box.

Note that all the above operations have an immediate effect on the block definitions, reflected by immediate changes to what is displayed in the list. However, any subsequent block changes made outside this dialog box, e.g. by issuing commands via the pro-STAR I/O window, will not be listed. To display these changes, click on the **Update List** button at the top of the box.

At the interface between two adjacent blocks whose meshes match each other structurally, there will be multiple vertices occupying an identical position in space. To ensure mesh continuity, it is important to merge such vertices with command `VMERGE` before proceeding further.

## Multi-block Meshing Using STAR-GUIde Panels

pro-STAR provides a special panel, called *Create Grids with Blocks (Fitted Shapes)*, for the purpose of mesh generation through the STAR-GUIde system. The philosophy behind this panel is based on multi-block mesh generation and relies on basic descriptions of the target model geometry being available in one form or another. The order in which all panel operations work is as follows:

- Specify the operation you want to perform
- Select all items involved in the operation
- Execute the operation

The minimum geometric information needed is the position of the vertices located on the corners of the target block(s). For complex shapes, detailed surface data in the form of shells and splines would also be provided.

The steps involved in creating a multi-block mesh are as follows:

### Stage 1: Subdivide the model geometry into blocks

***Step 1***

Define the edges of the blocks by fitting appropriate splines. If the block edges are straight lines, the position of corner points should be sufficient.

***Step 2***

Create the blocks by specifying the eight corner points. Make sure that the vertices marking the block corners lie on the splines forming the edges.

***Step 3***

If the block faces are to be mapped onto another surface, select the shells defining these surfaces and associate them with the appropriate block faces.

By this stage, all geometric details of the model will have been captured as one or more pro-STAR block definitions.

### Stage 2: Identify and store all mesh-related parameters for the block

***Step 1***

Specify the number of cells in the local I, J, K directions for each block, remembering that individual blocks can only be meshed in a structured way.

***Step 2***

Define the mesh distribution for each of the three local block directions.

### Stage 3: Create the mesh using data specified during Stages 1 and 2

The three stages outlined above and their associated steps are accessible through the *Creating Grids with Blocks* panel and its three tabs. Before attempting to use the panel, you should make sure that you have at least a set of vertices or surface shells from which the required entities (such as splines and block corner points) can be defined. The set of shells determining the model's surface geometry may be either created internally using pro-STAR or imported from external CAD packages using the "Import CAD/Surface Information" STAR GUIde panel.

## Using the panel

This section gives further details of the steps above in terms of actually using the *Creating Grids with Blocks* panel. It is assumed that you are familiar with selecting, displaying and manipulating various entities such as vertices, splines, shells, cells, etc.

The geometry of the example model given in this section is represented by surface shells (see Figure 3-53). The manner of subdivision of this geometry into blocks is up to you. In this case, it was decided to use three blocks (see Figure 3-54).

### Stage 1

***Step 1***

In order to fit splines to the edges of the constituent blocks, you need to select vertices for these splines. The vertex selection is accomplished as follows:

- Select the *Splines* tab
- Choose option **Vertex of Cell** from the *Select Items* button group
- Select the manner of picking items from the graphics window via the *Locate Items* pop-up menu; in this case the choice can be **closest to cursor**
- Click the **Create Spline** button
- Move the cursor to the graphics window and mark the appropriate vertices using the left mouse button (see Figure 3-55). A list of these vertices should appear in the *Located or Selected Items* scroll list. To remove one or more of them from the selection, mark the list item(s) with the cursor and remove it with the **Clear List Item** button.
- When satisfied with the vertex selection, click the **Done** button to create and display the current spline (see Figure 3-56)

This process is repeated for all splines that will eventually form the block edges. Figure 3-57 shows the 24 splines that will be used to define the blocks which constitute the two arms of the model.

***Step 2***

Display the splines using the spline selection facilities provided in the main pro-STAR window so as to confirm that the correct vertices have been chosen to mark the spline end-points. This is particularly important since these vertices also mark the block corners. To create a block:

- Select the *Blocks* tab
- Click the **Create Block** button
- Choose option **Vertex of Spline** from the *Select Items* button group
- Use the cursor to mark the appropriate vertices at the eight corners of each block (see Figure 3-58). A list of these vertices should appear in the *Located or Selected Items* scroll list.
- When satisfied with the vertex selection, click the **Done** button to create and display the current block.

This process should be repeated for all blocks in the model.

***Step 3***

To ensure that the block surfaces coincide with the shell surfaces defining the model geometry, it is sometimes necessary to map the block faces onto the shell surfaces. This is particularly important in this example, as the various blocks will be joined together along faces that need to be perfectly coincident (to avoid problems with arbitrary cell matching in the final mesh, see “Couple creation” on page 4-11). To map a block face to a shell surface:

- Select the *Mesh* tab
- Click the **Map Face to Shells** button. Note that option **Block Face** in the *Select Items* group is automatically selected.
- Mark the target block face with the cursor. Note that to pick the face furthest away from you, it is necessary to choose option **furthest from you** in the *Locate Items* pop-up.
- Choose option **Cell Type ID** from the *Select Items* group
- Mark the target shell surface with the cursor
- When satisfied with your selections, click the **Done** button to perform the mapping (see Figure 3-59)

This process must be repeated for all block faces that may participate in interfaces with arbitrary connectivity, or for any other block-face surface whose shape is not sufficiently well defined by the block-edge splines alone.

By this stage, the full geometry of the model will have been stored in three pro-STAR block definitions. The next stage is to specify the mesh spacing along each individual block edge.

## Stage 2

***Step 1***

Select and display one of the blocks on the screen using the block selection facilities provided in the main pro-STAR window. Given the structural nature of the mesh, only three edges need to be marked for each block. Specify the number of cells along each edge as follows:

- In the *Mesh* tab, click the **Number of Cells** button
- Note that option **Block Edge** in the *Select Items* group is automatically selected. Mark the edge in question with the cursor.
- Enter the number of cells along that edge (also called the ‘meshing number’) in the *Numeric Parameter* text box
- Match the edge with its corresponding meshing number by clicking the **Done**

button.

This process needs to be repeated for the remaining blocks.

Alternatively, you may first select all edges, irrespective of block, that share the same number of cells in a given direction; they will be displayed in the *Located or Selected Items* scroll list. Typing the meshing number and clicking **Done** will then assign that number to all of them (see Figure 3-60).

***Step 2***

If non-uniform mesh spacing is required for any of the blocks:

- In the *Mesh* tab, click the **Space Factor** button
- Select the appropriate edge as described in Step 1 above
- Enter the required spacing factor in the *Numeric Parameter* box
- Match the edge with the spacing factor by clicking **Done**

By this stage, all geometry and mesh-related parameters will have been stored (see Figure 3-61). The next and final stage consists of generating the calculation mesh.

### Stage 3

***Step 1***

To choose the cell type for the cells to be created:

- In the *Mesh* tab, click the **Cell ID** button. This displays automatically the *Cell Table Editor* and the currently defined blocks
- Make your choice of cell type by highlight it in the editor's scroll list and clicking **Apply**
- **Close** the *Cell Table Editor*
- Note that option **Block** in the *Select Items* group is automatically selected and that the cursor is active in the main window
- Select the block(s) to be meshed using the cursor. The block will be displayed in the *Located or Selected Items* scroll list
- Click the **Done** button to assign the chosen cell type to the selected blocks

This process should be repeated for all blocks.

***Step 2***

To create the mesh:

- Put all the blocks in a set by choosing **Bk > All** in the main window
- Click the **Generate Mesh** button. This will automatically select the appropriate cell type for each block and will produce a mesh matching the geometric and parametric values specified in Stages 1 and 2. The resulting mesh for all three blocks is shown in Figure 3-62.

## Other panel functions

Other functions of the *Creating Grids with Blocks* panel that have not been covered so far are described below. In each case, detailed instructions on how to proceed with each operation are displayed on-line within the STAR GUIde panels.

### Splines tab

- Once created, splines may be modified in a number of ways, including inserting additional vertices in them (**Modify Spline**), splitting a spline into two (**Split Spline**), joining two splines together (**Join Spline**) and finally deleting splines (**Delete Spline**).
- Splines can be chased across surfaces or through meshes. These functions require that the current cell set consists of shells. **Chase Spline** creates a spline with control points on the shell surface whilst **Mesh Chase Spline** keeps the control points on existing cell vertices. These functions are equivalent to command `SPL,CHASE`.
- **Move Vertex** allows a vertex (the first in the list) to be moved to a new location or on top of an existing vertex (the second in the list).

### Blocks tab

- When using the **Modify Block** button, option **Block Vertices** in the *Select Items* group is selected automatically. In this way, clicking on a block loads its eight defining vertices into the *Located items* list. They can then be selected and new vertices substituted in their place to change the block definition.
- The **Block Plot** button plots all blocks in the current set
- Using the **Delete Block** button automatically selects the **Block** option in the *Select Items* group. In this way, the block(s) to be deleted can be picked on the screen with the cursor.

### Mesh tab

- Where blocks share common faces, the block factors from one block can be traced onto adjacent blocks using the **Block Trace** button. The mesh factors are traced through the current block set. This is equivalent to command `BLKTRACE`.
- **Generate Factors** is a composite operation combining the functionality of the **Number of Cells** and **Block Trace** buttons. The meshing number appropriate to the selected edge(s) is calculated by pro-STAR by dividing the edge length by the nominal cell size along that edge, typed in the *Numeric Parameter* box. All meshing numbers thus calculated are propagated through the current block set.
- The mesh factors (i.e. number of cells and face mapping) for a block can be set back to the default values with the **Reset Factors** button
- All cells in a given block can be deleted using the **Delete Block Cells** button

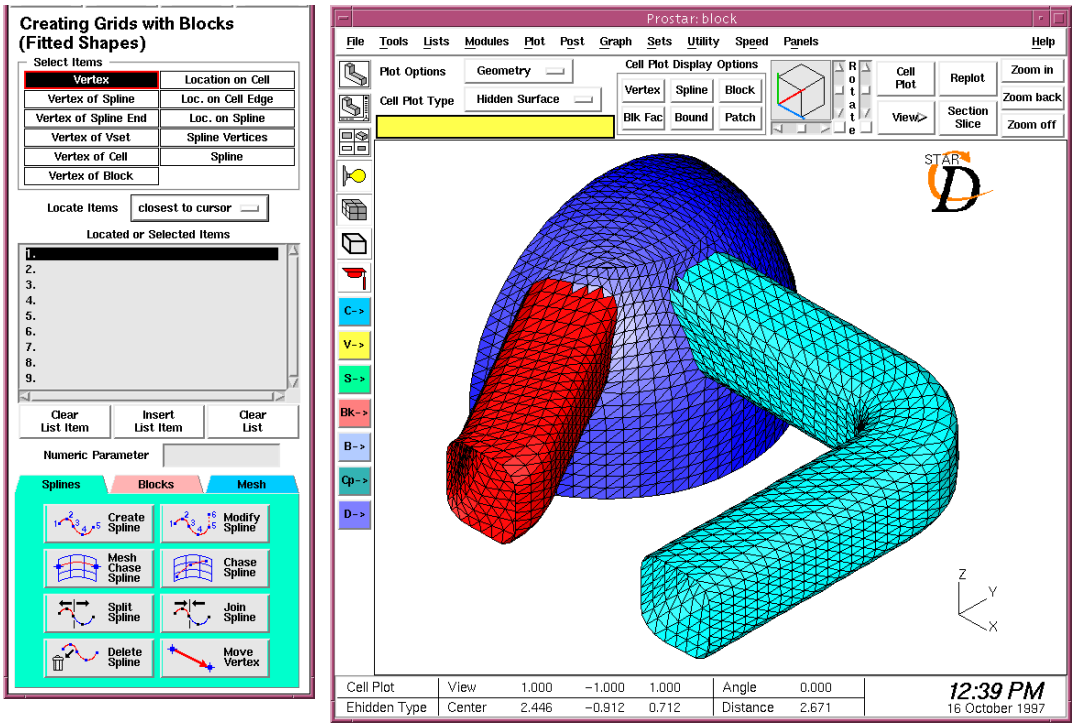


Figure 3-53 Surface shells from CAD package

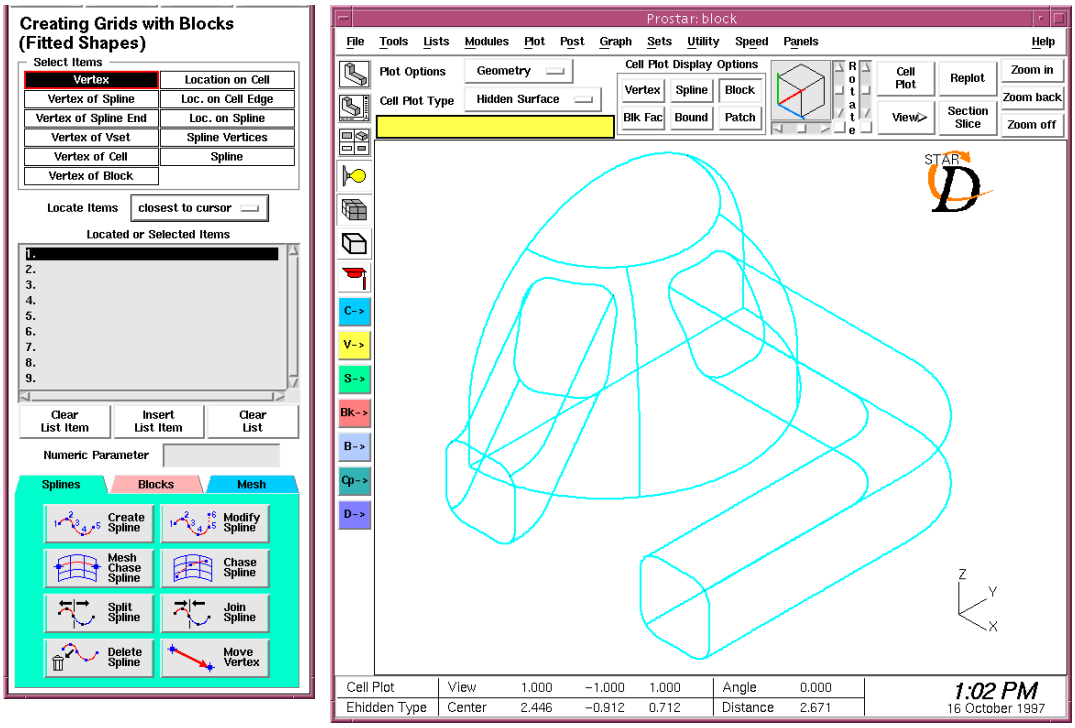


Figure 3-54 Blocking strategy

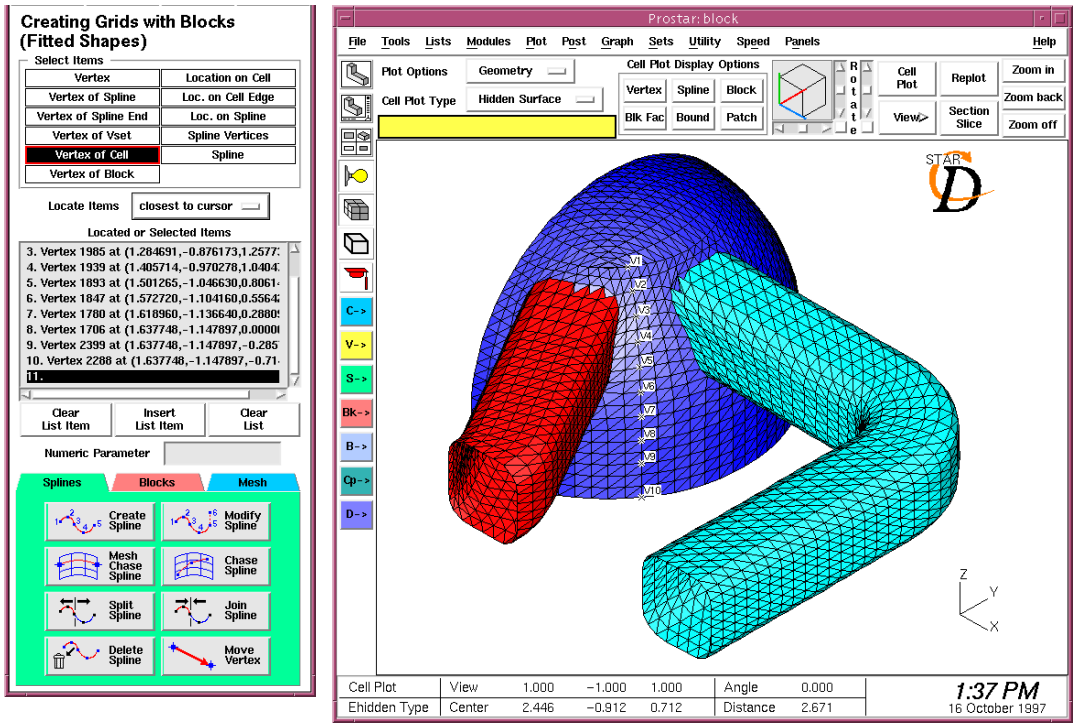


Figure 3-55 Vertices picked for spline

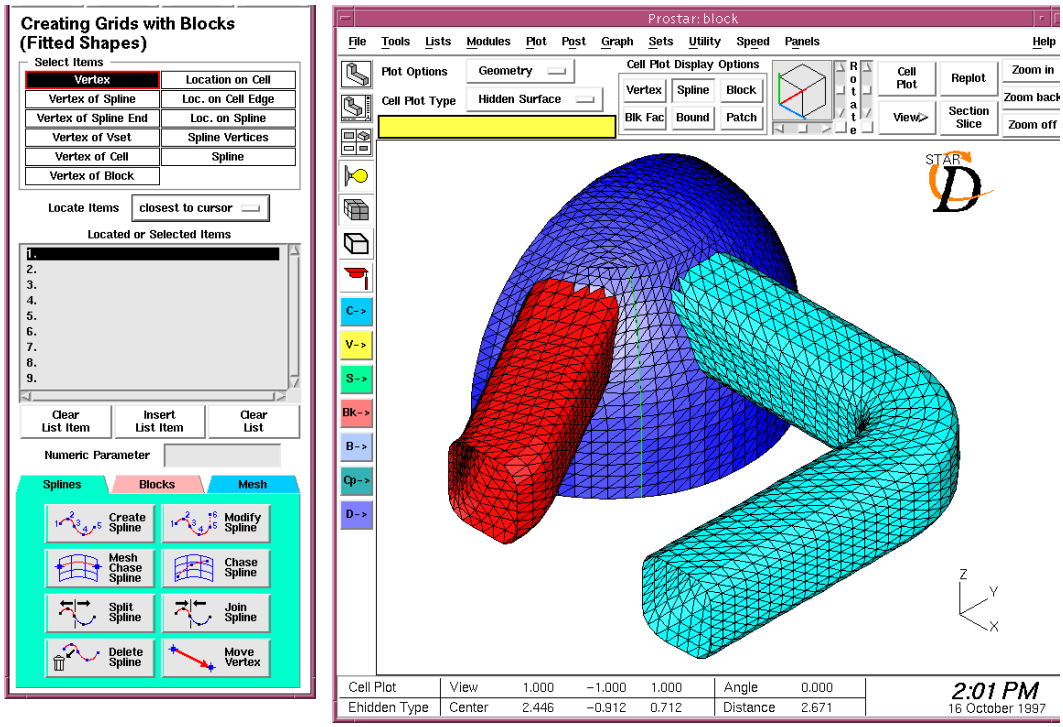


Figure 3-56 Spline created

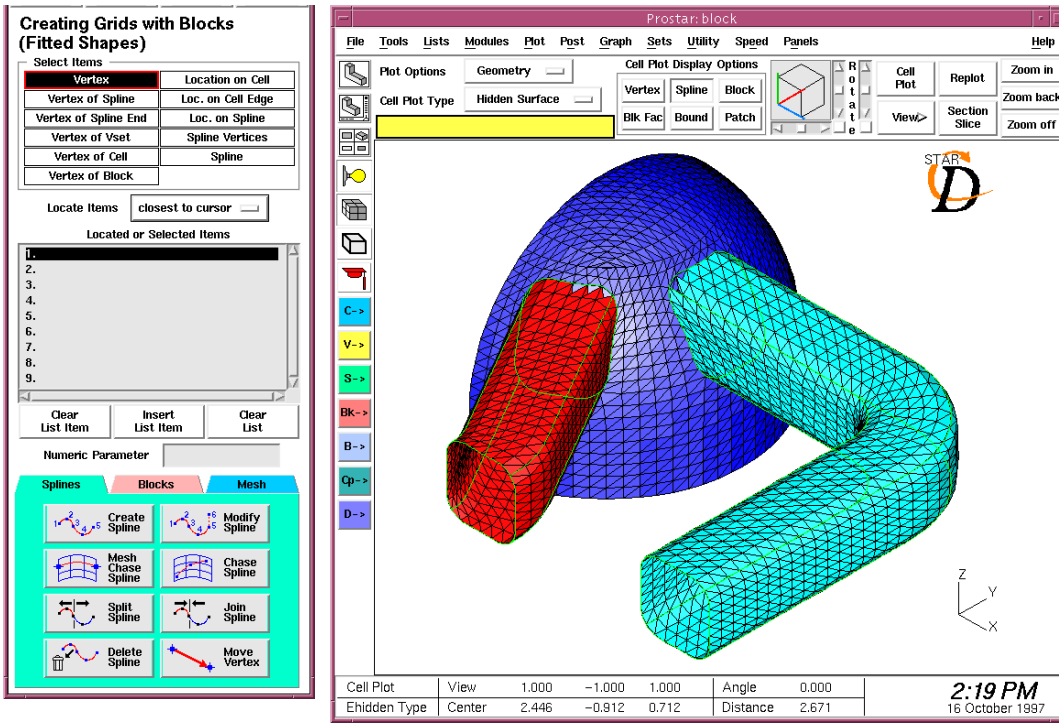


Figure 3-57 Splines defining block edges

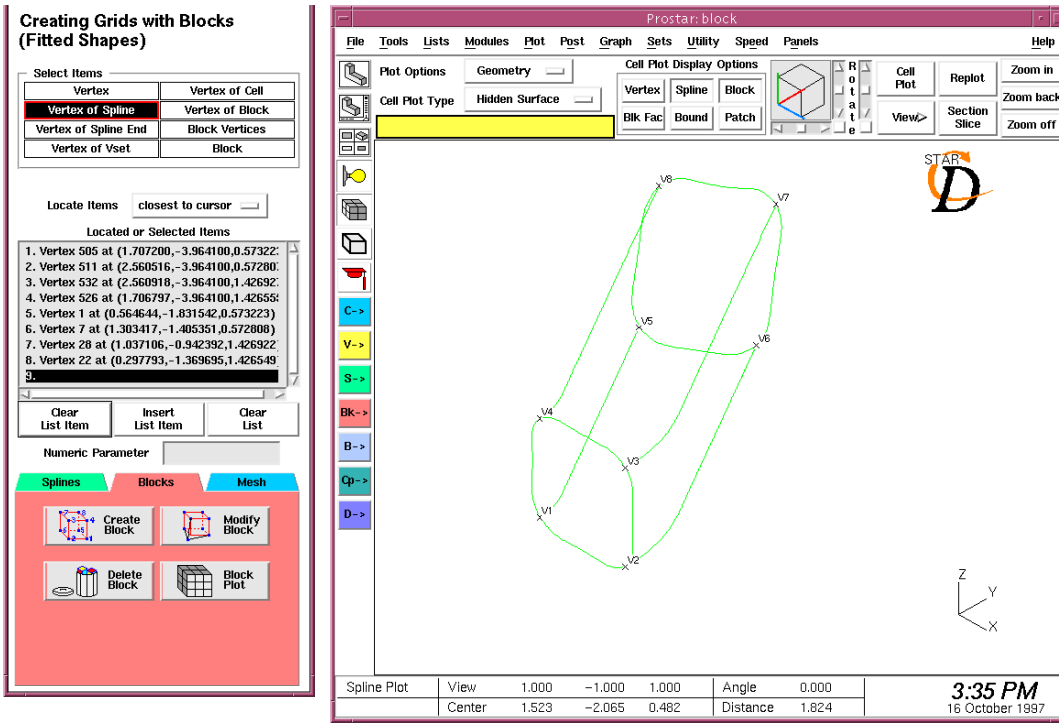


Figure 3-58 Selecting corner vertices

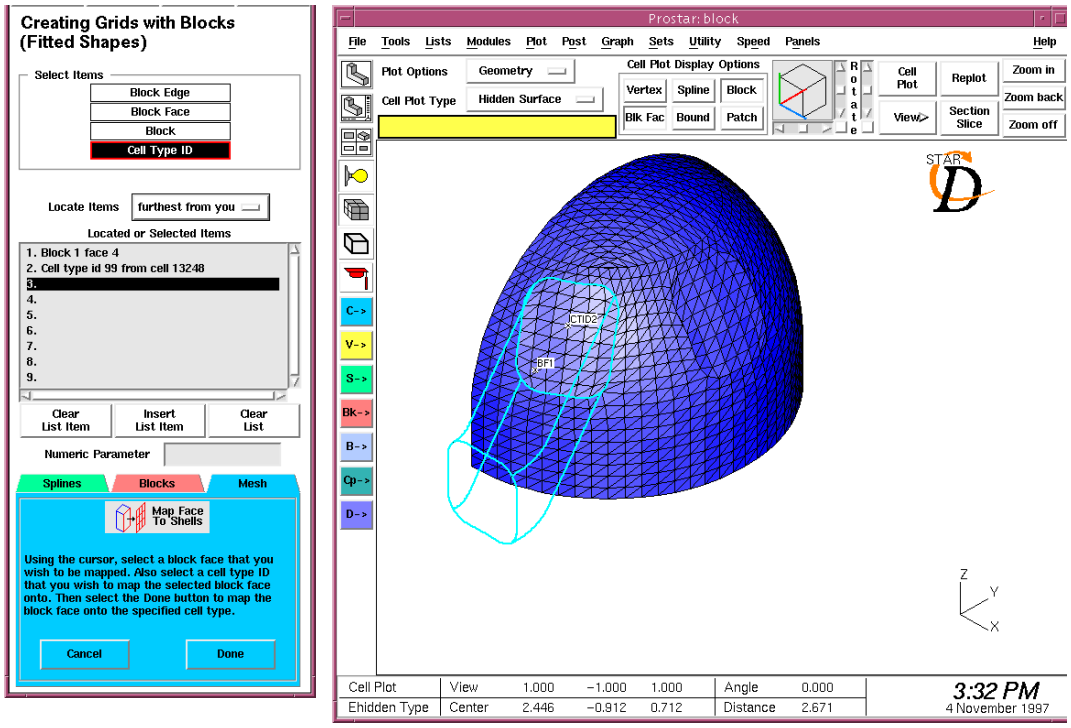


Figure 3-59 Mapping block faces to shells

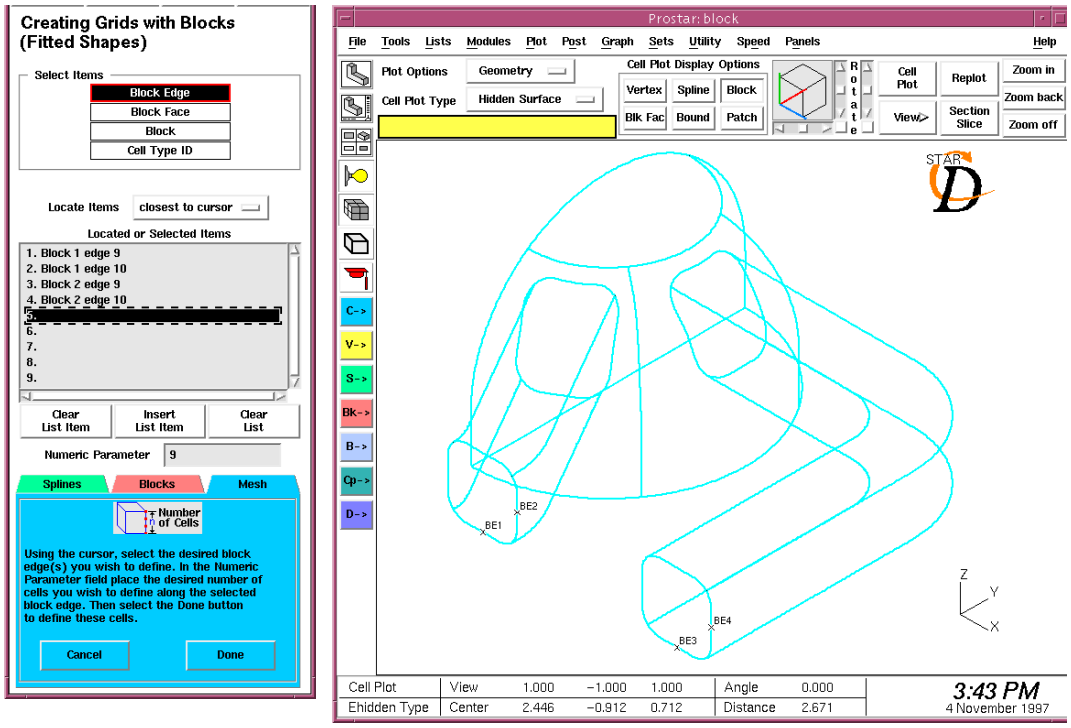


Figure 3-60 Defining block factors

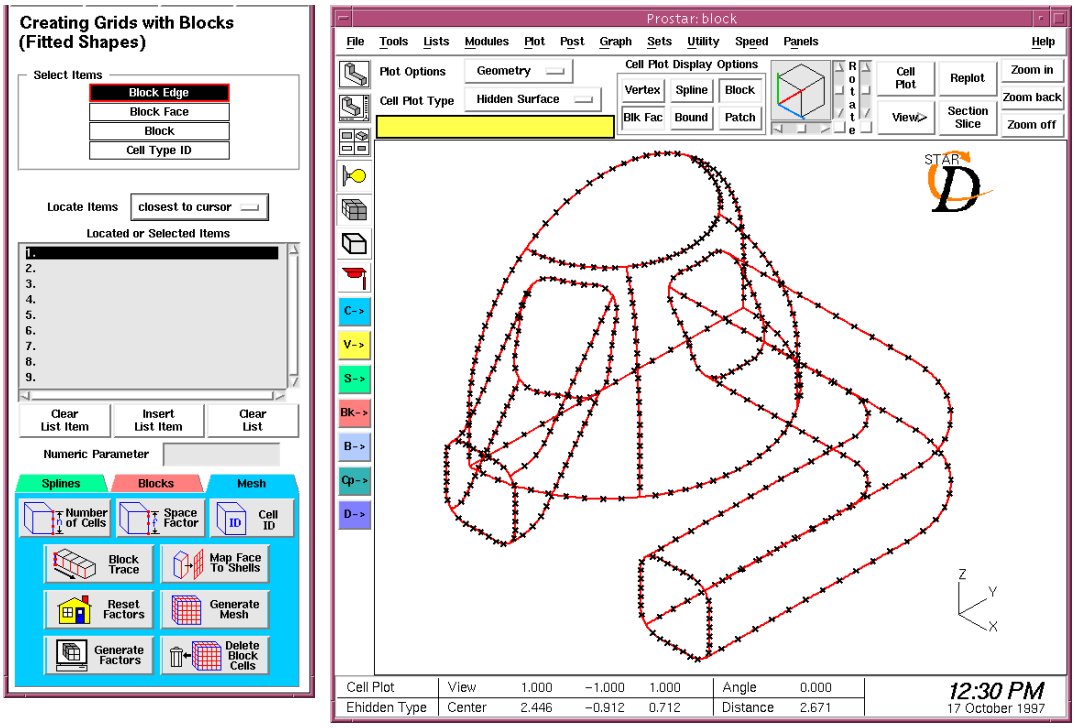


Figure 3-61 Block structure

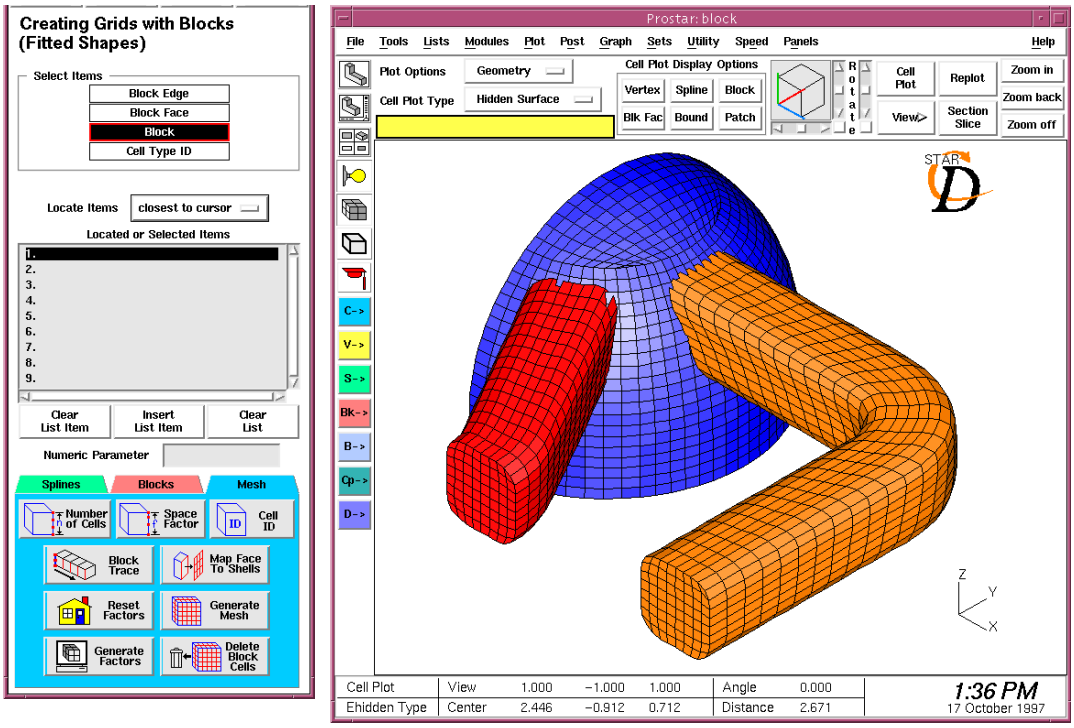


Figure 3-62 Resultant mesh