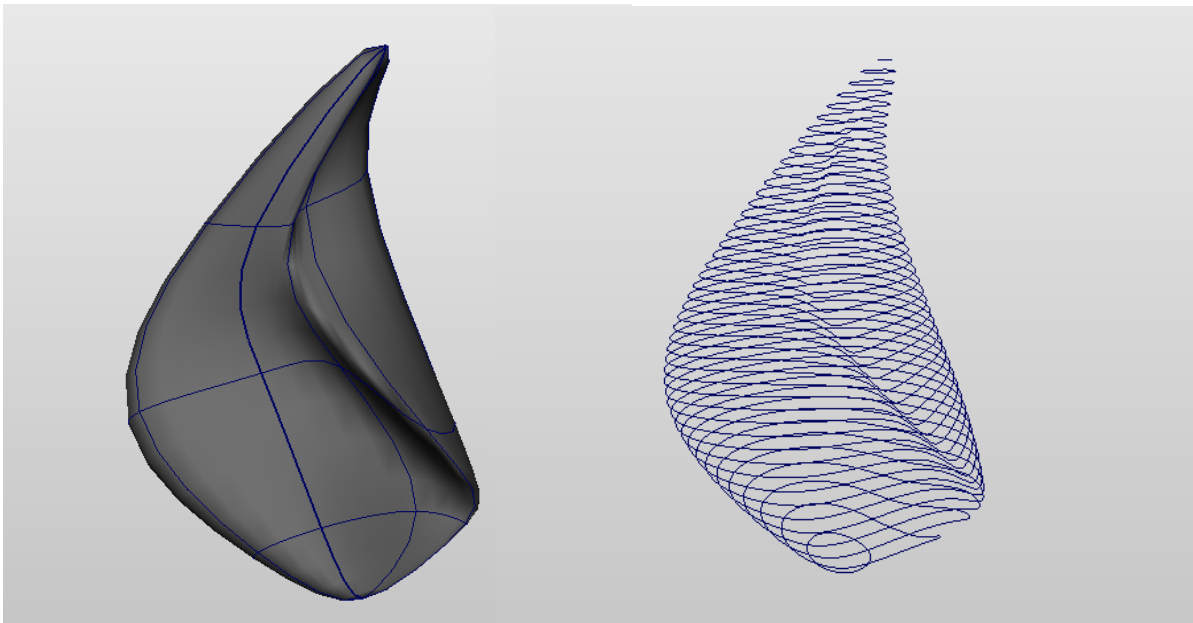# Creating Cross-Sections
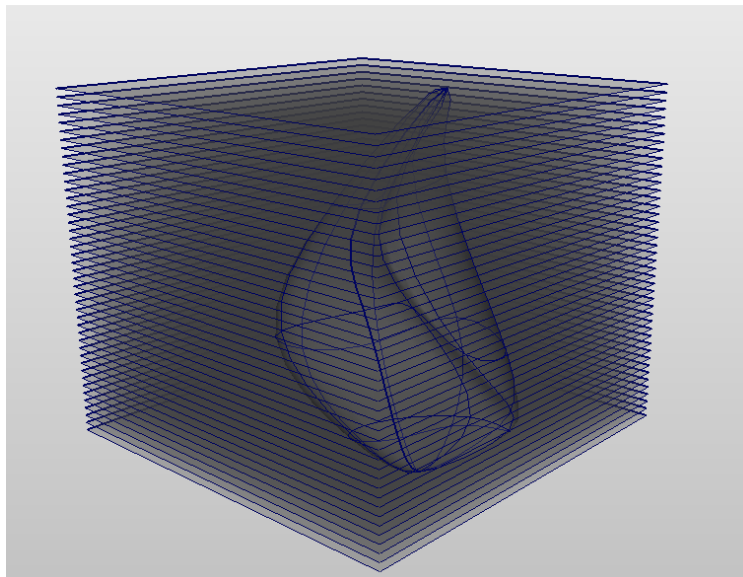# of a NURBS Model

A) Introduction

Create a NURBS model
- Using any techniques
- **Warning**:
    - The more extreme the concavities,
        - the more problems the following technique will have

The Basic Procedure:

- Create planes through the model
  - >Create >NURBS Primitives >Plane
- Create cross-sectional curves from those planes
  - >Edit NURBS >Intersect Surfaces
- Create cross-sectional polygon surfaces from those curves
  - >Surfaces >Planar

**Automated Version =**
crossSectionNurbs_MOR.mel

- I have written a MEL script
  - (derived from an Autodesk script)
  - that automates the procedure described above
- Download the script from my website
- The script is called *crossSectionNurbs_MOR.mel*

- **WARNING**:
  - Do NOT paste the text into a text editor such as Word or OpenOffice
  - These editors will add invisible characters
    - (for end-of-line, etc)

- To allow Maya to find the script...
  - >File >Set Project
    - Select your Maya project
  - Copy the script into the /scripts folder of your Maya project
  - >Window >General Editors >Script Editor
    - >File >Source Script
      - Browse and select the script in your /scripts folder
  - Maya will now be able to find the script

- To run the script...
  - Inside the Script Editor
    - >File >Load Script
    - The mel script will appear in the bottom half of the Script Editor
      - (In the "Input" section of the Script Editor window)

    - Look at the comments at the beginning of the script
      - First comments are in yellow, between the /* and the */
      - Instructions on use are in there
      - Briefly...

  - Name your NURBS model
    - For example, "ball"

  - In the Command Line, type
    - crossSectionNurbs_MOR ("ball", 1, 0.5, 0.2);
    - This will calculate cross-sections

- for the "ball" model
- along Y axis (1)
- with 0.5 units between each cross section
- starting 0.2 from the bottom of the object

- Result is:
    - one group of all the intersected curves
    - plus another group of all the intersected planes
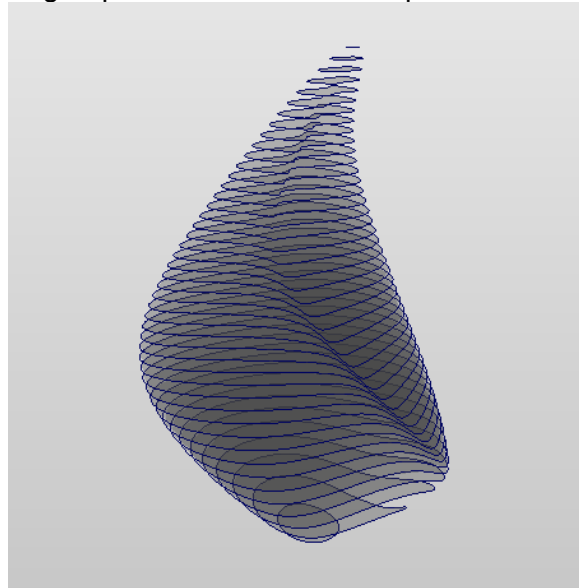
B) Re-do with Precision

Set up Correct Dimensions inside Maya
- Now let's redo this with precise measurements
- Delete or undo what you just did
    - leaving only the NURBS model ("ball")

- Set your scene dimensions correctly
        - (In the USA, this means inches or feet)
    - >Window >Settings/Preferences >Preferences
        - >Settings
            - Set Working Units, Linear to inches

- Now that you are working in inches
- Scale your model so that it is 10" tall as follows:
    - Move the Pivot Point to the very bottom of the object
        - Hit **w** key for Move
            - On Windows, hit *Insert* key for Pivot Point mode
            - On Mac, hit *Home* key – I think?
            - After moving Pivot Point, hit *Insert* or *Home* to leave Pivot Point mode

    - Make sure your grid is displaying inches
- Snap your object to 0,0,0

- Scale your object until it is 10" tall on the grid
  - Because pivot point is at bottom of object,
    - object does not go below Y = 0

- Save your file

Calculate Decimal Dimensions of your Material
- Maya parameters are always typed as decimals, not fractions

- Example#1
  - If your building material is 1/2" thick,
  - the space between your cross-sections will be 0.5

- Example#2
  - If your building material is 3/16" thick
  - the space between your cross-sections will be 0.1875

- **TIP + WARNING:**
  - The thinner your sections...
    - ... the more precise the form
    - ... the greater the number of sections

Re-create Cross-sections with Numerical Precision
- Example:
  - Assume your model is called "thing", your material is 1/2" thick
  - Load the script as described above
  - In the Command line type the following:

    crossSectionNurbs_MOR ("thing", 1, 0.5, 0);

  - This will calculate cross-sections every 1/2" through the model along the Y axis

C) Produce Drawings for Fabrication

Rotate your intersected planes group
- Still in Maya...
- Select the group containing all your planar surfaces
  - It is called *groupIntPlanes*
- Rotate it 90 around X
  - so that in the Front window you are looking at the top of the "object"
  - This is necessary for Adobe *Illustrator*
    - *Illustrator* will make one layer for each cross-section
    - Layer1 will be the topmost cross-section

- Save as Maya .mb under different name

Save as FBX file
- Note: To get data into Illustrator,
  - we must go from Maya -> FBX -> DXF -> Illustrator

- So...

- Inside Maya,
- Select the *groupIntPlanes*
- >Export Selection []
  - File Type = *FBX export*
  - **TIP:**
    - Use the same filename as your Maya .mb file
    - except with the .fbx extension

Convert to DXF Using *FBX Converter*
- **NOTE#1:**
  - Autodesk FBX Converter is a free stand-alone program
    - available for download from autodesk.com
- **NOTE#2**:
  - FBX Converter is <u>not</u> the same as the FBX plugin
    - The plugin allows Maya to export .fbx files
    - The Converter is a standalone program that runs apart from Maya

- Run *FBX Converter* program
- In "Source Files" window (on left side)
  - Add, browse to select the FBX file you just created

- In "Destination Files" window (right side)
  - Destination Format = DXF
  - At far bottom right, Convert
  - At top of Destination Files window
    - Result = "Converted"

- On your drive, browse to confirm that the .dxf file was created

Open DXF in Illustrator
- Open Adobe *Illustrator*
  - >Edit >Preferences >Units
    - Set units to inches
      - (That is, same as you used in Maya)
  - >File >Open
    - Browse to select the DXF file you just created
    - Artwork Scale = Original Size

  - Each planar cross-section surface is now vector data
    - Each surface is on a separate layer
    - >Window >Layers, to view the layers
    - Top layer = top cross-section of your model

- **WARNING**:
  - Don't scale you *Illustrator* drawings
    - because that will also scale the thickness of your cross-sections

Prepare the Illustrator Drawings

- Group your cross-section layers together

- Make registration lines
  - Make a layer for a grid drawing
    - Draw some horizontal and vertical lines in this layer
    - These will serve as registration marks
      - to show you how each layer aligns with its neighbors
  - **TIP**:
    - Save your grid of registration marks as a separate file
    - so you can paste it into subsequent files

Print the Illustrator Drawings
- Make visible:
  - the Registration lines layer
  - the layer of one cross-section
- >File >Export
- For printing you may, if you wish, assemble several layers onto one sheet
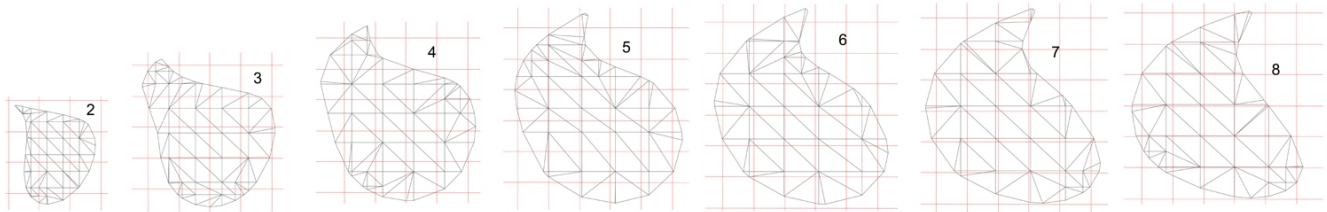
Transfer the Illustrator Drawings to your Material
- Several possible techniques:
  - Pin-hole transfer (the Renaissance fresco technique)
  - Printing on transparency and doing an alcohol transfer technique
  - Print on paper & cut through the paper to the material
  - Projecting onto your material and tracing
    - Note: this will change the scale
  - Etc.

D) Build the Physical Object

- Cut out your cross-sections
- Align according to registration marks
- Glue sections together