

FEM

My first FEM barrel - walkthrough

What it is....

Walkthrough that assumes some familiarity with Houdini.

Construction of a simple wooden barrel.

Peppered with cool procedural benefits and Houdini tips.

Inspiration! - go explore and implement FEM to suit your individual needs.

Output ready for realtime FEM simulation in Unreal.

What it is not....

AAA FEM prop tutorial

AAA UVing and Texturing tutorial

No complimentary FX/Audio (at this stage)

No material/texture building

Not the only way to generate FEM assets.



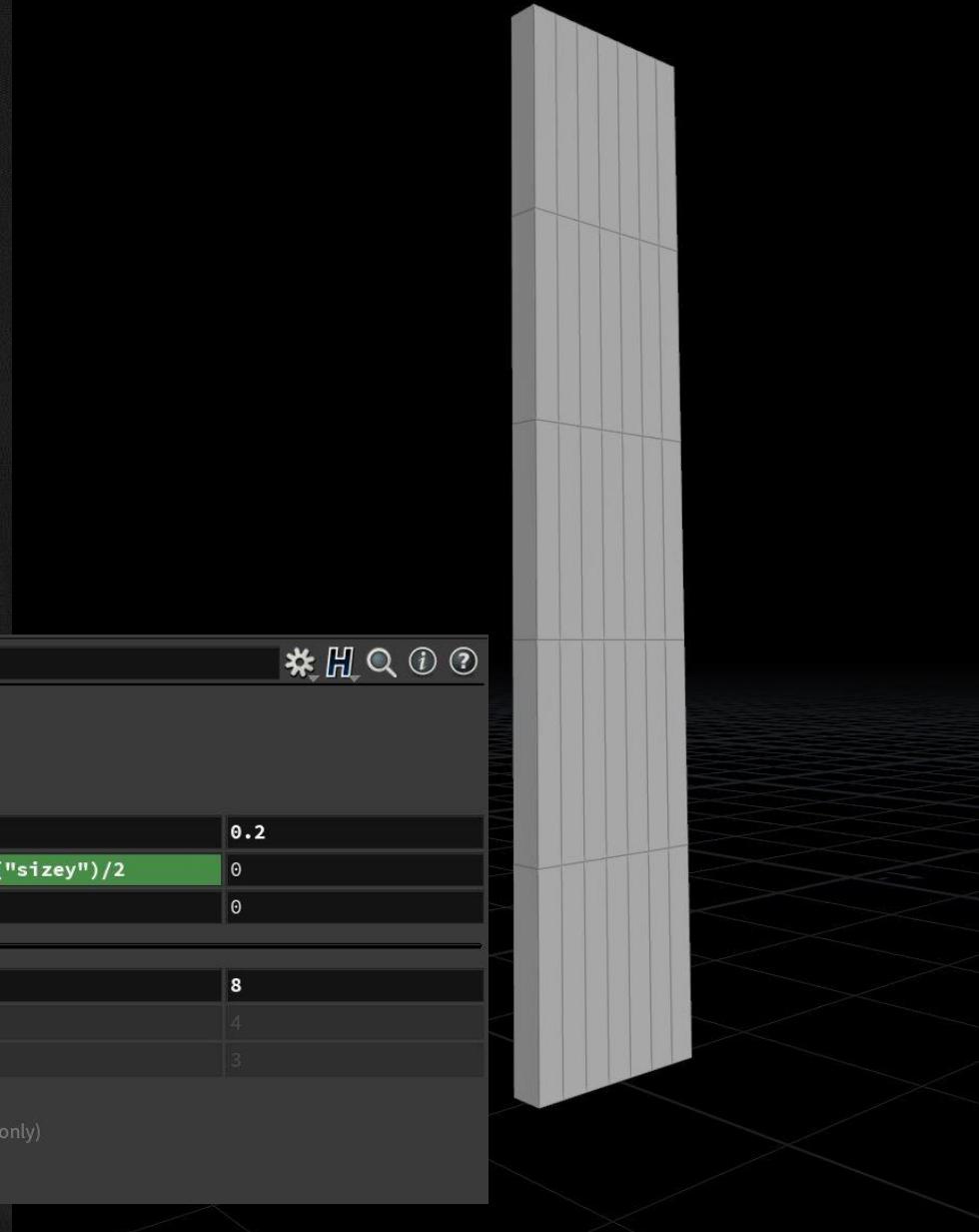
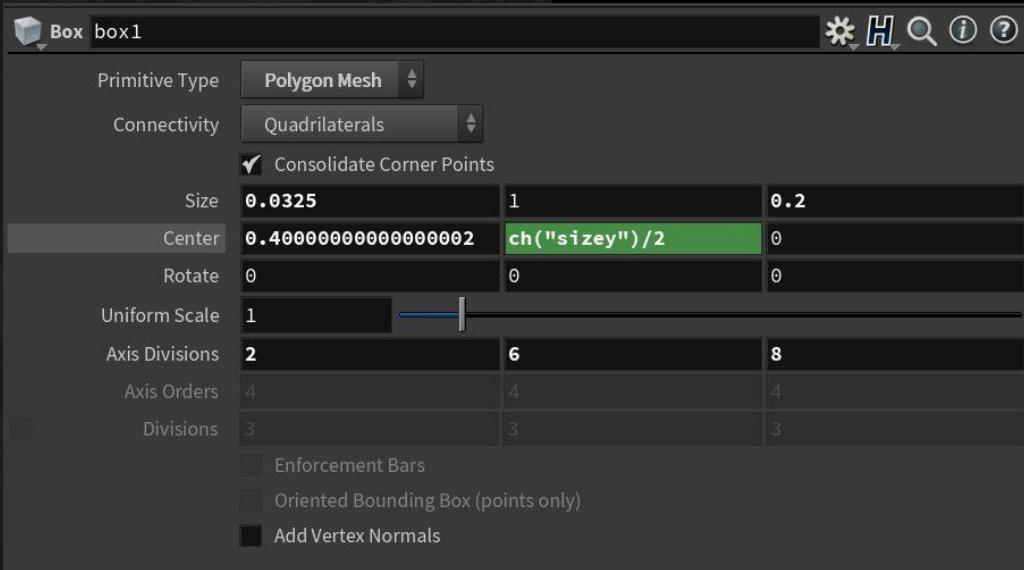
Step 1- The plank

Drop down a box

Give it divisions like in the picture.

Divisions dictate detail of wood breaks

Expression in Y Center.



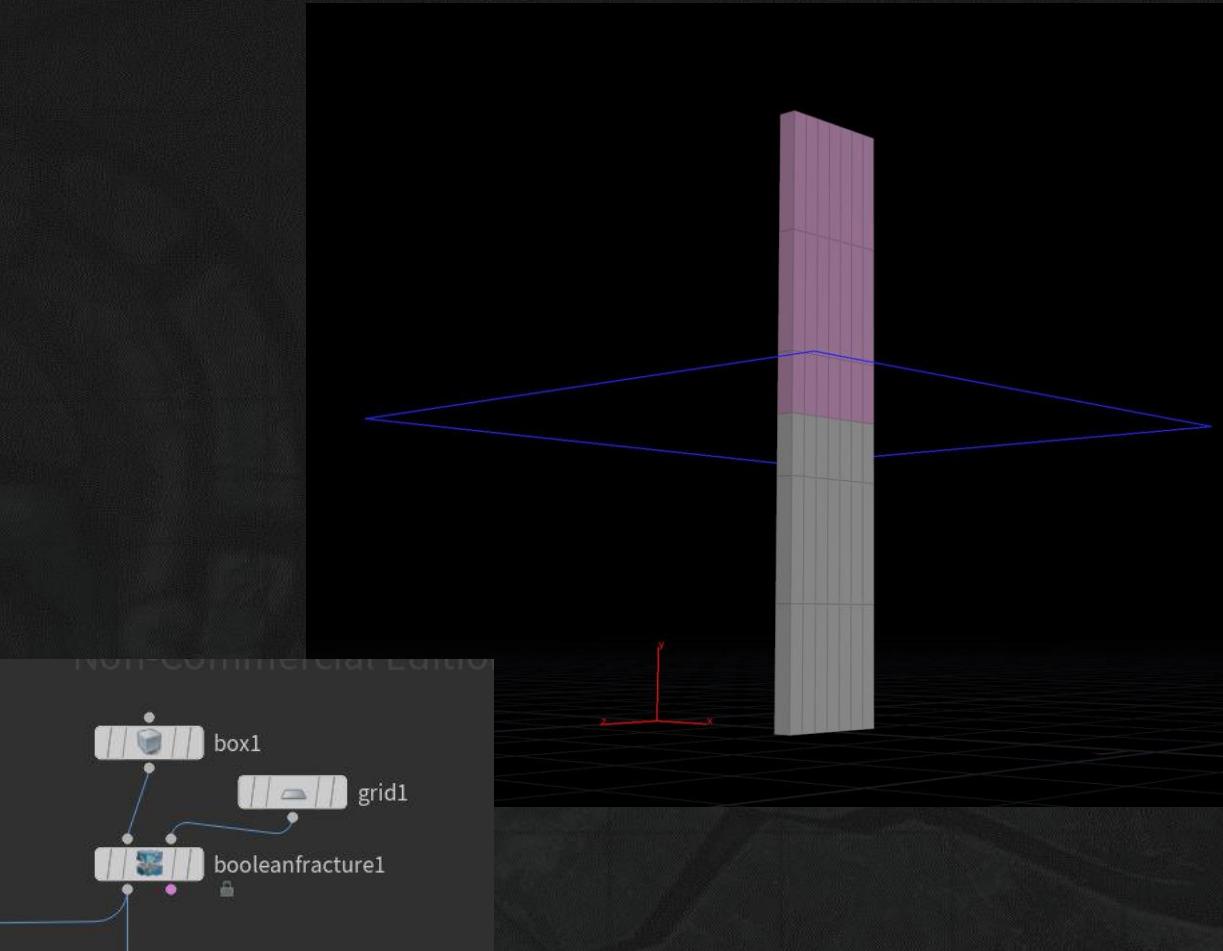
Step 2- Cut the plank

Drop down a ‘Boolean fracture’ node and a ‘Grid’ node.

Position the grid as in the picture.

To see a color representation of the cut, drop a ‘color’ node, set class to Primitive and ColorType to RandomFromAttribute

Type ‘name’ in the attribute field.



Step 3 – Select and Noise inner points

Drop down a Group node.

Uncheck Base Group ‘Enable’

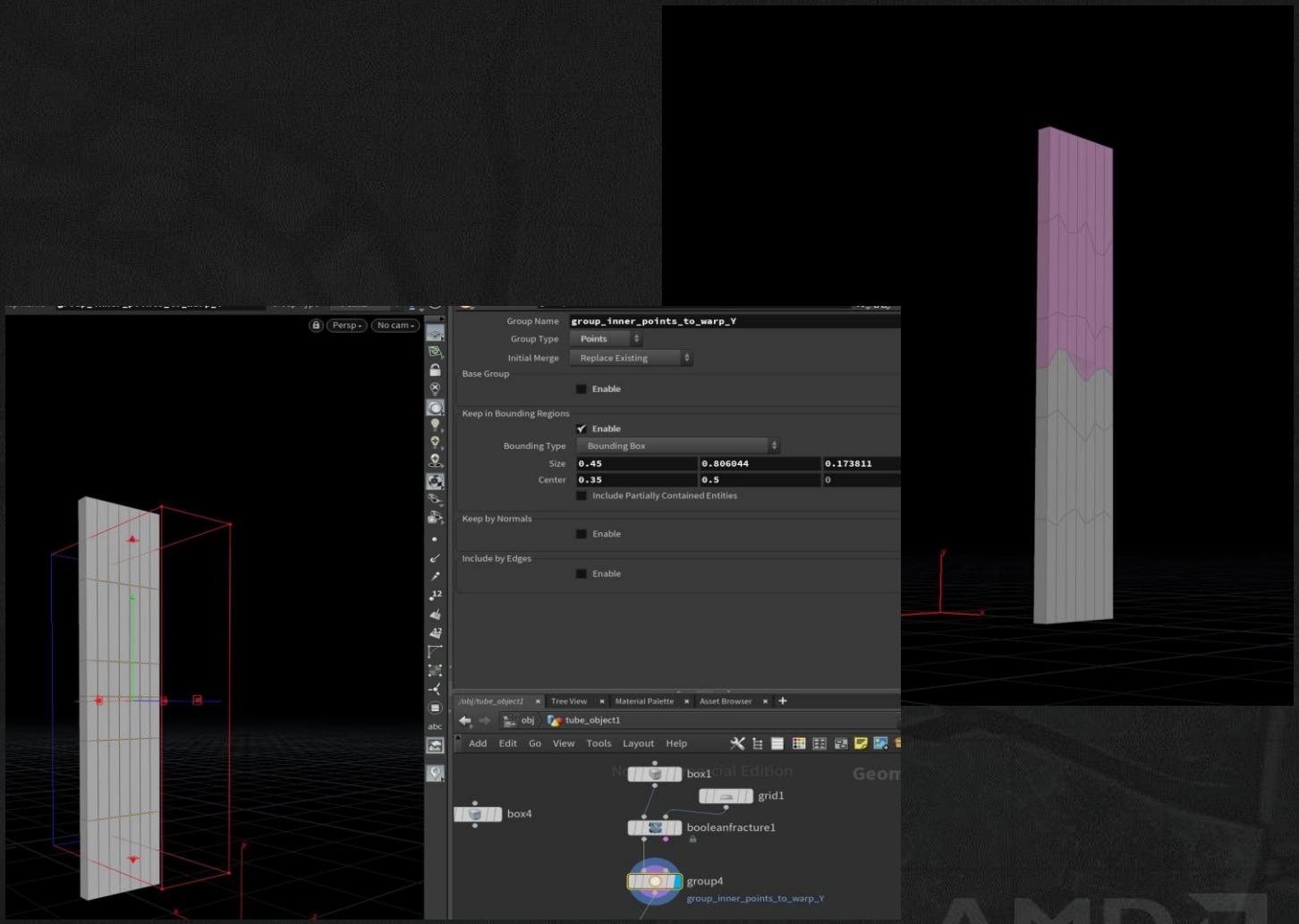
Check ‘Keep in Bounding Regions’

Position the bounding box as in the picture

Drop down a ‘pointVOP’ and add Group name.

A pointVOP can manipulate point attributes in many ways – and even create new attributes.

We'll add noise to give the geo a more ‘wooden’ and ragged edge to the cut.



Step 4- Inside the pointVOP

Double click the pointVOP to jump inside.

We grab 'Position'.

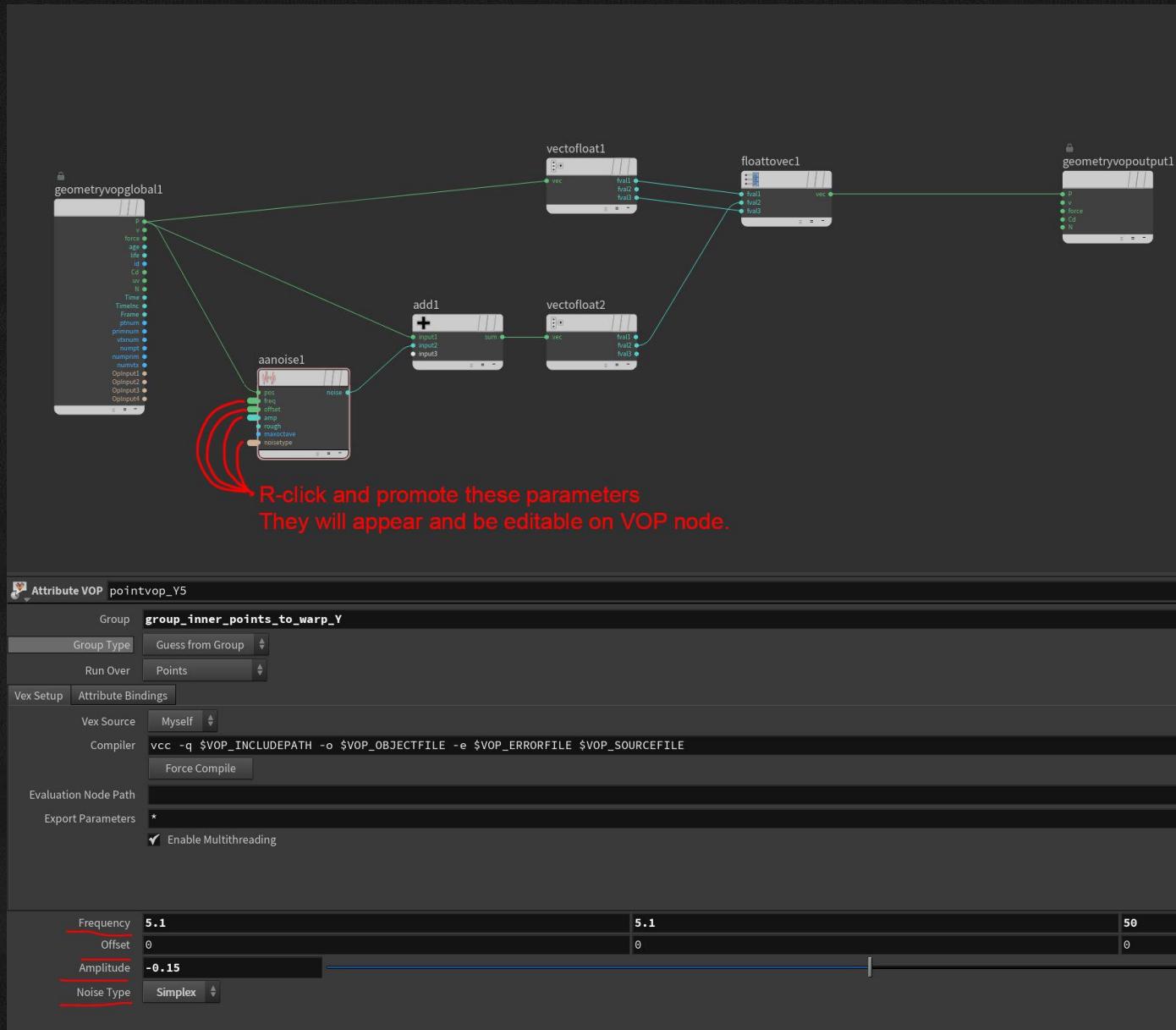
Add noise to Position

Split Position into X,Y,Z

Leave X and Z unaffected

Combine X and Z with new Y

Pass new values back out to Position



Step 5 – Circle of planks

Drop a ‘transform’ node.

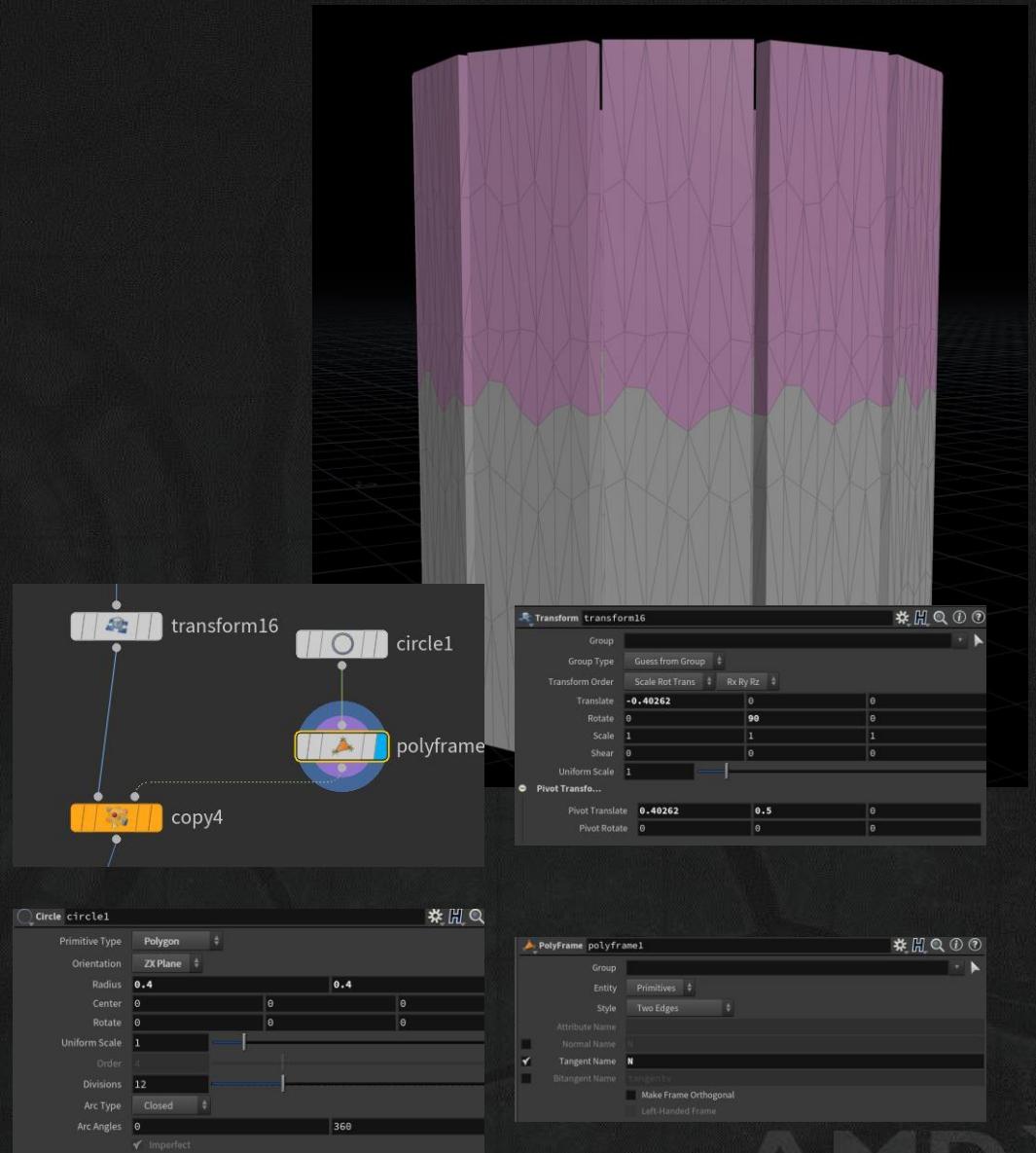
Drop a ‘copy stamp’ node.

Drop a ‘circle’ node –
polygon, ZX plane

Drop a ‘polyframe’ node to
adjust normal and effect
object orientations.

Nice!

But wait.....all the pieces of
wood have identical
breaks.... ☹



Step 6 – Add variables

Copynode parameters need adjusting.

Add two variables –

- noiseoffset (guess what this does?!)
- cutoffoffset (guess what this does?!)
 - Fit01 expression is awesome!



Maybe show how to expose sliders for min/max?

Step 7 – control cutter

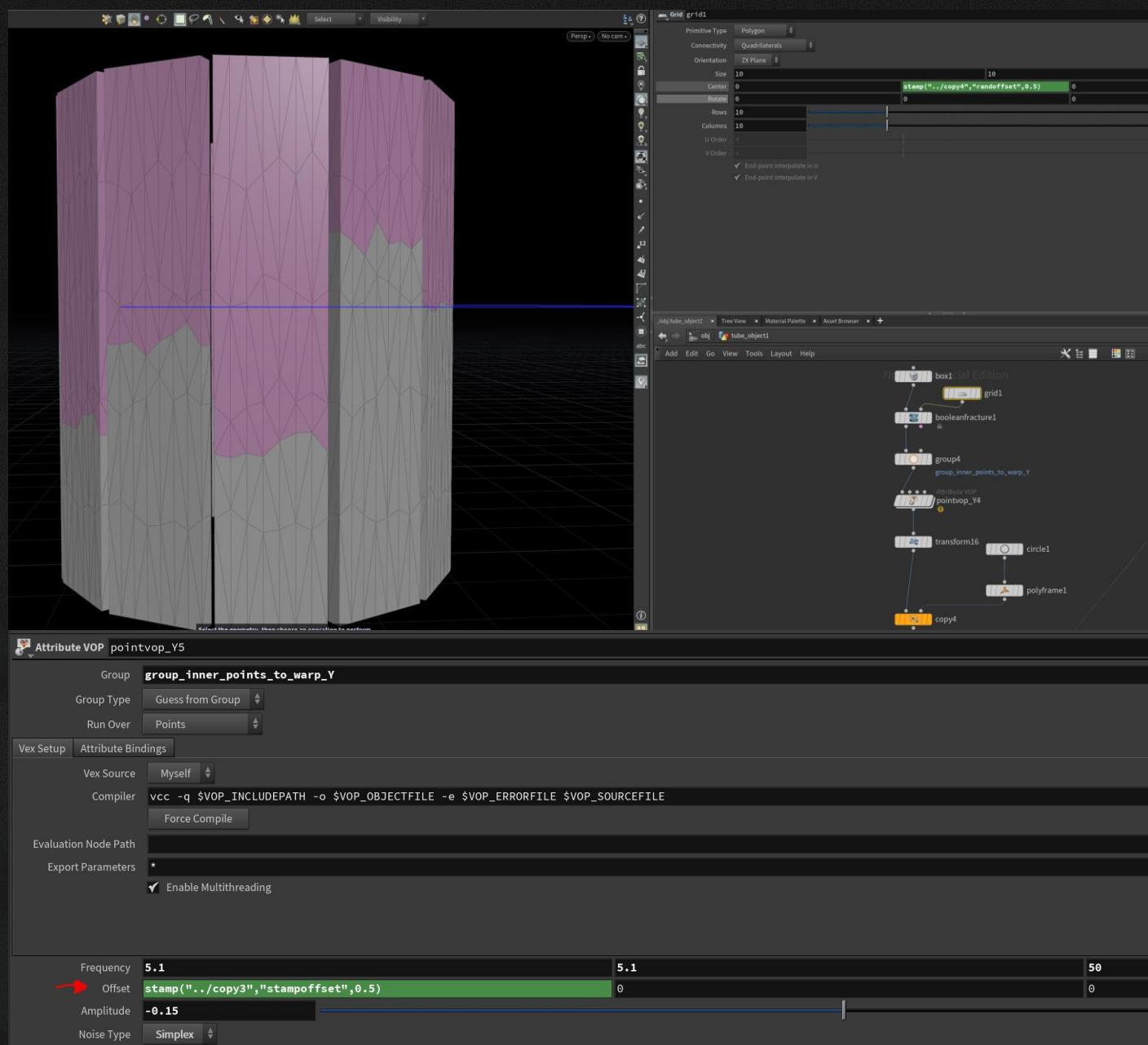
Go back up the network –
Ask cutter grid to reference
cutoff offset values for Y
position...

....and ask pointVOP to
reference noiseoffset

Different values per copy!

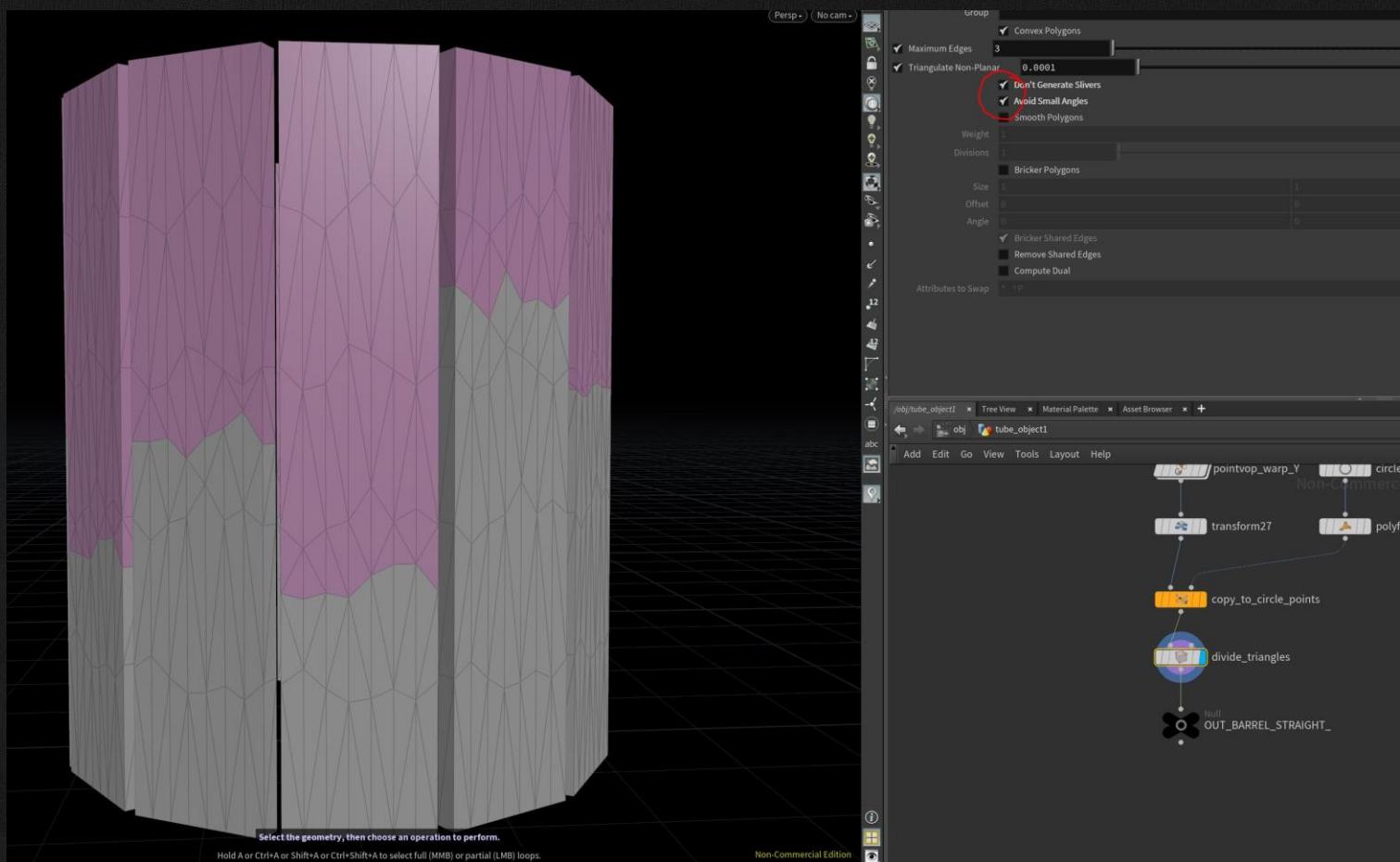
Procedural

Awesomeness!



Step 8 – Divide

Triangulate.
Fixes many cut issues.
Exposes any geometry
issues.

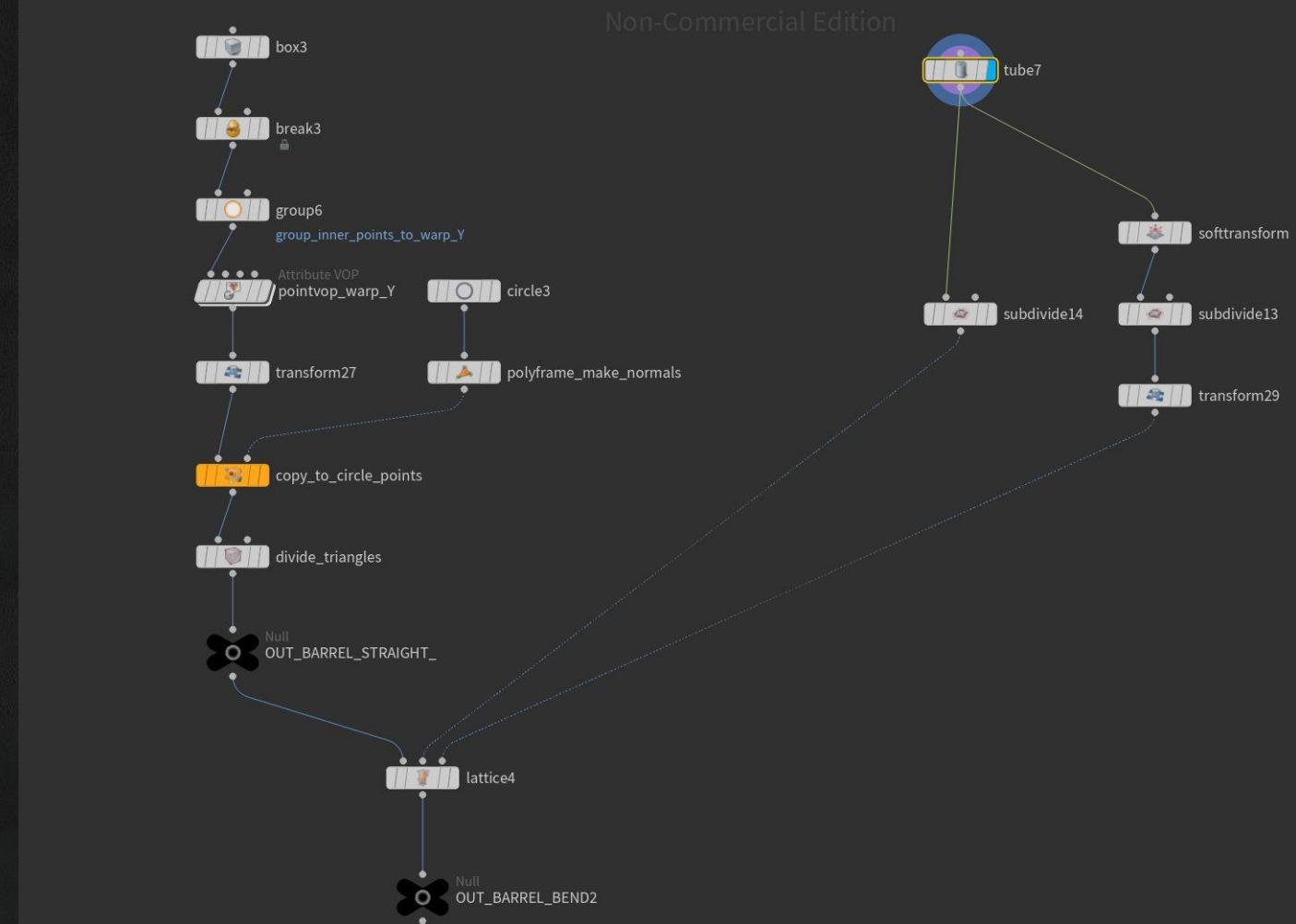


Step 9 - Lattice Deformation

Making the barrel bulge.

Overview of network.

Non-Commercial Edition



Step 10 – Lattice Deformer

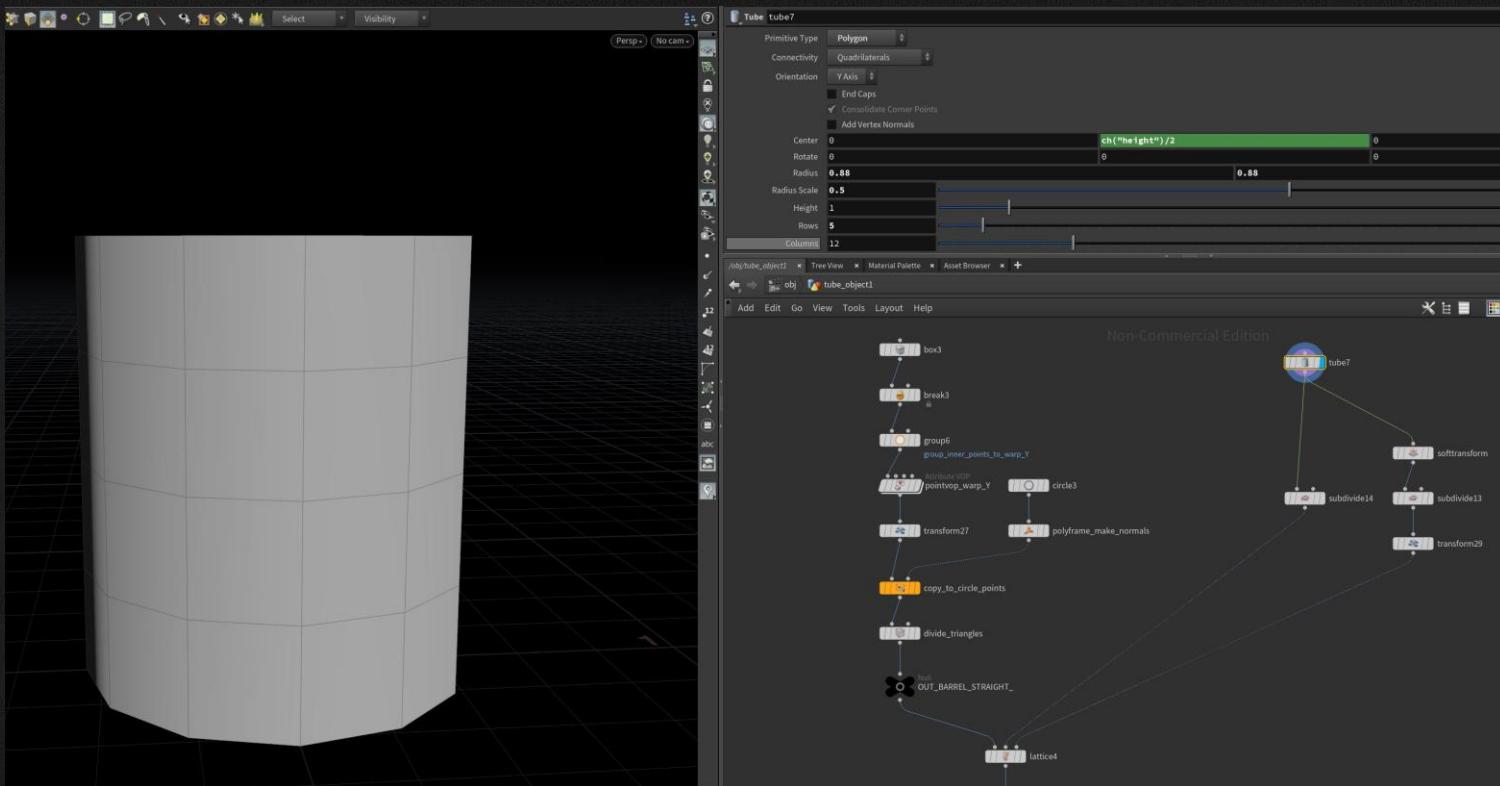
Use simple geo to deform
more complex geo

Easy to control.

Drop down a tube

Copy settings

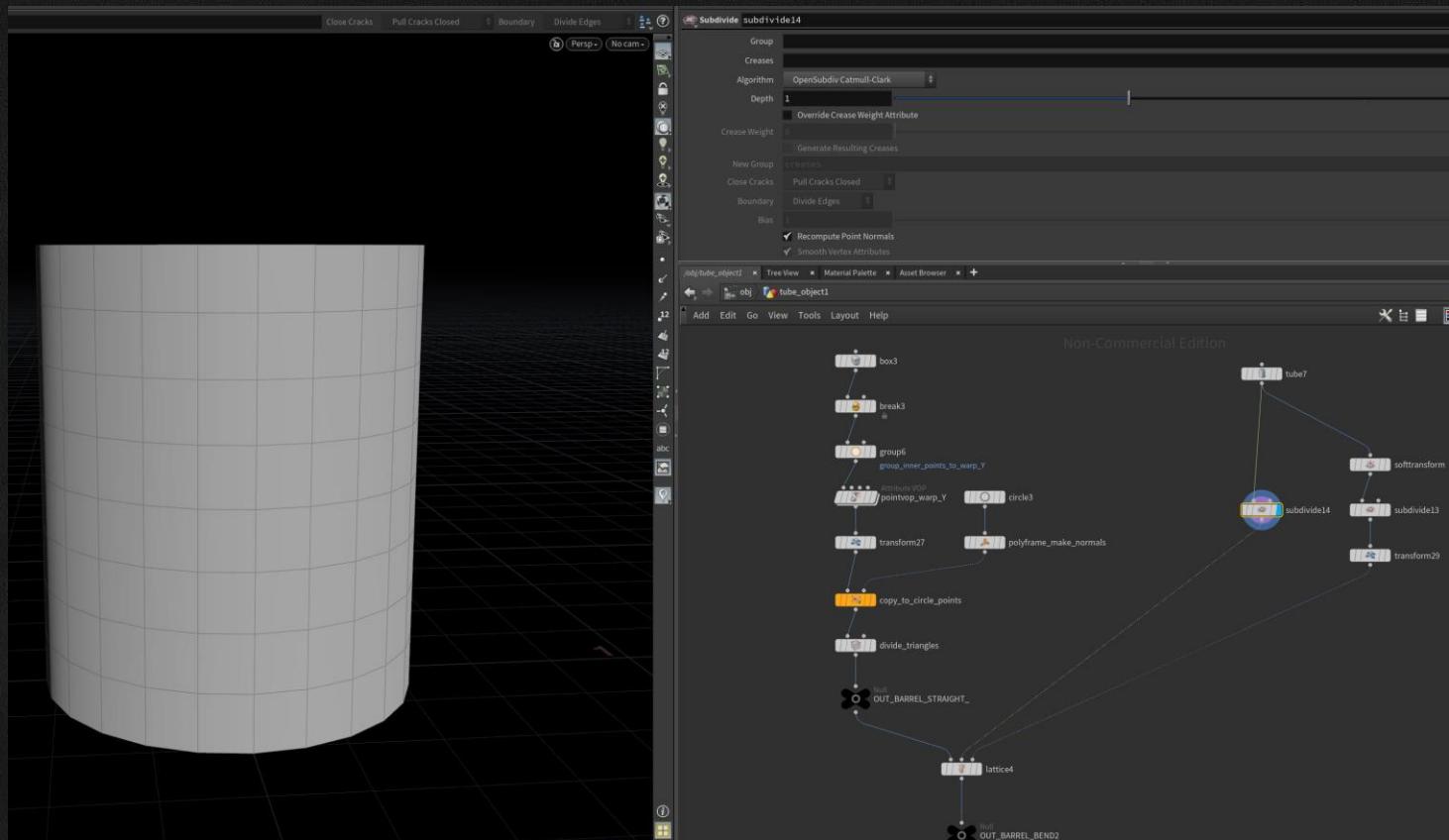
Expression in Center to
always place tube on
'ground'



Step 11- Rest Geo

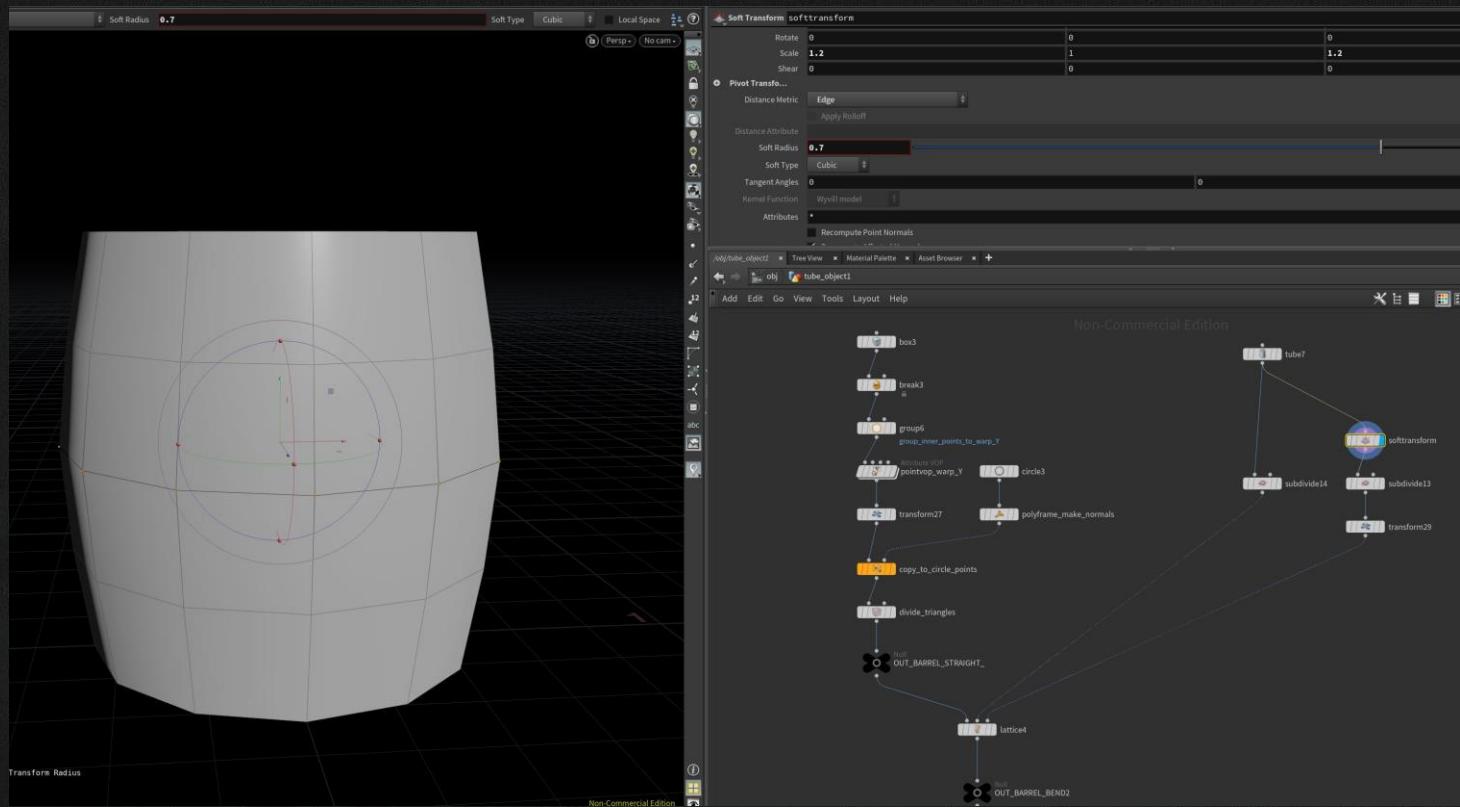
Branch off and....
...subdivide rest geo

Little note on
proceduralness.....and
branching/merging/non-
destructive
networks.....attTransfer
example....



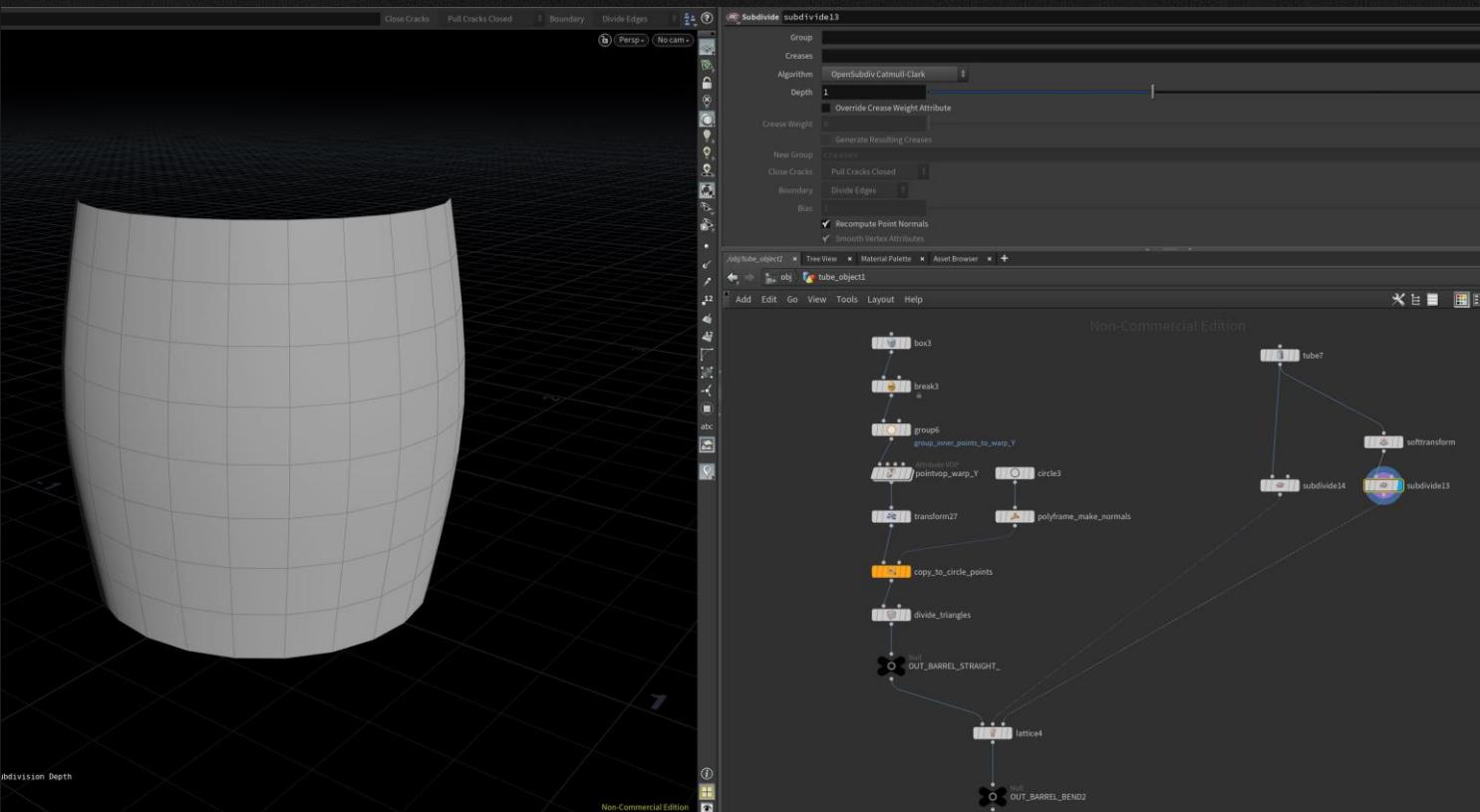
Step 12 – Deformed geo

Select middle ring of points
Use a soft transform
Scale up the points
Modify falloff



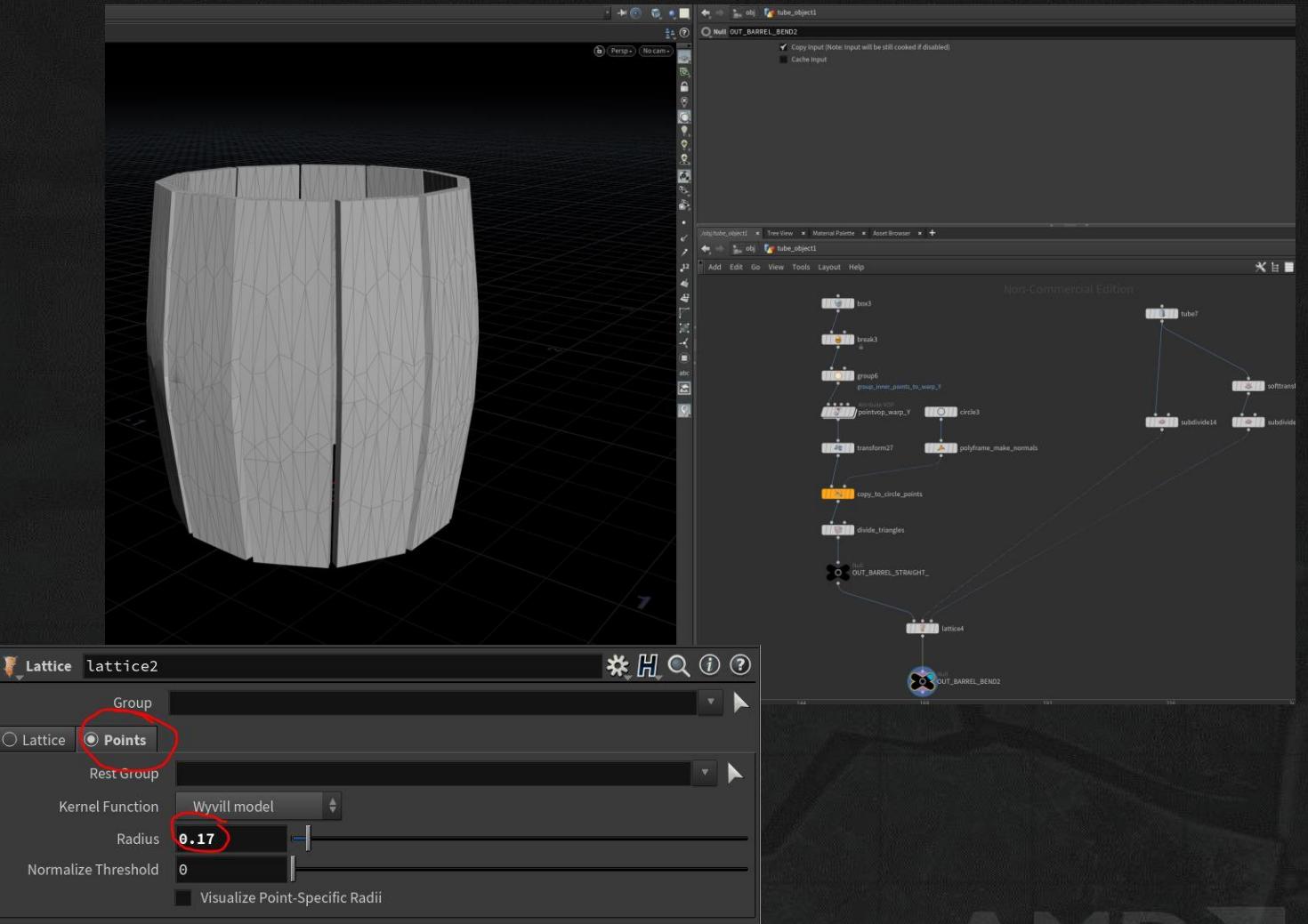
Step 13 – Match Geo

Add a subdivide to the deformed geo to match the point count of the rest geo.



Step 14 – Sides complete

Drop down a ‘Lattice Deformer’ and connect 3 inputs.



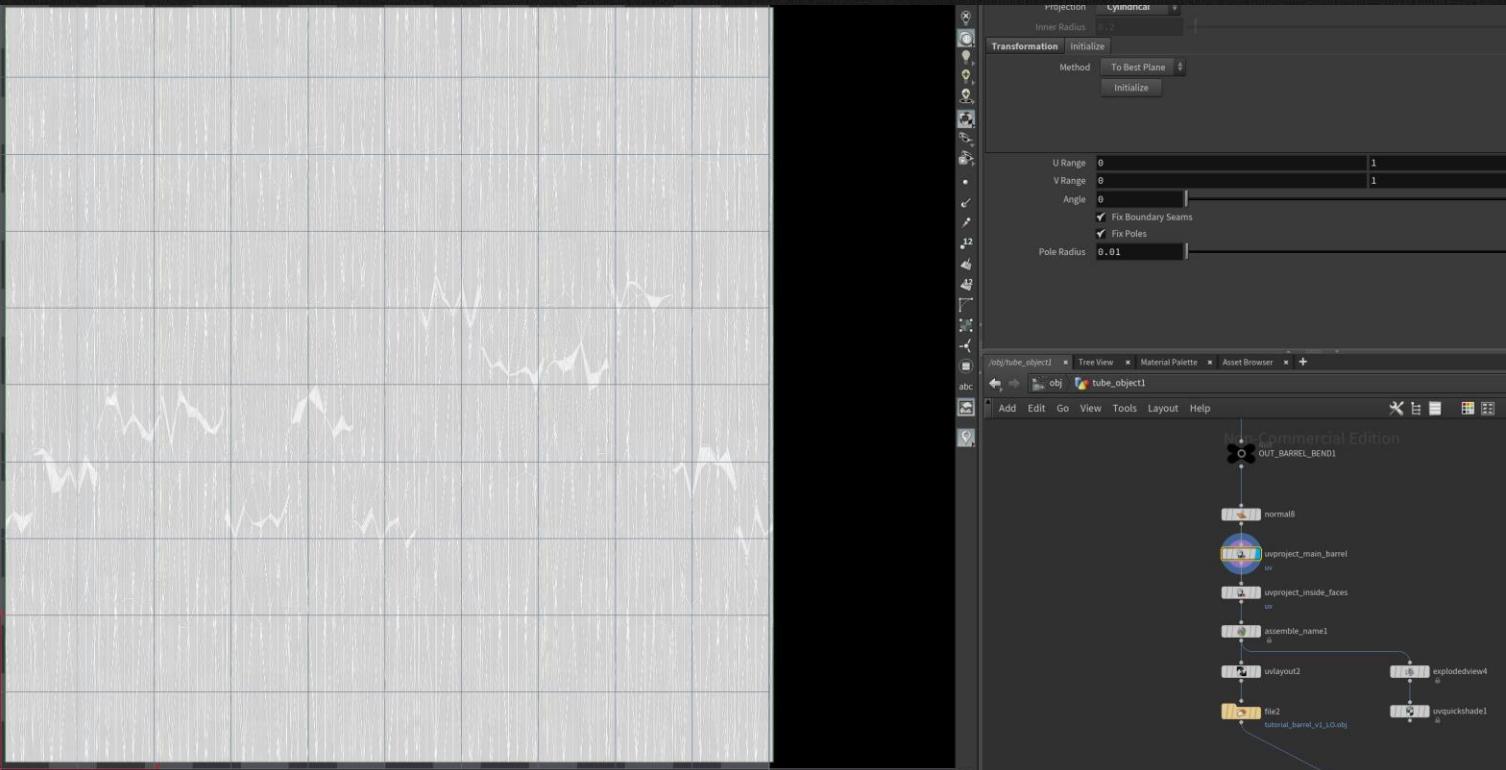
Step 15 – Rough UVs part1

Drop down a UV project
node

Cylindrical
Initialize

Make manipulator active

Look at UV viewport



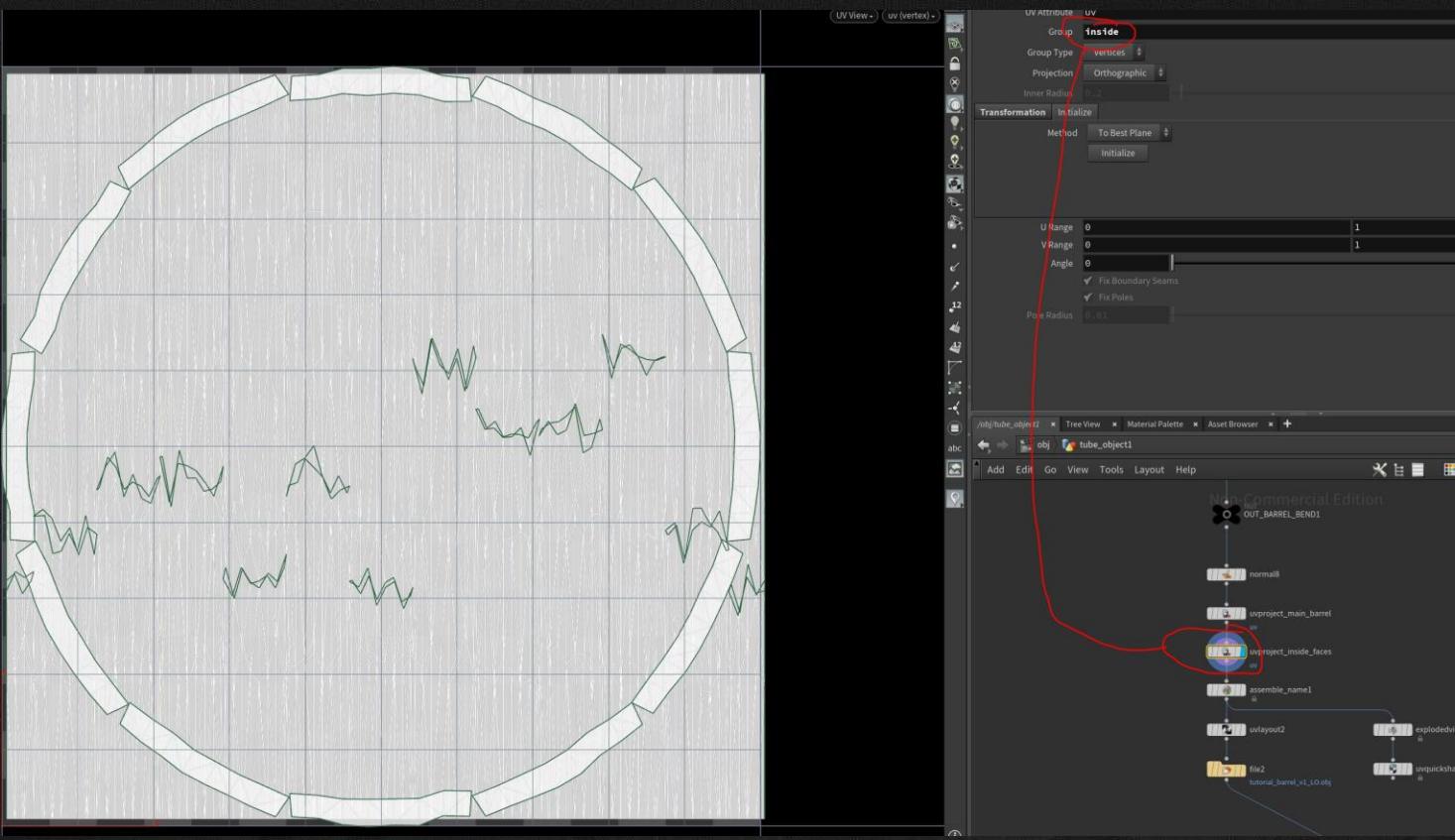
Step 16 – Rough Uvs part2

Drop down another
Uvproject

Group name – Inside
Initialize

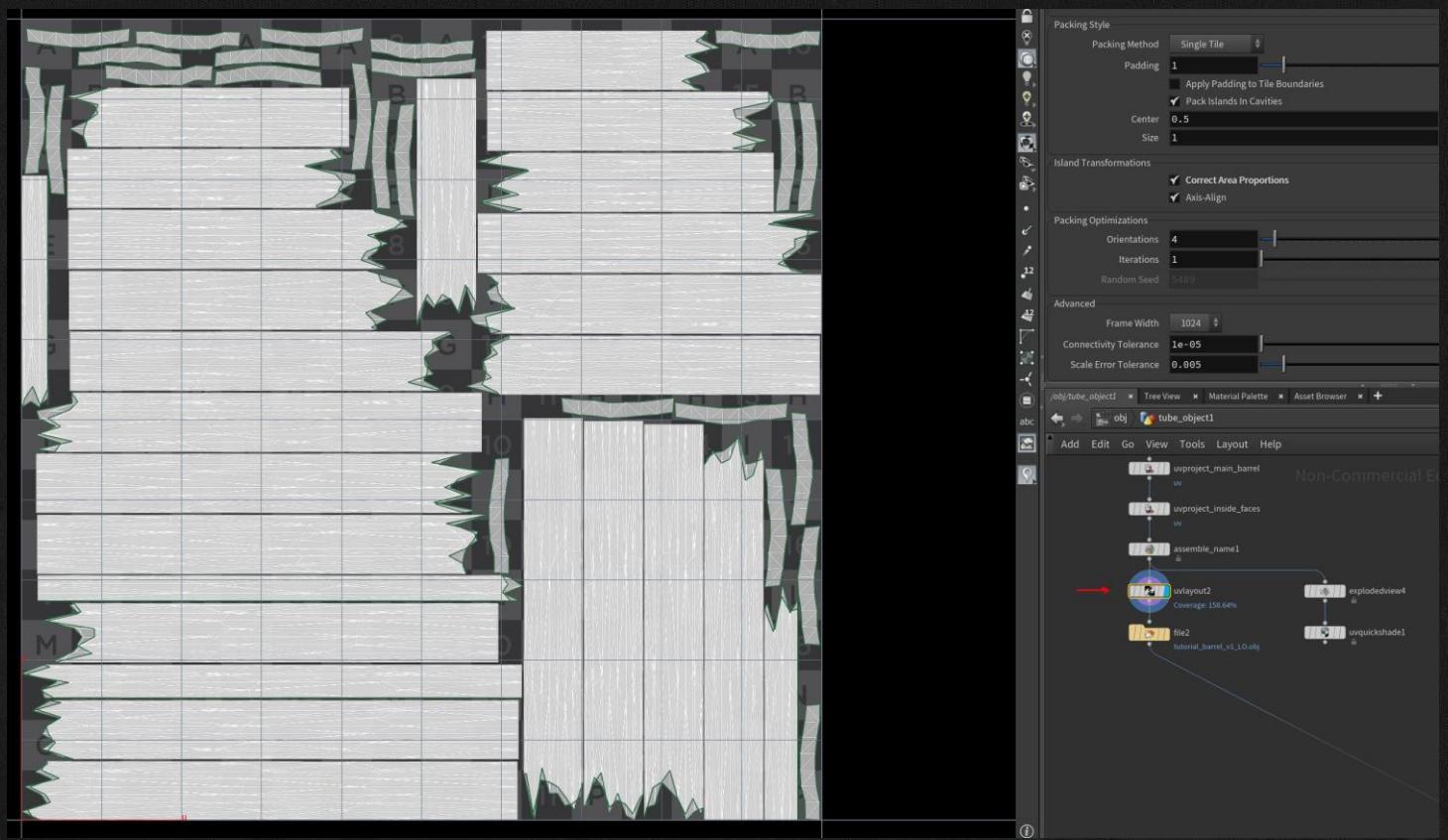
Make manipulator active
Look at UV viewport

But wait.....aren't all those
UVs overlapping?.....why
yes they are!....



Step 17 – Layout UVs

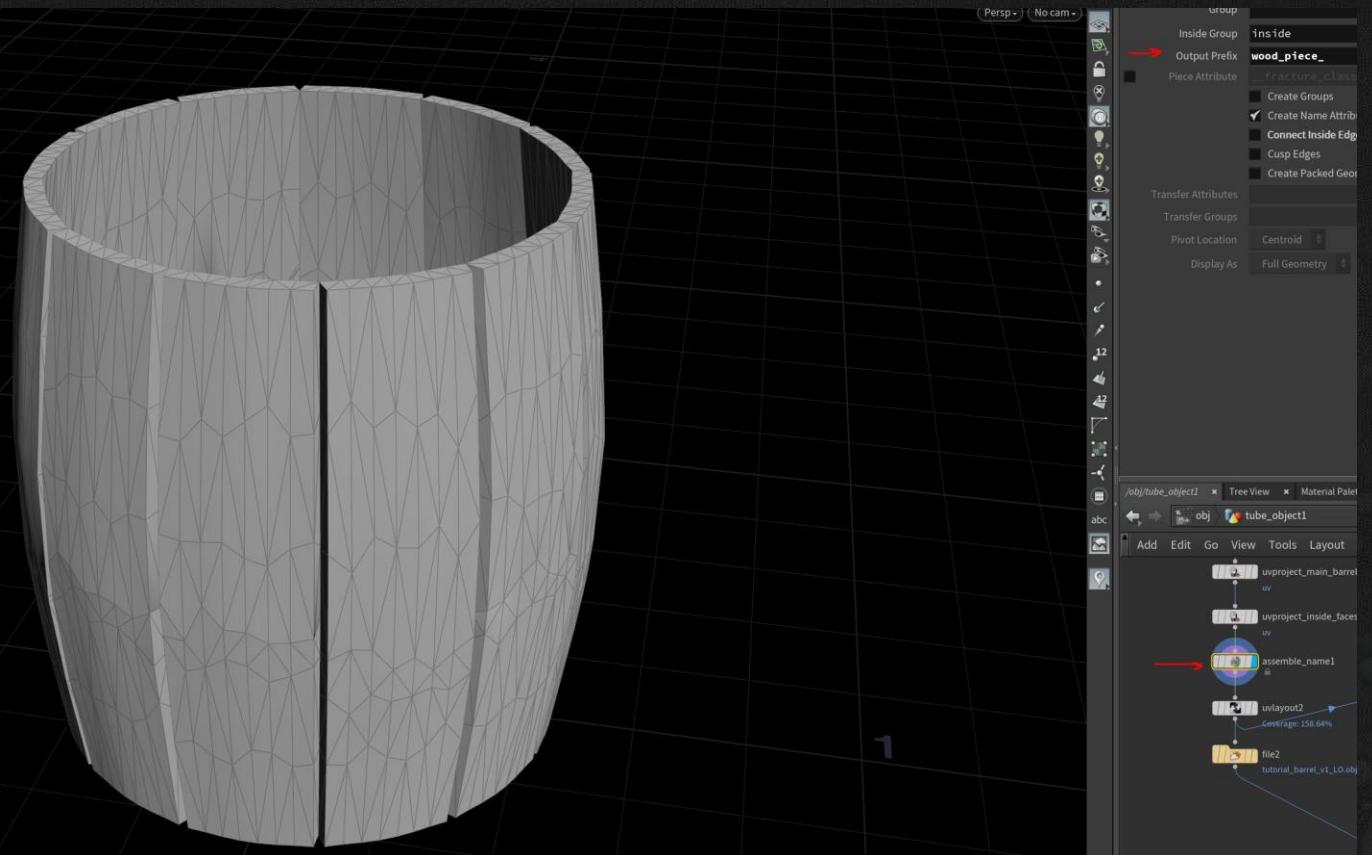
Drop down a UVlayout
Boom!



Step 18 – name parts

Drop down an assemble

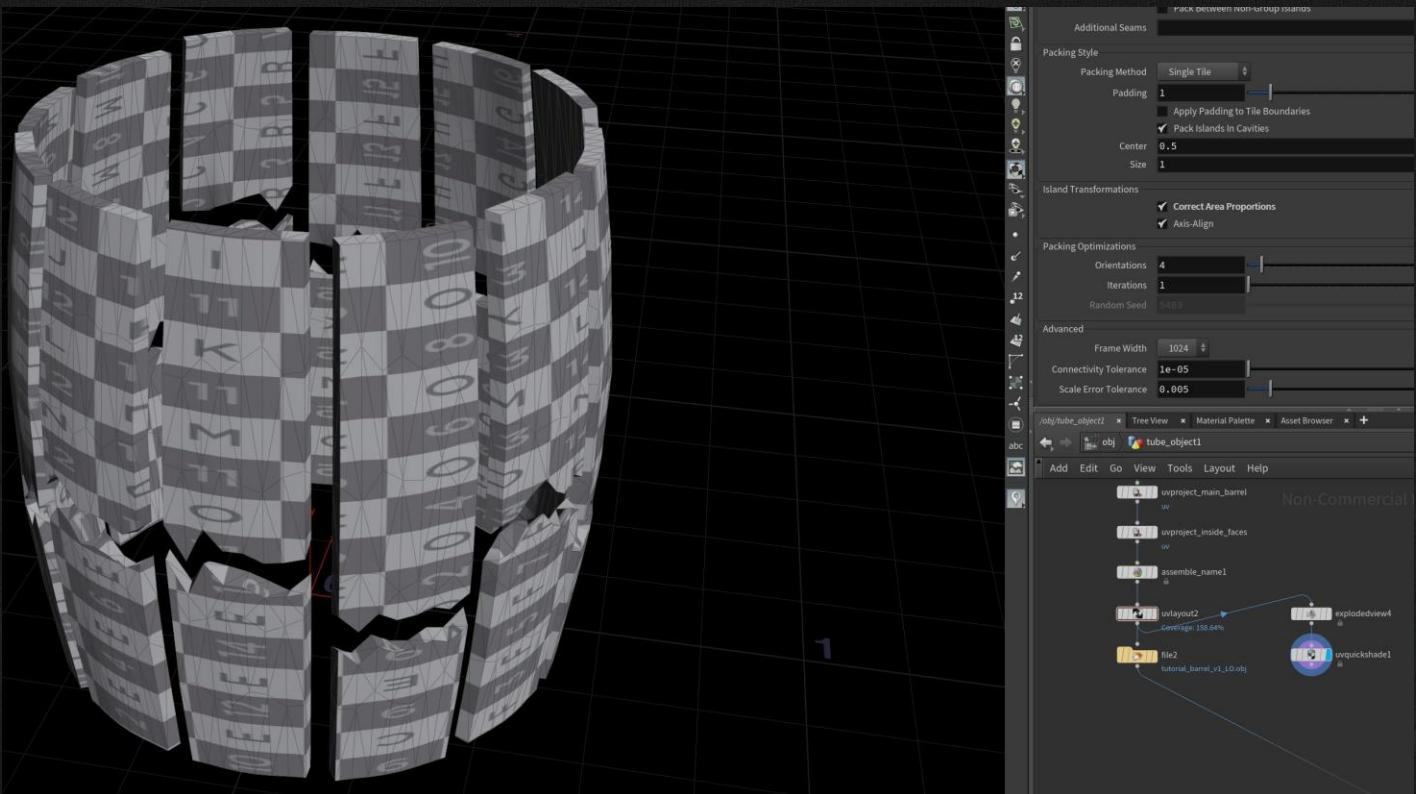
Give naming convention to each part.



Step 19 – test UVs and parts

Drop down an
'ExplodedView' node and a
'UVQuickshade' node

Viewport should show Uvs
and push each individual
part away from the center.



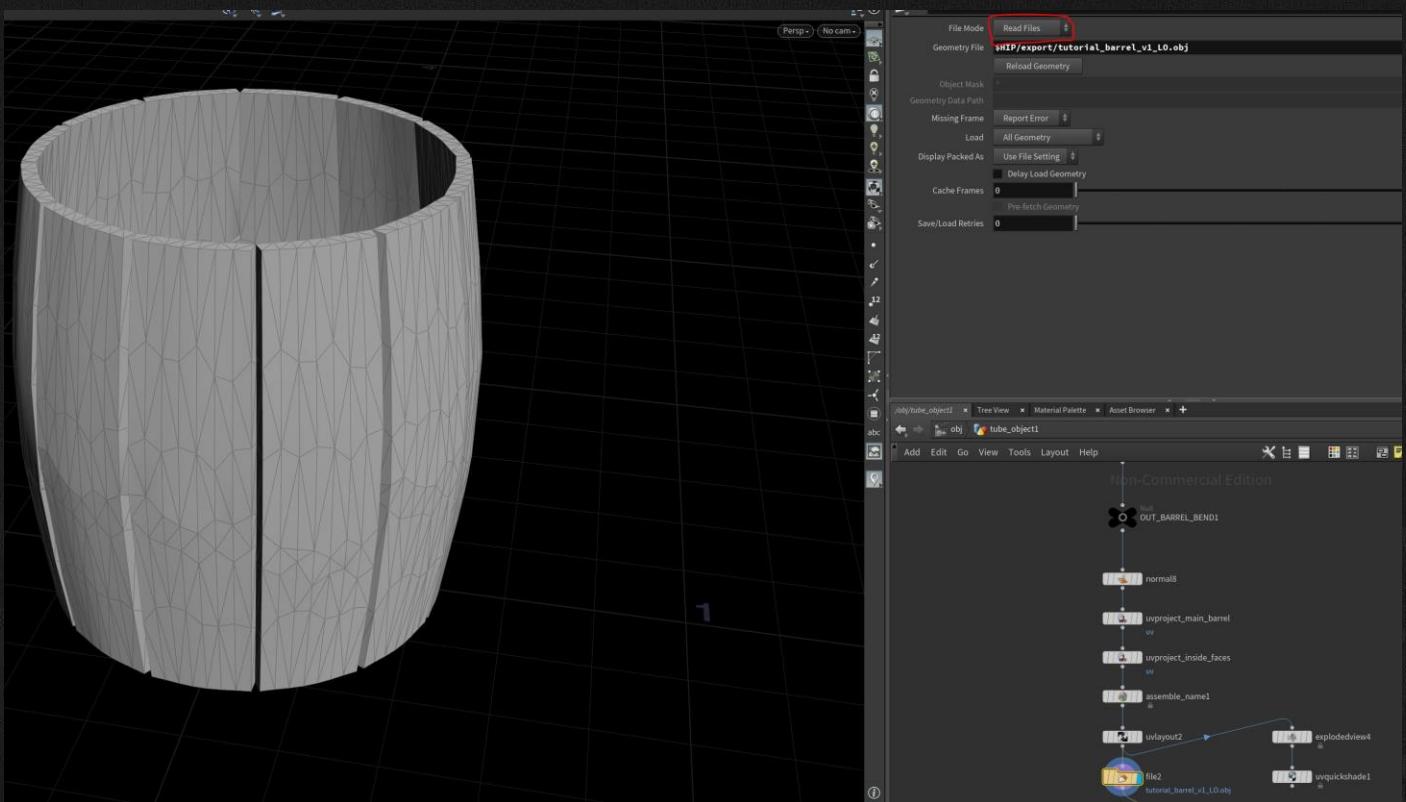
AMD

Step 20 – SAVE PROGRESS!

Drop down a file node.

Write out current progress.

We can ‘Read’ from here and disconnect from nodes above if necessary.

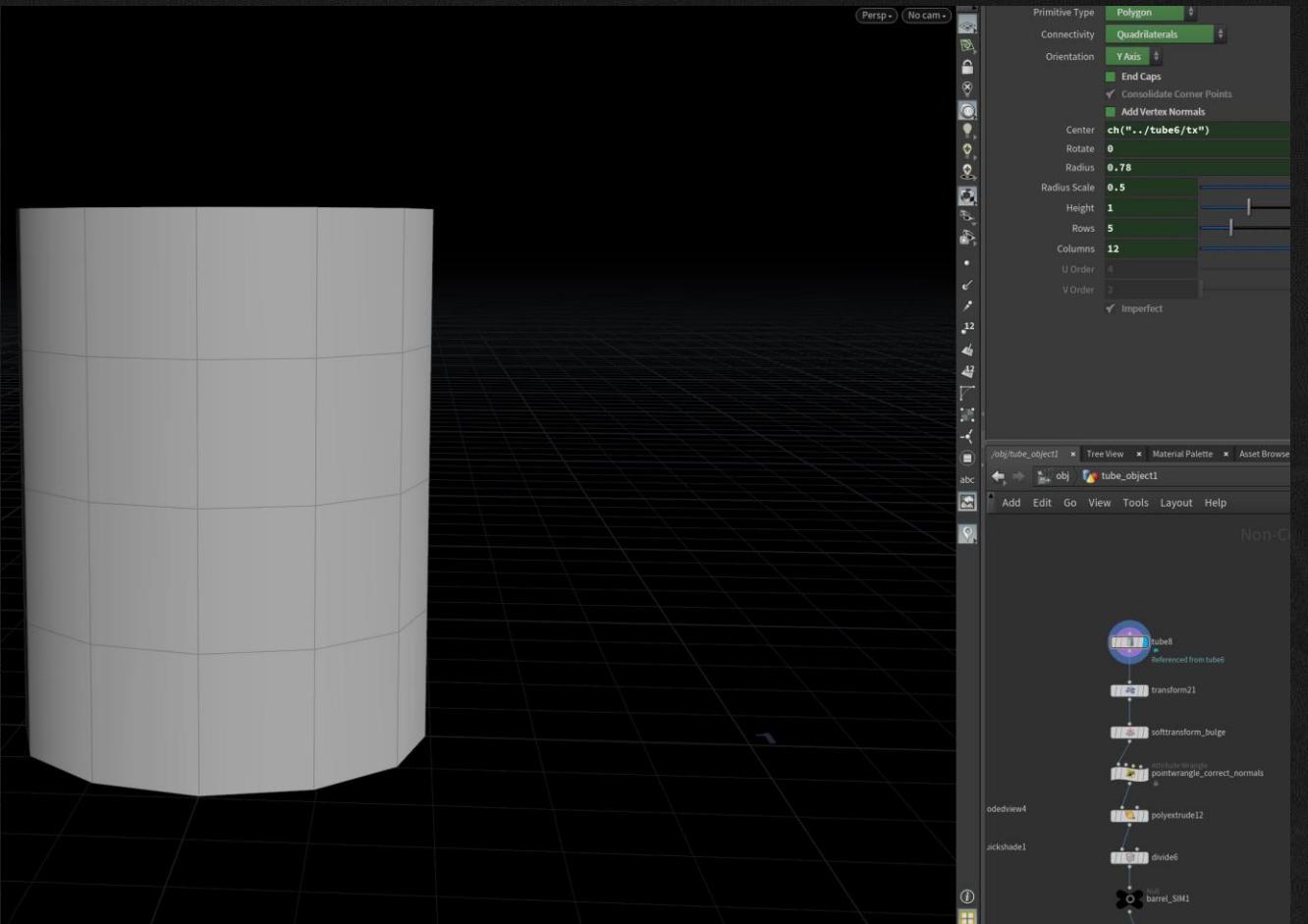


AMD

Step 21 – Barrel Body SIM MESH

Right Click(hold) previous ‘Tube’ – Actions – Create Reference Copy

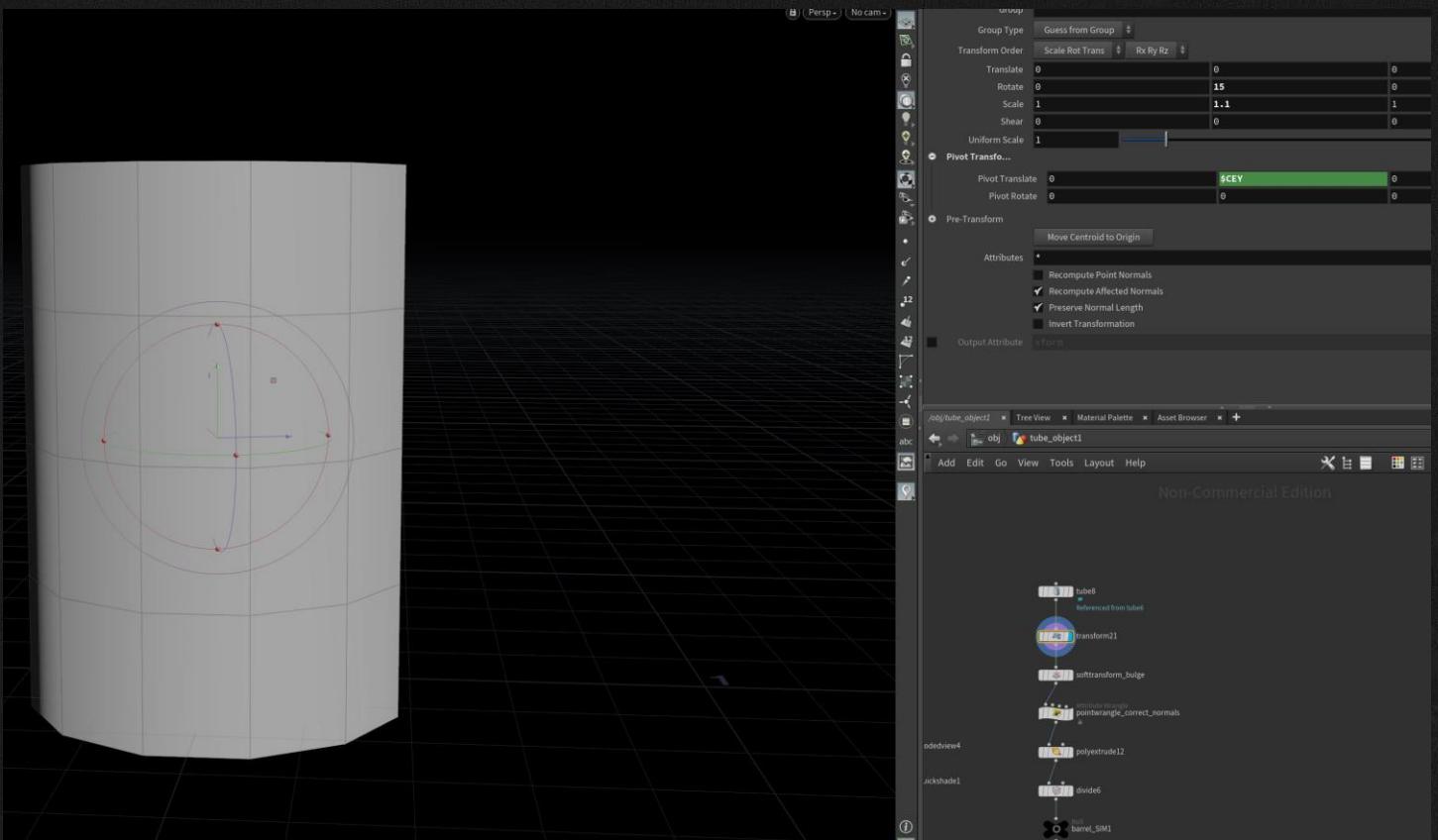
Linked to previous and inherits any changes.



Step 22 – adjust SIM geo

Drop down a ‘transform’ node.
Scale as in picture.

Note \$CEY in Pivots Y
channel.

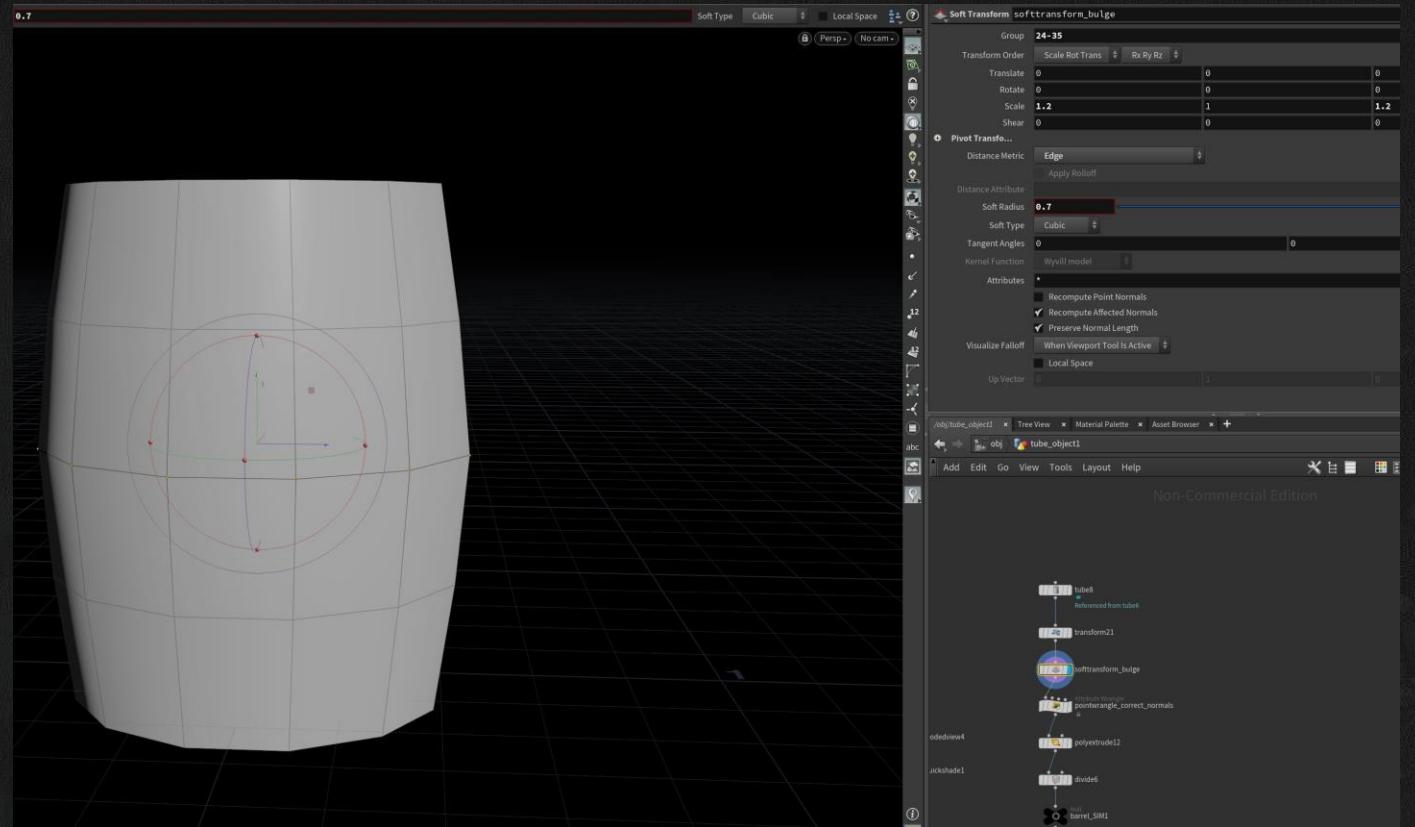


Step 23 - Bulge

Drop down a ‘softTransform’ node.

Select middle points.

Copy values from picture –
don’t forget Soft Radius.



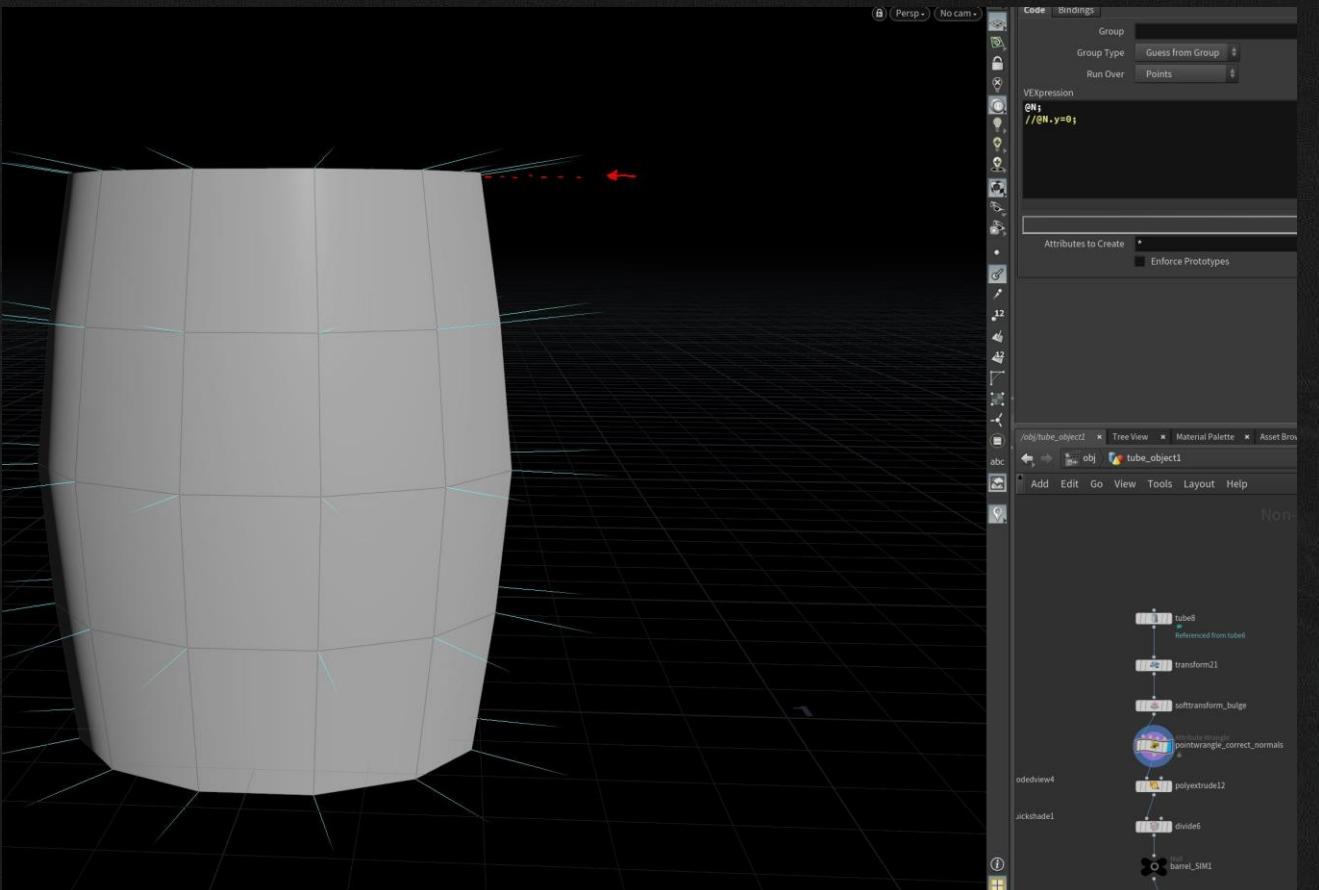
AMD

Step 24 – inspect normals

Drop down a ‘normal’ node.

Note view normal mode is active.

Normals are ok but we need to remove any Y values so that the normals only point out in a flat plane.



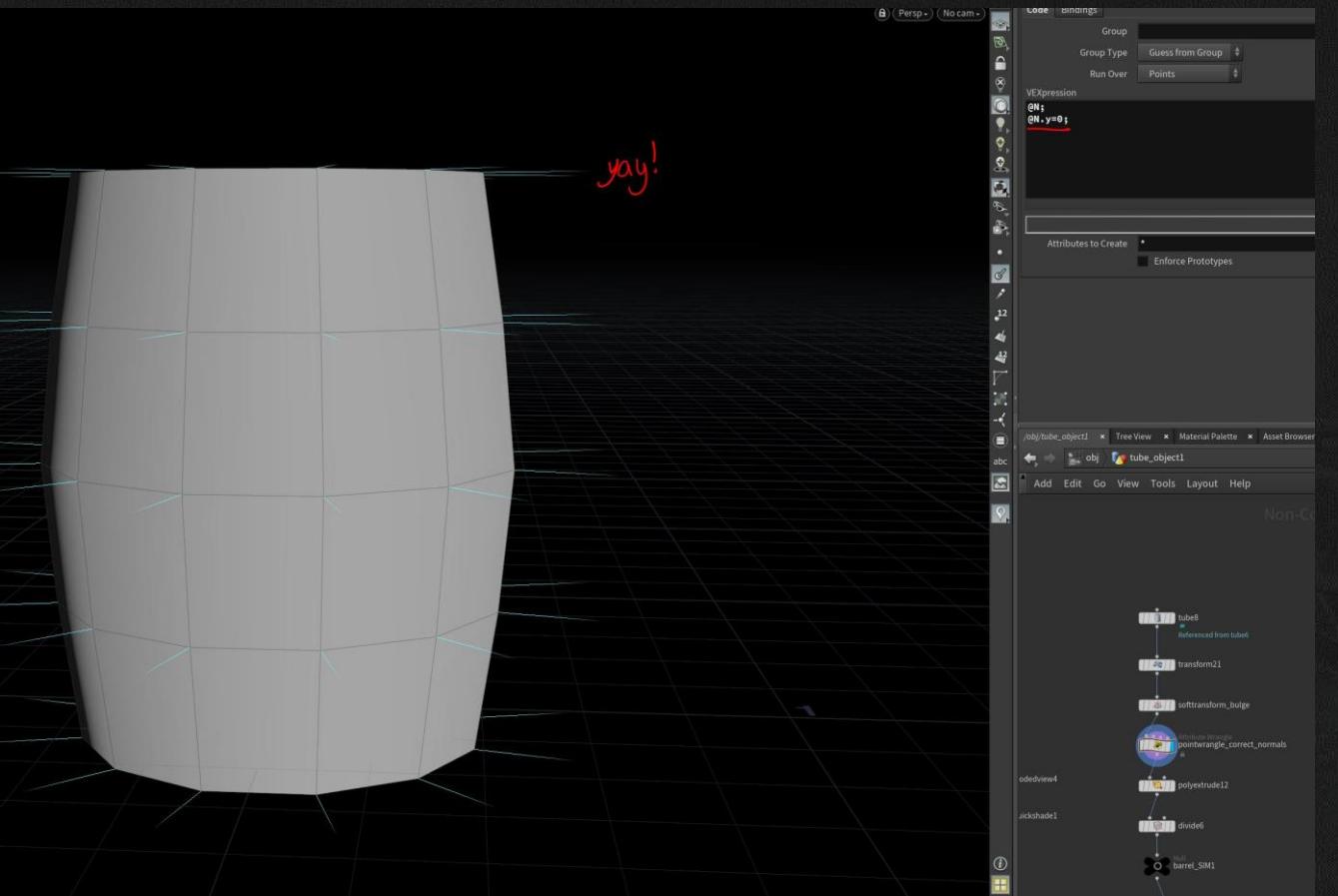
Step 25 – manipulate normals

Drop down a ‘pointWrangle’ node.

Write expression into wrangle.

$@N.y = 0;$

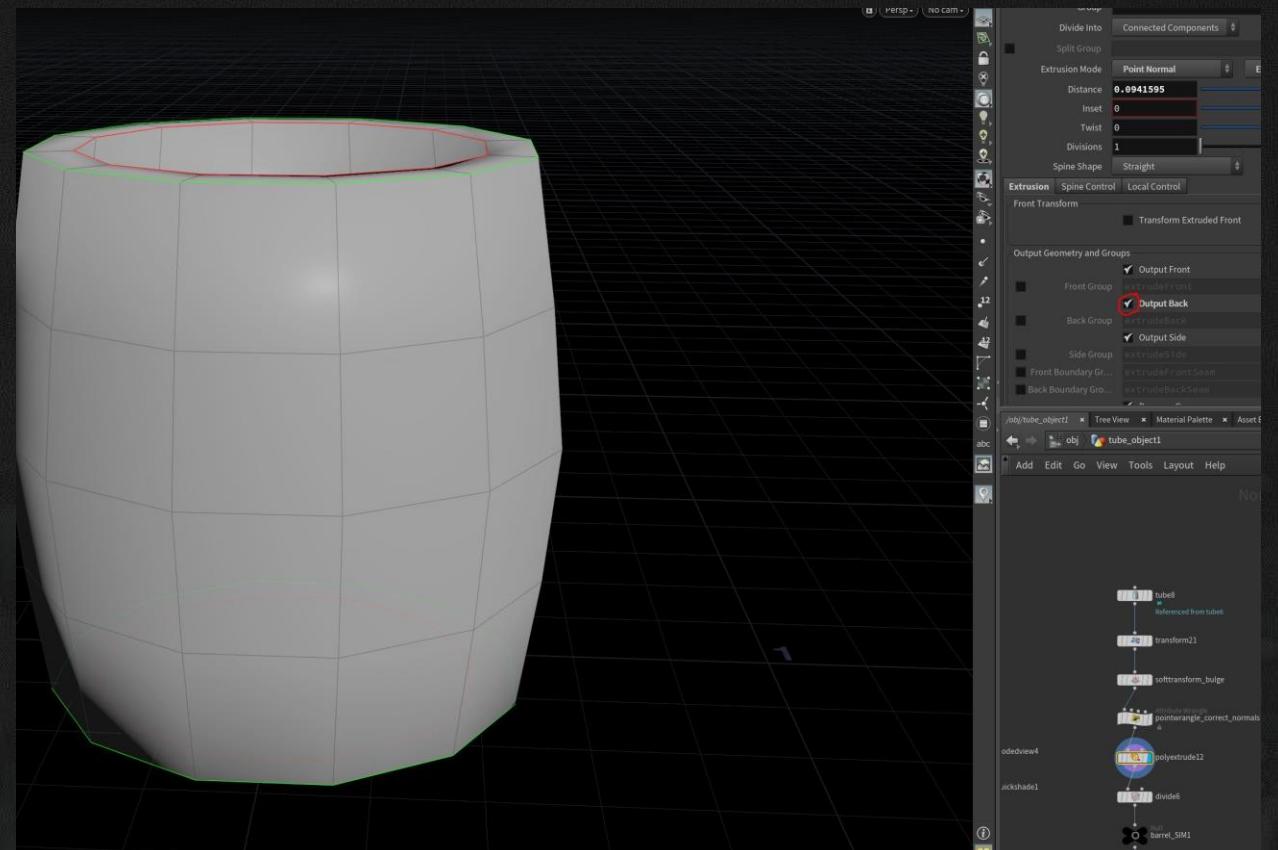
This only affects the Y component of the normal vector.....and sets it to 0....resulting in a ‘flattening’ of our normal.



Step 26 – extrude

Drop down a ‘PolyExtrude’ node.
Enter values as in picture.

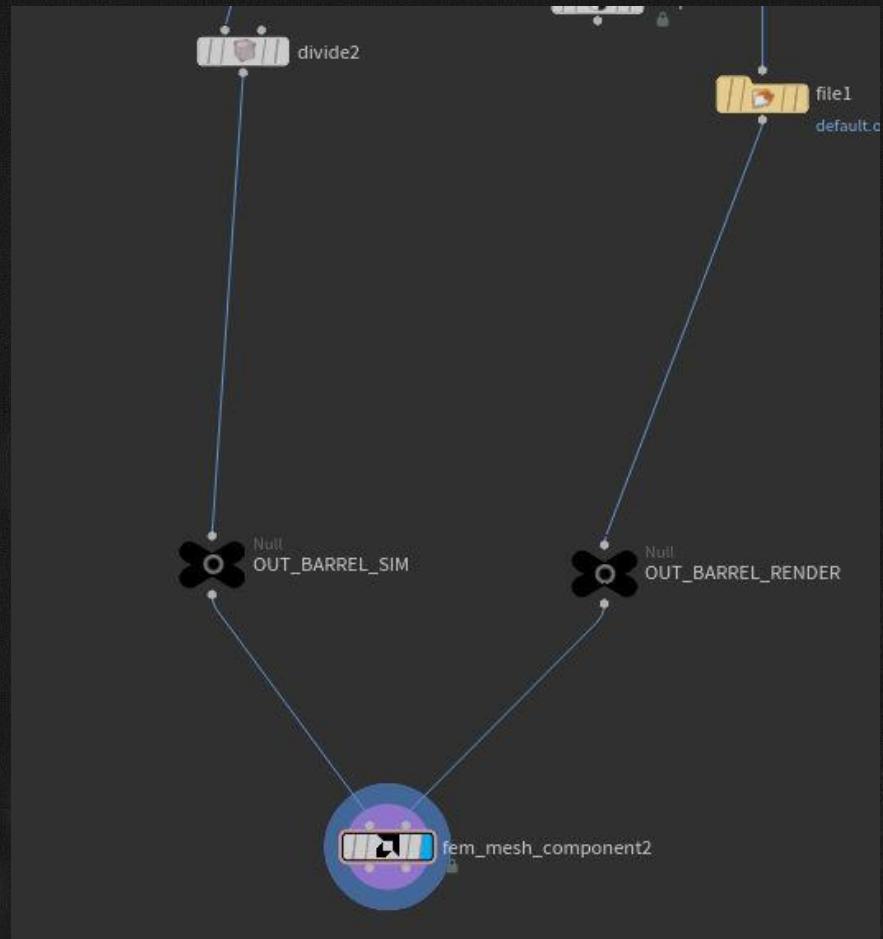
Note – output back.



Step 27 – NULLS are good

Add NULLS and name them
OUT_BARREL_SIM and
OUT_BARREL_RENDER.

Connect these to a FEM
mesh component as in the
picture.



Step 28 – non destructive edgeloop

Drop down an ‘divide’ node.

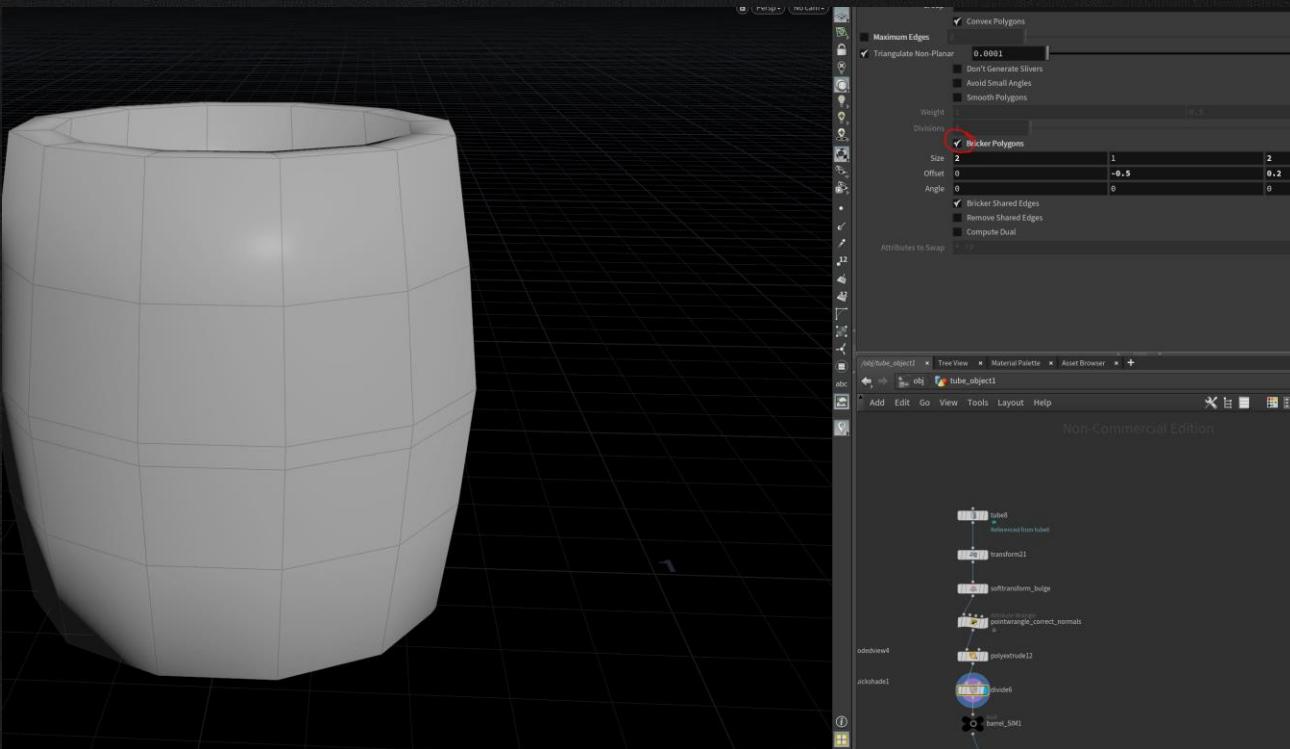
Enter values as in picture.

Can be used to add divisions
along x,y,z axis.

Large values can isolate x,y,
or z axis edgeloops.

Used here to make better
tetmesh for simulation.

Add NULLS and connect to a
FEM mesh component

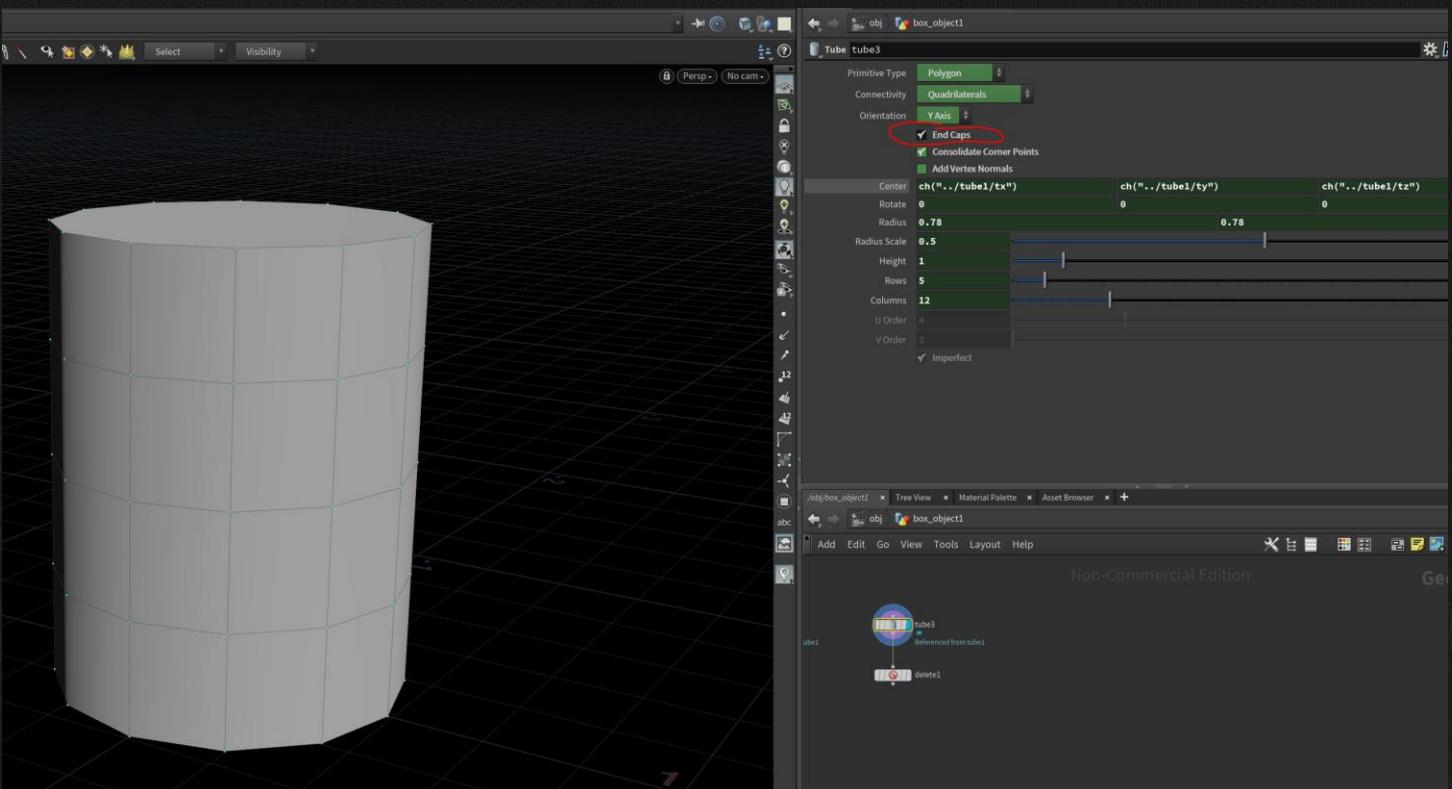


Step 29 – Barrel Top/Bottom

Drop down another reference copy of the ‘tube’.

CTRL+SHIFT click the ‘End Caps’ parameter and check the box.

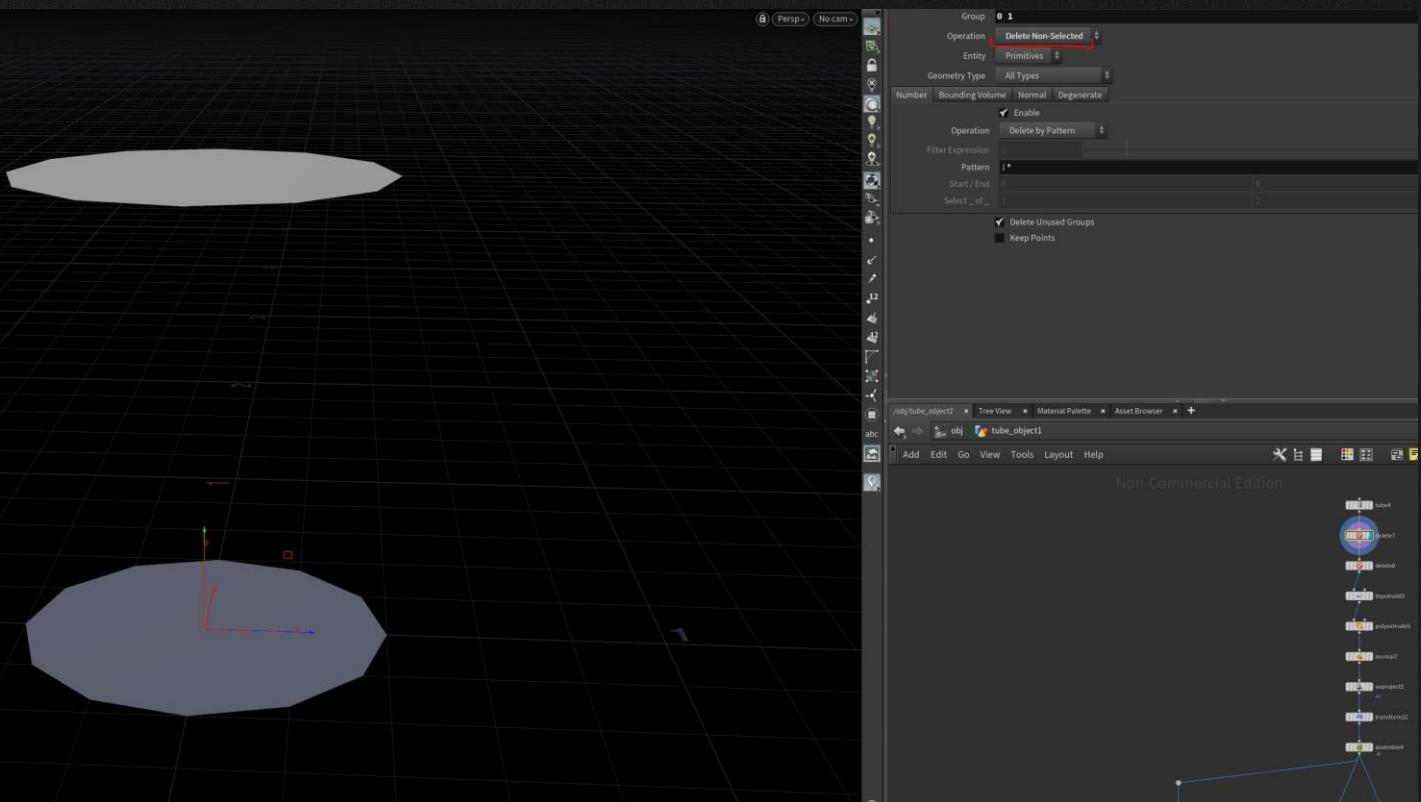
This still allows all other parameters to be referenced – but also allows unique adjustments.



Step 30 – Keep Top/Bottom

Drop down a ‘delete’ node.
Enter values as in picture.

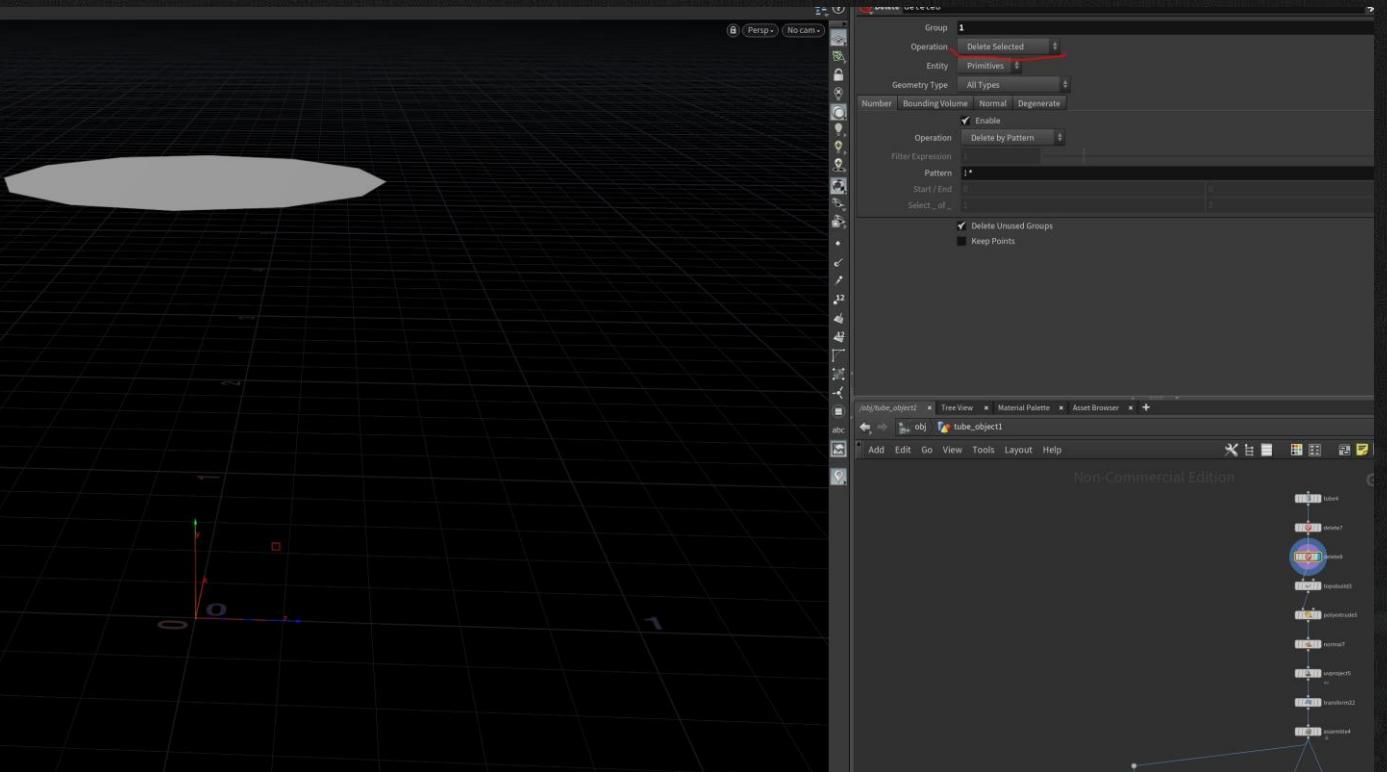
Note – mode can be switched to delete selected
OR delete everything but selected.



Step 31 – Keep Top only

Drop down another ‘delete’ node.
Enter values as in picture.

Note – mode can be switched to delete selected OR delete everything but selected.

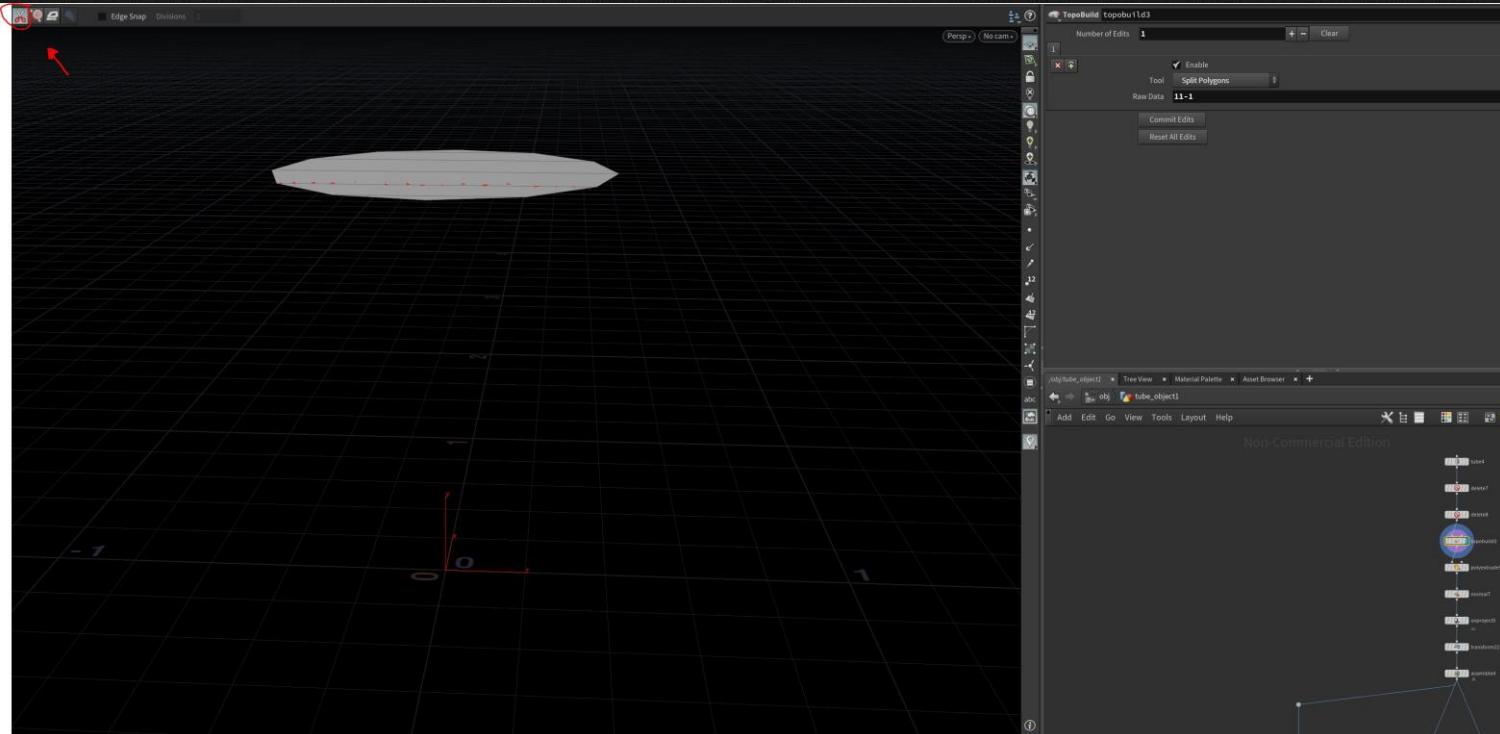


Step 32 – manual cuts

Drop down a ‘topobuild’ node.

Note ‘scissors’ mode.

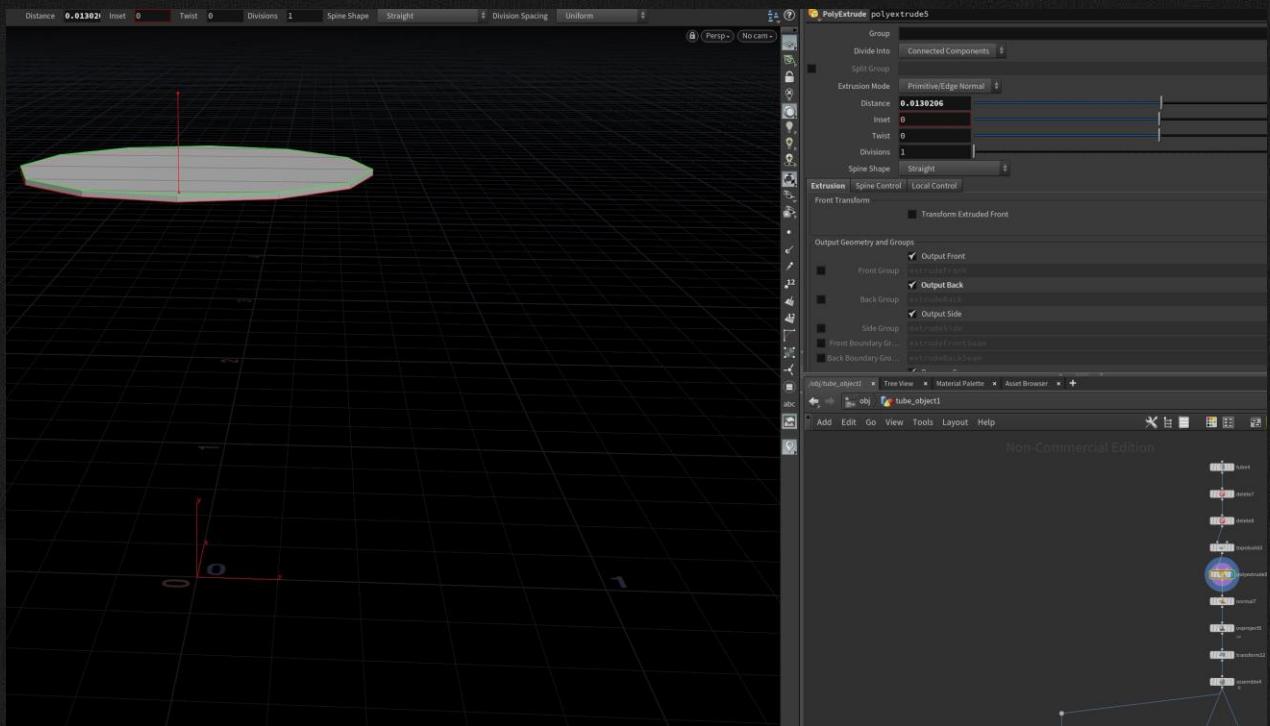
Make some cuts!



Step 33 – extrude top

Drop down a ‘PolyExtrude’ node.
Enter values as in picture.

Note – don’t forget ‘Output Back’



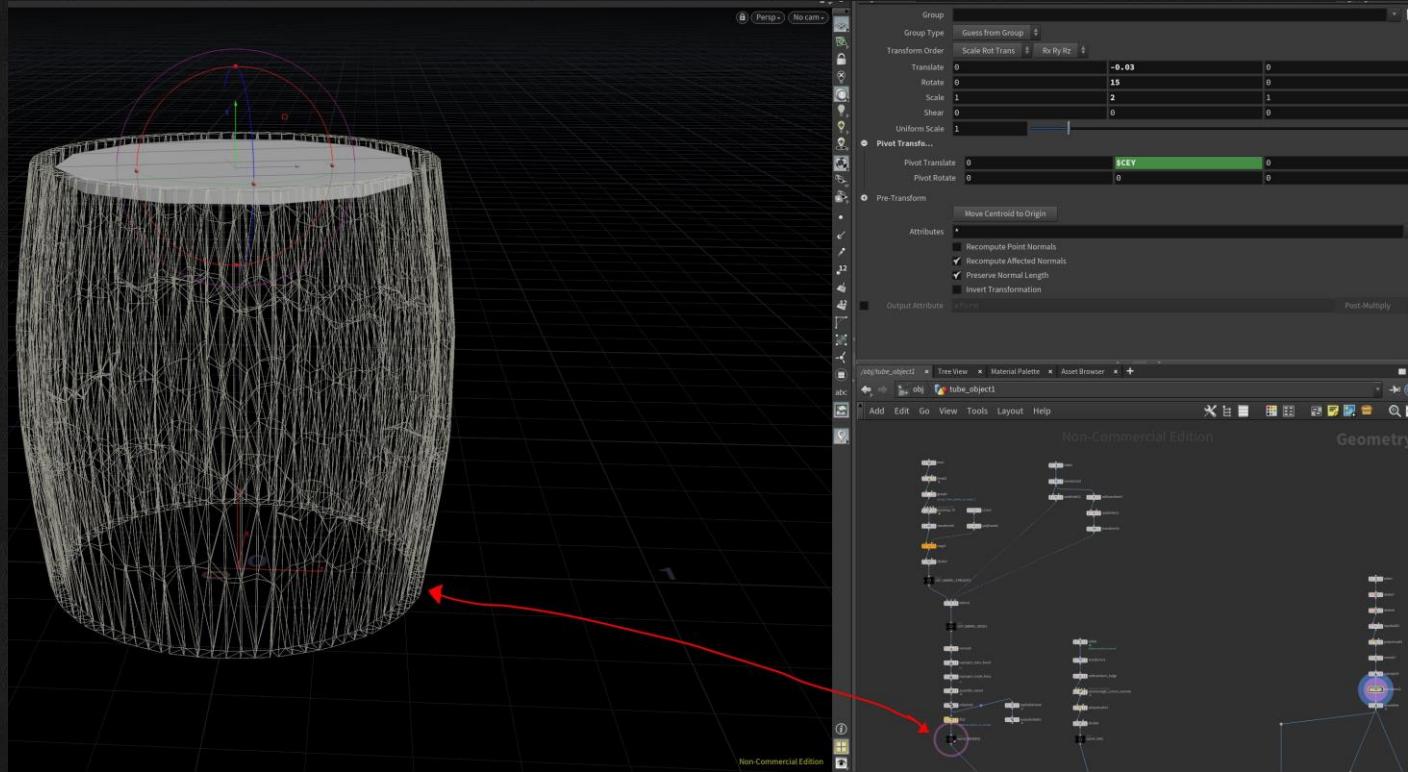
Step 34 – show wireframe

Note – you can work on one part of the network while wireframing another part as reference.

Here we set the wireframe flag on the barrel body to help align the barrel top.

Use the ‘transform’ node to align the geo as in the picture.

Note - \$CEY in pivot Y

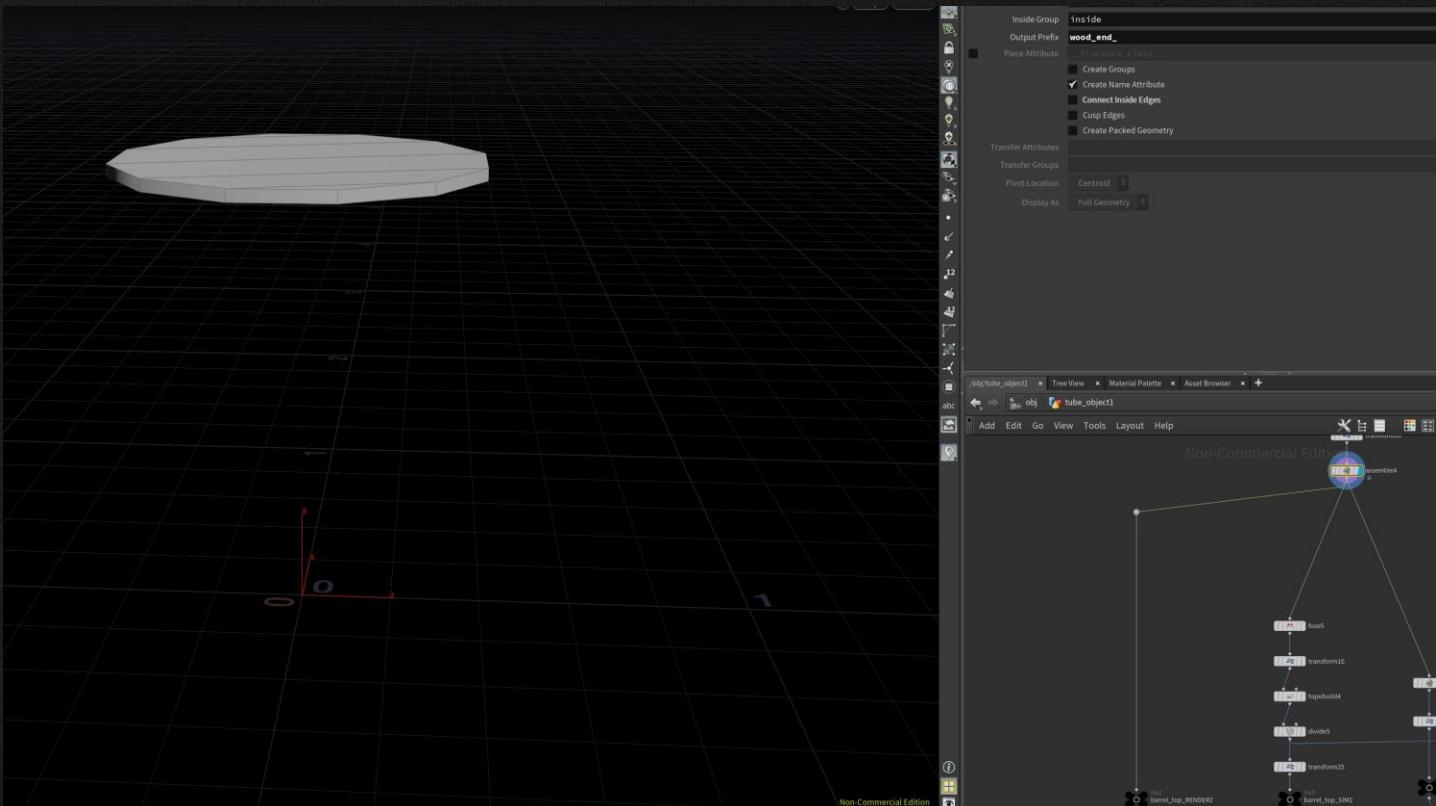


Step 35 – Top rough UVs

Drop down a UVProject.
This is a rough projection.

Drop down an ‘assemble’ node and give the piece a unique name.

This is our Render geo for the barrel top.



Step 36 – Barrel Top SIM mesh

Branch from the assemble node and -

Drop down a ‘fuse’.

Drop down a ‘transform’.

Drop down a ‘topobuild’.

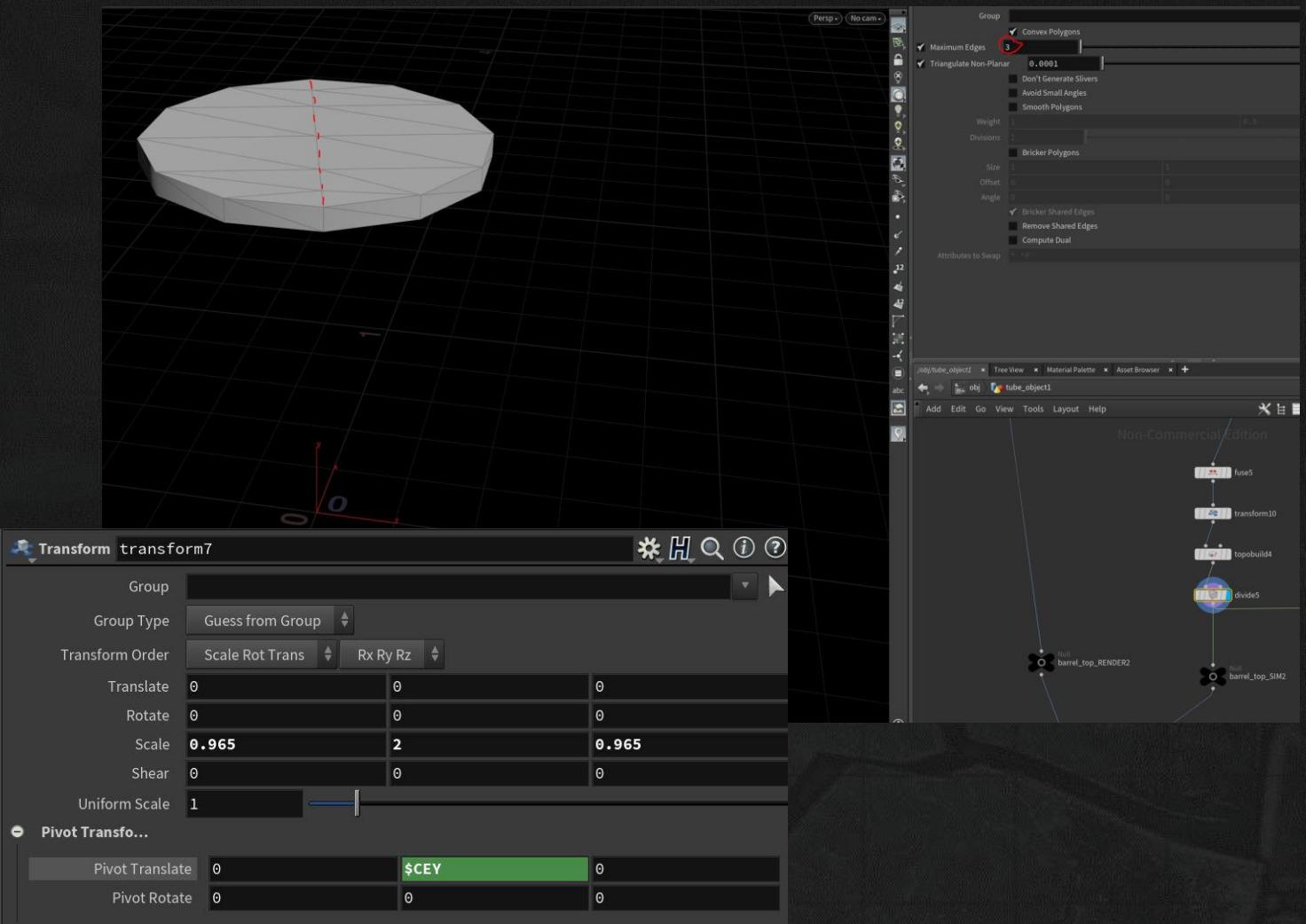
Drop down a ‘divide’.

Fuse – safety test

Transform – chunky

Topobuild – cut so better
tets will be created

Divide - triangulate



Step 37 – Keep it tidy

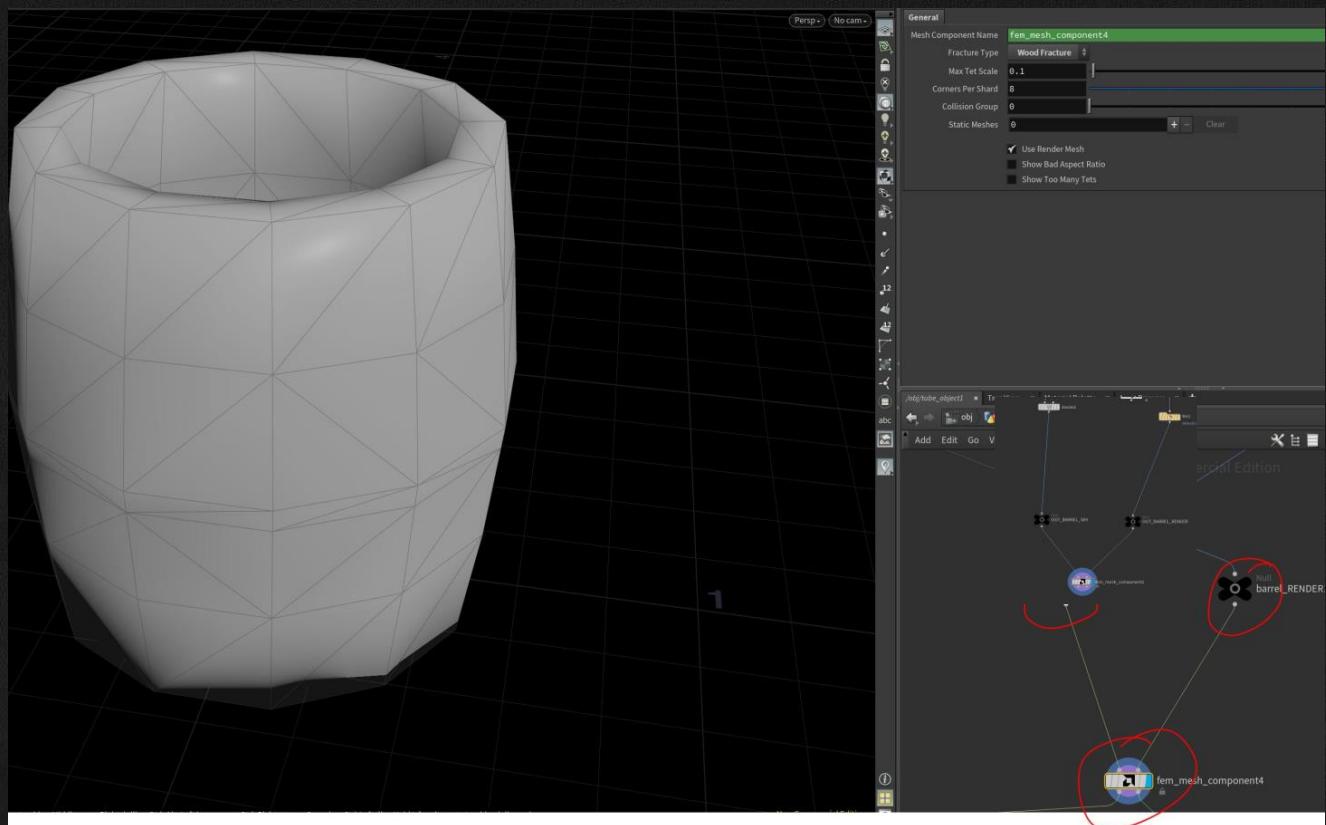
Drop down 2 ‘null’ nodes.
Name them OUT_TOP_SIM,
OUT_TOP_RENDER.

Drop down a ‘FEM mesh component’ node.

This FEM node needs a RENDER mesh and a SIM mesh.

Set node parameters as in picture.

Color the NULL nodes to easily find them later.

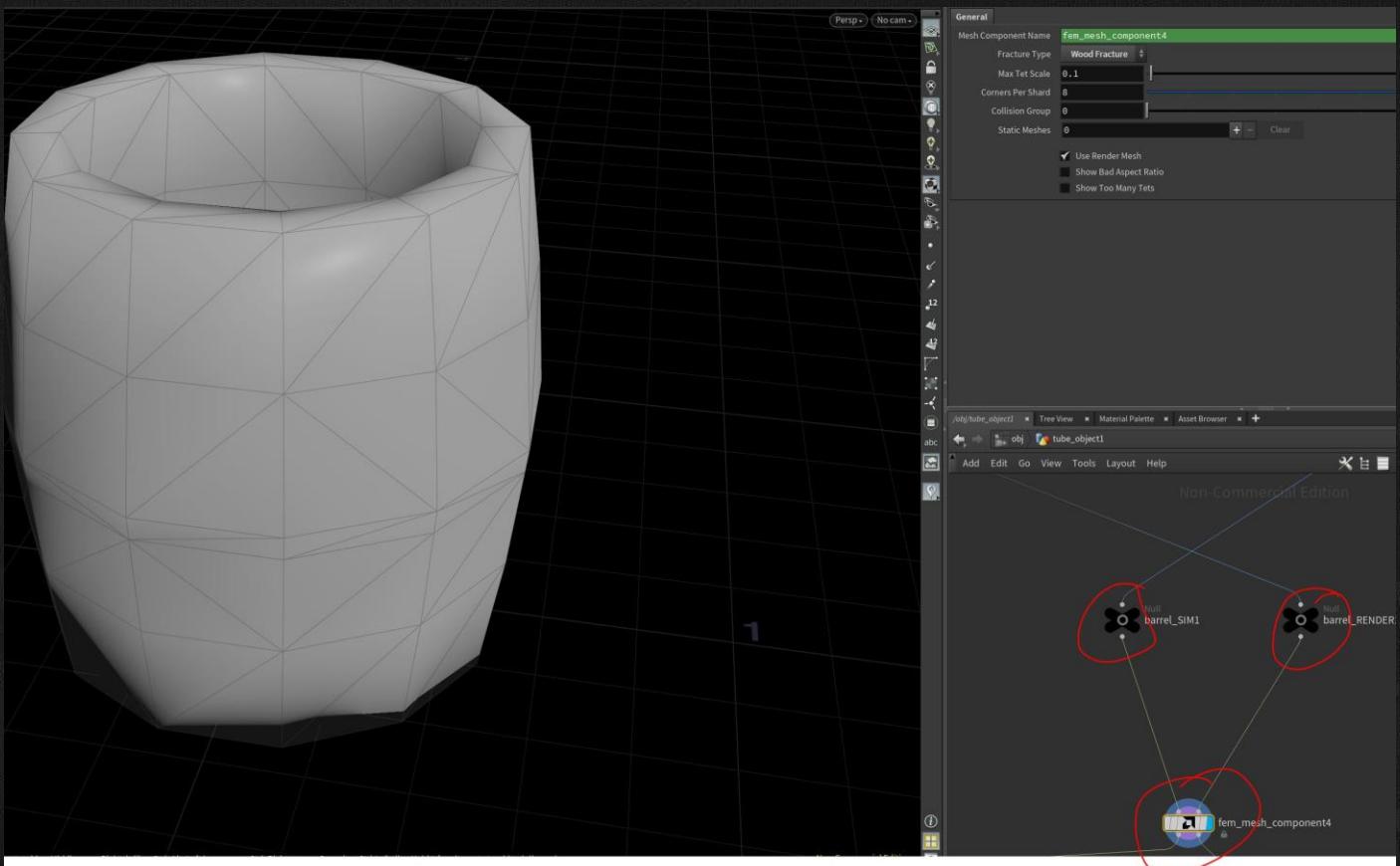


Step 38 – FYI - necessary FEM nodes

FEM Mesh Component needs RENDER and SIM inputs

RENDER output goes through a FEM Render Mesh Section and into the FEMWrite node.

SIM output can go to FEM Material nodes and FEM Constraints before connecting to the FEMWriteSimMesh node.



Step 39 – Barrel body non fracture regions

Drop down a ‘FEM Material’ node and connect to the SIM output of the FEM mesh component node.

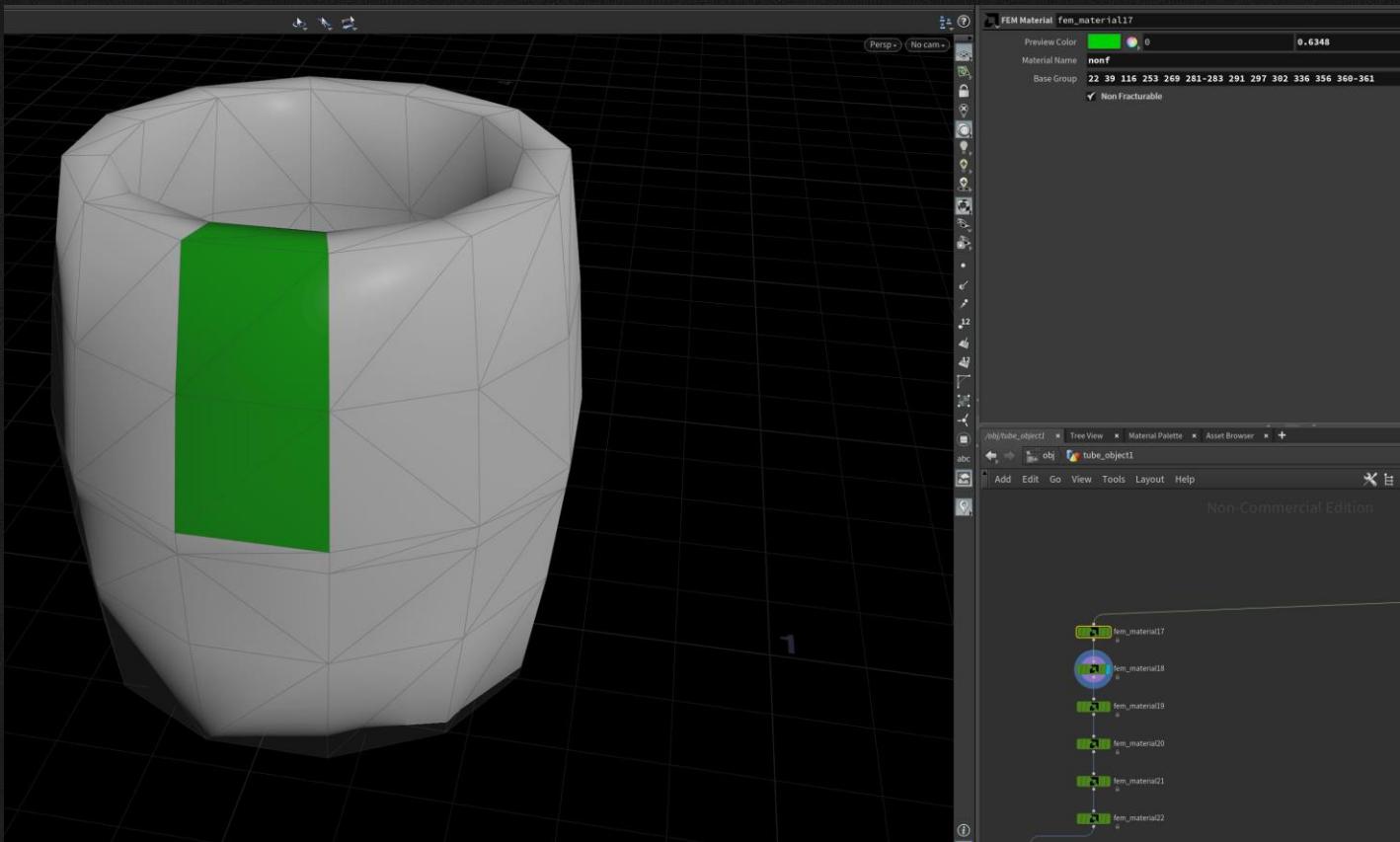
Our Wood breaks at specific places.

Add groups of tets until ALL plank breaks are covered.

1 group per node for easy managing.

Color nodes

Note – make sure no overlapping groups



Step 40 – Glue Constraints

Drop down a ‘FEM Glue Constraint’

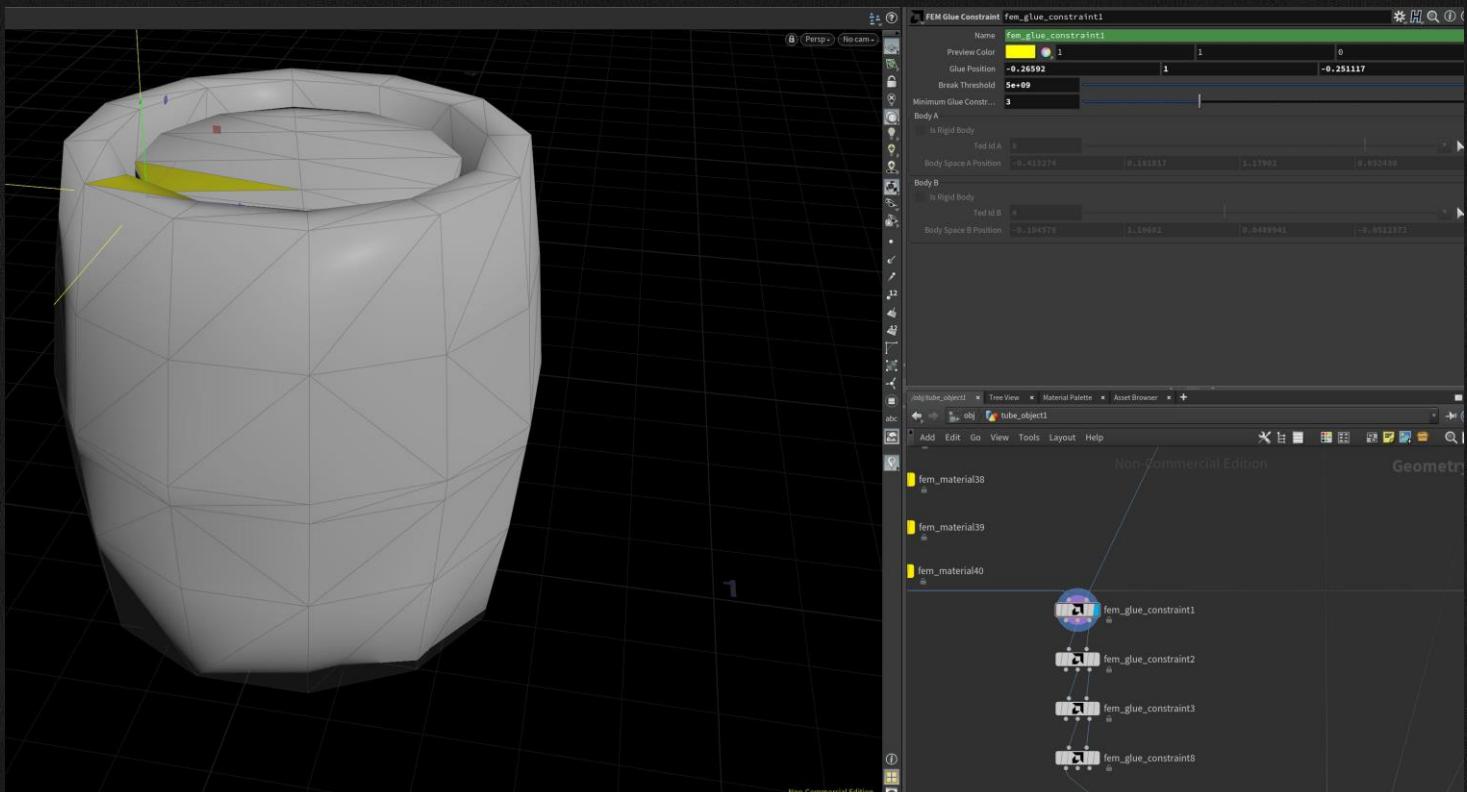
Connect barrel top SIM and barrel body SIM.

Connect from last FEM Material to constraint node input1.

Connect barrel top SIM Output to constraint node input 2.

Note - Hilighted tets and Glue position helper.

Color nodes.



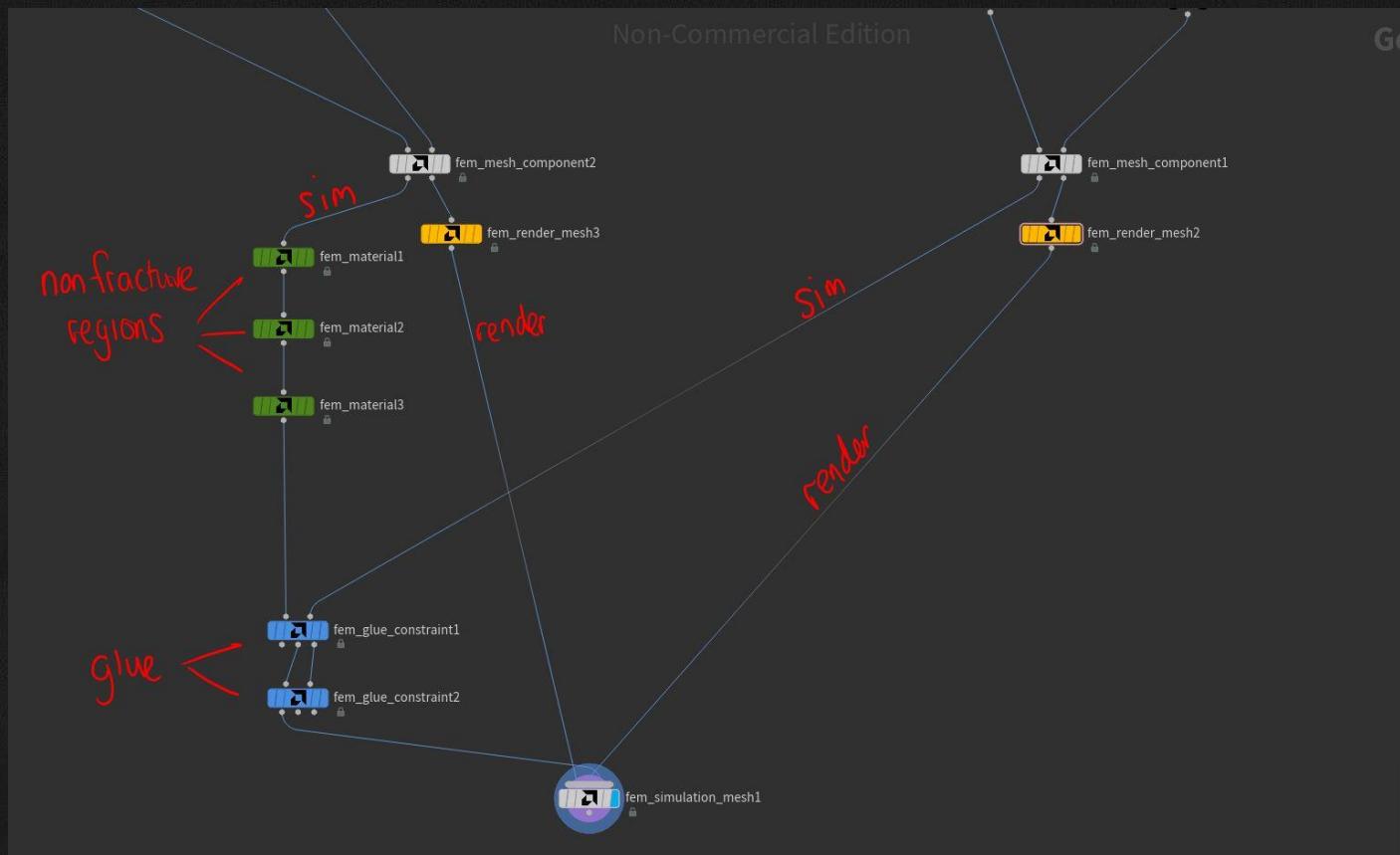
Step 41 – Final connections

Add FEM Render Mesh Section after each FEM Mesh Component and name accordingly.

Each object part needs SIM data and RENDER data connected to the final 'FEM Write Sim Mesh' node.

If Glue constraints are used, SIM data of both objects is passed through the Glue node.

In this instance, only one SIM connection is needed.



Step 42 – Finally!

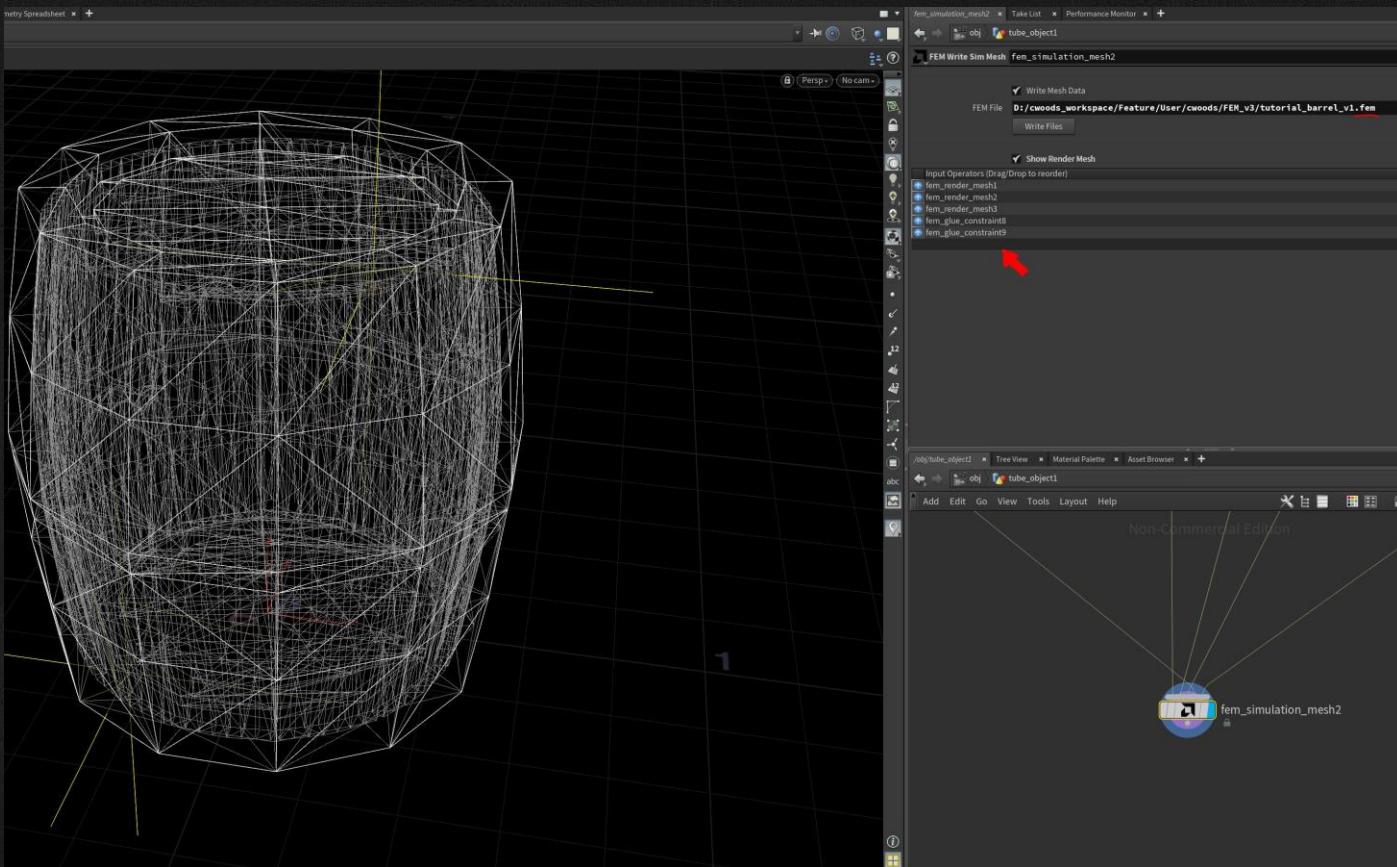
Give your FEM object a name.

Don't forget the .fem extension.

Press Write File

Now its time to head over to Unreal and see this in action!

Observant tutorial followers may realize that this barrel only has one end....this was totally intentional....and not a mistake at all....yes, all part of the plan (cough, cough) ☺



AMD

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