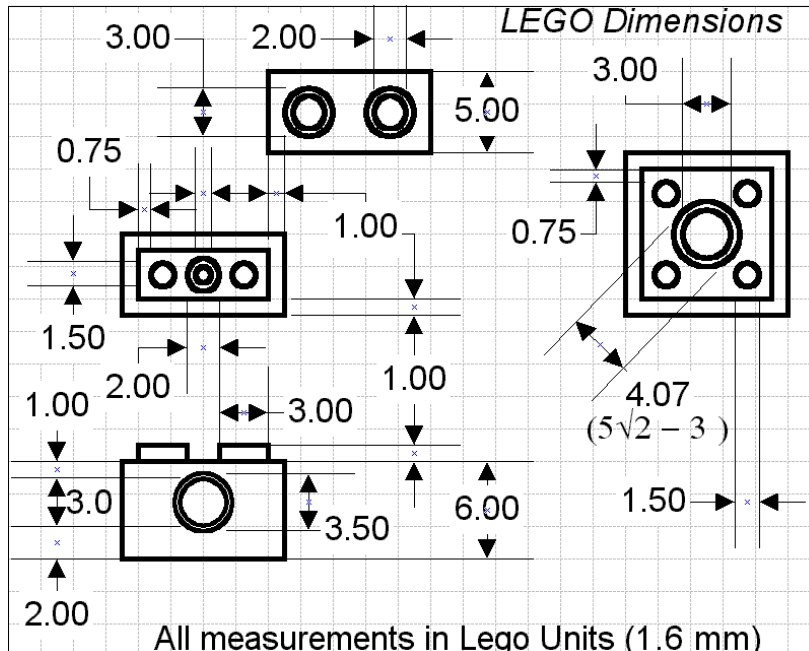


# Lesson 5: Building a basic Lego Brick

This tutorial explains how to build a basic Lego block using parametric design in NX. We will use Lego units as in this picture below.



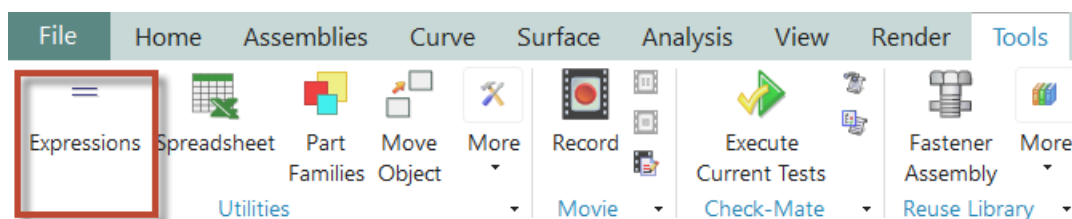
Start a new model and call it "basic lego.prt"

## Setting up the parameters list

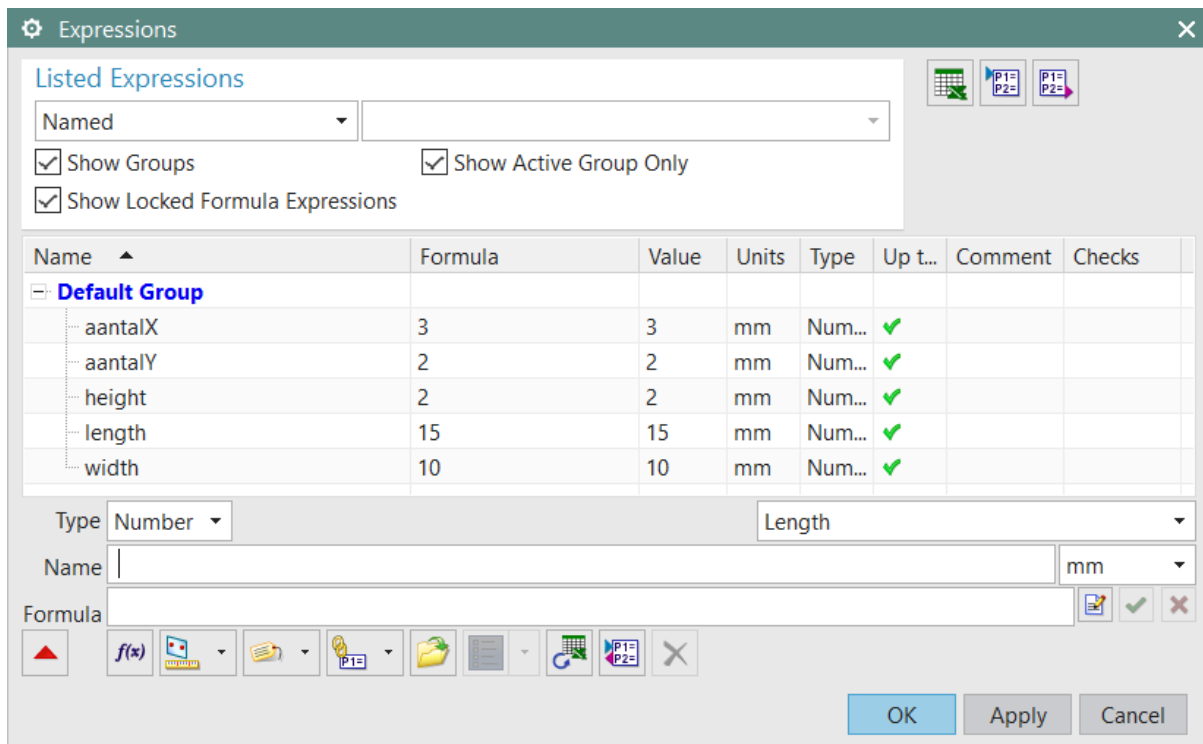
Before we do any modelling we will set up the parameters list first. When you choose a lego block you always choose it with the number of lego-studs that are on top of it (and not by the length for example). Also the length, width and height of the lego block are parameters we need which we will link to the number of studs.

It's smart to make your basic lego block a block of 3x2 studs to begin with. That way we can test all the parameters we need:

Click the "tools"-ribbonmenu and select "expressions" or press ctrl+E.



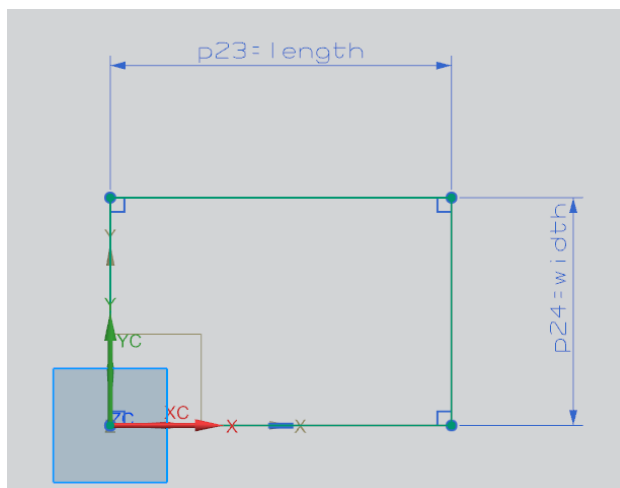
Make the named expressions as follows



Later in this tutorial we will link the parameters together so that the length and width are related to the number of studs.

## Building the base

Start an extrude and click the XY-plane as the sketch-plane.



It's important that you constrain everything to the CSYS in the next steps. That way block will only have the CSYS as a reference.

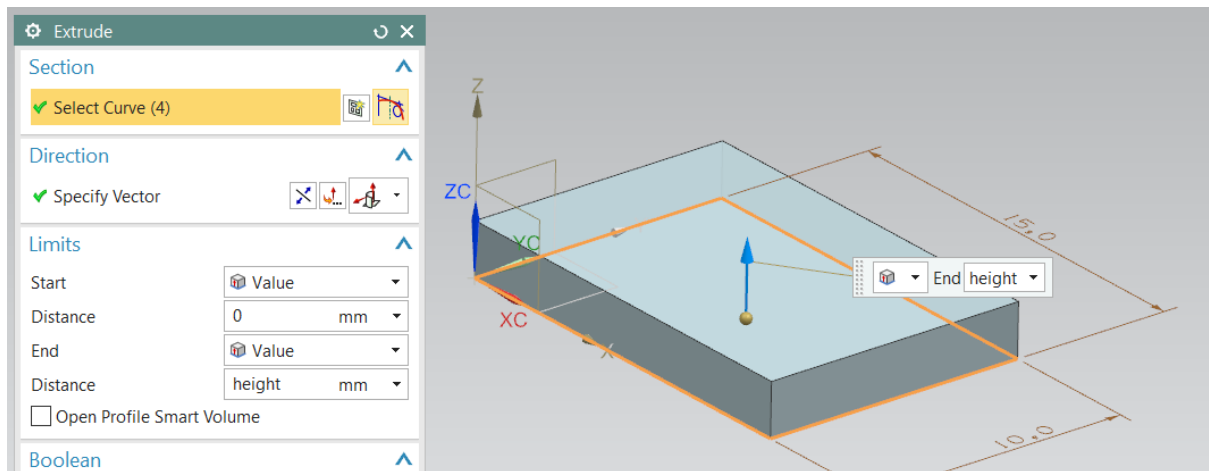
Draw a rectangle with its bottom-left corner on the origin of the CSYS.

Place two dimensions:

- Horizontal dim = length
- Vertical dim = width

We've set these parameter to 15 and 10 mm because we will build a 3x2 studs lego block.

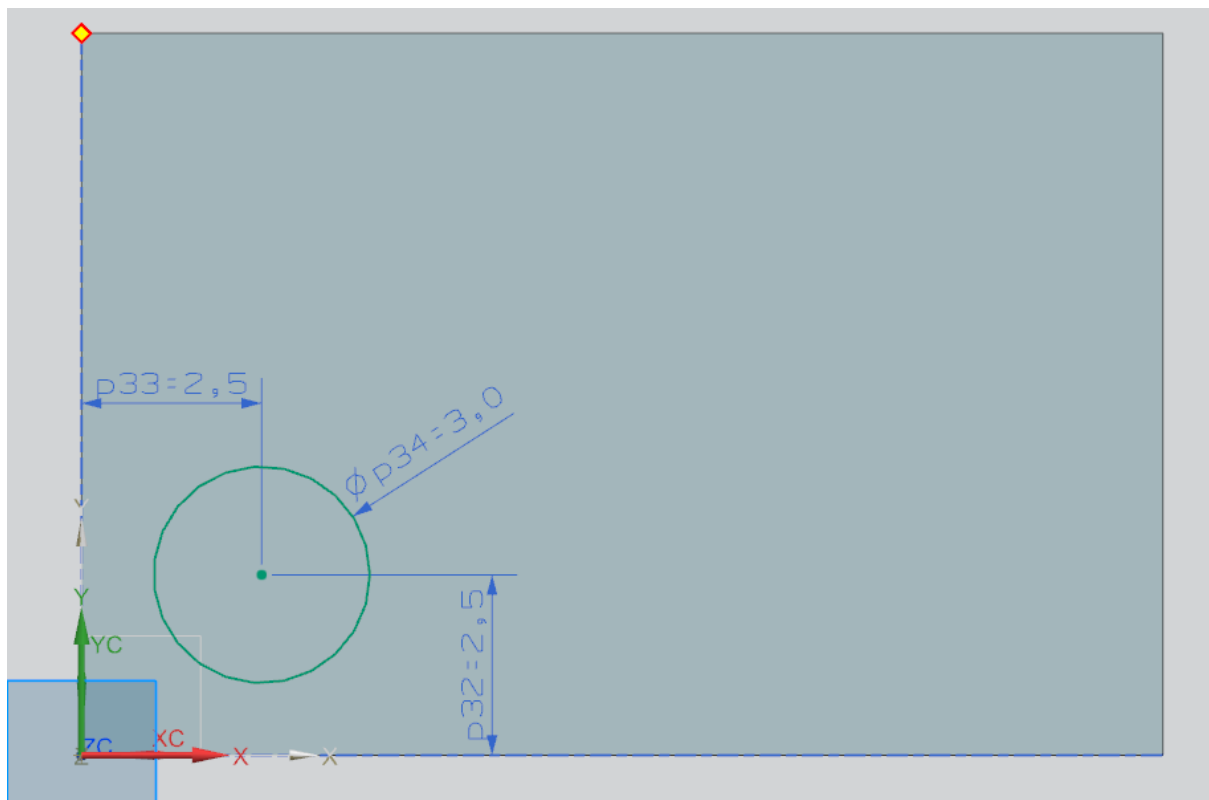
Click finish and extrude. Set the value for the end limit to the "height" parameter.



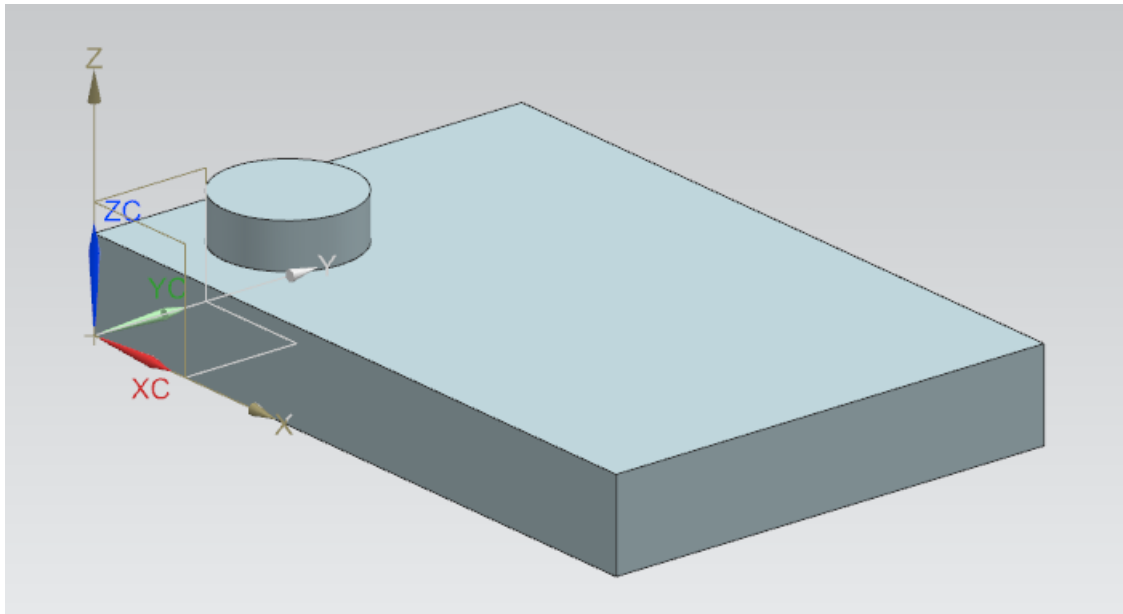
## The first stud

Here it is important that the first stud is referenced to the CSYS again. So place it on top of the first extrude but near to the origin of the CSYS.

Start extrude and select the top-plane of the block as the sketch-plane. Draw a circle near the CSYS origin and place the following dimensions.



Click finish and extrude 1mm high. Don't forget to unite the stud with the block!



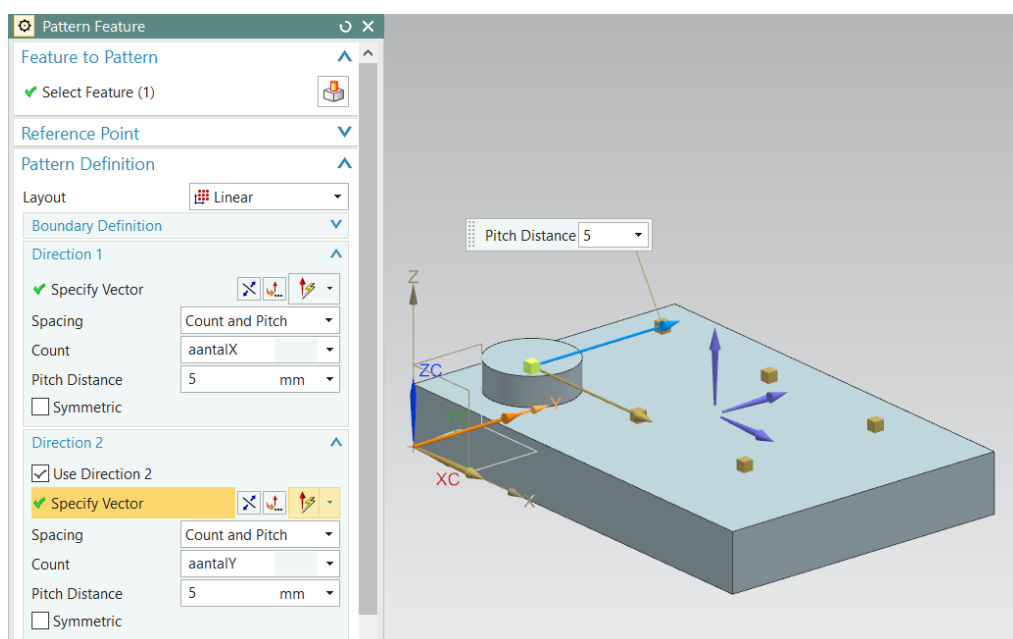
## Patterning the stud

Now we will use pattern feature to multiply the studs. Make sure you don't make any mistakes in the directions. We will link the parameters "aantalX" to the pattern in X-direction and "aantalY" to Y-direction.

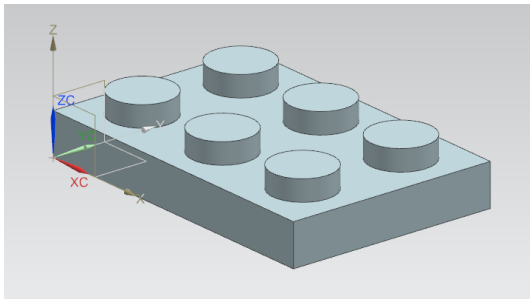
Start pattern feature and select the stud. Choose linear as the layout.

In direction 1 select the X-axis as the defining vector. Set the spacing to "count and pitch" and the set the count to "aantalX" and the pitch to 5mm.

In direction 2 select the Y-axis as the defining vector. Set the spacing to "count and pitch" and the set the count to "aantalY" and the pitch to 5mm.

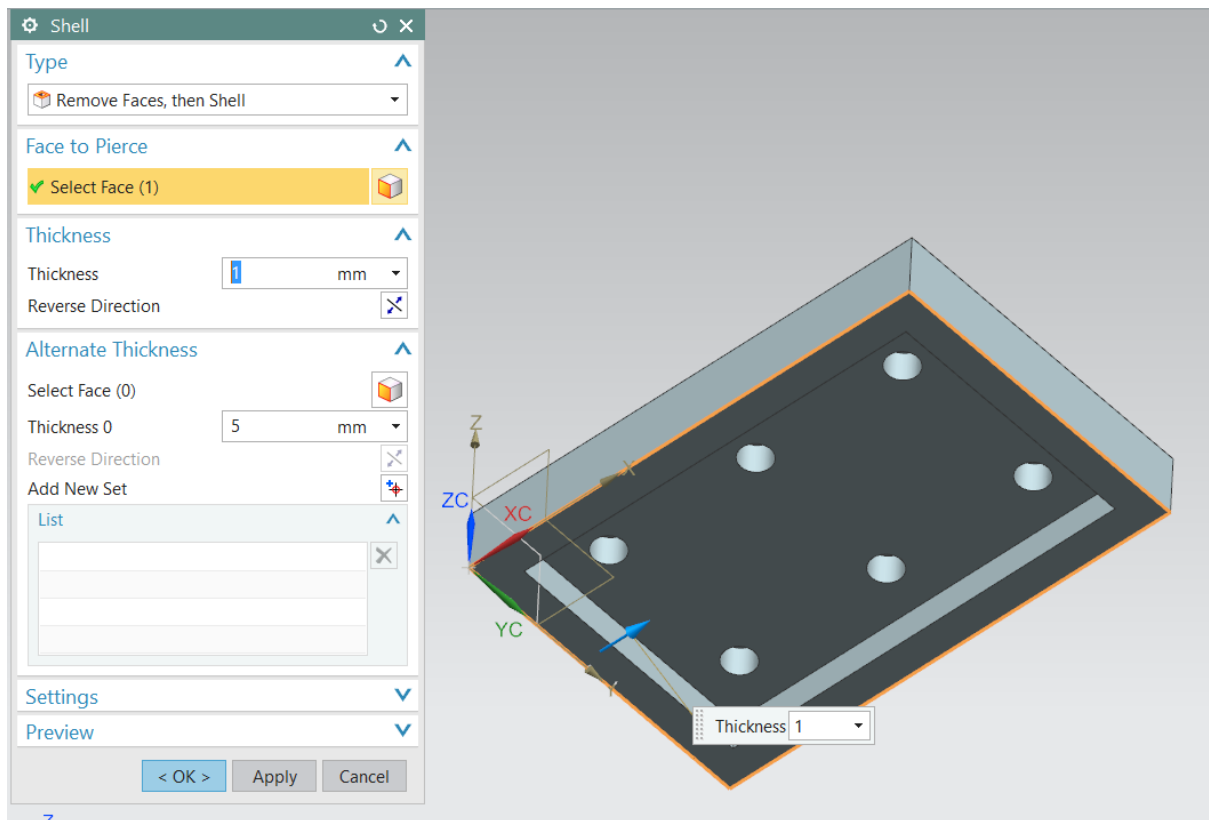


Press OK.



## Shell

Shell the bottom with a thickness of 1mm.



## Adjusting the parameters so the length and width change with the number of studs.

In this step we have to link the length to the number of studs in the X-direction and the width to the Y-direction. 1 stud takes up 5mm space. So the formula becomes: "number of studs" \* 5.

Change your parameter list (ctrl+E) to the following:

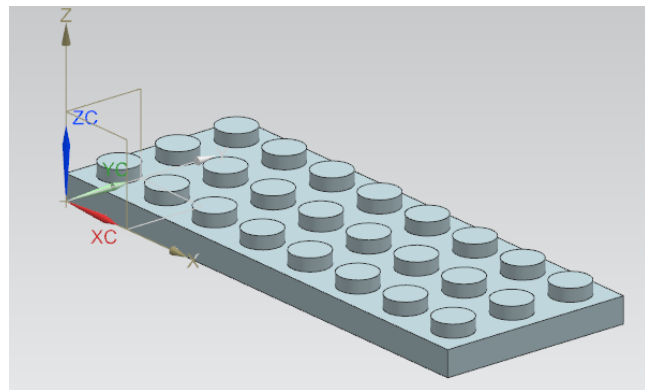
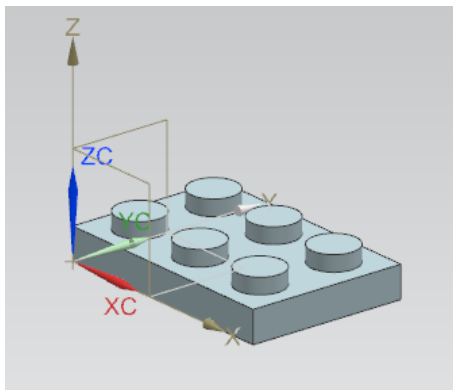
Name	Formula	Value	Units	Type	Up t...	Comment	Checks
<b>Default Group</b>							
aantalX	3	3	mm	Num...	✓		
aantalY	2	2	mm	Num...	✓		
height	2	2	mm	Num...	✓		
length	$aantalX \cdot 5$	15	mm	Num...	✓		
width	$aantalY \cdot 5$	10	mm	Num...	✓		

Type: Number      Length

Name:      mm

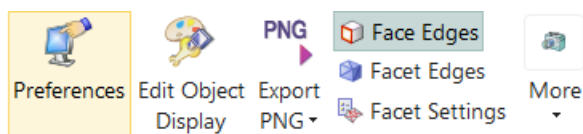
Formula:      [OK] [Apply] [Cancel]

Now when you change the number of studs "AantalX" and "AantalY". The block changes with it.

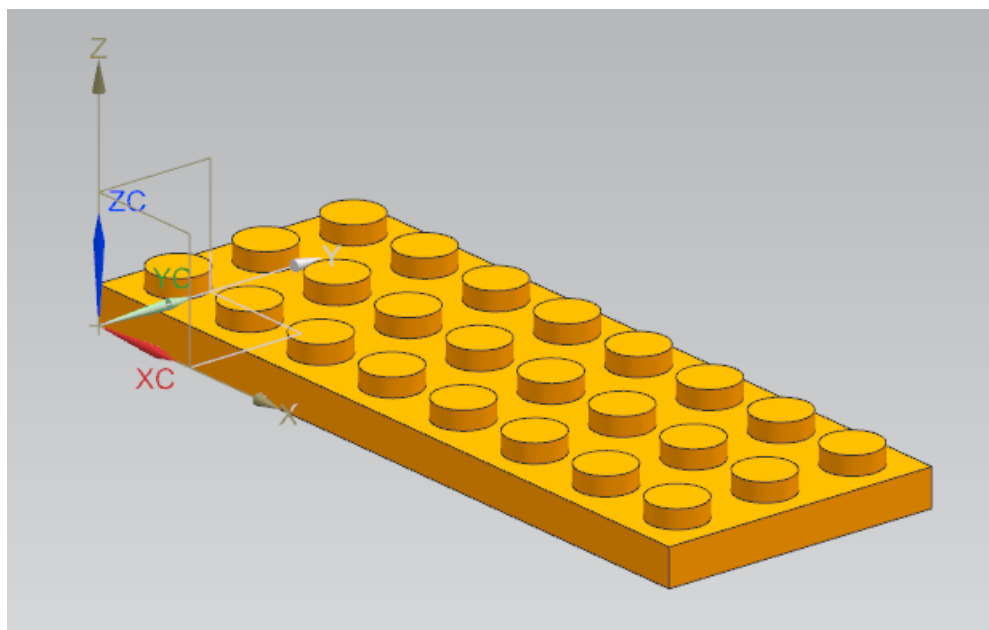
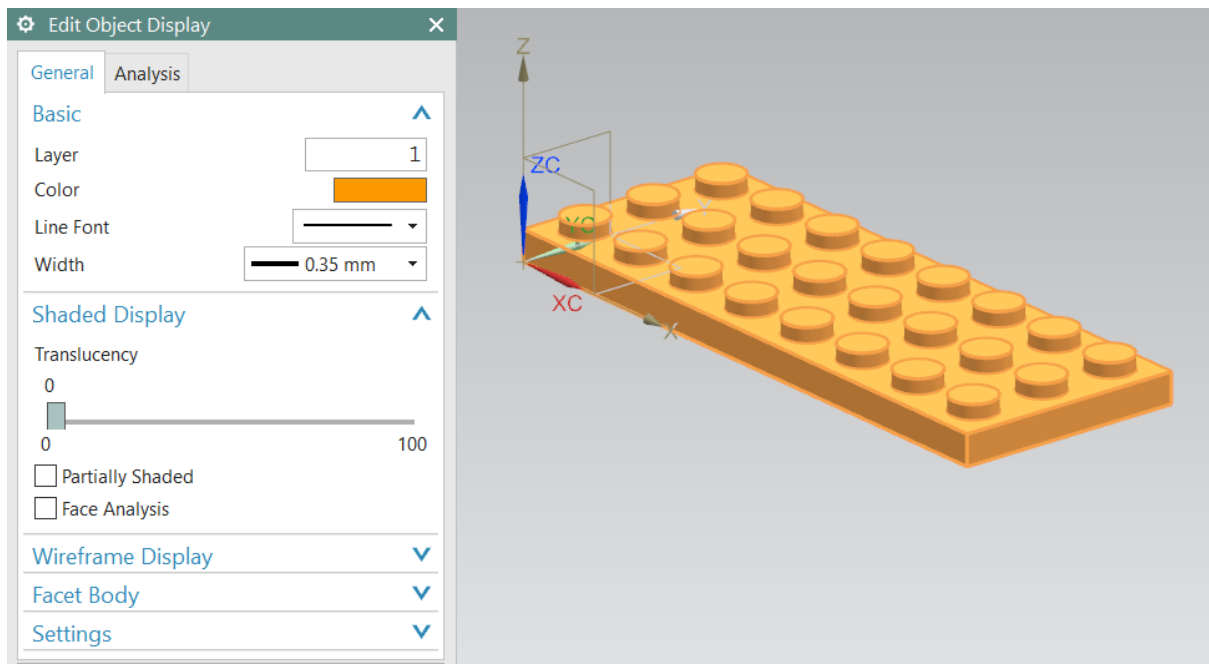


## Changing the color

Click the "view" ribbonmenu and select "edit object display"



Select the lego block as the body and press OK. Now you can change the color of the part.



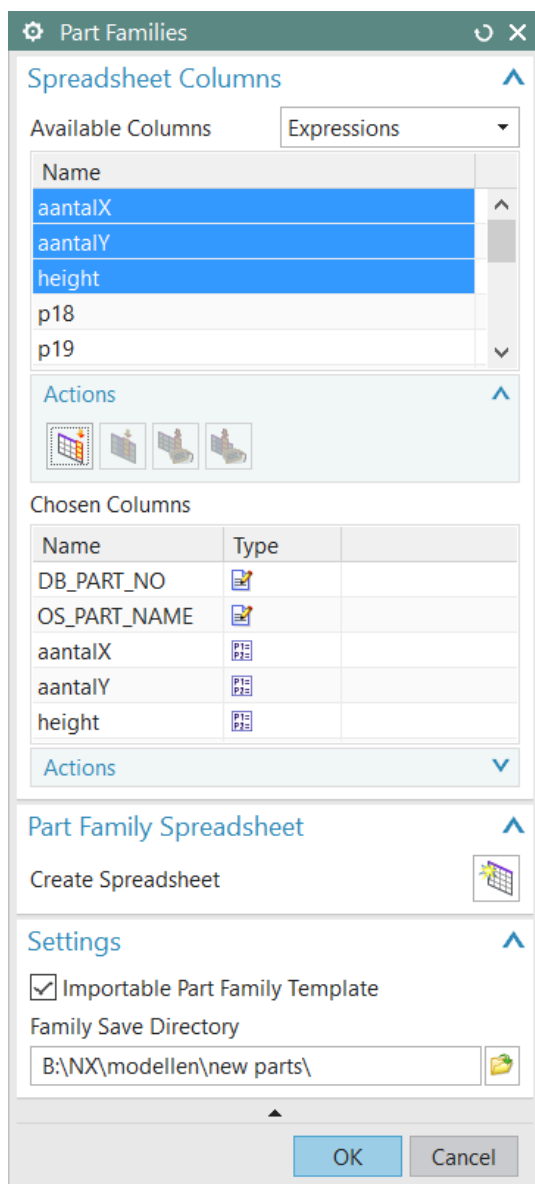
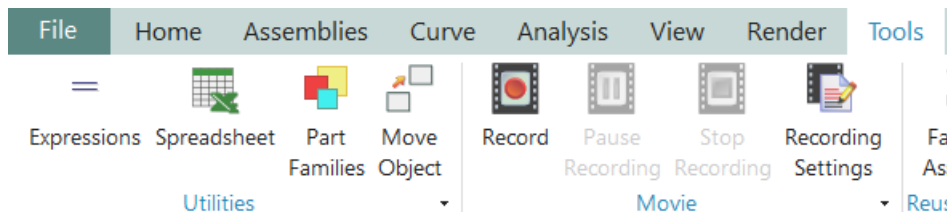
Save your work!

# Making a Part Family

Building smart models with relations in the expressions pays off when you make family parts. For this Lego block we will make a part family list of different configurations.


For this basic lego block we will be able to change the number of studs in the two directions, the height and we will be able to turn off the studs so we get a flat brick.

Start "part families" by clicking on the icon in the tools ribbon-menu.



## Expressions in the part family

Set the available columns to "expressions" and you get a list of all the parameters that are not consumed by relations (constant values) Here we will need the parameters AantalX, AantalY and height to be used in the part family. Select

them and click the "add columns button: . The chosen parameters appear in the second window.

### Remark: don't delete the columns

**DB\_PART\_NO and OS\_PART\_NAME. NX needs them to define these so you get a unique model afterwards.**

In the settings menu set the Family Save Directory to the directory of your assembly. All models that are generated during the making of the assembly are saved here!

Now click "create spreadsheet" 



NX now opens Excel and generates a spreadsheet that looks like this:

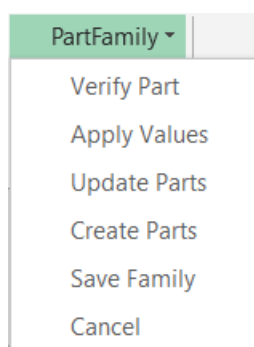
	A	B	C	D	E	
1	<b>DB_PART_NO</b>	<b>OS_PART_NAME</b>	<b>aantalX</b>	<b>aantalY</b>	<b>height</b>	
2			2	4	2	
3						
4						
5						
6						
7						

Now we can make a list of all the different variants we want our lego bricks to have. Make sure that you give a unique name to every brick you place in the spreadsheet. A column with all the same values is a redundant column because you can simply delete it and you a constant parameter.

<b>DB_PART_NO</b>	<b>OS_PART_NAME</b>	<b>aantalX</b>	<b>aantalY</b>	<b>height</b>
1x1low	1x1low	1	1	2
2x1low	2x1low	2	1	2
2x2low	2x2low	2	2	2
3x1low	3x1low	3	1	2
3x2low	3x2low	3	2	2
3x3low	3x3low	3	3	2
4x2low	4x2low	4	2	2
1x1high	1x1high	1	1	6
2x1high	2x1high	2	1	6
2x2high	2x2high	2	2	6
3x1high	3x1high	3	1	6
3x2high	3x2high	3	2	6
3x3high	3x3high	3	3	6
4x2high	4x2high	4	2	6

Analyze the list to see what variants it has.

To returns to NX from Excel go to Add-ins (invoegtoepassingen). Here you have a couple of choices:



- Verify part: checks the part
- Apply values: changes the current part to the one you selected in the row of the spreadsheet (select the entire row!)
- Update parts: updates the parts
- Create parts: with a couple of rows selected: saves the variants to different models in the save directory
- Save family: saves the spreadsheet and return to NX

Press save family.

## Features in family tables

We also want to be able to select a lego brick with no studs. You can do this by setting the available columns to "features". **Here we have to select both the extrude and the pattern of the studs, otherwise you will get conflicts.**

Select both the extrude and the pattern and add the columns to the chosen columns list as before. Now click edit spreadsheet.

You return to excel with the two columns added with the value set to "YES". If we don't want studs, we simply have to change the value to "NO".

Here is the new list:

<b>DB_PART_NO</b>	<b>OS_PART_NAME</b>	<b>aantalX</b>	<b>aantalY</b>	<b>height</b>	<b>Extrude(4)</b>	<b>Pattern(5)</b>
1x1low	1x1low	1	4	2	YES	YES
2x1low	2x1low	2	1	2	YES	YES
2x2low	2x2low	2	2	2	YES	YES
3x1low	3x1low	3	1	2	YES	YES
3x2low	3x2low	3	2	2	YES	YES
3x3low	3x3low	3	3	2	YES	YES
4x2low	4x2low	1	1	2	YES	YES
1x1high	1x1high	2	4	6	YES	YES
2x1high	2x1high	2	1	6	YES	YES
2x2high	2x2high	2	2	6	YES	YES
3x1high	3x1high	3	1	6	YES	YES
3x2high	3x2high	3	2	6	YES	YES
3x3high	3x3high	3	3	6	YES	YES
4x2high	4x2high	4	2	6	YES	YES
1x1flat	1x1flat	1	1	2	NO	NO
2x1flat	2x1flat	2	1	2	NO	NO
2x2flat	2x2flat	2	2	2	NO	NO
3x1flat	3x1flat	3	1	2	NO	NO
3x2flat	3x2flat	3	2	2	NO	NO
3x3flat	3x3flat	3	3	2	NO	NO
4x2flat	4x2flat	4	2	2	NO	NO

Select an entire row in Excel and then click apply values in the add-ins menu.

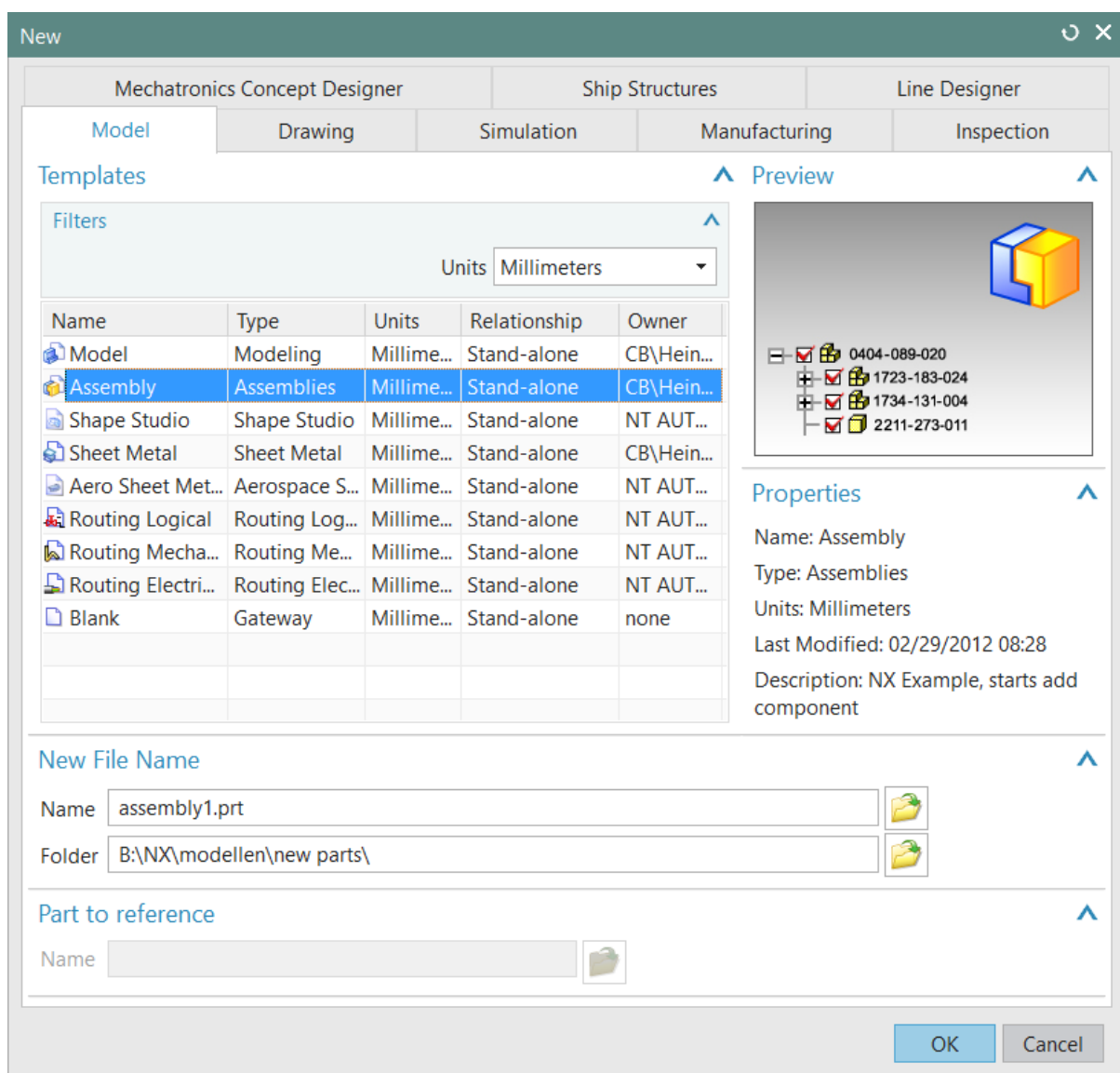
NX changes to the selected brick.

Click OK to leave the part families menu

**Save the part!**

## Building an assembly using family parts

Now we will start a new assembly.



When asked to add a part, load the lego brick family part you just made and click OK!

NX now gives you a list of possible bricks you can insert:

The screenshot shows the 'Choose Family Member' dialog box with the following sections:

- Family Attributes:** A list of attributes including DB\_PART\_NO, aantalX, aantalY, height, Instance[0](4)/Extrude(4), and Rectangular\_Array(5).
- Criteria:** A text input field and a 'Clear All Criteria' button.
- Valid Values / Not Valid Values:** Two empty list boxes for displaying results.
- Matching Members:** A list box containing '1x1low', '2x1low', '2x2low', '3x1low', '3x2low', '3x3low', and '4x2low'.
- Part Name:** A text input field.
- Buttons:** 'Choose Template', 'OK', 'Back', and 'Cancel'.

Insert a couple of different models to your assembly

When you save the assembly all the inserted parts are saved as models in the directory set in the part family definition of the "mother brick".

