HOW VIRTUAL BECOMES REAL

Fabricate a gridshell structure with vertical notched strips (F02)

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0:00 SLIDE

- In this tutorial you are going to fabricate the Diagrid generated in tutorial G01 with vertical notched beams

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- With this method, the Diagrid diamonds can be realised with two sets of strips. If you need bracing, you can simply add a third set of strips on top of the structure, and join it with glue
- Vertical notched strips are particularly effective when you want to emphasise the structural element thickness. It would be the ideal method, for instance, to make a model of Foster's gridshell for the Smithsonian Museum courtyard
- Remember that this technique can also be useful to realise formworks for plaster or concrete models
- Now, let's start!

0:40 GRASSHOPPER

- The Diagrid generated in tutorial G01 outputs four streams of segments and respective vertices, so that data is already organised for easy fabrication
- You need to select one stream at a time, so decide which steam you'd like to fabricate first
    o For example, select the main members in direction 1
- Use the **Scale** component to adopt a fabrication scale
    o For instance, you can make a model at 1:10
- Use **Polyline** to transform the sets of vertices into sets of continuous polylines
- Use **ExtendCurve** to extend the length of your polylines so that the thickness of the fabrication material is taken into account
    o Remember that in these tutorials you are always drawing in metres. However, mm are more convenient is this case, as the size of fabrication sheets is generally expressed with that unit
    o Assume you are using a 1mm boxboard sheet, so **Divide** 1 by 1000
    o Feed the thickness material into the L0 and L1 inputs of **ExtendCurve** and divide them by 2. The curves will be extended by half of the thickness, therefore 0.5mm on both ends
- Now use **Extrude** to generate the actual 3D strips from the polylines
    o For the purpose of this tutorial, assume the strip height is 10mm, so just **Divide** 10 by 1000, and feed the resulting value into a **UnitZ** vector
- Make sure you have installed the *FabTools plugin* for Grasshopper, version 0.95
- Use the **Unroll** component to develop the strips
    o You can also feed additional geometries to unroll. In this case, input the list of the polyline vertices, as they will be used to define the side of the notches
- Connect the unrolled Breps to a **BrepJoin** component to join the strip surfaces
    o Now use **Arrange** to distribute the strips on the XY plane. With this component you can also fit the strips to a defined frame

- You now want to cut the notches from the strips. They can either face up or down. In this case, let's assume they are facing down. Then remember to change direction for the next stream of beams
- Use a **LineSDL** component to draw the notch axes on the strips
    o Use **Transform** to get the starting points of the lines. This component will move the polyline vertices from their original position to the unrolled strips. Connect first the transform data from **Arrange**. Then, feed the unrolled points
    o Get now a **UnitX** vector to define the direction of the axes
    o Feed the height of the strips, divided by 2, as the length of the lines

- Use **ExtendCurve** to increase the height of the notches. This will make sure the strips will be properly trimmed, even when their curvature is important
    - o You can for instance set the tolerance L0 equal to the strip height
- Now use two **Offset** components to generate the notch edges
    - o Set the first offset distance to half of the boxboard sheet thickness
    - o then use the same distance, but with a negative value, for the second offset
- **Loft** the two sets of lines to obtain the planar trimming frame of the notches
- You need to generate a solid element and prevent subtraction issues between planar surfaces
    - o To do so, use **Move** and **Extrude**
    - o Use a **UnitZ** vector to define translation, and divide it by -2 with an expression
    - o Feed the same vector into **Extrude**
- To cut the notches in the strips, use **TrimSolid**
    - o Remember to feed the same data structure to the two component inputs. You can do that using **TrimTree** on the notch solids
- You can now use **BrepEdges** to get the notched strip outlines, but remember to take the naked edge curves only

- Before moving to the actual fabrication, you still need to label the strips and make them recognisable for assembly
- You can use the **3DTextAdvanced** component to generate the labels
    - o You need to provide label positions and texts as inputs
- To define the label positions:
    - o Get a **DeconstructBrep** component and connect it to the unrolled geometries which are already arranged on the XY plane
    - o Use a **ListItem** to select the first surface of each strip, and feed the output into an **Area** component. Now, feed the *Centroid* into **3DTextAdvanced**
- To define the label texts:
    - o Get a **Series** component, and use the **ListLength** component to calculate the number of labels you will need. Measure for instance, the length of the *Centroid*. This will return the list of progressive labelling numbers
    - o Use **Concatenate** to add a prefix, such as "D", which reminds you that the notches are facing down
    - o Feed the **Concatenate** output into **3DTextAdvanced**
- You can adjust the label size for instance to half of the strip height
- You can finally use a **ValueList** component to change the text justification

6:57   SLIDE
- This is the end of the tutorial. In the support master file, you will find the refined GH definition, which is linked to the other definitions of tutorials G01, G01.1 and G01.2:
    - o To activate or deactivate this modulus, use the switch on the top left **(ValueList)**
    - o The components highlighted in green are placeholders of the Diagrid input geometry
    - o The components highlighted in pink allow you to define the model scale, notch position and label alignment
    - o The first group in the middle generates the 3D beams, which are then unrolled by the second group of components
    - o The notches are defined in the third group, on the top right. The labels are instead added by the forth group of components, on the bottom right
    - o The components on the bottom left will finally allow you to arrange the unrolled beams on a rectangular sheet for fabrication

7:48   END OF TUTORIAL F02