



COMPUTERS & STRUCTURES INC.

SAFE™

DESIGN OF SLABS, BEAMS AND FOUNDATIONS
REINFORCED AND POST-TENSIONED CONCRETE

Tutorial

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Introduction

The two examples in this tutorial provide step-by-step illustrations of how SAFE can be used to create, analyze, design and detail concrete slab systems. The first example is for a mild-reinforced concrete slab (R/C), and the second example deals with a post-tensioned structure (P/T). Although the general procedure is similar for both examples, the structures and specific details differ.

Reinforced Concrete

R/C Example

The intent of this tutorial is to give you hands-on experience via step-by-step instructions on how to use SAFE to model, analyze, design and detail mild reinforced concrete slabs. Fundamentals of the model creation process are identified and various model construction techniques are introduced. As you complete the tutorial, you will build the model shown in Figure 1.

The Project

The tutorial project is an irregularly shaped suspended concrete slab, with overall dimensions of 113 feet by 120 feet. A large opening exists in the interior for stair access. The 10-inch thick slab is supported by 12-inch-thick walls, 16-inch-thick drop panels on columns, and 18-inch by 24-inch beams on two perimeter sides. Columns are 18 inches square, drop panels are typically 6 feet square, and the story height below the slab is 12 feet. The model will be analyzed for a uniform dead load of 30 pounds per square foot (psf) plus the self weight of the structure and a live load of 50 psf.

Concrete Materials:

- A. Concrete strength, $f'_c = 4000$ psi
- B. Unit weight of concrete = 150 pcf

Mild-steel reinforcing:

- C. $f_y = 60$ ksi

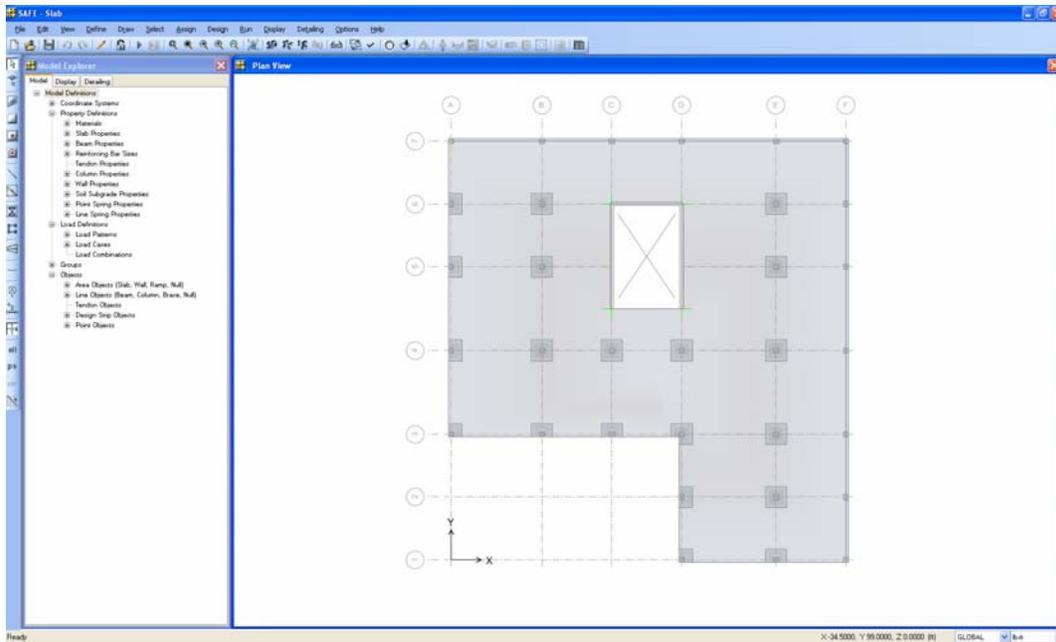


Figure 1 The Project Model

Navigating Through SAFE

The SAFE program provides the user with two principal ways to navigate through program commands: menu commands or toolbar buttons. All commands are available through the main menu bar (e.g., **Draw menu > Draw Columns**), and a majority of the menu commands are also available as buttons on toolbars (e.g., **Draw Columns**, ). The availability of a button on the toolbar is indicated in the menus by the existence of an icon to the left of the command, as shown in Figure 2.

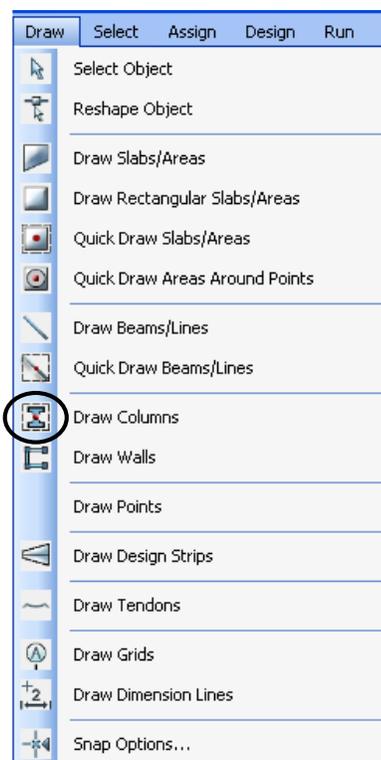


Figure 2 Draw Menu

In this tutorial, the reference to various commands will be given using the narrative description, i.e., **Draw menu > Draw Column** command, in lieu of the associated button.

Step 1 Begin a New Model

In this Step, the dimensions and basic grid will be defined, which will serve as a guide for developing the model. This model will be built without using the automated template tools provided in SAFE to demonstrate how to construct a model from scratch. However, as a general rule, we highly recommend using templates to start models whenever possible because they provide a quick, easy way of generating a model. Consult the SAFE Help topics for information about templates.

Set the Units

If the units shown in the drop-down list in the lower right-hand corner of the SAFE window are not lb-ft, scroll through the drop-down list to set the units to *lb-ft*.

Define the Grid

- A. Click the **File menu > New Model** command to access the New Model Initialization form shown in Figure 3. This form is used to specify the starting point of the model creation: a Blank screen, a screen with a Grid Only, or one of eight templates. Default units also may be selected here, along with the design code and preferences.

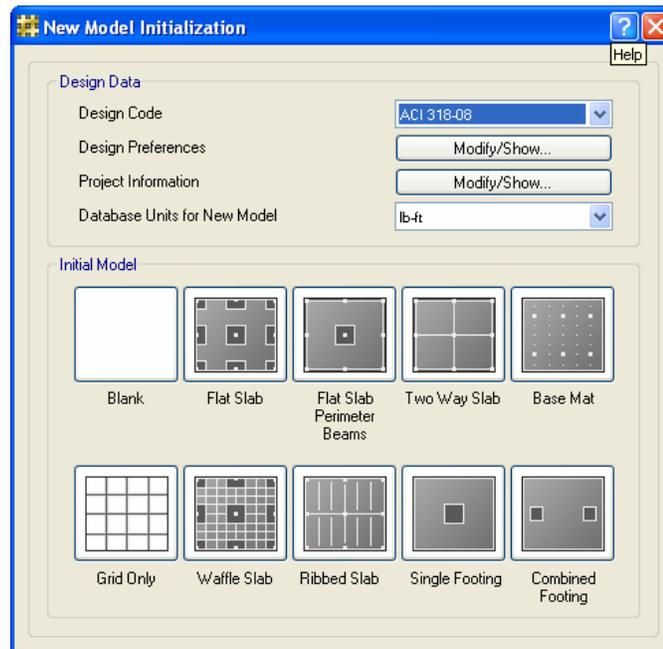


Figure 3 New Model Initialization form

- B. In the Design Data area, select *ACI 318-08* from the Design Code drop-down list.
- C. In the Initial Model area, click the **Grid Only** button to display the Coordinate System Definition form shown in Figure 4. This form is used to specify the number of grids and spacing in each direction. It is important that the grid be defined such as to accurately represent

4 Step 1 Begin a New Model

the geometry of the structure; so it is advisable to spend time carefully planning the number and spacing of the grid lines.

- D. Select the *Cartesian* option.
- E. As shown in Figure 4, set the Number of Grid Lines in the X Direction to **6** and in the Y Direction to **7**. Set the Spacing in the X Direction to **20** feet and in the Y Direction to **18** feet.

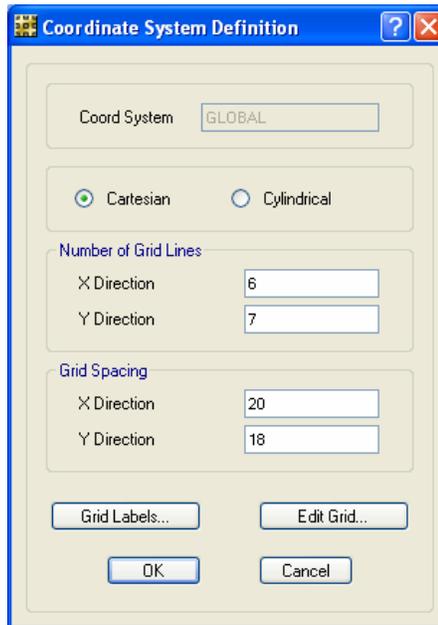


Figure 4 Coordinate System Definition form

- F. Click the **Edit Grid** button to display the form shown in Figure 5. The Coordinate System form is used to modify and edit the grid definitions, as well as set the top of model datum. It also allows the user to set the display options associated with the grids.
 - 1. In the *Display Grid Data as* area, select the *Spacing* option.
 - 2. In the **X Grid Data** table, change the X spacing as follows:

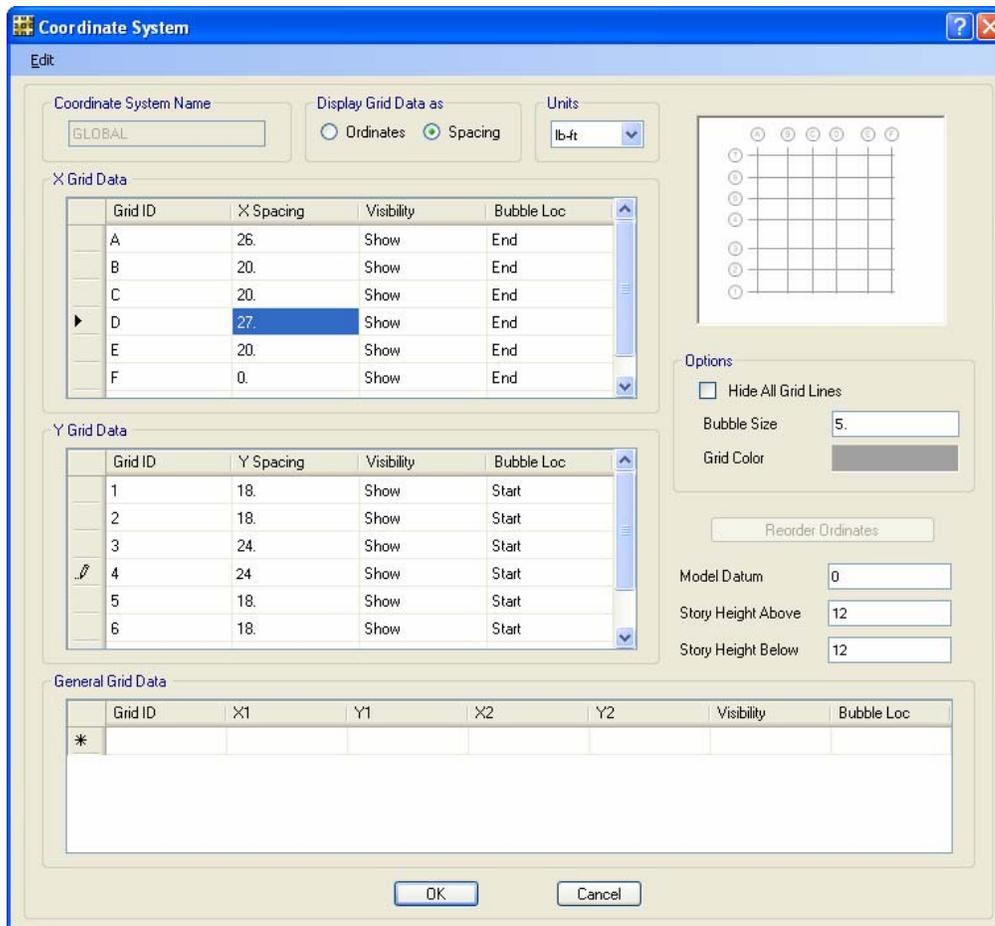


Figure 5 Coordinate System form

Grid ID	Change X Spacing to
A	26
D	27

3. In the **Y Grid Data** table, change the Y spacing as follows:

Grid ID	Change Y Spacing to
3	24
4	24

4. Click the **OK** button to accept your changes.

6 Step 1 Begin a New Model

Step 1 Begin a New Model

Upon closing the Coordinate System form, by default, the grid system displays in the main SAFE window, with two windows tiled vertically: a Model Explorer window on the left and a Plan View on the right. The number of view windows can be changed using the **Options menu > Windows** command.

- G. Click the **View menu > Set Display Options** command to display the Set Display Options form. Uncheck the *Horizon* option and click the **OK** button to exit that form. The *Horizon* option displays a plane that resembles an engineering calculation grid to illustrate the datum plane location; we are turning this option off to display our coordinate system grid better.

You should now have a display similar to that shown in Figure 6.

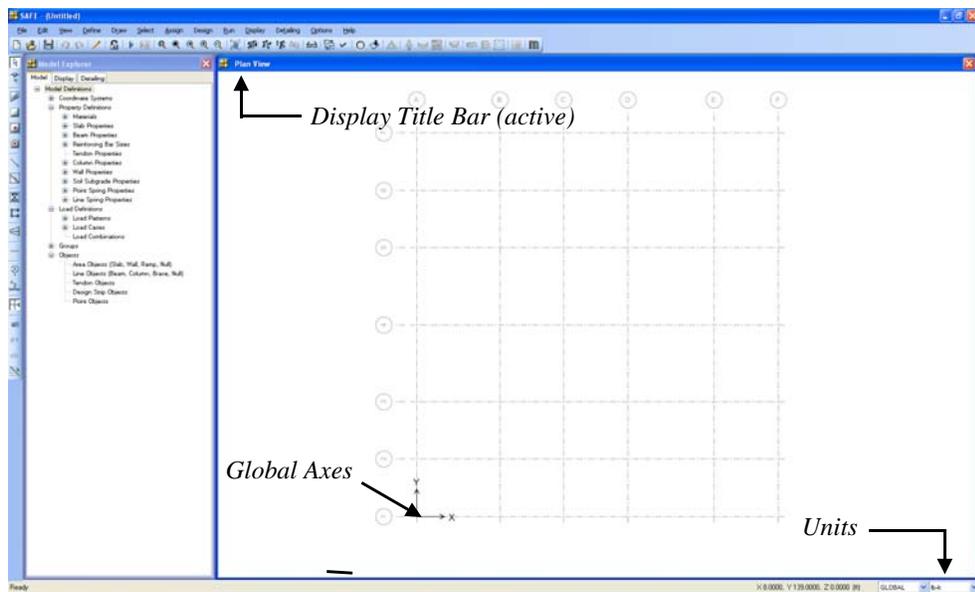


Figure 6 SAFE Main Window

Note that the Plan View window is active. When a window is active, the display title bar is highlighted. Set a window active by clicking anywhere in the window.

Note that the Global Axes are displayed and that the Z positive is in the “up” direction. When SAFE refers to the direction of gravity, this is in the negative Z direction, or “down.”

Save the Model

Save your model often! Click the **File menu > Save** command. Specify the directory in which to save the model. For this tutorial, specify the file name as *Slab*.

Typically a model would be saved with the same name. However to record work at various stages of development or as a backup, the **File menu > Save As** command can be used to save the file using another name.

Step 2 Define Properties

In this Step, material and section properties for the slab (area object) and beams (line objects), columns, and walls are defined. Note that previously defined materials and properties may be reviewed and modified using the Model Explorer window (see Figure 7). To do this, expand any of the property items on the tree by clicking the + node, and then double click on the desired item to display the associated form.

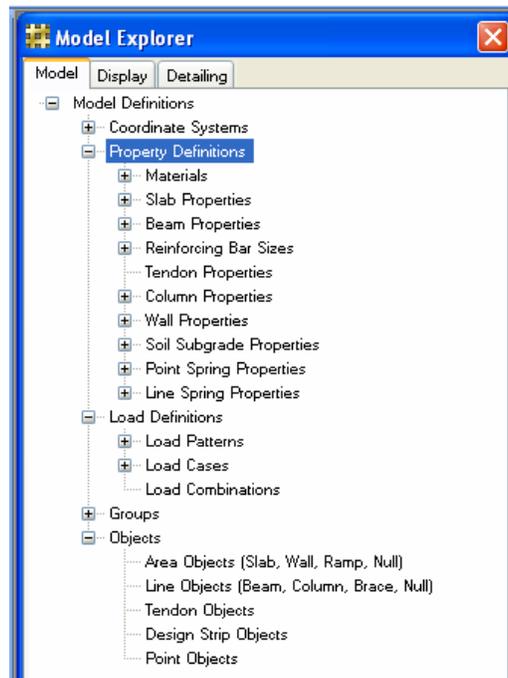


Figure 7 Model Explorer window

Define Material Properties

- A. Click the **Define menu > Materials** command to access the Materials form shown in Figure 8.

Step 2 Define Properties

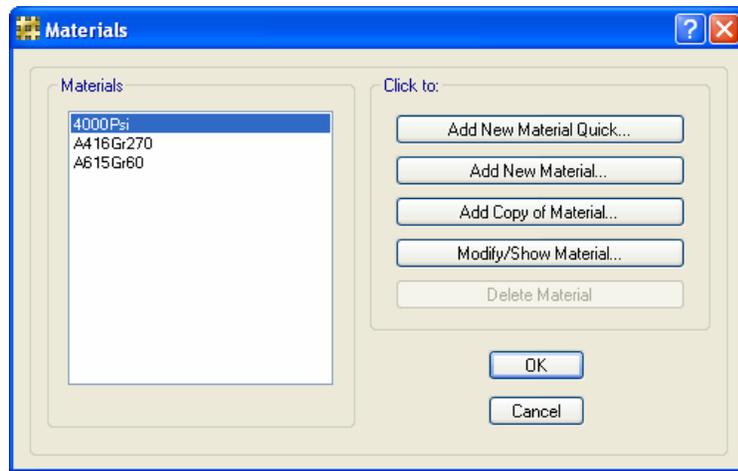


Figure 8 Materials form

- B. Highlight *4000Psi* in the Materials area, and click the **Modify/Show Material** button to display the Material Property Data form shown in Figure 9. That form lists the properties associated with 4000psi concrete; this is the concrete property that will be used in our model.

The screenshot shows a dialog box titled "Material Property Data". It is divided into several sections. The "General Data" section includes fields for "Material Name" (4000Psi), "Material Type" (Concrete), "Material Display Color" (with a "Change..." button), "Material Notes" (with a "Modify/Show Notes..." button), and "Units" (lb-ft). The "Material Weight" section has a "Weight per Unit Volume" field (150). The "Isotropic Property Data" section includes "Modulus of Elasticity, E" (5.191E+08), "Poisson's Ratio, U" (0.2), "Coefficient of Thermal Expansion, A" (5.500E-06), and "Shear Modulus, G" (2.163E+08). The "Other Properties for Concrete Materials" section includes "Specified Concrete Compressive Strength, f'c" (576000), a checkbox for "Lightweight Concrete", and a "Shear Strength Reduction Factor" field. "OK" and "Cancel" buttons are at the bottom.

Figure 9 Material Property Data form

- C. Click the **OK** button to accept this material as defined.
- D. In the Materials area, highlight *A615Gr60*.
- E. Click the **Modify/Show Material** button to display the Material Property Data form shown in Figure 10. This form lists the properties associated with Grade 60 reinforcing; this is the rebar property that will be used in our model.
- F. Click the **OK** button to accept this material as defined.
- G. Click the **OK** button on the Materials form to accept all of the defined materials.
- H. Click the **File menu > Save** command to save your model.

The image shows a software dialog box titled "Material Property Data". It is divided into several sections with input fields and buttons. The "General Data" section includes fields for Material Name (A615Gr60), Material Type (Rebar), Material Display Color (a green square), Material Notes (with a "Modify/Show Notes..." button), and Units (lb-ft). The "Material Weight" section has a field for Weight per Unit Volume (490). The "Uniaxial Property Data" section has a field for Modulus of Elasticity, E (4.176E+09). The "Other Properties for Rebar Materials" section has fields for Minimum Yield Stress, Fy (8640000) and Minimum Tensile Stress, Fu (12960000). At the bottom are "OK" and "Cancel" buttons.

Figure 10 Material Property Data form

Define Slab and Drop Properties

- A. Click the **Define menu > Slab Properties** command to access the Slab Properties form shown in Figure 11.

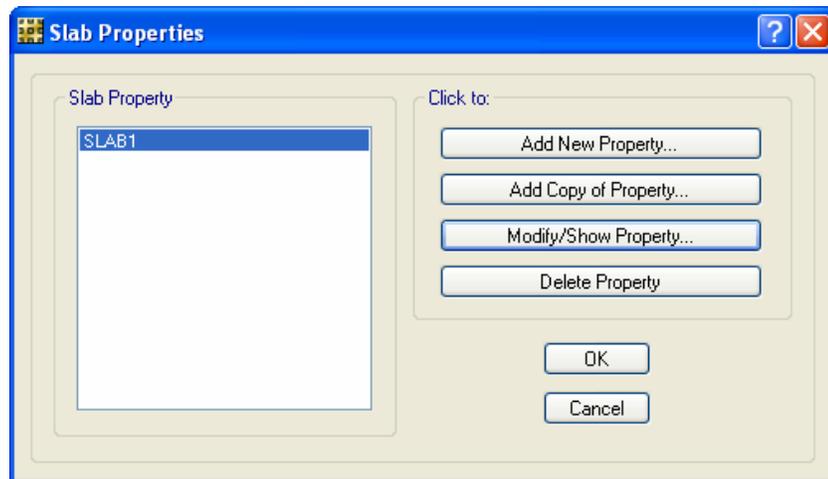


Figure 11 Slab Properties form

- B. In the Slab Property area, highlight *SLAB1*.
- C. Recall that for this tutorial project, the slab thickness is 10 inches. To adjust the default dimensions of *SLAB1*, click the **Modify/Show Property** button to access the Slab Property Data form shown in Figure 12.
 1. Select *Slab* from the Type drop-down list in the Analysis Property Data area; this ensures that any area object with this property assignment will be identified as a slab member.
 2. Type **10in** in the Thickness edit box in the Analysis Property Data area.

Note: When the units are explicitly stated, in this case inches (in), the program automatically converts the number input to be consistent with the database units (recall that the units have been set to lb-ft). The value also may have been input as 10/12, without the inch identifier.
 3. Click the **OK** button to accept the changes and return to the Slab Properties form.

The image shows a software dialog box titled "Slab Property Data". It contains two main sections: "General Data" and "Analysis Property Data".

- General Data:**
 - Property Name: SLAB1
 - Slab Material: 4000Psi
 - Display Color: A pink color swatch with a "Change..." button.
 - Property Notes: A "Modify/Show..." button.
 - Units: lb-ft
- Analysis Property Data:**
 - Type: Slab
 - Thickness: 10in

At the bottom of the dialog, there are two checkboxes: "No Design" and "Orthotropic", both of which are currently unchecked. "OK" and "Cancel" buttons are located at the bottom center.

Figure 12 Slab Property Data form

D. Recall that the project has 16-inch-thick drop panels on columns. To specify a property for the drop panel, click the **Add New Property** button on the Slab Properties form and complete the following.

1. Type **DROP** in the Property Name edit box on the Slab Property Data form.
2. Select *Drop* from the Type drop-down list in the Analysis Property Data area.

Note: When multiple area objects occupy the same location in plan, SAFE determines which property value to use in the stiffness formula based on the following hierarchy: the Drop type has priority over a Slab type.

3. Type **16in** in the Thickness edit box.
4. Click the **OK** button to accept the changes and return to the Slab Properties form.

- E. Click the **OK** button to end the slab property definitions. Click the **File menu > Save** command to save the model.

Define Beam Properties

- A. Click the **Define menu > Beam Properties** command to access the Beam Properties form shown in Figure 13.

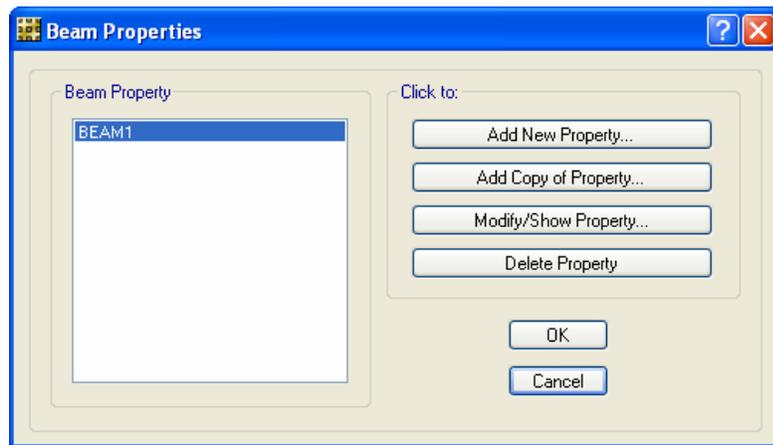


Figure 13 Beam Properties form

- B. In the Beam Property area, highlight *BEAM1*.
- C. Click the **Modify/Show Property** button to access the Beam Property Data form shown in Figure 14. Recall that the beams for the project are 18 inches by 24 inches (or 1.5 by 2 feet in the currently specified lb-ft units).
 1. In the Analysis Property Data area, select *L Beam* from the Beam Shape Type drop-down list.
 2. In the Analysis Property Data area, type **1.5** into the Web Width at Top edit box, type **1.5** into the Web Width at Bottom edit box, type **2** into the Depth edit box, type **5** into the Flange Width edit box, and **10/12** into the Slab Depth edit box.

Figure 14 Beam Property Data form

3. In the Design Property Data area, type **1.5** into the Web Width at Top edit box, type **1.5** into the Web Width at Bottom edit box, type **2** into the Depth edit box, select the *Auto* option, and type **10in** into the Slab Depth edit box.
 4. Click the **OK** button to end the beam property definition.
- D. Click the **OK** button to leave the Beam Properties form. Click the **File menu** > **Save** command to save your model.

Define Column Properties

- A. Click the **Define menu** > **Column Properties** command to access the Column Properties form.
- B. In the Column Property area, highlight *COL1*.
- C. Click the **Modify/Show Property** button to access the Column Property Data form shown in Figure 15. Recall that the columns for the project are 18 inches square and that the drop panels are 6 feet square.

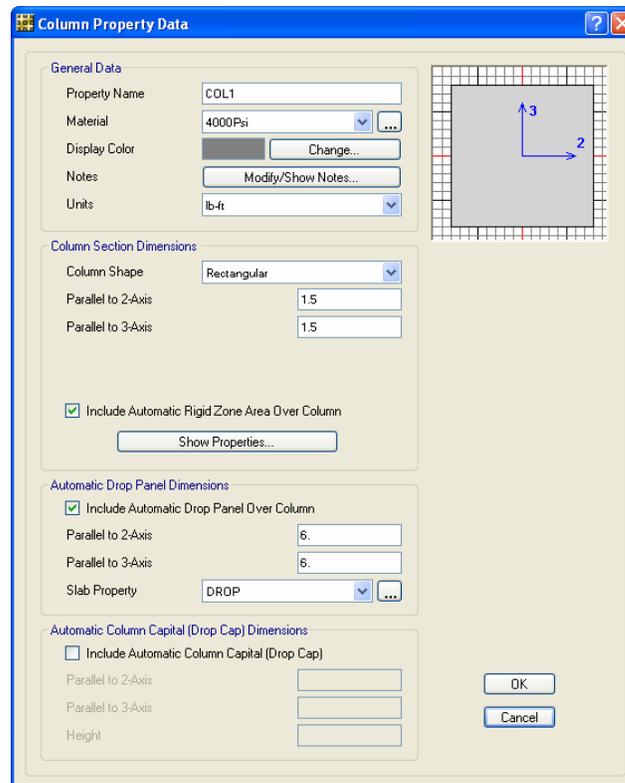


Figure 15 Column Property Data form

1. In the Column Section Dimensions area, select *Rectangular* from the Column Shape drop-down list.
2. In the Column Section Dimensions area, type **1.5** (or **18in**) into the Parallel to 2-Axis edit box and type **1.5** (or **18in**) into the Parallel to 3-Axis edit box.
3. Make sure that the *Include Automatic Rigid Zone Area Over Column* option is checked. This option restricts deformation of the slab at the column location, which prevents unrealistic peaks in moment distribution from occurring.
4. In the Automatic Drop Panel Dimensions area, check the *Include Automatic Drop Panel Over Column* option. This option automatically adds a drop panel when a column with this property is drawn.

5. In the Automatic Drop Panel Dimensions area, type **6** into the Parallel to 2-Axis edit box and type **6** into the Parallel to 3-Axis edit box.
 6. In the Automatic Drop Panel Dimensions area, select *DROP* from the Slab Property drop-down list.
 7. Click the **OK** button to leave the Column Property Data form.
- D. Click the **Add New Property** button to access the Column Property Data form.
1. In the General Data area, type **COL-PER** in the Property Name edit box.
 2. In the Column Section Dimensions area, select *Rectangular* from the Column Shape drop-down list.
 3. In the Column Section Dimensions area, type **1.5** into the Parallel to 2-Axis edit box and type **1.5** into the Parallel to 3-Axis edit box.
 4. Make sure that the *Include Automatic Rigid Zone Area Over Column* option is checked.
 5. In the Automatic Drop Panel Dimensions area, make sure that the *Include Automatic Drop Panel Over Column* option is un-checked.
 6. Click the **OK** button to leave the Column Property Data form.
- E. Click the **OK** button to accept the Column Property definitions.

Define Wall Properties

- A. Click the **Define menu > Wall Properties** command to access the Wall Properties form.
- B. In the Wall Property area, highlight *Wall1*.

- C. Click the **Modify/Show Property** button to access the Wall Property Data form shown in Figure 16. Recall that the walls for the project are 12 inches thick.

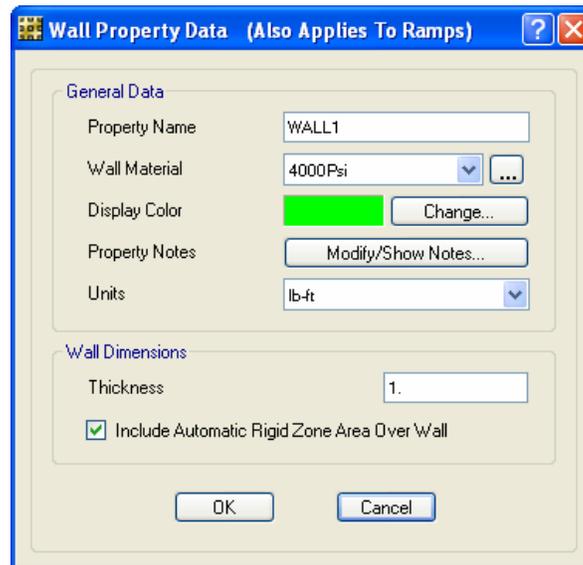


Figure 16 Wall Property Data form

1. In the Wall Dimensions area, type **1** into the Thickness edit box.
2. Make sure that the *Include Automatic Rigid Zone Area Over Wall* option is checked. This option restricts deformation of the slab at the wall location, which prevents unrealistic peaks in moment distribution from occurring.
3. Click the **OK** button to leave the Wall Property Data form.

- D. Click the **OK** button to accept the Wall Property definition.

This completes the material and section property definition phase of the model creation. The slab and beam properties will be assigned in the model datum plane, while the columns and walls will be assigned as supports. Supports also can be assigned as point restraints, point springs or line springs. Support stiffnesses are calculated by SAFE based on the cross-sectional properties, material properties, and lengths specified when the columns and walls are drawn.

Step 3 Define Static Load Patterns

In this Step, the dead and live static load patterns are defined. That is, we will name the various types of loads and specify the self-weight multipliers. The loads will be assigned to objects, and the values for the loads specified (uniform dead load of 30 psf and live load of 50 psf), in Step 8.

- A. Click the **Define menu > Load Patterns** command to access the Static Load Case Names form shown in Figure 17.

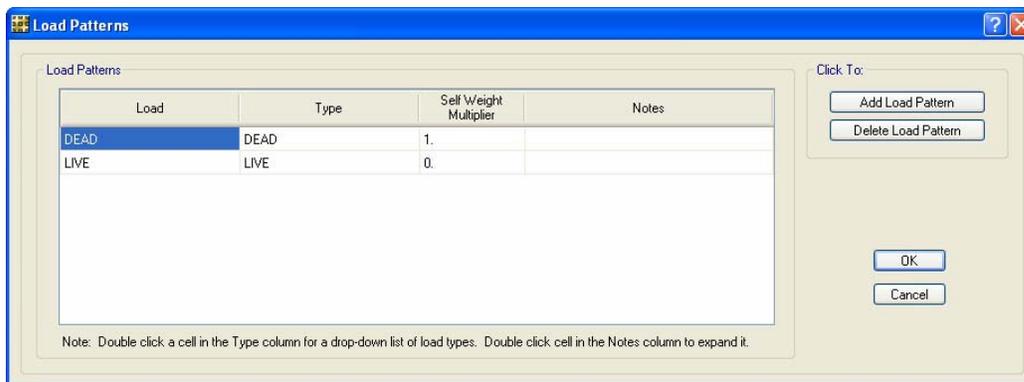


Figure 17 Load Patterns form

- B. Note that load patterns *DEAD* and *LIVE* are defined by default.
- C. Recall that the project will be analyzed for the dead load plus the self weight of the structure. Thus, the Self Weight Multiplier should be set equal to **1** (this will include 1.0 times the self weight of all members) for the *DEAD* load. Only the *DEAD* load pattern should have a non-zero Self Weight Multiplier.
- D. Click the **OK** button to accept the defined static load patterns.
- E. Click the **File menu > Save** command.

Step 4 Define Load Cases

In this Step, the Load Cases are defined. This is where the type of analysis is specified.

- A. Click the **Define menu > Load Cases** command to access the Load Cases form shown in Figure 18.

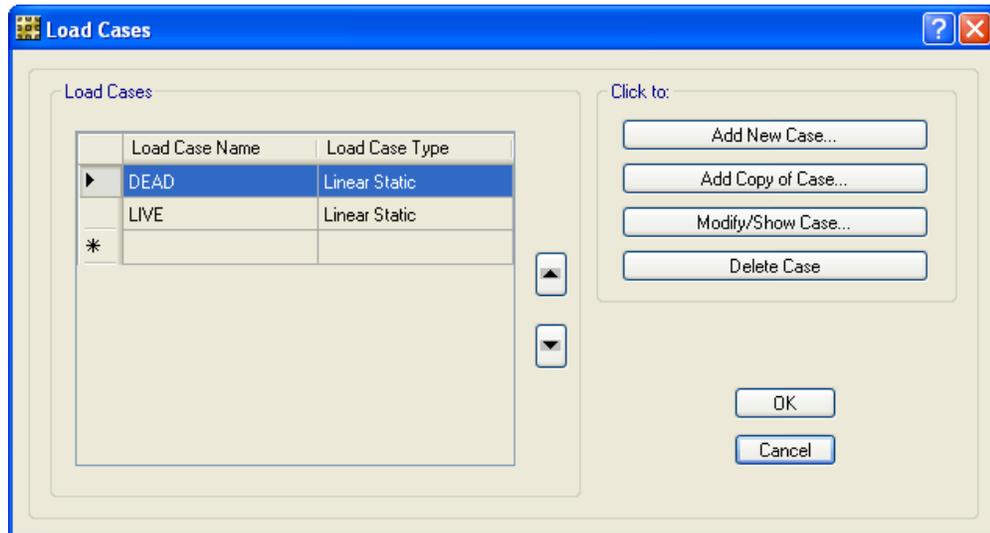


Figure 18 Load Cases form

- B. With the *DEAD* Load Case Name highlighted, click the **Modify/Show Case** button to display the Load Case Data form shown in Figure 19. This data form changes based on the type of load case specified.
1. In the Load Case Type area, select *Static* from the drop-down list. Modal and Hyperstatic also are available as load case types.
 2. In the Analysis Type area, select the *Linear* option. When working with a Static Load Case Type, the program offers the option to do Linear, Nonlinear (Allow Uplift), Nonlinear (Cracked), or Nonlinear (Long Term Cracked) analysis. For our tutorial example, a Static, Linear analysis will be performed for *DEAD* and *LIVE*.
 3. In the Loads Applied area, verify that the load pattern is *DEAD* with a scale factor of *1*.
 4. Click the **OK** button to close the Load Case Data form.

Load Case Data - Linear Static

Load Case Name: DEAD

Load Case Data Notes: Modify/Show Notes...

Load Case Type: Static

Design...

Stiffness to Use:

- Zero Initial Conditions - Unstressed State
- Stiffness at End of Nonlinear Case

Important Note: Loads from the Nonlinear Case are NOT included in the current case

Analysis Type:

- Linear
- Nonlinear (Allow Uplift)
- Nonlinear (Cracked)
- Nonlinear (Long Term Cracked)

Creep Coefficient: []

Shrinkage Strain: []

Loads Applied:

Load Name	Scale Factor
DEAD	1.
*	

OK Cancel

Figure 19 Load Cases Data form

- C. Review the LIVE load case, if so desired, by selecting it and using the **Modify/Show Case** button as described for the DEAD load case.
- D. Click the **OK** button to close the Load Cases form.
- E. Click the **File menu > Save** command.

Step 5 Draw Objects

In this Step, slabs, columns with drops, beams, walls, and openings will be drawn.

Draw Slabs

Ensure that the Plan View is active (click anywhere in the display window; a window is active when the Display Title Bar, just below the hori-

zontal toolbar, is highlighted). Now draw area objects to model the slab using the following Action Items.

- A. Click the **Draw menu > Snap Options** command to display the Snap Options form shown in Figure 20.

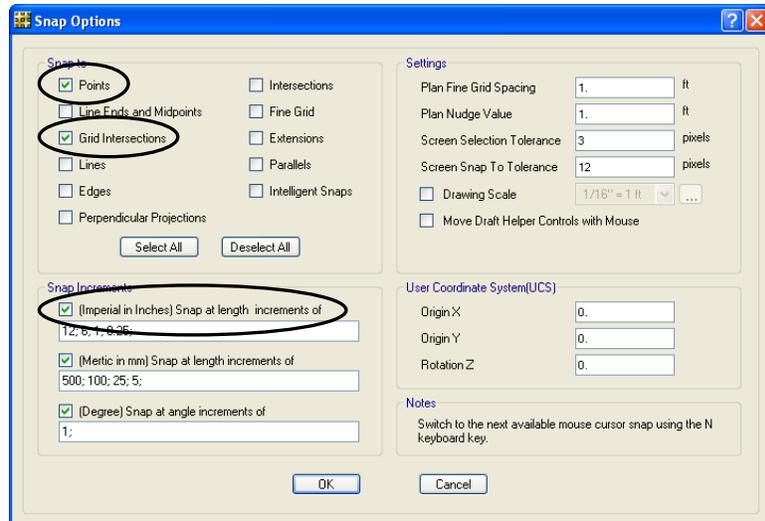


Figure 20 Snap Options form

- B. In the *Snap to* area, make sure that the *Points* and *Grid Intersections* options are checked. These snap options will assist in accurately positioning objects when drawing.
- C. In the *Snap Increments* area, make sure that the *(Imperial in Inches) Snap at length increments of* option is checked. When drawing slab edges, beams and walls, a dimension line will appear and the object will snap to the values specified in this edit box.
- D. Click the **OK** button to close the Snap Options form.
- E. Click the **Draw menu > Draw Slabs/Areas** command to access the Draw Slabs/Areas form shown in Figure 21. If the Draw Slabs/Areas form covers part of the model, click on the blue title bar, hold down the mouse button, and drag it out of the way.

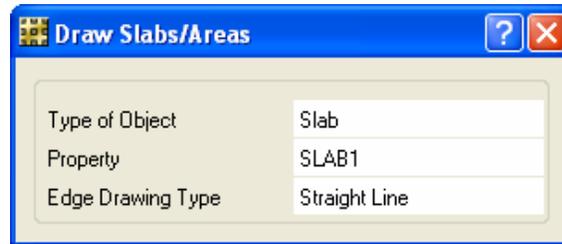


Figure 21 Draw Slabs/Areas form

- F. Make sure that the Type of Object is set to *Slab*. If it is not, click once in the drop-down list opposite the Type of Object item and select *Slab*.
- G. Click in the Property drop-down list and select *SLAB1*. This is the slab property defined in Step 2.
- H. Click in the Edge Drawing Type drop-down list and select *Straight Line*. Although not used in this project, slab edges also may be drawn with arcs and curves.
- I. To draw the first corner of the slab, click once in the Plan View at the intersection of grid lines A and 7 (the cursor should display *Grid Point A 7* at the correct location). Then moving clockwise around the grid (note how the slab edge is dimensioned as you draw), click once at these grid intersections in this order to draw the outline of the slab: F7, F1, D1, D3, and A3. After clicking at grid A3, press the **Enter** key on the keyboard. The shaded slab object should now appear.

If you have made a mistake while drawing this object, click the **Select menu > Select > Pointer/Window** command to leave the Draw mode and go to the Select mode. Then click the **Edit menu > Undo Area Add** command, and repeat Items E through I.

- J. Click on the **Select menu > Select > Pointer/Window** command or press the **Esc** key on the keyboard to exit the Draw Slabs/Areas command.
- K. Select the slab by clicking on it anywhere. The status bar in the lower left-hand corner should show “1 Areas, 6 Edges selected.” If

you make a mistake in selecting, press the **Select menu > Clear Selection** command and try again.

- L. Click the **Edit menu > Edit Areas > Expand/Shrink Areas** command to display the Expand/Shrink Areas form shown in Figure 22.
- M. Type **9in** into the Offset Value edit box. We will use this form to expand (a positive value expands) the slab by 9 inches at each corner to create the perimeter overhang that is needed to accommodate the width of the columns (1/2 of 18 inches).



Figure 22 Expand/Shrink Areas form

- N. Click the **OK** button to finish the slab.
- O. Click the **File menu > Save** command to save your model.

Draw Columns

With the active window set as described in the preceding *Draw Slabs* section (i.e., Plan View window active and the snap to points and grid intersections enabled), use the following Action Items to draw columns.

- A. Click the **Draw menu > Draw Columns** command to access the Draw Columns form shown in Figure 23.
- B. Click in the Property Below drop-down list and select *COL1*. This is the property for the 18-inch by 18-inch column with a drop panel defined in Step 2.
- C. Click in the Property Above drop-down list and select *NONE*. There are no columns above the slab.

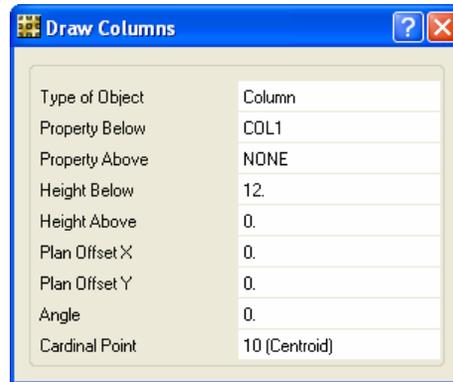


Figure 23 Draw Columns form

- D. Click in the Height Below edit box and type **12**. Note that the units are feet.
- E. Click in the Cardinal Point drop-down list and select *10 (Centroid)*.
- F. Locate the mouse cursor just above and to the left of grid intersection A6, hold down the left mouse button, and drag diagonally to just below and to the right of E3 and release the mouse button. Columns and drop panels should be placed at every grid intersection enclosed by the window just drawn. Note how the drop panels are trimmed at the slab edges.
- G. Locate the mouse cursor just above and to the left of grid intersection D2, hold down the left mouse button, and drag diagonally to just below and to the right of E1 and then release. Again, columns and drop panels should be added to the grid intersections enclosed by the window.
- H. Click in the Property Below drop-down list and select *COL-PER*. This is the property for the 18-inch by 18-inch column without a drop panel for use on the perimeter.
- I. Left click once at each of the following grid locations to draw the perimeter columns: A7, B7, C7, D7, E7, F7, F6, F5, F4, F3, F2, and F1.

- J. Click on the **Select menu > Select > Pointer/Window** command or press the **Esc** key on the keyboard to exit the Draw Columns command.
- K. Locate the mouse cursor just above and to the left of grid intersection C6, hold down the left mouse button, and drag diagonally to just below and to the right of D5 and release the mouse button. The status bar in the lower left-hand corner should show “24 Points, 4 Lines, 4 Areas, 16 Edges selected.” If the selection is not correct, simply click the **Select menu > Clear Selection** command and try again.
- L. Click the **Edit menu > Delete** command or press the **Delete** key on the keyboard to remove the columns enclosed in the window.
- M. Click the **File menu > Save** command to save your model.
- N. Click the **View menu > Set Default 3D View** command to display the model in 3D. Note how the columns extend below the slab.
- O. Click the **View menu > Set Plan View** command to return to the Plan View before continuing the project.

Draw Walls

Similar to the preceding two sections, ensure that the Plan View is active and that the snap to points, grid intersections and the snap increments options are enabled. Now use the following Action Items to draw walls.

- A. Click the **Draw menu > Draw Walls** command to access the Draw Walls form shown in Figure 24.
- B. Click in the drop-down list opposite the Wall Property Below item and select *WALL1*. This is the wall property for the 12-inch-thick wall defined in Step 2.
- C. Click in the Wall Property Above drop-down list and select *NONE*. There are no walls above the slab
- D. Click in the Wall Height Below edit box and type **12**. Note that the units are feet.

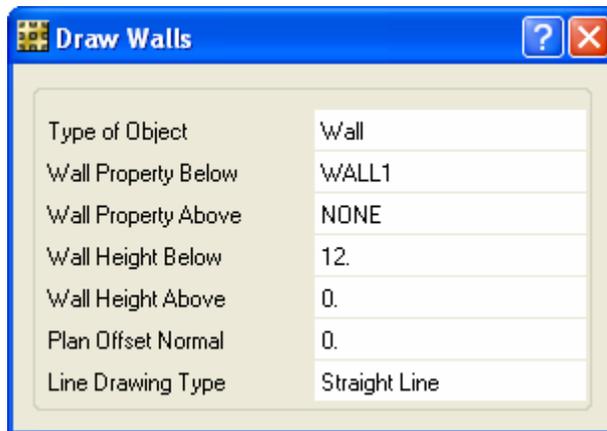


Figure 24 Draw Walls form

- E. Click in the drop-down list opposite the Line Drawing Type item and select *Straight Line*. Although not used in this project, walls may also be drawn with arcs and curves.
- F. Left click at grid intersection C6 to begin drawing the first wall. Draw the wall along grid line C (the wall is on grid line C if no angle measure is shown) past grid line 5 until the snap increments dimension line shows 30 and then click again. Hit the **Enter** key on the keyboard to complete the wall. This places a wall 30 feet long along grid line C.
- If you have made a mistake while drawing this object, click the **Select menu > Select > Pointer/Window** command to leave the Draw mode and go to the Select mode. Then click the **Edit menu > Undo Area Object Add** command, and repeat Items A through F.
- G. Click on the **Select menu > Select > Pointer/Window** command or press the **Esc** key on the keyboard to exit the Draw Walls command.
- H. Hold down the **Shift** key on your keyboard and **right** click once at the end point of the wall just drawn. A selection list similar to the one shown in Figure 25 appears because multiple objects exist at that location. In this example, two point objects and two area objects exist at the same location. Note that the selection list will appear only when the **Shift** key is used with the click.



Figure 25 Selection List form

- I. Highlight the first point object and click the **OK** button. Because a right click action initiated the selection process, a Point Object Information form similar to the one shown in Figure 26, will display.

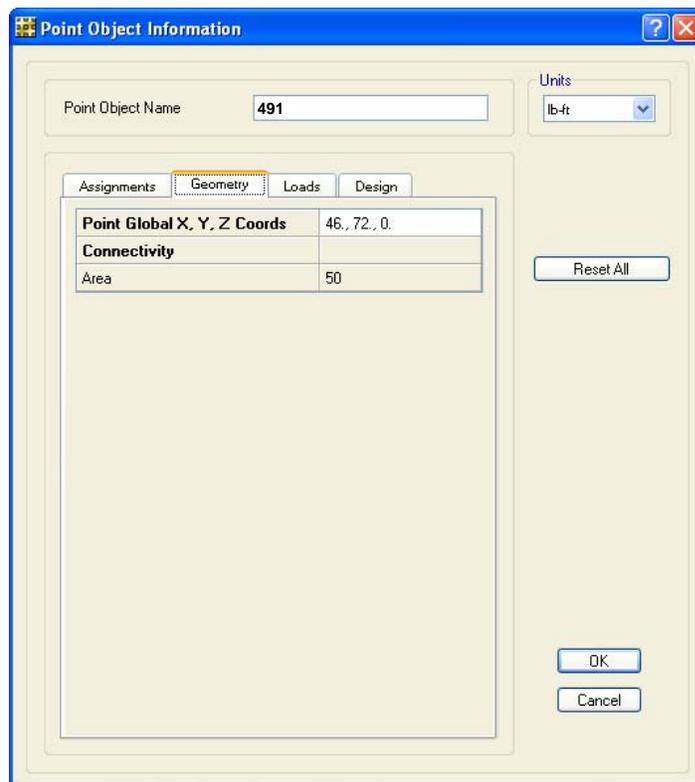


Figure 26 Point Object Information form

1. Click on the *Geometry* tab. Verify that the Point Global X and Y Coordinates are 46 and 72, respectively. If the coordinates are not correct, re-draw the wall following the instructions described in Item F above.
 2. Click the **OK** button to leave the Point Object Information form.
- J. Click the **Draw menu > Draw Walls** command to access the Draw Walls form.
- K. For the next wall, located along grid line 6, left click at grid intersection C6 to begin drawing the wall and at intersection D6 (the snap increment dimension line should show 20) to designate the end of the wall.
- L. With the draw mode still active, draw the last wall along grid line D past grid line 5 until the snap increments dimension line shows 30 and then click again. Hit the **Enter** key on the keyboard to complete the wall. This wall should be parallel to the first wall drawn.
- M. Click on the **Select menu > Select > Pointer/Window** command or press the **Esc** key on the keyboard to exit the Draw Walls command. Your model should look similar to Figure 27.

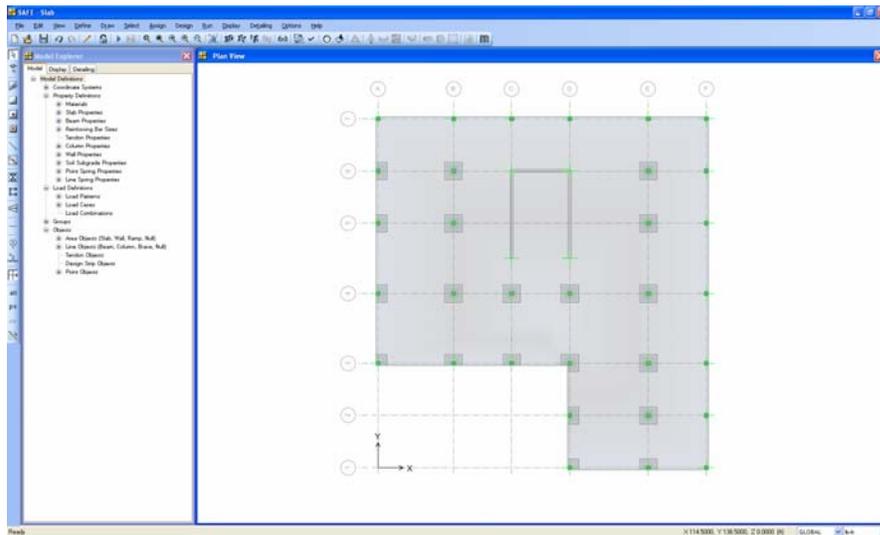


Figure 27 The model after drawing columns and walls

Draw Beams

Similar to the previous sections, ensure that the Plan View is active and the snap to points and grid intersections features are enabled. Draw the beams as follows.

- A. Click the **Draw menu > Draw Beams/Lines** command to access the Draw Beams/Lines form shown in Figure 28.

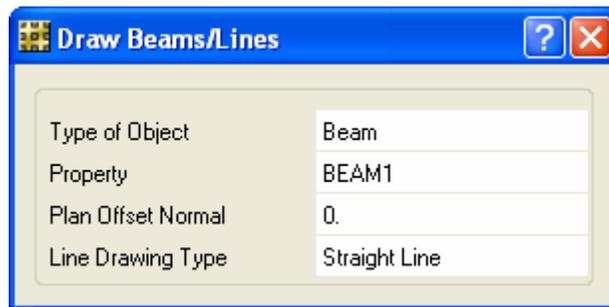


Figure 28 Draw Beams/Lines form

- B. Click in the drop-down list opposite the Property item and select *BEAM1*. Recall that BEAM1 is the 18-inch by 24-inch beam defined in Step 2.
- C. Click in the Line Drawing Type drop-down list and select *Straight Line*.
- D. Left click once at the grid intersection A7. Click again at grid intersections F7, followed by F1. Although only one beam per side was drawn, the program will automatically mesh this single object internally into multiple beam elements to provide the correct connectivity to the supporting columns and slab elements.
- E. Click on the **Select menu > Select > Pointer/Window** command or press the **Esc** key on the keyboard to exit the Draw Beams command.
- F. Click the **File menu > Save** command to save your model.

Draw Openings (Area Objects)

Similar to the previous sections, ensure that the Plan View is active and the snap to points and grid intersections features are enabled. Draw an area object to model the opening as follows:

- A. Click the **Draw menu > Draw Rectangular Slabs/Areas** command to display the Draw Rectangular Slabs/Areas form shown in Figure 29.
- B. Click once in the drop-down list opposite the Type of Object item and select *Opening*.

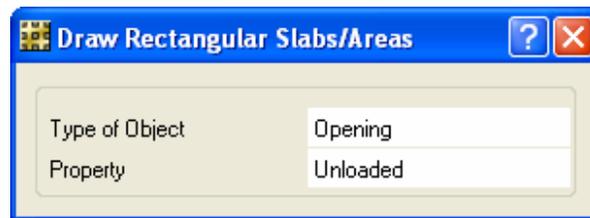


Figure 29 Draw Rectangular Slabs/Areas form

- C. Left click at the intersection of grid lines C and 6, and while holding the left mouse button down, move diagonally down to the wall end point located along grid line D between grids 4 and 5 and release the button. An area object with different shading should appear, indicating that an opening for the stairs has been drawn. An opening takes priority over an object with assigned slab properties when the program determines the stiffness formulation.
- D. Click on the **Select menu > Select > Pointer/Window** command or press the **Esc** key on the keyboard to exit the Draw Rectangular Slabs/Areas command.
- E. Click the **File menu > Save** command to save your model.

Step 6 Add Design Strips

In this step, design strips will be added to the model. Design strips determine how reinforcing will be calculated and positioned in the slab. Forces are integrated across the design strips and used to calculate the

required reinforcing for the selected design code. Typically design strips are positioned in two principal directions: Layer A and Layer B.

Similar to the previous sections, ensure that the Plan View is active and the snap to points and grid intersections features are enabled. Add design strips to the model as follows:

- A. Click the **Edit menu > Add/Edit Design Strips > Add Design Strips** command to display the Add Design Strips form shown in Figure 30.
- B. In the Options area, select the *Add Design Strips Along Cartesian Grid Lines* option.
- C. In the Parameters area, click in the Grid Direction drop-down list and select *X*.

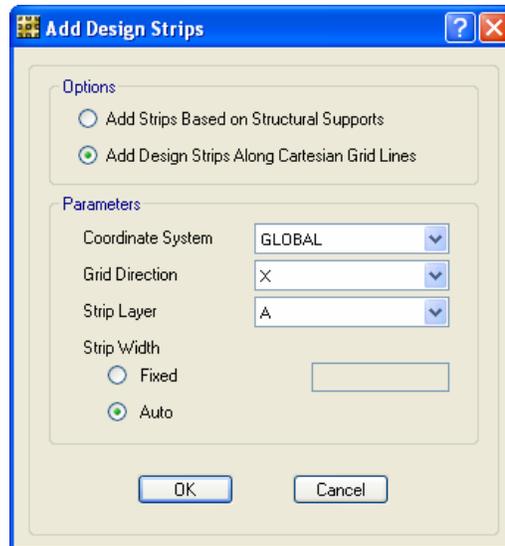


Figure 30 Add Design Strips form

- D. Select *A* from the Strip Layer drop-down list.
- E. Select the *Auto* option. The added design strips will automatically adjust their width to align with adjacent strips.

- F. Click the **OK** button to leave the Add Design Strips form. Design strips along the X-axis grids should now appear as solid lines.
- G. Left click on the design strips that lie on grid lines 1 and 2 to select them; the status bar in the lower left-hand corner should show “2 Design Strips selected.” If the selection is not correct, simply click the **Select menu > Clear Selection** command and try again.
- H. Left click on the slab (anywhere except at a column, drop panel, beam or design strip location) to select it; the status bar in the lower left-hand corner should now show “1 Areas, 6 Edges, 2 Design Strips selected.”
- I. Left click at grid intersection A1 and at grid intersection A2; the status bar in the lower left-hand corner should now show “2 Points, 1 Areas, 6 Edges, 2 Design Strips selected.”
- J. Click the **Edit menu > Align Points/Lines/Edges** command to display the Align Points/Lines/Edges form shown in Figure 31.
- K. Select the *Trim Line/Tendon/Strip Objects* option.

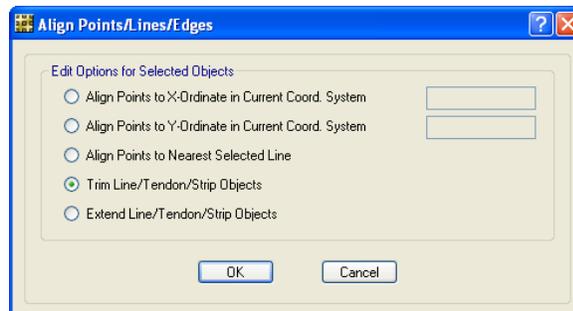


Figure 31 Align Points/Lines/Edges form

- L. Click the **OK** button to leave the Align Points/Lines/Edges form. The design strips along grid lines 1 and 2 should now be trimmed to the edge of the slab.
- M. Left click on the design strip that lies on grid line 5 to select it; the status bar in the lower left-hand corner should show “1 Design Strips selected.”

- N. Press the **Delete** key on the keyboard to remove the selected design strip from the model.
- O. Click the **Draw menu > Draw Design Strips** command to display the Draw Design Strips form shown in Figure 32.

Field	Value
Type of Object	Strip
Strip Layer	A
Start Width Left	9
Start Width Right	12
End Width Left	9
End Width Right	12

Figure 32 Draw Design Strips form

- P. Select **A** from the Strip Layer drop-down list.
- Q. Type **9** into the Start Width Left edit box.
- R. Type **12** into the Start Width Right edit box.
- S. Type **9** into the End Width Left edit box.
- T. Type **12** into the End Width Right edit box.
- U. Left click at grid intersection A5 and at C5, and then click the right mouse button to stop drawing.
- V. Left click at grid intersection D5 and at F5.
- W. Press the **Esc** key on the keyboard to leave the Draw Design Strips command.
- X. Click the **Edit menu > Add/Edit Design Strips > Add Design Strips** command to display the Add Design Strips form.
- Y. Select **Y** from the Grid Direction drop-down list.
- Z. Click in the Strip Layer edit box and select **B** from the drop-down list.

- AA. Click the **OK** button to leave the Add Design Strips form. Design strips along the Y-axis grids should now appear as solid lines.
- BB. Left click on the design strips that lie on grid lines A, B and C to select them; the status bar in the lower left-hand corner should show “3 Design Strips selected.”
- CC. Left click on the slab (anywhere except at a column, drop panel, beam or design strip location) to select it; the status bar in the lower left-hand corner should now show “1 Areas, 6 Edges, 3 Design Strips selected.”
- DD. Left click at grid intersections A1, B1 and C1; the status bar in the lower left-hand corner should now show “3 Points, 1 Areas, 6 Edges, 3 Design Strips selected.”
- EE. Click the **Edit menu > Align Points/Lines/Edges** command to display the Align Points/Lines/Edges form.
- FF. Select the *Trim Line/Tendon/Strip Objects* option.
- GG. Click the **OK** button to leave the Align Points/Lines/Edges form. The design strips along grid lines A, B, and C should now be trimmed to the edge of the slab.
- HH. Click the **File menu > Save** command to save your model.

Step 7 Set Display Options

In this Step, the set display options will be used to alter the objects displayed.

- A. Click the **View menu > Set Display Options** command. When the Set Display Options form displays, uncheck the *Design Strip Layer A* and *Design Strip Layer B* check boxes in the Items Present in View area, as shown in Figure 33. This action will turn off the display of the design strips.

Step 7 Set Display Options

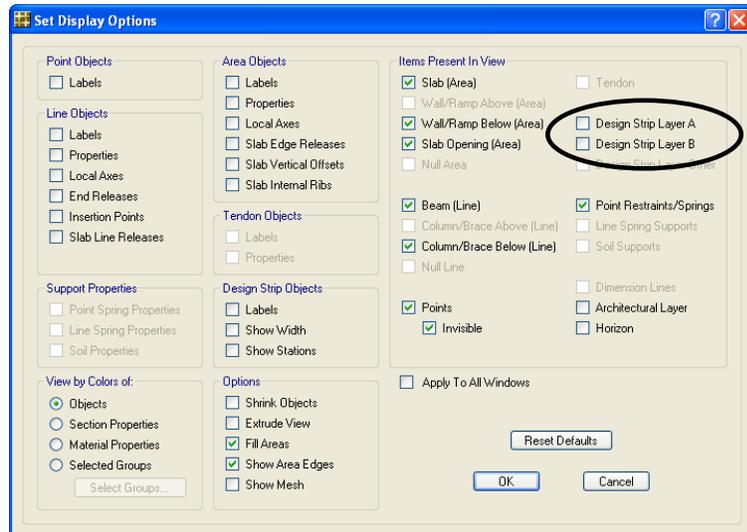


Figure 33 Set Display Options form

- B. Click the **OK** button to accept the changes, and the model now appears as shown in Figure 34.

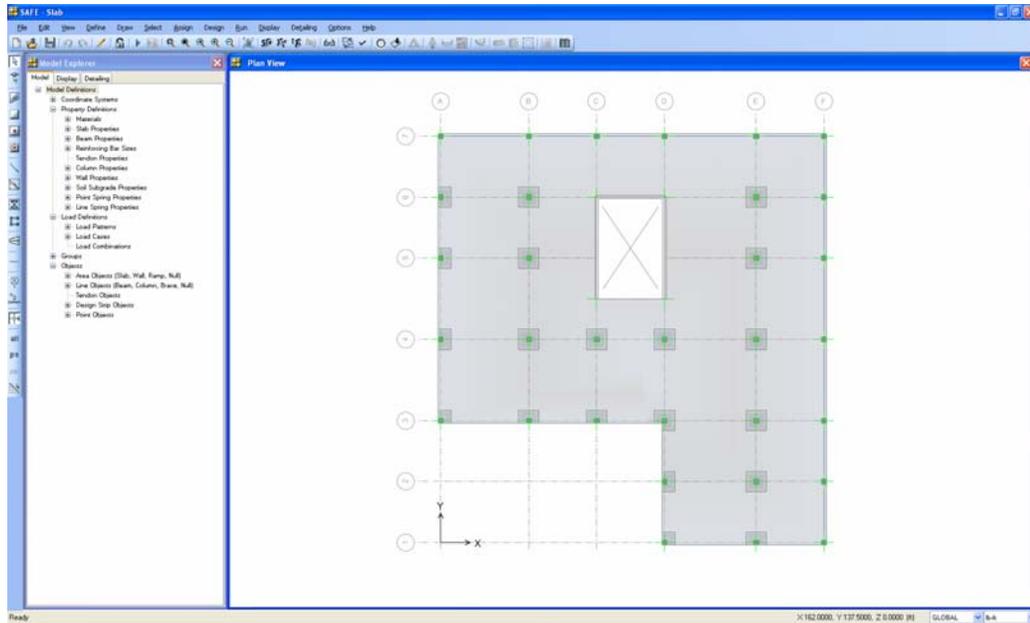


Figure 34 Model after all objects have been drawn

Step 8 Assign Loads

In this Step, the dead and live loads will be assigned to the slab. Ensure that the Plan View is still active, and that the program is in the select mode (**Draw menu > Select > Pointer/Window** command).

- A. Select the slab by clicking on it anywhere that is *not* a beam, wall, column, drop panel or opening. The status bar in the lower left-hand corner should show “1 Areas, 6 Edges selected.” If you make a mistake in selecting, click the **Select menu > Clear Selection** command, and try again.
- B. Click the **Assign menu > Load Data > Surface Loads** command to access the Surface Loads form shown in Figure 35.
- C. If it is not selected already, select DEAD from the Load Pattern Name drop-down list.
- D. Make sure *lb-ft* is displayed in the Units area.

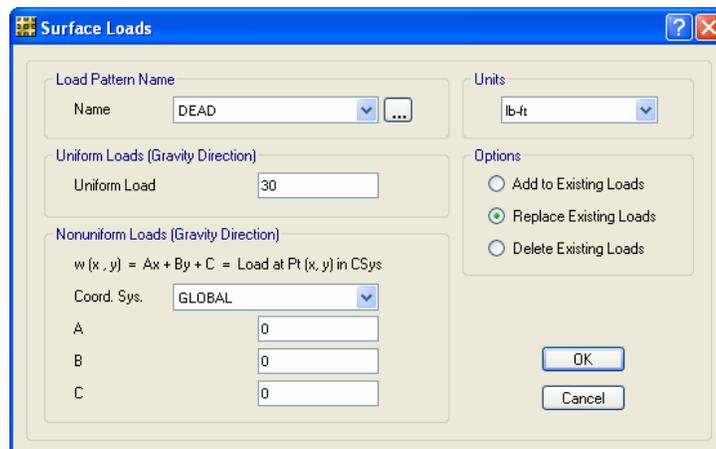


Figure 35 Surface Loads form

- E. In the Uniform Loads (Gravity Direction), type **30** in the Uniform Load edit box.

Note: Additional load cases may be defined by clicking on the “...” button next to the load pattern name. A “...” button returns you to the form used to define the item in the adjacent drop-down list or edit box, which in this case is the Load Patterns form.

- F. Click the **OK** button to accept the dead load assignment. SAFE will display the loads on the model. Use the **Assign menu > Clear Display of Assigns** command to remove the assignments from the display, if desired.
- G. Click anywhere on the main slab to reselect the slab, or click the **Select menu > Get Previous Selection** command to select the slab.
- H. Click the **Assign menu > Load Data > Surface Loads** command to again access the Surface Loads form.
- I. Select *LIVE* from the Load Pattern Name drop-down list.
- J. Type **50** in the Uniform Load edit box in the Uniform Loads area.
- K. Click the **OK** button to accept the live load assignment. Again, use the **Assign menu > Clear Display of Assigns** command to remove the assignments from the display.
- L. To review the assignments to the slab, **right** click on the slab anywhere that is *not* a beam, wall, column, drop-panel or opening to access the Slab-Type Area Object Information form shown in Figure 36.
- M. Select the *Loads* tab and note that the DEAD Load Pattern has a Force per Unit Area of 30, and that the LIVE Load Pattern has a Force per Unit Area of 50.
- N. Click the **OK** button to close the Slab-Type Area Object Information form.
- O. Click the **File menu > Save** command to save your model.

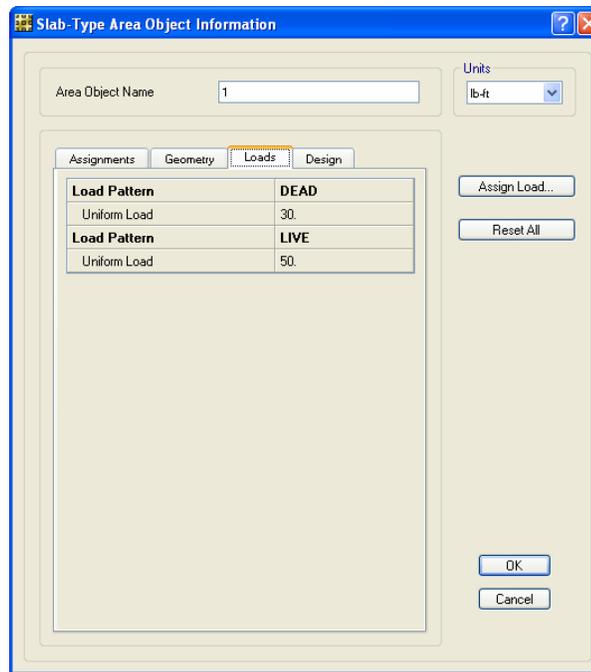


Figure 36 Slab-Type Area Object Information form

Step 9 Run the Analysis and Design

In this Step, the analysis and design will be run.

- A. Click the **Run menu > Run Analysis & Design** command to start the analysis. The program will create the analysis model from your object-based SAFE model and will display information in the status bar in the lower left-hand corner as the analysis and design proceeds. Additional information about the run may be accessed at a later time using the **File menu > Show Input/Output Text Files** command and selecting the filename with a *.LOG* extension.
- B. When the analysis and design are finished, the program automatically displays a deformed shape view of the model, and the model is locked. The model is locked when the **Options menu > Lock/Unlock Model** icon  appears depressed. Locking the model prevents any changes to the model that would invalidate the analysis results.

Step 10 Graphically Review the Analysis Results

In this Step, the analysis will be reviewed using graphical displays of the results.

- A. Click the **View menu > Set Default 3D View** command to display the deformed shape for the DEAD load case in 3D.
- B. Click the **Start Animation** button in the lower right-hand corner of the display to animate the deformed shape. Speed of the animation may be adjusted by using the slider control adjacent to the button. Click the **Stop Animation** button to end the animation.
- C. Click the **Display menu > Show Deformed Shape** command to access the Deformed Shape form shown in Figure 37.

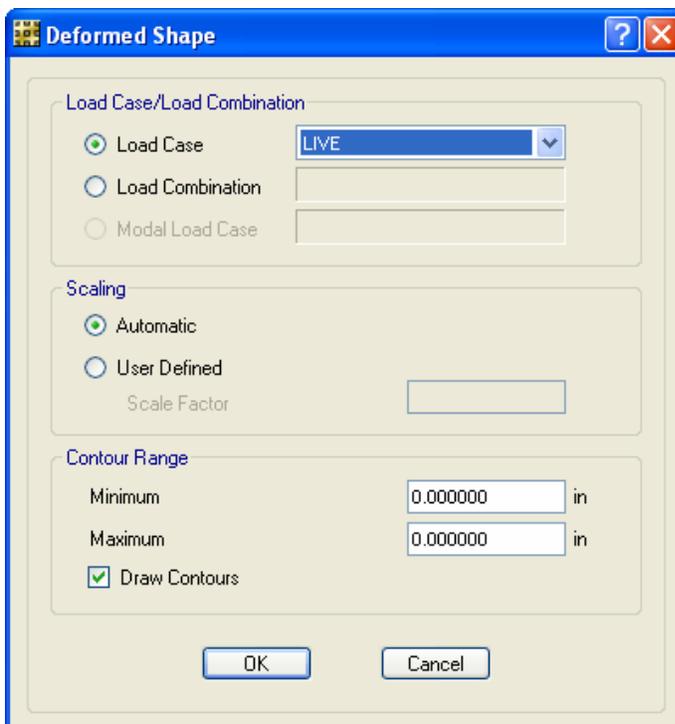


Figure 37 Deformed Shape form

- D. In the Load Case/Load Combination area, select the *Load Case* option.
- E. Select *LIVE* from the Load Case drop-down list.
- F. Select the *Automatic* option in the Scaling area.
- G. Check the *Draw Contours* checkbox in the Contour Range area.
- H. Click the **OK** button to generate a 3-D deformed shape with contours for the LIVE load case.
- I. Click the **Display menu > Show Slab Forces/Stresses** command to bring up the Slab Forces/Stresses form shown in Figure 38.

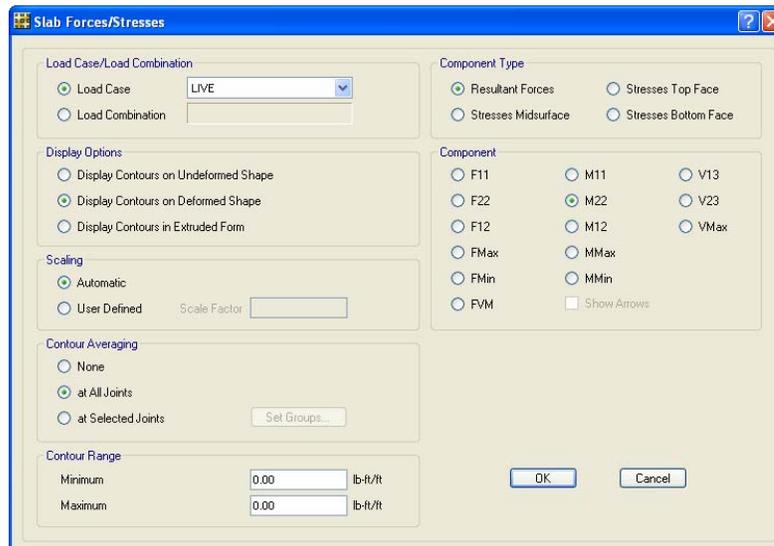


Figure 38 Slab Forces/Stresses form

- J. Select *LIVE* from the Load Case drop-down list.
- K. Select the *Resultant Forces* option in the Component Type area.
- L. Select the *M22* option in the Component area.
- M. Select the *Display Contours on Deformed Shape* option in the Display Options area.

Step 11 Design Display

- N. Click the **OK** button to generate the moment diagram shown in Figure 39.

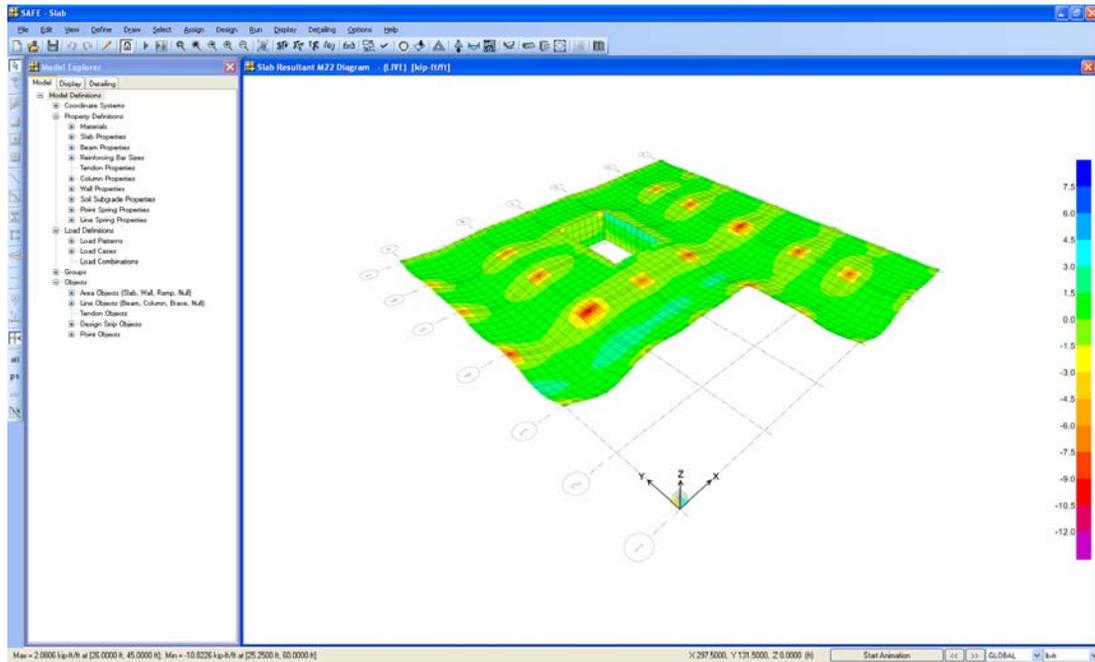


Figure 39 M22 Moment Diagram

Note that as you move the cursor over the moment diagram, the values are displayed at the cursor and in the lower left-hand corner of the window.

- O. Click the **Display menu > Show Undeformed Shape** command to clear the display of the moment diagram.
- P. Click the **View menu > Set Plan View** command to return to the Plan View.

Step 11 Design Display

In this Step, design results for the slab and beams will be displayed. Note that the design was run along with the analysis in Step 9. Design results are for the ACI 318-08 code, which was selected in Step 1. Design preferences may be reviewed or changed by going to the **Design menu > De-**

sign Preferences command (some design preferences are also set on the property data forms); be sure to re-run the analysis and design (Step 9) if changes to the preferences are made.

- A. Click the **Display menu > Show Slab Design** command to access the Slab Design form shown in Figure 40.

The screenshot shows the 'Slab Design' dialog box with the following settings:

- Choose Display Type:** Design Basis: Strip Based; Display Type: Enveloping Reinforcement; Impose Minimum Reinforcing.
- Choose Strip Direction:** Layer A; Layer B; Layer Other; Show Total Results on Each Strip; Break into Column and Middle Strip Results.
- Rebar Location Shown:** Show Top Rebar; Show Bottom Rebar.
- Reinforcing Display Type:** Show Rebar Intensity (Area/ Unit Width); Show Total Rebar Area for Strip; Show Number of Bars of Size: (with Bar Size dropdowns for Top and Bottom).
- Typical Value of Reinforcing:** Show Rebar Above Typical Value; Define by Bar Size and Bar Spacing; Define by Bar Area and Bar Spacing. (with Bar Size and Spacing, ft dropdowns for Top and Bottom).
- Reinforcing Diagram:** Show Reinforcing Envelope Diagram; Scale Factor: 1.; Show Reinforcing Extent.

Figure 40 Slab Design form

- B. In the Choose Display Type area, select *Strip Based* from the Design Basis drop-down list and *Enveloping Reinforcement* from the Display Type drop-down list.
- C. In the Choose Strip Direction area, check the *Layer A* checkbox and uncheck the *Layer B* checkbox. This will display the design results in the Layer A (X) direction only.

- D. In the Rebar Location Shown area, check the *Show Top Rebar* checkbox and uncheck the *Show Bottom Rebar* checkbox.
- E. In the Reinforcing Display Type area, select the *Show Total Rebar Area for Strip* option.
- F. Click the **OK** button to leave the Slab Design form and display the slab design results. The top reinforcing required in the Layer A direction is displayed.

Positioning the cursor at any location on a Layer A design strip causes the required top and bottom reinforcing values to be displayed in the lower left corner of the window and at the cursor.

- G. To view the required reinforcing in the Layer B direction, click the **Display menu > Show Slab Design** command to display the Slab Design form.
- H. In the Choose Strip Direction area, uncheck the *Layer A* checkbox and check the *Layer B* checkbox.
- I. Check the *Show Bottom Rebar* checkbox in the Rebar Location Shown area.
- J. In the Reinforcing Display Type area, select the *Show Number of Bars of Size:* option and select #5 from the Top drop-down list and #5 from the Bottom drop-down list.
- K. Click the **OK** button to leave the Slab Design form and display the slab design results for the Layer B direction. The view will be updated to that shown in Figure 41. Again, positioning the cursor anywhere on the strips will result in the display of the reinforcing values in the lower left-hand corner of the SAFE window.

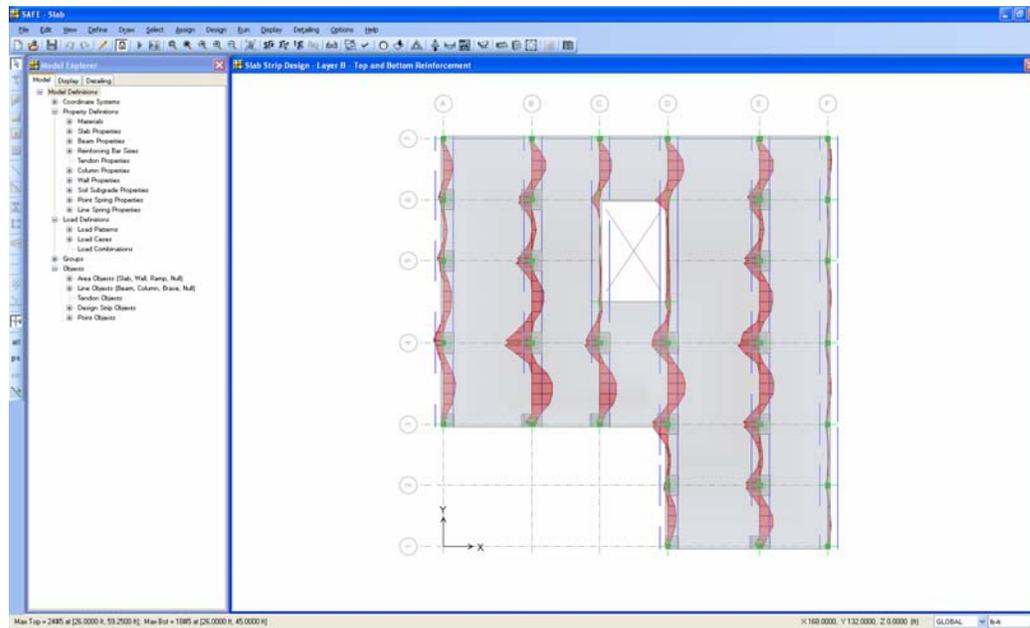


Figure 41 Layer B reinforcing

- L. To view the required reinforcing in the beams, click the **Display menu > Show Beam Design** command. The Beam Design form shown in Figure 42 displays.
- M. In the Choose Display Type area, select *Longitudinal Rebar* from the Display Type drop-down list and *Flexure* from the Rebar Type drop-down list.
- N. Review the other selected options and then click the **OK** button to close the Beam Design form.

The view will be updated to show the flexural reinforcing required in the beams along the two perimeter sides. Positioning the cursor on the beams will result in the display of the reinforcing values in the lower left-hand corner and at the cursor.

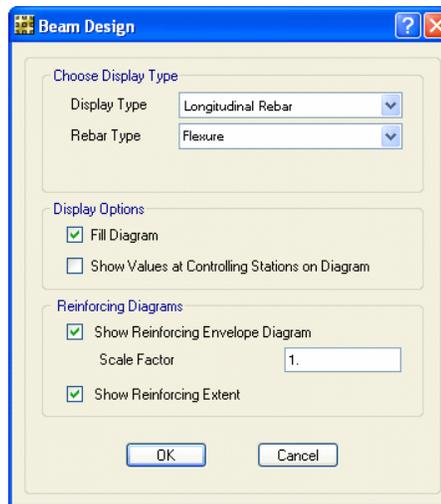


Figure 42 Beam Design form

- O. **Right** click on a beam to display the Design Details form shown in Figure 43.

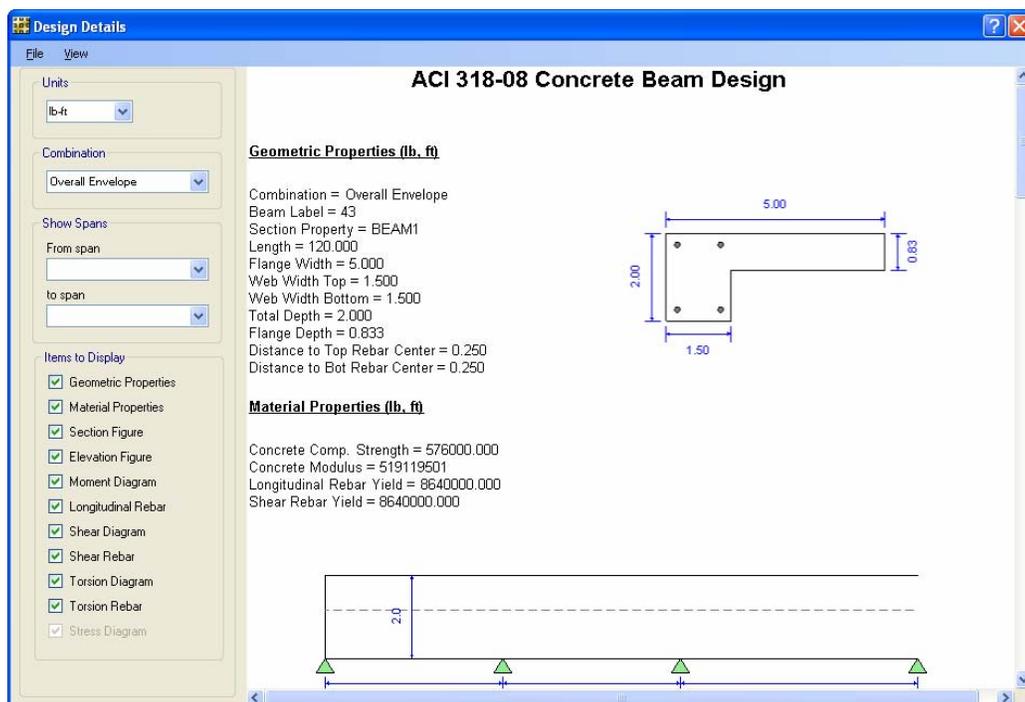


Figure 43 Design Details form

Scroll through the form to see all of the design information associated with the selected beam. Click the **X** button in the top-right corner of the form to close the form.

Step 12 Run Detailing

In this Step, detailing will be run and displayed. Detailing may be run only after analysis and design are complete.

- A. Click the **Detailing menu > Detailing Preferences** command to display the Detailing Preferences form shown in Figure 44. Use this form to set the regional standards, to control how dimensioning is displayed, to manage reinforcing bar notation, and to select the units for material quantity takeoffs.

The image shows a software dialog box titled "Detailing Preferences". It is organized into several sections with dropdown menus and buttons. The "Standards" section includes "Units" set to "US" and "Rebar Set" set to "US Customary (#8)". The "Dimension Units" section includes "Length" (Foot), "Section and Thickness" (Inch), "Rebar Spacing" (Inch), and "Force" (Kip). The "Bar Mark" section includes "Bar Mark Style" (MK-01, MK02...), "Number Separator" (-(Dash)), "Mark Separator" (-(Dash)), and "Spacing Separator" (@ (At)). The "Material Quantity Units" section includes "Rebar Length" (Foot), "Slab Area" (Sq ft), "Concrete Volume" (Cu ft), and "Rebar Weight" (Ton). At the bottom, there is a "Modify/Show Format..." button, and "OK" and "Cancel" buttons.

Figure 44 Detailing Preferences form

- B. Review the settings on this form (we will accept the default selections), and then click the **OK** button to close the form.
- C. Click the **Detailing menu > Slab/Mat Reinforcing Preferences** to display the Slab/Mat Detailing Preferences form shown in Figure 45.

The image shows the 'Slab/Mat Detailing Preferences' dialog box with the 'Rebar Selection' tab active. The dialog is organized into four main sections:

- Rebar Curtailment Options:** Contains two radio buttons: 'Apply Curtailment Rules' (selected) and 'Reinforcement Extent Based on Design Only'. A 'Modify/Show Rules...' button is next to the first option.
- Rebar Detailing Options:** Contains two radio buttons: 'Show All Bars' (selected) and 'Show Additional Bars Above Typical'. Below these are two groups of settings for 'Typical Bars Along Layer-A' and 'Typical Bars Along Layer-B'. Each group includes 'Top Bars, Bar Size' (set to #6), 'Top Bars, Spacing' (set to 9 in), 'Bottom Bars, Bar Size' (set to #5), and 'Bottom Bars, Spacing' (set to 12 in).
- Slab Sections:** Contains a 'Section Label Style' dropdown menu (set to 'A,B,C') and a 'Sections in Each Direction' text box (set to '1', with '(Max. = 5)' next to it).
- Rebar Calls Include:** Contains five checkboxes: 'Include Number of Bars' (checked), 'Include Bar Mark' (unchecked), 'Include Bar Shape/Placement' (checked), 'Include Bar Designation' (checked), 'Include Bar Spacing' (unchecked), and 'Include (T/B) Indication' (unchecked).

At the bottom right of the dialog are 'OK' and 'Cancel' buttons.

Figure 45 Slab/Mat Detailing Preferences form

- D. Click the *General and Display* tab. On this tab review or alter the rebar curtailment, detailing and callout options, as well as set how sections should be cut. We will accept the default settings.
- E. Click the *Rebar Selection* tab and review or change the rebar selection rules, preferred sizes, minimums and reinforcing around openings. We will accept the default settings.
- F. Click the **OK** button to accept the selections and close the form.
- G. Click the **Detailing menu > Drawing Sheet Setup** command to display the Drawing Sheet Setup form. The sheet size, scales, title block and text sizes can be reviewed and changed using this form. We will accept the default settings.
- H. Click the **OK** button to close the form.

- I. Review the line thicknesses and styles by clicking the **Detailing menu > Drawing Format Properties** command.
- J. Click the **OK** button to accept the selections and close the form.
- K. Now that the detailing preferences and drawing setup options have been reviewed, click the **Run menu > Run Detailing** command to generate the detailing drawings. A framing plan is displayed when detailing is complete.
- L. Click the **Detailing menu > Show Detailing** command to access the Display Detailing Item form shown in Figure 46.

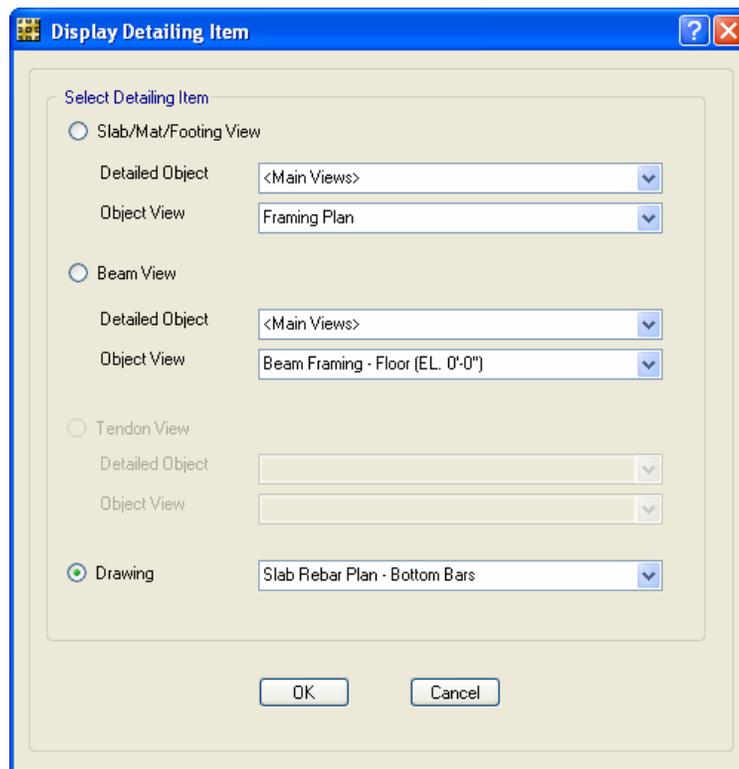


Figure 46 Display Detailing Item form

- M. Select the *Drawing* option.
- N. Select *Slab Rebar Plan – Bottom Bars* from the Drawing dropdown list.

Step 13 Create Report

- O. Click the **OK** button to leave the Display Detailing Item form and display the selected drawing shown in Figure 47.
- P. Clicking on the *Detailing* tab in the Model Explorer and expanding the Views and Drawing Sheets trees also provides access to detailing drawings and views.
- Q. Click the **Display menu > Show Undeformed Shape** command to return to the model.

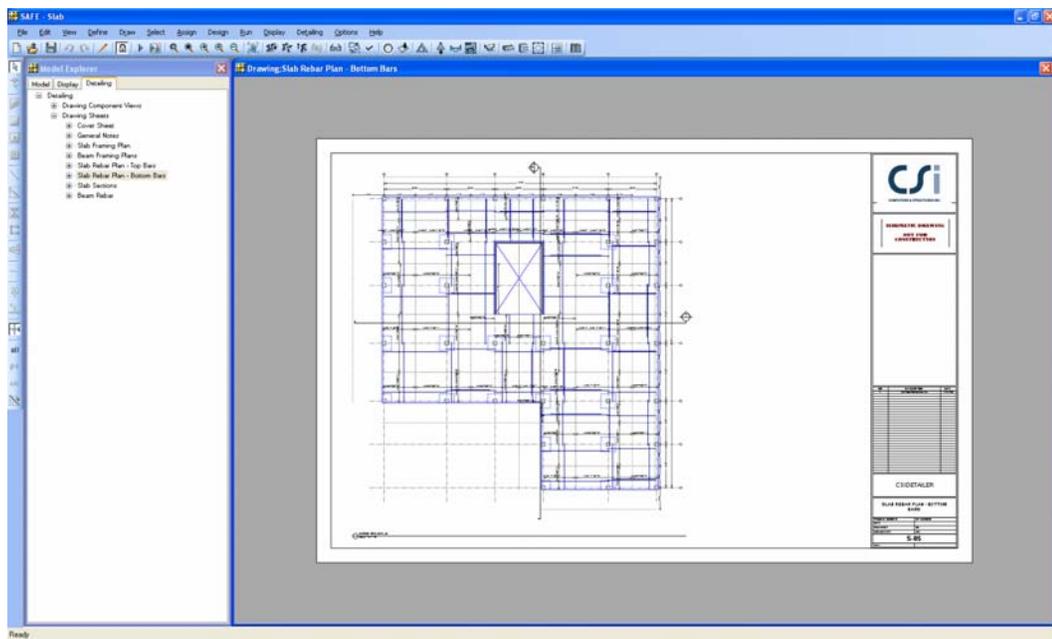


Figure 47 Slab Rebar Plan

Step 13 Create Report

In this Step, a report describing model input and output results will be created.

- A. Click the **File menu > Report Setup** command to display the Report Setup Data form.
- B. In the Report Output Type area, be sure that the *RTF File* option is selected.

- C. In the Report Items area, uncheck the *Include Hyperlinked Contents* checkbox.
- D. Click the **OK** button to leave the Report Setup Data form.
- E. Click the **File menu > Create Report** command to display the Microsoft Word Rich Text File Report form.
- F. Type **SLAB** in the File name edit box and click the **Save** button. A report, with a cover similar to that shown in Figure 48 should be displayed in your word processor, and will be saved to your hard disk.

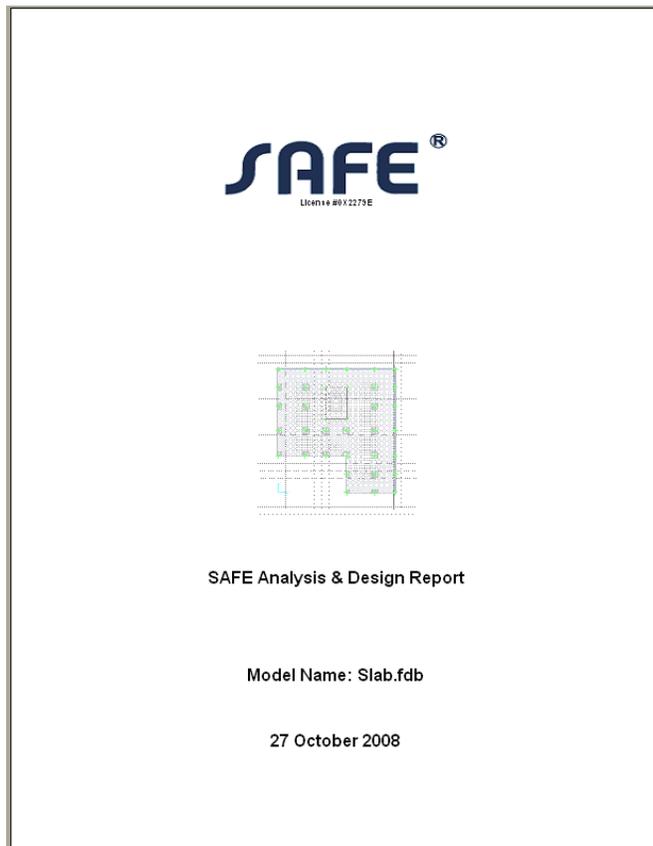


Figure 48 Cover Page for Report

- G. Scroll through the report to find tables that list geometry and properties, analysis results and design information, such as that shown if Figure 49.
- H. Close your word processor and return to the SAFE program.
- I. Click the **File menu > Save** command to save your model one last time.

Slab.kdb
27 October 2008

5. Analysis results

5.1. Support results

This section provides support results, including items such as column, support, and spring reactions.

Table 23: Nodal Reactions

Point	OutputCase	Table 23: Nodal Reactions					
		F1	F2	F3	M1	M2	M3
59	DEAD	6711.70	8252.60	2592.250	-20911	24232.510	-303.30
60	DEAD	107.25.270	-540.160	54833.440	1452.600	30453.960	-33.180
62	DEAD	9011.390	-944.300	43333.450	3068.740	34515.510	-36.870
64	DEAD	927.2190	740.110	39662.710	-3201.760	30980.960	-27.140
66	DEAD	-3202.980	1226.410	47590.480	-27158	-13439	-41630
68	DEAD	-4243.740	-1191.450	116960	4221.320	-16964	-43190
70	DEAD	-3644.080	-1053.830	90206.350	3710.800	-14304	-40630
72	DEAD	-2065.490	937.850	89511.270	-3921.850	-19451	-37140
74	DEAD	-942.640	907.3840	32000.000	-21630	-4992.440	-29.570
76	DEAD	-534.620	-2298.730	69817.430	848.5590	-3114.210	-207.60
82	DEAD	47096.20	3713.320	734.15.000	-1420.3	16096.020	-43.890
83	DEAD	227.66.40	-2297.600	912.41.680	8768.780	7359.820	-42.960
89	DEAD	-3190.390	134.4390	906.56.470	-4746.400	-137.11	-28.440
91	DEAD	-2484.620	-342.750	807.87.2	1659.430	-1067.1	-43.440
93	DEAD	-2287.370	-1471.250	915.18.560	6035.480	-9066.090	-45.460
95	DEAD	-2205.480	610.860	898.14.460	-1819.990	-8718.330	-51.440
97	DEAD	6163.570	2030.470	21179.130	-46967	20008.870	-20.970
98	DEAD	8138.990	-1002.510	37069.290	4366.690	28408.490	-247.80
100	DEAD	-3460.030	3713.440	36611.700	-13809	-15792	-65.290
102	DEAD	-3643.370	-1187.190	88938.910	493.710	-15991	-41.710
104	DEAD	6014.690	-2646.440	-2467.930	94530.60	14481.750	-23.890
105	DEAD	-1566.260	-3279.270	49031.840	12349.840	-9824.560	-42.220
107	DEAD	-432.90	-3003.000	33400.430	11694.200	-270.030	-25.890
109	DEAD	1184.4140	-3766.710	40290.270	14497.950	42444.700	-60.620
111	DEAD	-979.430	-3309.460	69447.840	13303.230	-3717.320	-11.010
113	DEAD	-1476.910	-1572.300	20710.000	6640.110	-5276.470	-40.900
114	DEAD	-3078.390	27.530	36530.260	736.420	-121148	-494.60
116	DEAD	-3623.900	-891.280	39125.200	407.4490	-14597	-71.420
118	DEAD	-4208.510	-306.360	47438.910	1869.840	-1727.9	-60.230
120	DEAD	-575.870	279.860	38843.250	-304.040	-16139	-40.320
122	DEAD	-3859.170	-466.120	39508.820	3165.910	-15760	-73.200
124	DEAD	-3000.590	843.230	17853.820	-2355.630	-14199	-73.200
319	DEAD	-593.200	-115.080	-2063.730	-284.360	-402.110	-28.610
380	DEAD	-638.690	-280.240	5499.590	-49.090	-2294.220	334.330
383	DEAD	44.910	464.940	-913.520	-488.580	489.700	18.790
385	DEAD	14637.90	-942.460	4721.950	-387.310	51117.40	-620.460
59	LIVE	2167.390	107.1040	6845.660	-6501.920	7151.390	-7.750
60	LIVE	3431.520	-172.650	15819.980	455.860	12620.320	-10.480
62	LIVE	2972.330	-304.580	12377.850	993.060	11021.790	-11.500
64	LIVE	2899.930	228.940	11161.150	-993.730	9303.990	-4.250
66	LIVE	-1025.290	2005.840	13730.140	-8887.090	-4296.590	-132.30
68	LIVE	-1360.130	-300.340	30676.990	1348.030	-5430.730	-13.690
70	LIVE	-1161.430	-338.850	27168.350	1212.670	-4888.380	-12.940
72	LIVE	-638.690	290.480	-2926.510	-1164.630	-3248.930	-11.430

Page 10 of 10

Figure 49 Typical Report information

Congratulations! You've successfully created, analyzed, designed, detailed, and reviewed a SAFE reinforced concrete model.

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Post-Tensioned Concrete

P/T Example

The intent of this tutorial is to give you hands-on experience via step-by-step instructions on how to use SAFE to model, analyze, design and detail post-tensioned concrete slabs. Fundamentals of the model creation process are identified and various model construction techniques are introduced. As you complete the tutorial, you will build the model shown in Figure 50.

The Project

The tutorial project is an irregularly shaped post-tensioned concrete slab as might be used for residential construction, with overall dimensions of 108 feet by 92 feet. Several openings exist in the interior for stair access. The 8-inch thick slab is supported by a combination of 8-inch-thick walls and 12-inch-square columns. The floor-to-floor height is 10 feet. The model will be analyzed for a uniform dead load (partitions + mechanical) of 35 pounds per square foot (psf) plus the self weight of the structure, and a live load of 50 psf.

Concrete Materials:

- A. Concrete strength, $f'_c = 5000$ psi
- B. Unit weight of concrete = 150 pcf

Prestressing Tendons:

- C. Unbonded mono-strand
- D. 1/2" diameter strand; 0.153 square-inch area
- E. $f_{se} = 175.5$ ksi (216 ksi @ stressing – 40.5 ksi losses)

Reinforced Concrete:

- F. $f_y = 60$ ksi

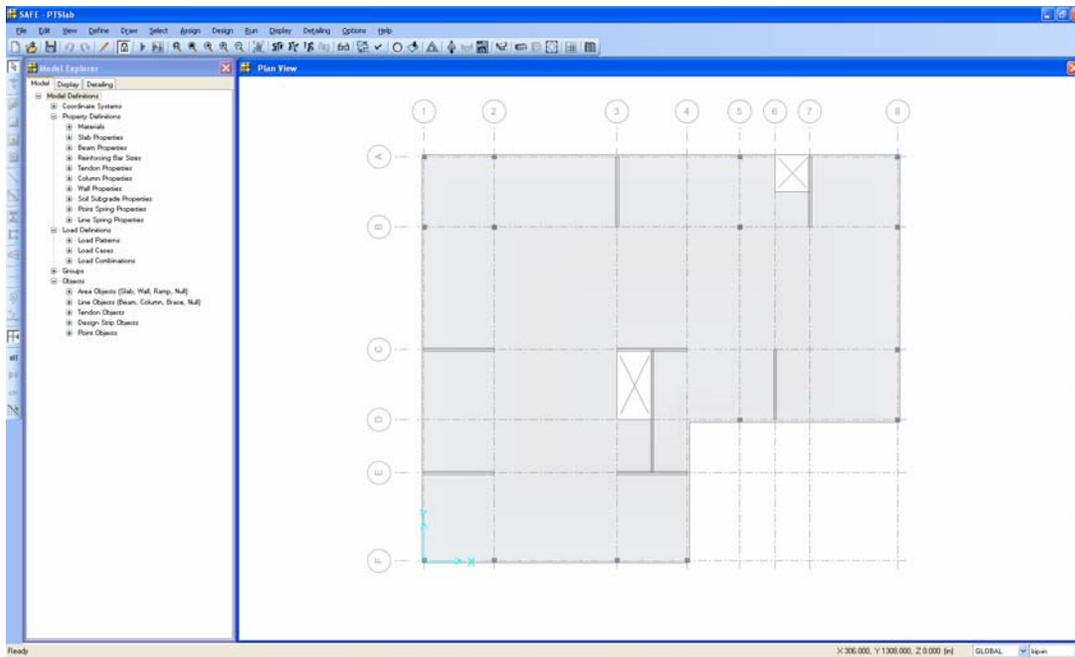


Figure 50 The Project Model

Navigating Through SAFE

The SAFE program provides the user with two principal ways to navigate through program commands: menu commands or toolbar buttons. All commands are available through the main menu bar (e.g., **Draw menu > Draw Columns**), and a majority of the menu commands are also available as buttons on toolbars (e.g., **Draw Columns**, ). The

availability of a button on the toolbar is indicated in the menus by the existence of an icon to the left of the command, as shown in Figure 51.

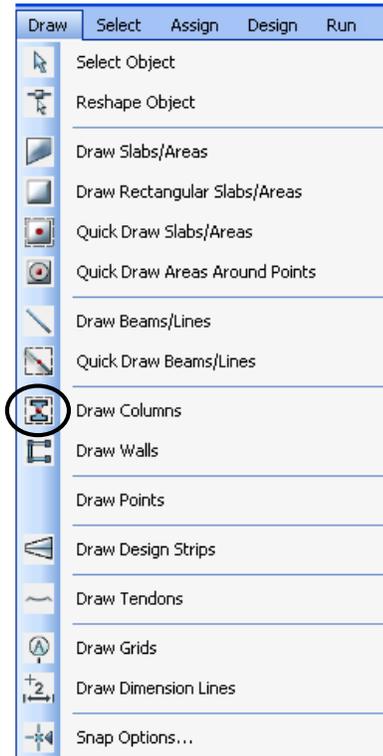


Figure 51 Draw Menu

In this tutorial the reference to various commands will be given using the narrative description, i.e., **Draw menu > Draw Column** in lieu of the associated button.

Step 1 Begin a New Model

In this Step, the dimensions and basic grid will be defined, which will serve as a guide for developing the model. This model will be built without using the automated template tools provided in SAFE to demonstrate how to construct a model from scratch. However, as a general rule, we highly recommend using templates to start models whenever possible

because they provide a quick, easy way of generating a model. Consult the SAFE Help topics for information about templates.

Set the Units

If the units shown in the drop-down list in the lower right-hand corner of the SAFE window are not kip-in, scroll through the drop-down list to set the units to *kip-in*.

Define the Grid

- A. Click the **File menu > New Model** command to access the New Model Initialization form shown in Figure 52. This form is used to specify the starting point of the model creation: a Blank screen, a screen with a Grid Only, or one of eight templates. Default units may also be selected here, along with the design code and preferences.

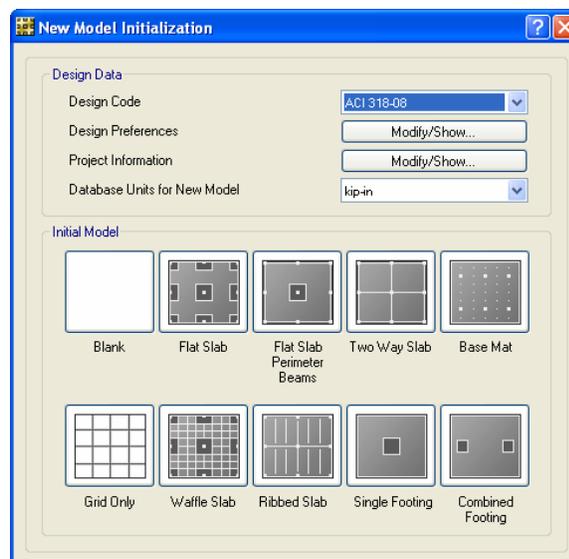


Figure 52 New Model Initialization form

- B. In the Design Data area, select *ACI 318-08* from the Design Code drop-down list.
- C. In the Initial Model area, click the **Grid Only** button to display the Coordinate System Definition form shown in Figure 53. This form is used to specify the number of grids and spacing in each direction. It

is important that the grid be defined such as to accurately represent the geometry of the structure, so it is advisable to spend time carefully planning the number and spacing of the grid lines.

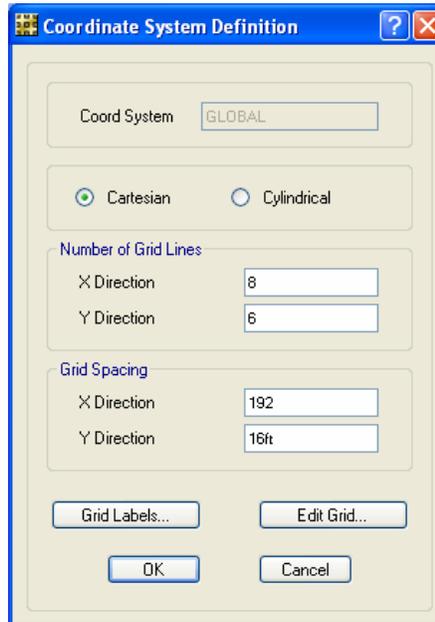


Figure 53 Coordinate System Definition form

1. Select the *Cartesian* option.
2. As shown in Figure 53, set the Number of Grid Lines in the X Direction to **8** and in the Y Direction to **6**.
3. In the Grid Spacing area, type **16ft** in the X Direction edit box.

Note: When the units are explicitly stated, in this case feet (ft), the program automatically converts the number input to be consistent with the database units (recall that the units have been set to kip-in). The value also may have been input as 16*12, without the ft identifier.

4. Type **16ft** in the Y Direction edit box in the Grid Spacing area.
5. Click the **Grid Labels** button to display the Grid Labeling Options form shown in Figure 54.

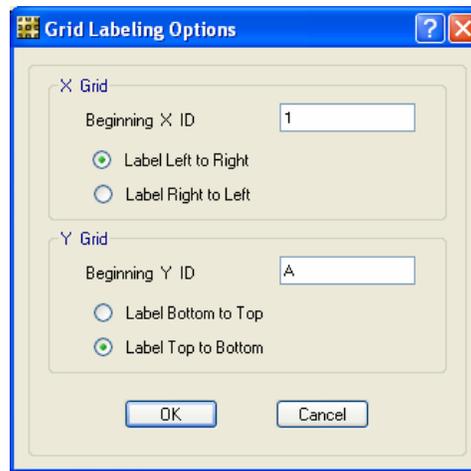


Figure 54 Grid Labeling Options form

- a. In the X Grid area, type **1** in the Beginning X ID edit box. This will number the grids along the X-axis starting with 1.
 - b. In the Y Grid area, type **A** in the Beginning Y ID edit box. This will label the grids along the Y-axis starting with A.
 - c. In the Y Grid area, select the *Label Top to Bottom* option – grid A will start at the top of the model.
 - d. Click the **OK** button to accept the changes and leave the Grid Labeling Options form.
6. Click the **Edit Grid** button on the Coordinate System Definition form to display the form shown in Figure 55. The Coordinate System form is used to modify and edit the grid definitions, as well as set the top of model datum. It also allows the user to set the display options associated with the grids.

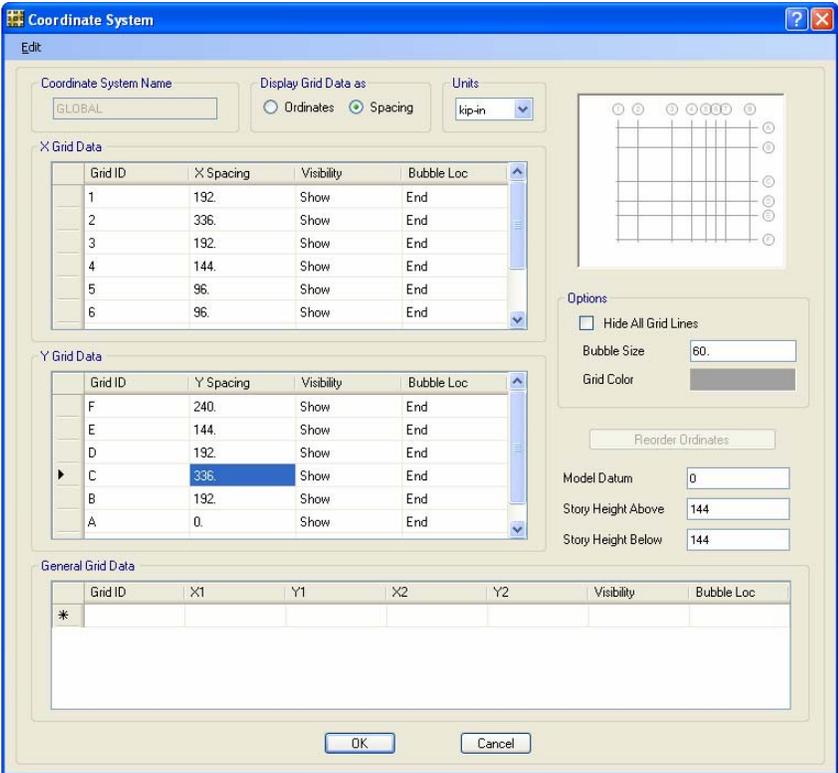


Figure 55 Coordinate System form

- a. In the Display Grid Data as area, select the *Spacing* option.
- b. In the **X Grid Data** table, change the X spacing as follows (make sure to type **ft** in the edit box):

Grid ID	Change X Spacing to
2	28ft
4	12ft
5	8ft
6	8ft
7	20ft

- c. In the **Y Grid Data** table, change the Y spacing as follows (make sure to type **ft** in the edit box):

Grid ID	Change Y Spacing to
F	20ft
E	12ft
C	28ft

- d. Click the **OK** button to accept your changes.

When you leave the Coordinate System form, by default, the grid displays on screen in the main SAFE window with two windows tiled vertically: a Model Explorer window on the left and a Plan View on the right. The number of view windows can be changed using the **Options menu > Windows** command.

- D. Click the **View menu > Set Display Options** command to display the Set Display Options form. Uncheck the *Horizon* option in the Items Present In View area and click the **OK** button to exit this form. The *Horizon* option displays a plane that resembles an engineering calculation grid to illustrate the datum plane location; we are turning this option off to display our coordinate system grid better.

You should now have a display similar to that shown in Figure 56.

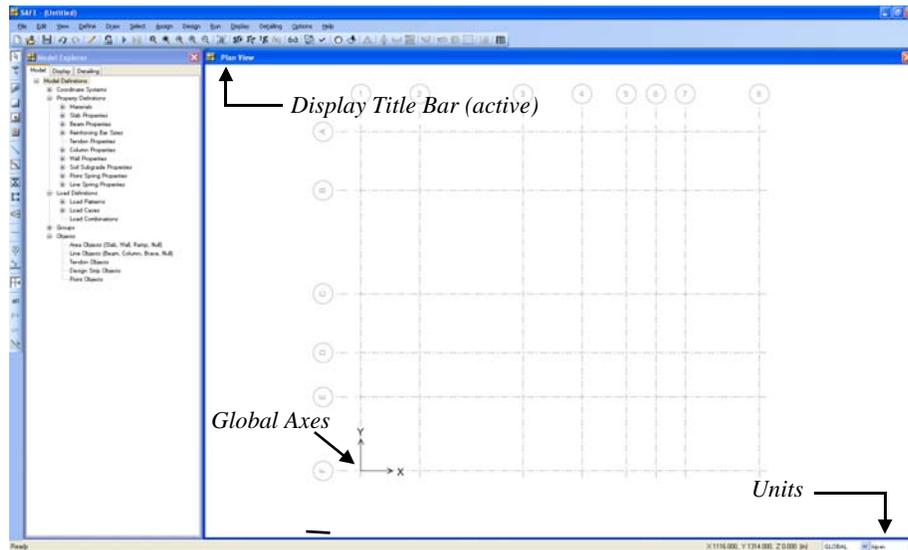


Figure 56 SAFE Main Window

Note that the Plan View window is active. When the window is active, the display title bar is highlighted. Set a window active by clicking anywhere in the window.

Note that the Global Axes are displayed as well, and that the Z positive is in the “up” direction. When SAFE refers to the direction of gravity, this is in the negative Z direction, or “down.”

Save the Model

Save your model often! Click the **File menu > Save** command. Specify the directory in which you want to save the model. For this tutorial, specify the file name as *PTSlab*.

Typically you will save the model with the same name. However to record your work at various stages of development or as a backup, the **File menu > Save As** command can be used to save the file using another name.

Step 2 Define Properties

In this Step, material and section properties for the slab, tendons, columns, and walls are defined.

Although we are going to define our materials and sections using menu commands, previously defined materials and properties also may be reviewed and modified using the Model Explorer window (see Figure 57). To do this, expand any of the property items on the tree by clicking the + node, and then double click on the desired item to display the associated form.

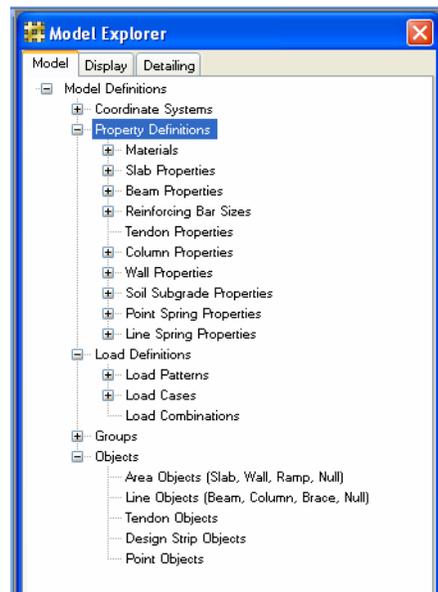


Figure 57 Model Explorer window

Define Material Properties

- A. Click the **Define menu > Materials** command to access the Materials form shown in Figure 58.

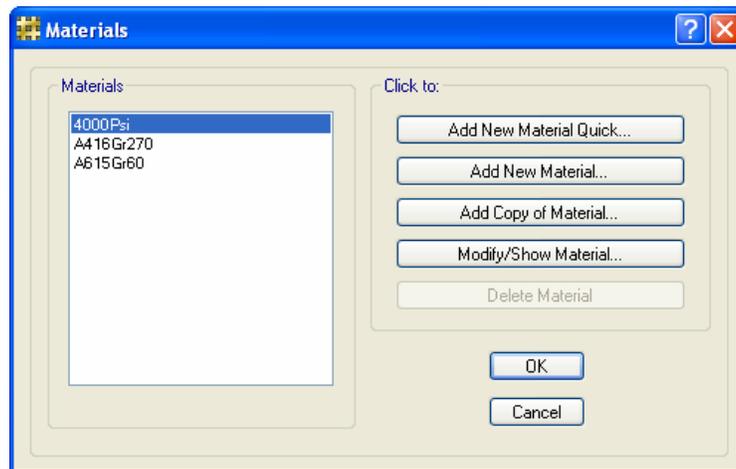


Figure 58 Materials form

- B. Click the **Add New Material Quick** button to display the Quick Material Definition form shown in Figure 59. This form will be used to define the 5000psi concrete material for the model.
1. Select *Concrete* from the Material Type drop-down list.
 2. Select *f_c 5000 psi* from the Specification drop-down list.
 3. Click the **OK** button to exit the Quick Material Definition form.

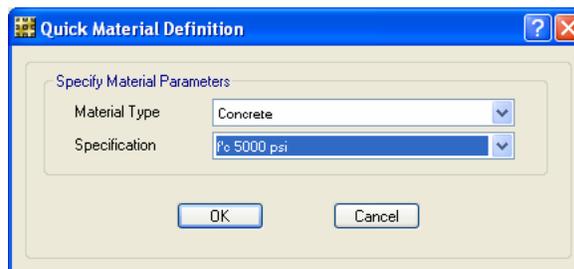
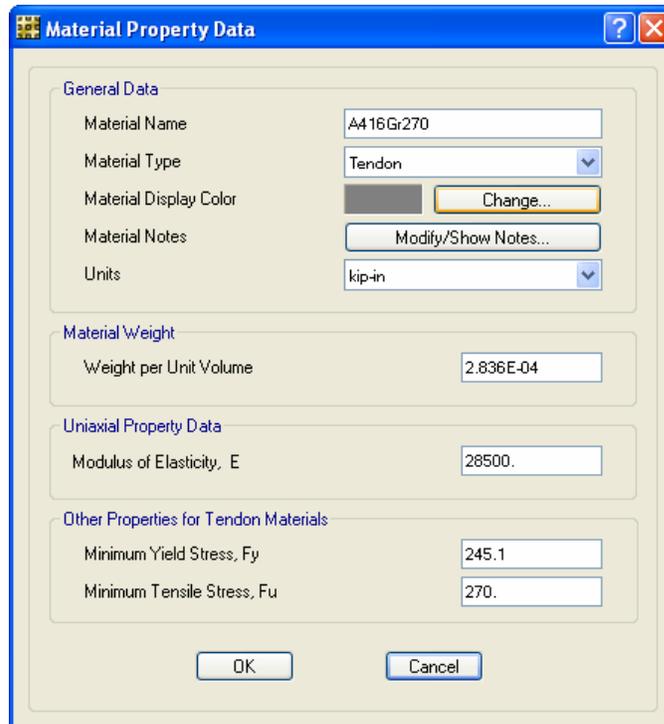


Figure 59 Quick Material Definition form

- C. In the Materials area of the Materials form, highlight *A416Gr270*.

- D. Click the **Modify/Show Material** button to display the Material Property Data form shown in Figure 60. This form lists the properties associated with Grade 270 prestressing strands; this is the tendon material property that will be used in our model.
1. Click the **OK** button to accept this material as defined.



The image shows a dialog box titled "Material Property Data" with a blue header bar containing a help icon and a close button. The dialog is divided into several sections:

- General Data:** Includes fields for Material Name (A416Gr270), Material Type (Tendon), Material Display Color (with a "Change..." button), Material Notes (with a "Modify/Show Notes..." button), and Units (kip-in).
- Material Weight:** Includes a field for Weight per Unit Volume (2.836E-04).
- Uniaxial Property Data:** Includes a field for Modulus of Elasticity, E (28500).
- Other Properties for Tendon Materials:** Includes fields for Minimum Yield Stress, Fy (245.1) and Minimum Tensile Stress, Fu (270).

At the bottom of the dialog are "OK" and "Cancel" buttons.

Figure 60 Material Property Data form

- E. Click the **OK** button on the Materials form to accept all of the defined materials.
- F. Click the **File menu** > **Save** command to save your model.

Define Slab Properties

- A. Click the **Define menu** > **Slab Properties** command to access the Slab Properties form shown in Figure 61.

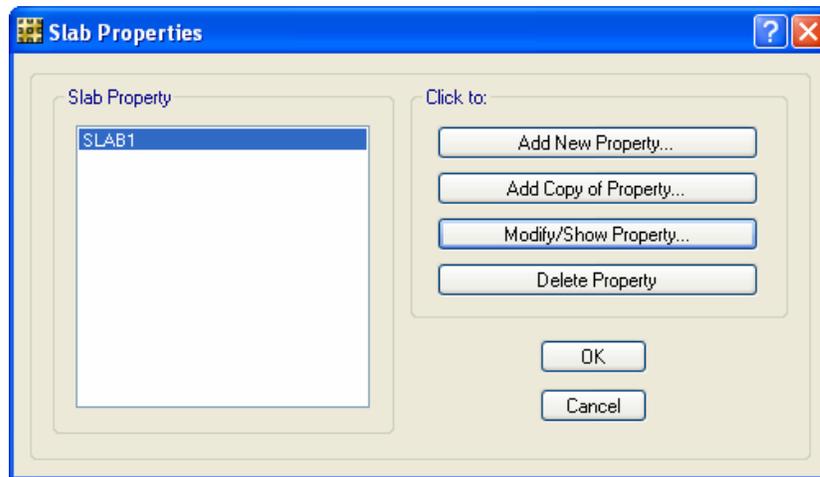


Figure 61 Slab Properties form

- B. In the Slab Property area, highlight *SLAB1*.
- C. Recall that for this tutorial project, the slab thickness is 8 inches. To adjust the default dimensions of *SLAB1*, click the **Modify/Show Property** button to access the Slab Property Data form shown in Figure 62.
 1. In the General Data area, select *5000Psi* from the Slab Material drop-down list.

Note: Additional material properties may be defined by clicking on the “...” button next to the load pattern name. A “...” button returns you to the form used to define the item in the adjacent drop-down list, which in this case is the Materials form.
 2. Select *Slab* from the Type drop-down list in the Analysis Property Data area; this ensures that any area object with this property assignment will be identified as a slab member.
 3. If not already displayed, type **8** in the Thickness edit box in the Analysis Property Data area.
 4. Click the **OK** button to accept the changes and return to the Slab Properties form.

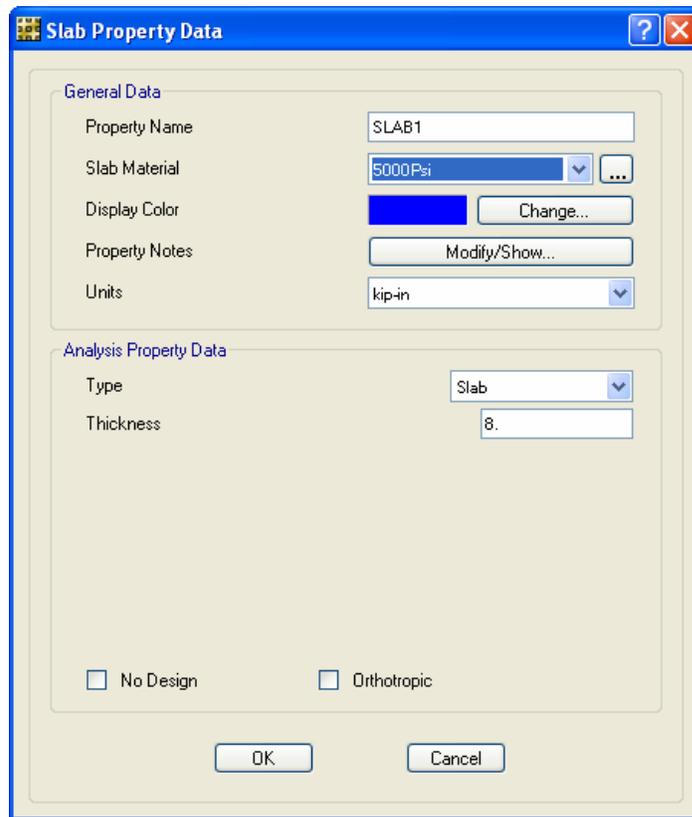


Figure 62 Slab Property Data form

- D. Click the **OK** button to end the slab property definition.
- E. Click the **File menu > Save** command to save the model.

Define Tendon Properties

- A. Click the **Define menu > Tendon Properties** command to access the Tendon Properties form.
- B. Click the **Add New Property** button to access the Tendon Property Data form shown in Figure 63. Recall that the strands for the tendons have an area of 0.153 square inches.
 - 1. Verify that *TENDON1* is showing in the Property Name edit box in the General Data area.

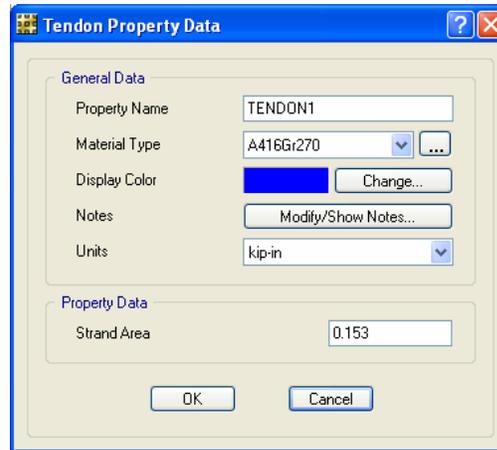


Figure 63 Tendon Property Data form

2. In the General Data area, make sure that *A416Gr270* is displayed in the Material Type drop-down list.
 3. If not already entered, type **0.153** in the Strand Area edit box in the Property Data area.
 4. Click the **OK** button to end the tendon property definition.
- C. Click the **OK** button to leave the Tendon Properties form.
- D. Click the **File menu** > **Save** command to save your model.

Define Column Properties

- A. Click the **Define menu** > **Column Properties** command to access the Column Properties form.
- B. In the Column Property area, highlight *COL1*.
- C. Click the **Modify/Show Property** button to access the Column Property Data form shown in Figure 64. Recall that the columns for the project are 12-inch square.
 1. In the General Data area, select *5000Psi* from the Material drop-down list.

Step 2 Define Properties

The screenshot shows the 'Column Property Data' dialog box. The 'General Data' section includes: Property Name (COL1), Material (5000Psi), Display Color (cyan), Notes, and Units (kip-in). The 'Column Section Dimensions' section includes: Column Shape (Rectangular), Parallel to 2-Axis (12), Parallel to 3-Axis (12), and a checked checkbox for 'Include Automatic Rigid Zone Area Over Column'. The 'Automatic Drop Panel Dimensions' section includes: 'Include Automatic Drop Panel Over Column' (unchecked), Parallel to 2-Axis, Parallel to 3-Axis, and Slab Property. The 'Automatic Column Capital (Drop Cap) Dimensions' section includes: 'Include Automatic Column Capital (Drop Cap)' (unchecked), Parallel to 2-Axis, Parallel to 3-Axis, and Height. A grid diagram on the right shows a column cross-section with axes 2 and 3. Buttons for 'Show Properties...', 'OK', and 'Cancel' are also visible.

Figure 64 Column Property Data form

2. In the Column Section Dimensions area, select *Rectangular* from the Column Shape drop-down list.
 3. In the Column Section Dimensions area, type **12** into the Parallel to 2-Axis edit box and type **12** into the Parallel to 3-Axis edit box.
 4. Make sure that the *Include Automatic Rigid Zone Area Over Column* option is checked. This option restricts deformation of the slab at the column location, which prevents unrealistic peaks in moment distribution from occurring.
 5. Click the **OK** button to leave the Column Property Data form.
- D. Click the **OK** button to accept the Column Property definition.

Define Wall Properties

- A. Click the **Define** menu > **Wall Properties** command to access the Wall Properties form.
- B. In the Wall Property area, highlight *Wall1*.
- C. Click the **Modify/Show Property** button to access the Wall Property Data form shown in Figure 65. Recall that the walls for the project are 8-inch thick.

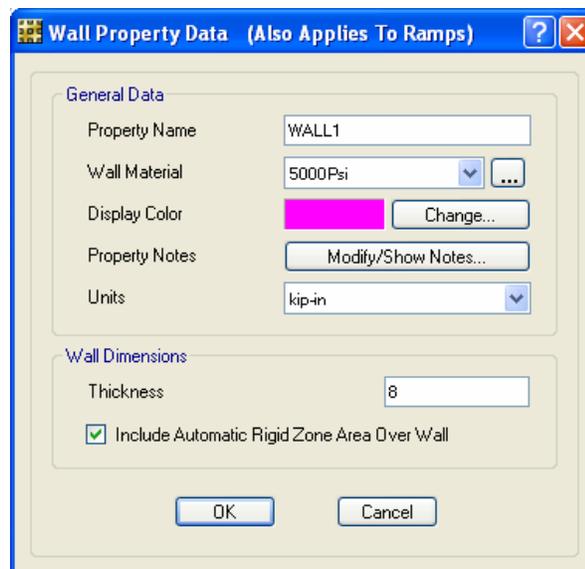


Figure 65 Wall Property Data form

1. In the General Data area, select *5000Psi* from the Wall Material drop-down list.
2. In the Wall Dimensions area, type **8** into the Thickness edit box.
3. Check the *Include Automatic Rigid Zone Area Over Wall* checkbox. This option restricts deformation of the slab at the wall location, which prevents unrealistic peaks in moment distribution from occurring.
4. Click the **OK** button to leave the Wall Property Data form.

D. Click the **OK** button to accept the Wall Property definition.

This completes the material and section property definition phase of the model creation. The slab and tendon properties will be assigned in the model datum plane, while the columns and walls will be assigned as supports. Supports also can be assigned as point restraints, point springs or line springs. Support stiffnesses are calculated by SAFE based on the cross-sectional properties, material properties and lengths specified when the columns and walls are drawn.

Step 3 Define Static Load Patterns

In this Step, the dead, live, and post-tensioning static load patterns are defined. That is, we will name the various types of loads (dead, live, prestress-final, and so on), and specify the self-weight multipliers. The loads will be assigned to objects, and the values for the loads specified (uniform dead load of 35 psf and live load of 50 psf), in Step 8.

A. Click the **Define menu > Load Patterns** command to access the Static Load Case Names form shown in Figure 66.

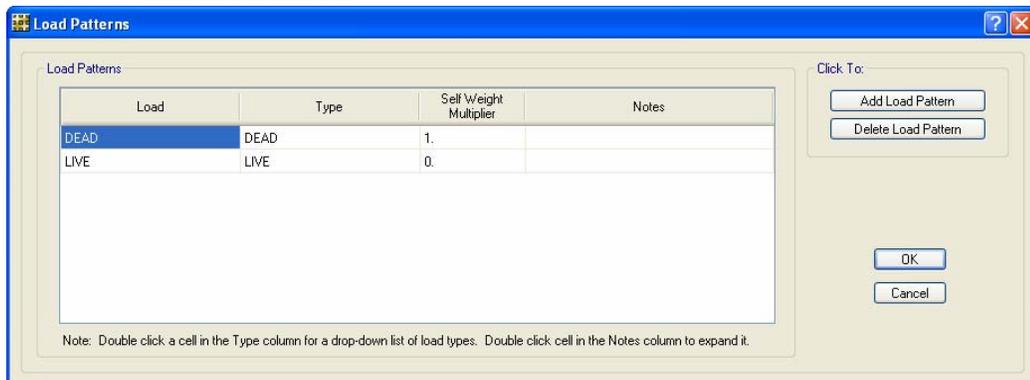


Figure 66 Load Patterns form

- B. Note that load patterns *DEAD* and *LIVE* are defined by default.
- C. Recall that the project will be analyzed for the dead load plus the self weight of the structure. Thus, the Self Weight Multiplier should be set equal to **1** (this will include 1.0 times the self weight of all mem-

bers) for the *DEAD* load. Only the *DEAD* load pattern should have a non-zero Self Weight Multiplier.

- D. Click the **Add Load Pattern** button.
- E. Highlight *LPAT1* in the Load column and type **PT-FINAL**.
- F. Select *PRESTRESS-FINAL* from the drop-down list under Type for the PT-FINAL load pattern.
- G. Click the **Add Load Pattern** button.
- H. Highlight *LPAT1* in the Load column and type **PT-TRANSFER**.
- I. Select *PRESTRESS-TRANSFER* from the drop-down list under Type for the PT-TRANSFER load pattern. The Load Patterns form should appear as shown in Figure 67.

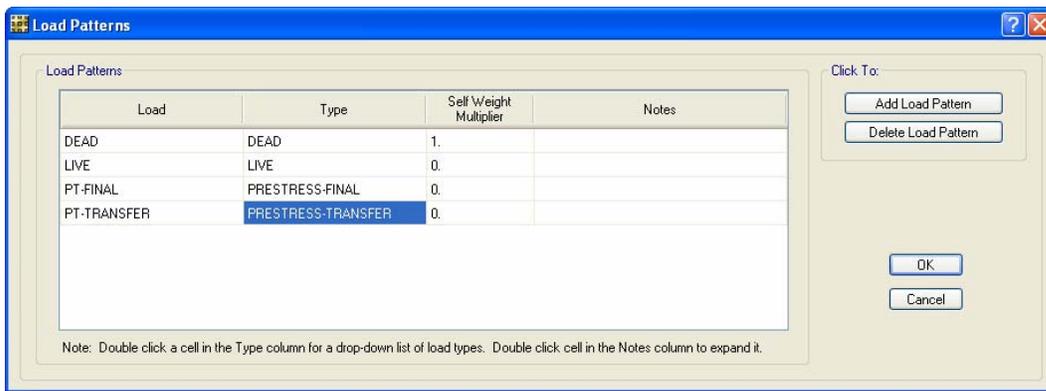


Figure 67 Load Patterns form after all load patterns are entered

- J. Click the **OK** button to accept all of the defined static load patterns.
- K. Click the **File menu > Save** command.

Step 4 Define Load Cases

In this Step, the Load Cases are defined. This is where the type of analysis is specified.

Step 4 Define Load Cases

- A. Click the **Define menu > Load Cases** command to access the Load Cases form shown in Figure 68.

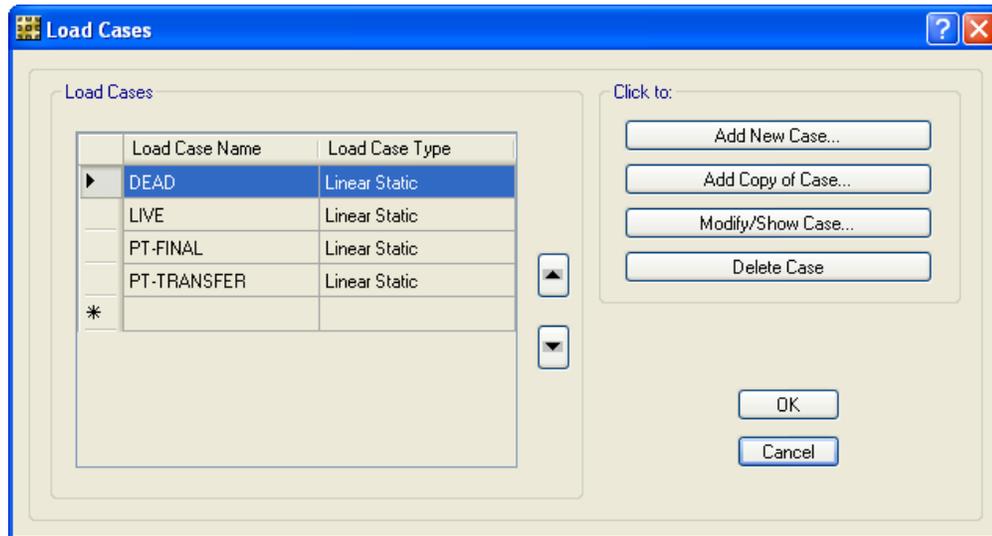


Figure 68 Load Cases form

- B. With the *DEAD* Load Case Name highlighted, click the **Modify/Show Case** button to display the Load Case Data form shown in Figure 69. This data form changes based on the type of load case specified.
1. In the Load Case Type area, select *Static* from the drop-down list. Modal and Hyperstatic are also available as load case types.
 2. In the Analysis Type area, select the *Linear* option. When working with a Static Load Case Type, the program offers the option to do Linear, Nonlinear (Allow Uplift), Nonlinear (Cracked), or Nonlinear (Long Term Cracked) analysis. For our tutorial example a Static, Linear analysis will be performed for DEAD, LIVE, PT-FINAL and PT-TRANSFER.
 3. In the Loads Applied area, verify that the load pattern is *DEAD* with a scale factor of *1*.
 4. Click the **OK** button to close the Load Case Data form.

Load Case Name: DEAD

Load Case Data Notes: Modify/Show Notes...

Load Case Type: Static

Design...

Stiffness to Use:

- Zero Initial Conditions - Unstressed State
- Stiffness at End of Nonlinear Case

Important Note: Loads from the Nonlinear Case are NOT included in the current case

Analysis Type:

- Linear
- Nonlinear (Allow Uplift)
- Nonlinear (Cracked)
- Nonlinear (Long Term Cracked)

Creep Coefficient: []

Shrinkage Strain: []

Loads Applied:

Load Name	Scale Factor
DEAD	1.
*	[]

OK Cancel

Figure 69 Load Case Data form

- C. Review the other load cases, if so desired, by selecting a case and using the **Modify/Show Case** button as described for the DEAD load case.
- D. Click the **OK** button to close the Load Cases form.
- E. Click the **File menu > Save** command.

Step 5 Draw Objects

In this Step, slabs, columns, walls, openings, and design strips will be drawn.

Draw Slabs

Ensure that the Plan View is active (click anywhere in the display window; a window is active when the Display Title Bar, just below the hori-

zontal toolbar, is highlighted). Now draw area objects to model the slab using the following Action Items.

- A. Click the **Draw menu > Snap Options** command to display the Snap Options form shown in Figure 70.

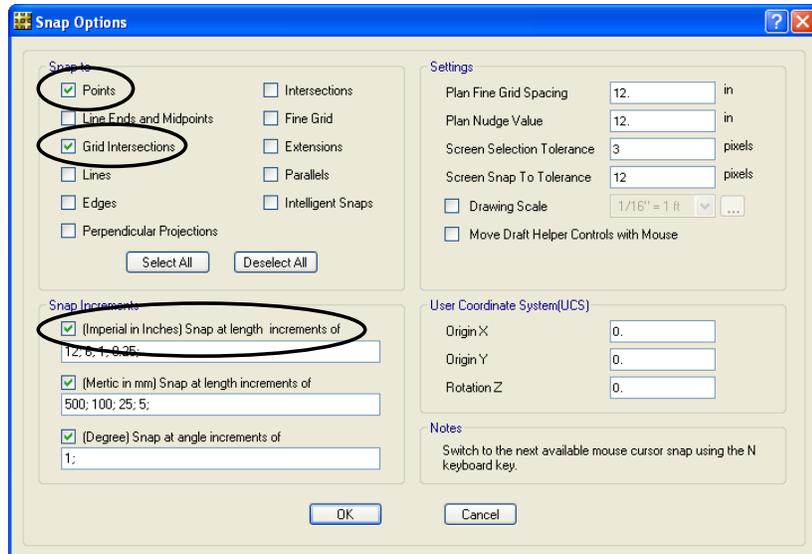


Figure 70 Snap Options form

- B. In the Snap to area, make sure that the *Points* and *Grid Intersections* options are checked. These snap options will assist in accurately positioning objects when drawing.
- C. In the Snap Increments area, make sure that the *(Imperial in Inches) Snap at length increments of* option is checked. When drawing slab edges, beams and walls, a dimension line will appear and the object will snap to the values specified in this edit box.
- D. Click the **OK** button to close the Snap Options form.
- E. Click the **Draw menu > Draw Slabs/Areas** command to access the Draw Slabs/Areas form shown in Figure 71. If the Draw Slabs/Areas form covers part of the model, click on the blue title bar, hold down the mouse button, and drag it out of the way.

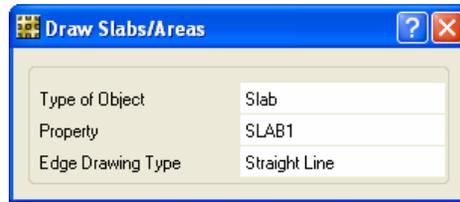


Figure 71 Draw Slabs/Areas form

- F. Make sure that the Type of Object is set to *Slab*. If it is not, click once in the drop-down list opposite the Type of Object item and select *Slab*.
- G. Click in the Property edit box and select *SLAB1* from the drop-down list. This is the slab property defined in Step 2.
- H. Click in the Edge Drawing Type drop-down list and select *Straight Line*. Although not used in this project, slab edges also may be drawn with arcs and curves.
- I. To draw the first corner of the slab, click once in the Plan View at the intersection of grid lines 1 and A (the cursor should display *Grid Point 1 A* at the correct location). Then moving clockwise around the grid (note how the slab edge is dimensioned as you draw), click once at these grid intersections in this order to draw the outline of the slab: 8A, 8D, 4D, 4F, and 1F. If you mistakenly click at the wrong point, use the **Backspace** key on the keyboard to “undo” the point and try again. After clicking at grid 1F, press the **Enter** key on the keyboard. The shaded slab object should now display.

If you made a mistake and wish to try re-drawing the entire object, click the **Select menu > Select > Pointer/Window** command to leave the Draw mode and go to the Select mode. Then click the **Edit menu > Undo Area Add** command, and repeat Items E through I.

- J. Click on the **Select menu > Select > Pointer/Window** command or press the **Esc** key on the keyboard to exit the Draw Slabs/Areas command.
- K. Select the slab by clicking on it anywhere. The status bar in the lower left-hand corner should show “1 Areas, 6 Edges selected.” If

you make a mistake in selecting, press the **Select menu > Clear Selection** command and try again.

- L. Click the **Edit menu > Edit Areas > Expand/Shrink Areas** command to display the Expand/Shrink Areas form shown in Figure 72.

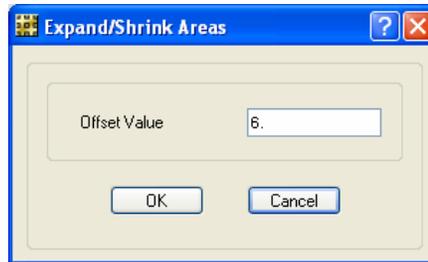


Figure 72 Expand/Shrink Areas form

- M. Type **6** into the Offset Value edit box. We will use this form to expand (a positive value expands) the slab by 6-inches at each corner to create the perimeter overhang that is needed to accommodate the width of the columns (1/2 of 12 inches).
- N. Click the **OK** button to finish the slab.
- O. Click the **File menu > Save** command to save your model.

Draw Columns

With the active window set as described in the preceding *Draw Slabs* section (i.e., Plan View window active and the snap to points and grid intersections enabled), use the following Action Items to draw columns.

- A. Click the **Draw menu > Draw Columns** command to access the Draw Columns form shown in Figure 73.
- B. Click in the Property Below edit box and select *COL1* from the drop-down list. This is the property for the 12-inch by 12-inch column defined in Step 2.
- C. Click in the Property Above edit box and select *COL1* from the drop-down list.

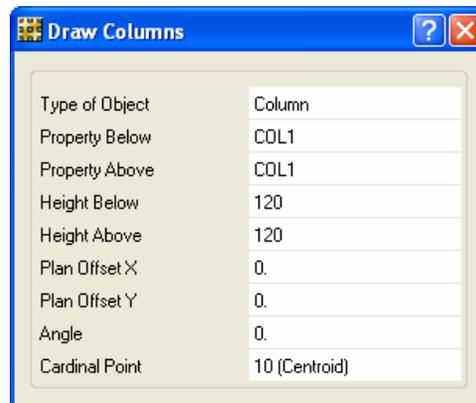


Figure 73 Draw Columns form

- D. Click in the Height Below edit box and type **10ft**. Note that the units are inches, so this value will be converted to 120.
- E. Click in the Height Above edit box and type **10ft**.
- F. Click in the Cardinal Point edit box and select *10 (Centroid)* from the drop-down list.
- G. Left click once at each of the following grid intersections to draw the columns: 1A, 1B, 1F, 2A, 2B, 2F, 3F, 4F, 5A, 5B, 5D, 8A, 8B, 8C, and 8D.
- If you have made a mistake while drawing the columns, click the **Select menu > Select > Pointer/Window** command to leave the Draw mode and go to the Select mode. Then click the **Edit menu > Undo Column Object Add** command as many times as needed to remove the incorrectly drawn columns, and repeat Items A through G.
- H. Click on the **Select menu > Select > Pointer/Window** command or press the **Esc** key on the keyboard to exit the Draw Columns command.
- I. Click the **File menu > Save** command to save your model.
- J. Click the **View menu > Set Default 3D View** command to display the model in 3D. Note how the columns extend above and below the slab.

- K. Click the **View menu > Set Plan View** command to return to the Plan View before continuing with the project.

Draw Walls

Similar to the preceding two sections, ensure that the Plan View is active and that the snap to points, grid intersections and the snap increments options are enabled. Now use the following Action Items to draw walls.

- A. Click the **Draw menu > Snap Options** command to access the Snap Options form.
- B. Check the *Line Ends and Midpoints* checkbox in the Snap to area.
- C. Click the **OK** button to close the Snap Options form.
- D. Click the **Draw menu > Draw Walls** command to access the Draw Walls form shown in Figure 74.

Type of Object	Wall
Wall Property Below	WALL1
Wall Property Above	WALL1
Wall Height Below	120
Wall Height Above	120
Plan Offset Normal	0.
Line Drawing Type	Straight Line

Figure 74 Draw Walls form

- E. Click in the drop-down list opposite the Wall Property Below item and select *WALL1*. This is the wall property for the 8-inch-thick wall defined in Step 2.
- F. Click in the Wall Property Above drop-down list and select *WALL1*.
- G. Click in the Wall Height Below edit box and type **10ft**. Note that the units are inches, so the value will be converted to 120.

- H. Click in the Wall Height Above edit box and type **10ft**.
- I. Click in the drop-down list opposite the Line Drawing Type item and select *Straight Line*. Although not used in this project, walls may also be drawn with arcs and curves.
- J. Left click at grid intersection 1C to begin drawing the first wall. Draw the wall along grid line C to grid intersection 2C and then click again. The snap increments dimension line should show *16 ft*. Hit the **Enter** key on the keyboard to complete the wall. This places a wall 16 feet long along grid line C.

If you have made a mistake while drawing this object, click the **Select menu > Select > Pointer/Window** command to leave the Draw mode and go to the Select mode. Then click the **Edit menu > Undo Area Object Add** command, and repeat Items A through G.

- K. For the next wall, also located along grid line C, left click at grid intersection 3C to begin drawing the wall and at intersection 4C (the snap increment dimension line should show *16 ft*) to designate the end of the wall. Hit the **Enter** key on the keyboard to complete the wall.
- L. Click at grid intersection 1E and then at intersection 2E to draw the next wall along grid E. Hit the **Enter** key on the keyboard to complete the wall.
- M. Click at grid intersection 3E and then at intersection 4E to draw the last x-direction wall along grid E. Hit the **Enter** key on the keyboard to complete the wall.
- N. Click at grid intersection 3A and then at intersection 3B to draw the first y-direction wall along grid 3. Hit the **Enter** key on the keyboard to complete the wall.
- O. Snap the mouse to the *Mid Point* of the wall (a triangular cursor should display) along grid line C between grids 3 and 4, and left click. Move the mouse to the *Mid Point* of the wall along grid line E between grids 3 and 4 and click again – the snap increment dimen-

sion line should show 28 ft. Hit the **Enter** key on the keyboard to complete the wall.

- P. Click at grid intersection 6C and then at intersection 6D to draw the next y-direction wall along grid 6. Hit the **Enter** key on the keyboard to complete the wall.
- Q. Click at grid intersection 7A and then at intersection 7B to draw the last y-direction wall. Hit the **Enter** key on the keyboard to complete the wall.
- R. Click on the **Select menu > Select > Pointer/Window** command or press the **Esc** key on the keyboard to exit the Draw Walls command. Your model should look similar to Figure 75.

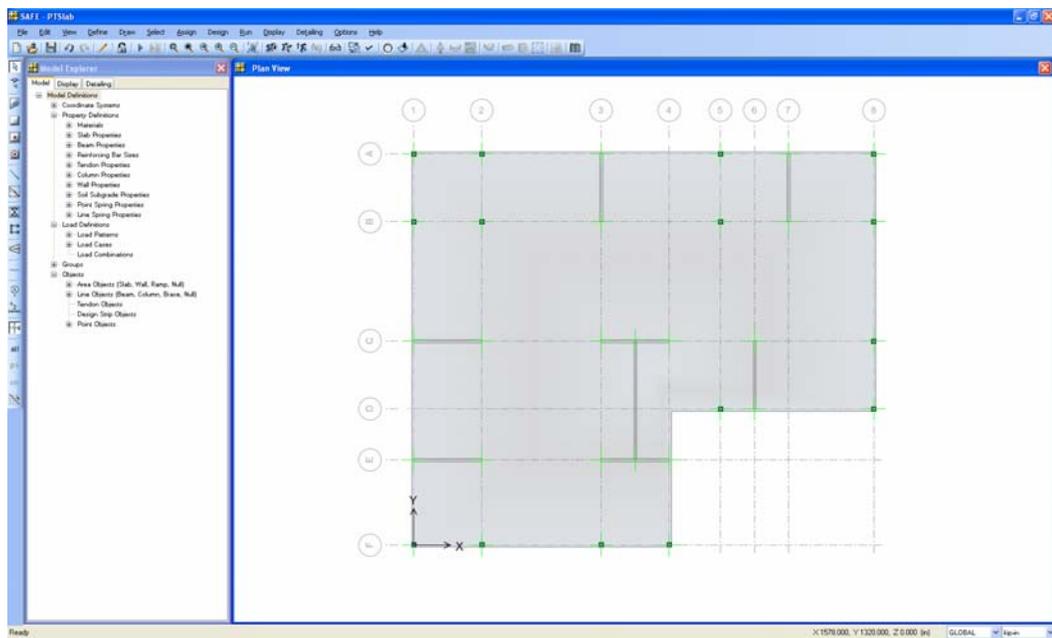


Figure 75 The model after drawing columns and walls

Draw Openings (Area Objects)

Similar to the previous sections, ensure that the Plan View is active. Draw an area object to model the opening as follows:

- A. Click the **Draw menu > Draw Rectangular Slabs/Areas** command to display the Draw Rectangular Slabs/Areas form shown in Figure 76.



Figure 76 Draw Rectangular Slabs/Areas form

- B. Click once in the drop-down list opposite the Type of Object item and select *Opening*.
- C. Left click at the intersection of grid lines 3 and C, and while holding the left mouse button down, move diagonally down and to the right to the point where grid line D intersects the adjacent y-direction wall, and release the button. An area object (8 ft x 28 ft) with different shading should appear, indicating that an opening for the stairs has been drawn. An opening takes priority over an object with assigned slab properties when the program determines the stiffness formulation.
- D. Click on the **Select menu > Select > Pointer/Window** command or press the **Esc** key on the keyboard to exit the Draw Rectangular Slabs/Areas command.
- S. Click the **Draw menu > Snap Options** command to access the Snap Options form.
- T. Check the *Intersections* checkbox in the Snap to area.
- E. Click the **OK** button to close the Snap Options form.
- F. Click the **View menu > Rubber Band Zoom** command. Left click just above and to the left of grid intersection 6A, and while holding the mouse button down, drag a window down and to the left of grid intersection 7B.

- G. Click the **Draw menu > Draw Rectangular Slabs/Areas** command to display the Draw Rectangular Slabs/Areas form.
- H. To draw the second opening, snap the mouse to the intersection of grid line 6 and the edge of the slab (the cursor should say *Intersection*), and while holding the left mouse button down, move diagonally down and to the right to the *Mid Point* of the wall that lies along grid line 7, and release the button.
- I. Click on the **Select menu > Select > Pointer/Window** command or press the **Esc** key on the keyboard to exit the Draw Rectangular Slabs/Areas command.
- J. Click the **View menu > Restore Full View** command.
- K. Click the **File menu > Save** command to save your model.

Draw Design Strips

Similar to the previous sections, ensure that the Plan View is active. Design strips determine how tendons and reinforcing will be calculated and positioned in the slab. Typically design strips are positioned in two principal directions: Layer A and Layer B. Use the following Action Items to draw design strips:

- A. Click the **Draw menu > Draw Design Strips** command to display the Draw Design Strips form shown in Figure 77.



Type of Object	Strip
Strip Layer	A
Start Width Left	72.
Start Width Right	72.
End Width Left	72.
End Width Right	72.

Figure 77 Draw Design Strips form

- B. Select *A* from the Strip Layer drop-down list. Design strips subsequently drawn will be assigned to Layer A.
- C. The values showing in the width edit boxes may be ignored, as we will edit the design strips in a later step to automatically adjust their width based on the location of adjacent strips.
- D. Left click at grid intersection 1A to begin drawing the first design strip. Click again at grid intersection 6A and hit the **Enter** key on the keyboard to complete the design strip.
- E. Repeat Item D for the following pairs of grid intersections: 7A to 8A; 1B to 8B; 1C to 8C; 1E to 4E; and 1F to 4F.
- F. Snap the mouse to the *Point* at the approximate intersection of grids D and 3.5 (between 3 and 4) along the wall and left click to begin the design strip, and then click again at grid intersection 8D. Hit the **Enter** key to complete the design strip. This completes the Layer A design strips.

Note that although the majority of the design strips were drawn using grid intersections rather than the edge of the slab, the program assumes that they should go to the slab edge and will automatically extend the design strips when the tolerance is small.

- G. On the Draw Design Strips form, select *B* from the Strip Layer drop-down list. Design strips subsequently drawn will be assigned to Layer B.
- H. Left click at grid intersection 1A to begin drawing the first Layer B design strip. Click again at grid intersection 1F and hit the **Enter** key on the keyboard to complete the design strip.
- I. Repeat Item H for the following pairs of grid intersections: 2A to 2F; 3A to 3F; 4A to 4F; 5A to 5D; 6A to 6D; 7A to 7D; and 8A to 8D.
- J. Click on the **Select menu > Select > Pointer/Window** command or press the **Esc** key on the keyboard to exit the Draw Design Strips command and return to the select mode.

- K. Click the **Select menu > Select > Properties > Design Strip Layers** command to display the Select Design Strip Layers form shown in Figure 78.

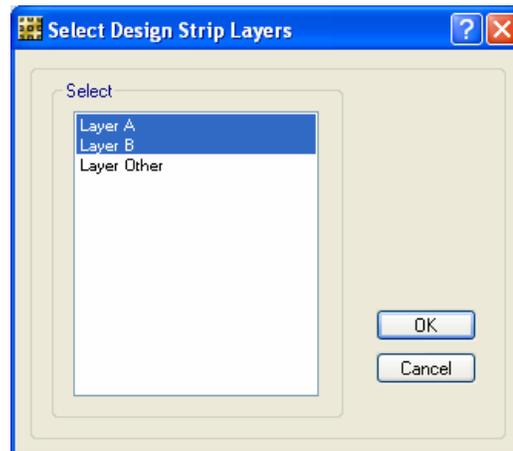


Figure 78 Select Design Strip Layers form

- L. Highlight *Layer A* and *Layer B* in the Select area by holding down the Shift key on the keyboard while clicking on the items.
- M. Click the **OK** button to leave the form. The status bar in the lower left-hand corner should now show “15 Design Strips selected.”
- N. Click the **Edit menu > Add/Edit Design Strips > Edit Strip Widths** command to display the Edit Strip Widths form.
- O. In the Strip Width Options area, select the *Auto Widen Entire Strip* option. Selecting this option allows the program to automatically set the width of each design each strip based on the location of adjacent strips.
- P. Click the **OK** button to accept the selections and leave the Edit Strip Widths form.
- Q. Click the **File menu > Save** command to save your model.

Step 6 Add Tendons

In this step, tendons will be added to the model. Although tendons may be drawn in the model using the **Draw menu > Draw Tendons** command, it is often more efficient to add them to the design strips, which is how tendons will be added to this project. The number of tendons (and strands) will be determined by the program based on the following defaults: tendon jacking stress = 216 ksi; stressing losses = 27 ksi; long-term losses = 13.5 ksi; tendons are jacked from the J-end (ending point) of the tendon.

Similar to the previous sections, ensure that the Plan View is active. Add tendons to the design strips as follows:

- A. Click the **Select menu > Select > Properties > Design Strip Layers** command to display the Select Design Strip Layers form.
- B. Highlight *Layer A* in the Select area.
- C. Click the **OK** button to accept the selection. The status bar in the lower left-hand corner should now show “7 Design Strips selected.”
- D. Click the **Edit menu > Add/Edit Tendons > Add Tendons in Strips** command to display the Quick Tendon Layout form shown in Figure 79.

The screenshot shows the 'Quick Tendon Layout' dialog box. It features a title bar with a help icon and a close button. The main area is divided into several sections. On the left, under 'Selected Design Strips', there are four dropdown menus: 'Layout Type' (set to 'Banded'), 'Band Width' (set to '0.'), 'Tendon Property' (set to 'TENDON1'), and 'Vertical Profile' (set to 'Reverse Parabola'). Below these is a small diagram of a parabolic tendon profile. To the right of these are two sections: 'Precompression Level' with 'Maximum' (0.275) and 'Minimum' (0.125) input fields, and 'Self Load Balancing Ratio' with 'Maximum' (0.8) and 'Minimum' (0.6) input fields. At the bottom left, there is a 'Units' dropdown menu set to 'kip-in'. At the bottom right, there are 'OK' and 'Cancel' buttons. A checkbox labeled 'Add Partial Tendons if Needed' is located below the tendon profile diagram and is currently unchecked.

Figure 79 Quick Tendon Layout form

- E. Select *Banded* from the Layout Type drop-down list. Tendons will be banded in the Layer A direction, and distributed in the Layer B direction.
- F. Type **0** into the Band Width edit box. By using a value of 0, the program will calculate how many total strands are needed.
- G. Select *TENDON1* from the Tendon Property drop-down list. This is the tendon property defined in Step 2.
- H. Select *Reverse Parabola* from the Vertical Profile drop-down list.
- I. Verify that the Self Load Balancing Ratios are set to *0.8* for Maximum and *0.6* for Minimum. This controls how much of the structure's self weight the program will try to balance with the post-tensioning.
- J. Click the **OK** button to leave the Quick Tendon Layout form. A single tendon in each Layer A design strip should now appear.
- K. Click the **Select menu > Select > Properties > Design Strip Layers** command to display the Select Design Strip Layers form.
- L. Highlight *Layer B* in the Select area.
- M. Click the **OK** button to accept the selection. The status bar in the lower left-hand corner should now show "8 Design Strips selected."
- N. Click the **Edit menu > Add/Edit Tendons > Add Tendons in Strips** command to display the Quick Tendon Layout form.
- O. Select *Distributed* from the Layout Type drop-down list.
- P. Type **38** into the Tendon Spacing edit box. The program will determine how many strands are needed in each tendon for this spacing.
- Q. Select *Parabola* from the Vertical Profile drop-down list.
- R. Verify that the Self Load Balancing Ratios are set to *0.8* for Maximum and *0.6* for Minimum.

- S. Click the **OK** button to leave the Quick Tendon Layout form. Tendons in the Layer B design strips should now display.
- T. Hold down the **Shift** key on your keyboard and **right** click once on any of the tendons just drawn. A selection list similar to the one shown in Figure 80 displays because multiple objects exist at that location. In this case, one tendon and one area object exist at the same location. Note that the selection list will display only when the **Shift** key is used with the right click.

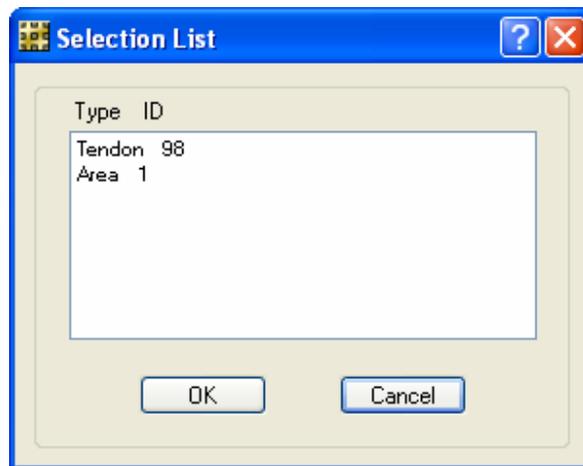


Figure 80 Selection List form

- U. Highlight the tendon object and click the **OK** button. Because a right click action initiated the selection process, a Tendon Object Information form similar to the one shown in Figure 81 will display.
 1. Click on the *Loads* tab. Note that the Tendon Jacking Stress is 216 ksi, and that the losses are 27 ksi for Stressing and 13.5 ksi for Long Term.
 2. Click on the *Geometry* tab. This tab describes the geometry of the tendon in both plan and elevation.

Tendon Object Name: 98

Units: kip-in

Assignments | Geometry | **Loads**

Tendon Load Data	
Transfer Load Pattern	PT-TRANSFER
Final Load Pattern	PT-FINAL
Jack From This Location	J-End
Tendon Jacking Stress	216.
Tendon Jacking Force	66.096

Tendon Loss Data	
Loss Type	Fixed
Stressing Loss	27.
Long Term Loss	13.5

Reset All

OK

Cancel

Figure 81 Tendon Object Information form

- Left click in any of the edit boxes associated with a vertical span, and the Tendon Vertical Profile form appears, similar to that shown in Figure 82. This form displays the vertical profile of the tendon in elevation, and allows the tendon profile to be altered either graphically, by grabbing a control point on the tendon and moving it to a new position, or numerically, by selecting the desired span and entering new values into the table. Click the **OK** button, to accept the default profiles.

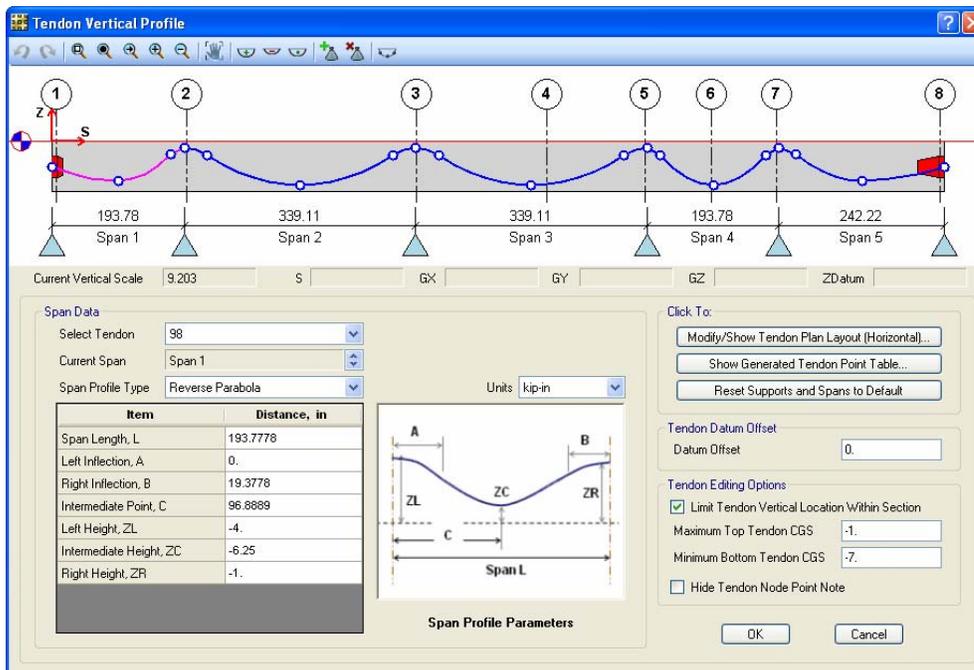


Figure 82 Tendon Vertical Profile form

4. Click the *Assignments* tab. This tab lists the number of strands associated with the selected tendon.
5. Click the **OK** button to exit the Tendon Object Information form.

V. Click the **File menu** > **Save** command to save your model.

Step 7 Set Display Options

In this Step, the set display options will be used to alter the objects displayed.

- A. Click the **View menu** > **Set Display Options** command. When the Set Display Options form displays, uncheck the *Tendon*, *Design Strip Layer A* and *Design Strip Layer B* check boxes in the Items Present in View area as shown in Figure 83. This action will turn off the display of the tendons and design strips.

Step 7 Set Display Options

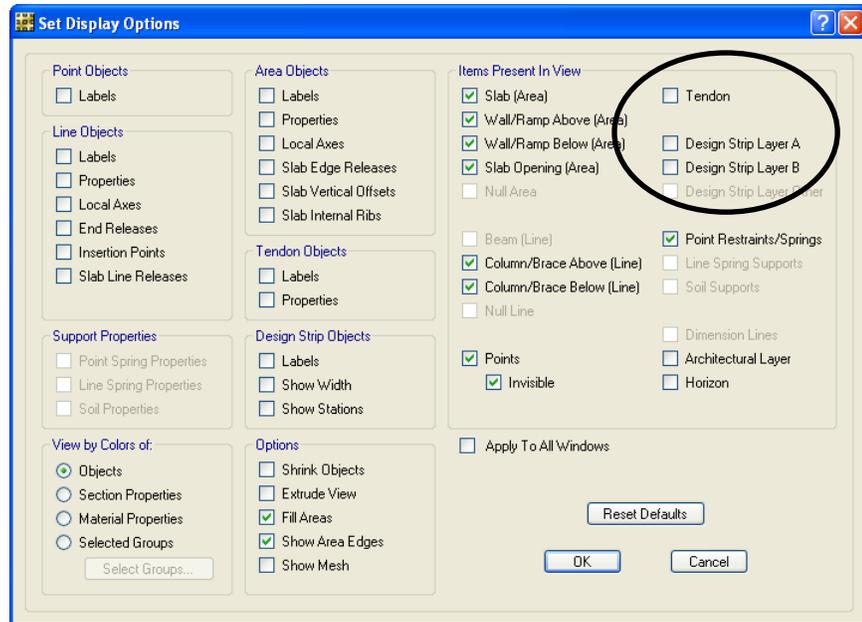


Figure 83 Set Display Options form

- B. Click the **OK** button to accept the changes, and the model now appears as shown in Figure 84.

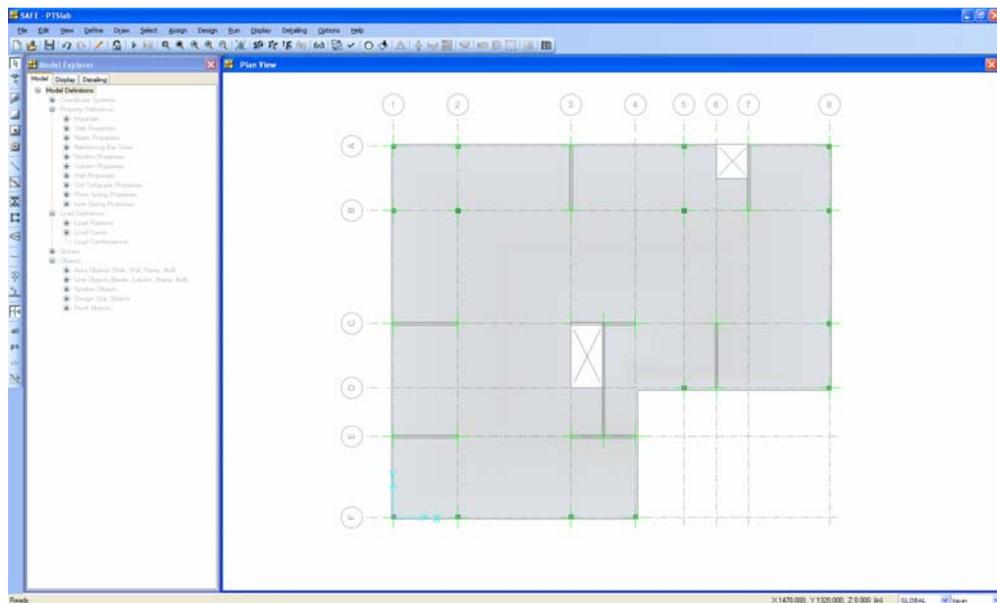


Figure 84 Model after all objects have been drawn

Step 8 Assign Loads

In this Step, the dead and live loads will be assigned to the slab. Ensure that the Plan View is still active, and that the program is in the select mode (**Draw menu > Select > Pointer/Window** command).

- A. Select the slab by clicking on it anywhere that is *not* a wall, column or opening. The status bar in the lower left-hand corner should show “1 Areas, 6 Edges selected.” If you make a mistake in selecting, click the **Select menu > Clear Selection** command, and try again.
- B. Click the **Assign menu > Load Data > Surface Loads** command to access the Surface Loads form shown in Figure 85.
- C. If it is not already displayed, select DEAD from the Load Pattern Name drop-down list.
- D. Select *lb-ft* from the Units area drop-down list.
- E. In the Uniform Loads (Gravity Direction), type **35** in the Uniform Load edit box.

The screenshot shows the 'Surface Loads' dialog box. The 'Load Pattern Name' is set to 'DEAD'. The 'Units' are set to 'lb-ft'. Under 'Uniform Loads (Gravity Direction)', the 'Uniform Load' is set to '35'. Under 'Nonuniform Loads (Gravity Direction)', the 'Coord. Sys.' is set to 'GLOBAL', and the coefficients A, B, and C are all set to '0'. The 'Options' section has 'Replace Existing Loads' selected. The 'OK' and 'Cancel' buttons are visible at the bottom right.

Figure 85 Surface Loads form

Note: Additional load cases may be defined by clicking on the “...” button next to the load pattern name. A “...” button returns you to the form used to define the item in the adjacent drop-down list, which in this case is the Load Patterns form.

- F. Click the **OK** button to accept the dead load assignment. SAFE will display the loads on the model. Use the **Assign menu > Clear Display of Assigns** command to remove the assignments from the display, if desired.
- G. Click anywhere on the main slab to reselect the slab, or click the **Select menu > Get Previous Selection** command to select the slab.
- H. Click the **Assign menu > Load Data > Surface Loads** command to again access the Surface Loads form.
- I. Select *LIVE* from the Load Pattern Name drop-down list.
- J. Type **50psf** in the Uniform Load edit box in the Uniform Loads area.
- K. Click the **OK** button to accept the live load assignment. Again, use the **Assign menu > Clear Display of Assigns** command to remove the assignments from the display.

To review the assignments to the slab, **right** click on the slab anywhere that is *not* a wall, column or opening to access the Slab-Type Area Object Information form shown in Figure 86.

Select the *Loads* tab and then *lb-ft* from the Units drop-down list and note that the DEAD Load Pattern has a Force per Unit Area of 35, and that the LIVE Load Pattern has a Force per Unit Area of 50. Click the **OK** button to close the Slab-Type Area Object Information form. Click the **File menu > Save** command to save your model.

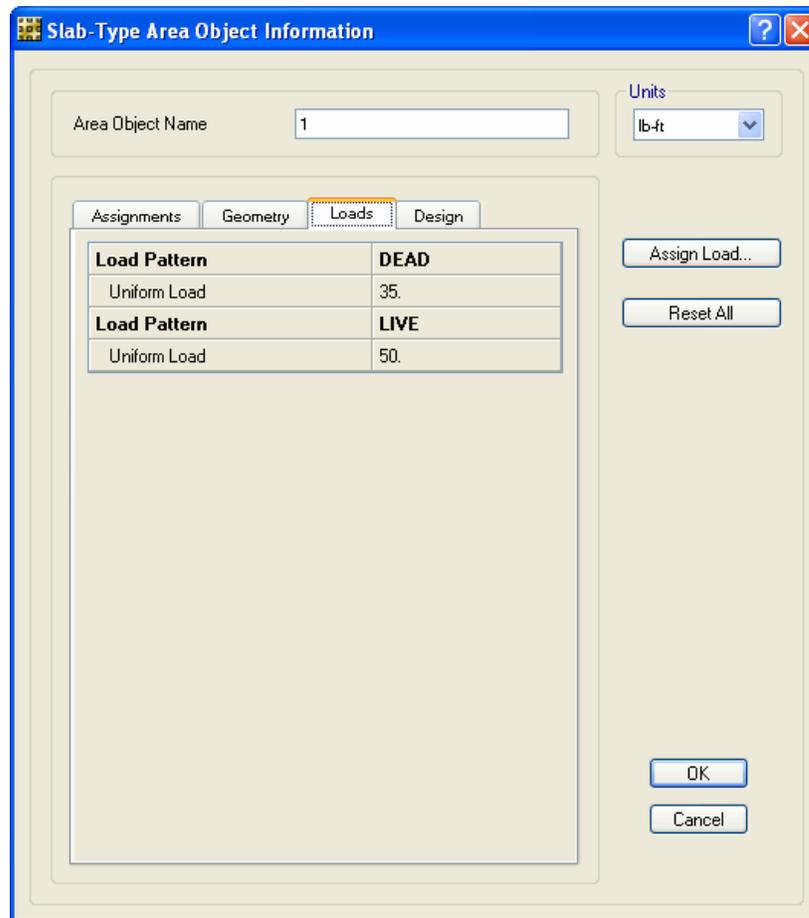


Figure 86 Slab-Type Area Object Information form

Step 9 Run the Analysis and Design

In this Step, the analysis and design will be run.

- A. Click the **Run menu > Run Analysis & Design** command to start the analysis. The program will create the analysis model from your object-based SAFE model, and will display information in the status bar in the lower left-hand corner as the analysis and design proceeds. Additional information about the run may be accessed at a later time using the **File menu > Show Input/Output Text Files** command and selecting the filename with a *.LOG* extension.

Step 10 Graphically Review the Analysis Results

- B. When the analysis and design are finished, the program automatically displays a deformed shape view of the model, and the model is locked. The model is locked when the **Options menu > Lock/Unlock Model** icon  appears depressed. Locking the model prevents any changes to the model that would invalidate the analysis results.

Step 10 Graphically Review the Analysis Results

In this Step, the analysis will be reviewed using graphical displays of the results.

- A. Click the **View menu > Set Default 3D View** command to display the deformed shape for the DEAD load case in 3D.
- B. Click the **Start Animation** button in the lower right-hand corner of the display to animate the deformed shape. Speed of the animation may be adjusted by using the slider control adjacent to the button. Click the **Stop Animation** button to end the animation.
- C. Click the **Display menu > Show Deformed Shape** command to access the Deformed Shape form shown in Figure 87.

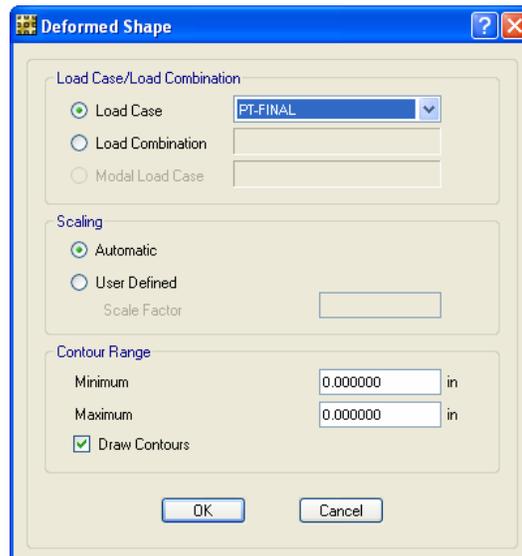


Figure 87 Deformed Shape form

- D. In the Load Case/Load Combination area, select the *Load Case* option.
- E. Select *PT-FINAL* from the Load Case drop-down list. Note that in addition to the DEAD, LIVE, PT-FINAL and PT-TRANSFER load cases that were previously defined, the program has automatically created a PT-FINAL-HP load case for hyperstatic analysis.
- F. Select the *Automatic* option in the Scaling area.
- G. Check the *Draw Contours* checkbox in the Contour Range area.
- H. Click the **OK** button to generate a 3-D deformed shape with contours for the PT-FINAL load case.
- I. Click the **Display menu > Show Slab Forces/Stresses** command to bring up the Slab Forces/Stresses form shown in Figure 88.
- J. Select *PT-TRANSFER* from the Load Case drop-down list.
- K. Select the *Stresses Top Face* option in the Component Type area.
- L. Select the *S11* option in the Component area.

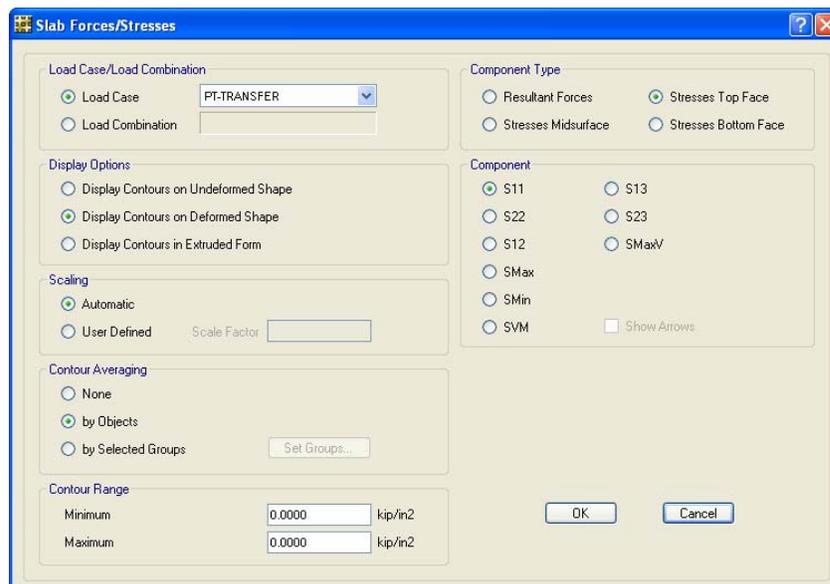


Figure 88 Slab Forces/Stresses form

- M. Select the *Display Contours on Deformed Shape* option in the Display Options area.
- N. Click the **OK** button to generate the moment diagram shown in Figure 89.

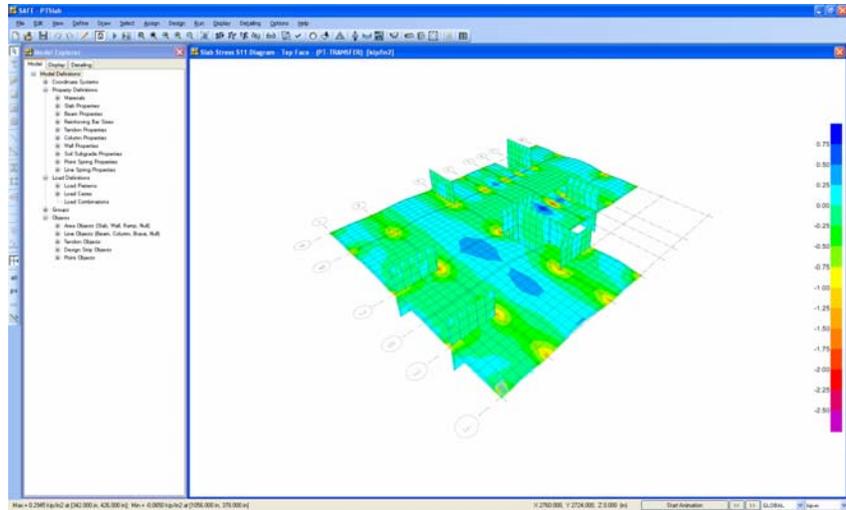


Figure 89 S11 Stress Diagram

Note that as you move the cursor over the diagram, the values are displayed at the cursor and in the lower left-hand corner of the window.

- O. Click the **Display menu > Show Undeformed Shape** command to clear the display of the stress diagram.
- P. Click the **View menu > Set Plan View** command to return to the Plan View.

Step 11 Design Display

In this Step, design results for the slab will be displayed. Note that the design was run along with the analysis in Step 9. Design results are for the ACI 318-08 code, which was selected in Step 1. Design preferences may be reviewed or changed by going to the **Design menu > Design Preferences** command (some design preferences are also set on the

property data forms); be sure to re-run the analysis and design (Step 9) if changes to the preferences are made.

- A. Click the **Display menu > Show Slab Design** command to access the Slab Design form shown in Figure 90.

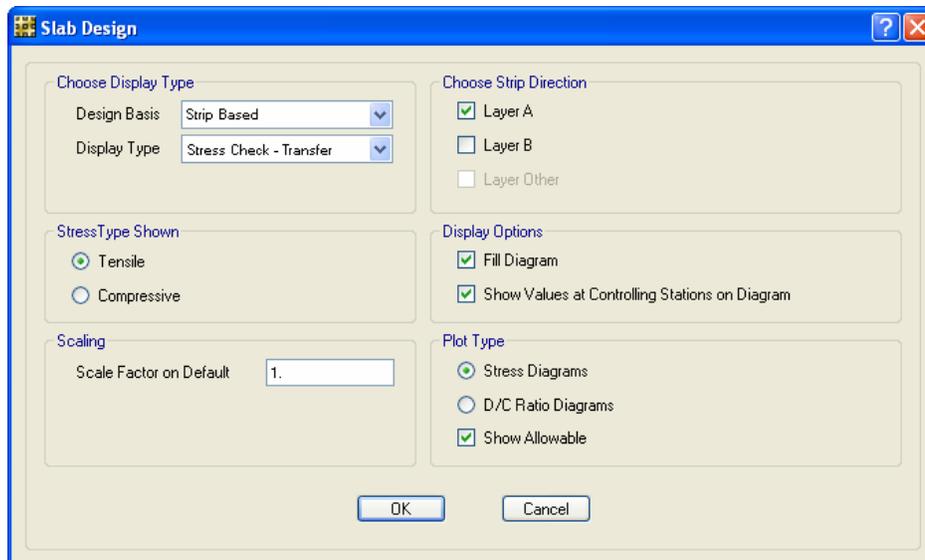


Figure 90 Slab Design form

- B. In the Choose Display Type area, select *Strip Based* from the Design Basis drop-down list and *Stress Check - Transfer* from the Display Type drop-down list.
- C. In the Choose Strip Direction area, check the *Layer A* checkbox and uncheck the *Layer B* checkbox. This will display the stress check results in the Layer A (X) direction only.
- D. In the Stress Type Shown area, select the *Tensile* option.
- E. Click the **OK** button to leave the Slab Design form and display the stress check results. The tensile stresses at transfer are displayed; if *failed* is displayed, the stress at that location exceeds the allowable P/T Stress Check ratio specified on the Design Preferences form accessed using the **Design menu > Design Preferences** command.

Step 11 Design Display

Positioning the cursor at any location on a Layer A design strip causes the top and bottom stress values to be displayed in the lower left corner of the window and at the cursor.

- G. To view the stress check results in the Layer B direction, click the **Display menu > Show Slab Design** command to display the Slab Design form.
- H. In the Choose Display Type area, select *Stress Check – Long Term* from the Display Type drop-down list.
- I. In the Choose Strip Direction area, uncheck the *Layer A* checkbox and check the *Layer B* checkbox.
- J. In the Stress Type Shown area, select the *Compressive* option.
- K. Click the **OK** button to leave the Slab Design form and display the long-term compressive stress check results for the Layer B direction. The view will be updated to that shown in Figure 91. Again, positioning the cursor anywhere on the strips will result in the display of the stress check values in the lower left-hand corner of the SAFE window.

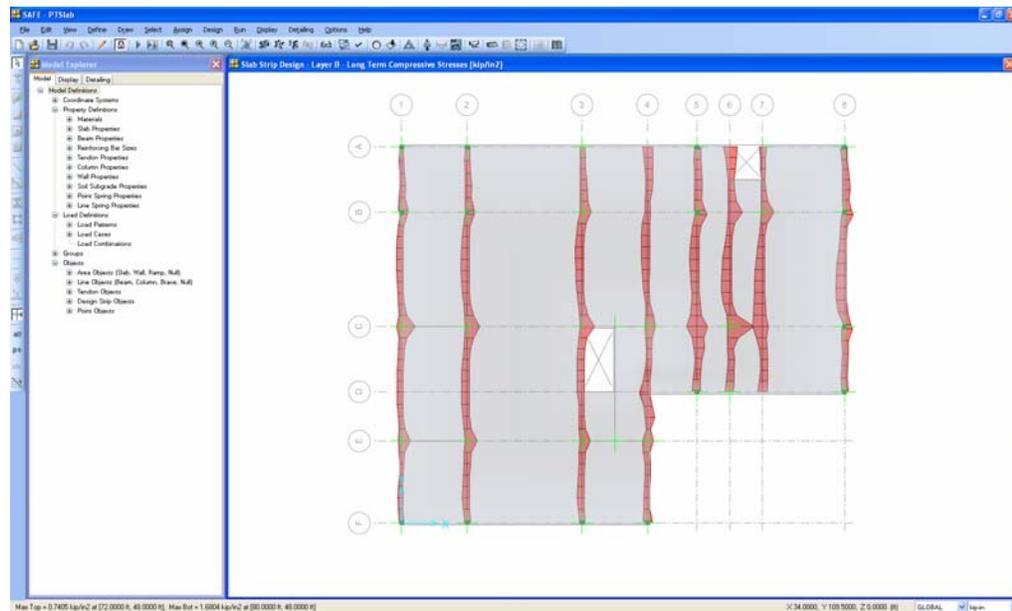


Figure 91 Layer B Long-Term Compressive Stresses

Step 12 Run Detailing

In this Step, detailing will be run and displayed. Detailing may be run only after analysis and design are complete.

- A. Click the **Detailing menu > Detailing Preferences** command to display the Detailing Preferences form shown in Figure 92.

The image shows a software dialog box titled "Detailing Preferences". It is organized into several sections with dropdown menus for selection:

- Standards:** Units (US), Rebar Set (US Customary (#8)).
- Dimension Units:** Length (Foot), Section and Thickness (Inch), Rebar Spacing (Inch), Force (Kip).
- Bar Mark:** Bar Mark Style (MK-01, MK02...), Number Separator (-(Dash)), Mark Separator (-(Dash)), Spacing Separator (@ (At)).
- Material Quantity Units:** Rebar Length (Foot), Slab Area (Sq ft), Concrete Volume (Cu ft), Rebar Weight (Ton).

At the bottom, there is a "Modify/Show Format..." button on the left, and "OK" and "Cancel" buttons on the right.

Figure 92 Detailing Preferences form

Use this form to set the regional standards, to control how dimensioning is displayed, to manage reinforcing bar notation, and to select the units for material quantity takeoffs.

- B. Review the settings on this form (we will accept the default selections), and then click the **OK** button to close the form.
- C. Click the **Detailing menu > Slab/Mat Reinforcing Preferences** to display the Slab/Mat Detailing Preferences form shown in Figure 93.

The screenshot shows the 'Slab/Mat Detailing Preferences' dialog box with the 'General and Display' tab selected. The dialog is organized into four main sections:

- Rebar Curtailment Options:** Contains two radio buttons: 'Apply Curtailment Rules' (selected) and 'Reinforcement Extent Based on Design Only'. A 'Modify/Show Rules...' button is next to the first option.
- Slab Sections:** Contains a 'Section Label Style' dropdown menu set to 'A,B,C' and a 'Sections in Each Direction' text box set to '1' with '(Max. = 5)' in parentheses.
- Rebar Detailing Options:** Contains two radio buttons: 'Show All Bars' (selected) and 'Show Additional Bars Above Typical'. Below are two groups of settings for 'Typical Bars Along Layer-A' and 'Typical Bars Along Layer-B'. Each group includes 'Top Bars, Bar Size' (dropdown #6), 'Top Bars, Spacing' (text box 9 in), 'Bottom Bars, Bar Size' (dropdown #5), and 'Bottom Bars, Spacing' (text box 12 in).
- Rebar Calls Include:** Contains five checkboxes: 'Include Number of Bars' (checked), 'Include Bar Mark' (unchecked), 'Include Bar Shape/Placement' (checked), 'Include Bar Designation' (checked), 'Include Bar Spacing' (unchecked), and 'Include (T/B) Indication' (unchecked).

At the bottom right of the dialog are 'OK' and 'Cancel' buttons.

Figure 93 Slab/Mat Detailing Preferences form

- D. Click the *General and Display* tab. On this tab review or alter the rebar curtailment, detailing and callout options, as well as set how sections should be cut. We will accept the default settings.
- E. Click the *Rebar Selection* tab and review or change the rebar selection rules, preferred sizes, minimums and reinforcing around openings. We will accept the default settings.
- F. Click the **OK** button to accept the selections and close the form.
- G. Click the **Detailing menu > Drawing Sheet Setup** command to display the Drawing Sheet Setup form. The sheet size, scales, title block and text sizes can be reviewed and changed using this form. We will accept the default settings.
- H. Click the **OK** button to close the form.

- I. Review the line thicknesses and styles by clicking the **Detailing menu > Drawing Format Properties** command.
- J. Click the **OK** button to accept the selections and close the form.
- K. Now that the detailing preferences and drawing setup options have been reviewed, click the **Run menu > Run Detailing** command to generate the detailing drawings. A framing plan is displayed when detailing is complete.
- L. Click the **Detailing menu > Show Detailing** command to access the Display Detailing Item form shown in Figure 94.

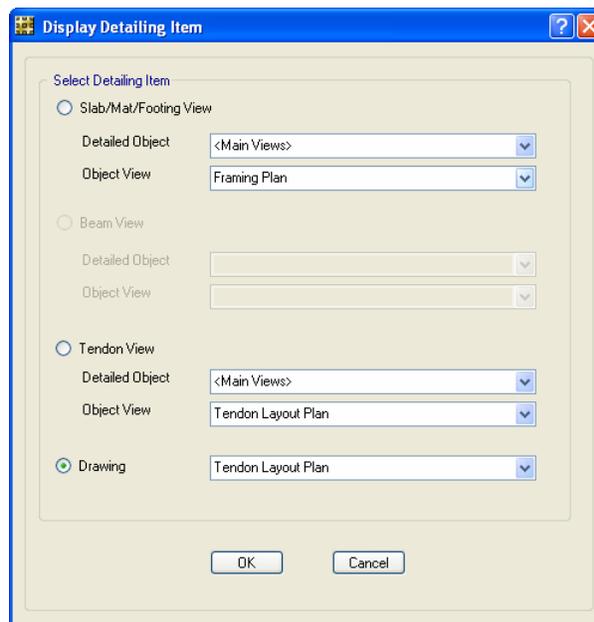


Figure 94 Display Detailing Item form

- M. Select the *Drawing* option.
- N. Select *Tendon Layout Plan* from the Drawing drop-down list.
- O. Click the **OK** button to leave the Display Detailing Item form and display the selected drawing shown in Figure 95.

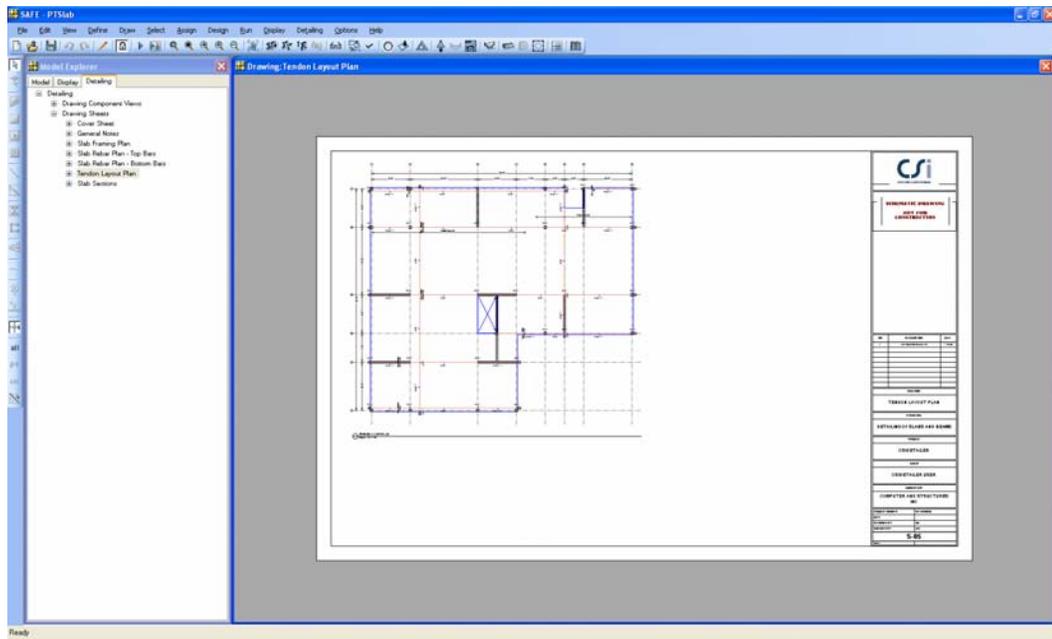


Figure 95 Tendon Layout Plan

- P. Clicking on the *Detailing* tab in the Model Explorer and expanding the Views and Drawing Sheets trees also provides access to detailing drawings and views.
- Q. Click the **Display menu > Show Undeformed Shape** command to return to the model.

Step 13 Create Report

In this Step, a report describing model input and output results will be created.

- A. Click the **File menu > Report Setup** command to display the Report Setup Data form.
- B. In the Report Output Type area, make sure that the *RTF File* option is selected.
- C. In the Report Items area, uncheck the *Include Hyperlinked Contents* checkbox.

- D. Click the **OK** button to leave the Report Setup Data form.
- E. Click the **File menu > Create Report** command to display the Microsoft Word Rich Text File Report form.
- F. Type **PTSLAB** in the File name edit box and click the **Save** button. A report, with a cover similar to that shown in Figure 96 should be displayed in your word processor, and will be saved to your hard disk.
- G. Scroll through the report to find tables that list geometry and properties, analysis results and design information, such as that shown in Figure 97.

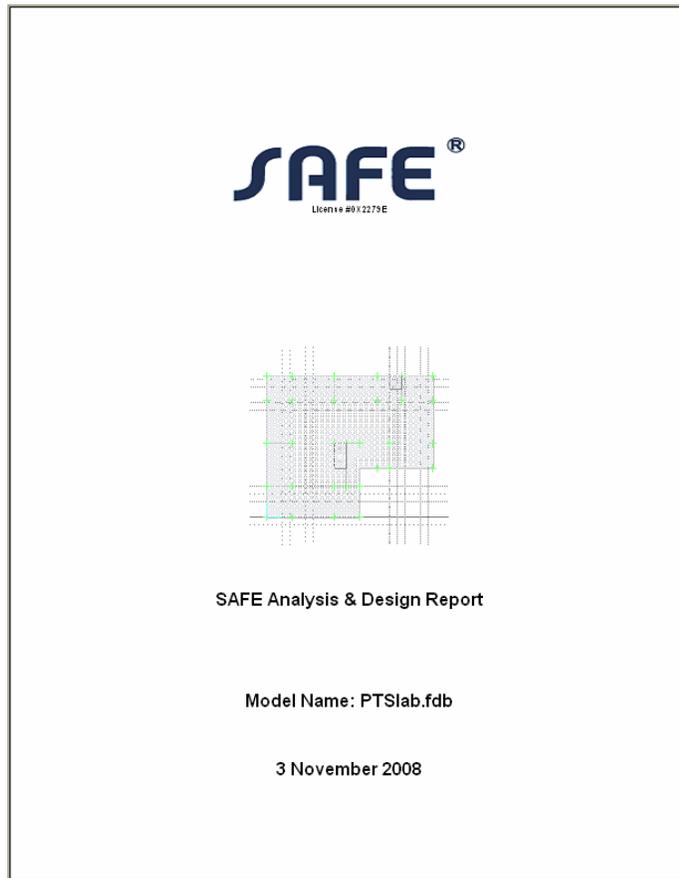


Figure 96 Cover Page for Report

- H. Close your word processor and return to the SAFE program.
- I. Click the **File menu > Save** command to save your model one last time.

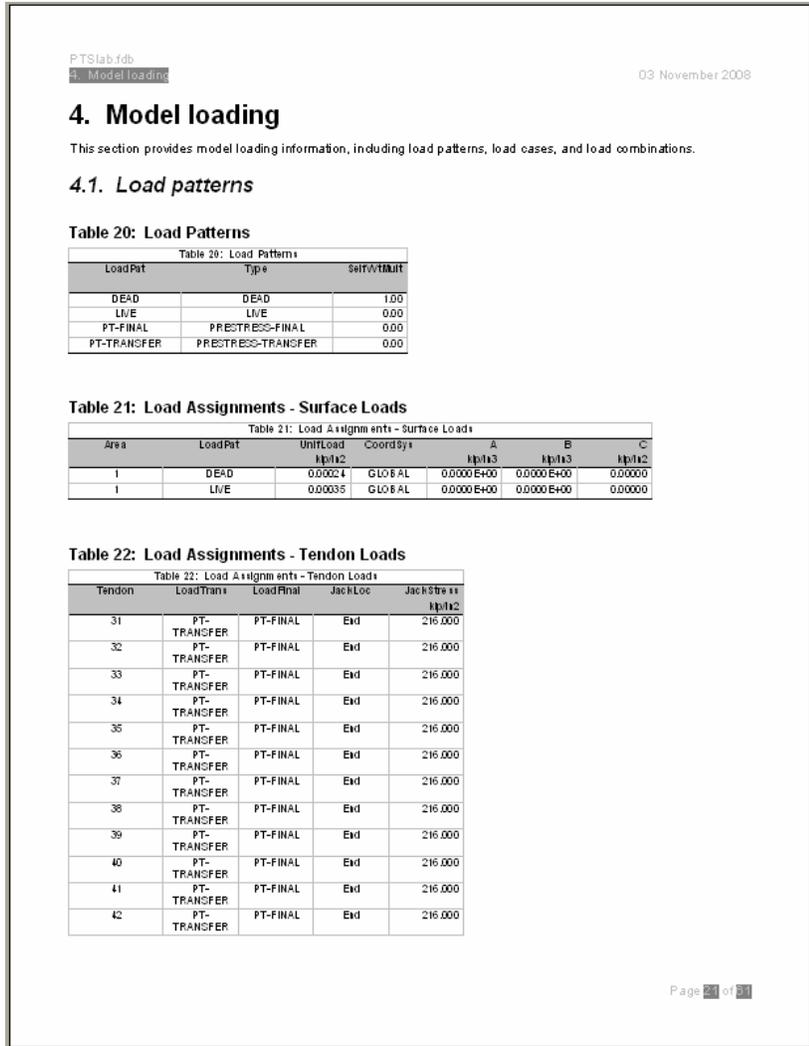


Figure 97 Typical Report information

Congratulations! You've successfully created, analyzed, designed, detailed, and reviewed a SAFE post-tensioned concrete model.