Disheveled Geometries

Kitbashing

Mark Foster Gage with Adam Wagoner
Disheveled Geometries

Kitbashing | Yale School of Architecture 2014

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Disheveled Geometries: Kitbashing

2014 PARAMETERS
For the Spring of 2014, the focus of this course will be on digitally re-inventing the analogue technique of “kitbashing” to, as a class, produce a single large-format 3d-printed volume or room. The seminar is funded at a significant level by Autodesk (currently being formalized, but approximately $35,000-$40,000 for the class) towards this end. As the final design allows, we may also CNC mill portions of the volume or room in solid Carrara marble through an ongoing affiliation with the Digital Stone Project. As part of the latter there will be the opportunity for one student to study digital stone carving in Tuscany to further develop a portion of the project for one month over the summer, as was the case with last year’s seminar. No prerequisites or particular digital skills are required for this course. Enrollment limited to 10.

KITBASHING
Kitbashing originally emerged from the hobby of plastic model building, and involves using pieces from multiple model kits, glued together in unexpected arrangements in order to produce objects that seem strange and otherworldly. This technique was adopted heavily by designers of 1970’s science fiction films such as Alien, Star Wars, Blade Runner and numerous other films that predate the emergence of digital special effects. We will be digitally “kitbashing” in much the same way as these early special effects pioneers—by relying on existing forms that are radically recomposed, but also mutated, fused and mistranslated in novel and creative ways. For us this involves not plastic model kits and glue, but the 3D scanning of found objects using our smartphones, and the downloading of existing objects from large online object sharing clearinghouses. We will kitbash these objects by organizing them in vast numbers and forcibly manipulating and mutating them into massive figurative arrays which read texturally.

SOFTWARE
We will be collaborating with the software company Autodesk for this venture, and they will be providing us with funding, instruction and access to their new Fusion 360 and 123D programs. We will use these tools synergistically to do everything from scanning existing objects with our smart phones and creatively re-sculpting them, to seamlessly producing and combining mechanical and biological languages using modeling tools such as t-splines, mesh fusing, solid bodies, and assemblies. As the final design allows, we may also CNC mill portions of the room in solid Carrara alongside additional support from Autodesk in the form of access to their CAM 360 tools. The software tools used in this course are powerful, but intuitive, and accordingly no particular software skills are required to enroll.

HISTORIC POSITION OF COURSE
From the Latin rusticatioem, and originally defining an unsophisticated rural mentality, the term rustication is used to describe architecture’s most extreme category of surface textures. If, historically, architectural rustication was seen as a less refined manner of shaping material that subsequently retained a rough texture, then the twenty-first-century condition would be the exact reverse. Rustication now takes more effort rather than less, and skill is measured in moving away from architectural smoothness instead of toward it. With the ability to kitbash figures and forms at increasingly complex scales of resolution, this seminar revisits the topic of rustication, where architects use new tools to design, in this case the Fusion 360 and 123D programs, to design unapologetically
contemporary textures and forms. Students study methods of rustication throughout history and use this research as a foundation to design and produce, again through techniques of kitbashing, a single, heavily figured and rusticated 3d printed volume.

**Preliminary Course Schedule**

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>January 16</td>
<td>Introductory class</td>
</tr>
<tr>
<td>January 16-30</td>
<td>Additional software instruction will be provided by experts from Autodesk. Some sessions may take place in the evenings or weekends and participation is mandatory.</td>
</tr>
<tr>
<td>January 23</td>
<td>Michael Leach, Keyshot tutorial (MG London)</td>
</tr>
<tr>
<td>January 30</td>
<td>PINUP of Individual KitBashing Research and Individual Version 1 projects</td>
</tr>
<tr>
<td>February 6</td>
<td>No Class. Advanced Studio travel week</td>
</tr>
<tr>
<td>February 13</td>
<td>FINAL PINUP of Individual Version 1 projects</td>
</tr>
<tr>
<td>February 20</td>
<td>Mathieu Victor, Director of Fabrication for Jeff Koons</td>
</tr>
<tr>
<td>February 21</td>
<td>Required attendance: Digital Post Modernities Symposium</td>
</tr>
<tr>
<td>February 21</td>
<td>Required attendance: Digital Post Modernities Symposium</td>
</tr>
<tr>
<td>February 22</td>
<td>Required attendance: Digital Post Modernities Symposium</td>
</tr>
<tr>
<td>February 27</td>
<td>PINUP of Group version 1 project, final workflow protocols developed</td>
</tr>
<tr>
<td>March 6</td>
<td>No Class, Mid Term Reviews</td>
</tr>
<tr>
<td>March 13</td>
<td>No Class, Spring Break</td>
</tr>
<tr>
<td>March 20</td>
<td>No Class, Spring Break</td>
</tr>
<tr>
<td>March 27</td>
<td>PINUP of Group version 1 project, revised</td>
</tr>
<tr>
<td>April 3</td>
<td>Possibly No Class. Open House, TBD</td>
</tr>
<tr>
<td>April 10</td>
<td>PINUP of Group version 2 project, revised</td>
</tr>
<tr>
<td>April 17</td>
<td>PINUP of Group version 2 project. FINAL REVISION COMMENTS</td>
</tr>
<tr>
<td>April 24</td>
<td>FINAL PROJECT SENT TO 3D PRINT</td>
</tr>
<tr>
<td>May 1</td>
<td>No Class, Final review week</td>
</tr>
<tr>
<td>May 5,6,7</td>
<td>Exam week, final discussion on readings</td>
</tr>
<tr>
<td>June</td>
<td>One student studies Digital Stone Carving in Tuscany for one month</td>
</tr>
</tbody>
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*Additional workshops run by the TA and others will be offered during the course of the semester in the evenings. Attendance is mandatory unless student can demonstrate competence in the area being covered.

**Projects**

Students will be expected to complete a series of assignments during the course of the semester that address the technical aspects of the subject material, as well as the various thematic topics presented in the discussions and lectures. In all design assignments students will be required to produce original and expert work, devoid of errors and omissions on the part of any material or mechanical processes. This is even more important with large-scale 3d printing. That is to say that given the physical and financial resources made available to the students, as well as the professional research standard set in the seminar, no incomplete, damaged, or otherwise sub-standard final projects will be allowed to be presented during any point in the term. As such it is recommended that students test their techniques and materials far in advance of the production of projects, in order to assure the efficacy of the process. Alternatively, students may outsource their fabrication to professionals outside of the school in the event that the schools resources are unable to reliably produce the intended result. Such outsourcing, per the rules of the school, must be clearly labeled in subsequent portfolio or award submission materials.

**INDIVIDUAL PROJECT**

Students will, using magazines, online sources, physical objects, and other forms of research to compile a collection of ten contemporary kitbashed textures or forms that fit within the sensibilities described in the introductory lecture. Students will print one 8x10 page per kitbashed project at 150 dpi, for a pinup/post-it session where we will distill the significant formal aspects of each proposed texture.
Simultaneous to this exercise students will 3d model a single kitbashed "gallery style" prototype panel. The ten images and one 11 x 17" 150 dpi photo-realistic rendering of the 3d model will be reviewed in class. Students should assume they are modeling a 4' x 8' panel for a building facade, oriented vertically, to be hung in a manner similar to that of the stone panels on Beinecke Library. All renderings must be done in solid marble using Keyshot and exhibit sub-surface-scattering properties.

CLASS PROJECT
Based on the individual student projects the class will develop an aesthetic direction, and a workflow system using Autodesk Fusion. Each student will contribute equal time to the final design which will be sent as a 3d file to be printed by the selected fabricator on April 24th. While the design parameters of the single volume or room are yet to be determined, the intent is that the space is large enough to physically occupy by either walking into or positioning one’s head in in an immersive way. As the parameters of this final 3d print are being developed, additional information will be forthcoming.

Publication

The three previous Disheveled Geometry courses were documented in 200-300 page books which were distributed widely. This seminar will also culminate in the production of a book that, likewise, documents all of the research done, as well as the final post-seminar fabrication in Italy by the selected student. The research and documentation of process is as important as the final product and is a significant part passing this course.

Solid Marbles CRC panel, completed in Siena, Italy, by R.J. Mitchell and Nicholas Kehogas as part of last years Disheveled Geometrics course.
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DISHEVELED GEOMETRIES: KITBASHING

THURSDAY, JAN 16th 2014
4TH FLOOR PIT
11:30-12:15

FUNDED BY AUTODESK
DISHEVELED GEOMETRIES: KITBASHING

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DISHEVELED GEOMETRIES: KITBASHING

THURSDAY, JAN 16th 2014
4TH FLOOR PIT
11:30-12:15

FUNDED BY AUTODESK
For the first day of class students were asked to each compile a collection of ten contemporary kitbashed textures or forms from magazines, online sources, physical objects, and other forms of research that fit within the sensibilities described in the introductory lecture. These images were pinned up and each texture was discussed for its significant formal aspects.
STOP CLIMATE CHANGE BEFORE IT CHANGES YOU.
Mark Foster Gage | Yale School of Architecture | Disheveled Geometries
You eat what you touch.
You eat what you touch.
Mathieu Victor works in the New York studio of world-renown artist Jeff Koons where he is a project manager/art director. His responsibilities include:

“Direction of projects ranging from High-end Jewelry to Monumental sculpture. Research, development, and implementation of design and fabrication. Sourcing and management of vendors and contractors. Special focus on emerging arts technologies including rapid prototyping and direct manufacturing, large scale ink jet printing, and varied other industrial fabrication techniques. Studio technology management, including IT management, color management, and print workflow.”

http://www.linkedin.com/pub/mathieu-victor/5/b85/787
Mark Foster Gage | Yale School of Architecture | Disheveled Geometries
Individual Projects

Kitbashing Exercise and Workflow
New Haven, CT

February 20, 2014

Based on the discussion from their kitbashing research, students each modeled one assumed 4’ x 8’ facade panel. These models were then photo-realistically rendered in solid marble using Keyshot and exhibiting sub-surface-scattering properties. Throughout the process students documented their workflow process, with an emphasis on working within Autodesk Fusion 360.

“Fusion 360 is an integrated form, function and fabrication experience. Quickly and easily explore product ideas in Fusion 360. Start by using simple free-form modeling tools, take a shortcut and seamlessly pull your existing data into Fusion 360, or freely create your own complex mechanical design. Engineer and test your model for function. Then prepare it for manufacturing by generating tool paths or using the 3D printing utility.”

http://fusion360.autodesk.com/about
Daniel Nguyen
Daniel Nguyen
Daniel Nguyen

When DynaMesh is pressed ZBrush will provide sculptural geometry to any mesh without any stretching or constraints. It will give you a freedom to continue sculpting with not having to worry about your underlying geometry.

To re-DynaMesh at any point hold the Ctrl key and click drag anywhere in this open document.

DynaMesh is the new basemesh.

Button path: Tool Geometry => DynaMesh
The ZPlugin palette contains ZScripted plugins. To add a ZScript to the ZPlugin palette, place it in the ZScript folder inside your ZBrush folder. The ZScript will appear in this palette the next time ZBrush is restarted.

ZScript button path: ZPlugin-Decimation Master-Decimate Current
Autodesk3DPrint.exe has stopped working

A problem caused the program to stop working correctly. Windows will close the program and notify you if a solution is available.
After working with ZBrush, Daniel tried to recreate the object within Fusion and documented the process and the downfalls of the new program.
WORKFLOW FOR FUSION

DOWNLOAD FROM THINGIVERSE

MESH REPAIR IN RHINO

EXPORT AS STL FROM RHINO

IMPORT TO FUSION VIA CREATE NEW FUSION DESIGN

USE TRANSFORM FUNCTIONS IN FUSION

...

WORKFLOW FOR ZBRUSH

DOWNLOAD FROM THINGIVERSE

MESH REPAIR IN RHINO

EXPORT AS OBJ FROM RHINO

IMPORT TO ZBRUSH AS A ZTOOL

CREATE NEW BRUSH FROM IMPORTED MESH

APPLY BRUSH FOR KITBASHING

DYNAMESH + DECIMATE

EXPORT AS STL

IMPORT TO AUTODESK 3D PRINT UTILITY
TOO MANY MENUS TO IMPORT AN OBJ FILE. IT'S MUCH SIMPLER IN OTHER PROGRAMS.

Inserts the selected OBJ on the active design. Use mesh reference for T-Spline surface.
TOO MANY MENUS TO IMPORT AN OBJ FILE.

IT'S MUCH SIMPLER IN OTHER PROGRAMS.
FILE CONVERSION SHOULD HAVE OCCURRED UPON IMPORT. HAVING TO CONVERT THE FILE ONCE IT’S ALREADY IN FUSION IS A MAJOR INCONVENIENCE.

FOR THE PURPOSES OF THIS COURSE, 1582 IS AN INFINITESIMAL NUMBER OF POLYGONS. THIS IS A SEVERE LIMITATION WHEN OUR MODELS CAN REACH POLY COUNTS IN THE MILLIONS.
AGAIN, THE POLY COUNT LIMITATION IS A CRIPPLING SETBACK

Attempts to recover the file prove unfruitful.
COMMAND LINE INTERFACES (CLI) ARE COMMON AMONG MANY CAD PROGRAMS BECAUSE THEY ARE FASTER THAN GRAPHIC INTERFACES THAT FORCE THE USER TO HUNT FOR BUTTONS. THE FRAMEWORK FOR TEXT-BASED INPUT LOOKS LIKE IT’S ALREADY IN PLACE, BUT IT COULD USE SOME EXPANSION. AUTOCAD ITSELF HAS A DECENT IMPLEMENTATION OF THIS INTERFACE, AIDED BY AN AUTOCOMPLETE FUNCTION.

AN ATTEMPT TO IMPORT FROM AN STL FILE TAKES QUITE A WHILE.
I AM UNABLE TO MODIFY THE IMPORTED STL FILES. I CAN ONLY MOVE THEM.

MOVING AND ROTATING WITH THE GIMBAL ARE CONFUSINGLY GROUPED UNDER ‘MOVE’. THEY ARE TYPICALLY SEPARATE FUNCTIONS THAT MERIT SEPARATE BUTTONS.
THIS WAS AS CLOSE AS I COULD GET TO MY ORIGINAL MODEL BEFORE CRASHING.

(1) WeedySeadragonHead

**eagle_repaired**

- Named Views
- Units: mm
- Origin
- Bodies
THIS WAS AS CLOSE AS I COULD GET TO MY ORIGINAL MODEL BEFORE CRASHING.
FEATURE WISH LIST:

HIGH POLYCOUNT SUPPORT

TEXT-BASED COMMANDS

REDUCE NEED TO DIG THROUGH MENUS

A MORE STANDARD MENU BAR (FILE, EDIT, SELECT, VIEW, ETC)

LOCAL NETWORK PEER DISCOVERY AND SHARING

DYNAMESH-LIKE MERGING (AUTOMATICALLY FILLING HOLES AND BOOLEAN INTERSECTIONS)

MULTITHREADING

DECIMATION UTILITY FOR OPTIMIZING MESH FACES

REMESH TO A SPECIFIC POLY COUNT

Z-BRUSH LIKE PAINTING MODE (AUTOMATIC ORIENTATION OF INSERTED MESHES TO FACES/SURFACES) -- SEE ADDITIONAL IMAGES

CURVE INSERT MESH FUNCTION -- SEE ADDITIONAL IMAGES
FEATURE WISH LIST:

HIGH POLYCOUNT SUPPORT

TEXT-BASED COMMANDS

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DECIMATION UTILITY FOR OPTIMIZING MESH FACES

REMESH TO A SPECIFIC POLY COUNT

Z-BRUSH LIKE PAINTING MODE (AUTOMATIC ORIENTATION OF INSERTED MESHES TO FACES/SURFACES) -- SEE ADDITIONAL IMAGES

CURVE INSERT MESH FUNCTION -- SEE ADDITIONAL IMAGES
CURVE INSERT MESH IN ZBRUSH generates a model with start/end blocks along an editable curve. The curve remains editable and the model updates to reflect any changes.

Mark Foster Gage | Yale School of Architecture | Disheveled Geometries
CURVE INSERT MESH IN ZBRUSH GENERATES A MODEL WITH START/END BLOCKS ALONG AN EDITABLE CURVE. THE CURVE REMAINS EDITABLE AND THE MODEL UPDATES TO REFLECT ANY CHANGES.
ZBrush uses a Photoshop-like interface where the axis of transformation is perpendicular to the view plane. Mesh "brushes" are automatically oriented to whatever surface the brush hovers over.
ZBrush uses a Photoshop-like interface where the axis of transformation is perpendicular to the view plane. Mesh “brushes” are automatically oriented to whatever surface the brush hovers over.
After completing the workflow with Z-Brush, Dionysus was able to recreate the process with Fusion.
MeshSO18
fregi-xa.stl
ChryslerBuilding.stl
_l_medieval_barrel.stl
skyscraper 1.stl
MeshSO33
MeshSO36
Flower-Collapsible-just-flower.stl
Dragon_Fly_Aft_Wing--RH_small.stl
Platter_200x200,STL
gate_repairedBase_repaired_.stl
MeshSO67
MeshSO7
Junpei Okai
THINGIVERSE
SMITHSONIAN 3D
TURBOSQUID

ZBRUSH
- dymash to fuse all models and create manifold
- decimate to reduce poly mesh count to make manageable
- 3D print plugin to export as .stl file

GEOMAGIC
- fill small hole and self-intersecting surfaces

RHINO
- great for rotating/moving objects
- offset mesh to give thickness to open surfaces
- mesh repair to fix small holes/naked edges/small faces

POWDER PRINTER
ZPRINT
- prep file for powder print
ORGANIZE MESHES INTO DESIRED LOCATION

Mark Foster Gage | Yale School of Architecture | Disheveled Geometries 125
RUN _MESHREPAIR COMMAND TO CLEAN UP MESHES TO THE
BEST OF YOUR ABILITY.

IMPORT .OBJ INTO ZBRUSH

126  Mark Foster Gage  |  Yale School of Architecture  |  Disheveled Geometries
RUN DYNAMesh (AT HIGHEST RESOLUTION IF POSSIBLE.)

RUN DECIMATE TO LOWER MESH COUNT.
EXPORT FROM ZBRUSH AS .STL USING 3D PRINT EXPORTER AND OPEN FILE IN GEOMAGIC. RUN MESHREPAIR TO FIX SELF-INTERSECTIONS, HOLES, AND NON-MANIFOLD EDGES.
EXPORT FROM ZBRUSH AS .STL USING 3D PRINT EXPORTER AND OPEN FILE IN GEOMAGIC.

RUN MESHREPAIR TO FIX SELF-INTERSECTIONS, HOLES, AND NON-MANIFOLD EDGES.
Junpei Okai
THINGIVERSE → MAYA → AUTODESK 123 → MAKERWARE

create .gcode file

not good for mesh checking
THINGVERSE

RHINO
composition, rotate, scale, mirror, boolean

ZBRUSH
combine, simplify meshes with dynamesh, export as .obj

AUTODESK PRINT UTILITY
check mesh

-makerware
create .gcode file

REPAIR
check mesh for naked edges and non manifold

FUSION
import .stl
rotate scale
import rotate scale
cumbersome

KEYSHOT
renderer

repeat cycle

fail

attempt combining

attempt mirror

fail
Madelynn Ringo
Madelynn Ringo
Disheveled Geometries
Process

Technical Collaboration with Autodesk

Throughout the semester, the class worked closely with representatives from Autodesk, specifically with their department developing Autodesk Fusion. Program manager Chris Hall traveled to New Haven to meet with the students. He analyzed the previous work flows and gave tutorials to suggest alternatives.

This began a back and forth process with the students and Autodesk, resulting in multiple conference calls citing the benefits and drawbacks for particular programs and work flows used in kitbashing.
Issues brought up by class for Autodesk:

- Students would like to use .stl files in Fusion without remodeling them
- Cannot add more faces after objects are created in Fusion
- No trim tool in Fusion for meshes
- Sometimes objects reorientation when moving in Fusion
- In Meshmaker it is difficult to Boolean a large amount of objects together
- The Disheveled Geometries class needs a program that can handle files of 10-20 million polygons

Information from Autodesk for class:

FUSION:

- Shift-middle button orbits
- To recreate an object
  - Create a box over the object
  - Add more faces
  - PULL command- select vertices
- “surface points”= points on object’s surface
- “control points”= points off surface that create geometry (usually better to use)
- Alt-w= rotating
- Alt-e= translating
- Alt-r= scaling

Other:

- Mudbox will convert objects from triangular meshes to quad meshes which can then be used in Fusion
- Autodesk 360- could be a good interactive interface to share models/information/responsibilities
- Source for clean models: http://www.deespona.com/3denciclopedia/categoria_vehicles.html
- Chris will try to send Disheveled class clean model files
- Autodesk softimage ICE
Meshmixer
- We brought models into Meshmixer and used the Make Solid command. Complex objects lost a large amount of detail and the form was sometimes disintegrated (see fig. 01-02).
- We changed the mode on Make Solid to Accurate and adjusted the the settings. When all the settings were increased to the maximum, the action failed (object became ghosted, see fig. 03) or the object still disintegrated (fig. 04). Many students were unable to find settings that would make their objects acceptably detailed (fig. 05-08).

Maya:
- While we saw the value of recreating files to create quadrangulated meshes in Maya like shown in the Autodesk tutorial, we determined that this method would be far too time consuming to convert all the files that we need for our use. Most of the models we need to recreate, cannot be broken down into flat surfaces like the wing in the tutorial.
- We did try to convert triangulated mesh models to quadrangulated mesh models in Maya using the Quadrangulate command. This command, after adjusting the quad face options, did reduce the amount of polygons but did not completely convert all the triangles to quads (see fig. 09-12).
- After being converted the amount of triangles was visually decreased, but under the Maya’s analysis information, the number of edges and vertices was much lower but the triangles count did not change (fig. 12-13). This fact puzzled us.
- We also used Maya’s Reduce command which helped to lower the size of the model.

Mudbox:
- As many of the class tried to insert models into Mudbox they were prompted with an error (fig. 14-15).
- We used the Retopologize command and most of the models also had an error (fig. 16-17).
- If the Retopologize command worked, many times the model was disintegrated (fig. 18-19).
- The majority of the times when we tried the Reduce Mesh command in Mudbox, it also errored (fig. 20-21).

Our next step in moving forward with the class is to create objects along the lines of Michael Hansmeyer’s 1:3 models for his Digital Grotesque 3D printed room (fig. 22).
fig. 01: Meshmixer_object first inserted

fig. 02: Meshmixer_Make Solid command, standard settings
fig. 03: Meshmixer_Make Solid command, higher settings, object becomes “ghosted”

fig. 04: Meshmixer_Make Solid command, increased settings, object is still incomplete
fig. 05: Meshmixer_Inserted model

fig. 06: Meshmixer_Make Solid command
fig. 07: Meshmixer_Make Solid command, adjusted settings

fig. 08: Meshmixer_Make Solid command, accurate settings
fig. 09: Maya_Inserted triangulated mesh model with poly count

fig. 10: Maya_Quadrangulate Face Options
fig. 11: Maya_Quadrangulate command complete with new poly count

fig. 12: Meshmixer_Some triangles still remain after Quadrangulate command
fig. 13: Maya_Tri count before Quadrangulate command

fig. 13: Maya_Tri count after Quadrangulate command- the same number.
fig. 14: Mudbox_Error message when trying to import model to Mudbox

fig. 15: Mudbox_Imported model after ignoring error message
fig. 16: Mudbox_Retopologize command

fig. 17: Mudbox_Retopologize error
fig. 18: Mudbox_Retopologized

fig. 19: Mudbox_Retopologized detail
fig. 20: Mudbox_Reduce Mesh

fig. 21: Mudbox_Reduce Mesh error
fig. 22: Michael Hansmeyer_1:3 models for Digital Grotesque 3D printed room
YSOA Disheveled Geometries: Kitbashing + Autodesk Meeting
April 3, 2014
Meeting Notes:

Autodesk Attendees: Chris Hall, Marcel De Jong, Ryan Schmidt, Craig Bar, Steve Vasko
Yale School of Architecture Students: Adam Wagoner (TA), Elvira Hoxha, Anne Ma, Dionysus Cho

Suggested work flow from Autodesk for YSOA:
- Clean the imported object’s meshes in Meshmixer
- Add details to object in Mudbox
- Arrange and Boolean models in Maya
- Reduce the size of the model in Meshmixer
- Make Solid to 3d print in Meshmixer

Meshmixer
- YSOA students were having troubles with geometry in Meshmixer. Autodesk informed us that we need to change the shader display mode to the gray sphere and flip all normals that were rendered in pink.
- The offset distances that YSOA were using were also too large during the Make Solid command in Meshmixer.
- Autodesk demonstrated the align tool that would graft one object on to the surface of another. This could be very helpful for YSOA.
- To cut models apart for printing in, Autodesk suggested to use the Edit-Plane Cut Tool in Meshmixer. Then remesh edges or fill cut edge.

Maya
- The models could also be separated (maybe more efficiently) in Maya using the Polygon-Mesh-Edit Mesh command.
- Autodesk then suggested using Alembic file types in Maya to drastically reduce the size of the file.
- YSOA could also load Alembic files into GPU cash mode to "stamp" with the object.
- It was also recommended to YSOA to use one master Maya file and reference all other files into it.
- Autodesk informed YSOA that the multi-cut tools in Maya 2015 are much better than 2014 and if YSOA did not have access to 2015 there might be a way to get copies of the new program.

The following image mark the progress of a group of YSOA students as they kitbash a project in Maya and render in Keyshot
Fig 1: Maya Master File

Fig 2: Maya Base Box
Fig 3: Maya Hidden Box

Fig 4: Maya Adding Model
Fig 5: Maya Base Box

Fig 6: Maya Result
Fig 7: Maya Added from Other Group

Fig 8: Maya Add Floor and Stair
Fig 9: Maya Stair Sculpting

Fig 10: Maya Duplicate Special
Fig 11: Final Image rendered in Keyshot
Comments From Kitbashing Students on Fusion

- The simple answer is that Fusion isn’t the right program for our Kitbashing class. Fusion is a cloud-based T-Splines; in other words, it is used for modeling a free-form NURB object. For Kitbashing, we need a program that can handle large file sizes (although this is mainly dependent on hardware), that has an intuitive move/mirror/rotate/scale tool, that splits meshes well, and that creates 3D printable manifold meshes. The 360 dashboard is a useful tool, but the file-sharing speed is dependent on internet upload/download speeds.

- Fusion’s tools seem fine, it’s in the managing and drag-dropping of the many different individual models that made it cumbersome. Maya turned out great with reference managing, and using the gumball was a little easier to control, especially when shifting the pivot. This also extends to mirror and mirrorcutting, as well as hole filling, which was great in Maya, but the same could only performed on objects drawn in Fusion. Fusion seemed great for whipping up models from scratch, but manipulating the mess of objects was easier in Maya. I think one point for us was not the learning curve (since it seemed relatively intuitive) but that Fusion might not have had the right tools for this very particular project. That said, it’s ability to do a bunch of Maya stuff quickly and smoothly, like generating and manipulating blobby forms to shrinkwrapping was great, and having TSplines (so strange using it outside of Rhino!) is pretty powerful. Also, the team approach that Fusion enables is pretty good, but would be wicked with something beyond Revit worksessions to real-time group modeling like Google documents...would be fun. More hands on than guessing what each other did in references and then refreshing the Master. Maybe our computers are need to be better to accomplish this however.

- Workflow for Fusion with multiple objects was not efficient enough to Kitbash the number of objects that we did. Maya was incredibly fast for the process and as long as the computer had enough memory, even cropping/cutting geometry worked out much better. Fusion’s reliance on an internet connection proved to be a hindrance for working with large files, especially since our internal network is much, much faster.
• The user interface for Fusion is intuitive and the possibility of sharing models over the cloud is promising, but the program had difficulty handling multiple files and reference files simultaneously. It was possible to work with 5-10 models at a time but we were working with nearly 10 times as many complex models. The speed of importing, placing, and manipulating objects was insufficient when files became heavy. I think Fusion makes a lot if sense for collaborative design that relies on a few complex models but not as much sense for Kitbashing, which demands many many complex models to be edited and manipulated simultaneously.

• For the purposes of kitbashing we tried the “rebuild” method which was unsuccessful, another method we tried was to shrink-wrap a surface to the model so get a spline object. It seemed that fusion tried to guess the areas of interest, each shrink-wrap attempt seemed different, and no attempts were able to get resolution even close to the original object.

• Our process for Kitbashing was about import, copy, move, rotate, snap, mirror. Not a single step to this process was easier to do in Fusion than it was to do in a program that already exists. It was instead harder......so it didn’t make sense for us to use Fusion. I feel that Maya is a more mature and robust program with better tools for editing meshes...its something that is more capable for our purposes than fusion.

See the following images for current Kitbashing progress.
Kitbashing
Group Projects
Process and Final Products
Spring 2014

Team A: Dionysus Cho, Anne Ma and Daniel Nguyen
Team B: Elvira Hoxha and Madelynn Ringo
Team C: Emily Bell and Peter Le
Team D: Junpei Okai and Jack Wolfe
Team A: Dionysus Cho, Anne Ma and Daniel Nguyen
Team B: Elvira Hoxha and Madelynn Ringo
Team C: Emily Bell and Peter Le
Team D: Junpei Okai and Jack Wolfe
Disheveled Geometry Seminar

May 5, 2014

David Erdman: David received his Bachelor of Science from The Ohio State University in 1993 and his Master of Architecture from Columbia University in 1998. He has been a Visiting Professor at Rice University, UC Berkeley, UCLA and The University of Michigan. David has been an Assistant Professor of Design at The University of Hong Kong Department of Architecture since 2010, served as the coordinator of Public Programs and is currently the Master of Architecture Thesis Chair. David co-founded servo where he designed projects from 1999-2006.

Simon Kim: After graduating from the Design Research Laboratory at the Architectural Association, Simon Kim was a designer and project architect for the Office of Zaha Hadid, and a consultant to Gehry Technologies. Simon has taught studios and workshops at MIT, Yale University, and the AA.

Elie Abrons: Ellie received her M.Arch from the University of California Los Angeles where she graduated with distinction and received the AIA Certificate of Merit. She received her B.A. in art history and gender studies from New York University and has a certificate in graphic and digital design from Parsons School of Design. She has worked in numerous offices in Los Angeles and Boston such as servo, GregLynnFORM, and Office dA.

Kyle Miller: Kyle Miller is an Assistant Professor at the Syracuse University School of Architecture and Co-Founder of Possible Mediums. He is a graduate of the University of Michigan Taubman College of Architecture and Urban Planning and the University of California – Los Angeles Department of Architecture and Urban Design, where he earned his professional degree. Miller previously taught at the University of Kentucky College of Design, University of California - Los Angeles, and worked professionally with UNSstudio in Amsterdam.

Ariane Lourie-Harrison: Ariane is an architect, educator, and co-founder of Harrison Atelier. Ariane has taught at the Yale School of Architecture since 2006. She is also currently teaching at Pratt Institute GAUD. She is the editor of Architectural Theories of the Environment: Posthuman Territory. Ariane received her Ph.D in architectural history from the Institute of Fine Arts NYU, her M.Arch from Columbia University and an AB, summa, in architectural history from Princeton University. She is a LEED AP and registered architect in the state of New York.

Brennan Buck: Brennan Buck is a principal at FreelandBuck in New York and a Critic at the Yale School of Architecture. From 2004-2008 he was assistant professor in Studio Greg Lynn at the University of Applied Arts, Vienna. He has practiced architecture and landscape architecture at offices including Neil M. Denari Architects and Johnston Marklee & Associates in Los Angeles. He is a graduate of Cornell University and the UCLA Department of Architecture and Urban Design.
Final Product

3d Printed Object

Spring 2014

After the final reviews, the projects were scaled to a 3d-printable size, documented and distributed to multiple 3d printing companies through the world. Ultimately Materialise, a Belgium manufacturing company, received the bid to print one model of Team A’s project. The object used a stereolithography process to print one 40” x 27” x 31” model all in one piece in a protogen white resin material.

“Through our work with Additive Manufacturing (AM), also known in the popular media as 3D printing, Materialise is helping bring great ideas to life. We work with others to put great products aimed at niche markets directly into the marketplace as well as helping make the prototypes of products later manufactured by the millions. What’s more, through our software, we enable others to do the same with their own AM equipment and services.”

- http://www.materialise.com/about-materialise
Yale School of Architecture Disheveled Geometries: Kitbashing
Title: DEATHSTROKE
Students: Dionysus Cho, Anne Ma & Daniel Nguyen
Garafagnana

Marble Fabrication Trip

June 08 - July 06, 2014

Students were given the opportunity to travel to Garafagnana, Italy to participate in marble fabrication processes in an attempt to create their proposed prototype panel. The following photos and descriptions track the month-long process of Daniel Nguyen as he fabricated a portion of his group's design in marble.
Disheveled Geometries