Assembling Display

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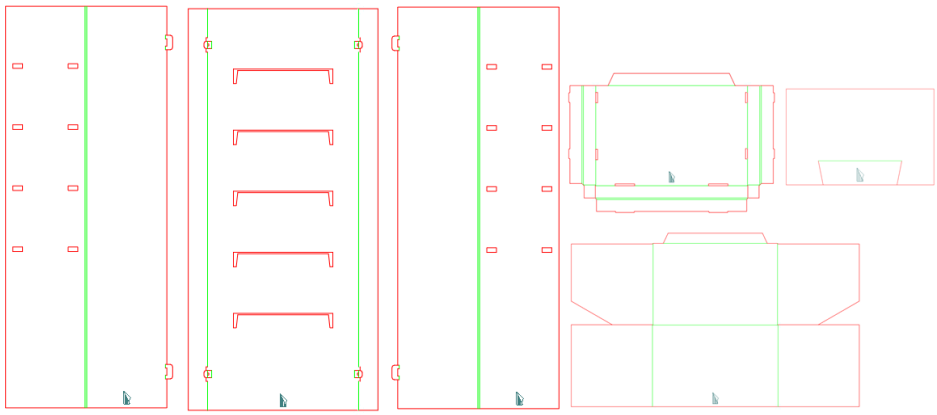
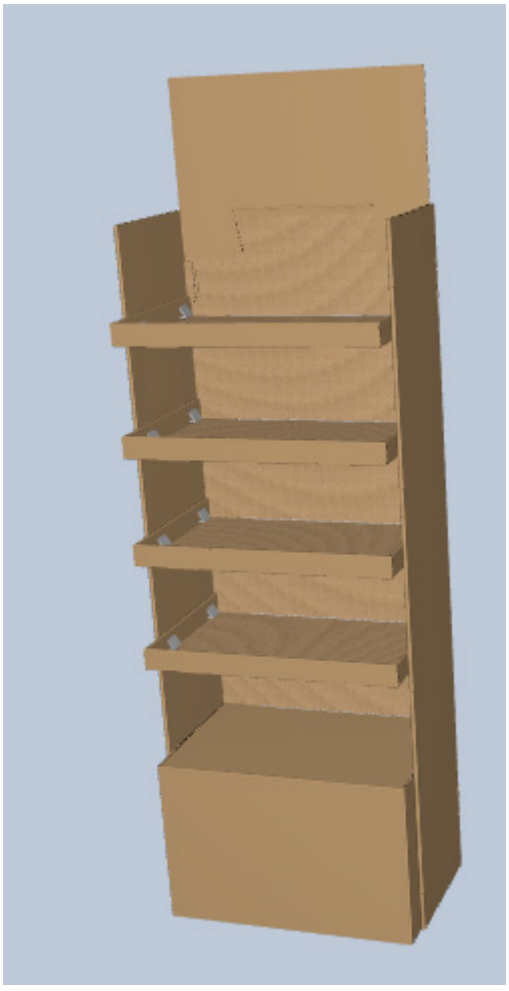
Task

This exercise takes us through the assembly of a display. It consists of (1) the making of 3D drawings for all the parts for the display and (2) steps of how to assemble them into one 3D model.

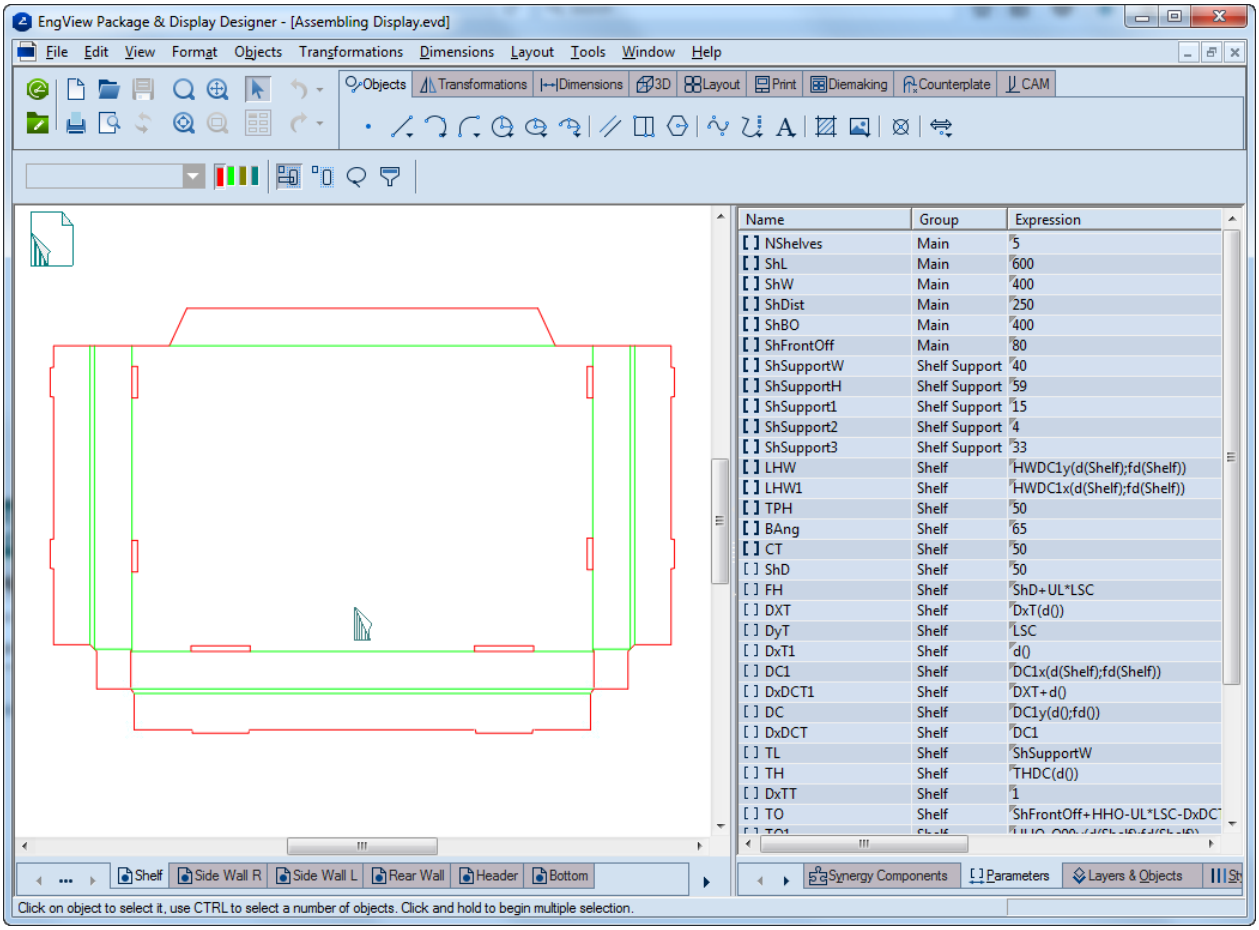
Result





Exercise Description

1. From the folder C:\EngViewWork6\EngView Samples, open the file Assembling Display.evd.



Pic. 1: Views of the 2D drawings of the design's parts

Creating 3D Drawings for Each Part of the Display

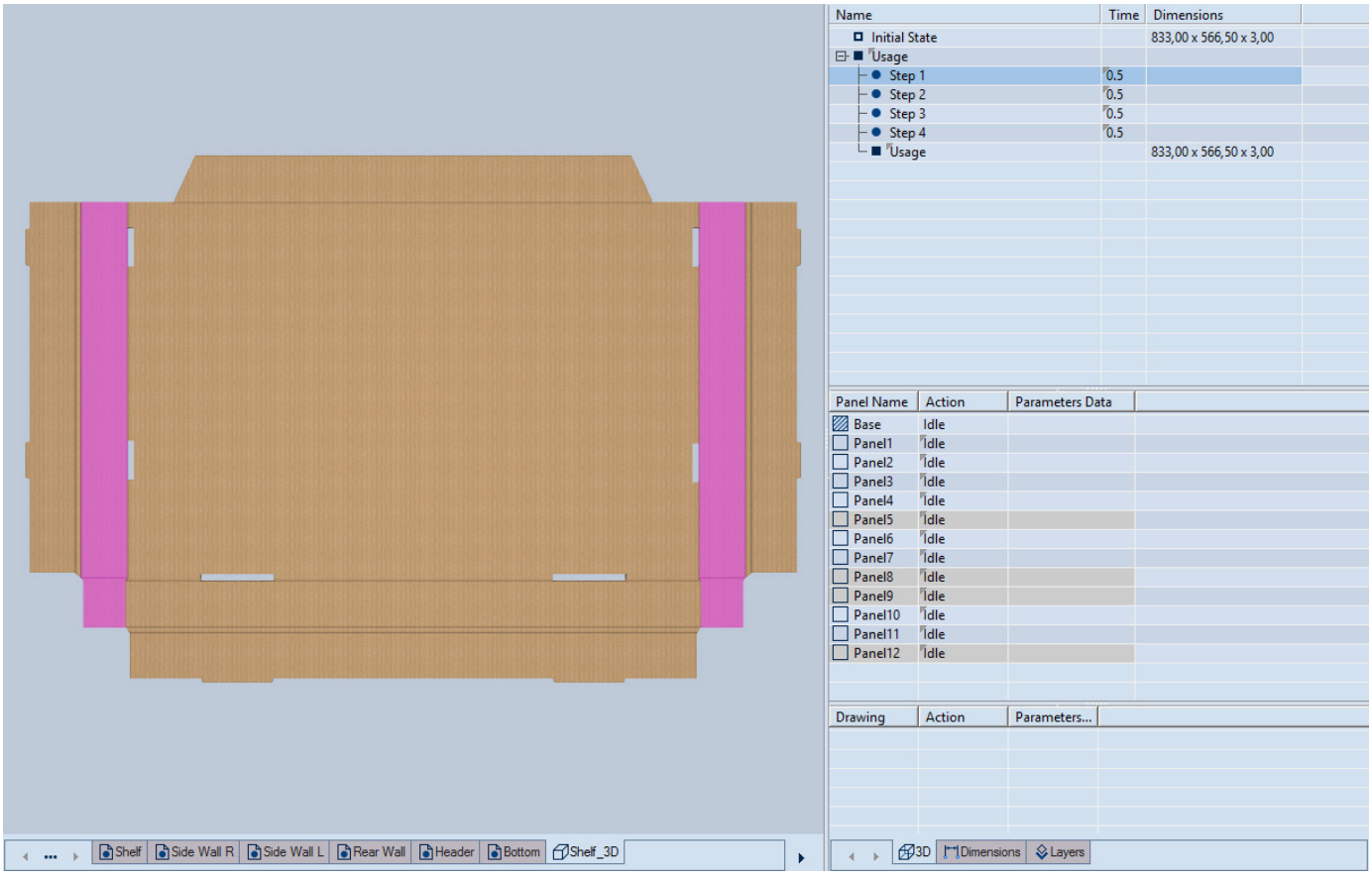
Creating a 3D for the Shelf

During the assembly, the shelf will need to fold halfway to its completed form, and will then be placed into particular places of the display. Then it will be folded completely. In other words, the shelf will have two states: semi-folded and folded. That is why we will create two phases in its 3D drawing.

Creating the first phase: Usage

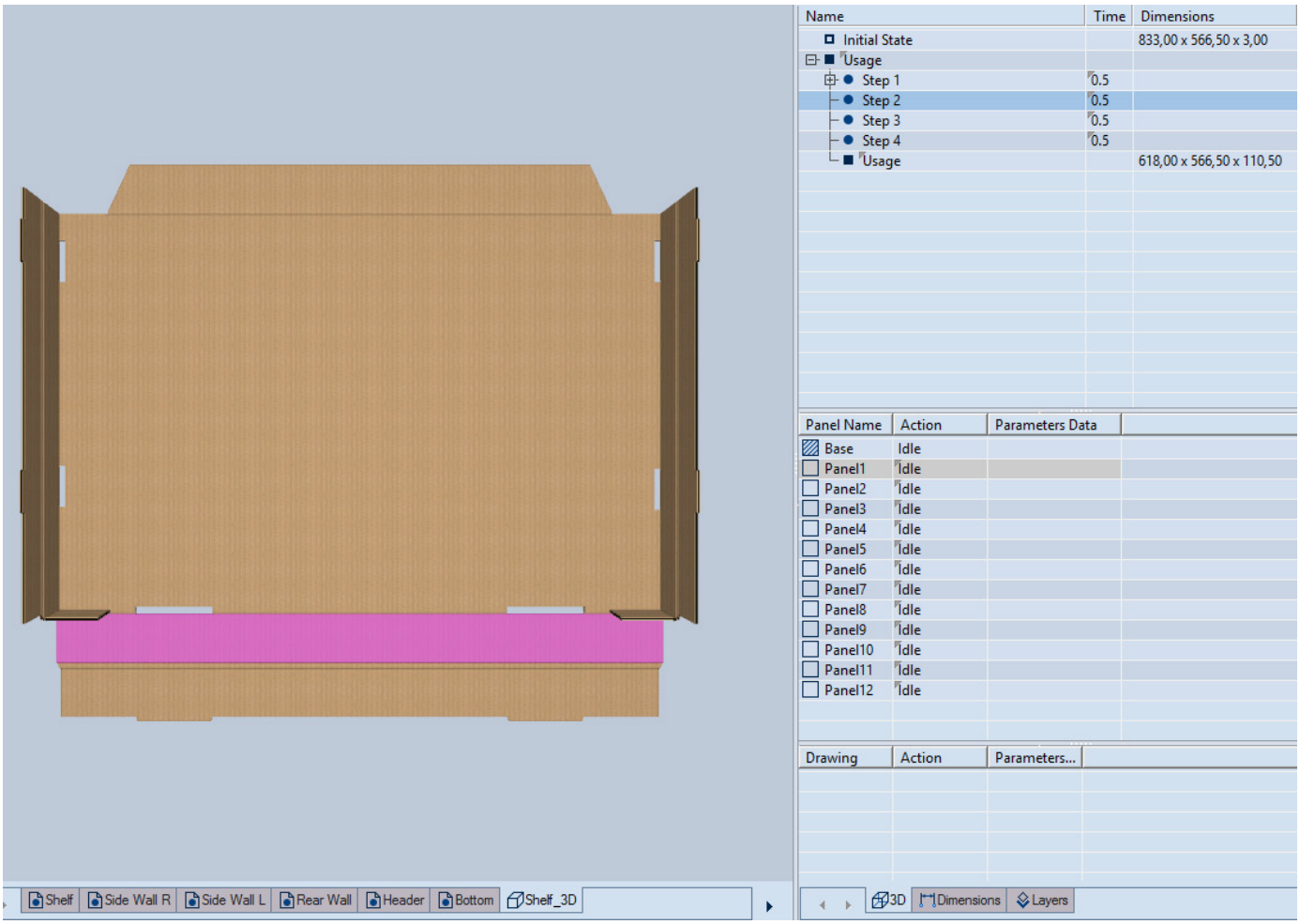
1. Click the tab of the Shelf drawing and then on the **3D** tab, click **New 3D Presenter Drawing**  .
2. In the tabular area, delete Step 1. It was created by default and in it all panels except the base are folded at 90 degrees.
3. Create four new steps.

4. Click Step 1.
5. Select the panels as shown in Pic. 2, and then fold them at 90 degrees.



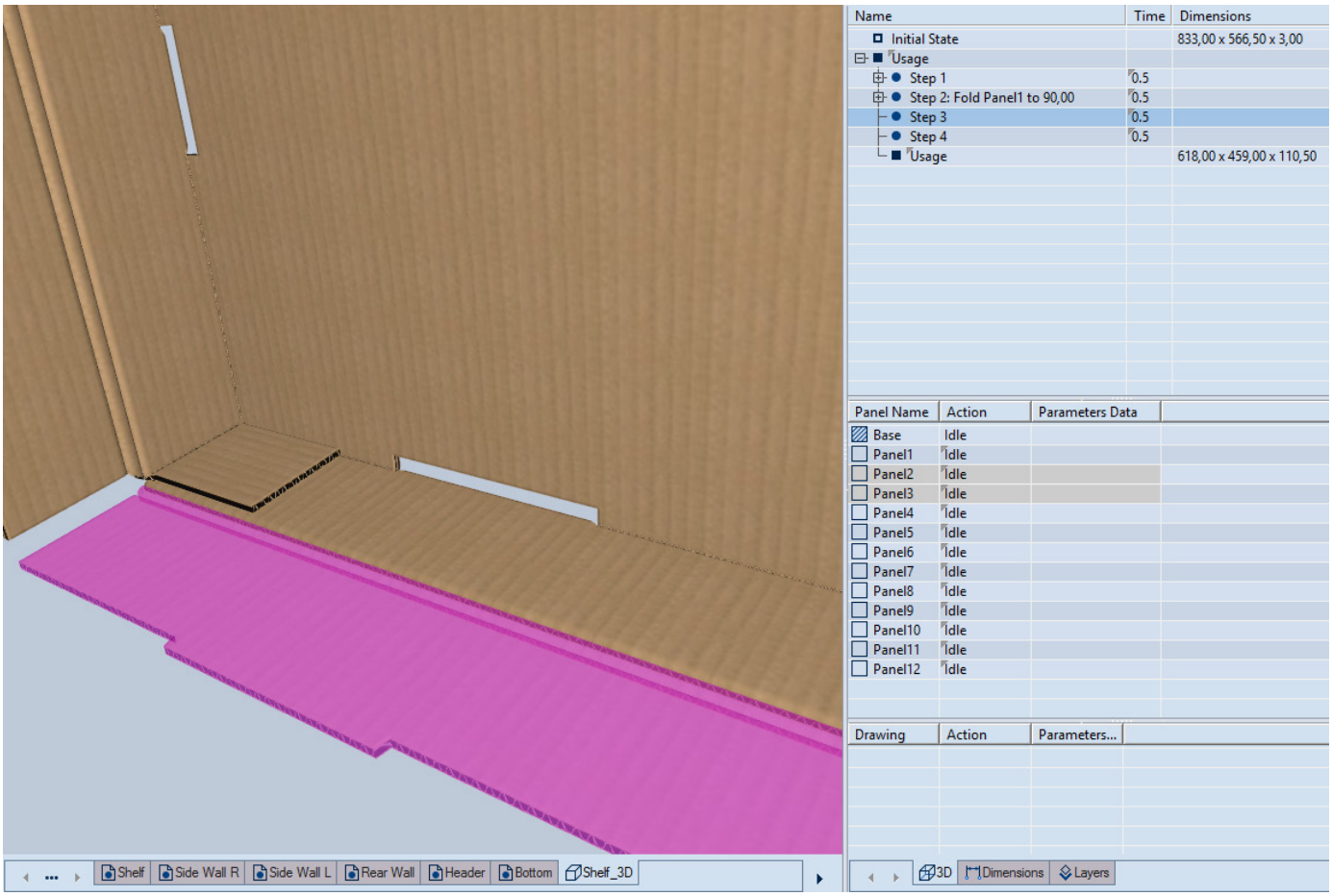
Pic. 2: Selecting the four side panels

6. Click Step 2.
7. Select the panel as shown in Pic. 3, and then fold it at 90 degrees.



Pic. 3: Selecting the internal lower panel

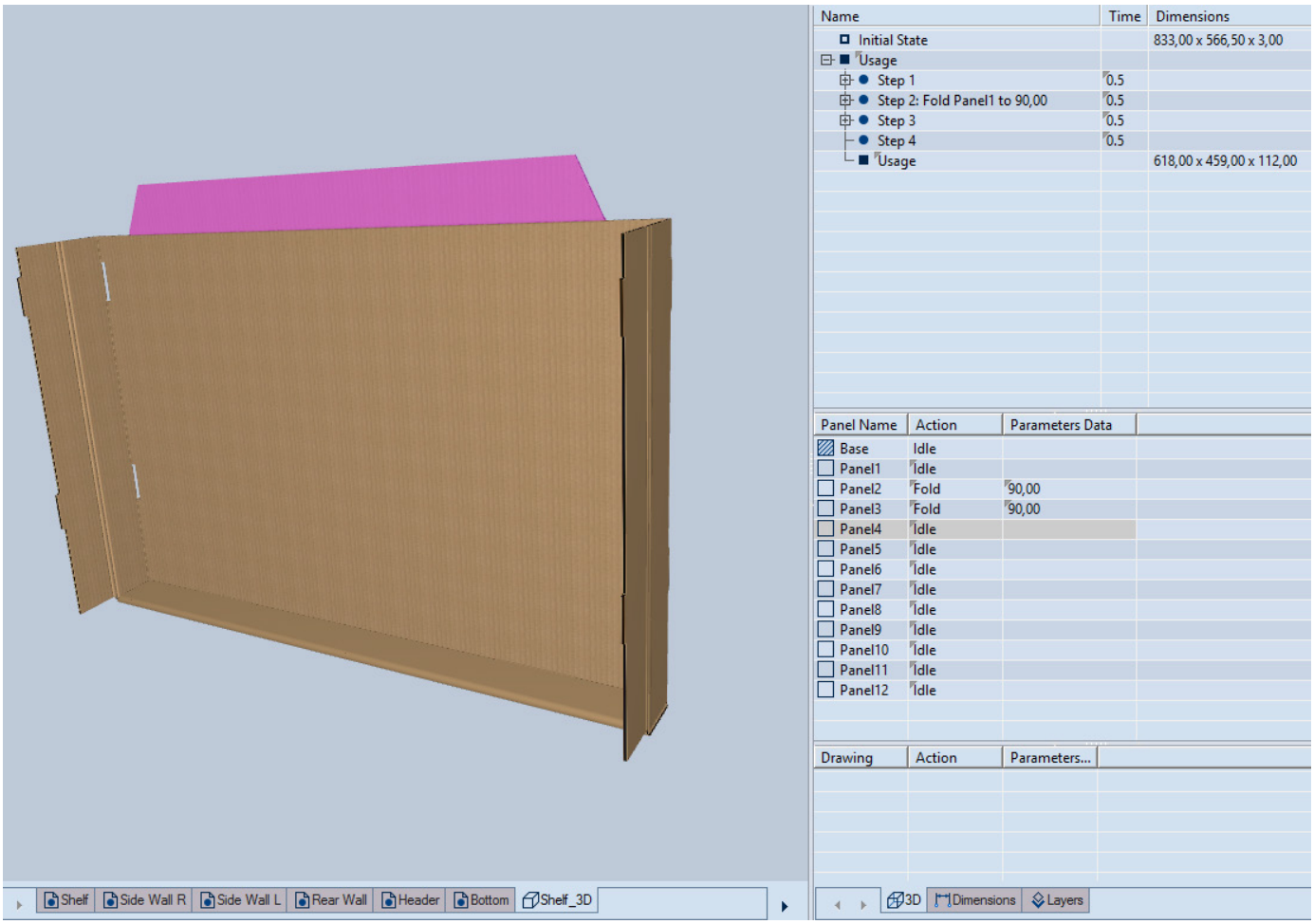
8. Click Step 3.
9. Select the two panels as shown in Pic. 4, and then fold them at 90 degrees.



Pic. 4: Selecting the outward lower panel and the connecting double crease panel

10. Click Step 4.

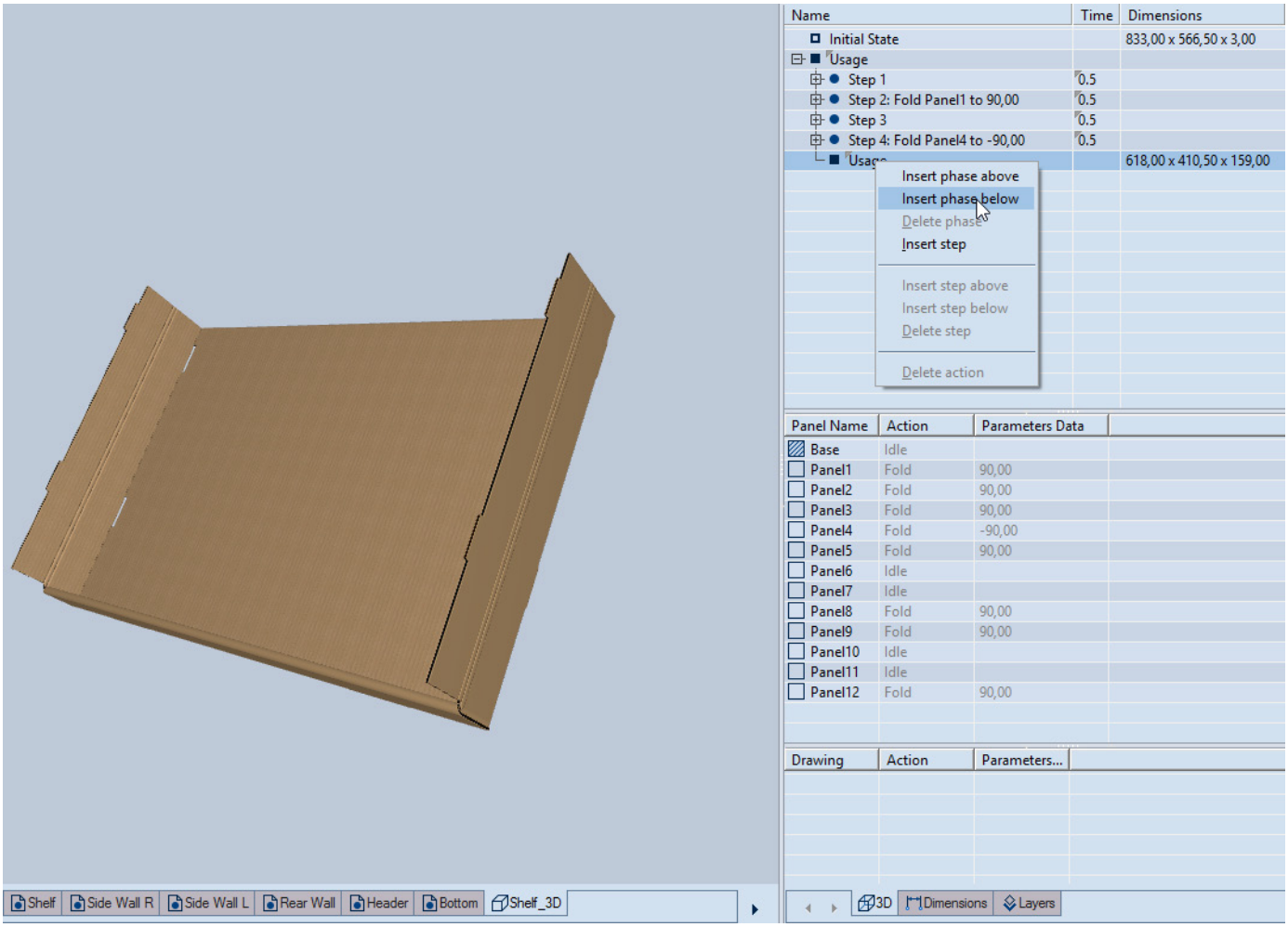
11. Select the panel as shown in Pic. 5, and then fold it at –90 degrees.



Pic. 5: Selecting the upper trapezoid panel

Creating the second phase: Connect

12. In the tabular area, right-click the Usage phase, and then click **Insert phase below** on the context menu.

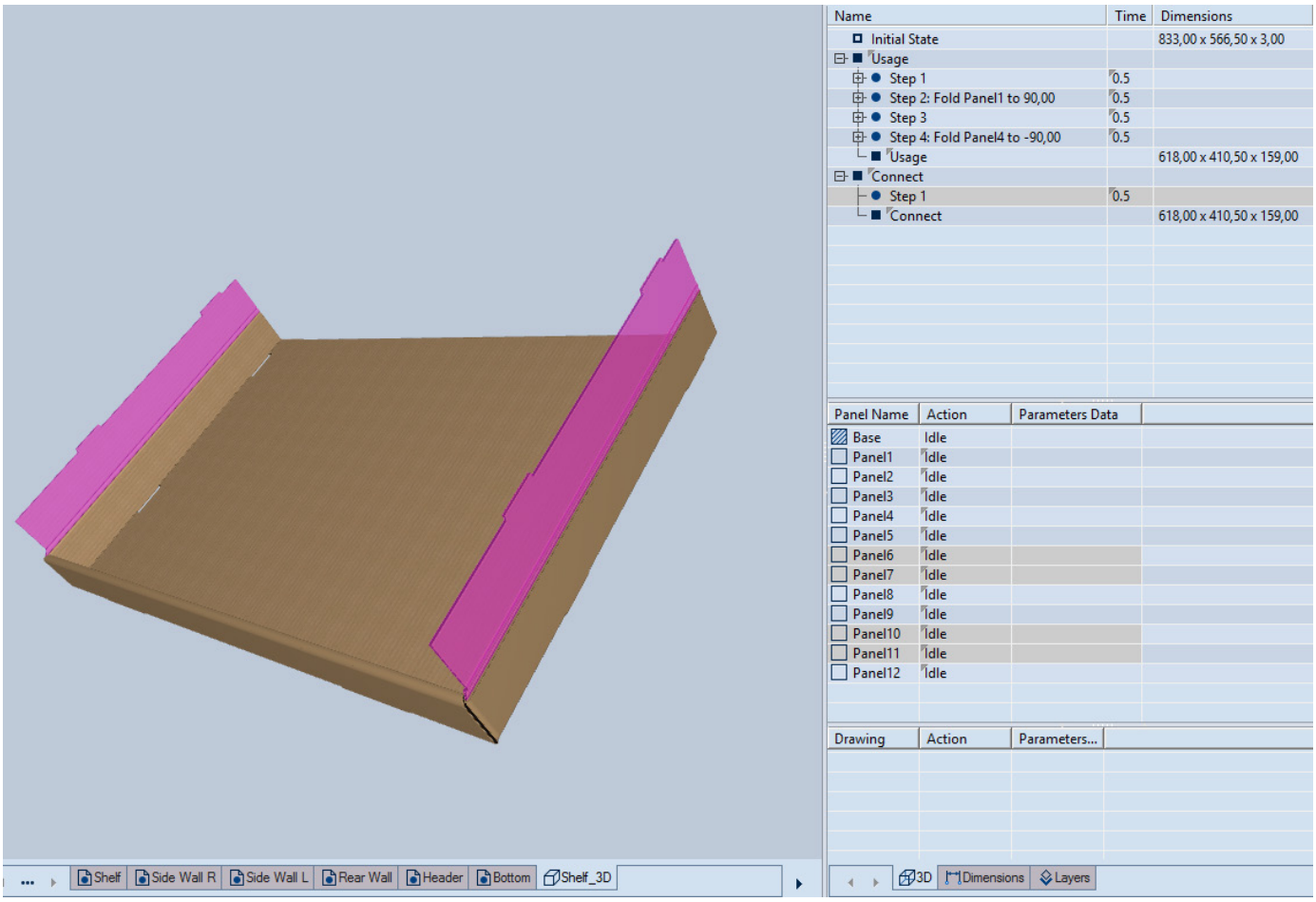


Pic. 6: Creating a new phase in the tabular area

13. In the **Edit phase** dialog box that appears, type Connect. This will be the name of the new phase.

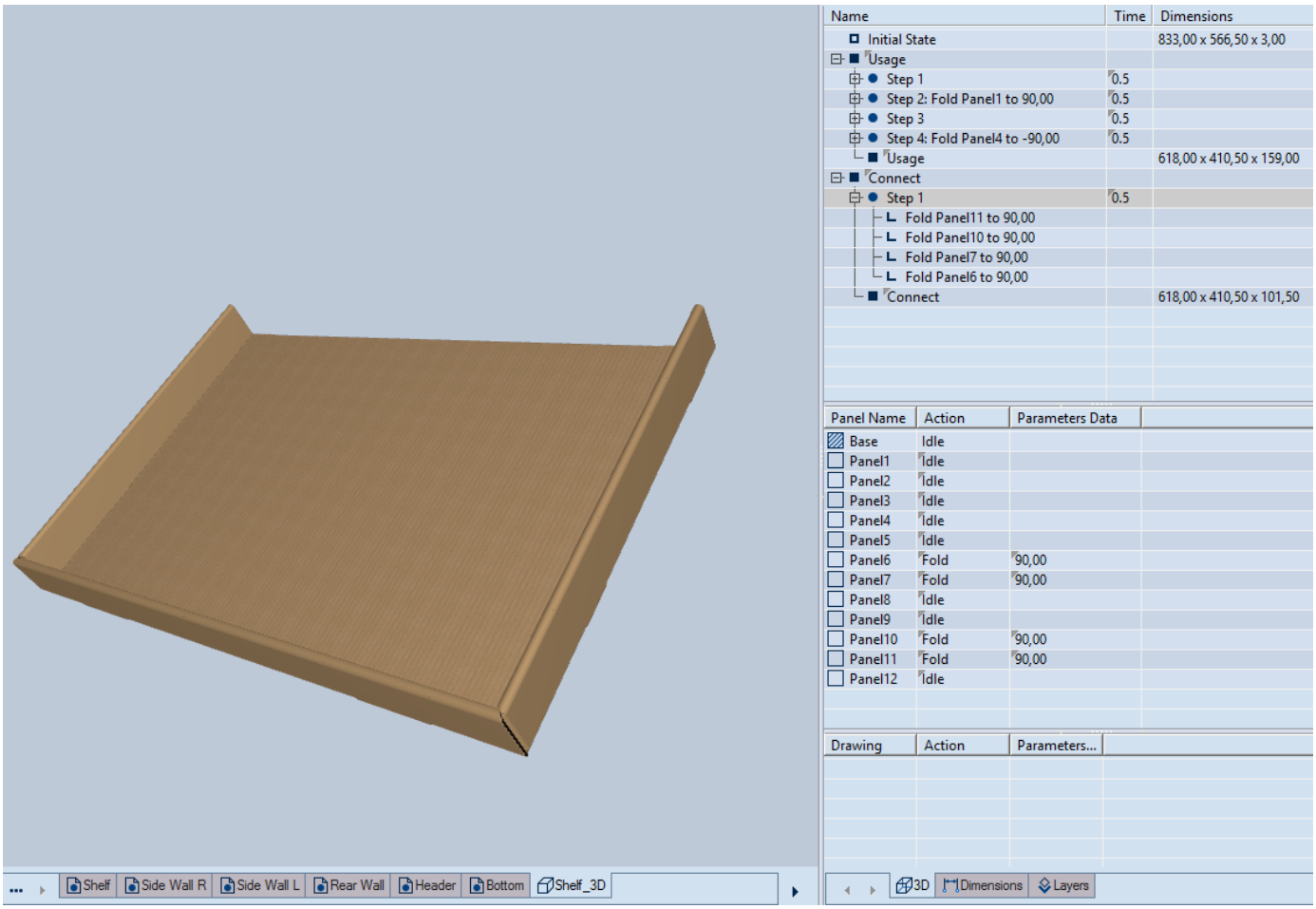
14. Select Step 1 of the phase Connect.

15. Select the four panels as shown in Pic. 7, and then fold them at 90 degrees.



Pic. 7: Selecting the outward side panels

The part has been folded as we need it.



Pic. 8: Final state of the shelf

Preparing the Part 'Side Wall R'

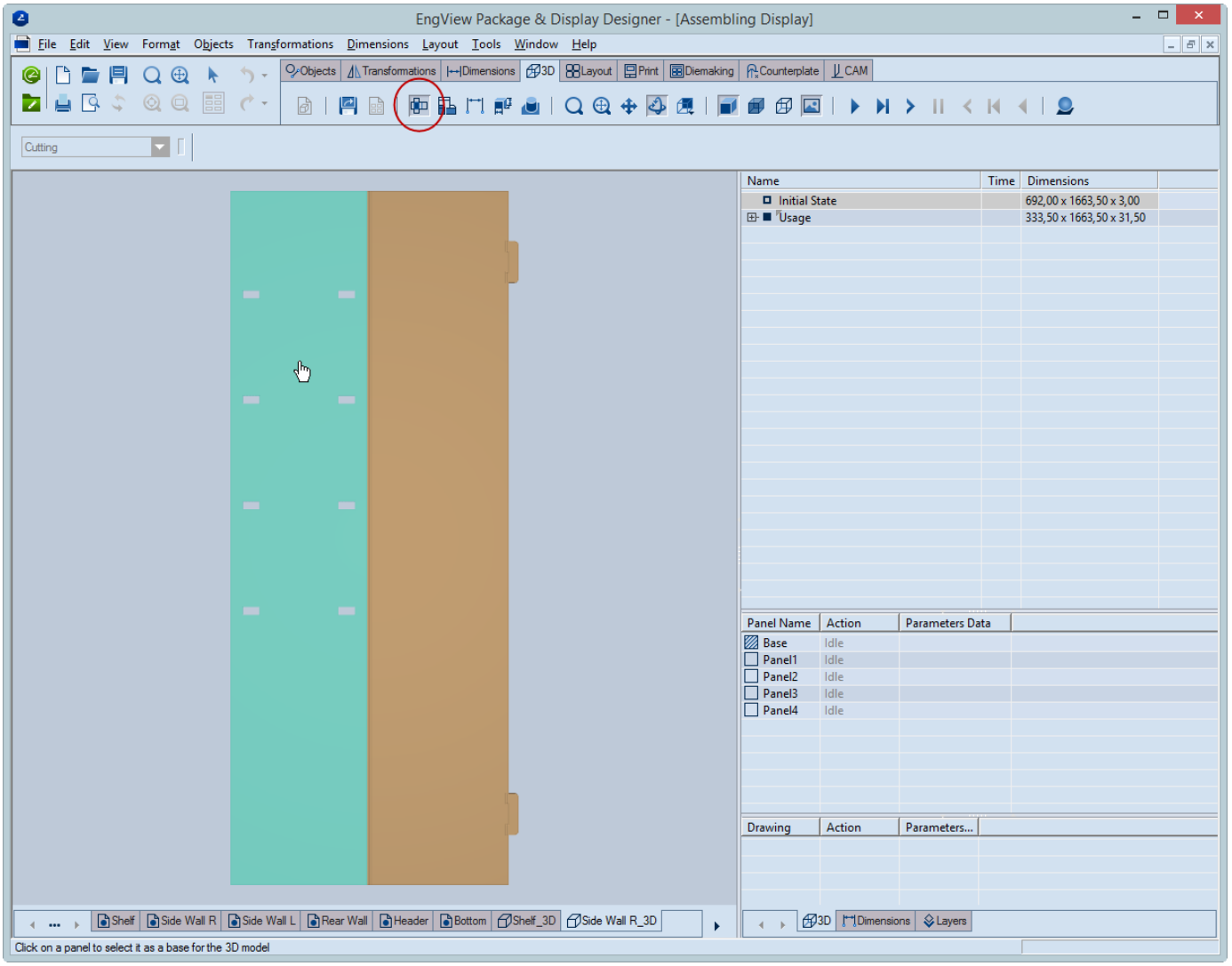
1. Click the tab of the Side Wall R drawing.
2. Create a 3D drawing.

We have one step, in which all the panels are folded at 90 degrees. These folds take place at once because all the actions for the individual panels are placed in a single step.

In terms of the assembly of the display, all this takes place in one and the same moment. That is, there is no need that we edit the folding sequence we now have.

The only thing we need is change the base. We need this to achieve a more realistic animation of the display assembly.

3. On the **3D** toolbar, click **Set Base Panel**  , and then click the panel as shown in Pic. 9.

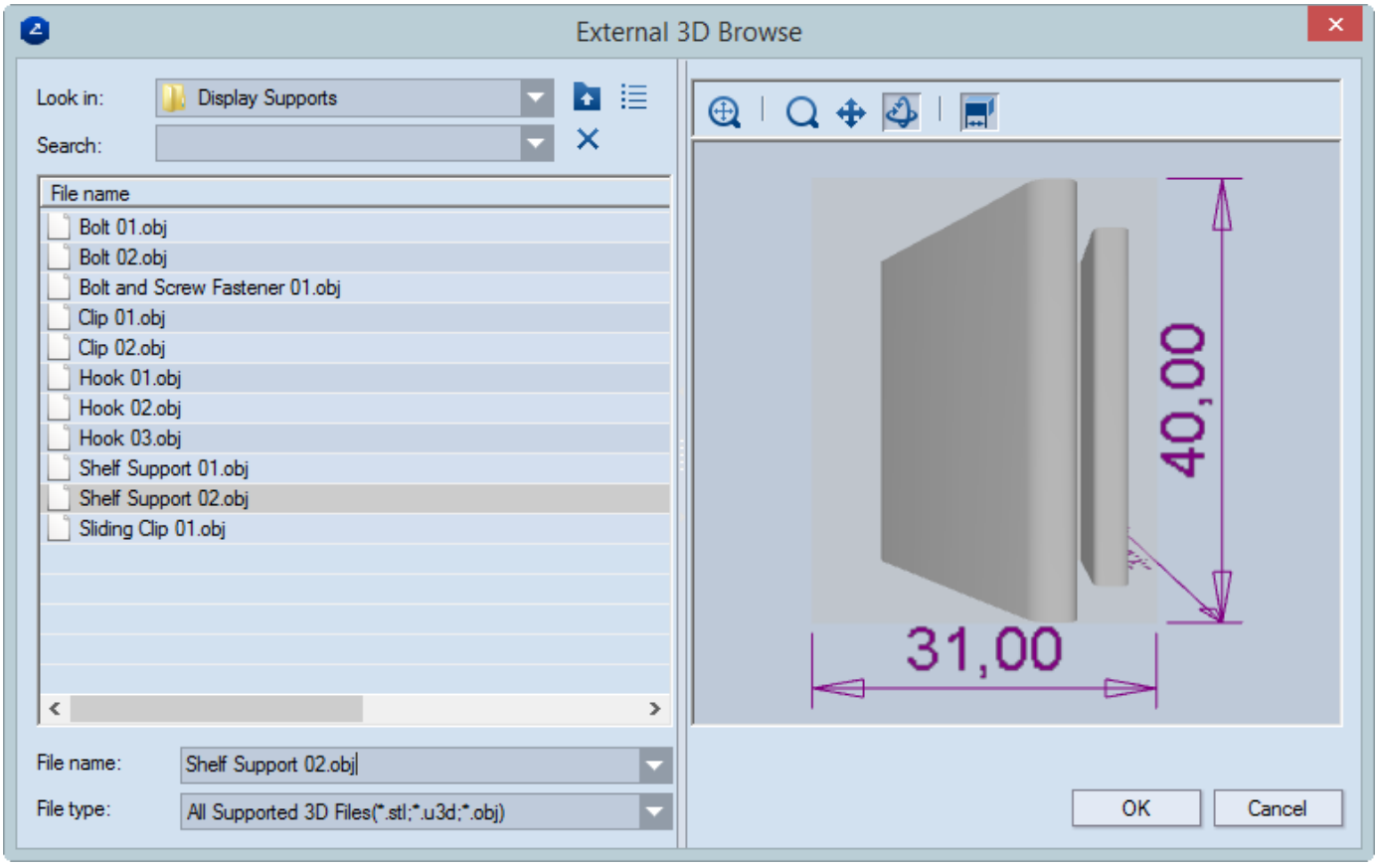


Pic. 9: Changing the base panel for the Side Wall R

Placing External Objects

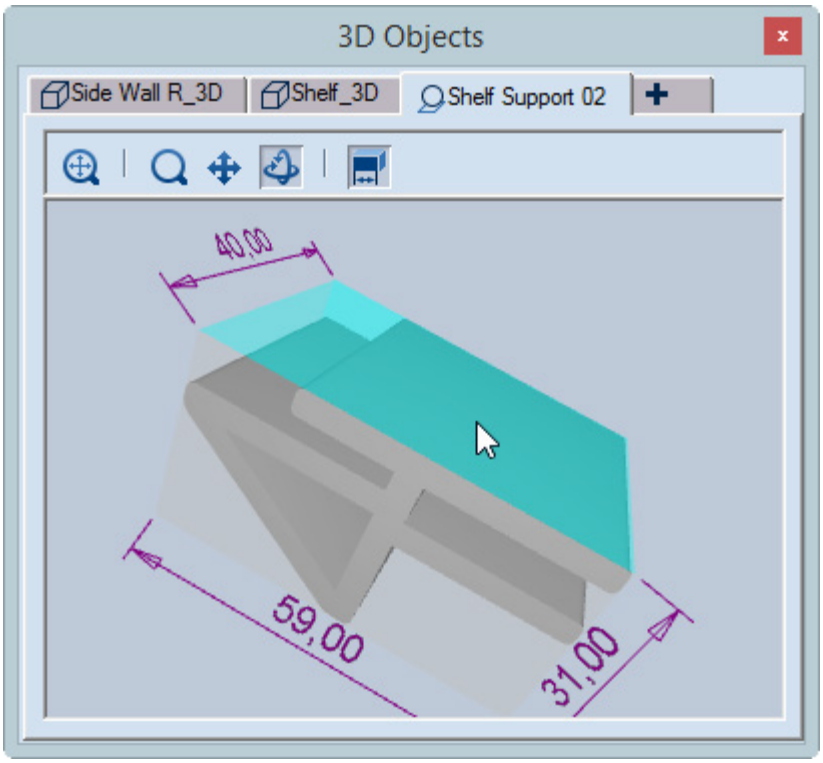
We proceed by placing the holders, which are external objects.

4. On the **3D** toolbar, click **3D Objects**  .
5. In the dialog box that appears, click the Plus sign.
6. Open the OBJ directory, and then open the Display Supports folder.
7. Select the file Shelf Support 02.obj.



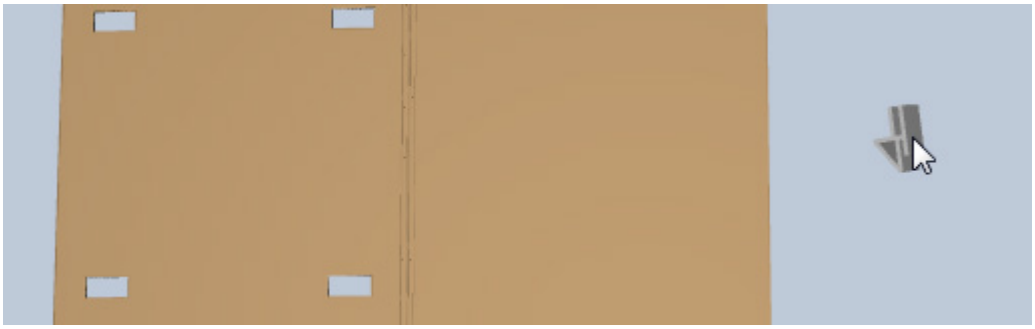
Pic. 10: A view of the Shelf Support 02, which will be used in the 3D part

8. Click **OK.**
9. Assure that the current state of the Side Wall R is Initial State, and you see its front side.
10. Click the external object's surface as shown in Pic. 11, and then begin dragging it into the work area.



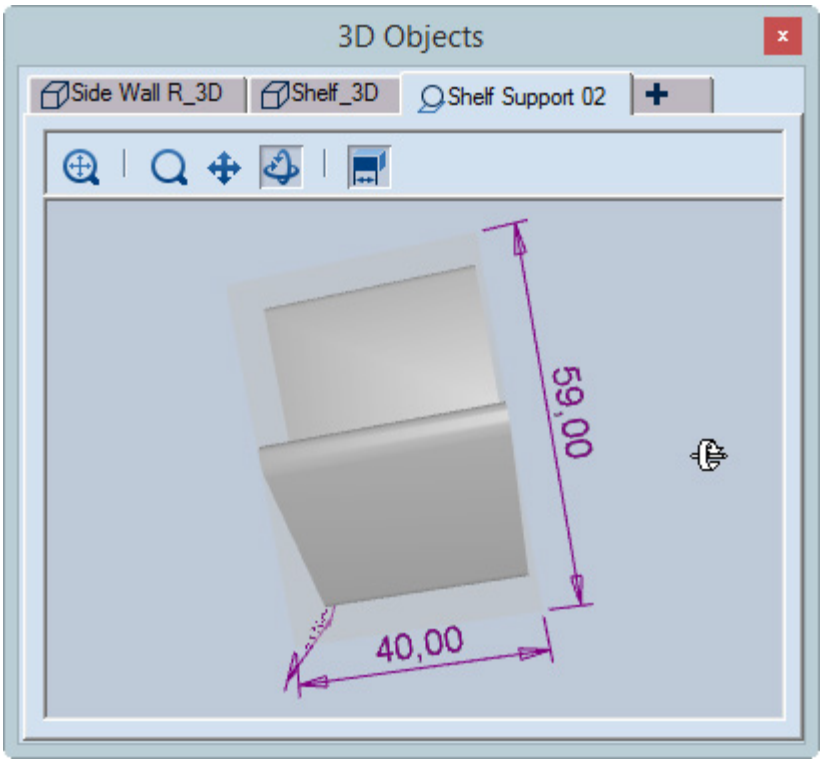
Pic. 11: Rotating the support while searching for a good side to use for dragging

11. Note that the object is in the state in which we selected it.

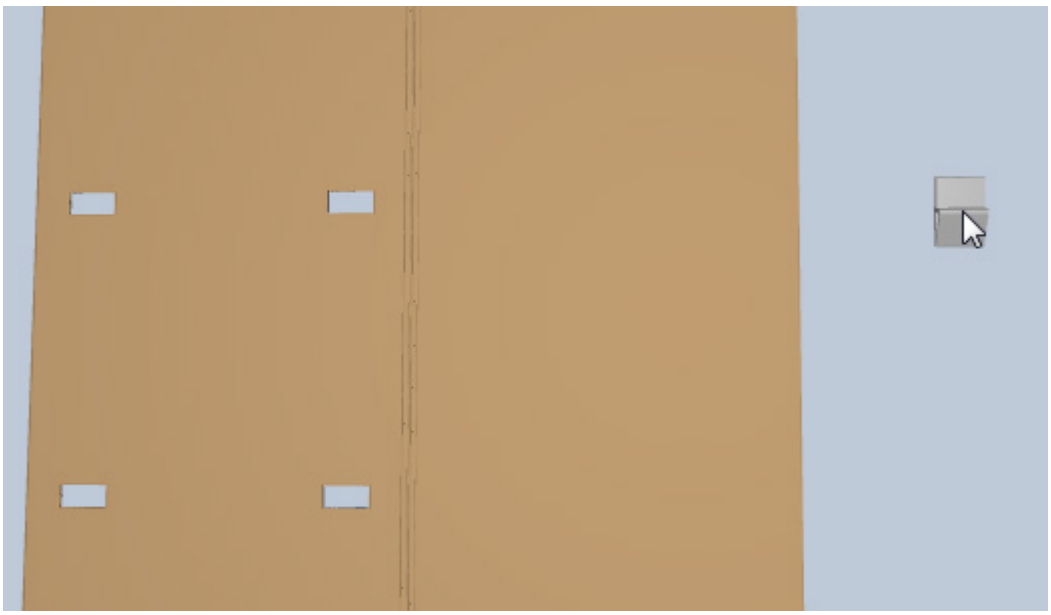


Pic. 12: Dragging the support into the work area

Once the object is in the work area, we can now change its state by rotating it in the **3D Objects** dialog box.

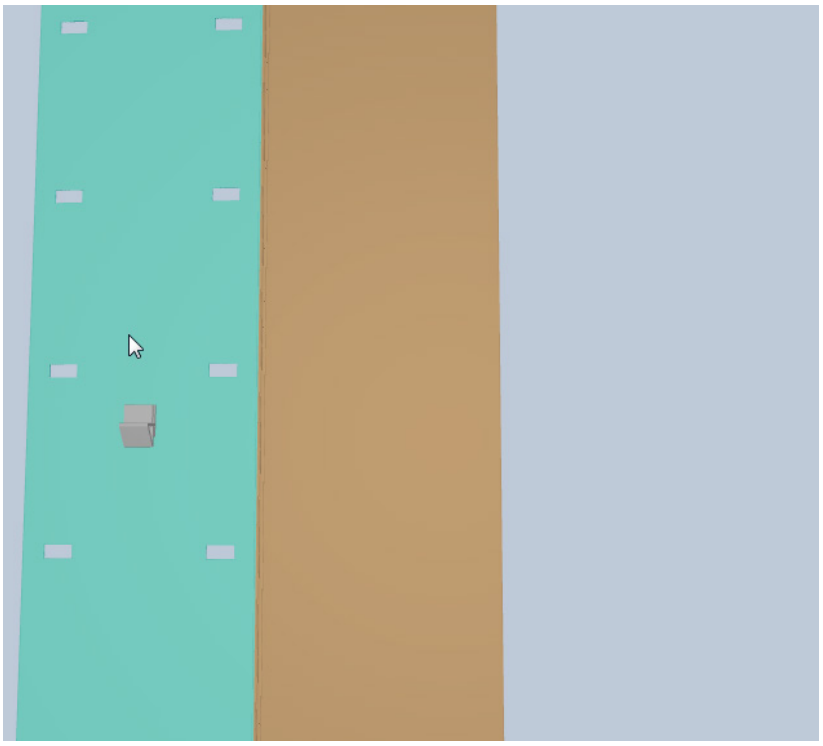


Pic. 13: Adjusting the support's position while it's hanging unattached in the work area



Pic. 14: The support is now in its correct position.

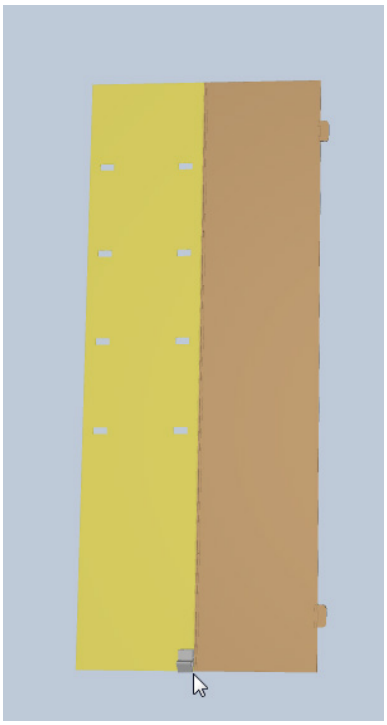
12. Use the mouse to go to the panel to which we will attach the object, and then click.



Pic. 15: Clicking the panel means we are ready to attach the support.

The panel is highlighted in yellow. This means that we are in the mode for aligning the external object to the panel we are attaching it to.

13. Use the mouse to take the support to the lower right corner of the highlighted object, and then click.

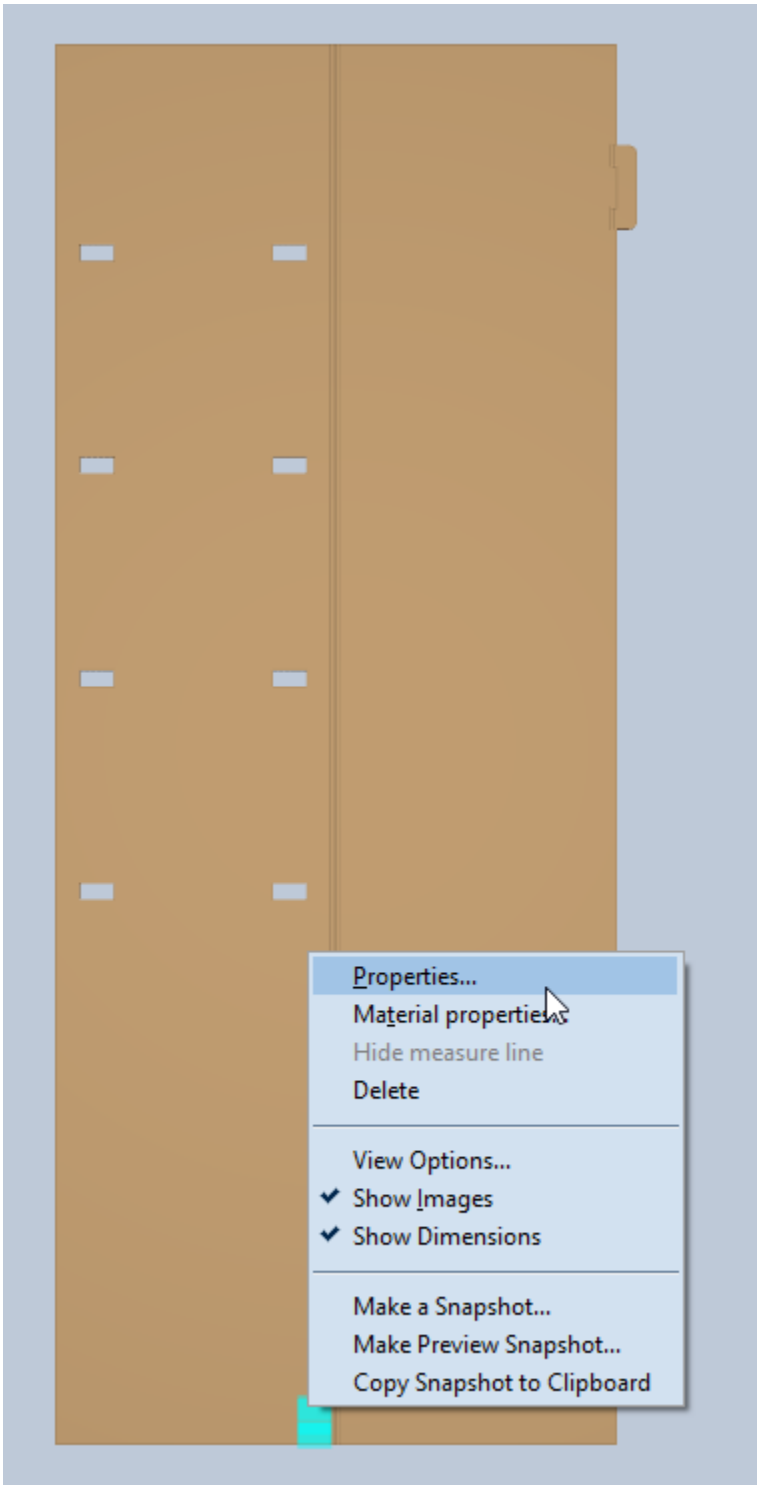


Pic. 16: Positioning the support where we need it.

The inserted object is now aligned bottom right.

We proceed by setting the shelf support in its correct position.

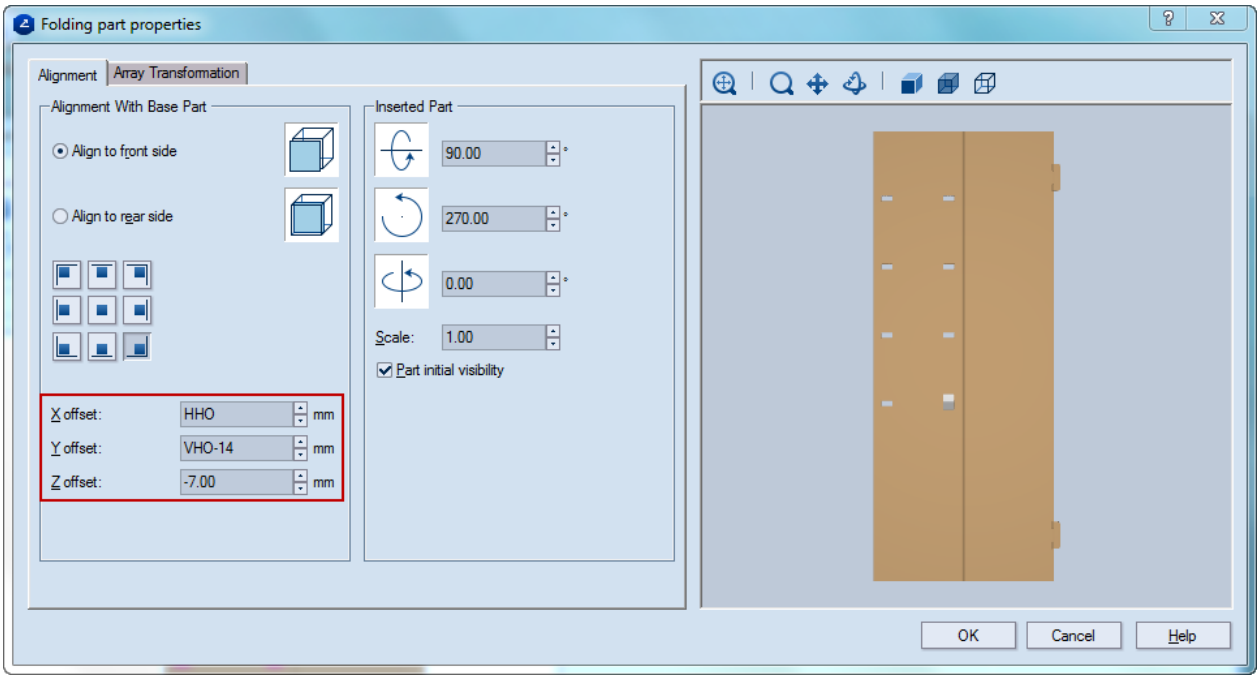
14. Right-click the support, and then click **Properties**.



Pic. 17: Opening the properties of the support for fine-tuning

The **Folding Part Properties** dialog box appears.

15. To move the support to the first right-hand hole, in **X offset**, type HHO; in **Y offset** type VHO-14; in **Z offset** type -7.



Pic. 18: The support's position is being adjusted along the three distances.

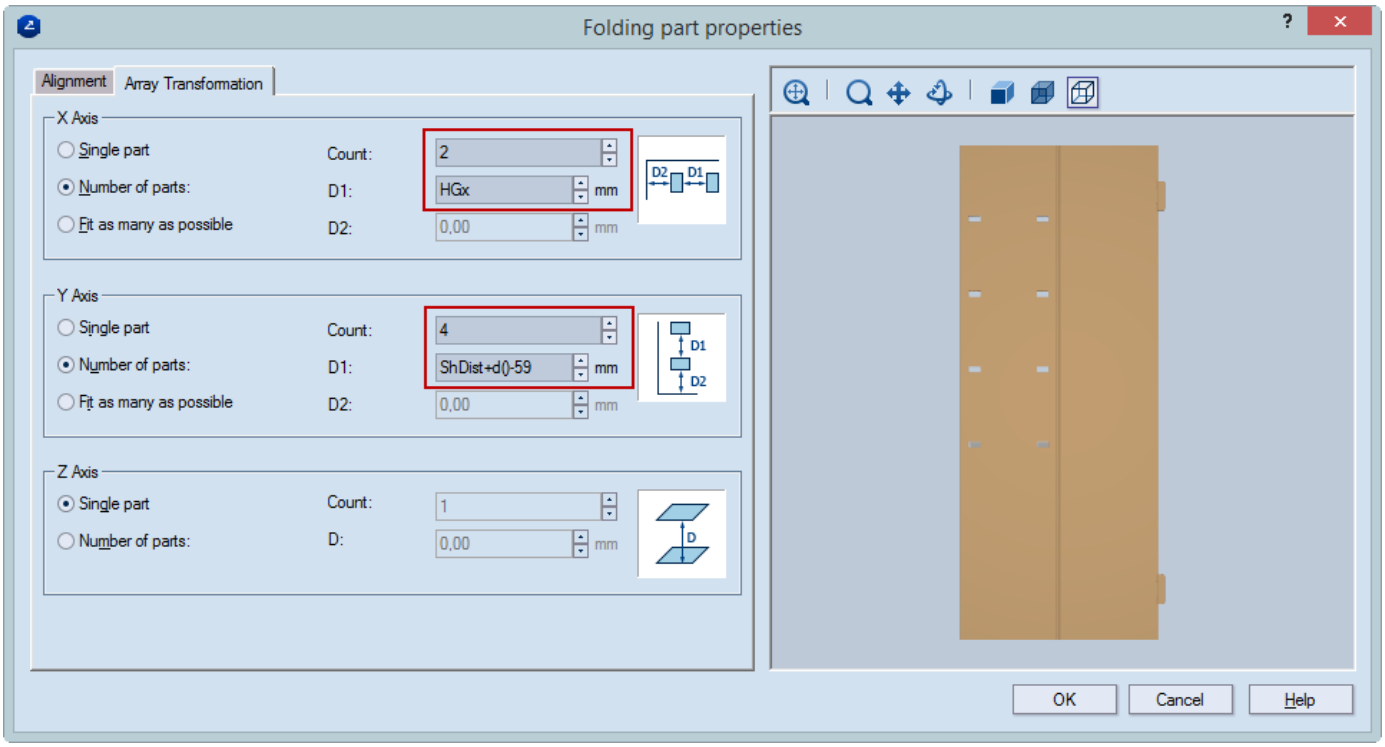
NOTES:

- Though we can type also numbers in these edit boxes, in this case we use parameters from the 2D drawing. This guarantees that the 3D representation responds to changes of the size of the display.
- The values 7 and 14 are linked to the support's physical size.

16. To animate the attachment of the support to the wall, we will set an additional z-axis offset: in **Z offset** type -7.00+50. Do not click **OK**.

    We have attached one support. But we need seven more.

17. Click the **Array Transformation** tab, and then type the values as shown on Pic. 19.

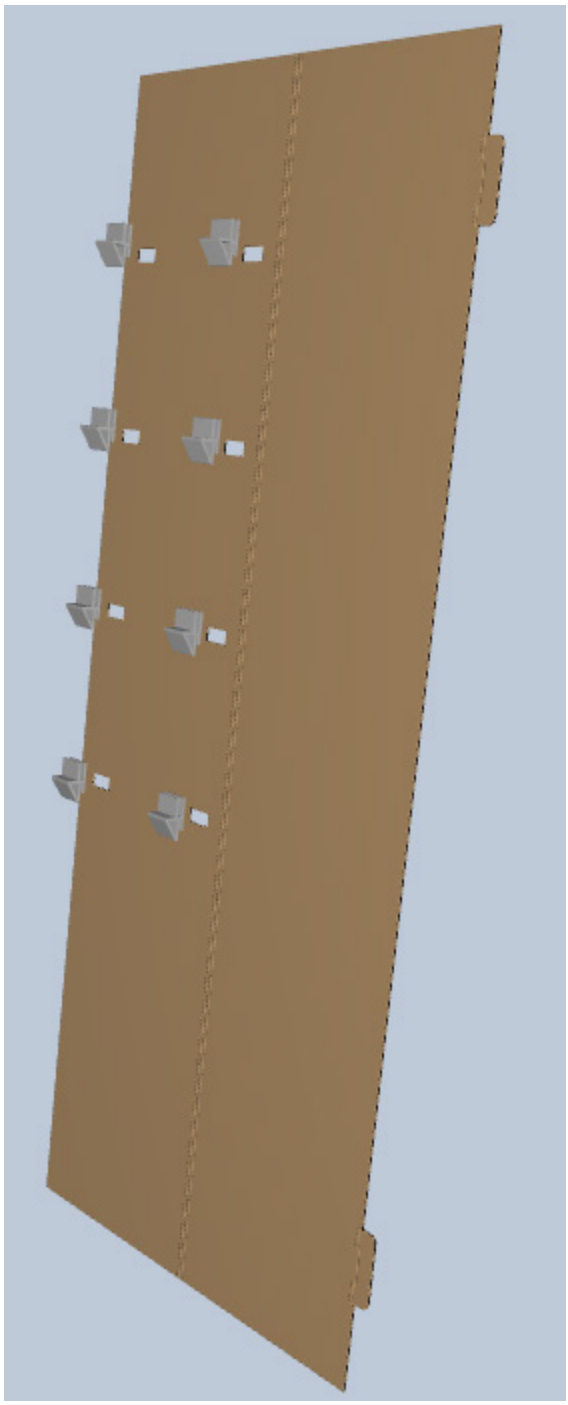


Pic. 19: Mulitplying and distributing the necessary supports

NOTES:

- We again use parameters from the 2D drawing to make the 3D representation respond to changes of size.
- In D1 of Y Axis group the physical height of the support has been taken into account: 59 mm.

18. To adopt the changes, click **OK**.



Pic. 20: The eight supports are now in place.

We have inserted the supports and will now create actions in the 3D folding sequence to animate their attachment to the wall. This attachment need to take place prior to the folding of the wall — that is, the actions that relate to the attachment of the supports need to be in a separate step that takes place before the step for the folding. Besides, we need this attachment to be visible during the assembling of the display — that is, from the point of view of assembling the display, this wall will go through two states:

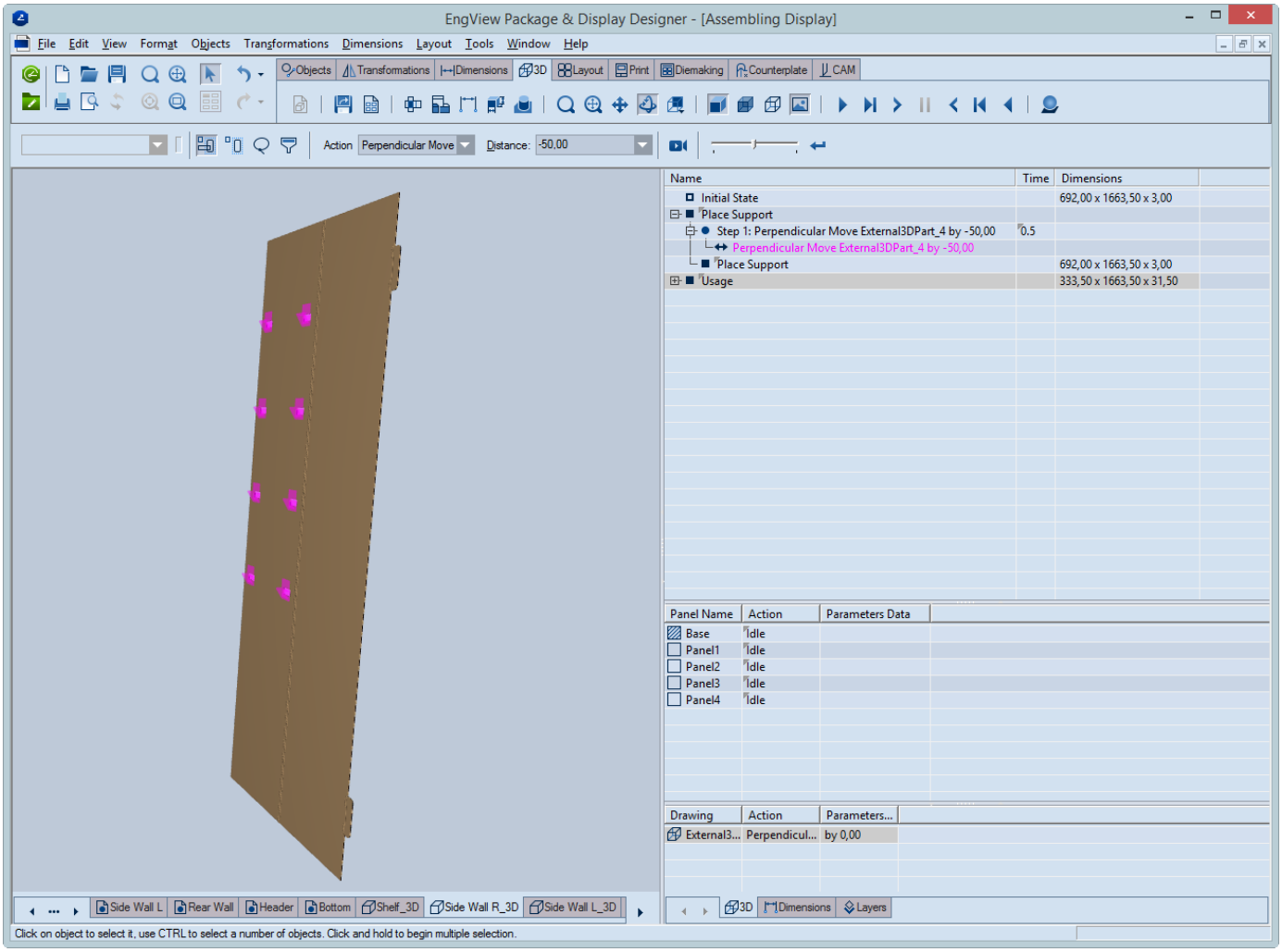
supports placement and folding. That is why, the actions linked to the attachment of the supports need to be in a separate step and also in a separate phase.

19. In the tabular area, right-click Usage, and then click **Insert phase above**.

20. Name the phase Place Support.

21. In the work area, select the inserted object, and then, in **Action**, select Perpendicular Move.

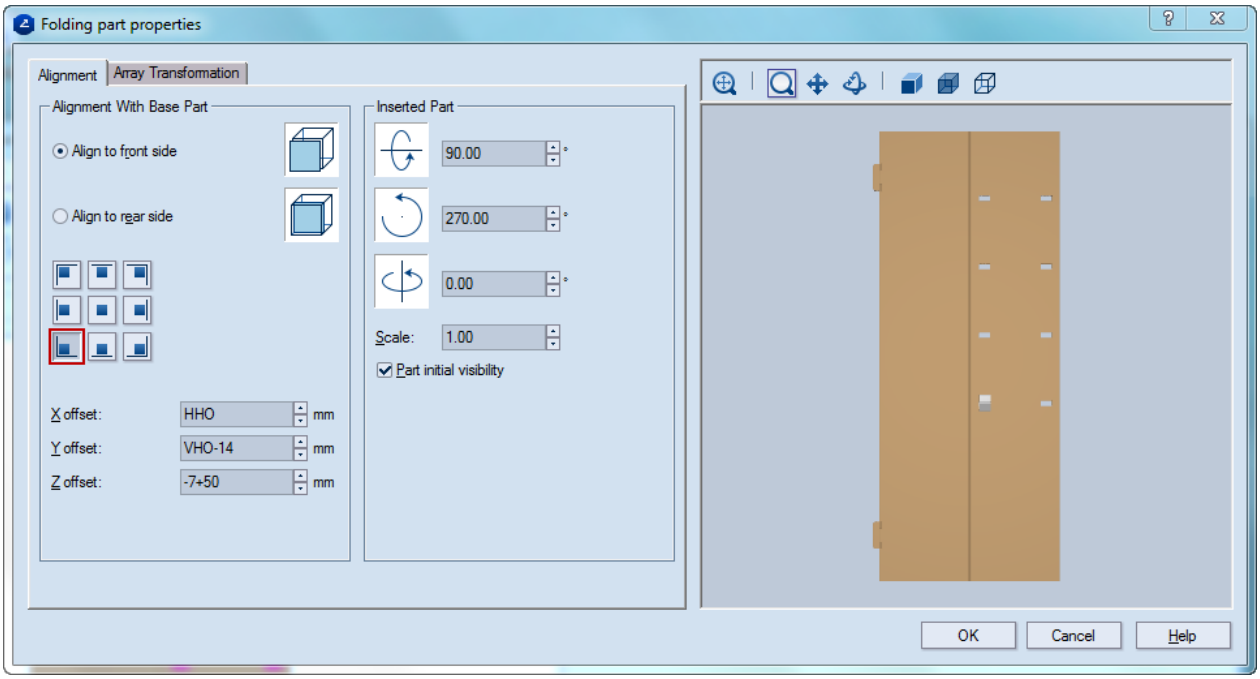
22. In **Distance**, type –50, and then press ENTER.



Pic. 21: Setting a perpendicular move for the supports

Preparing the Part 'Side Wall L'

- For the Side Wall L Repeat the steps in the section *Preparing the Side Wall R part* in their exact order. NOTE: When you are repeating the instructions, bear in mind that the walls are mirrored – that means that in Side Wall L you need to align the shelf support in the lower left corner.



Pic. 22: The support's position is being adjusted along the three distances.

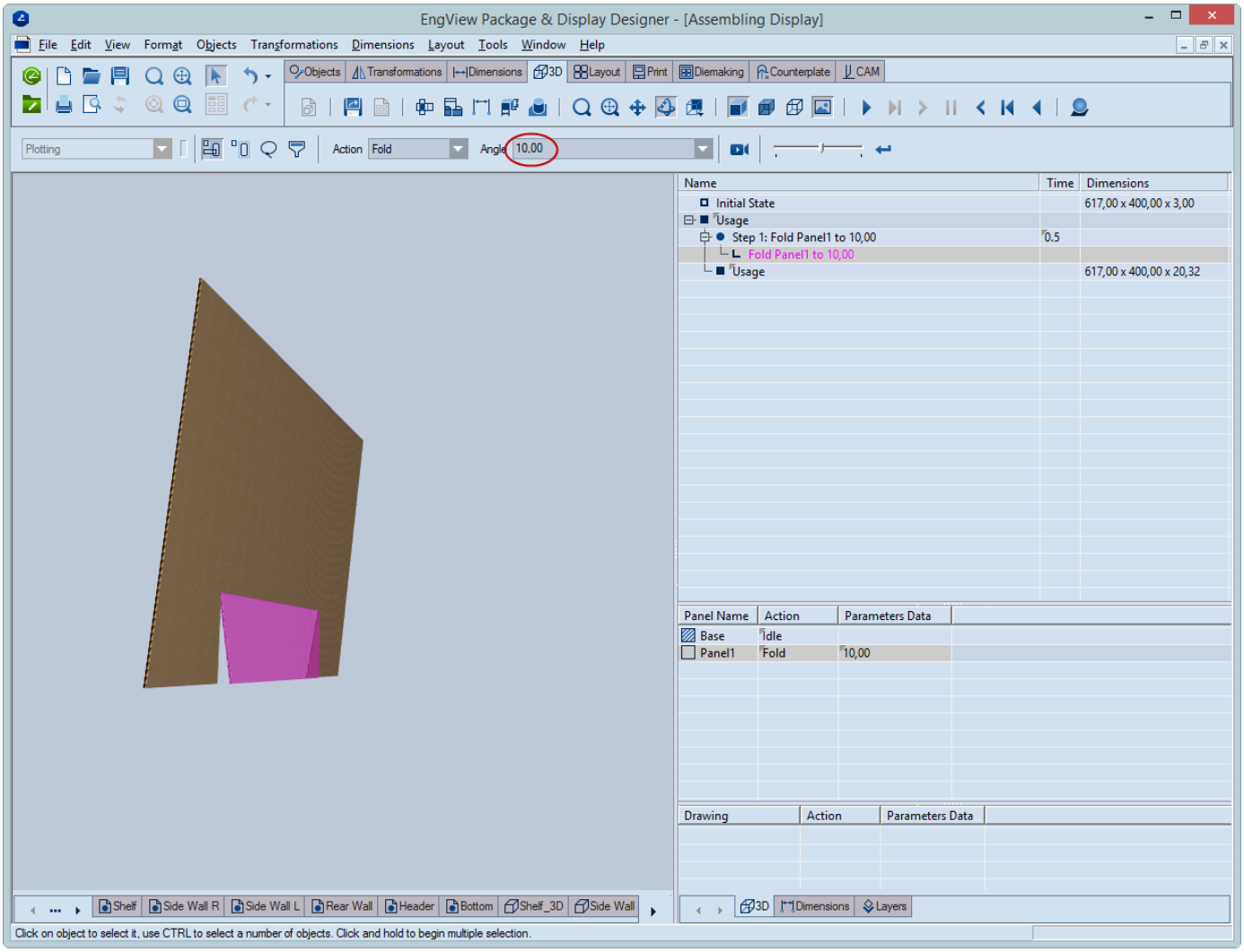
Preparing the Rear Wall

- Click the Rear Wall tab, and then create a 3D drawing from it.

This is the drawing that we'll use to assemble the entire display. That is why we will leave it for the moment, and will return to it later.

Preparing the Header

1. Click the Header tab, and then create a 3D drawing from it.
2. In the tabular area, open Step 1.
3. Select the action for Panel 1.
4. In the contextual edit bar, in **Angle** type 10, and then press ENTER as shown in Pic. 23.



Pic. 23: Changing the default angle of folding of the panel

Preparing the Bottom

- Click the Bottom tab, and then create a 3D drawing from it.

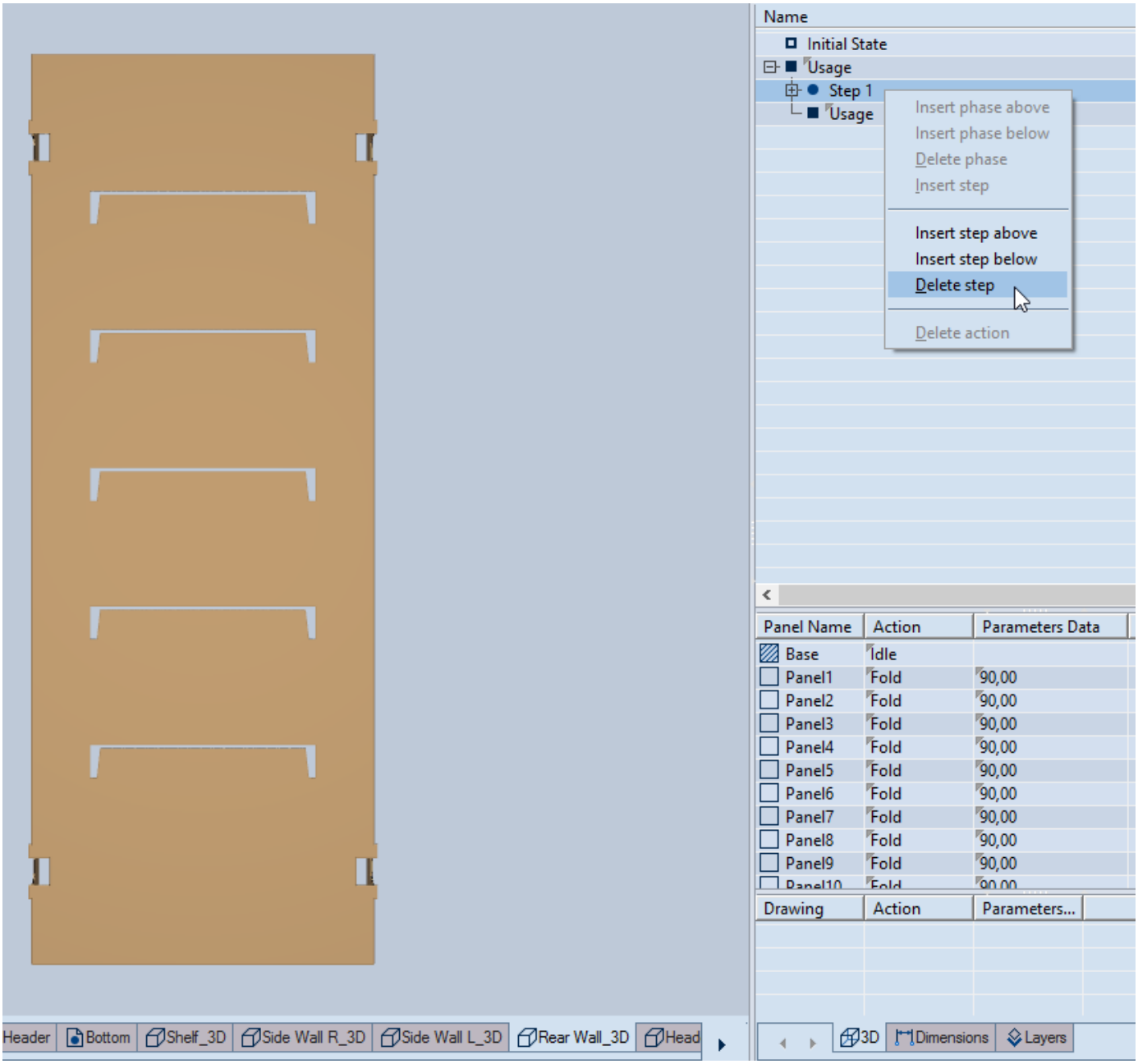
Here we accept the default folding sequence, and will not edit it.

Assembling the Display

We begin the assembling of the display by selecting a base 3D drawing, to which we will attach the rest of the parts. We have opted for the rear wall to be the base part.

- Go to the Rear Wall drawing.

Currently we have one phase – Usage – which has one step, and all the panels in this step are folded at 90 degrees. However, for the purposes of the assembly of the display these panels need to be folded at different stages of the assembly. That is why we will delete this step.

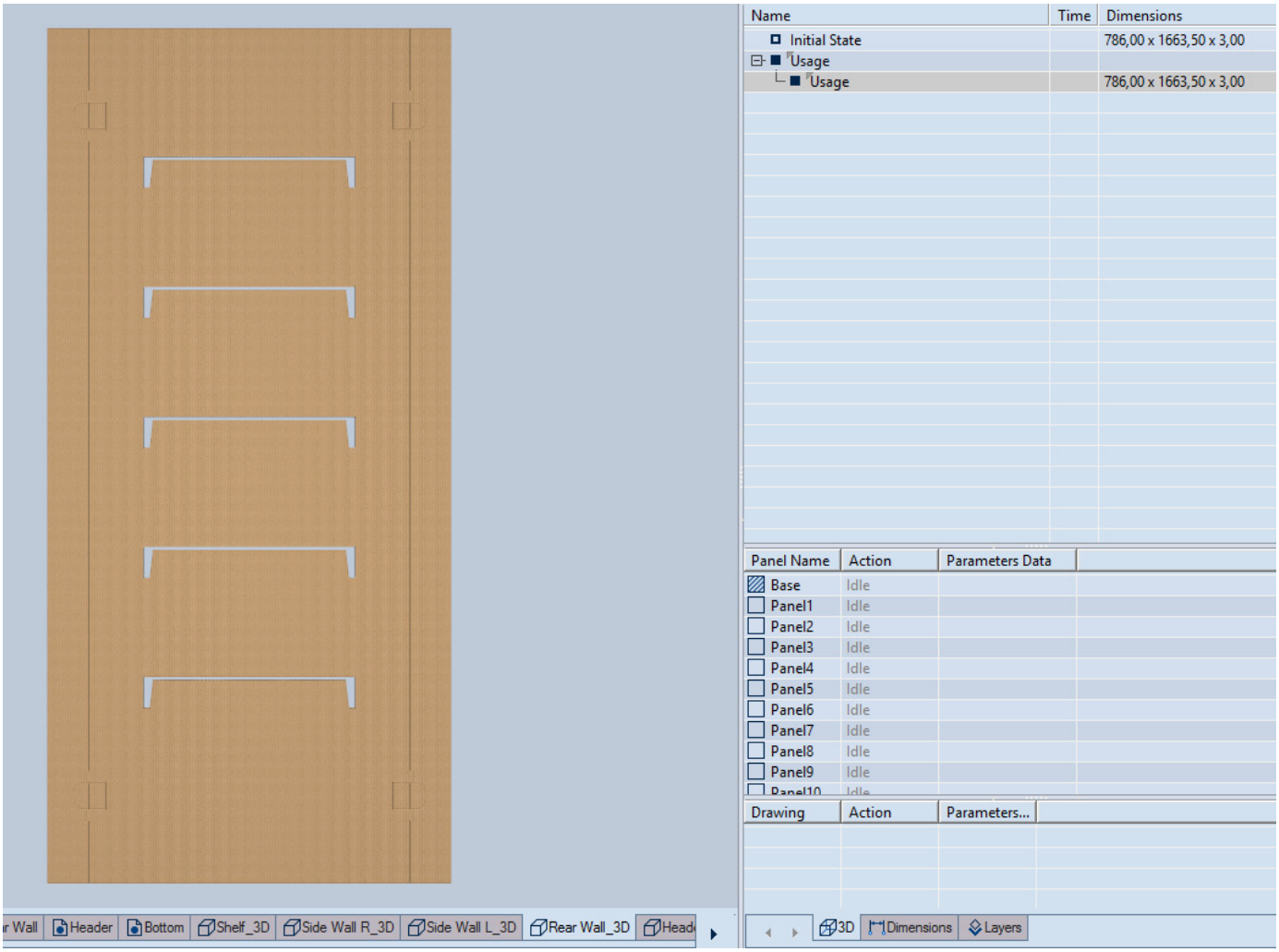


Pic. 24: Deleting the default step

We begin by attaching the side walls.

Attaching Side Wall R

1. Turn over the wall so as to see its rear side.

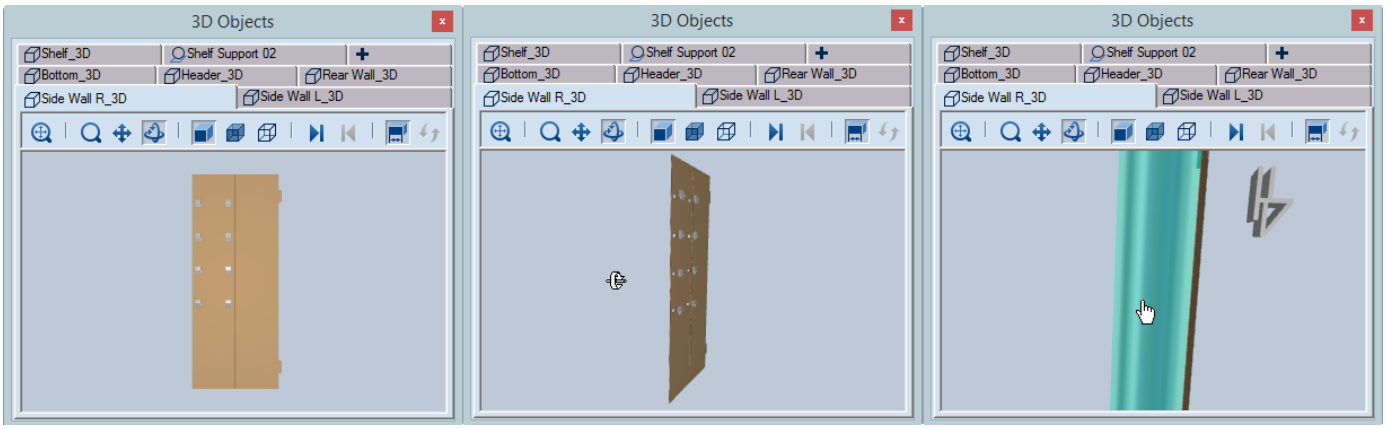


Pic. 25: The wall needs to be turned with its rear side facing us.

2. On the **3D** toolbar, click **3D Objects**  .

The **3D Objects** dialog box appears, showing all the 3D drawings we have in the project.

3. Click the **Side Wall R_3D** tab.
4. Use the **Reverse Play** animation button, and go to the the wall's initial state.
5. Rotate the part so as to see the edge. TIP: Press CTRL and scroll to zoom into the image and see the edge. This ensures that when we will be able to attach the part perpendicularly right from the start.



Pic. 26: Verifying the different material for the cellophane component

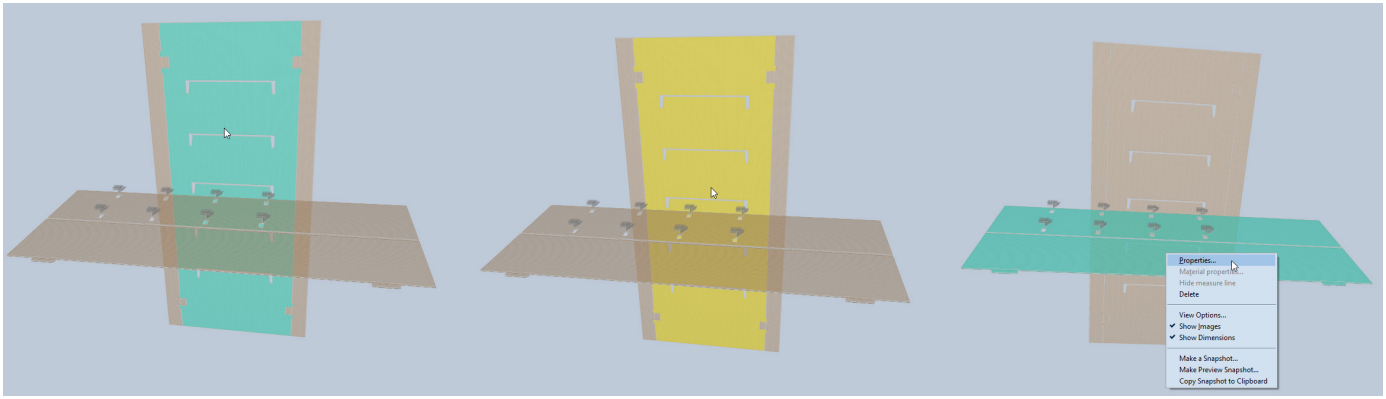
6. Click the edge, and then drag the part into the work area.
7. On the **3D** toolbar, click **Transparent**  . This will give us a clearer view of how to attach the panel.
8. When the rear panel becomes highlighted, click to attach the part to it.

The rear panels has highlighted in yellow, which means we are in the alignment mode.

9. Click again.

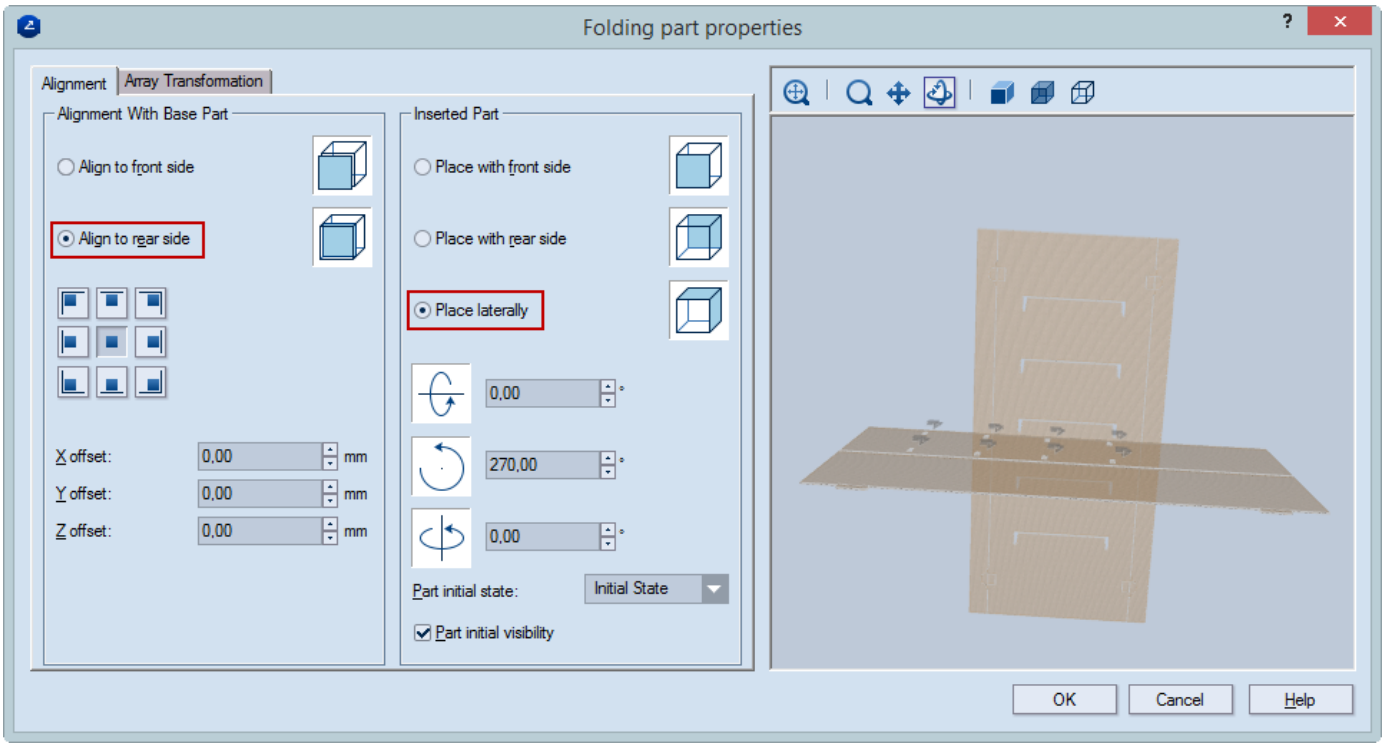
The part is now attached laterally to the rear surface of the main 3D drawing.

10. Open the properties of the attached part: right-click, and then click **Properties** on the context menu.



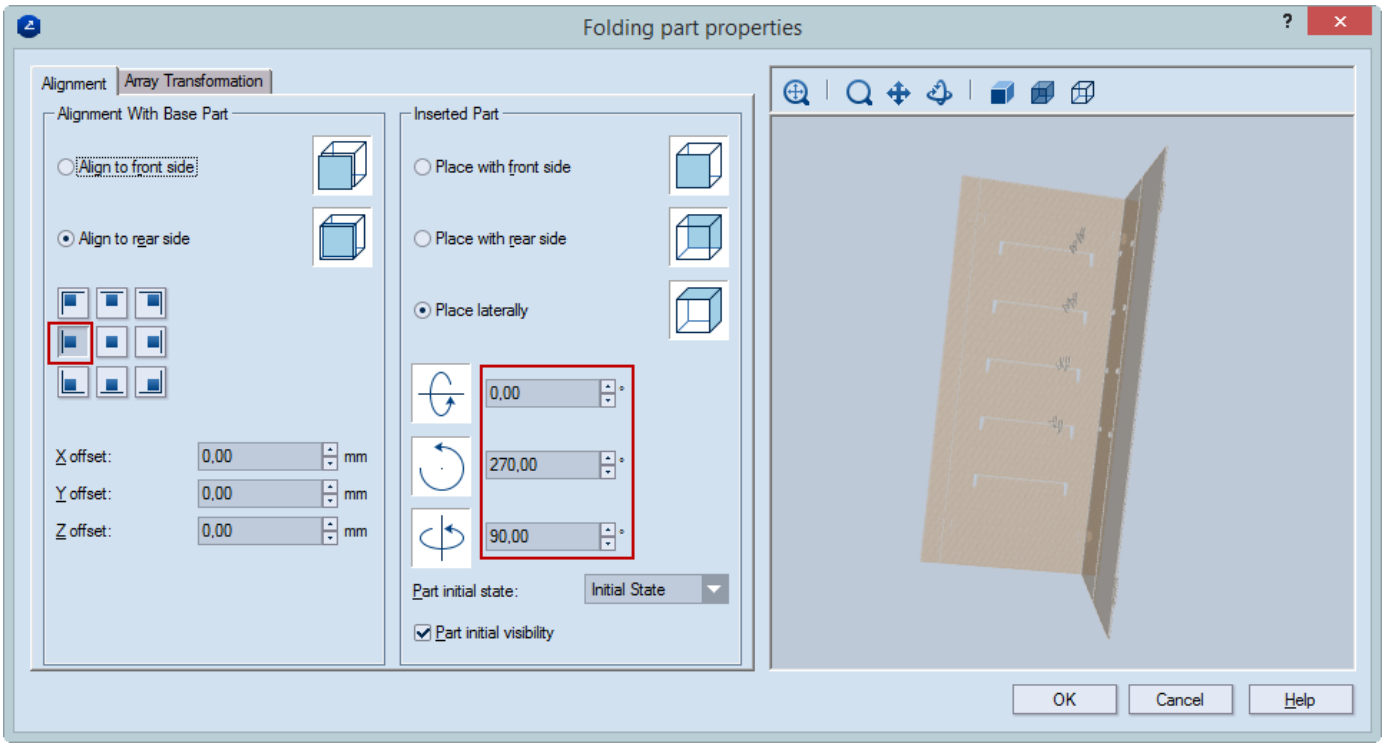
Pic. 27: The cellophane's apperance in 3D

The **Folding Part Properties** dialog box appears.



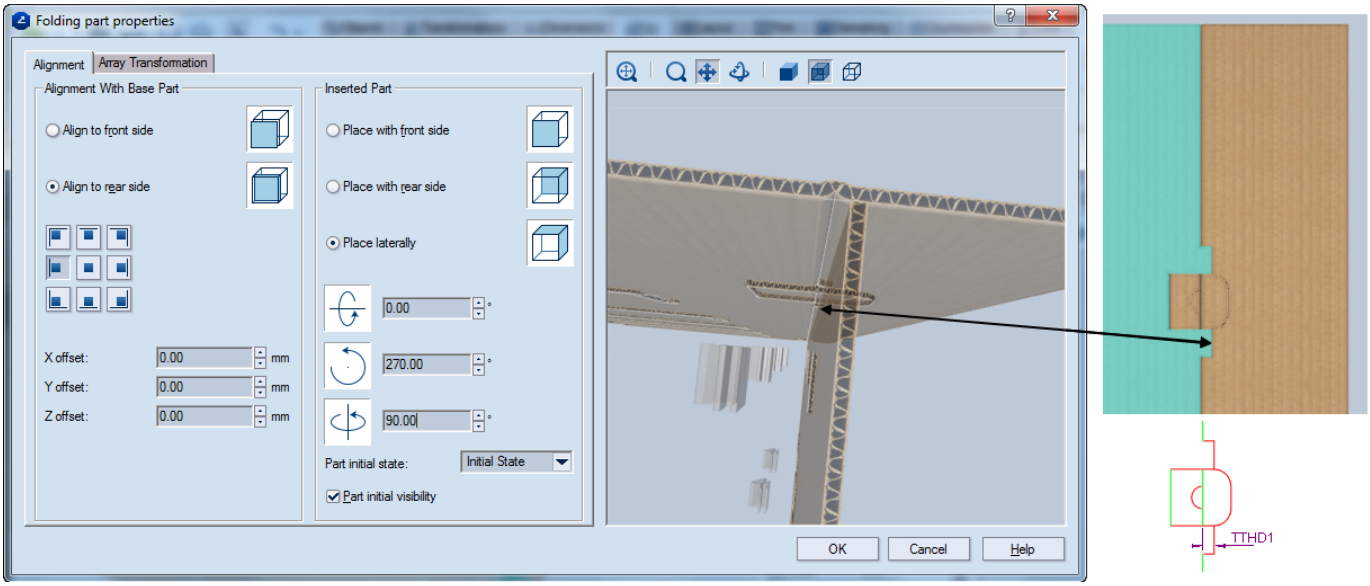
Pic. 28: Adjsuting the position of the side wall

We are now going to adjust its position.



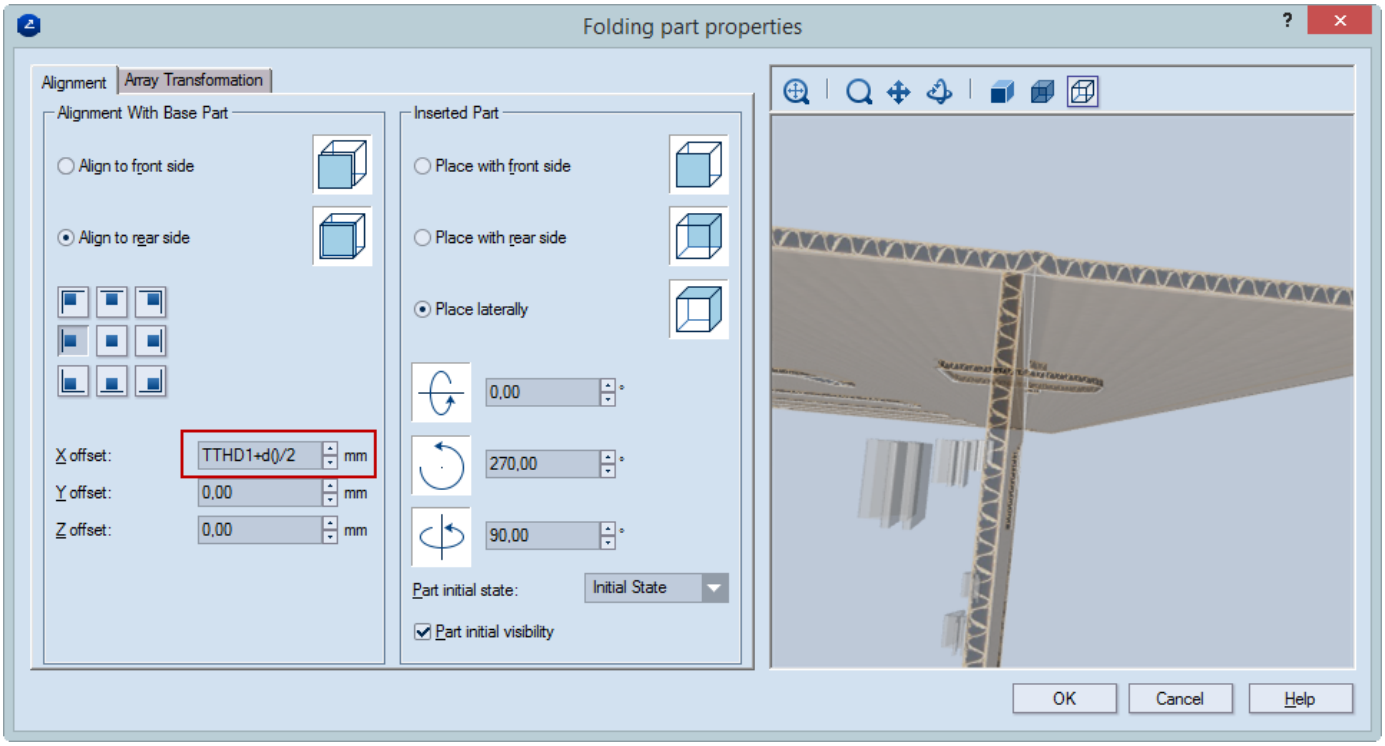
Pic. 29: Fine-tuning the adjustment of the side wall

At this stage we need to clarify one point. While a panel is being attached to another, the program uses their 2D bounding rectangles. In the current case we have a locking system at the rear end, and part of it changes the 2D bounding rectangle of the rear wall:



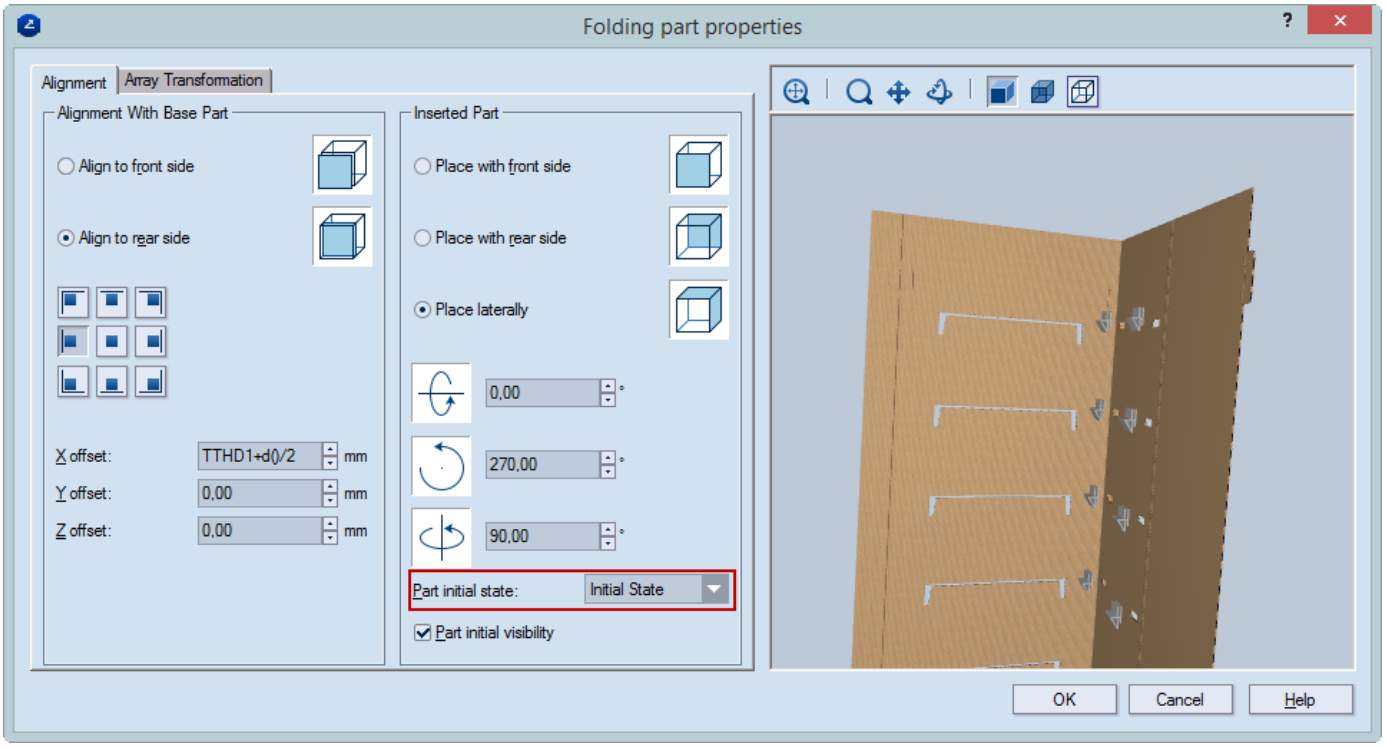
Pic. 30: The wall's positioning needs to take into account the parts' bounding recatngles.

This requires an additional adjustment to the side wall's position:



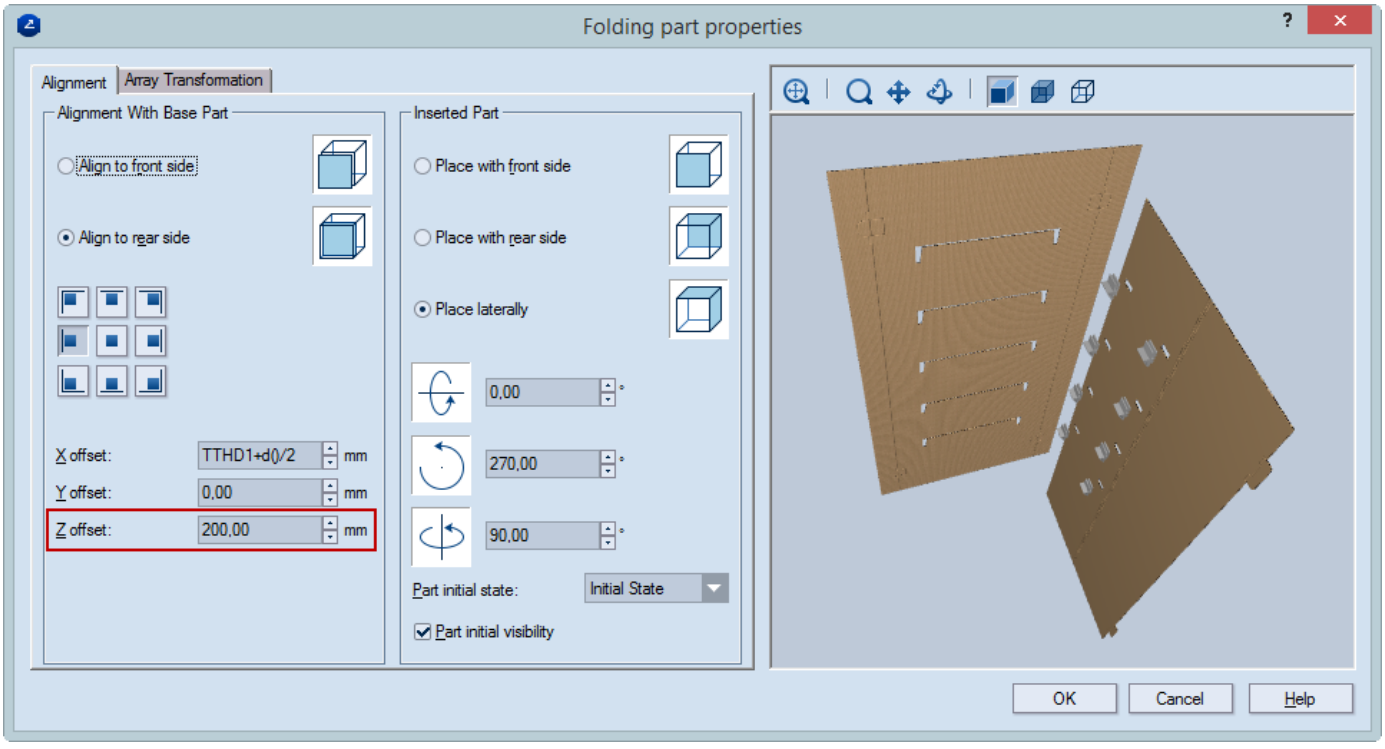
Pic. 31: Additional adjustment of the side wall's position

To show how the supports will be inserted into the assembled 3D model, in the tabular area we set the part's initial state to be not Usage but Initial State.



Pic. 32: The side wall will be fitted into place with its initial state.

We will now detach the side wall from the rear wall, and then will animate the attachment.

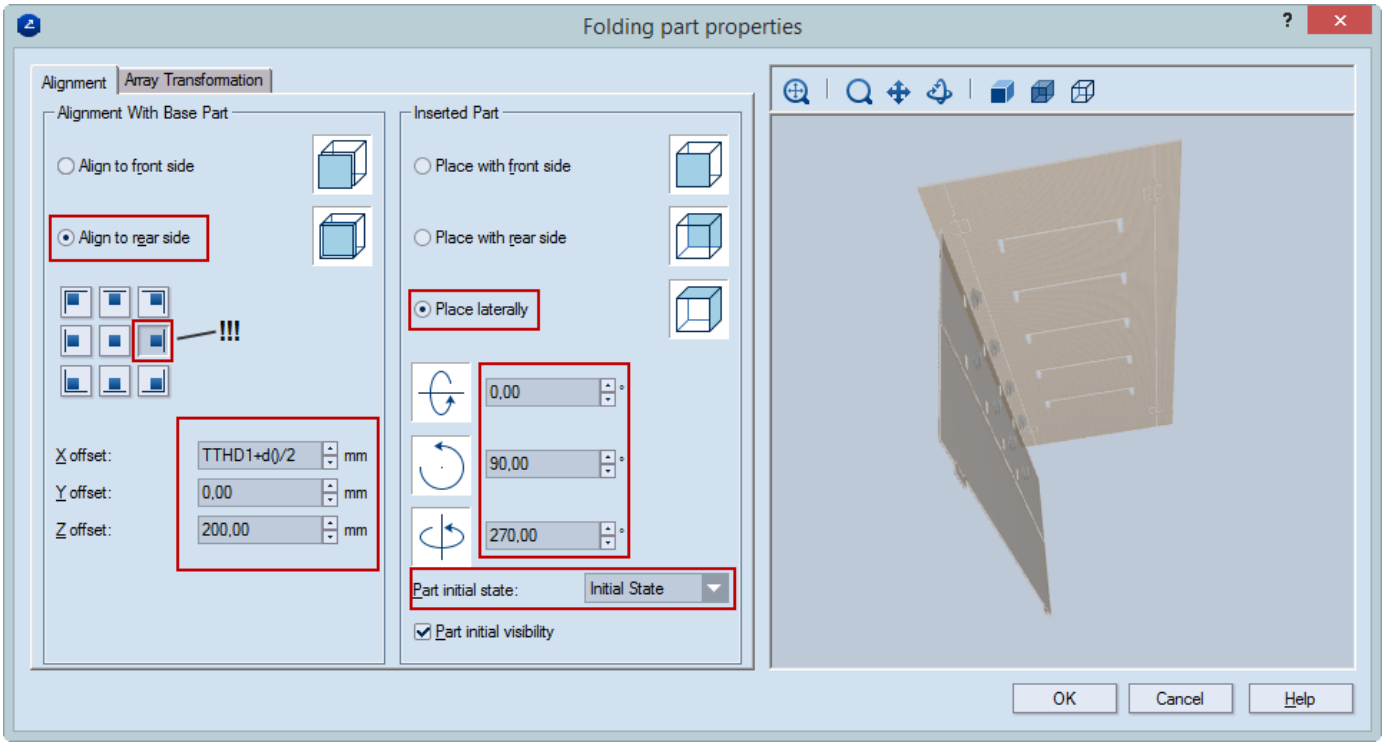


Pic. 33: Detaching the wall is needed for the eventual 3D animation.

11. Click **OK**.

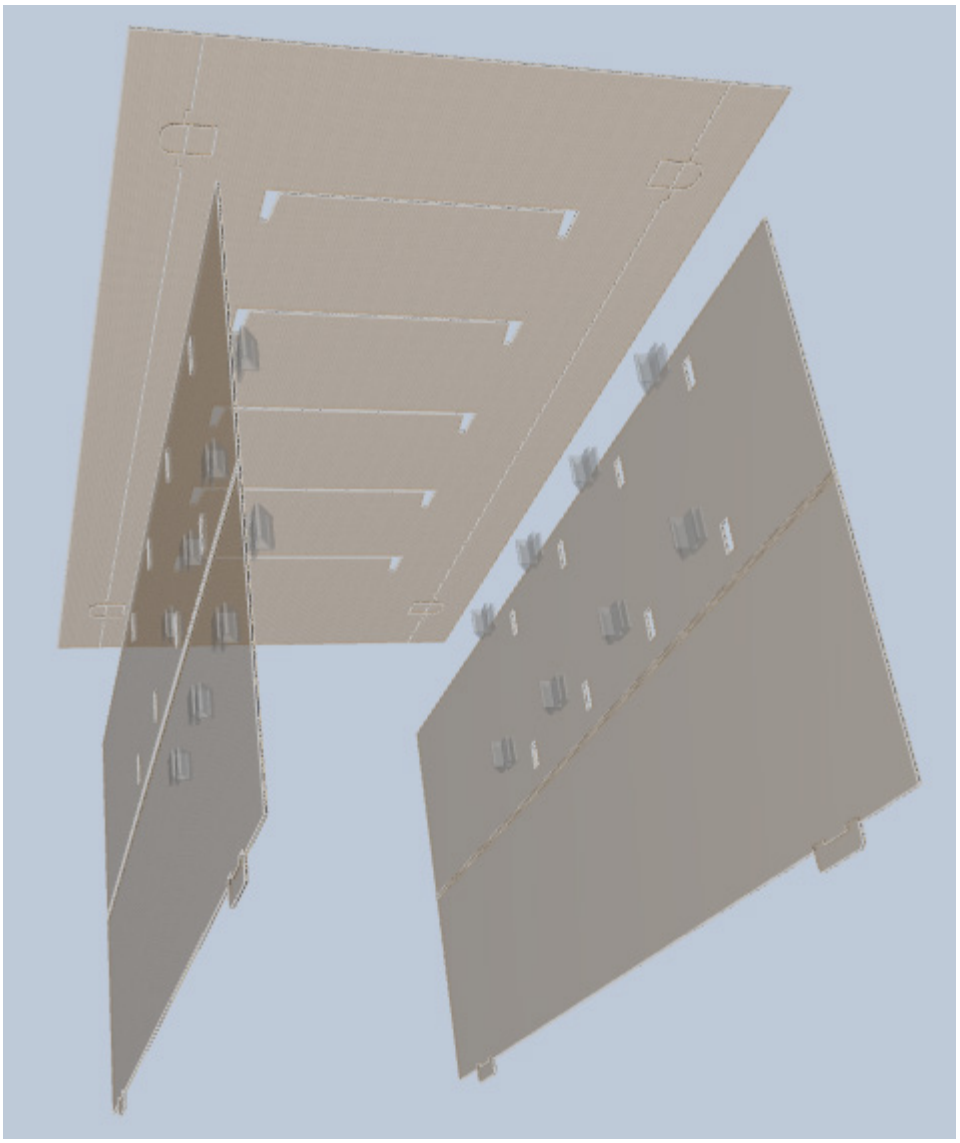
Attaching Side Wall L

- Attach this wall in the same manner as Side Wall R.



Pic. 34: Fine-tuning the position of the Side Wall L.

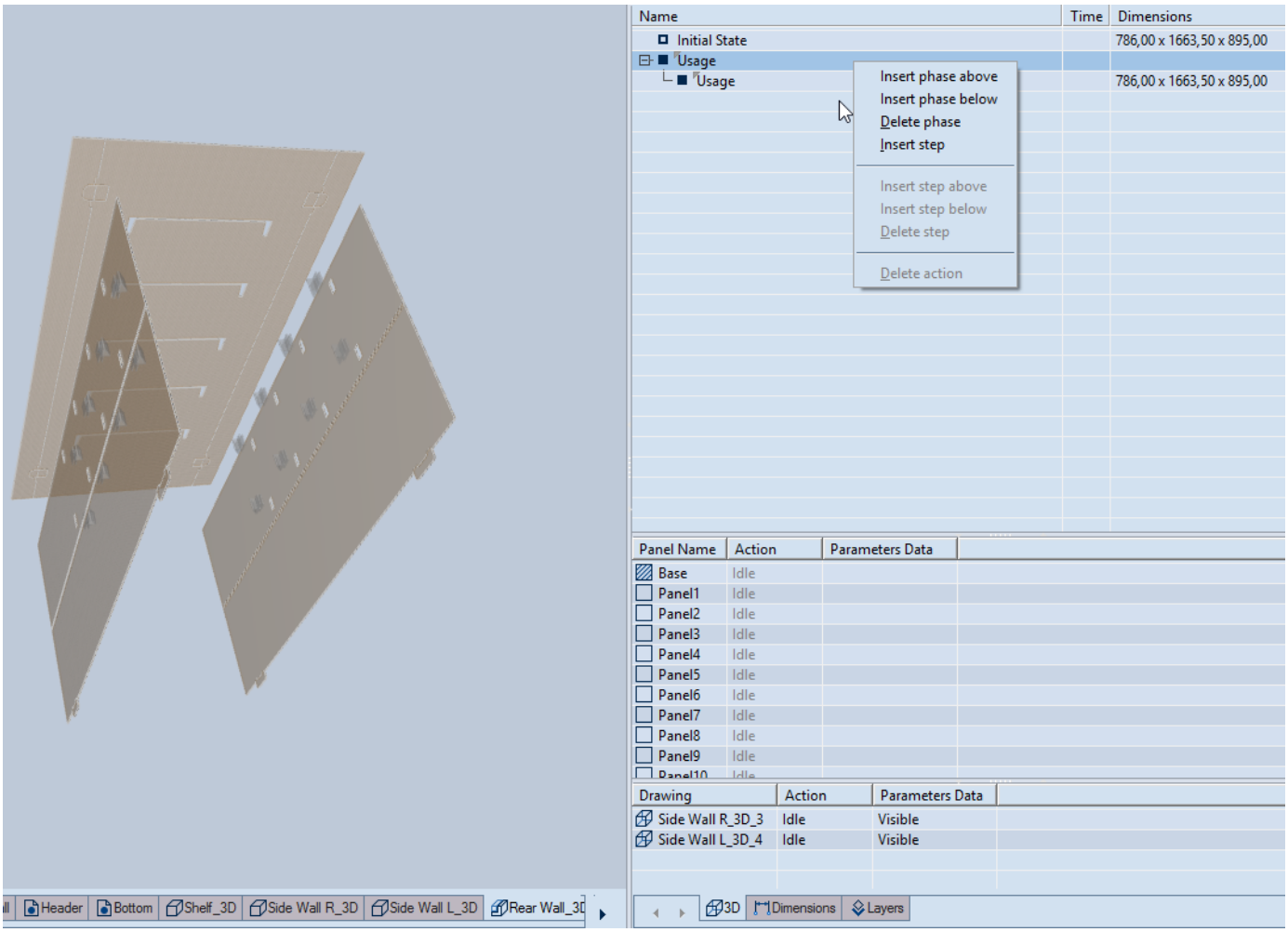
We have now attached the side walls to the rear wall.



Pic. 35: The two side walls are now positioned at a remove from the rear wall.

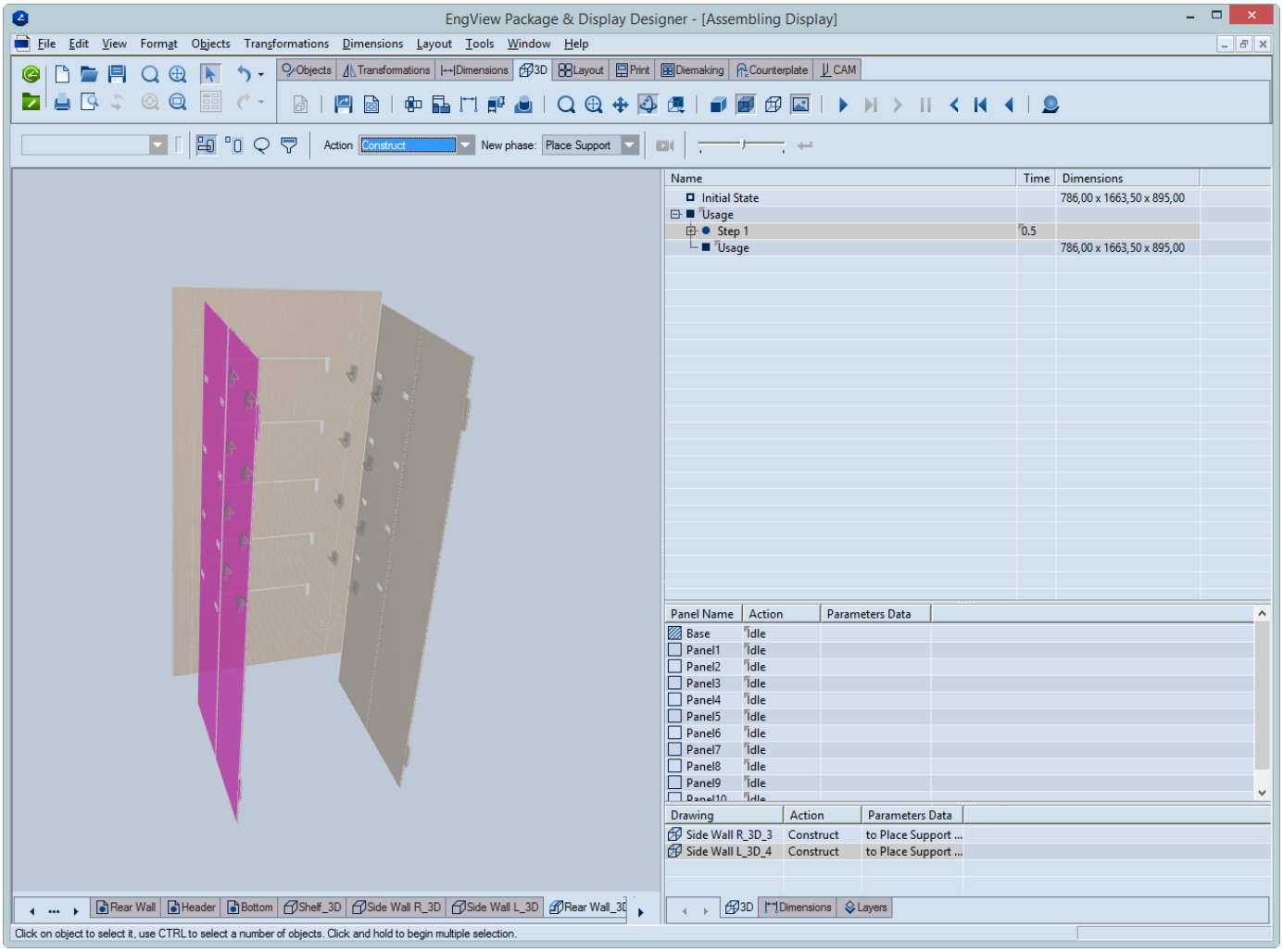
Creating Actions to Animate the Assembling of the Walls

1. In the tabular area, create a step in the Usage phase.



Pic. 36: Creating a new step in the Usage phase

2. Select any of the side walls.
3. In the contextual edit bar: in **Action**, select Construct; in **New phase**, select Place Support.

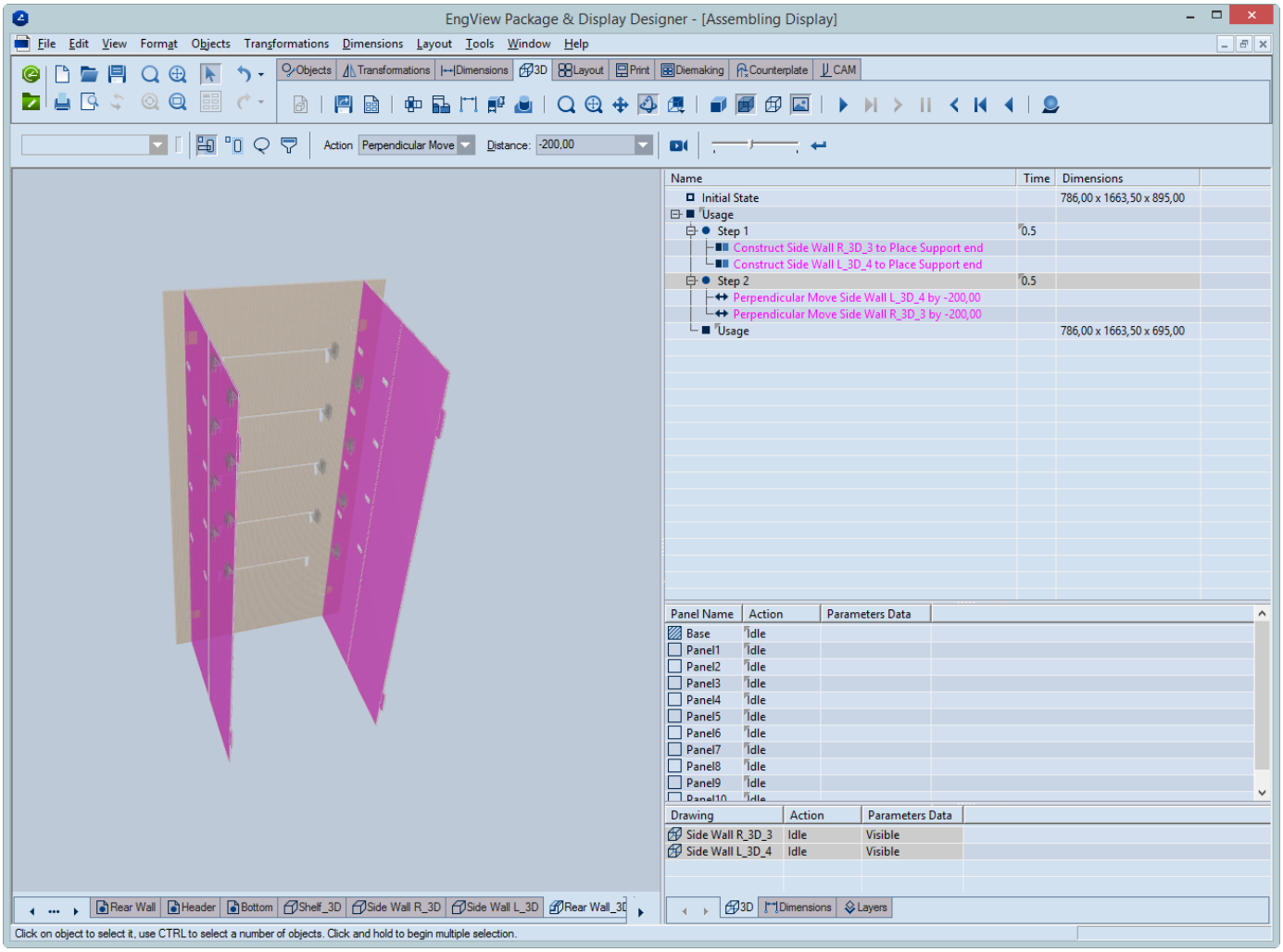


Pic. 37: Adding a Construct action to Step 1.

4. In the same step, do the same for the other side wall.
5. Insert a new step below Step 1.

We are now going to make a multiple selection.

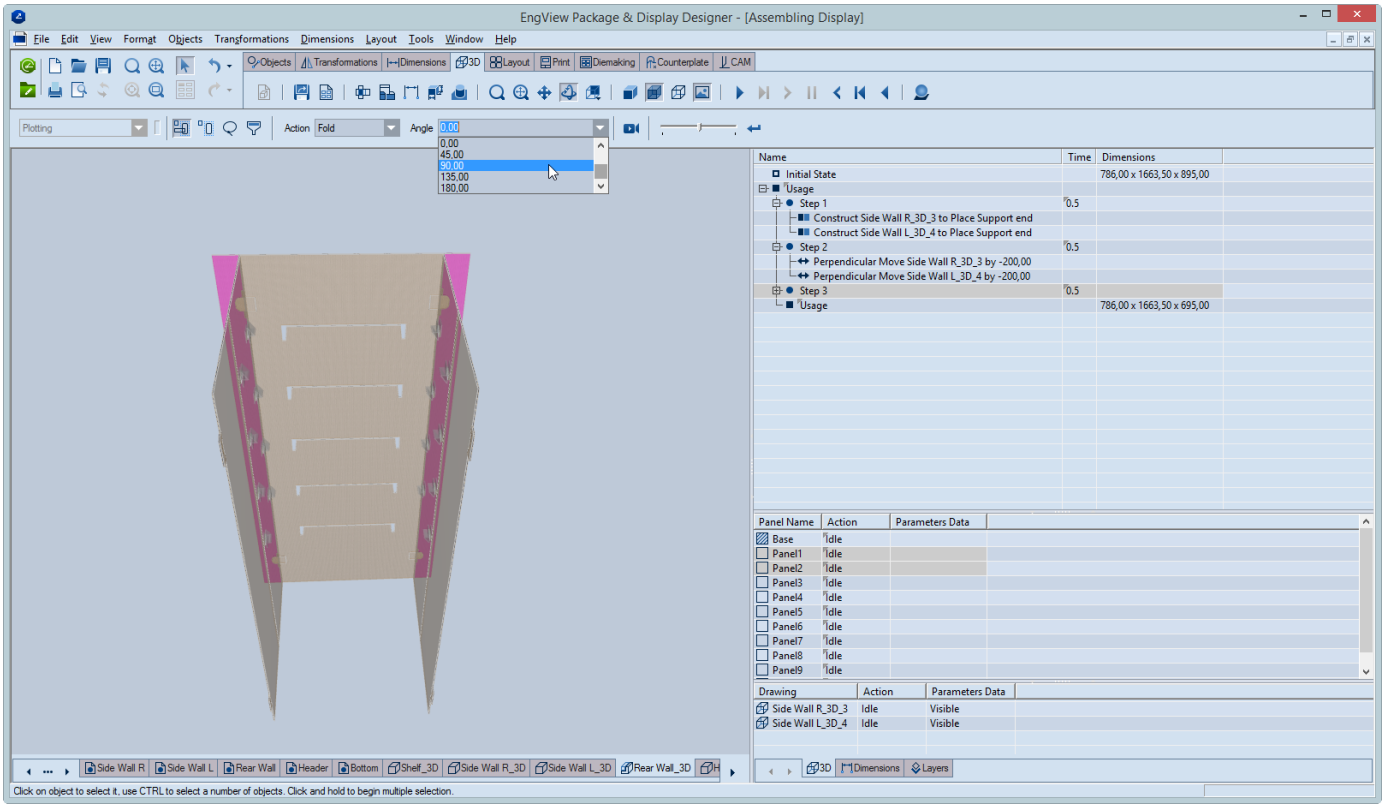
6. Press CTRL and then select the two side walls.
7. In the contextual edit bar: in **Action**, select Perpendicular Move; in **Distance**, type –200.



Pic. 38: Moving the side walls to the rear wall

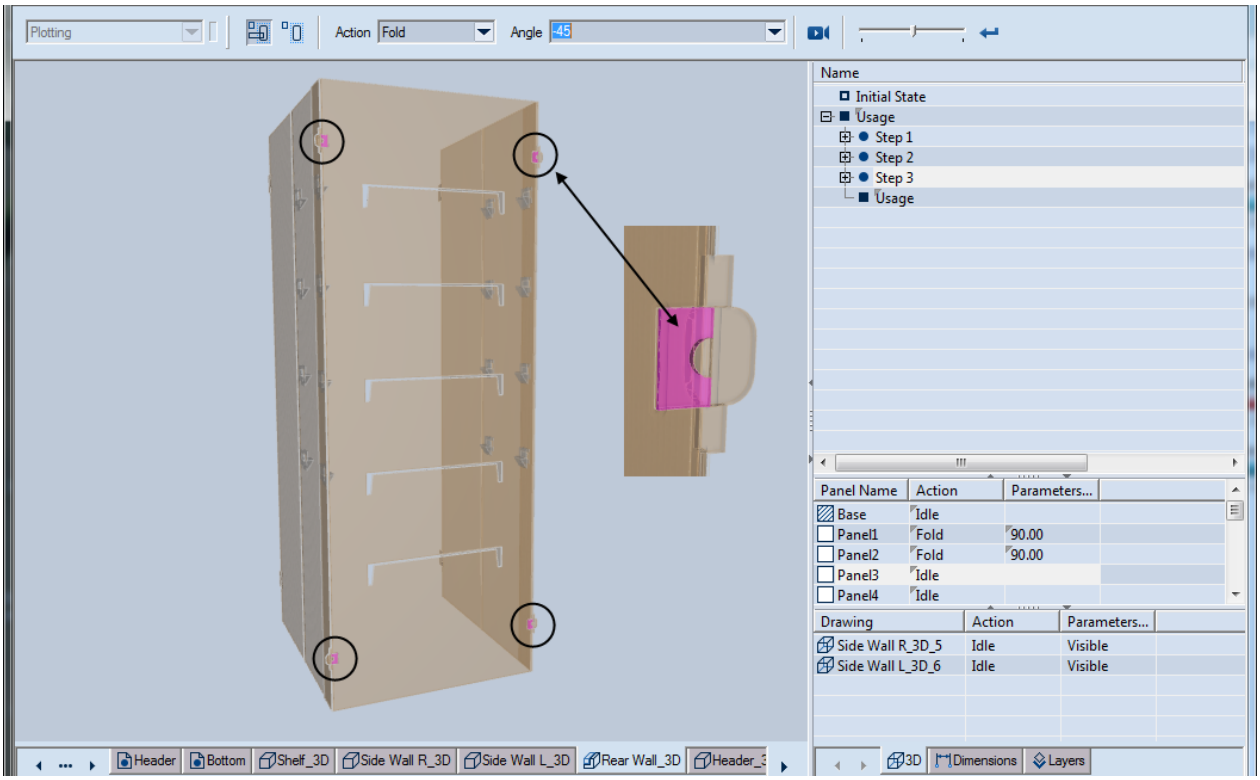
We are going to fold the side panels of the rear wall.

8. Insert a new step below Step 2.
9. Select the two panels as shown on Pic. 39, and then fold them at 90 degrees.



Pic. 39: Selecting the vertical side panels of the rear wall

10. Select the small panels of the locking system, and then fold them at –45 degrees.

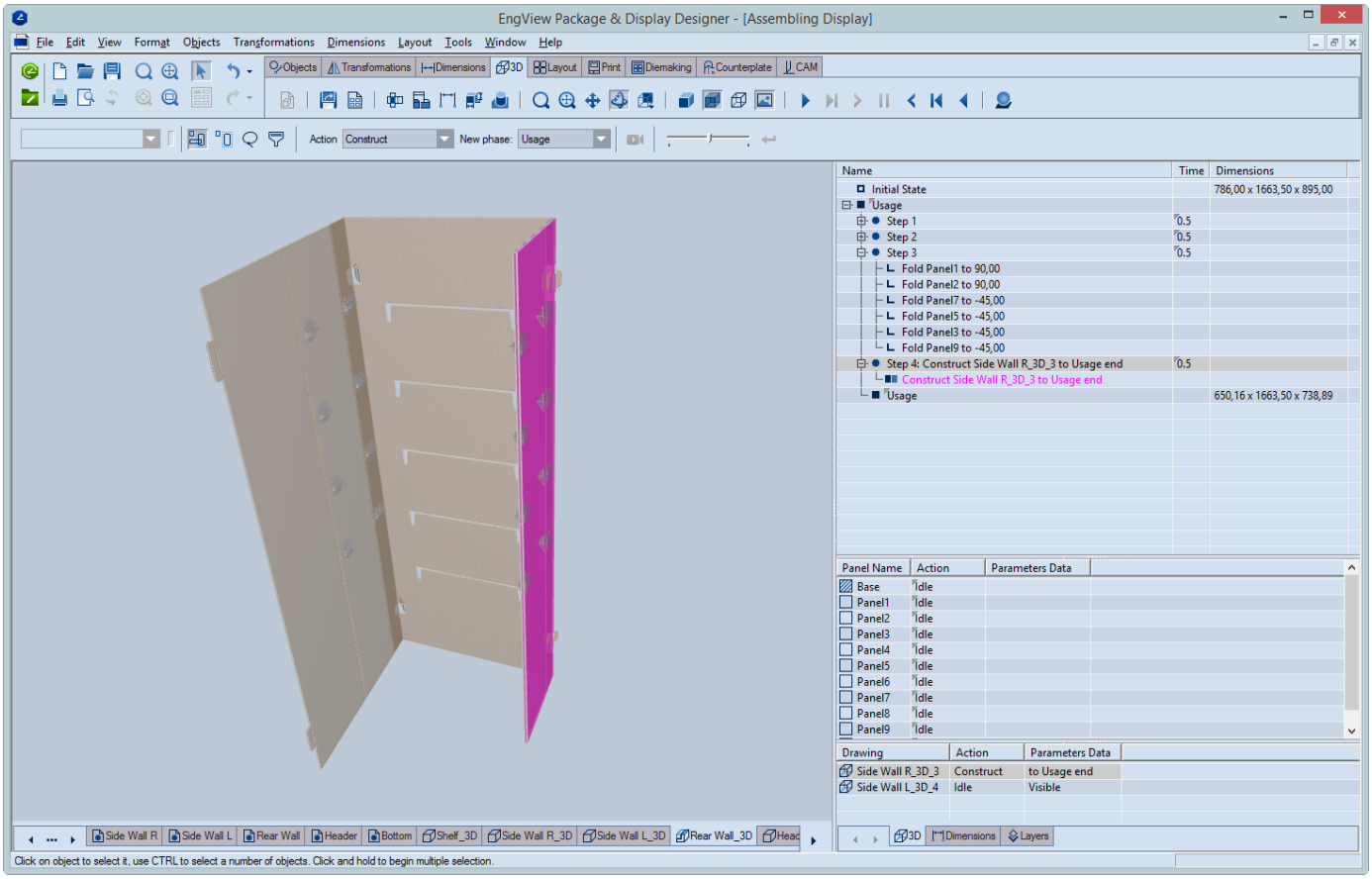


Pic. 40: Folding the four small panels of the locking system at 45 degrees

11. Insert a new step below Step 3.

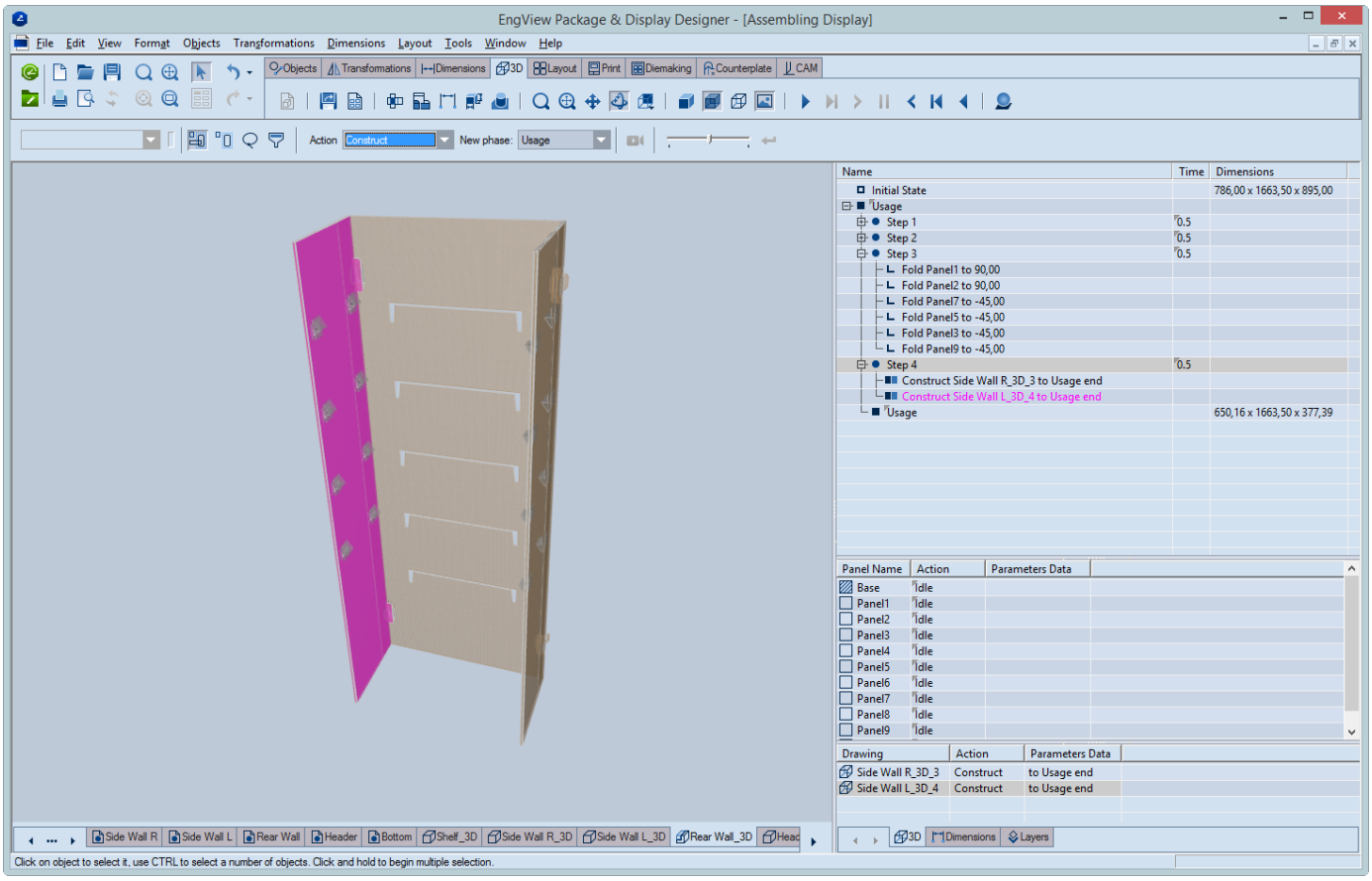
12. Select any of the side walls.

13. On the contextual edit bar: in **Action**, select Construct; in **New phase**, select Usage.



Pic. 41: Folding the right-hand wall

13. In the same step, do the same for the other side wall.

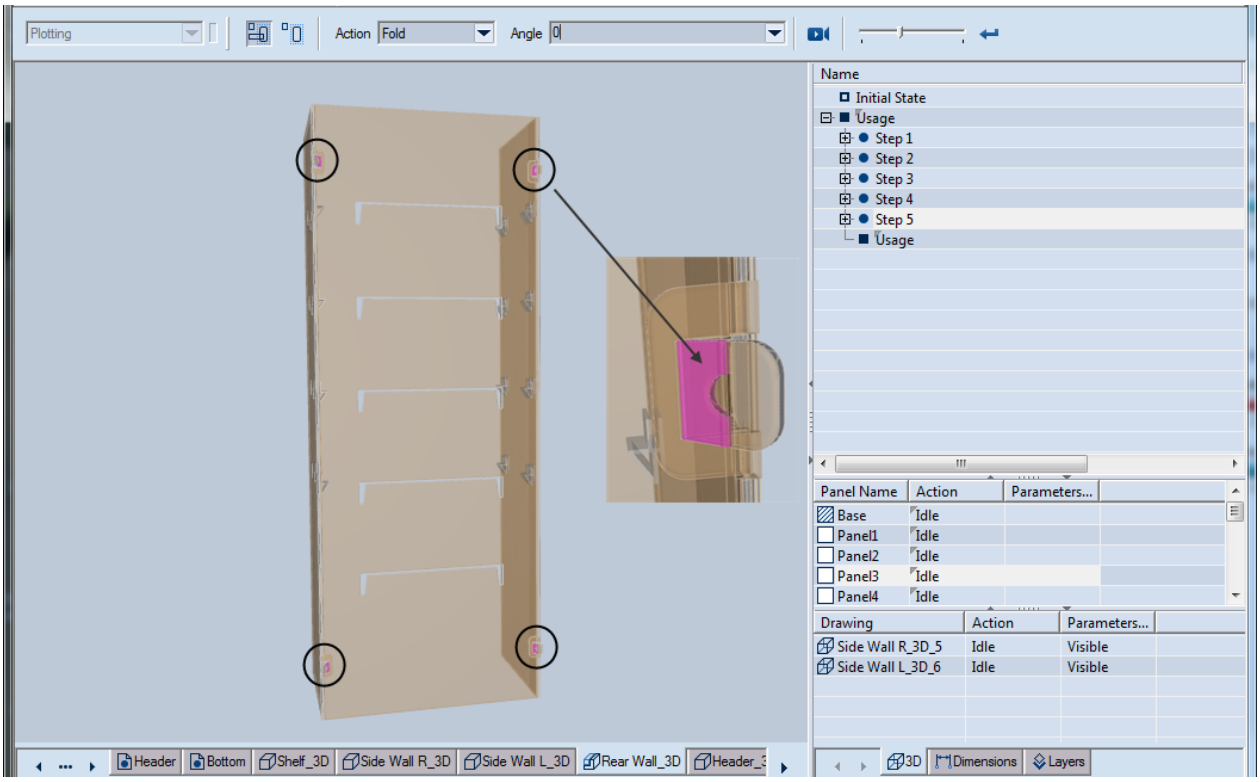


Pic. 42: Both side walls are now folded.

We proceed by locking the walls.

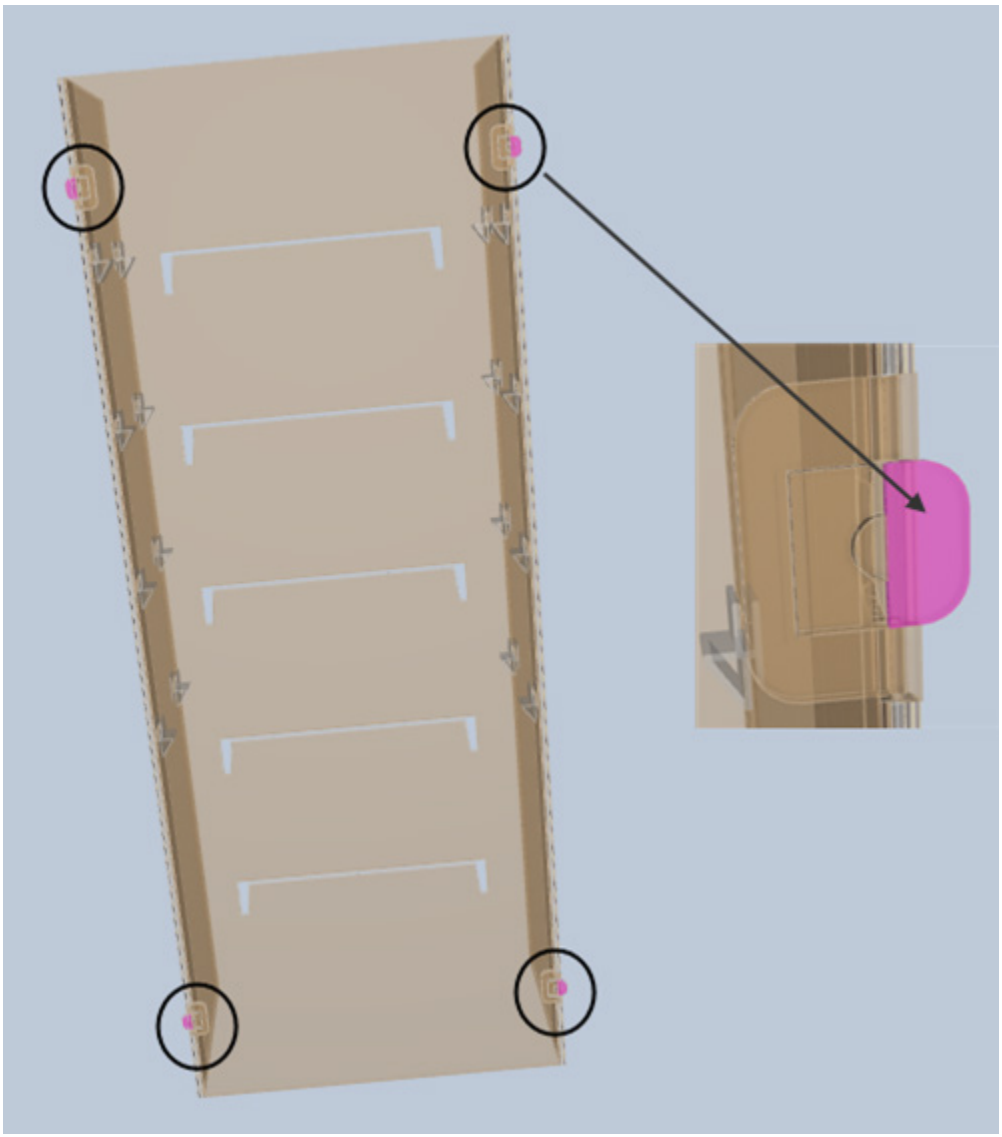
14. Create step below Step 4.

15. Select the panels as shown in Pic. 43, and then fold them at 90 degrees.



Pic. 43: Folding the four tiny angle panels

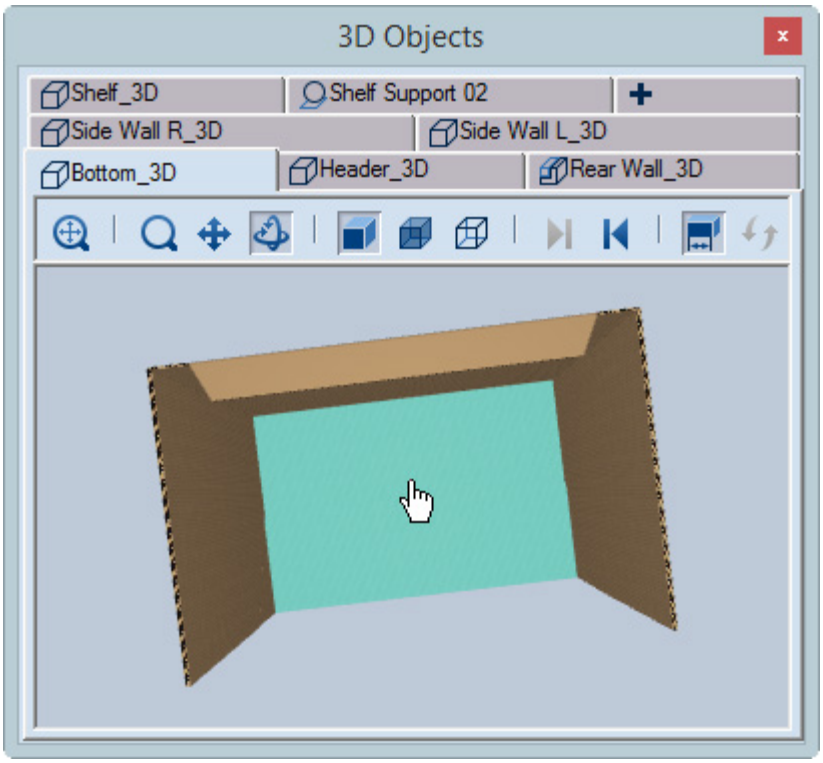
16. In the same step, select the tiny tongues as shown on Pic. 44, and then fold them at 90 degrees.



Pic. 44: Folding the four tiny end tongues

Inserting the Bottom

1. On the **3D** toolbar, click **3D Objects**  , and in the diaog box that appears, click the **Bottom_3D** tab.
2. Position the bottom as shown in Pic. 45.

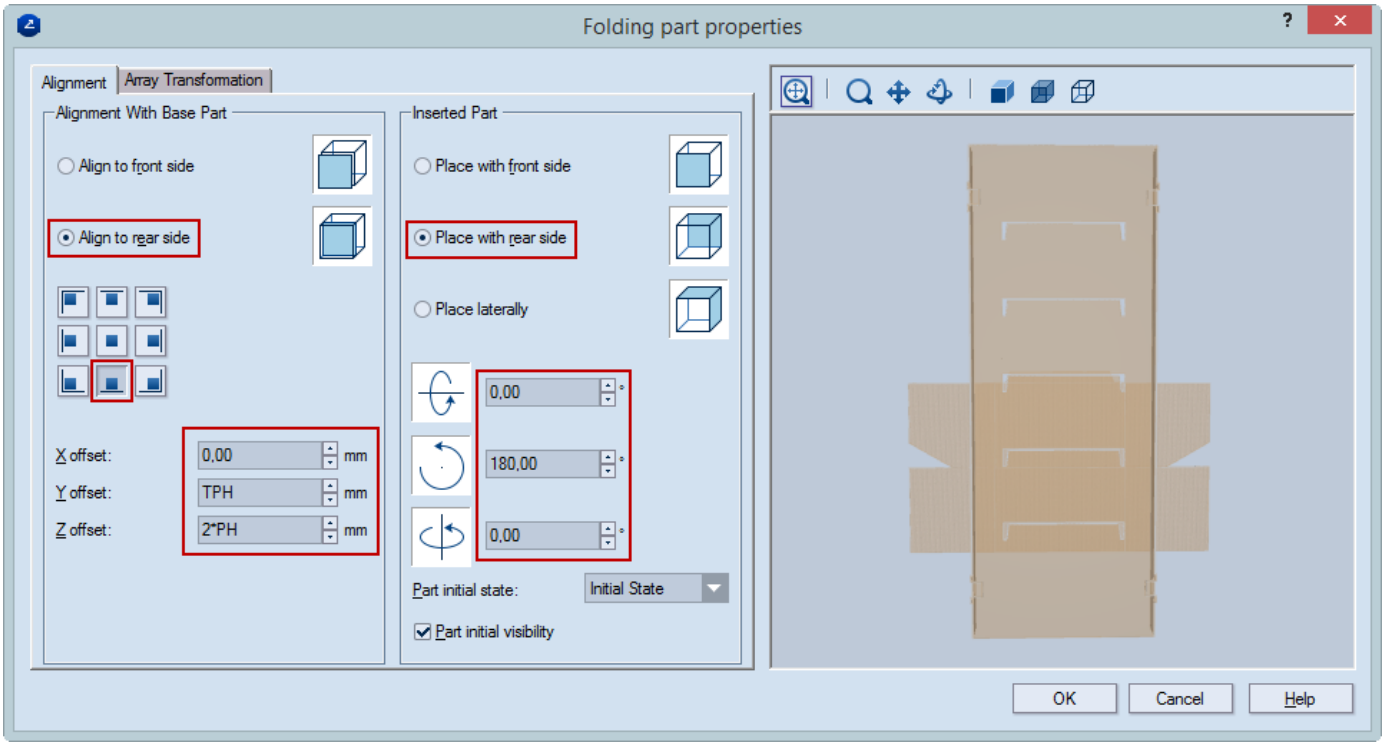


Pic. 45: Selecting the inside of the rear side

3. Drag the part into the work area as shown in Pic. 46.

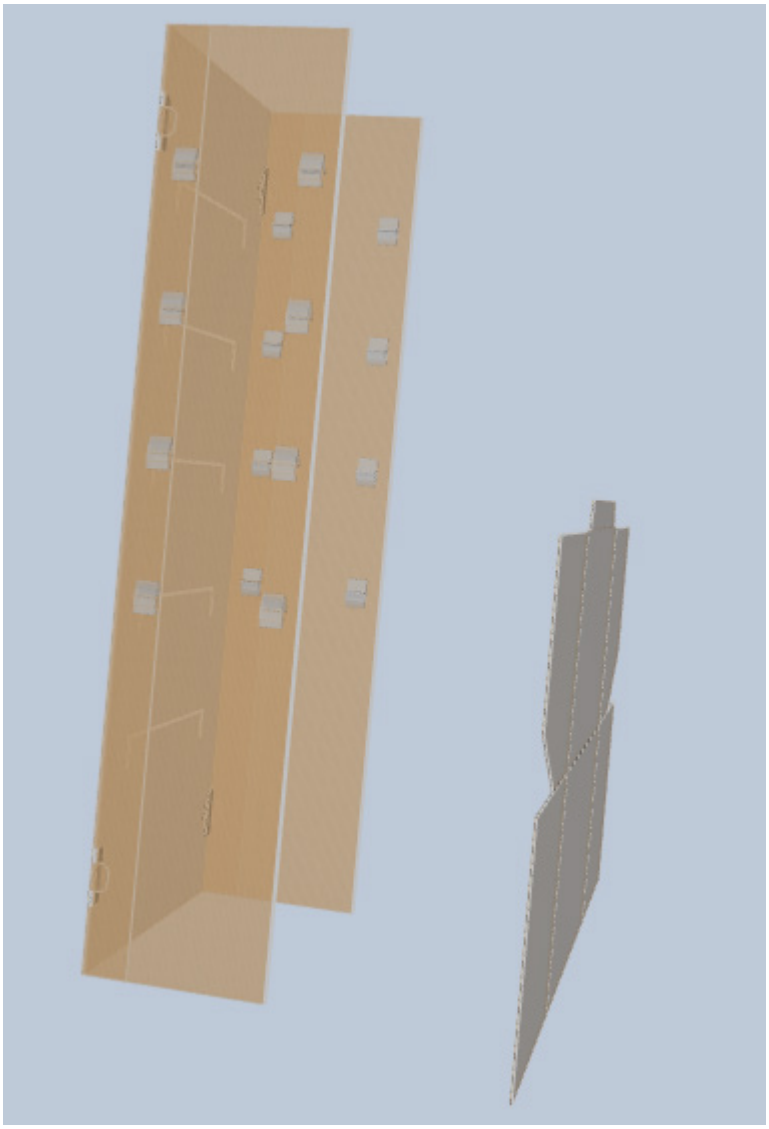
Pic. 46: Positioning the bottom takes place in two steps.

4. Right-click the part, and then click **Properties**, and then edit the part's properties as shown in Pic. 47



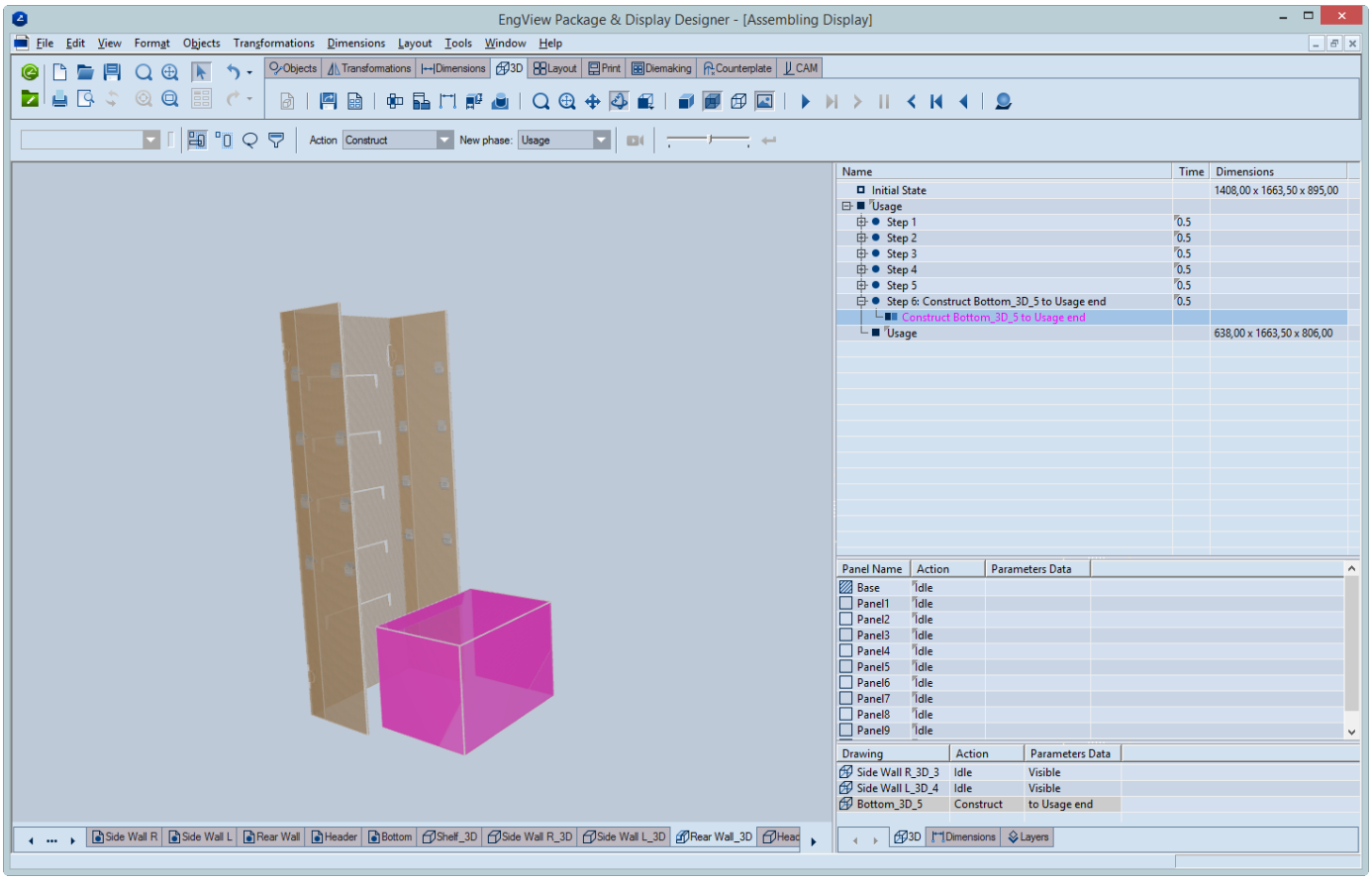
Pic. 47: Fine-tuning the position of the bottom

NOTE: The z-axis offset is double PH because one PH positions the bottom to its correct place; the second moves it additionally so that later we can animate the assembly. Also the y-axis offset is used for the purposes of animating the assembly.



Pic. 48: Leaving the bottom at a remove from the 3D model for the purposes of the eventual animation

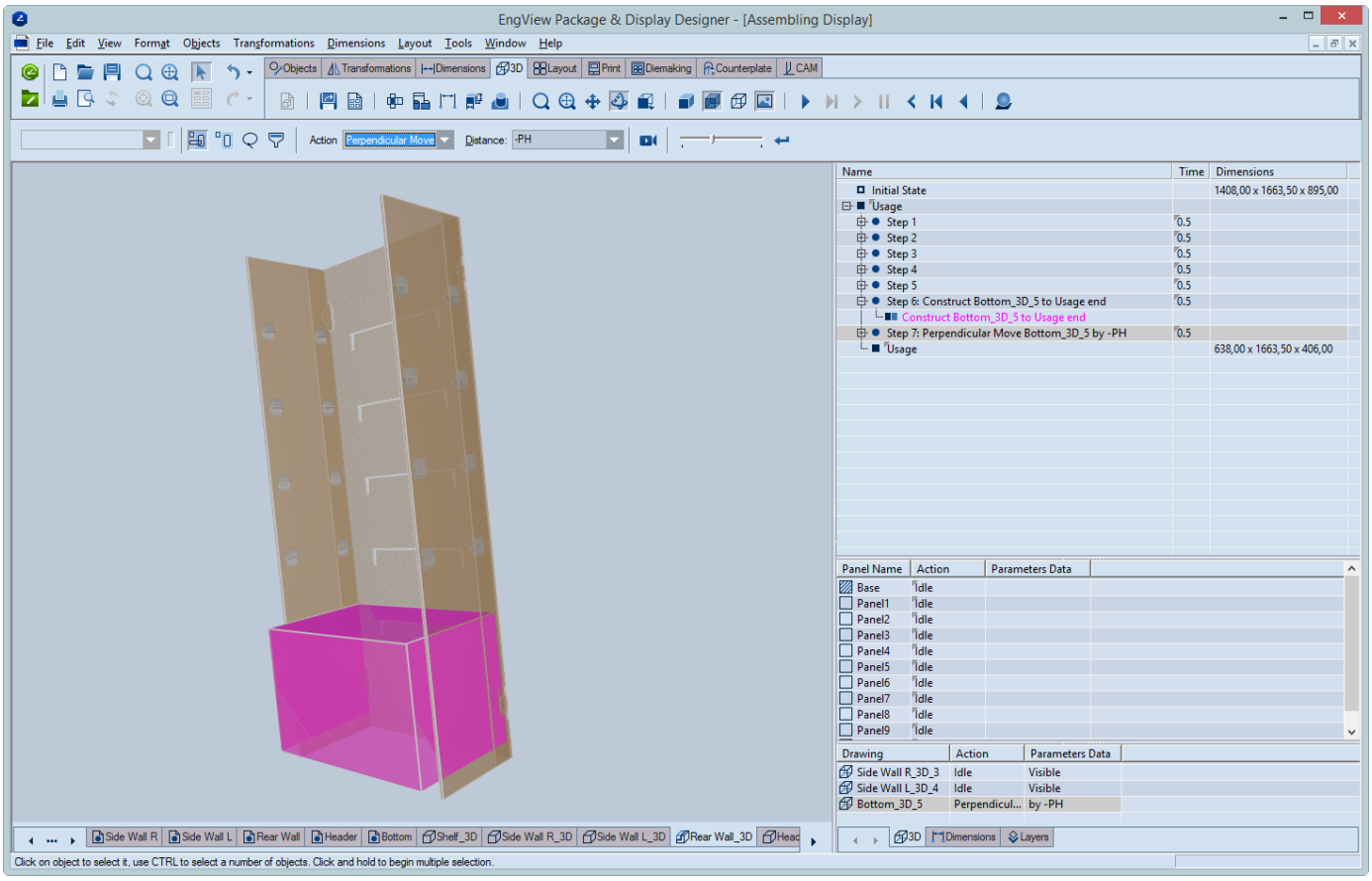
5. In the tabular area, create step below Step 5.
6. Select the bottom.
7. In the contextual edit bar: in **Action** select Construct; in **New phase** select Usage.



Pic. 49: Folding the bottom

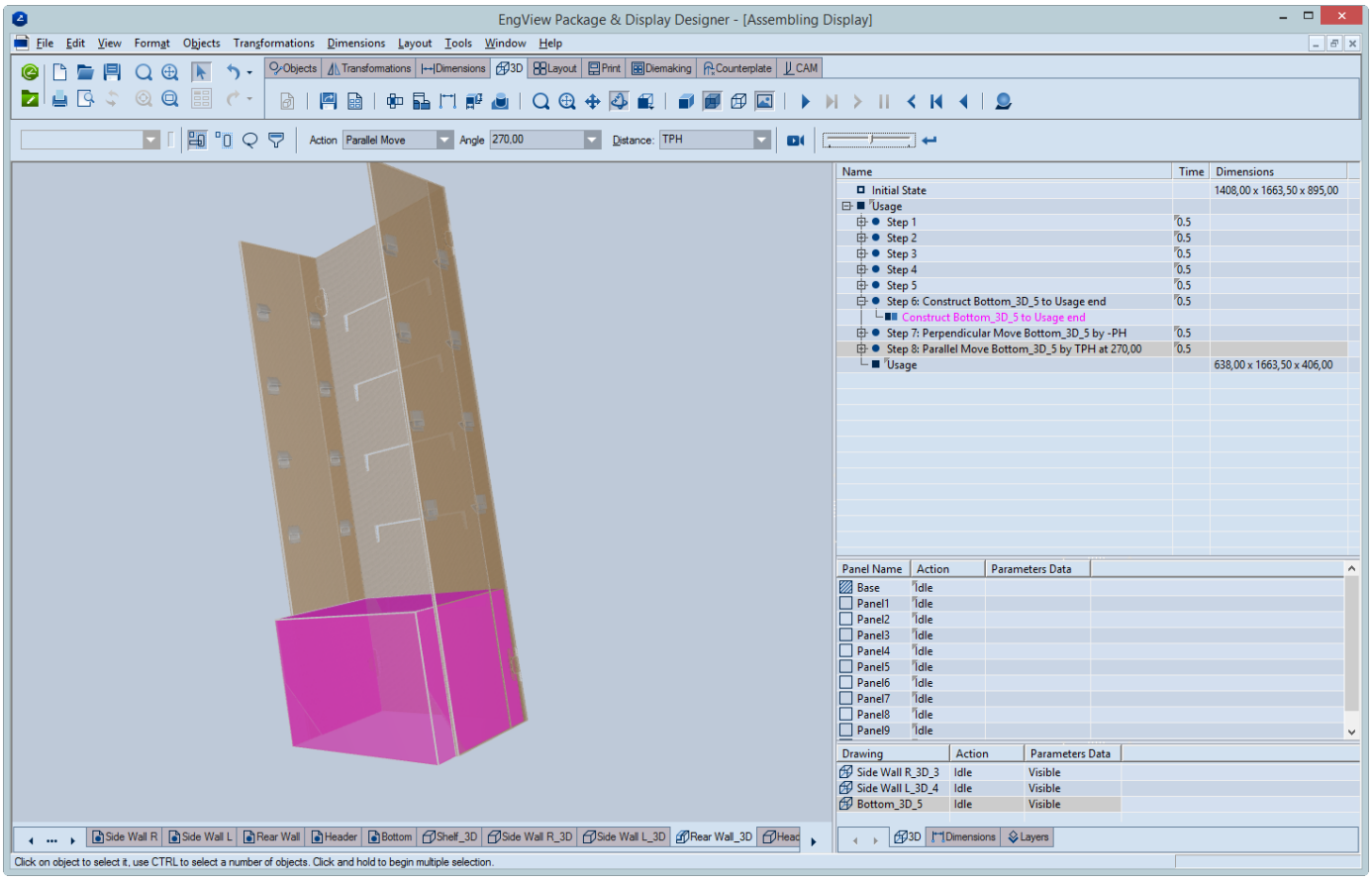
We will now animate the movement of the bottom.

8. Create a new step below Step 6.
9. Select the bootom.
10. In the contextual edit bar: in **Action**, select Perpendicular Move; in **Distance**, type –PH.



Pic. 50: Animating the movement of the bottom

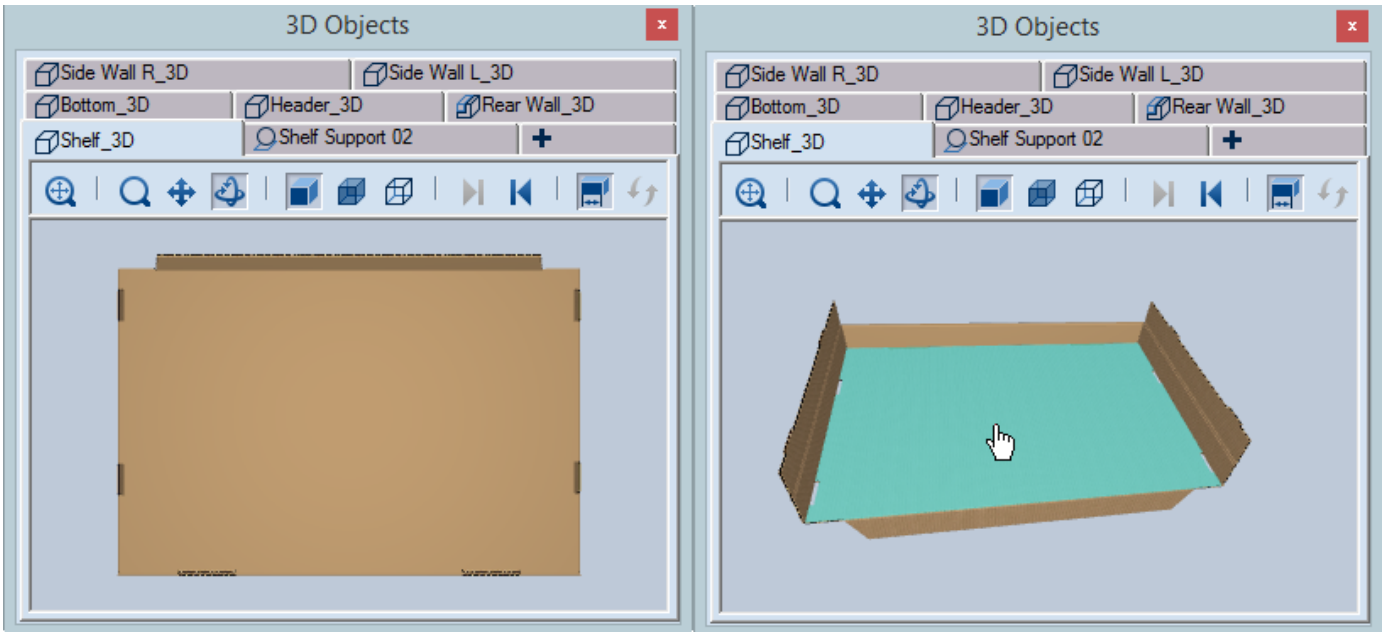
11. Create another step below Step 7.
12. Select the bottom.
13. In the contextual edit bar: in **Action**, select Parallel Move; in **Angle**, select 270 degrees; in **Distance**, type TPH.



Pic. 51: The bottom is now in place.

Inserting the Shelves

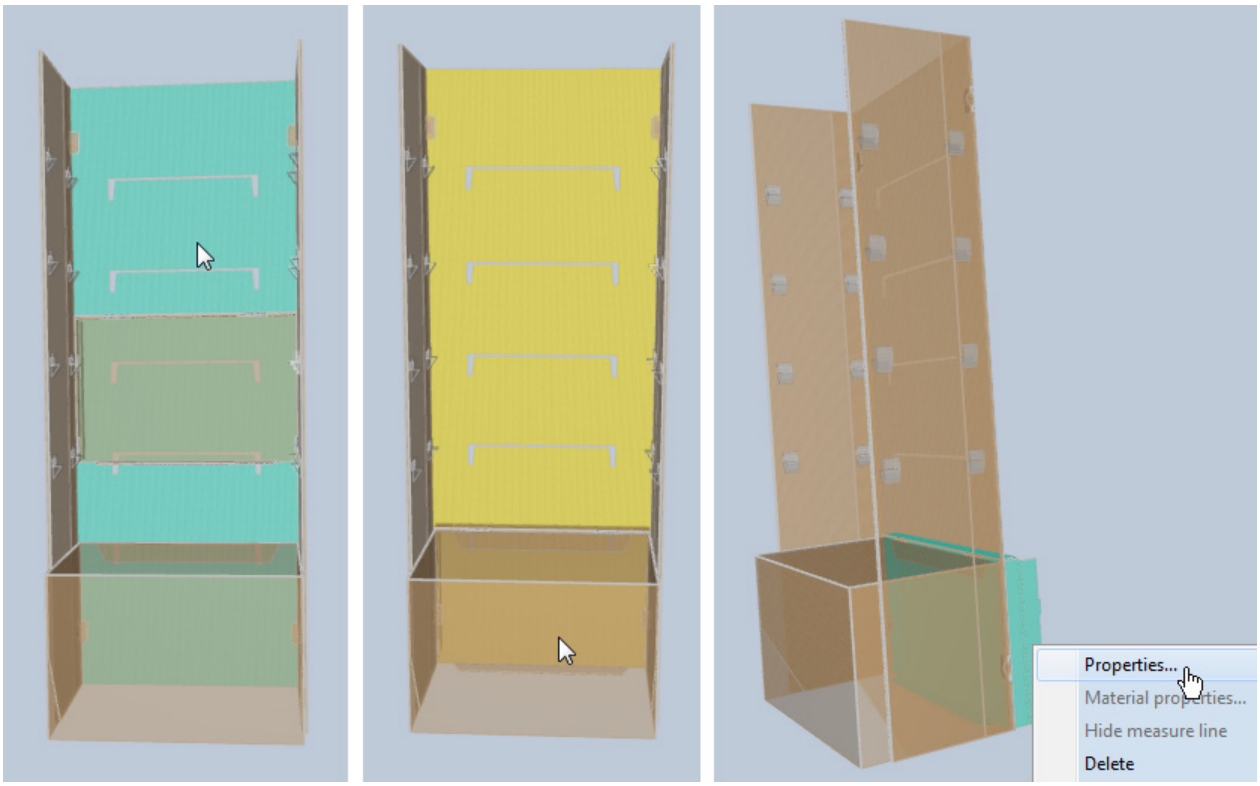
1. On the **3D** toolbar, click **3D** Objects  .
2. In the dialog box, click the **Shelf_3D** tab, and then rotate it so as to allow handy selection of the panel as shown in Pic. 52.



Pic. 52: Select the inside of the shelf.

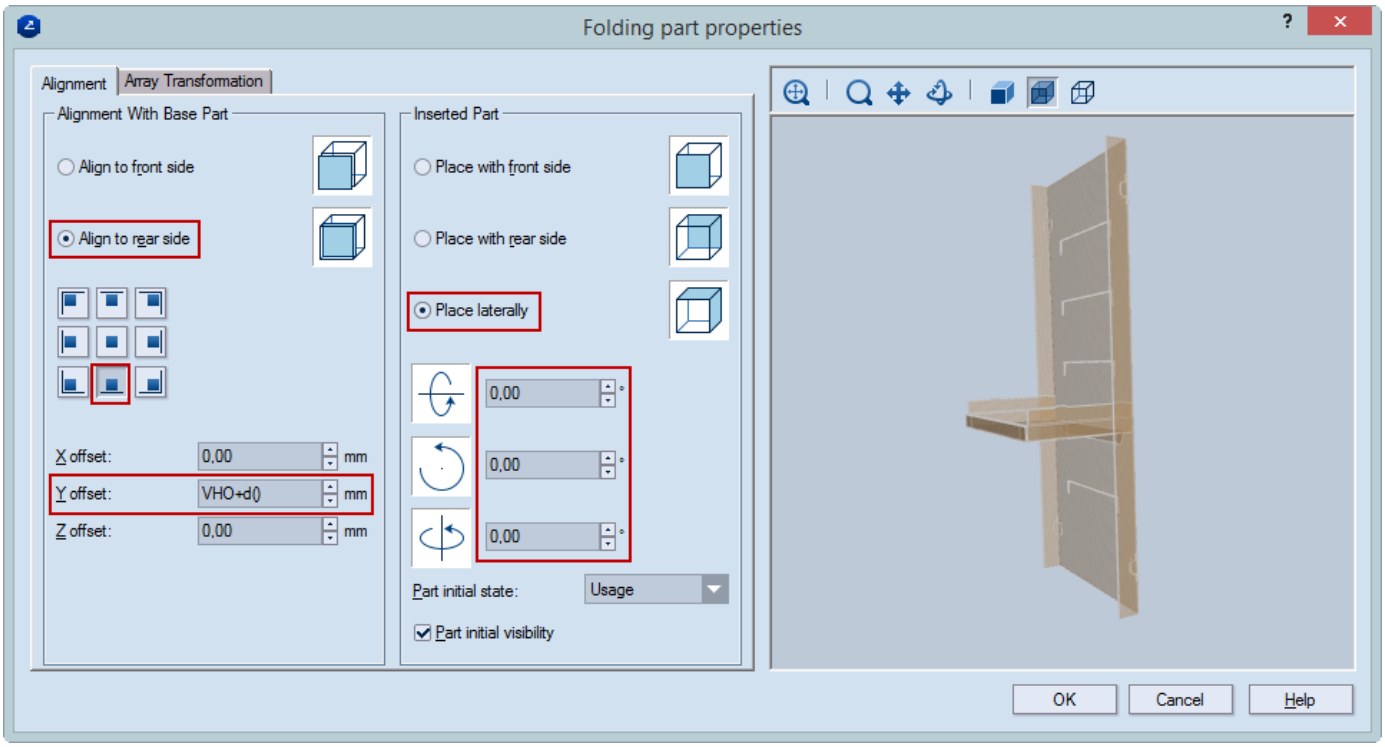
NOTE: We select this panel to get a more realistic animation during the assembling of the display.

3. Drag the shelf into the work area, and then attach it to the bottom of the rear side as shown on Pic. 53.
4. Right-click the panel, and then click **Properties**.



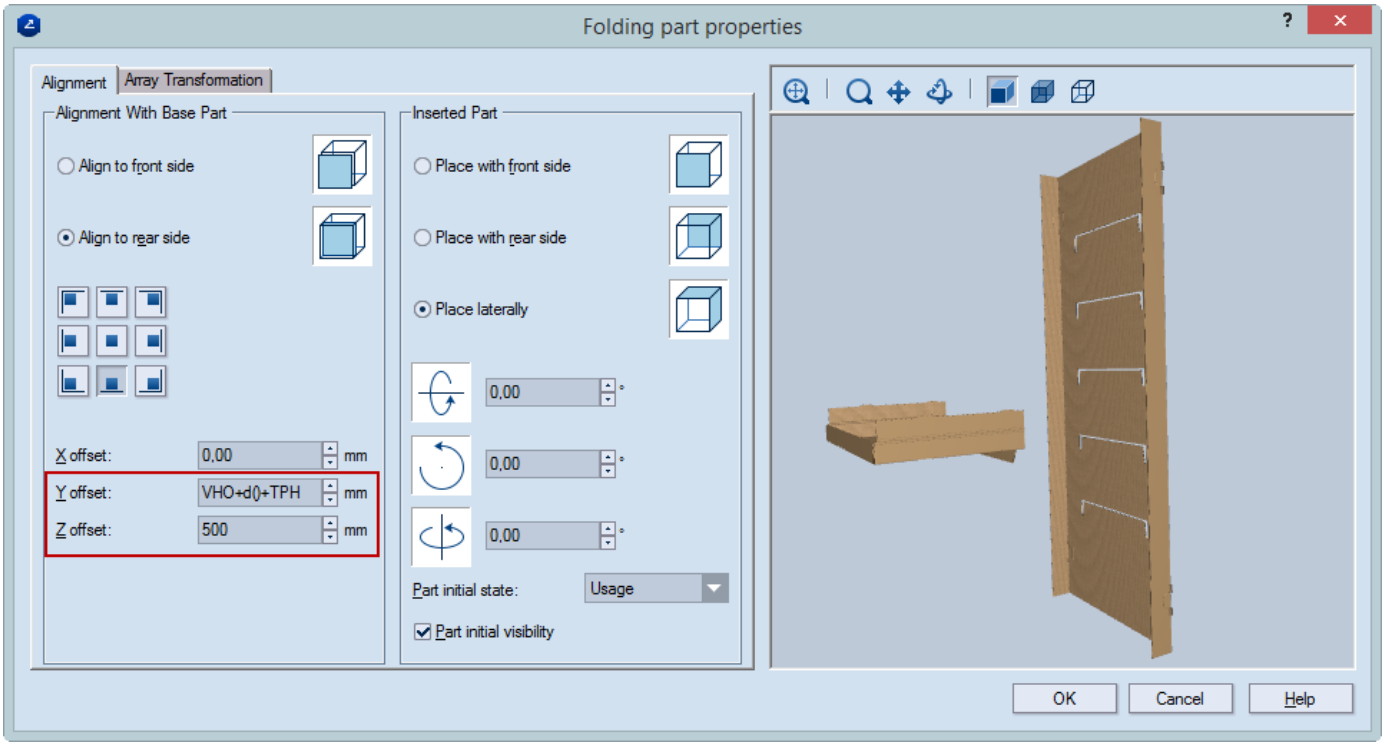
Pic. 53: Getting ready to fine-tune the position of the shelf

5. Adjust the position as shown in Pic. 54.



Pic. 54: Fine-tuning the position of the shelf

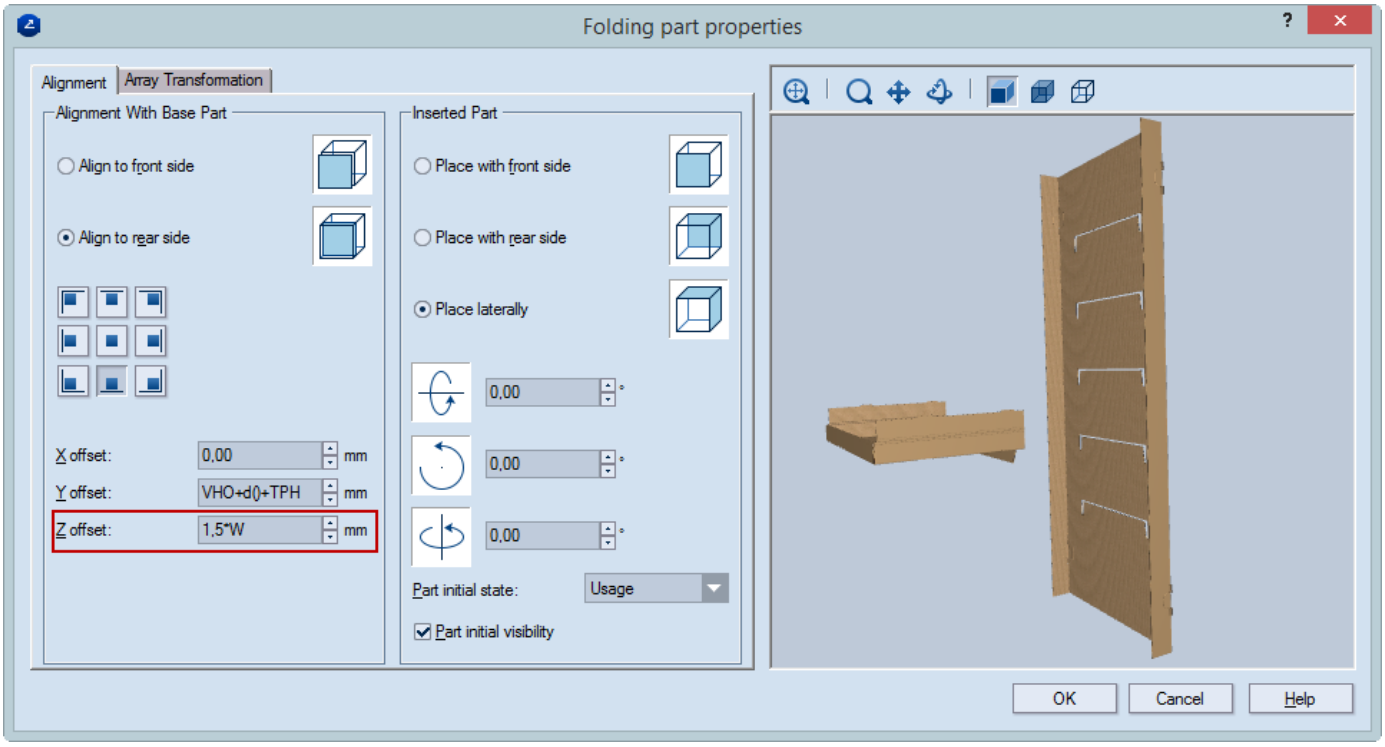
Since during the assembling of the entire display we need to animate the folding of the shelf and its positioning into its correct place, we make some additional corrections (Pic. 55).



Pic. 55: Setting up the eventual animation of the shelf folding

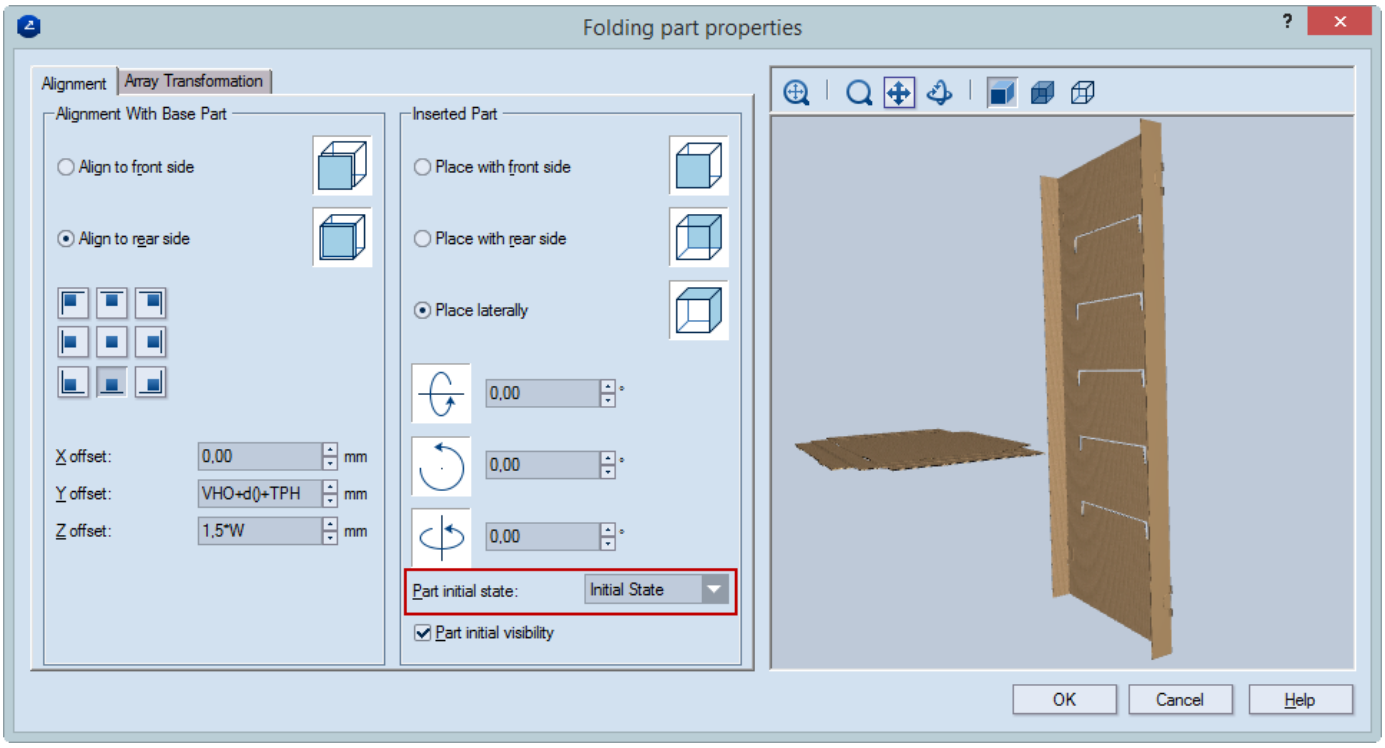
NOTE: The z-axis offset moves the shelf away from the rear wall. The additional movement along the y-axis (+TPH) enables us to animate the insertion of the shelf into the slits.

Instead of fixing the z-axis movement to a specific value (500), we can use a parameter – for example, the parameter W, which controls the width of the side wall. This would come in handy so that the 3D model is up to date in relation to the size of the display.



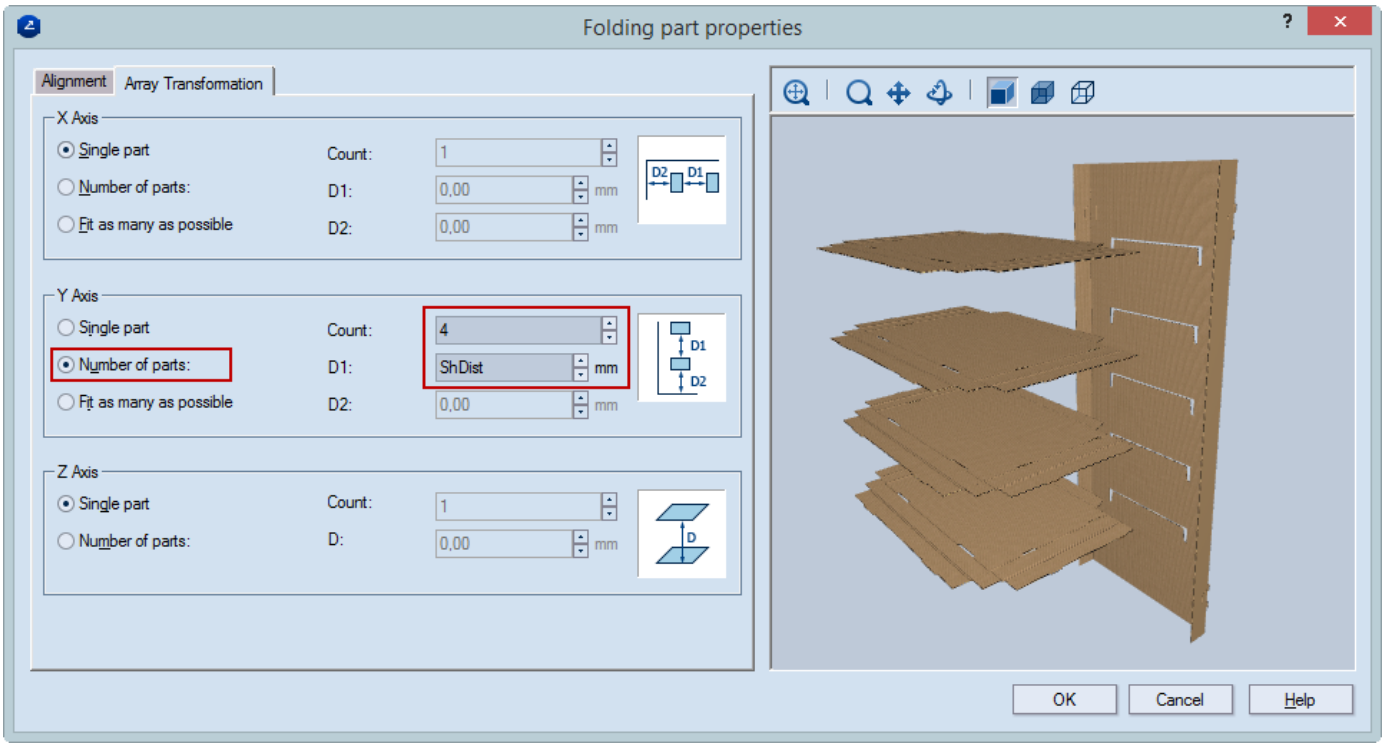
Pic. 56: A parameter-based alignment along the z-axis ensures that the shelf 3D will update when the display size changes

Besides, we need that in the beginning the shelf is spread out, so that we can animate its folding later.



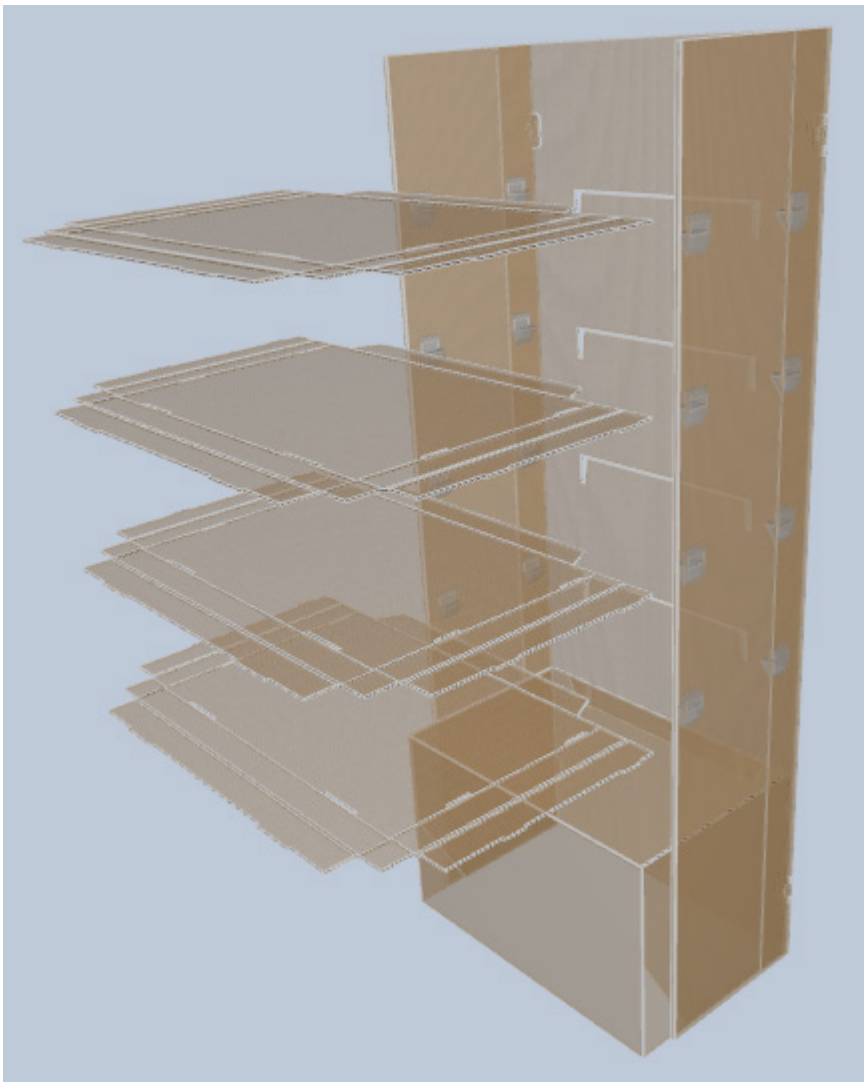
Pic. 57: Leaving the shelf 3D unfolded (in its initial state) helps the full-feature animation later

To produce four shelves, we will make changes also in the **Array Transformation** tab.



Pic. 58: Fixing the needed number of shelves

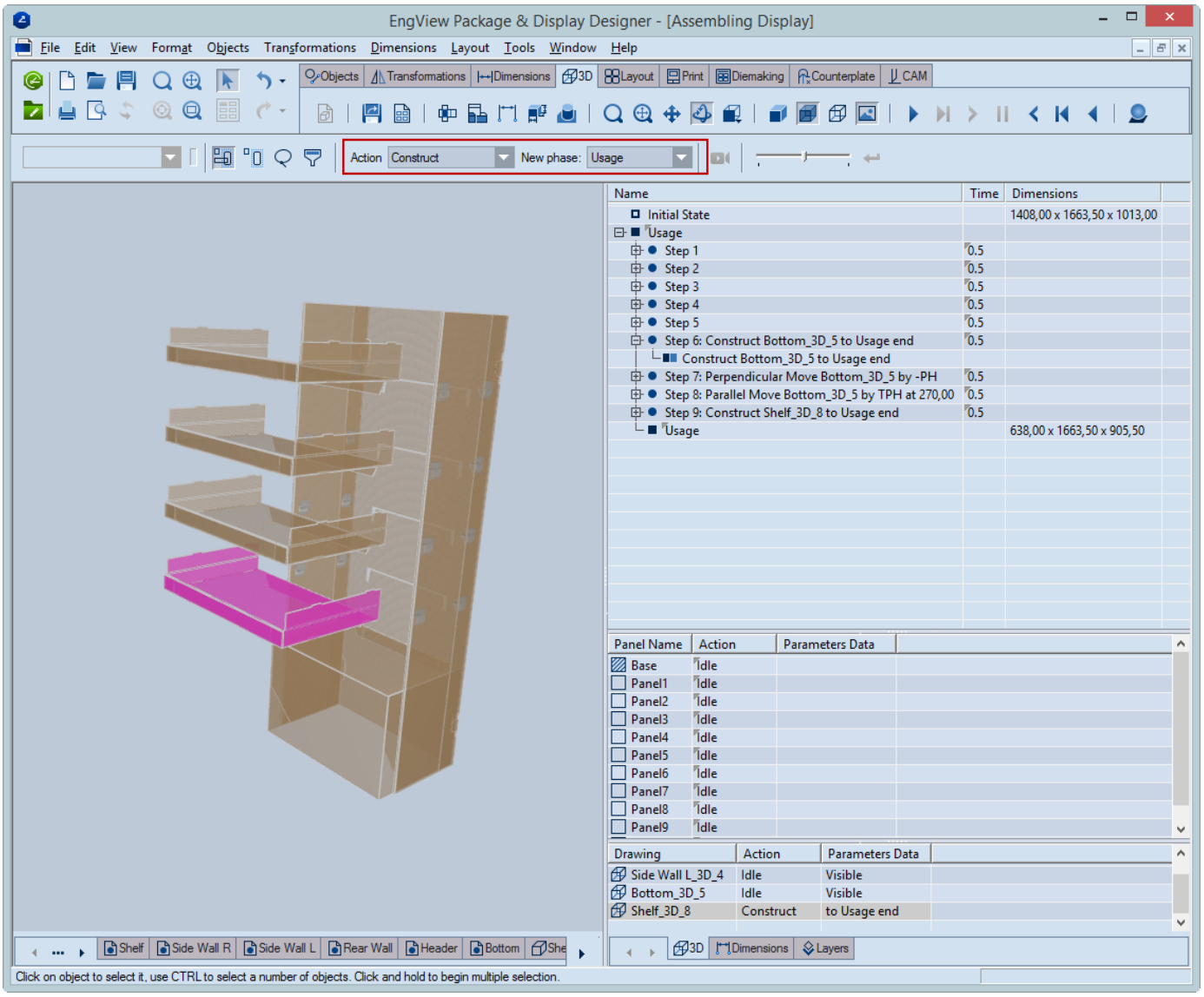
6. To adopt the editing of the shelf placement, click **OK**.



Pic. 59: The four shelves are positioned into place.

We proceed by folding the shelf to the position in which it will be attached to the display.

7. In the tabular area, create a step below Step 8.
8. Select the shelf.
9. In the contextual edit bar: In **Action**, select Construct; in **New phase** select Usage.



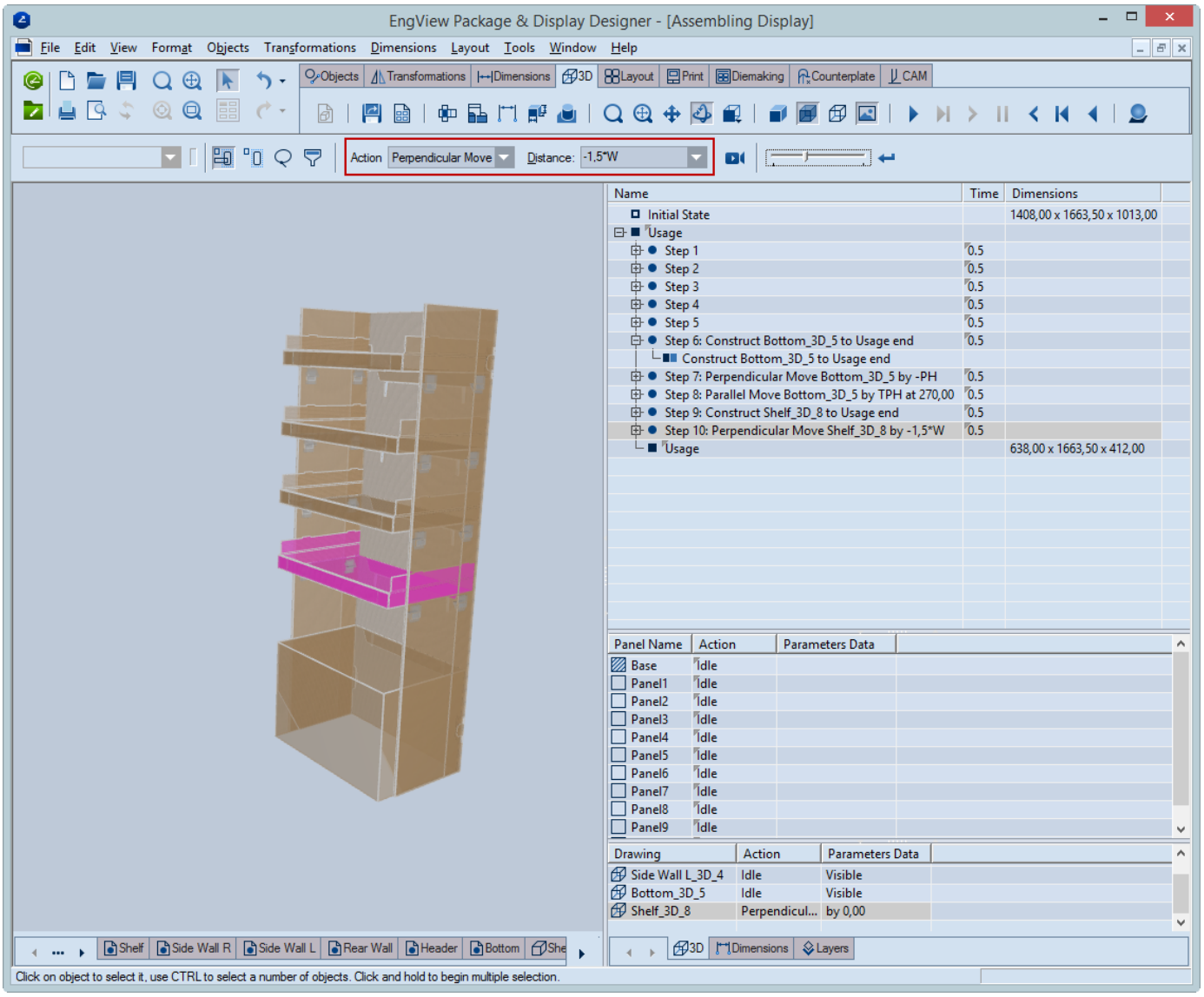
Pic. 60: Getting the four shelves ready for attaching

In the next step we will move the shelves to their places.

10. In the tabular area, create a step below Step 9.

11. Select the shelf.

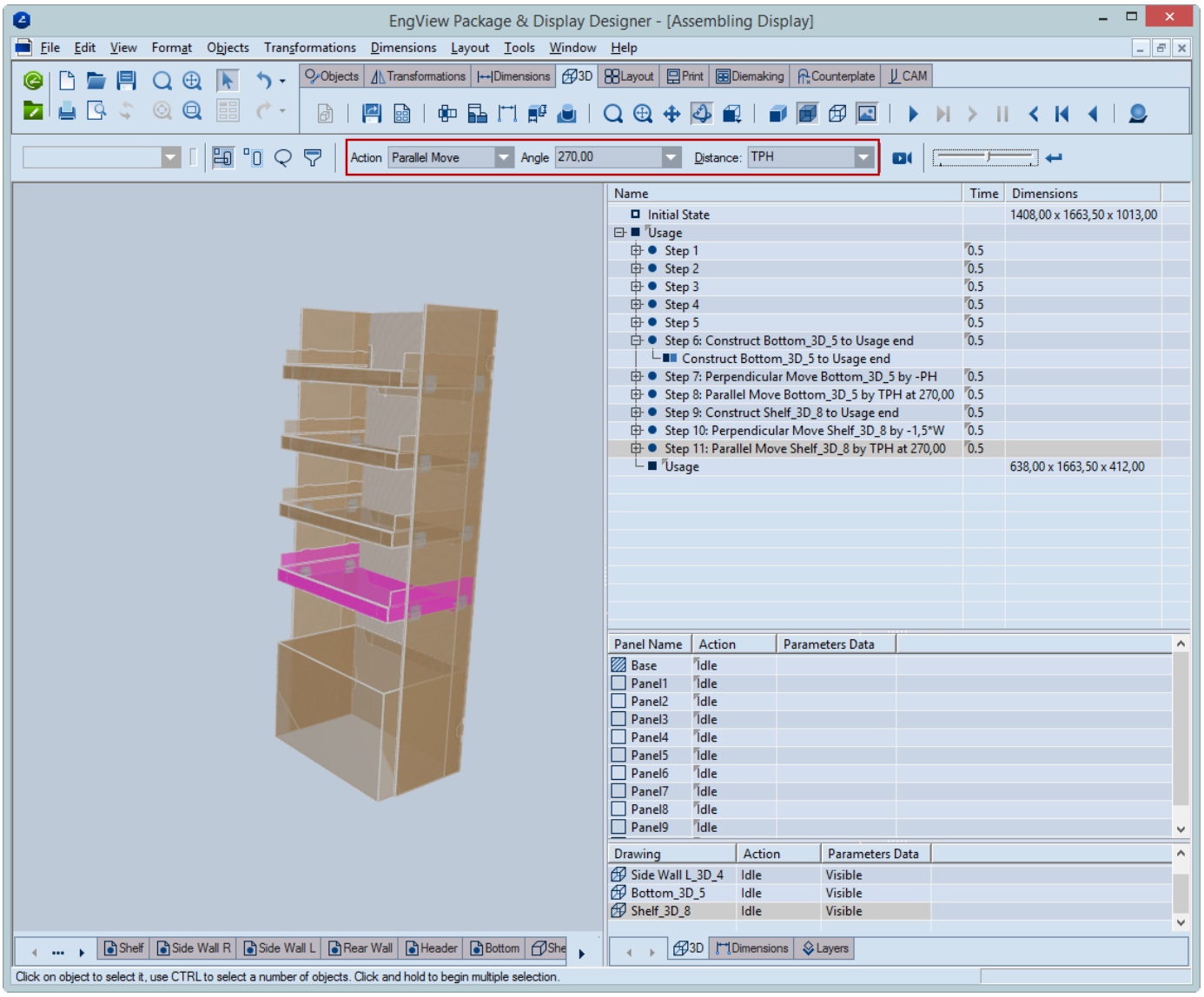
12. In the contextual edit bar: In **Action**, select Perpendicular Move; in **Distance**, type –1.5*W.



Pic. 61: Moving the four shelves closer to their points of attachment

13. Create a new step below Step 10. It is where we will do the final attachment of the shelves.

14. In the contextual edit bar: In **Action**, select Parallel Move; in **Angle**, type 270; in **Distance**, type TPH.

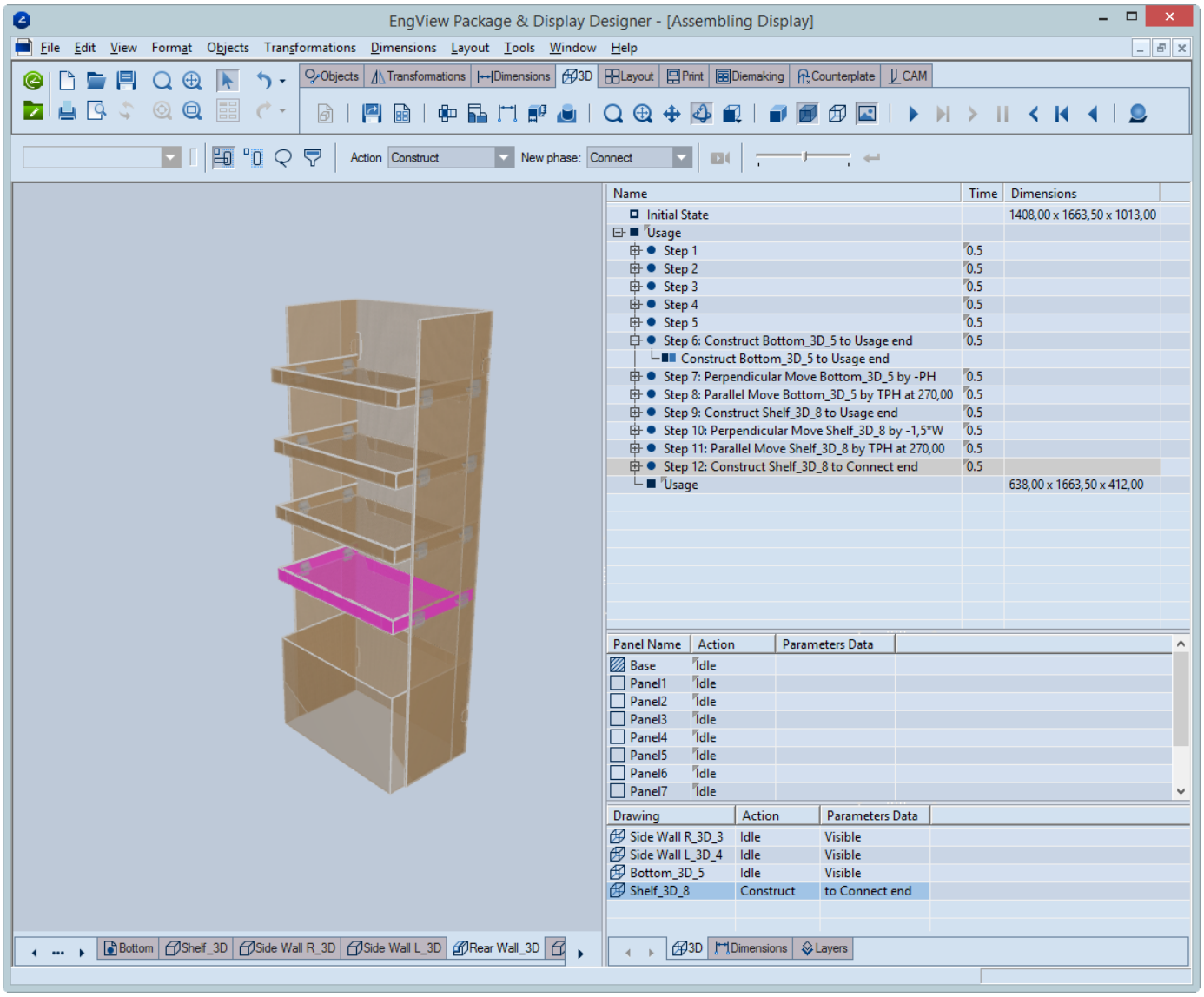


Pic. 62: Final attachment of the four shelves

Now we will close the shelves.

15. Create a new step below Step 11.

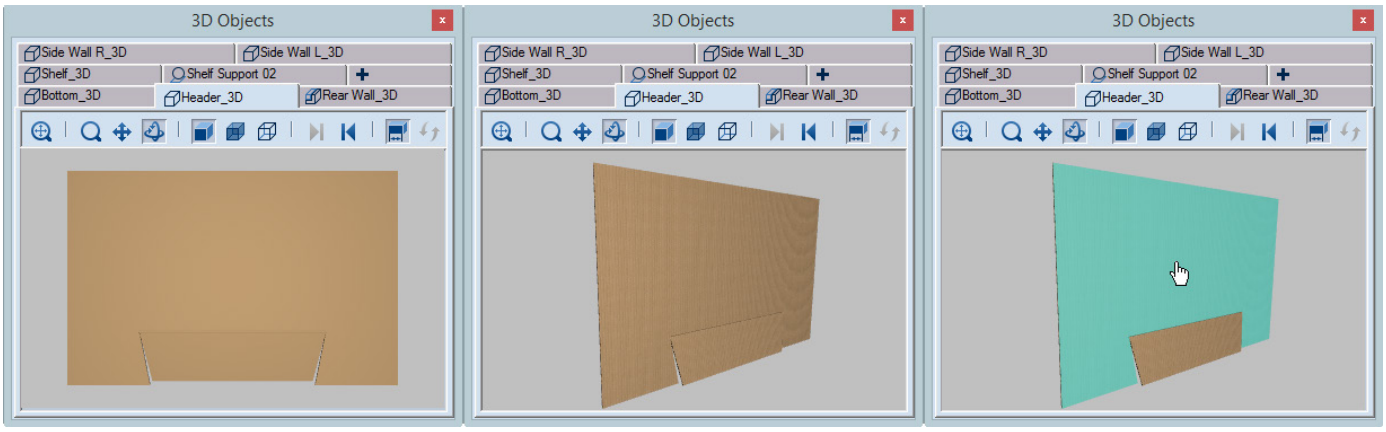
16. In the contextual edit bar: In **Action**, select Construct; in **New phase**, type Connect.



Pic. 63: The shelves are now attached and fully folded.

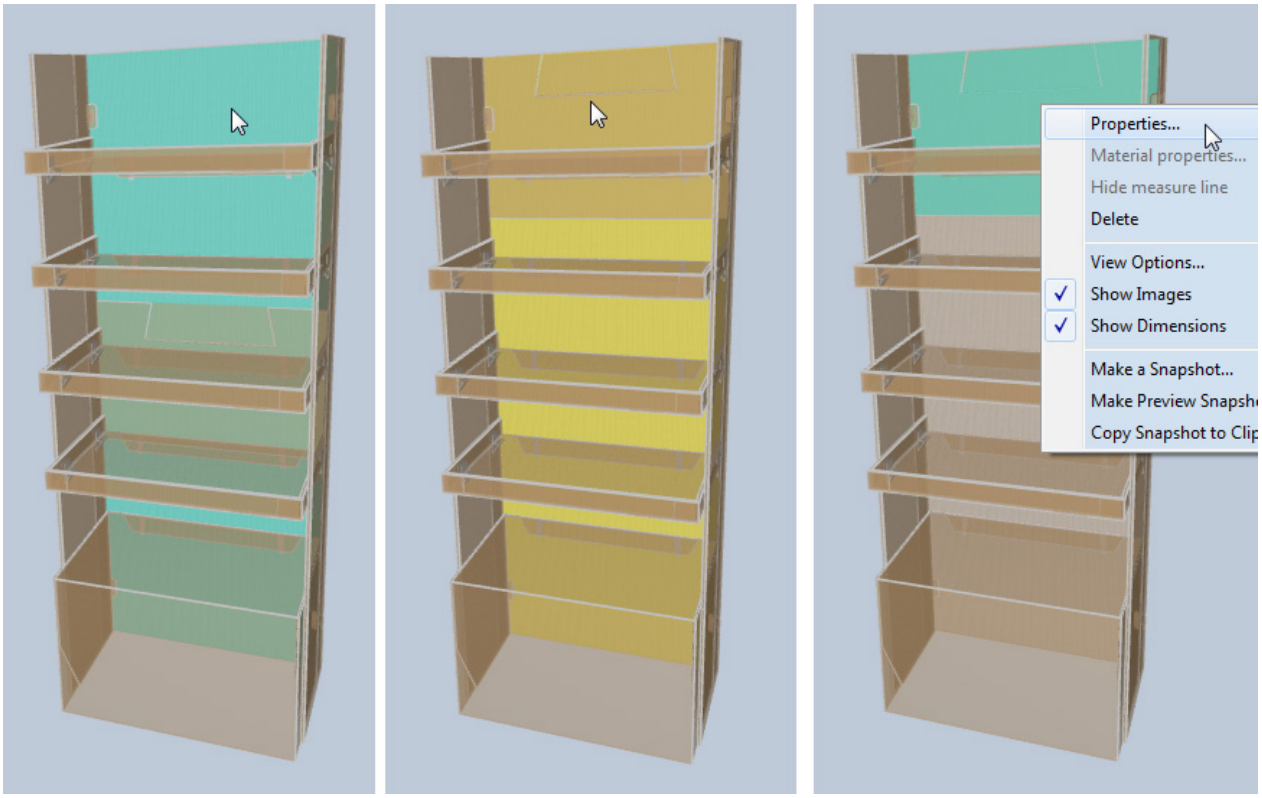
Attaching the Header

1. On the **3D** toolbar, click **3D Objects** and then, in the dialog box, click the **Header** tab.
2. Turn the header so as to see its rear side, and then use the panel as shown in Pic. 64.



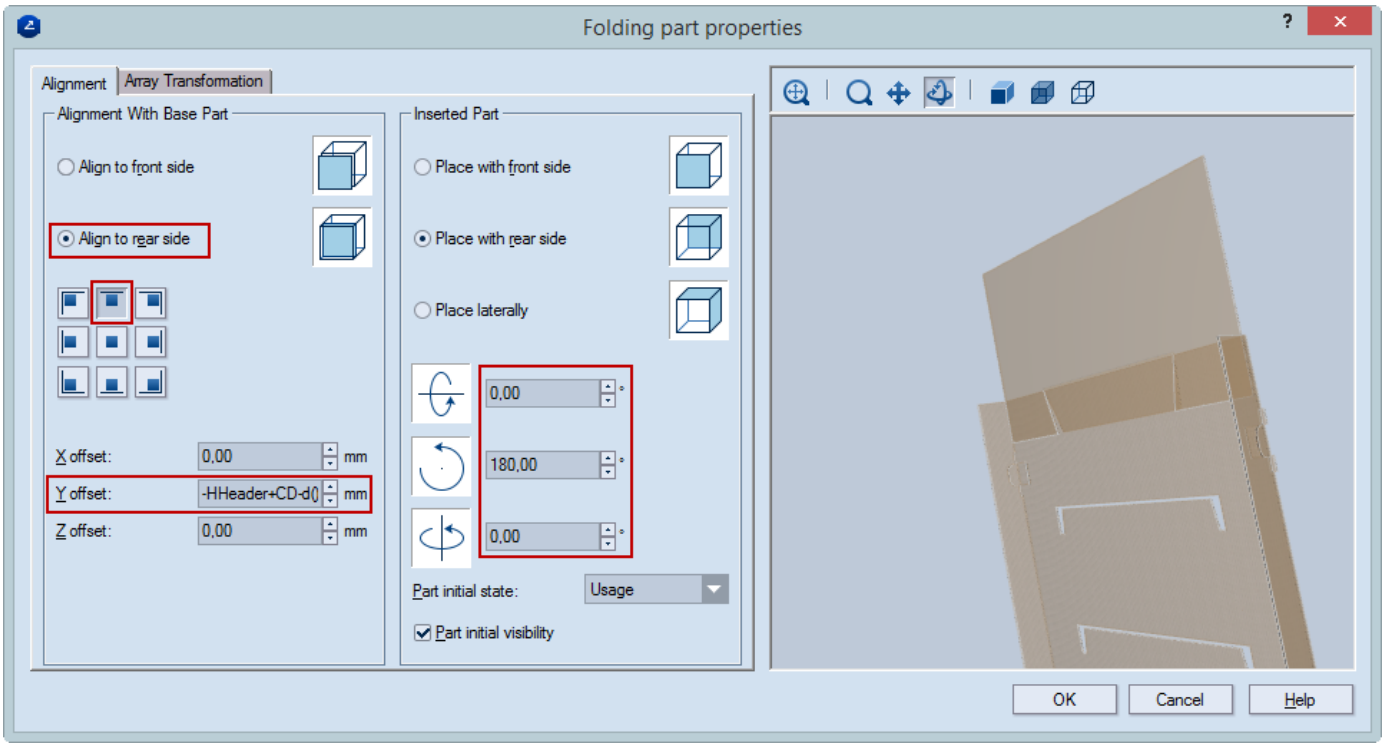
Pic. 64: Rotating the header for the right position to drag into the work area

3. Drag the header into the work area, and attach it to the rear wall's rear surface.
4. Right-click the header, and then click **Properties** on the context menu.



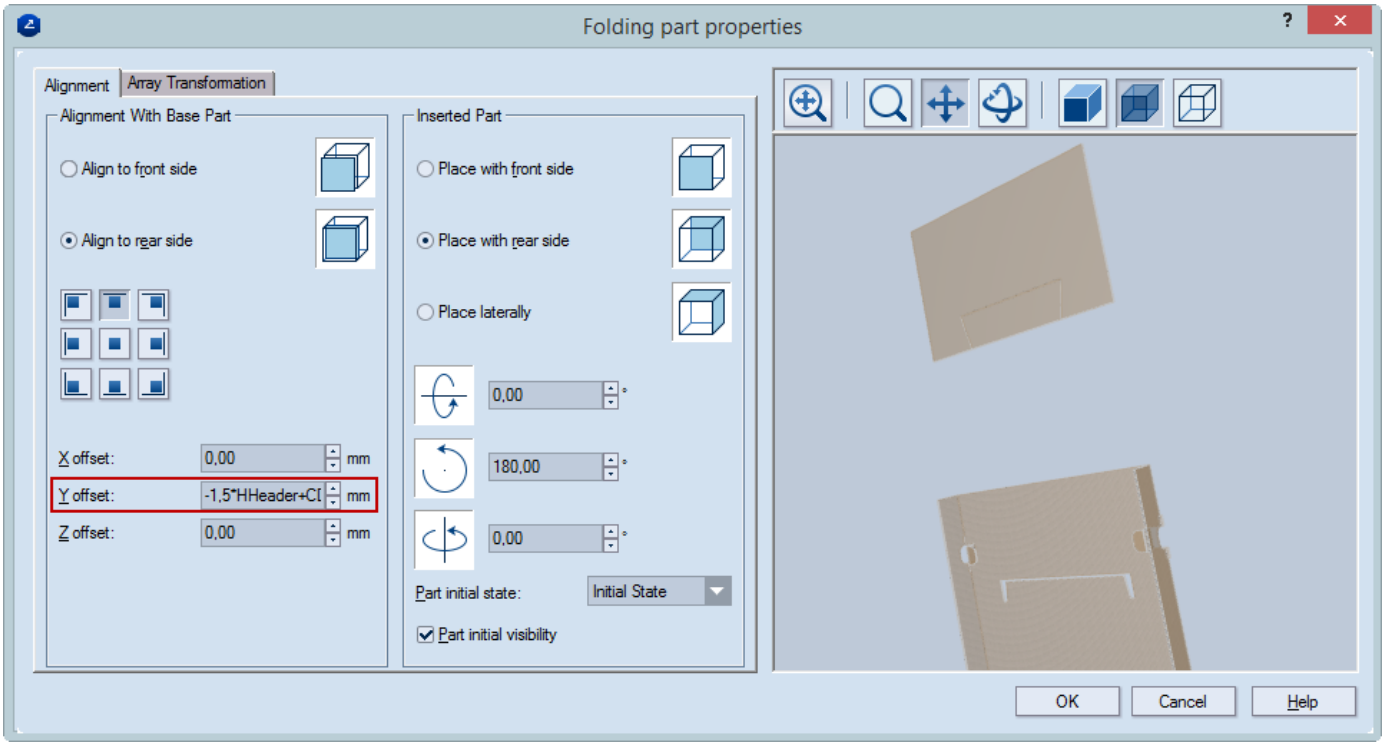
Pic. 65: About to fine-tune the header's position

5. Adjust the position of the head by editing its properties as shown in Pic. 66.



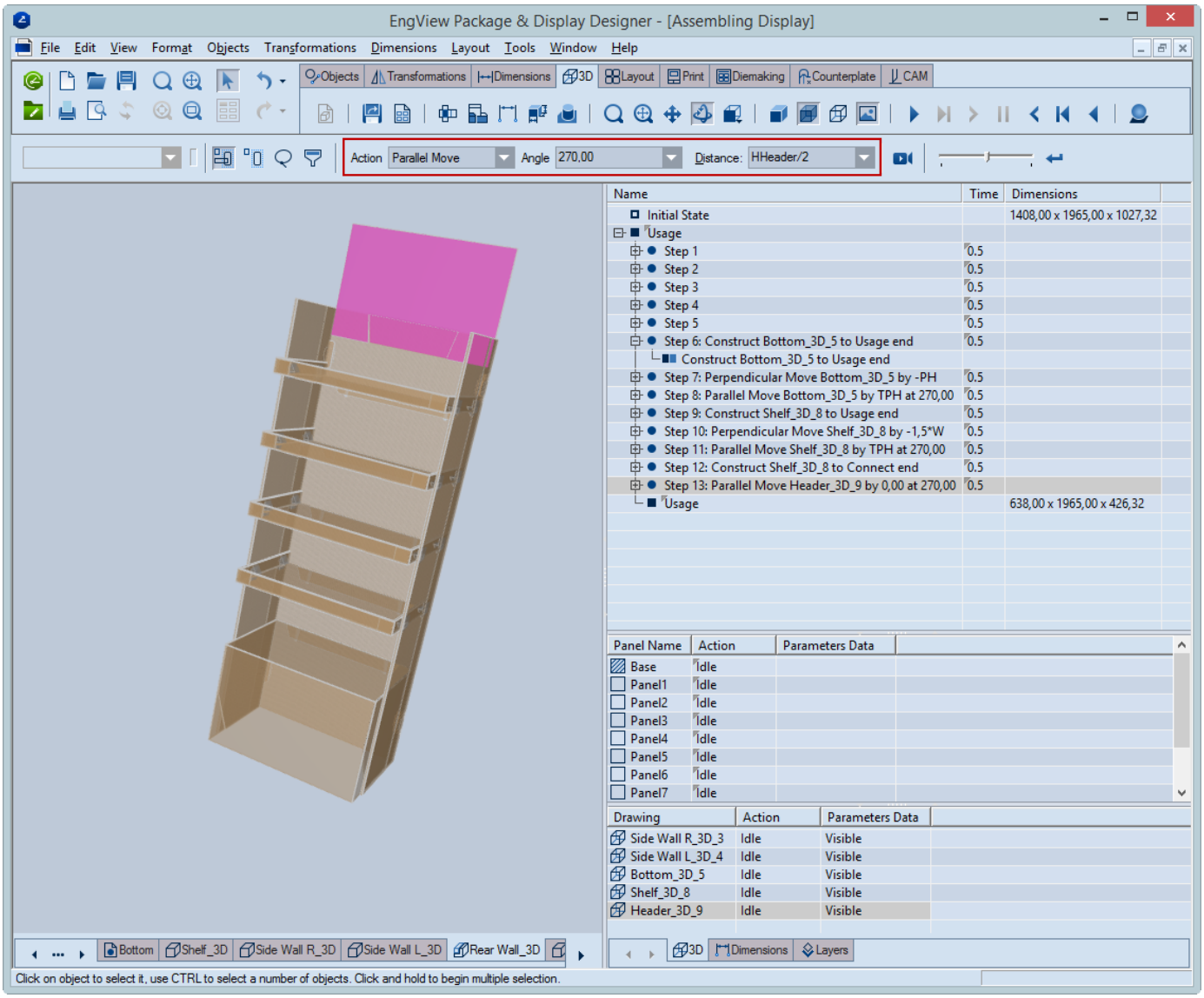
Pic. 66: Adjusting the position of the header

6. To allow for the animation of the attachment, add a half-HHeader movement away along the y-axis: in **Y offset**, type –1.5*HHeader+CD+d().



Pic. 67: An additional distance controls the eventual vertical animation of the header.

7. In the tabular area, create a step below Step 12. In it, we will set the movement of the header.

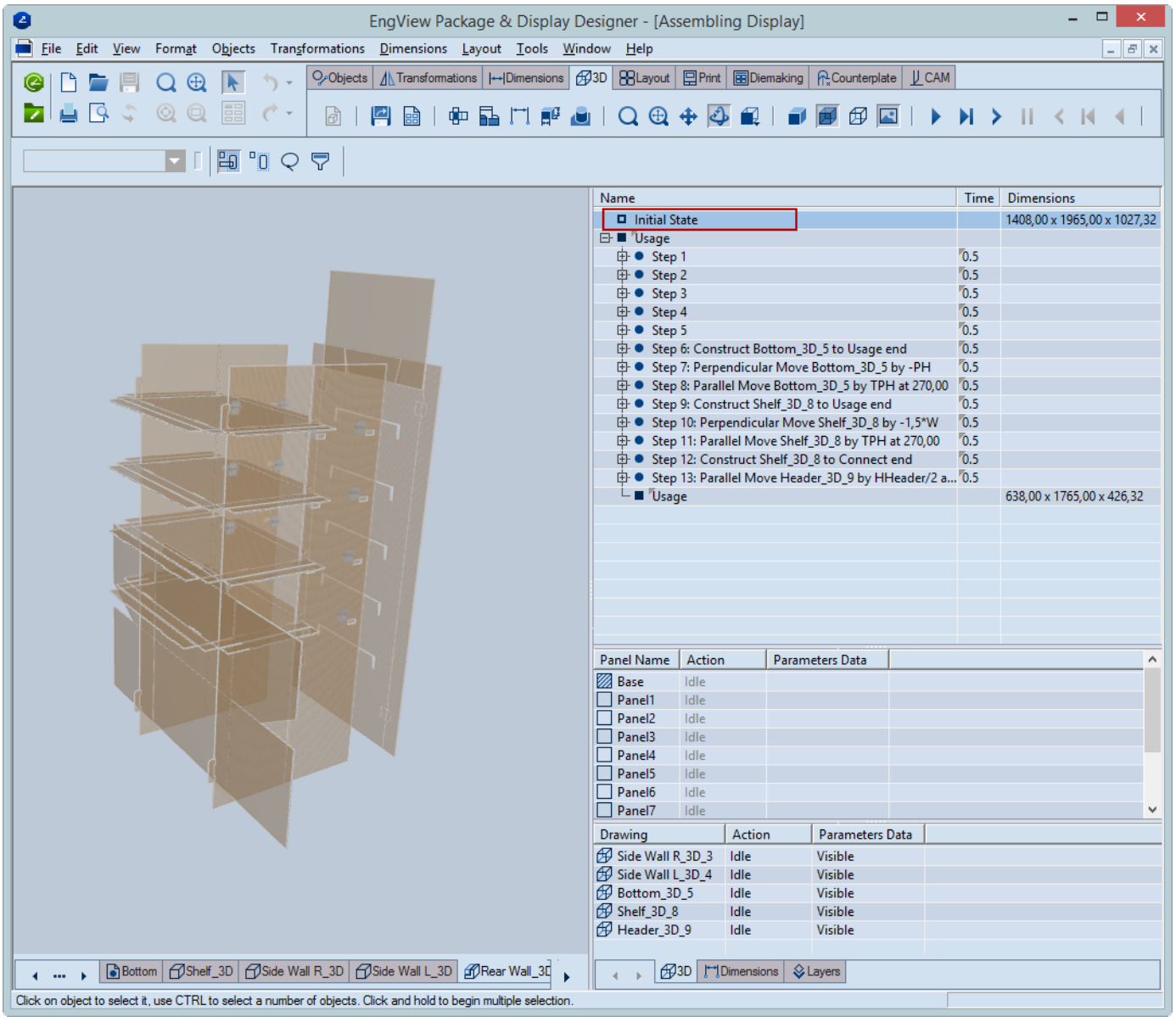


Pic. 68: The header is in place.

This completes the assembly of the display.

Hiding and Showing the Parts

Currently during the animation of the assembly, all the parts of the display are on view, and some even intersect each other.

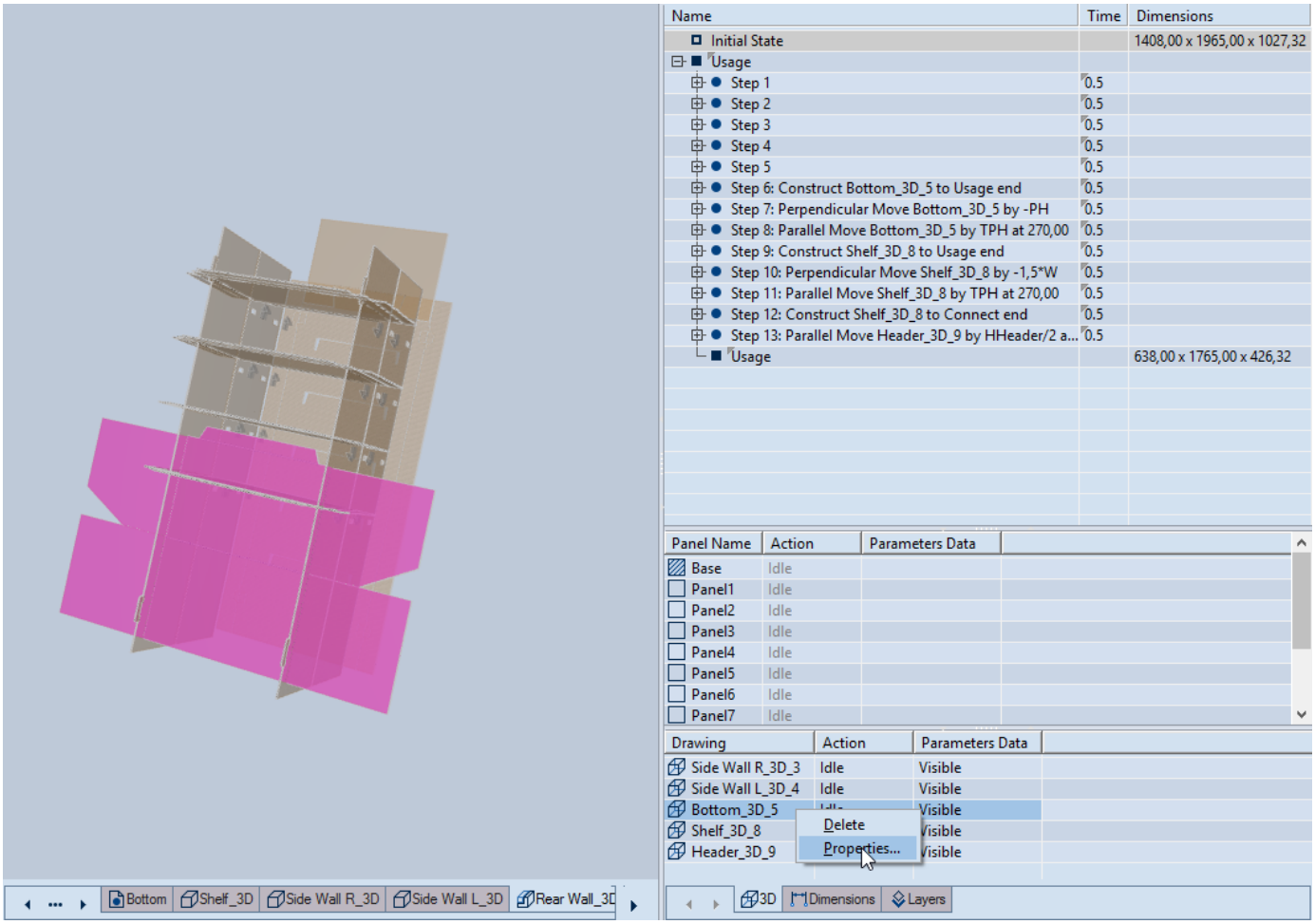


Pic. 69: Because of the great number of parts in a complex display, hiding the ones that are not needed yields better visual orientation.

To follow the animation without any visual clutter, we will arrange it so that only the parts that are immediately involved in the assembly are visible.

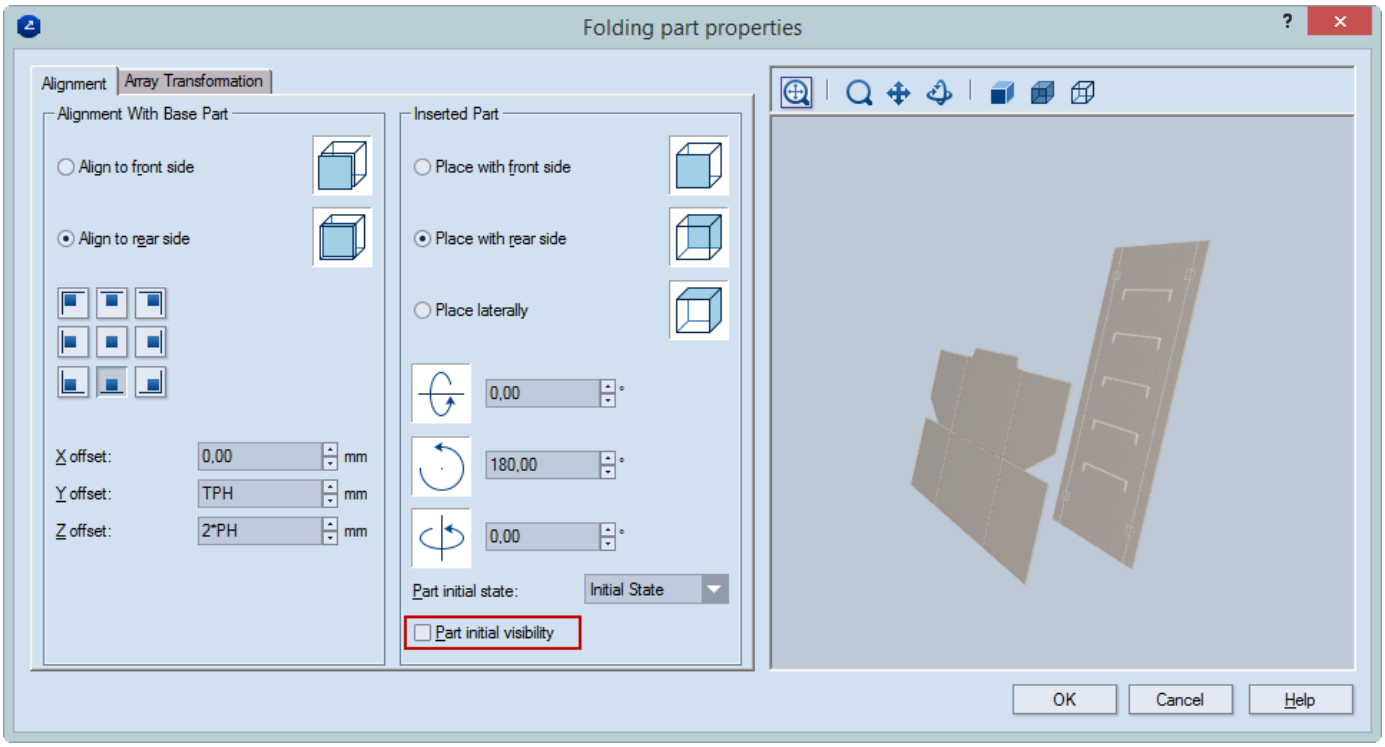
Initially we want to see only the side walls. That is why we will hide the rest of the parts.

1. In the tabular area, in the lower section, right-click the **Bottom_3D** part, and then click **Properties** on the context menu.



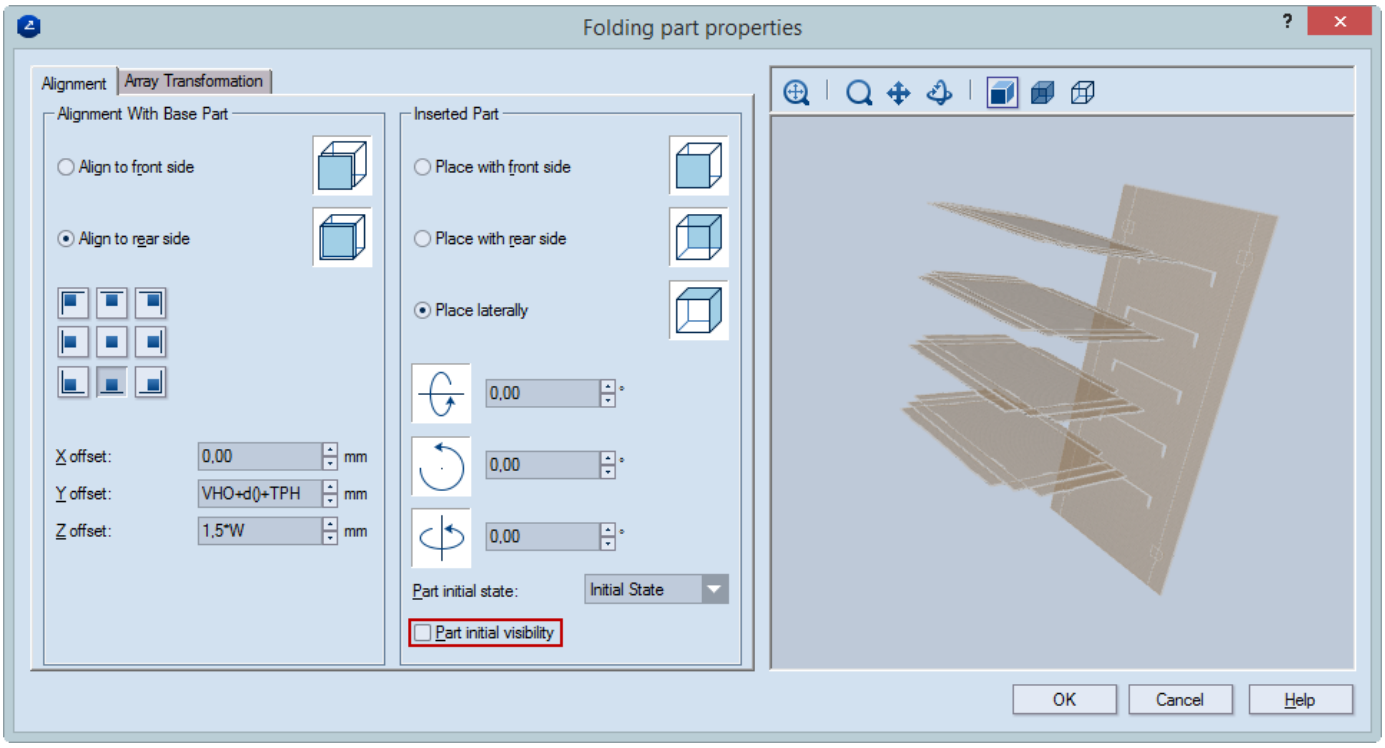
Pic. 70: Preparing to hide the bottom

2. In the dialog box, leave empty the **Part initial visibility** check box. This ensures that the bottom will not be visible at the start.

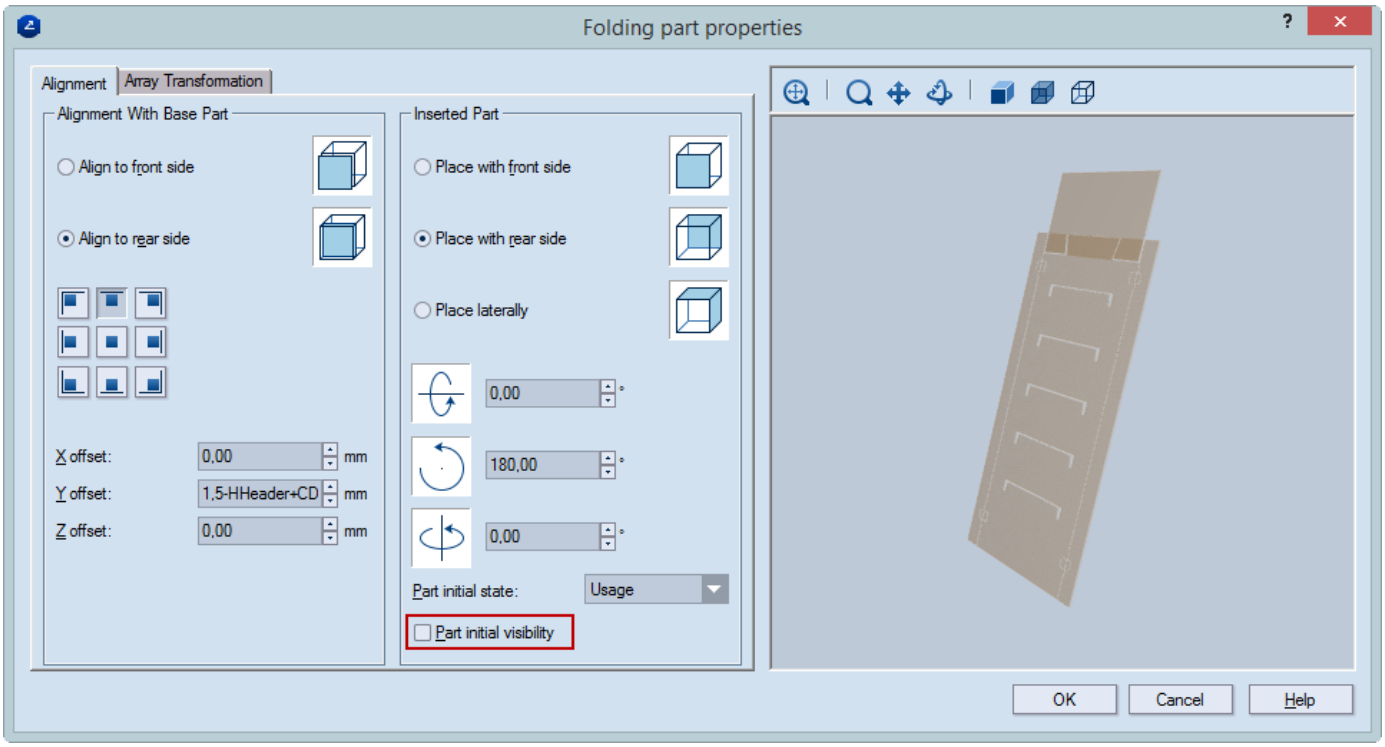


Pic. 71: Hiding the bottom

3. Repeat Steps 4 and 5 also for the parts Shelf_3D and Header_3D.

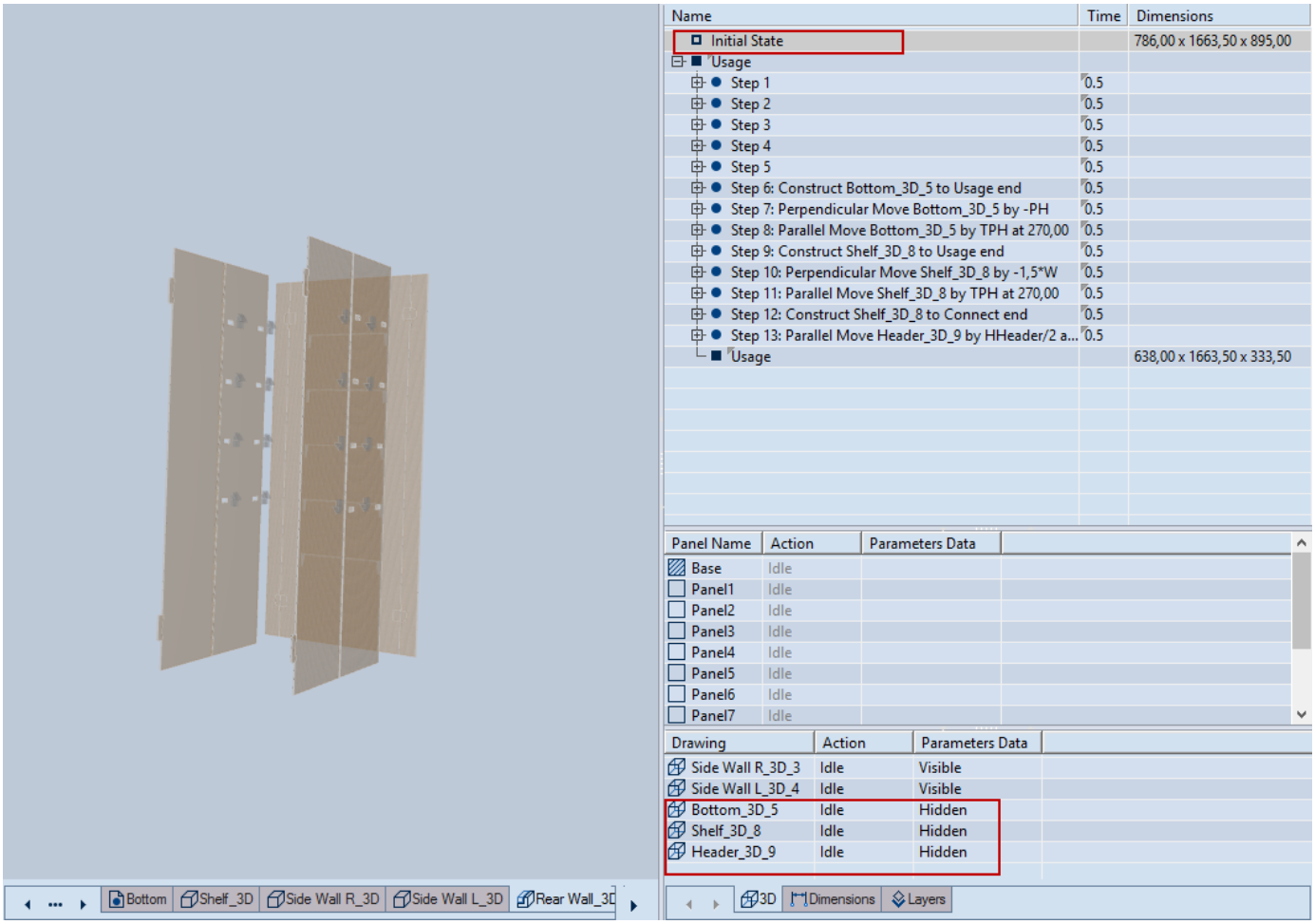


Pic. 72: Hiding the shelf



Pic. 73: Hiding the header

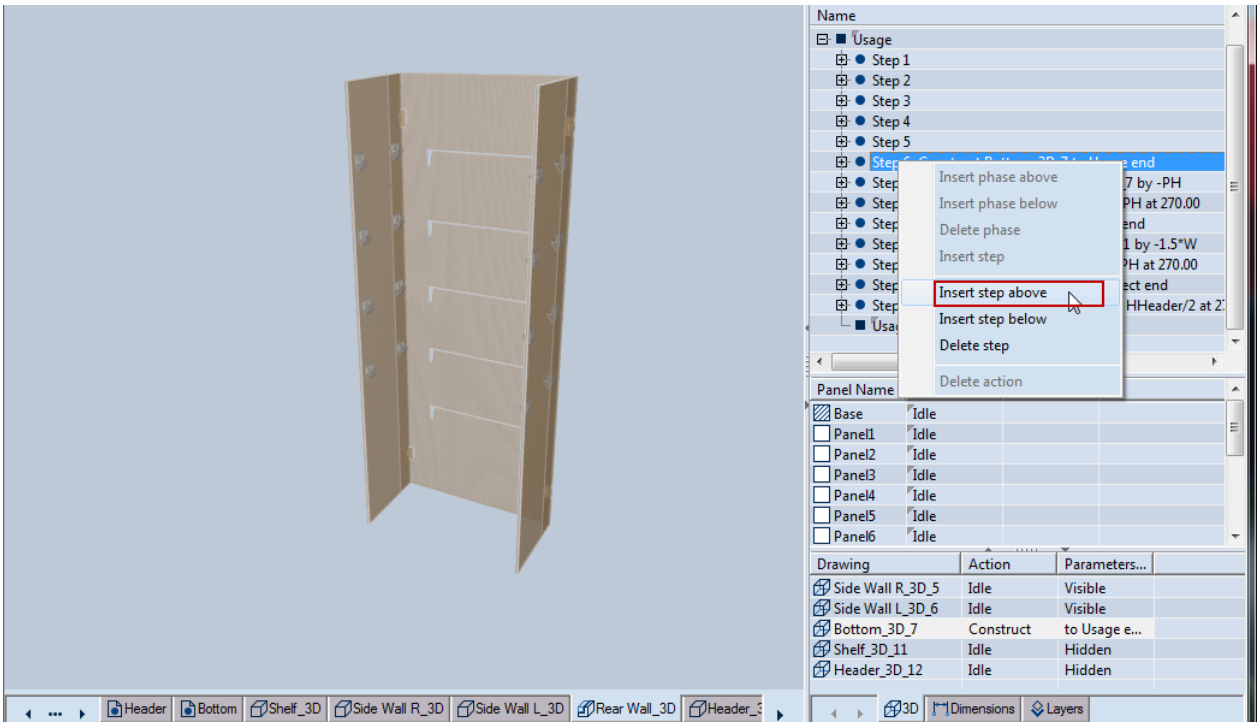
Now the three parts are hidden in the folding sequence's initial state.



Pic. 74: The bottom, the shelf and the header are not visible in the folding sequence' initial state.

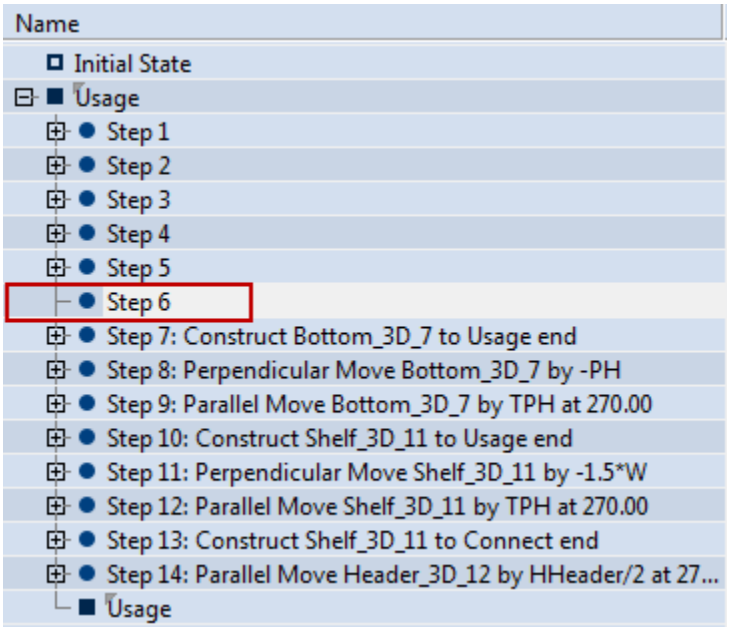
A new part — Bottom_3D — appears in Step 6. This means that we need to show this part in advance.

4. In the tabular area, right-click Step 6, and then click **Insert step above** on the context menu.



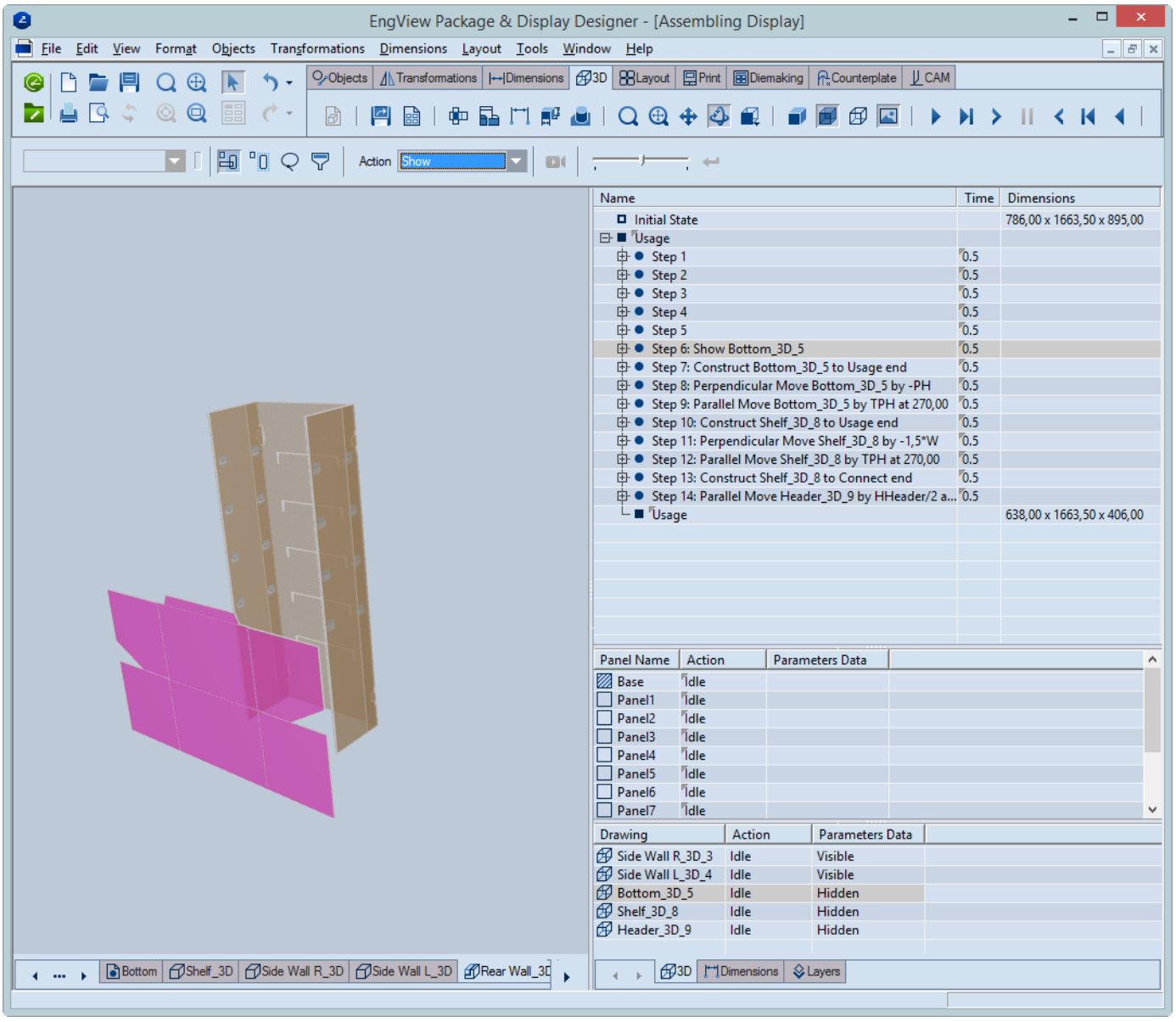
Pic. 75: Adding a step in which the visualization of the bottom

A new step appears.



Pic. 76: The visualization of the bottom will begin in the new step.

5. In the tabular area, in the lower section, select the part Bottom_3D.
6. On the contextual edit bar: in **Action**, select Show.

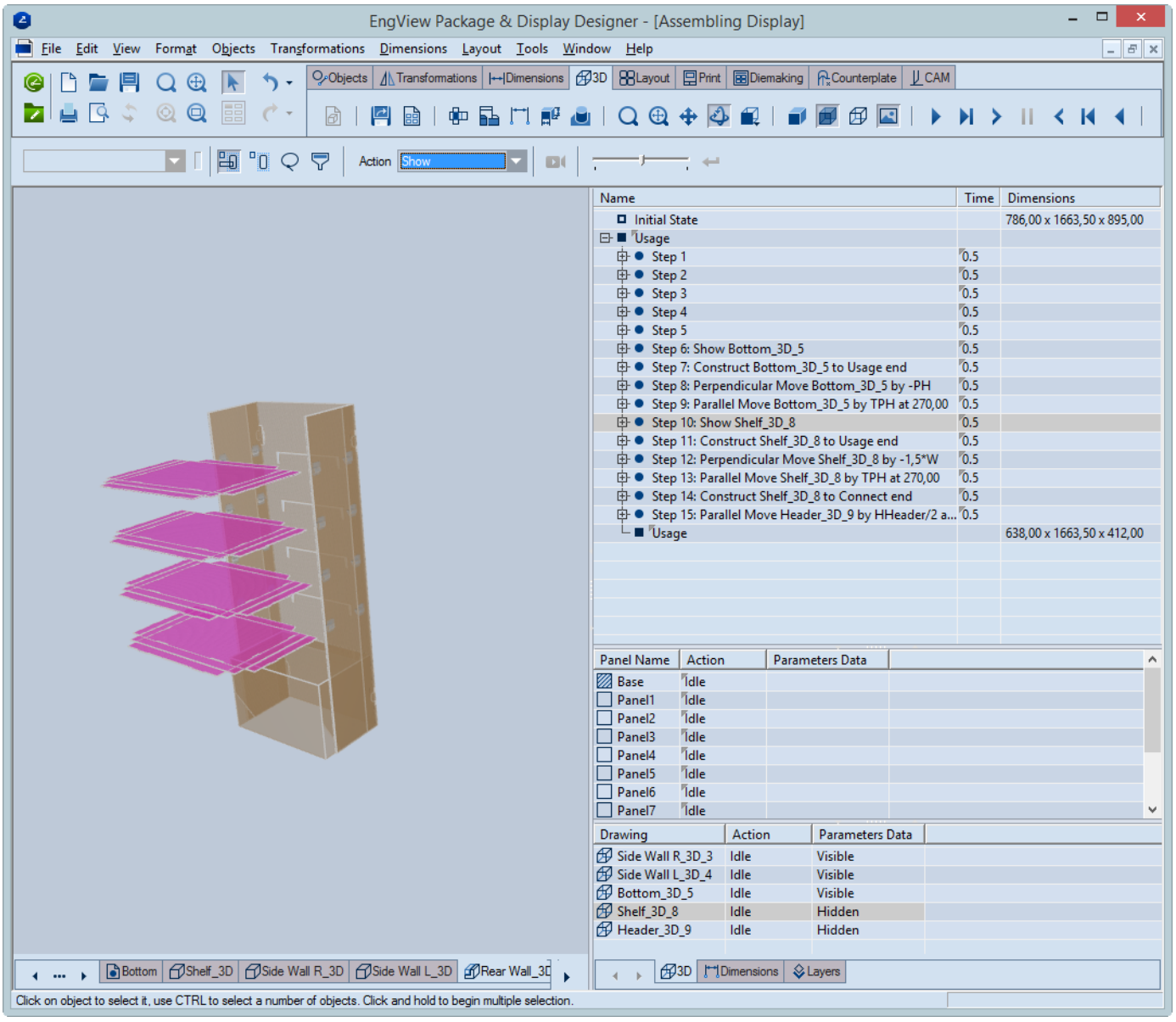


Pic. 77: The bottom is now visible.

Now steps 7, 8 and 9 pertain also for the part Bottom_3D.

Step 10 controls actions related to the shelves. Ths means we need to show the shelves in advance.

7. In the tabular area, right-click Step 10, and then click **Insert step above** on the context menu.
8. In the tabular area, in the lower section, select the part Shelf_3D.
9. On the contextual edit bar: in **Action**, select Show.

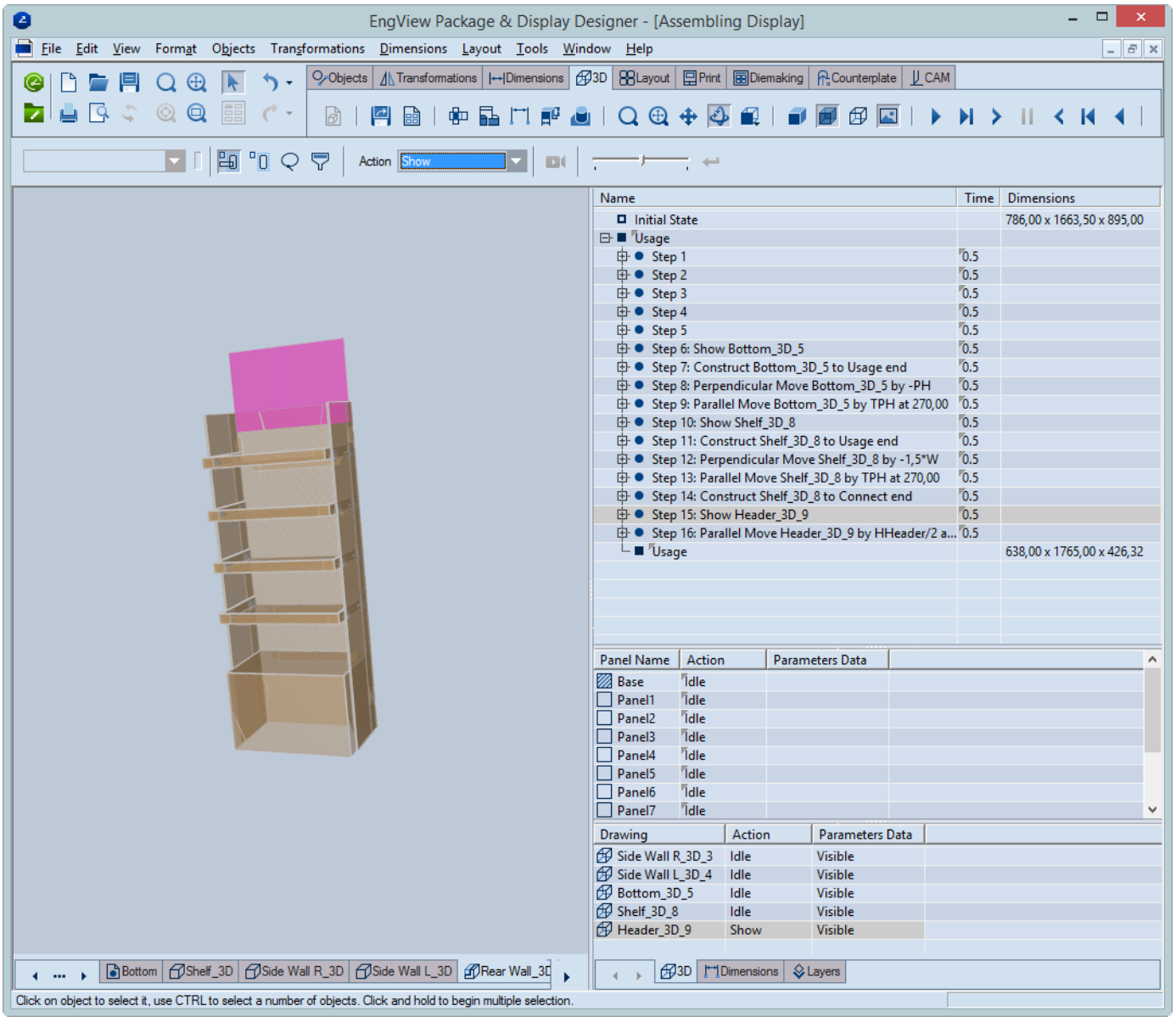


Pic. 78: The shelves are now visible.

10. In the tabular area, right-click Step 15, and then click **Insert step above** on the context menu.

11. In the tabular area, in the lower section, select the part Header_3D.

12. On the contextual edit bar: in **Action**, select Show.



Pic. 79: The header is now visible.

To recap. We created a detailed animation of the assembling of the display. Now this animation can be exported as a PDF and be used as an instruction for the assembly of an actual display.

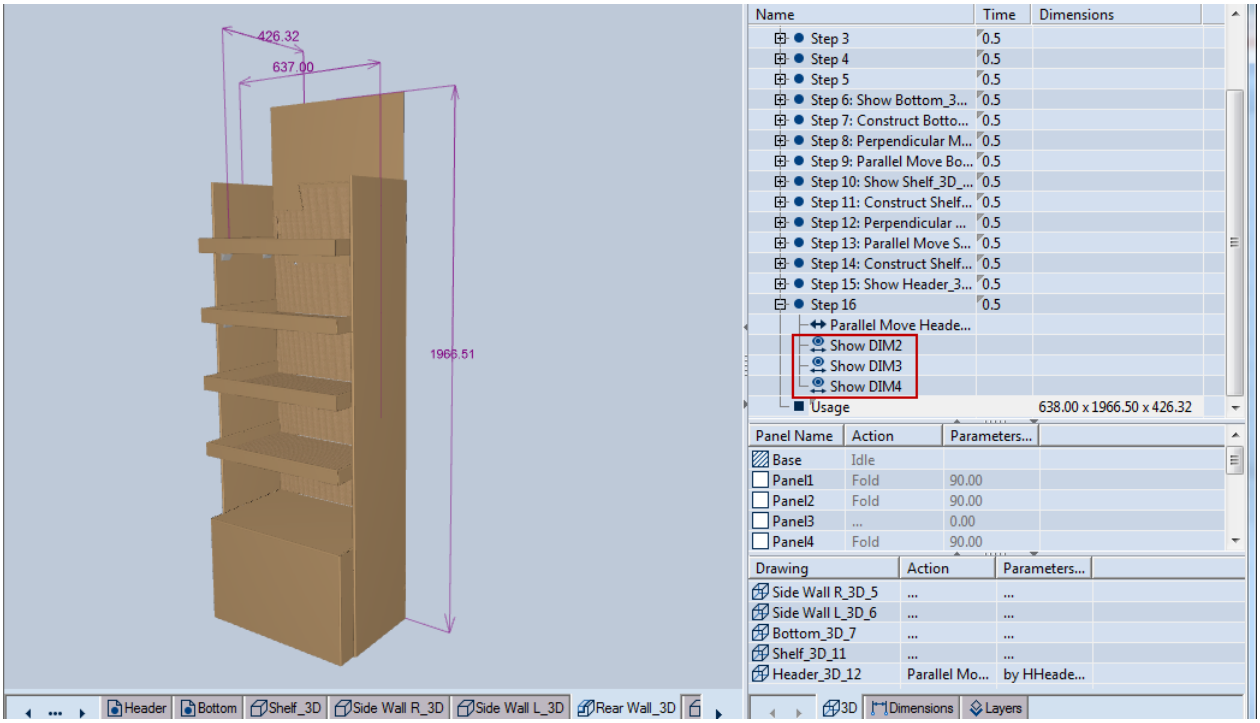
Placing 3D Dimension Lines

NOTE: When a 3D model is displayed, any dimension lines added to it can be exported too.

We can add dimesnion lines, which make visible the display's outermost points. For this purpose, we need to view the display in its fully folded state.

1. In the tabular area, click the end of the Usage phase.

2. On the **3D** toolbar, click **3D Overall Dimensions** .

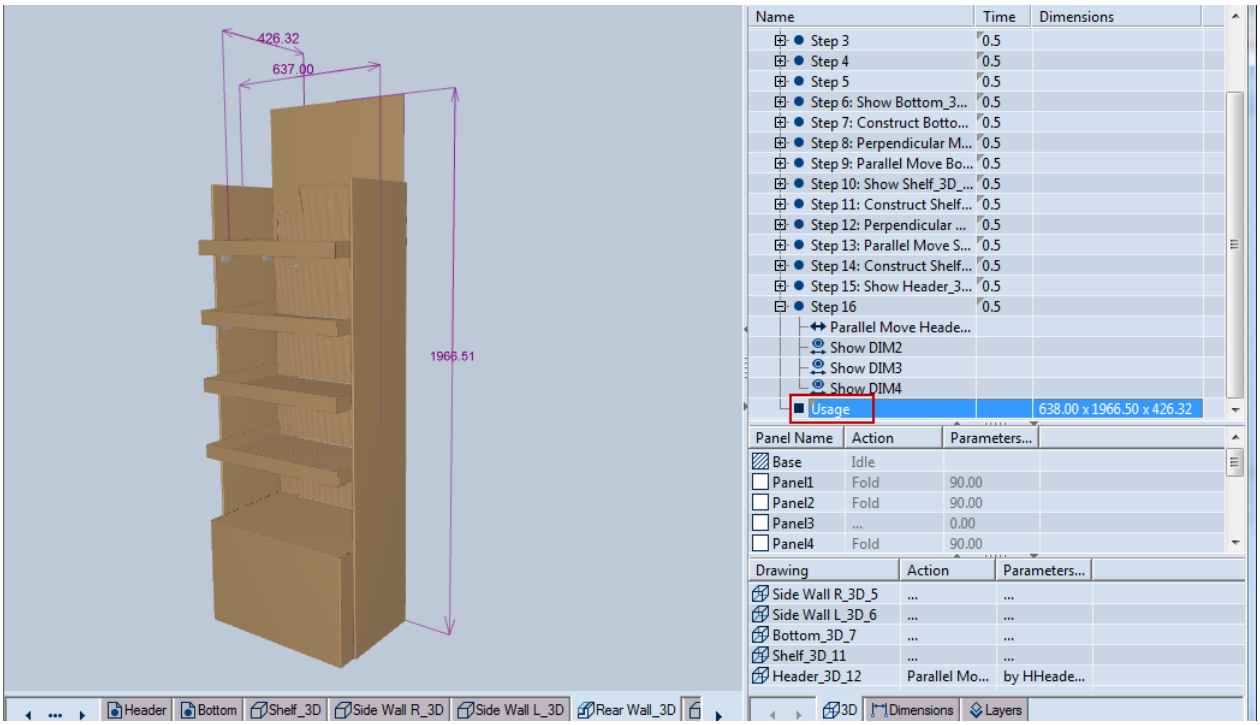


Pic. 80: The actions for the 3D dimension lines are listed at the bottom of the step they are in.

NOTE: After we have added the dimension lines, their actions have appeared in the last step of the folding sequence.

We can also show some additional distances that we consider important — for example, the distance between the shelves.

3. In the tabular area, click the end of the Usage phase.



Pic. 81: Positioning of 3D dimension lines in the Usage phase

4. On the **3D** toolbar, click **3D Measure Lines** .

NOTE: We can use this mode to measure the distance between:

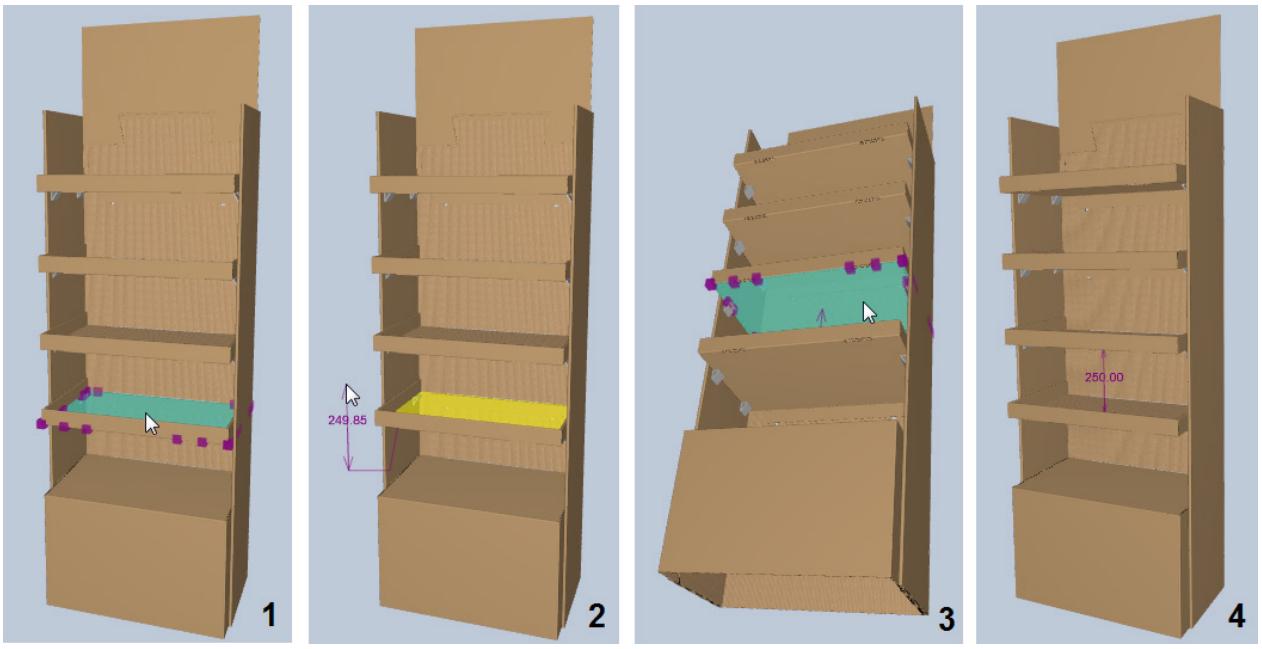
- Two surfaces
- A surface and a control point
- Two control points
- An edge and a control point

We proceed by adding the distance between two surfaces.

5. Click the surface as shown in Section 1 in Pic. 82.

   The selected surface is highlighted in yellow. A dimension lines appears and the visualization of the distance between the surface and the position of the mouse pointer (Section 2).

6. Rotate the display so as to be able to click the lower surface of the upper shelf (Section 3).
7. Using the mouse, position the dimenion line as you want it, and then click to fix it into place (Section 4).



Pic. 82: A list of the available 3D drawings

NOTE: Since we added this dimension line at the end of the folding sequence, also it appeared as an action in the last step of the sequence.

NOTE: We can show distances also during the assembly. In fact the program takes into account the step in which a dimension line is being added and creates the respective action in it. If you want this dimension line to be visible also in the next steps of the folding sequence, on the contextual edit bar, leave empty the **Hide in next step** check box, which appears while the dimension line is being added. Also, you can keep a dimension line visible for a few steps, and then apply the Hide action for it.

Deleting a Dimension Line

There are two ways to delete a dimension line:

- In the tabular area, right-click the action of a dimension line, and then click **Delete action**.
- In the work area, position the mouse pointer over the dimension line until it's highlighted. Then right-click and click **Delete** on the context menu.