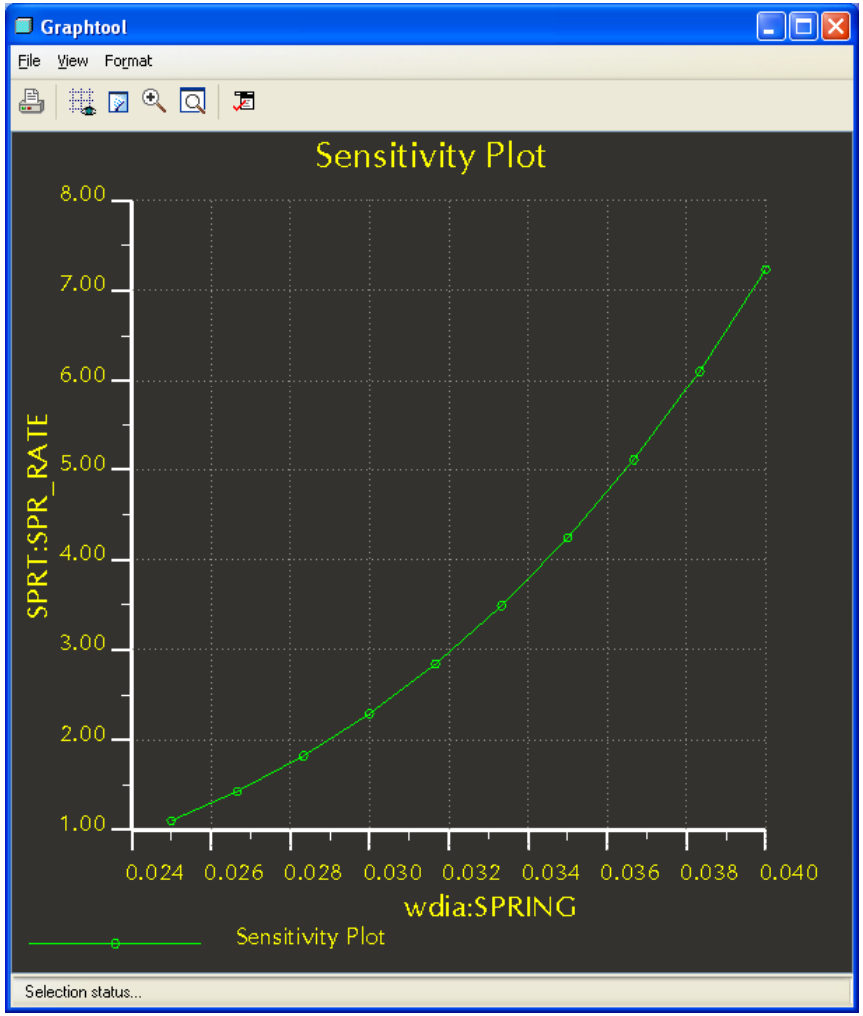
1. Click Dimension
2. Select the wire diameter of the spring
3. Specify range as .025 to .040
4. Click the select button in Parameters to Plot
5. Select SPRT:SPR_RATE for the spring rate
6. Click OK
7. Click Compute



EXERCISE - Design Analysis

Sensitivity, Feasibility, Optimization, Analysis Features and Relations

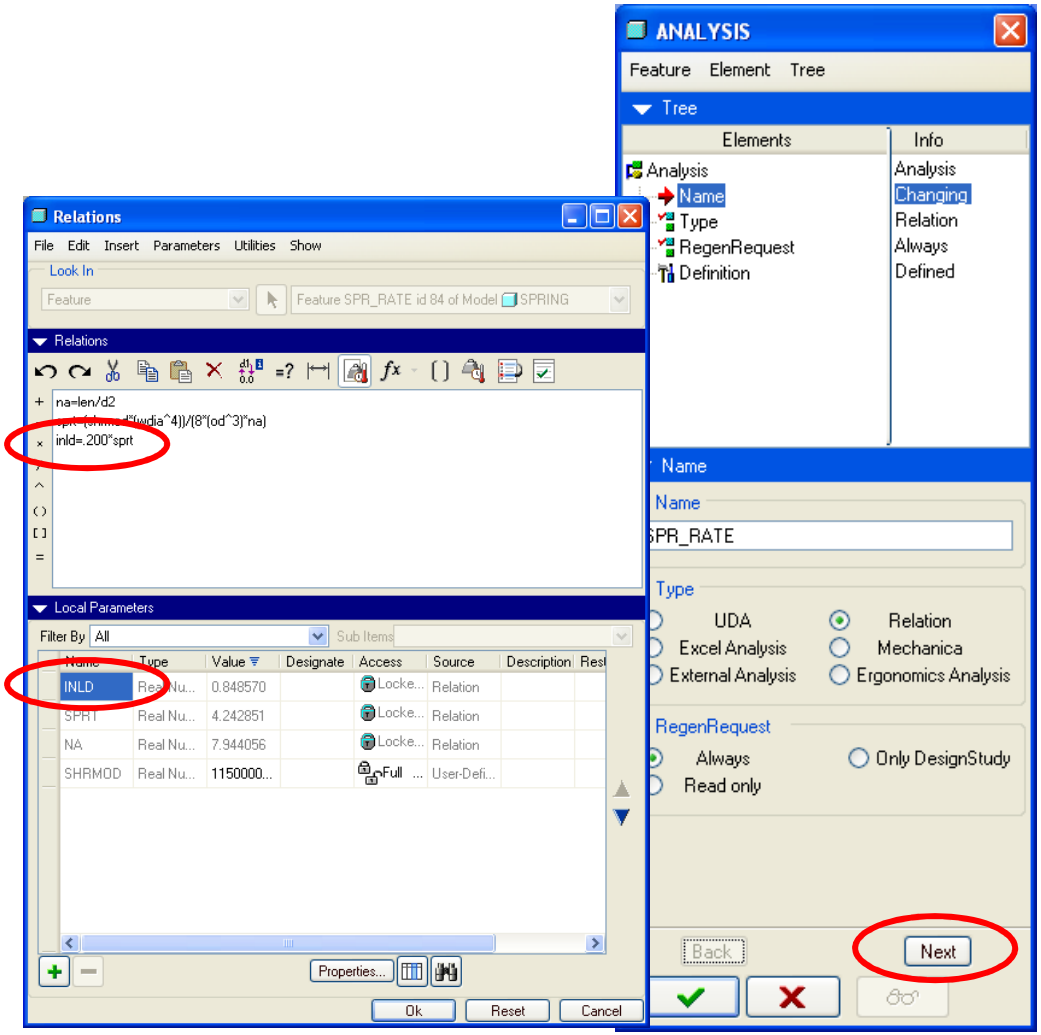
- Take a look at the plotted results
- Sensitivity Analysis illustrates the influence a particular variable has on design objective



EXERCISE - Design Analysis

Sensitivity, Feasibility, Optimization, Analysis Features and Relations

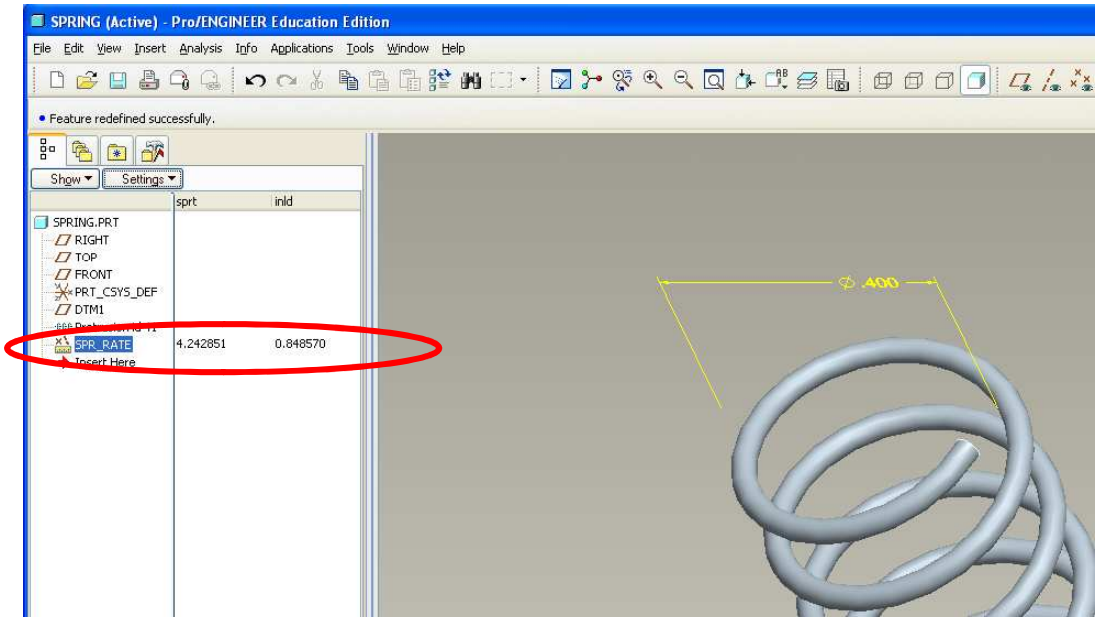
- Modify the Analysis Feature
  - RMB on Analysis feature in model tree
  - Edit Definition
  - Next in the ANALYSIS dialog
- Write an expression to determine the load at a deflection of .200in
  - Call the variable *inld*
  - $P_i = k\delta$



EXERCISE - Design Analysis

Sensitivity, Feasibility, Optimization, Analysis Features and Relations

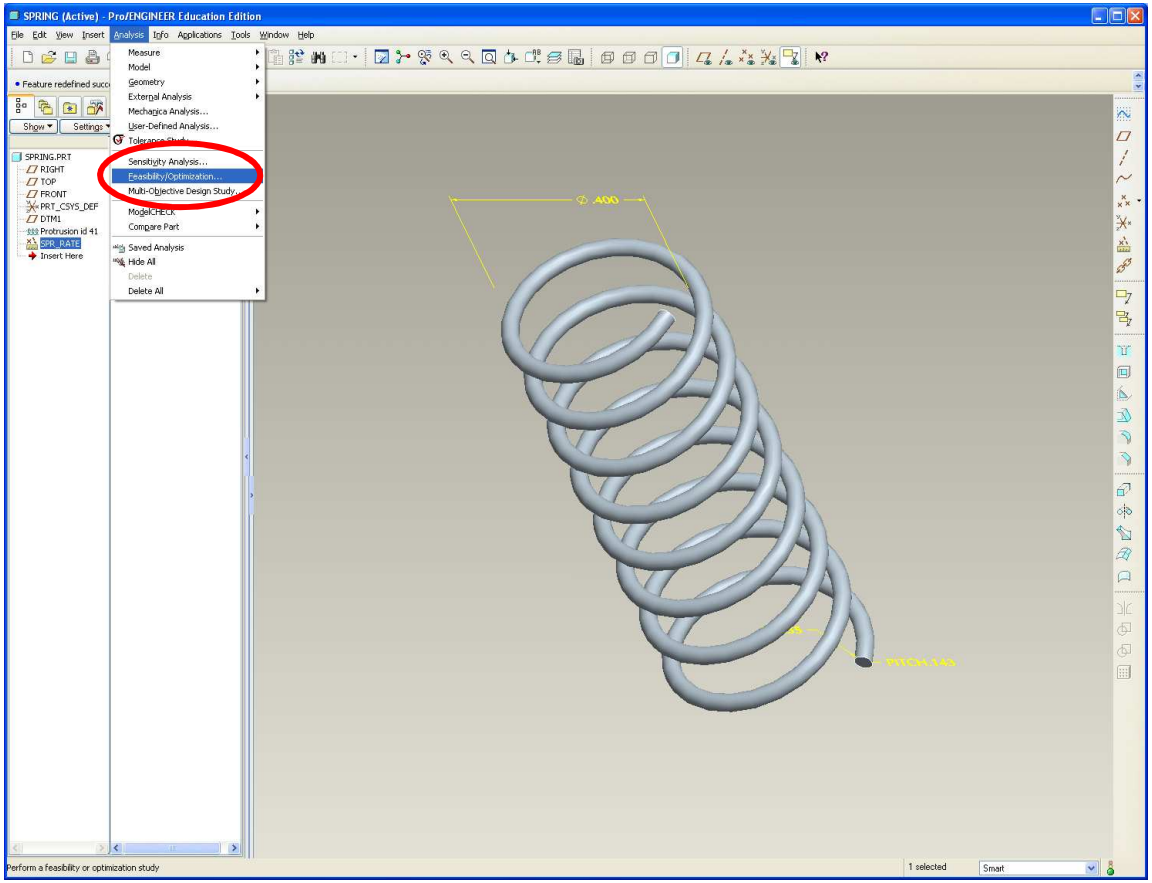
- Add this result to the model tree as was done prior



EXERCISE - Design Analysis

Sensitivity, Feasibility, Optimization, Analysis Features and Relations

- ***Perform a Feasibility Analysis***
  - Have Pro/E find the correct wire diameter to have a 1lbf installed load (at .200in deflection)
  - Analysis > Feasibility/Optimization…

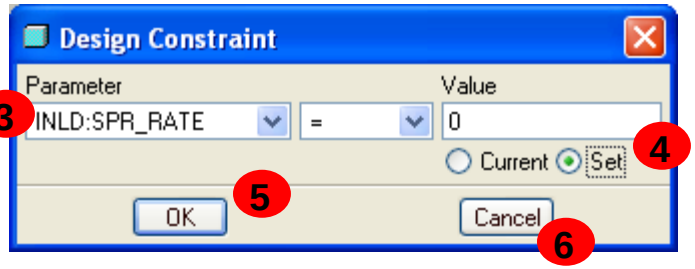


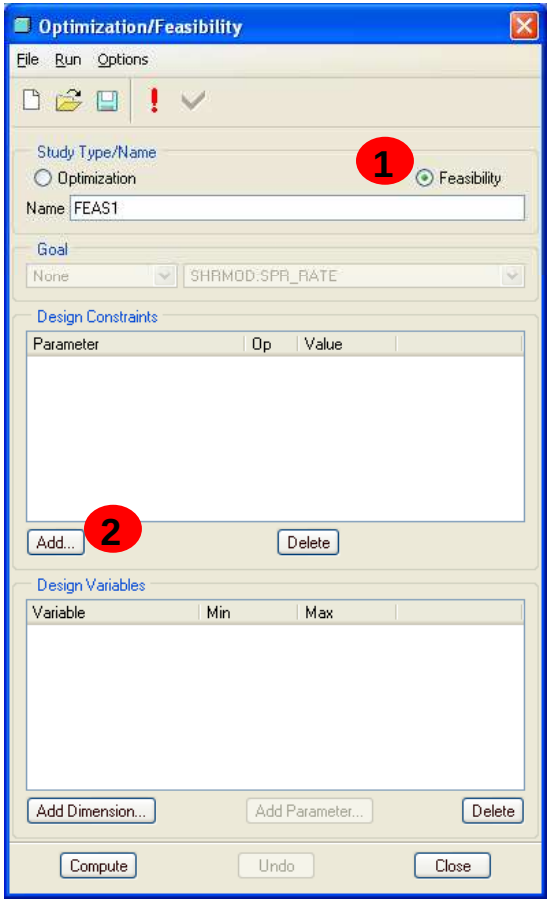
EXERCISE - Design Analysis

Sensitivity, Feasibility, Optimization, Analysis Features and Relations

1. Click Feasibility
2. Click Add… in Design Constraints
3. In Design Constraint dialog change

   Parameter to INLD:SPR_RATE
4. Check Set radio button
5. Click OK
6. Click Cancel

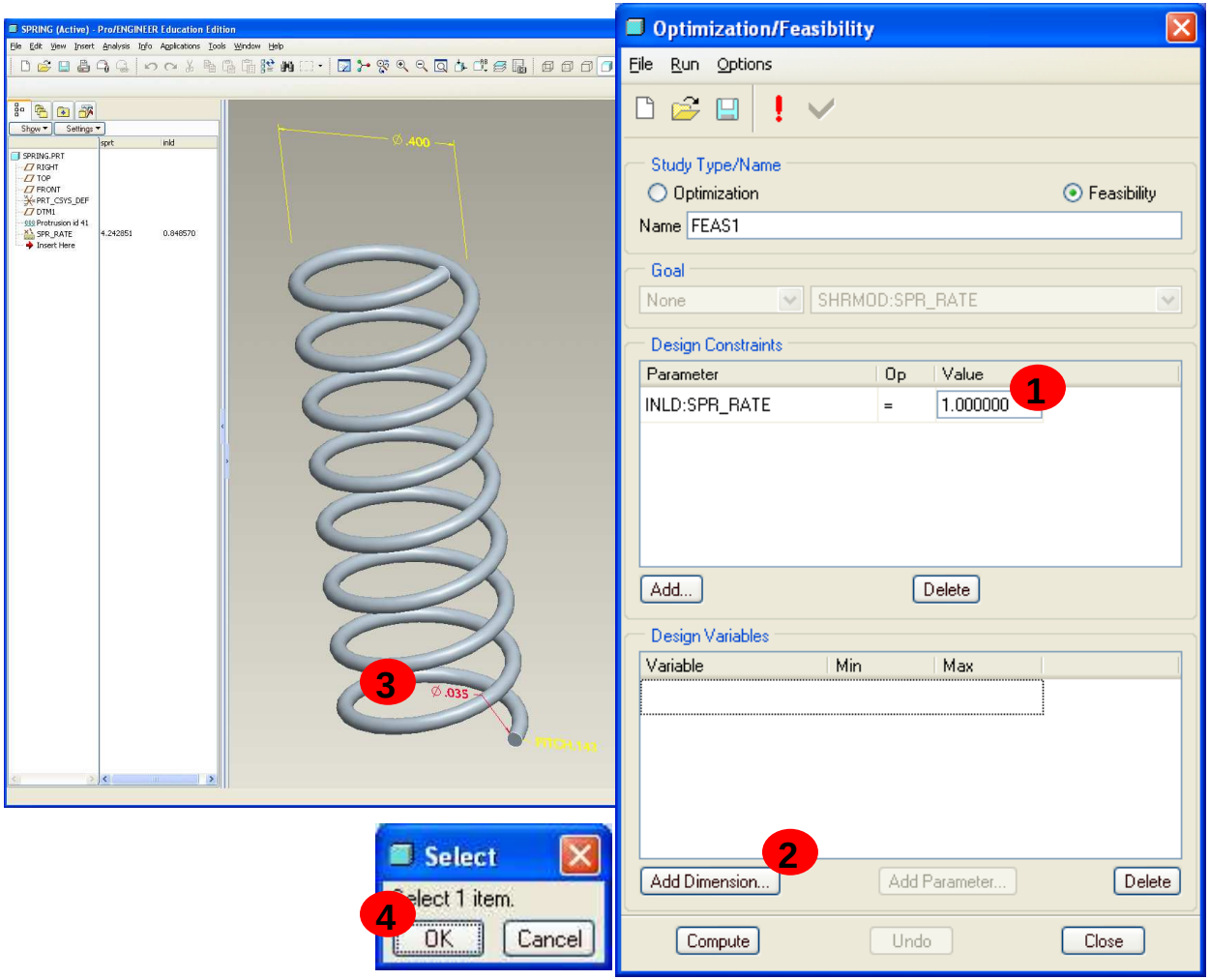




EXERCISE - Design Analysis

Sensitivity, Feasibility, Optimization, Analysis Features and Relations

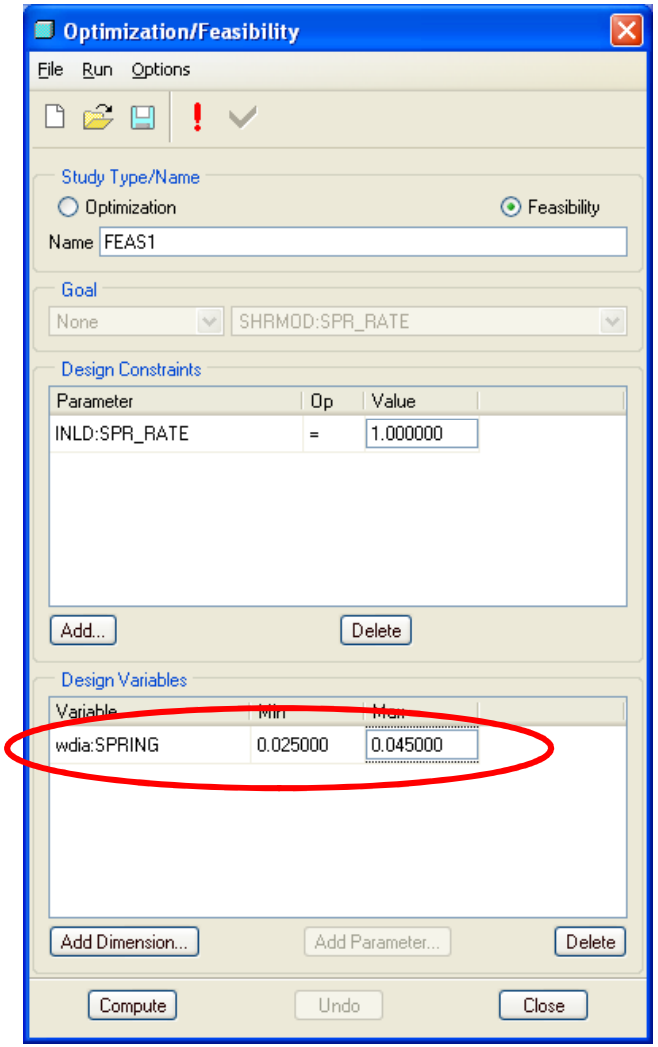
1. Change Value to 1.0
2. Click Add Dimension…
   in Design Variables
3. Select the wire
   diameter dimension
4. Graphics Window
   Click OK



EXERCISE - Design Analysis

Sensitivity, Feasibility, Optimization, Analysis Features and Relations

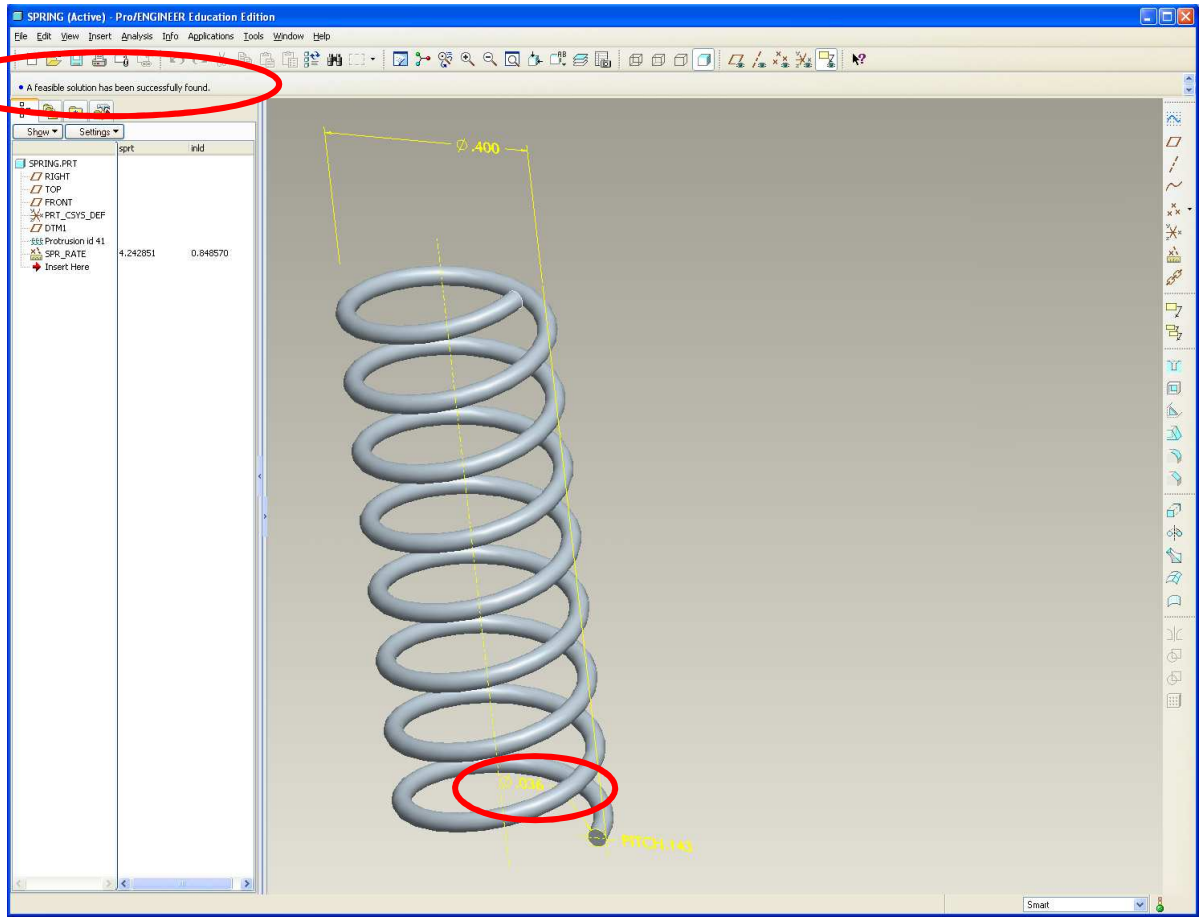
- Change the range to .025in minimum and .045in maximum
- Click Compute



EXERCISE - Design Analysis

Sensitivity, Feasibility, Optimization, Analysis Features and Relations

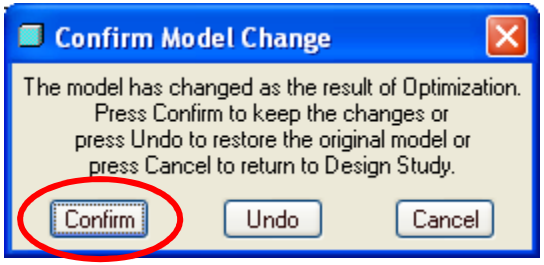
- Note message stating a feasible solution has been found
- Notice that the wire diameter value has changed to .036in

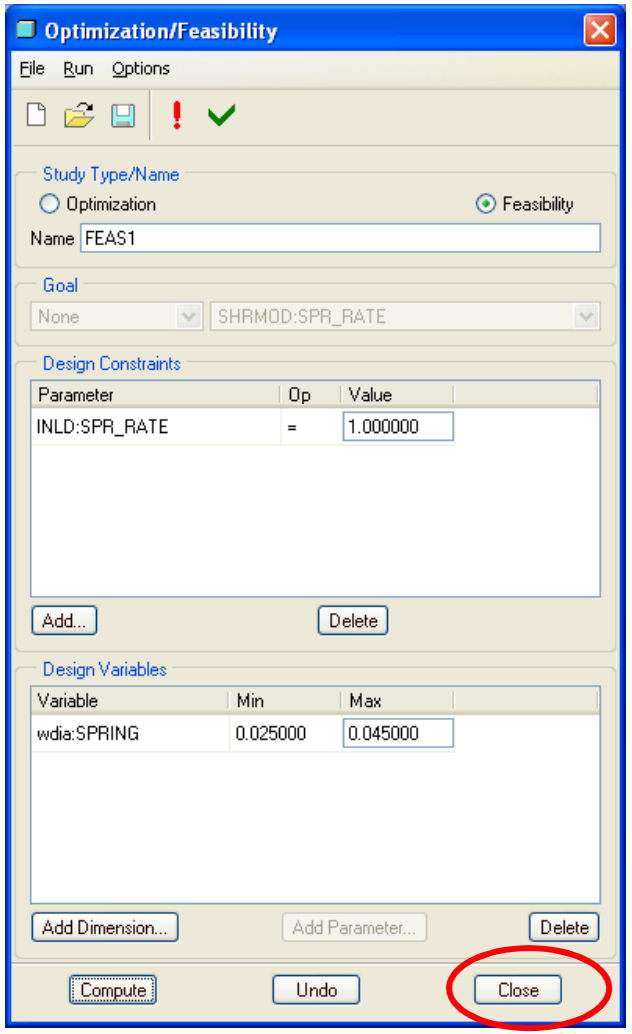


EXERCISE - Design Analysis

Sensitivity, Feasibility, Optimization, Analysis Features and Relations

- Click Close on the dialog box
- A message stating the model has changed pops up
    - Confirm to accept the changes





EXERCISE - Design Analysis

Sensitivity, Feasibility, Optimization, Analysis Features and Relations

• Regenerate the window and notice that the installed load in the model tree is now .997lbf