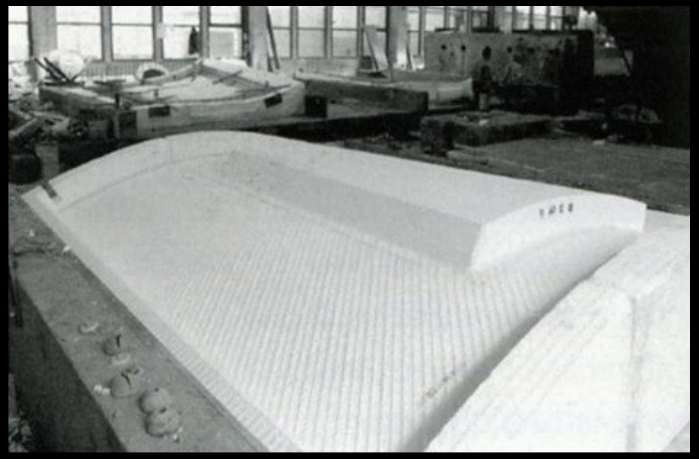
Free-form Construction Workflow

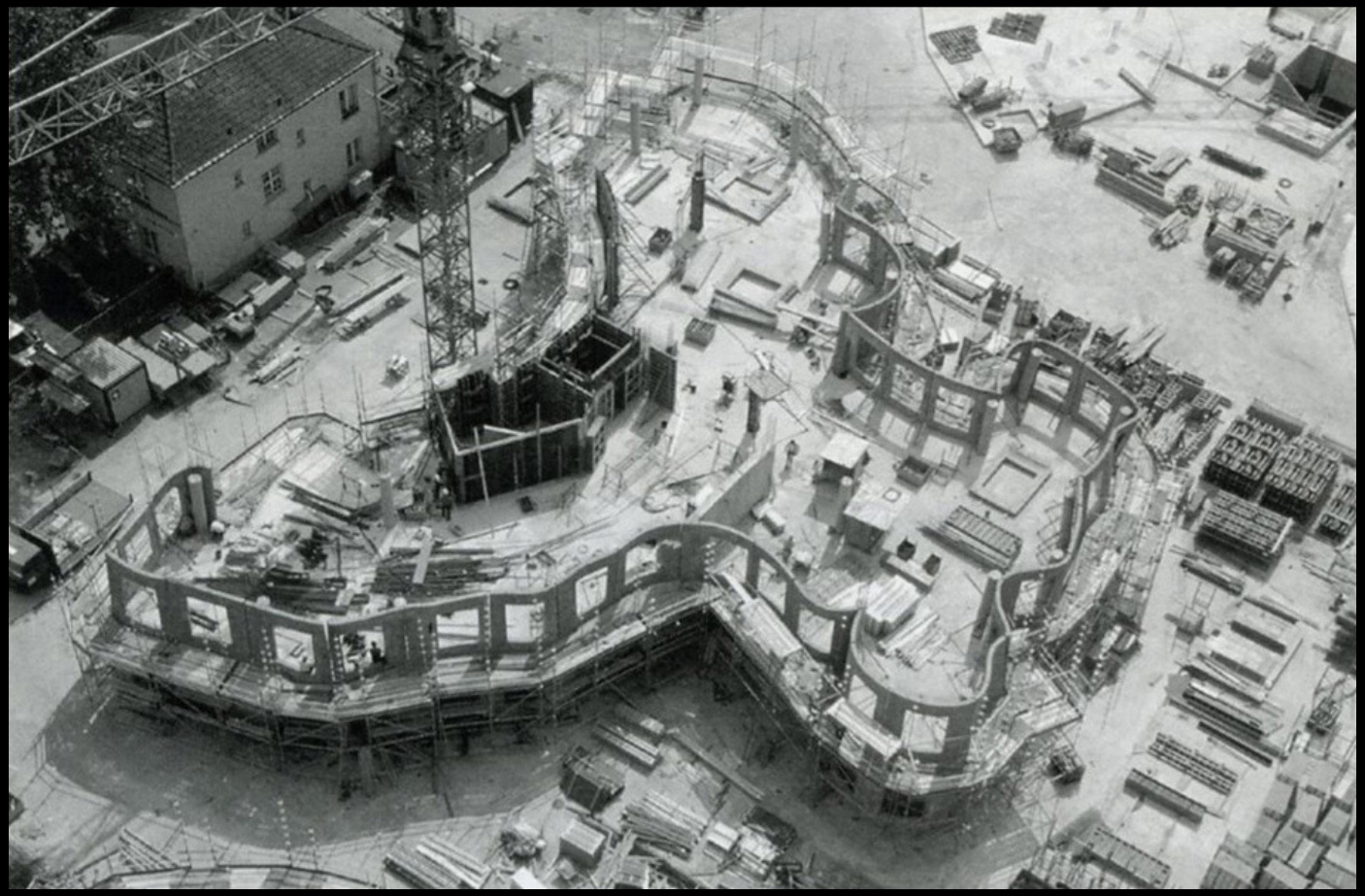
With emphasis on Rhino modeling environment and model building

Luka Piskorec, MSc ETH Arch
Lecturer in Design of Structures, Department of Architecture, Aalto University
luka.piskorec@aalto.fi

A” Aalto University
School of Arts, Design
and Architecture

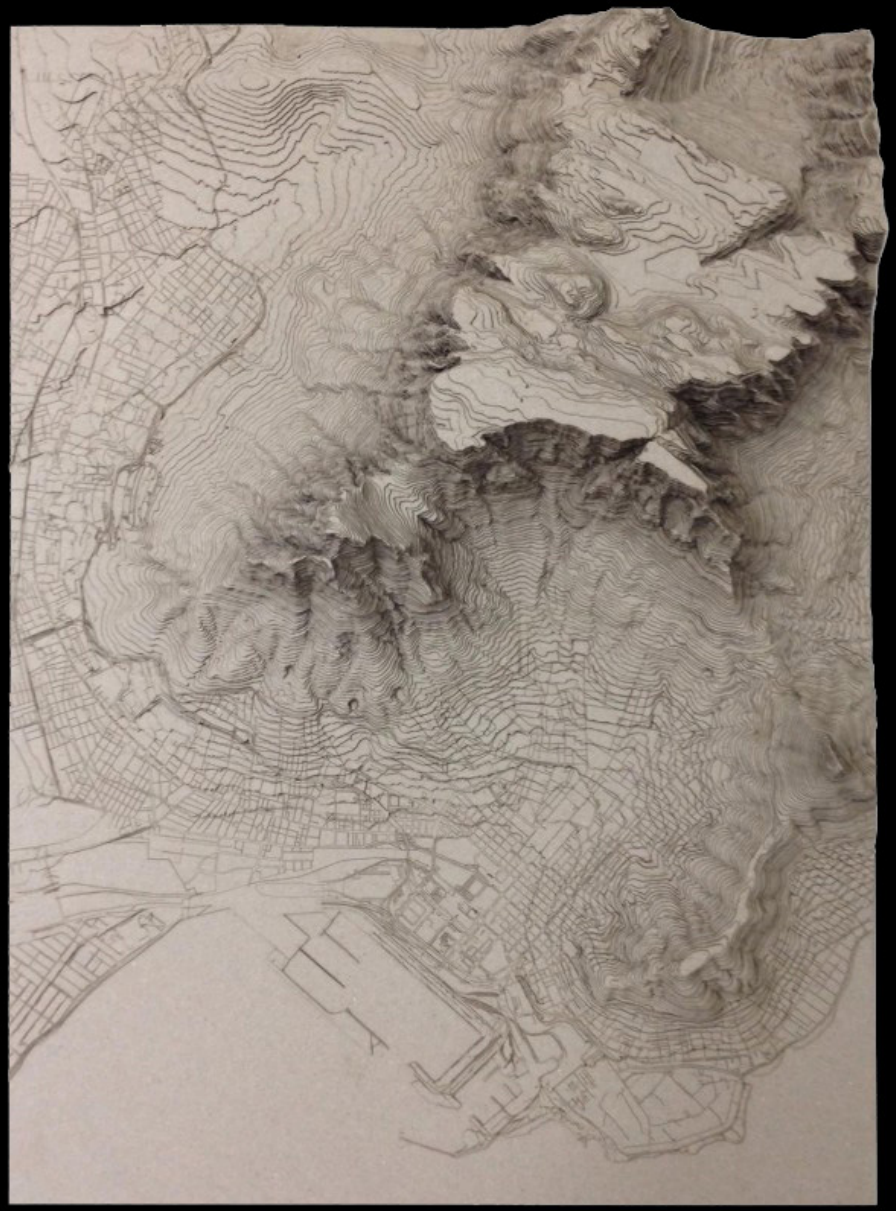
luka.piskorec@aalto.fi





Zollhof Towers in Dusseldorf by Gehry Partners, 2000, source - Branko Kolarevic, 2003

luka.piskorec@aalto.fi

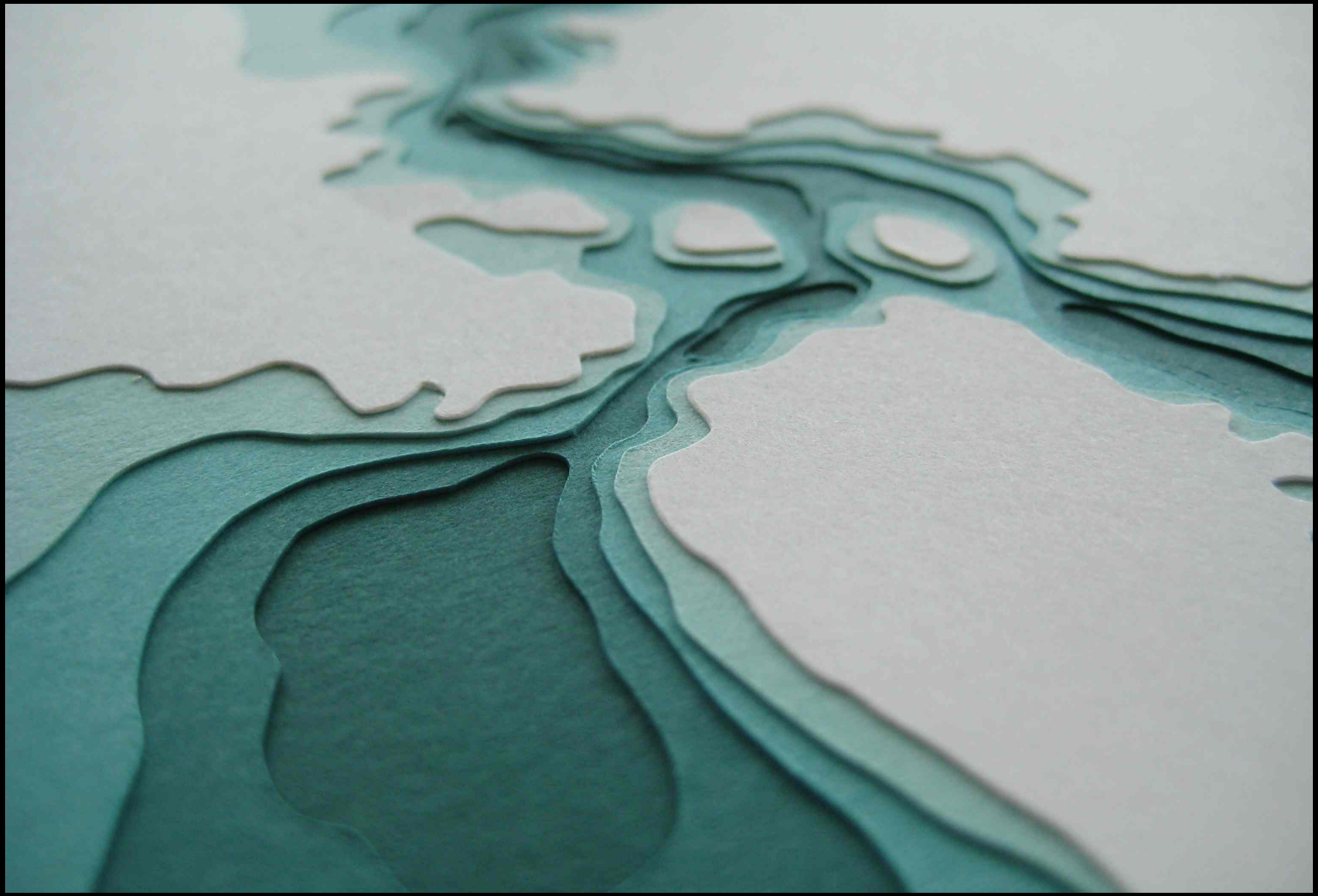


Layered landscape model of Cape Town, by Nikki Onderstall, 2015

luka.piskorec@aalto.fi

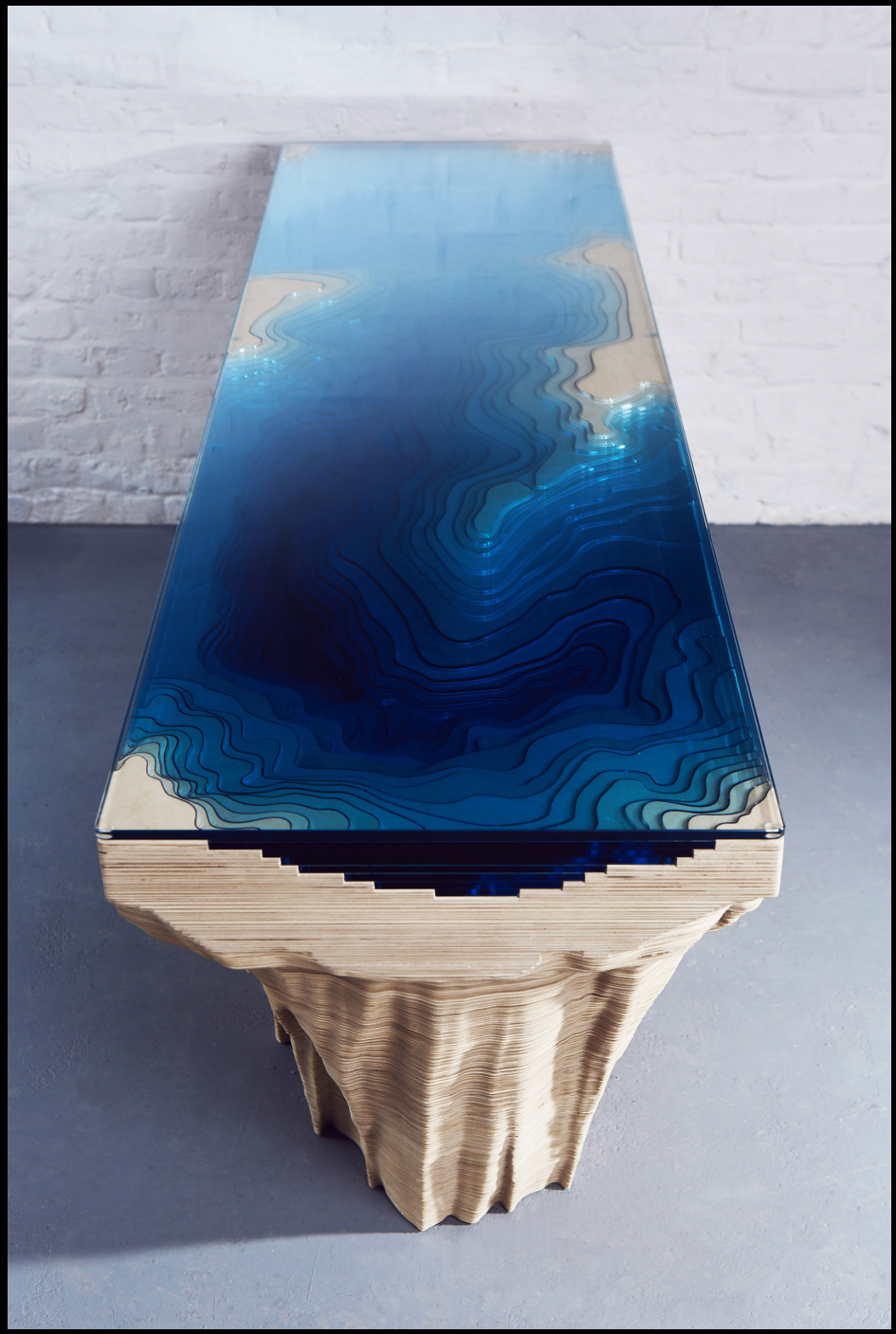
Layered landscape model of Cape Town, by Nikki Onderstall, 2015

luka.piskorec@aalto.fi



Layered cardboard model of a river bed

luka.piskorec@aalto.fi



Abyss Console Table, Christopher Duffy, courtesy of the designer and Sarah Myerscough Gallery, 2016

luka.piskorec@aalto.fi

Abyss Console Table, Christopher Duffy, courtesy of the designer and Sarah Myerscough Gallery, 2016

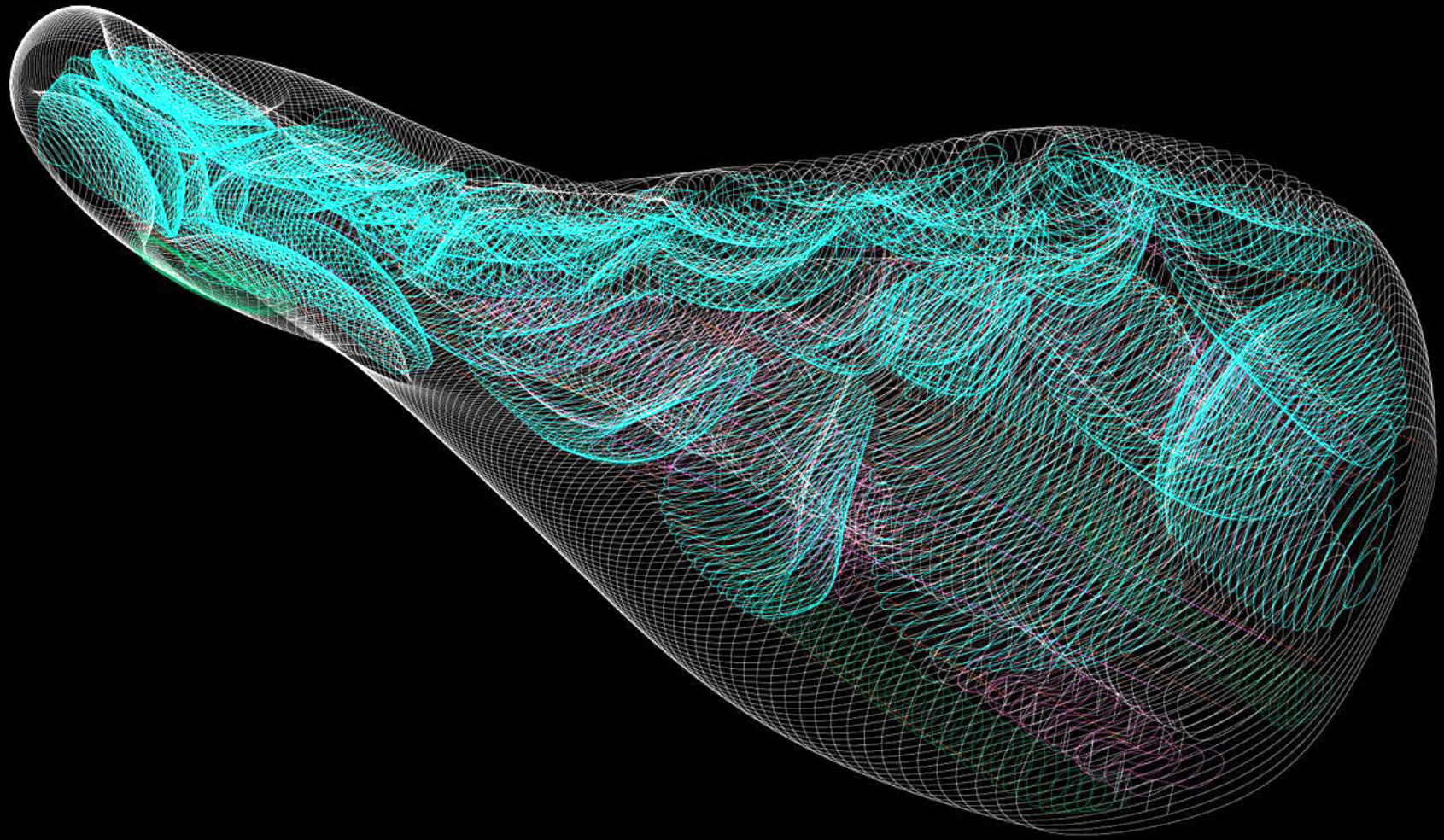
luka.piskorec@aalto.fi

Paper sculpture by Noriko Ambe, 2012

luka.piskorec@aalto.fi

Saltworks, Washington University in St. Louis, © Saltworks Studio, 2011

luka.piskorec@aalto.fi



Saltworks, Washington University in St. Louis, © Saltworks Studio, 2011

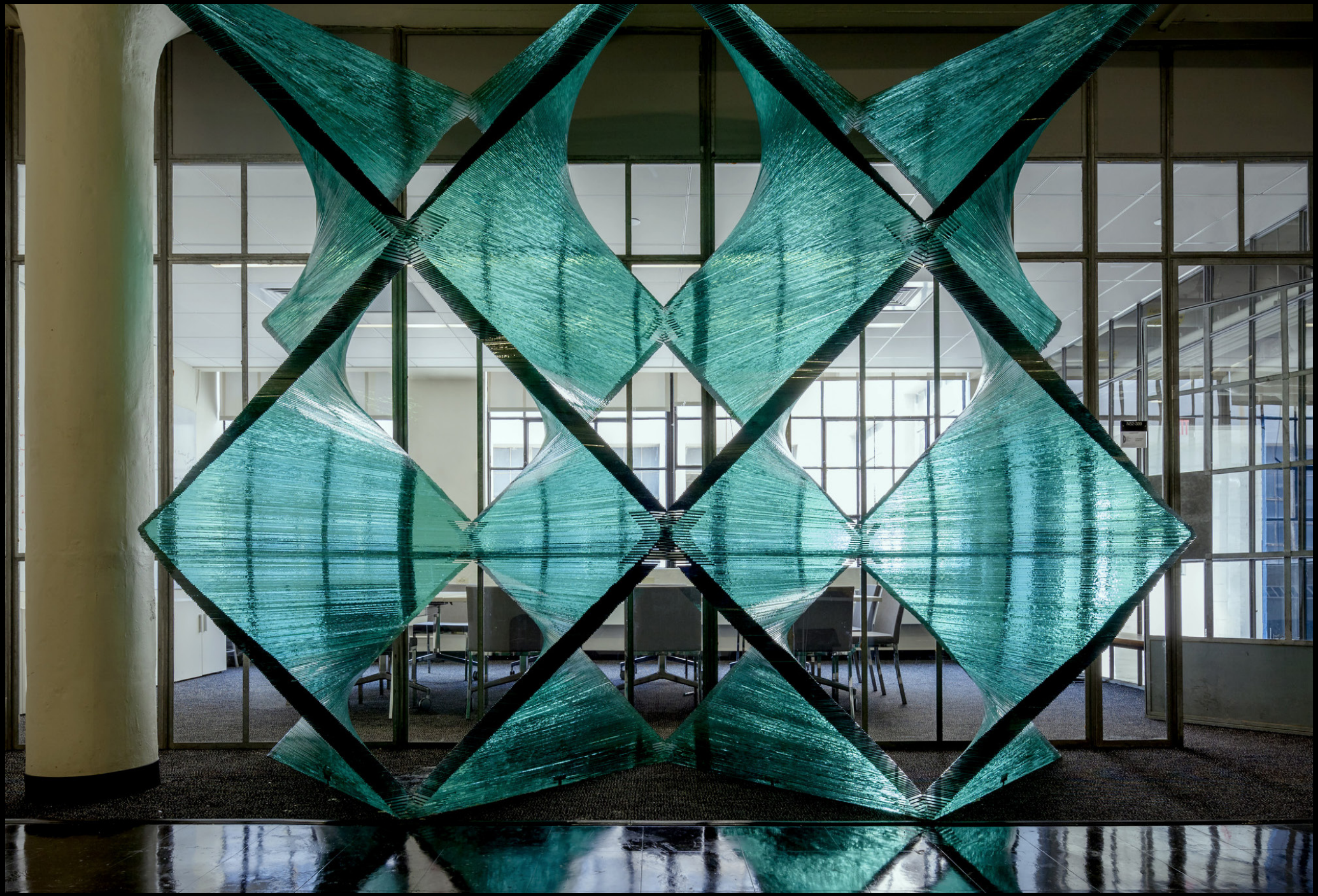
luka.piskorec@aalto.fi

Saltworks, Washington University in St. Louis, © Saltworks Studio, 2011

luka.piskorec@aalto.fi

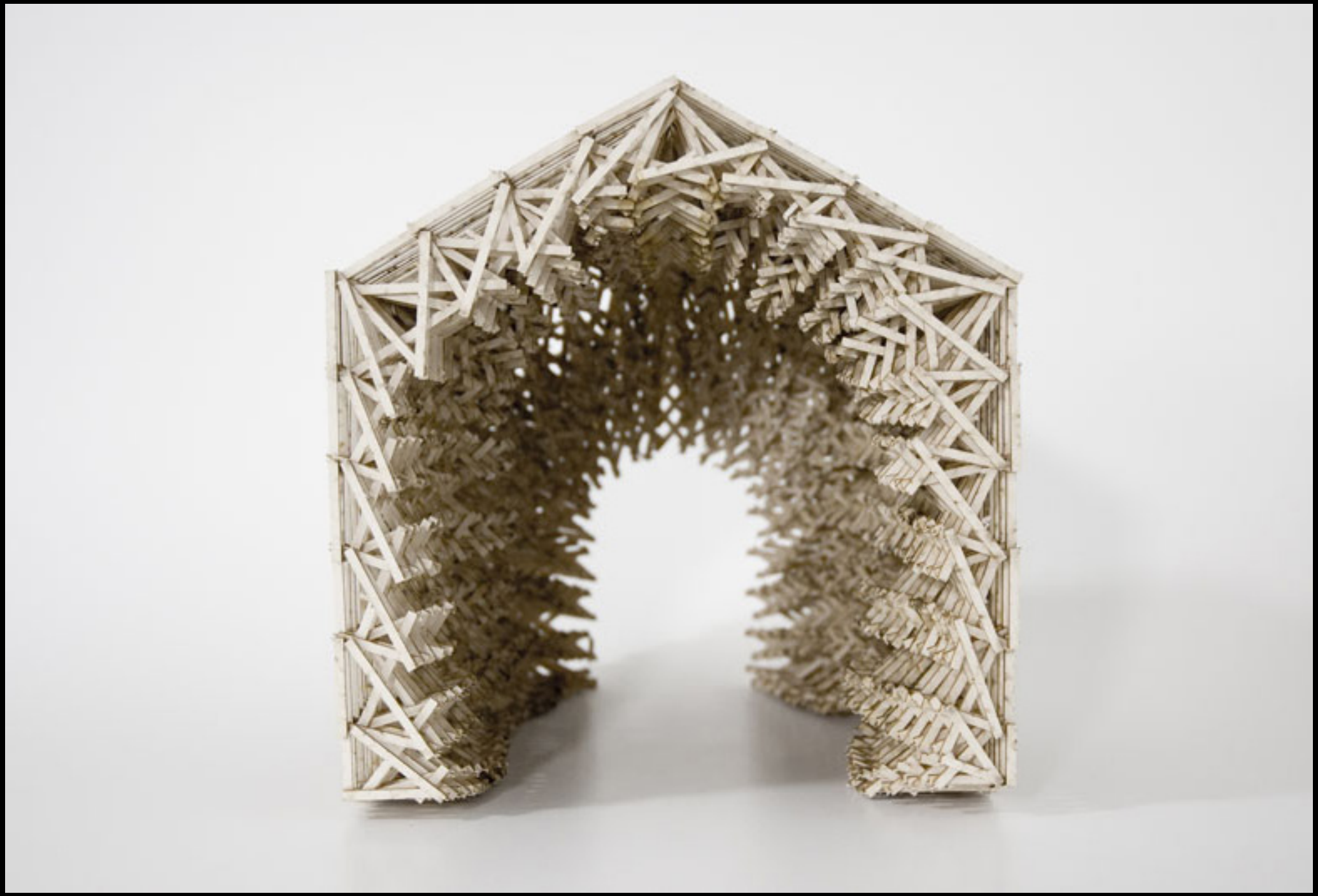
Saltworks, Washington University in St. Louis, © Saltworks Studio, 2011

luka.piskorec@aalto.fi



Tectonics of Transparency, Cristina Parreño Architecture, 2015

luka.piskorec@aalto.fi

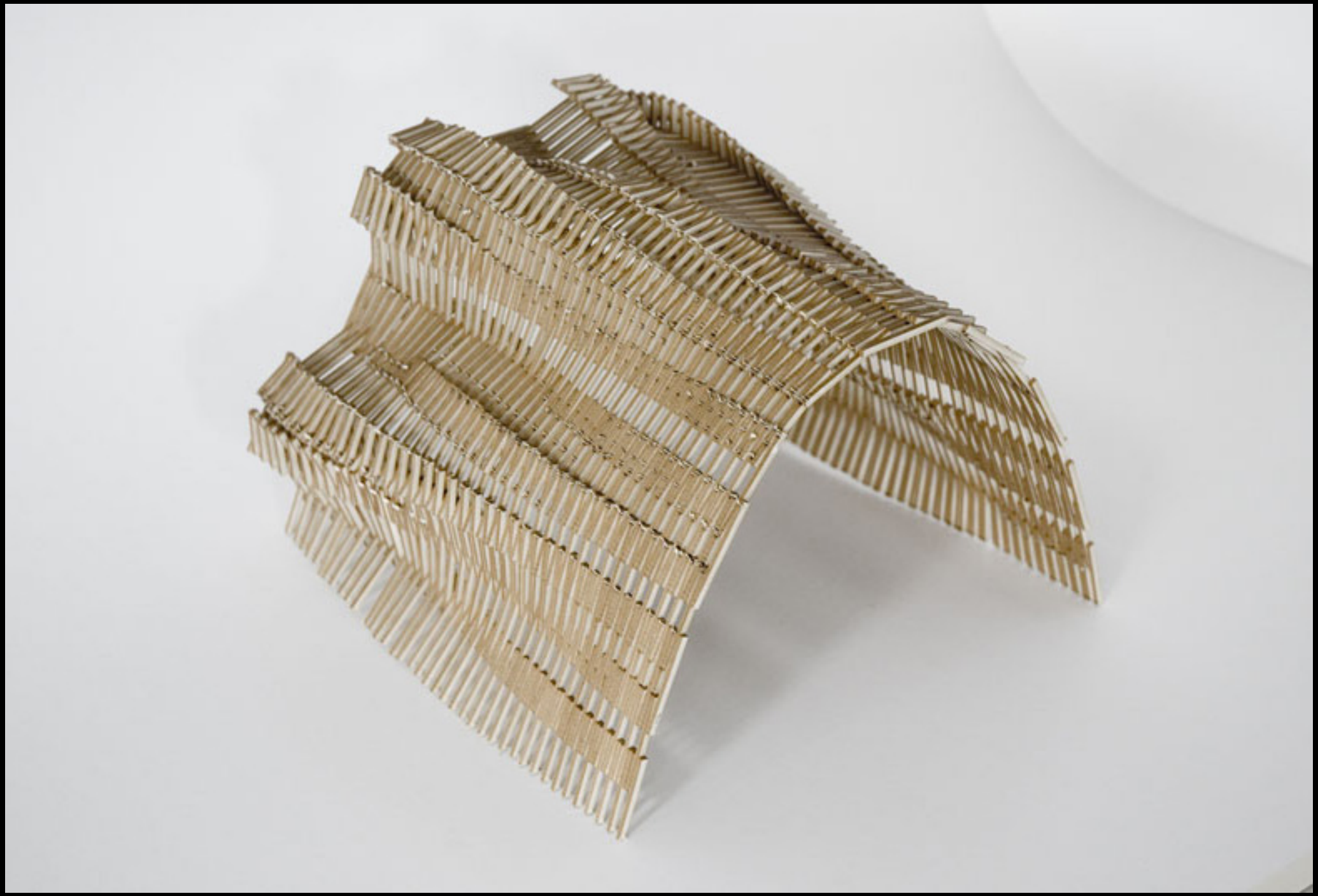


Sequential Structure, student work, Gramazio Kohler Research, ETH Zürich, 2010

luka.piskorec@aalto.fi

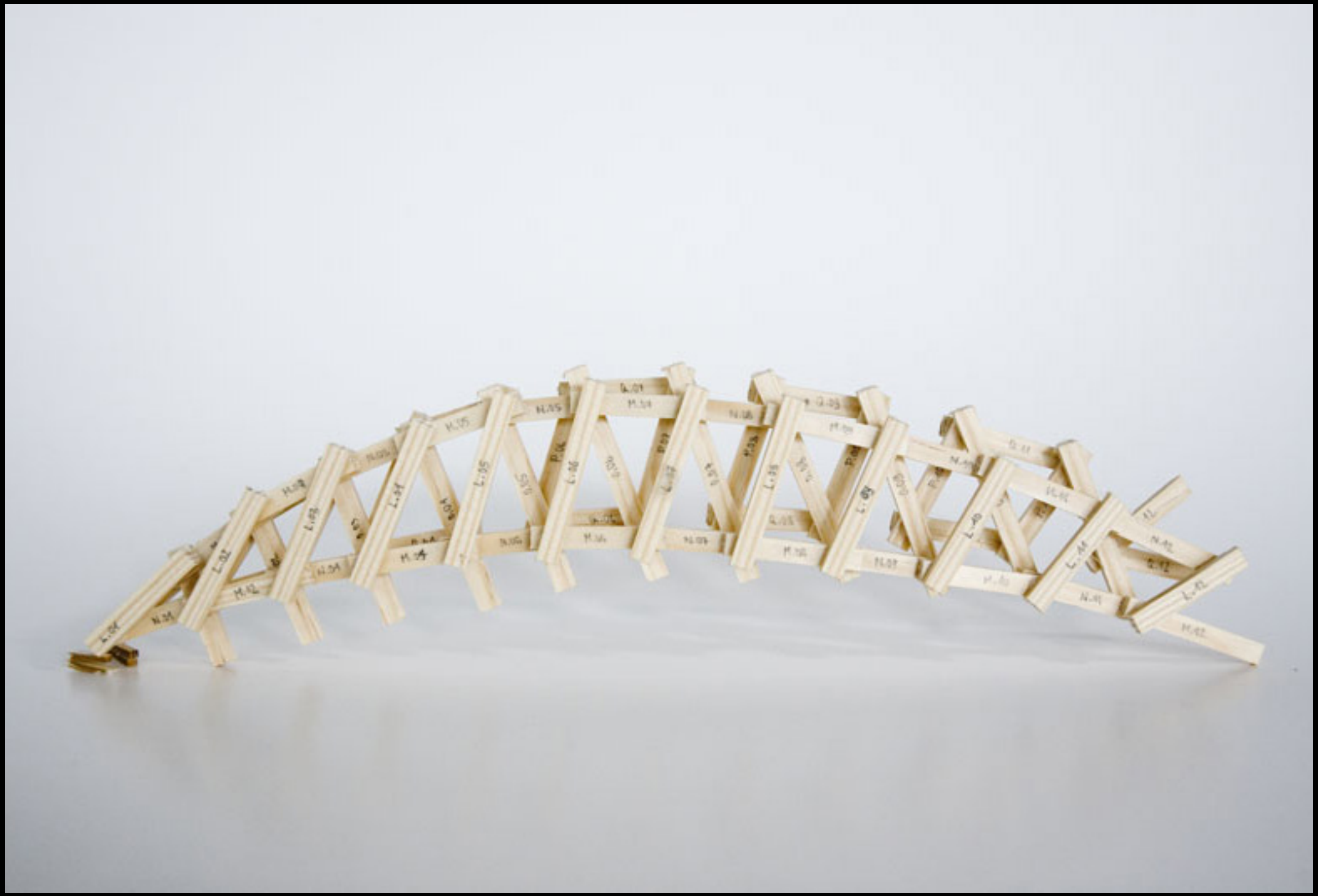
Sequential Structure, student work, Gramazio Kohler Research, ETH Zürich, 2010

luka.piskorec@aalto.fi



Sequential Structure, student work, Gramazio Kohler Research, ETH Zürich, 2010

luka.piskorec@aalto.fi



Sequential Structure, student work, Gramazio Kohler Research, ETH Zürich, 2010

luka.piskorec@aalto.fi

Sequential Structure, student work, Gramazio Kohler Research, ETH Zürich, 2010

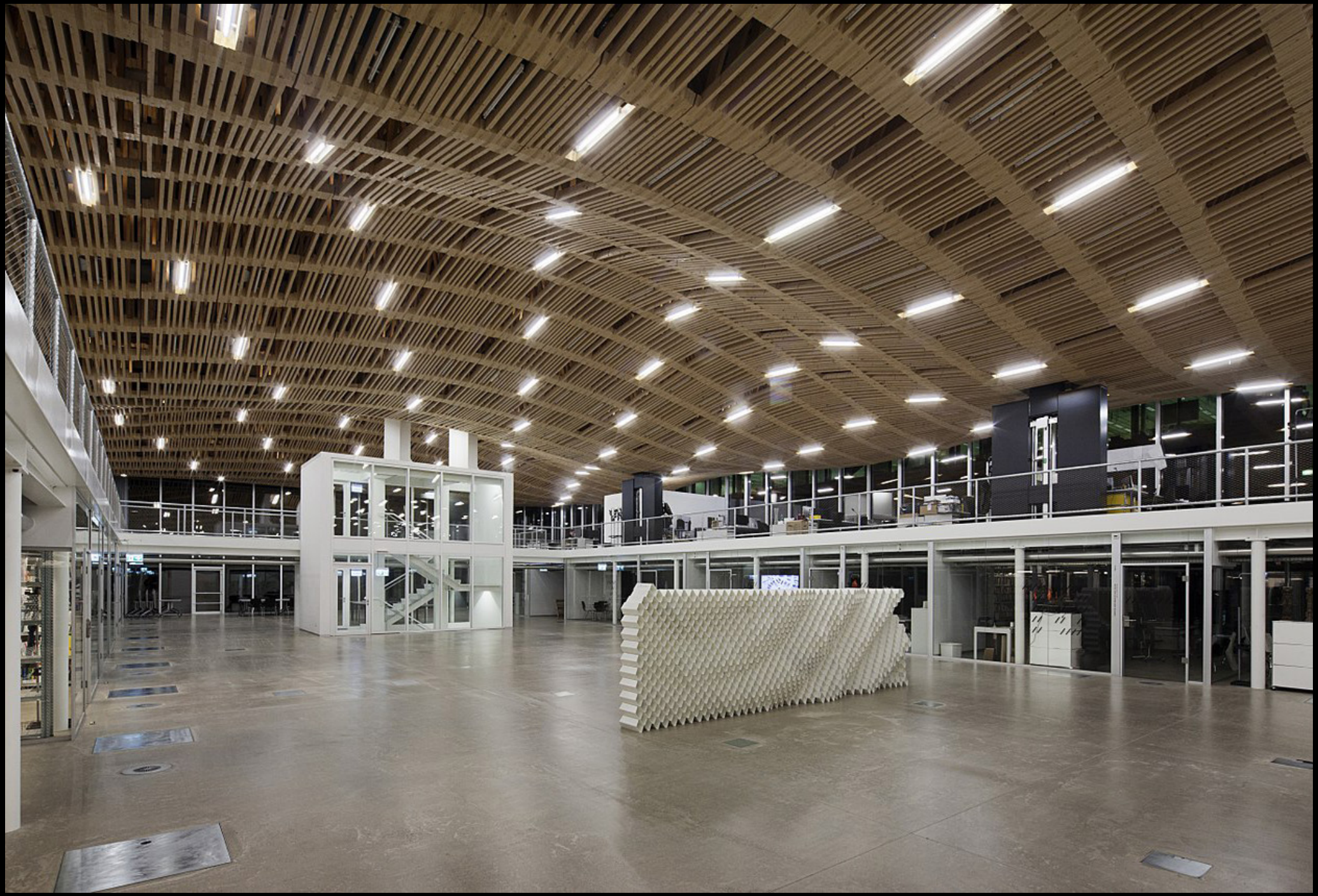
luka.piskorec@aalto.fi

Sequential Structure, student work, Gramazio Kohler Research, ETH Zürich, 2010

luka.piskorec@aalto.fi

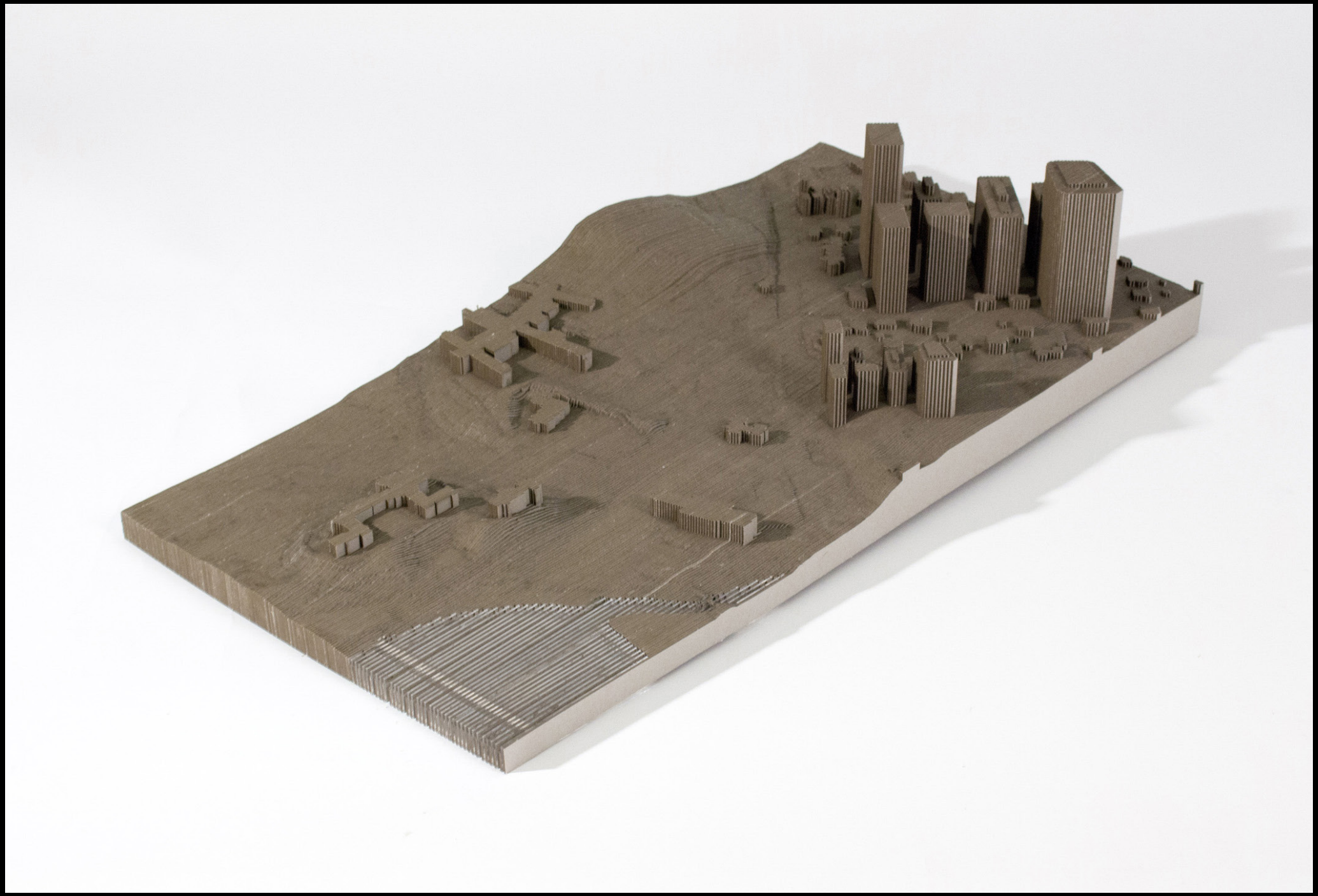
Sequential Structure, student work, Gramazio Kohler Research, ETH Zürich, 2010

luka.piskorec@aalto.fi



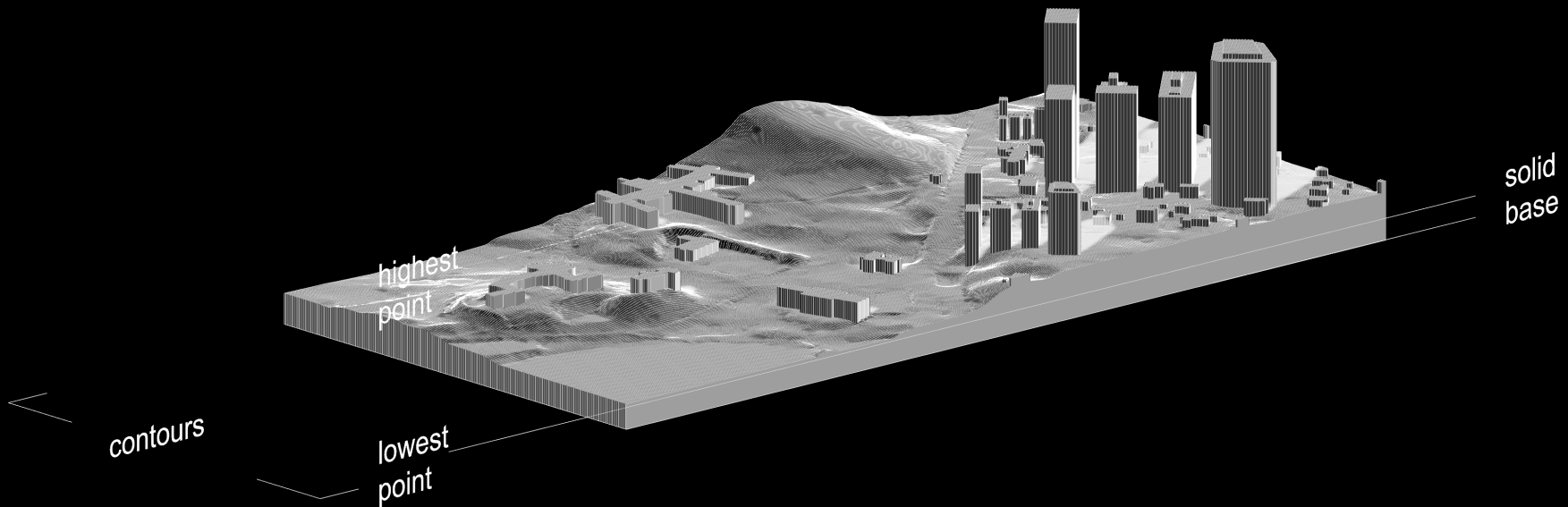
The Sequential Roof in Arch Tech Lab building, Gramazio Kohler Research, ETH Zürich, photographer Daniel Erne, 2016

luka.piskorec@aalto.fi



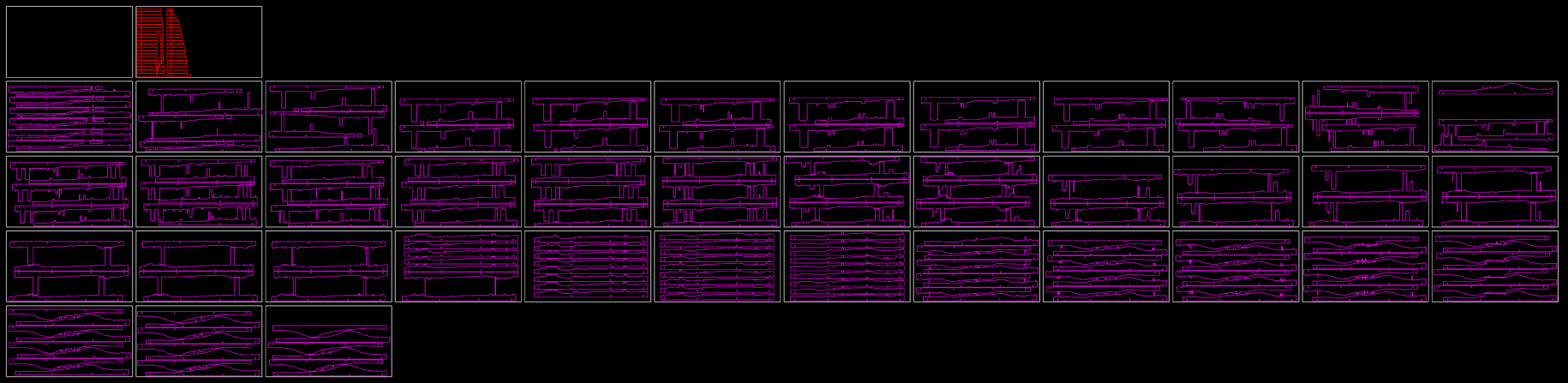
Vertical layering technique - https://wiki.harvard.edu/confluence/display/fabricationlab/Site+Modeling+Methods

luka.piskorec@aalto.fi



Vertical layering technique - https://wiki.harvard.edu/confluence/display/fabricationlab/Site+Modeling+Methods

luka.piskorec@aalto.fi

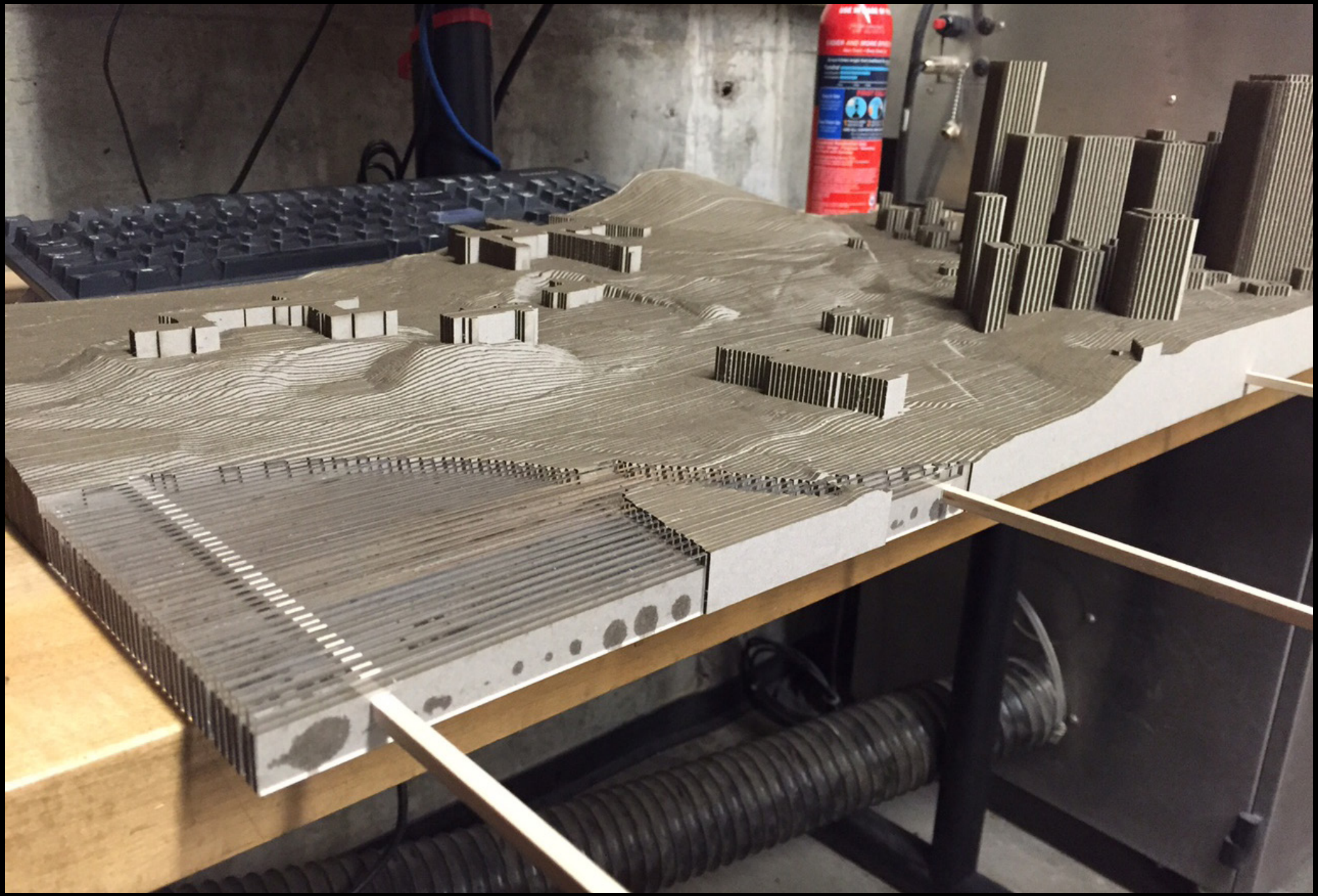


Vertical layering technique - https://wiki.harvard.edu/confluence/display/fabricationlab/Site+Modeling+Methods

luka.piskorec@aalto.fi

Vertical layering technique - https://wiki.harvard.edu/confluence/display/fabricationlab/Site+Modeling+Methods

luka.piskorec@aalto.fi

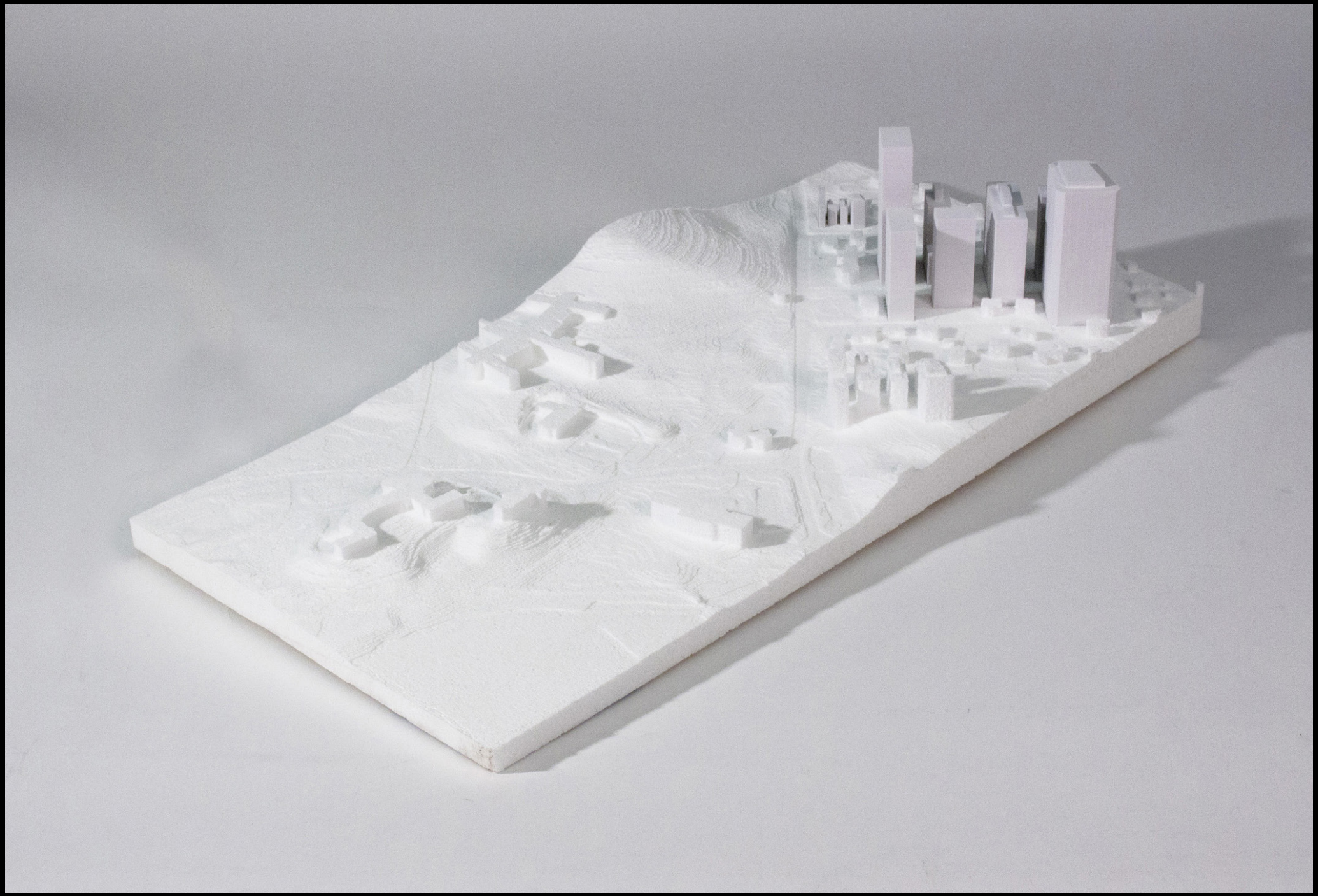


Vertical layering technique - https://wiki.harvard.edu/confluence/display/fabricationlab/Site+Modeling+Methods

luka.piskorec@aalto.fi

CNC milling technique - https://wiki.harvard.edu/confluence/display/fabricationlab/Site+Modeling+Methods

luka.piskorec@aalto.fi

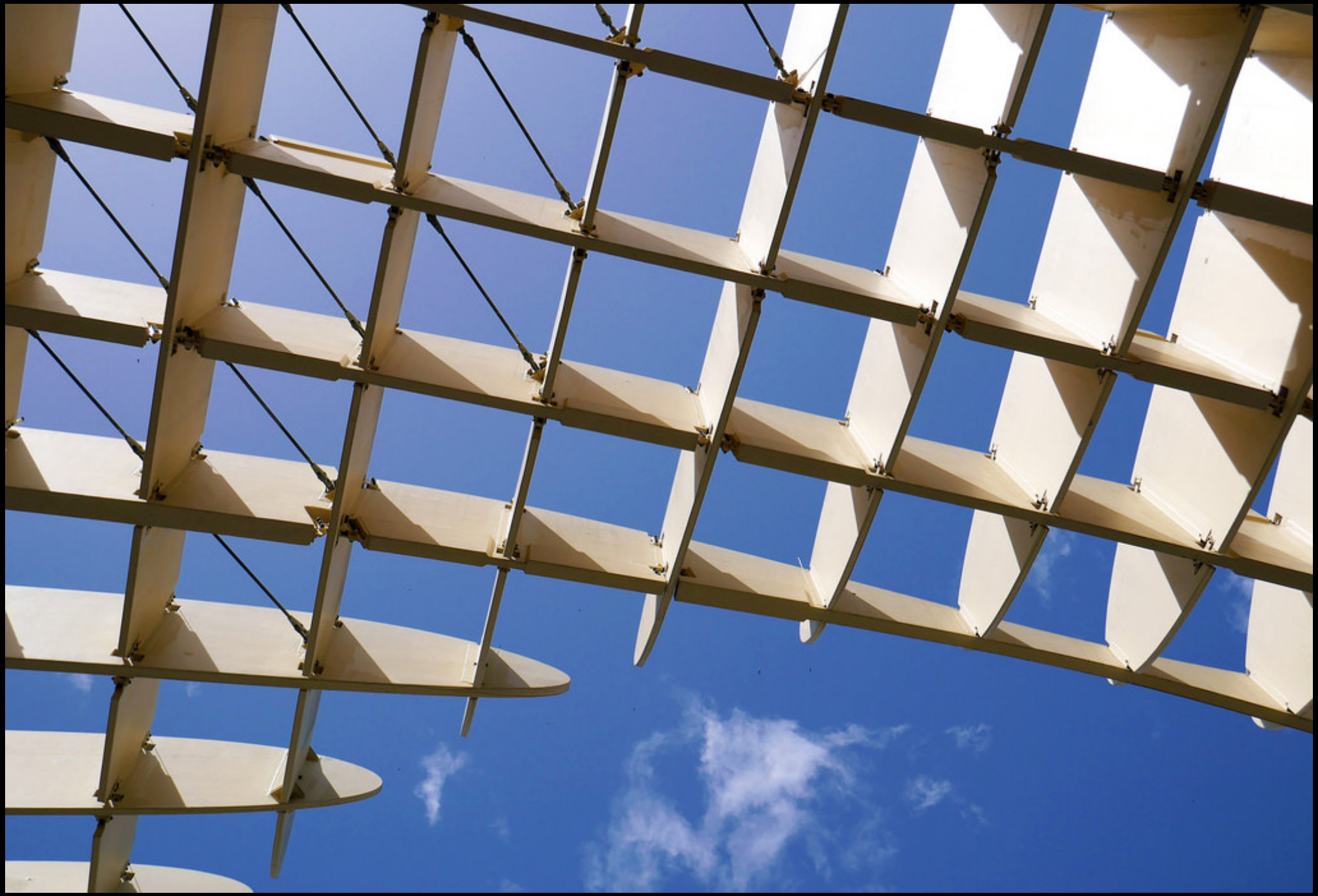


CNC milling technique - https://wiki.harvard.edu/confluence/display/fabricationlab/Site+Modeling+Methods

luka.piskorec@aalto.fi

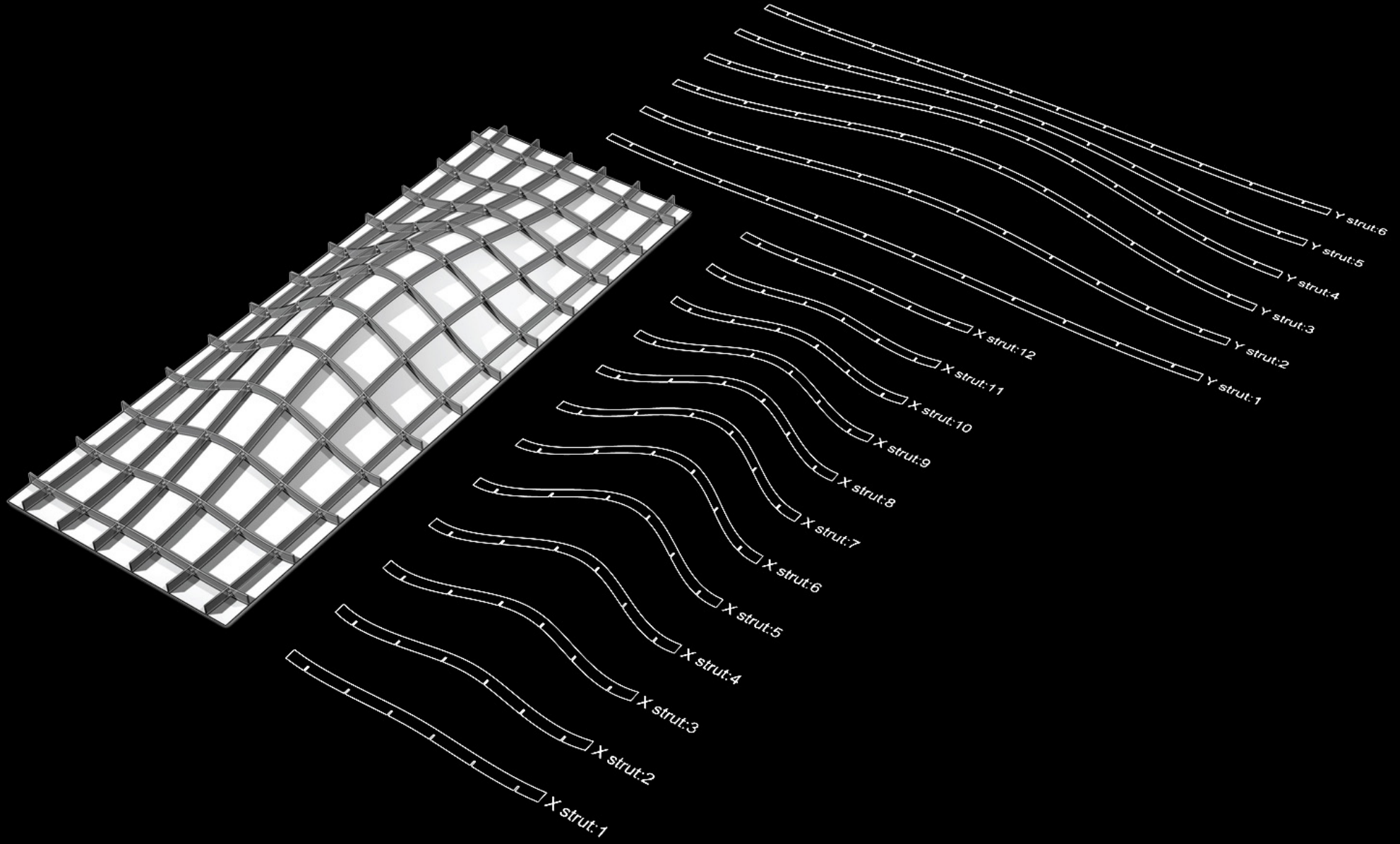
Metropol Parasol, Seville, by Jürgen Mayer, 2011

luka.piskorec@aalto.fi



Metropol Parasol, Seville, by Jürgen Mayer, 2011

luka.piskorec@aalto.fi

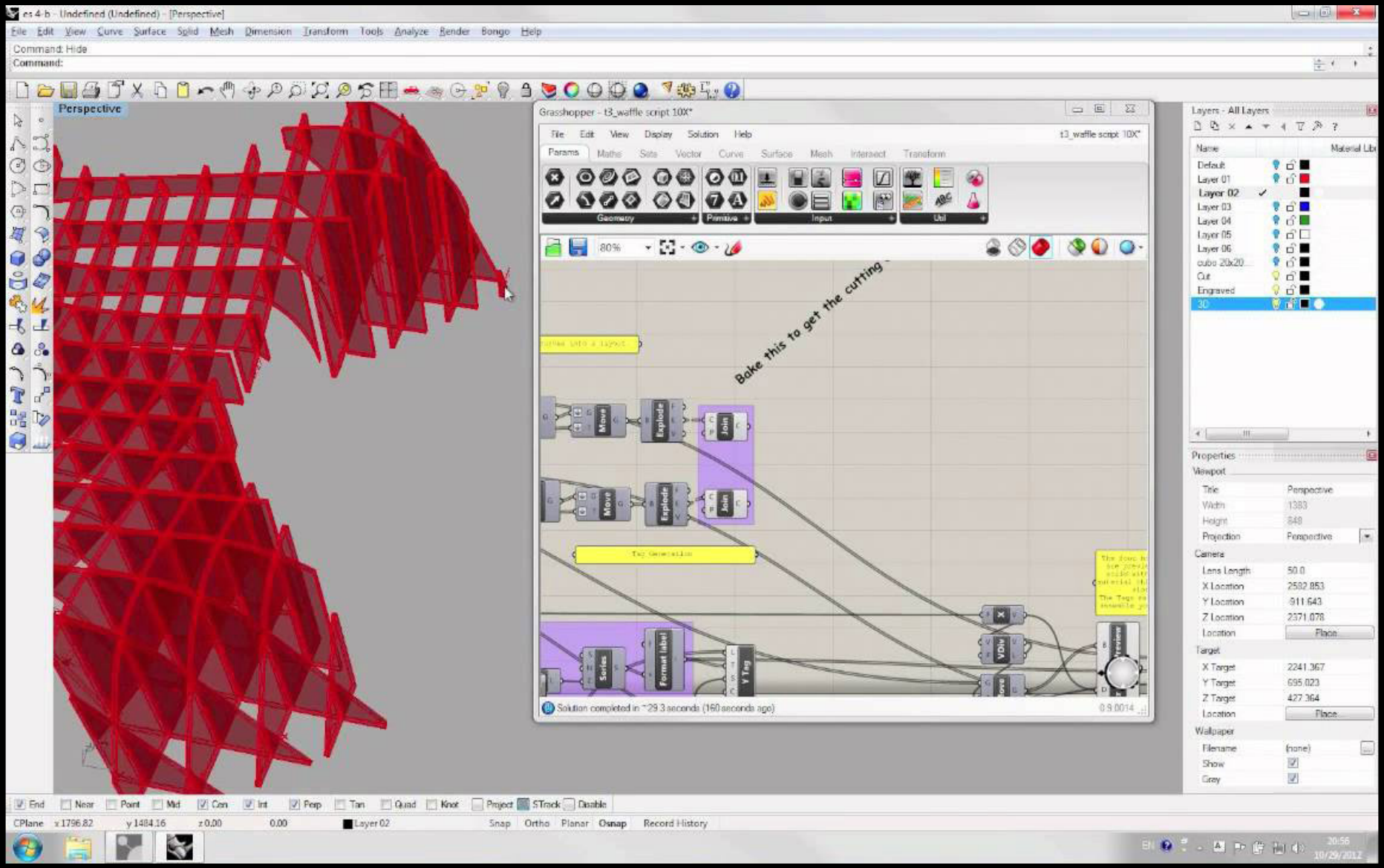


Waffle structural system, coded by Andrew Payne, Lift Architects, 2011

luka.piskorec@aalto.fi

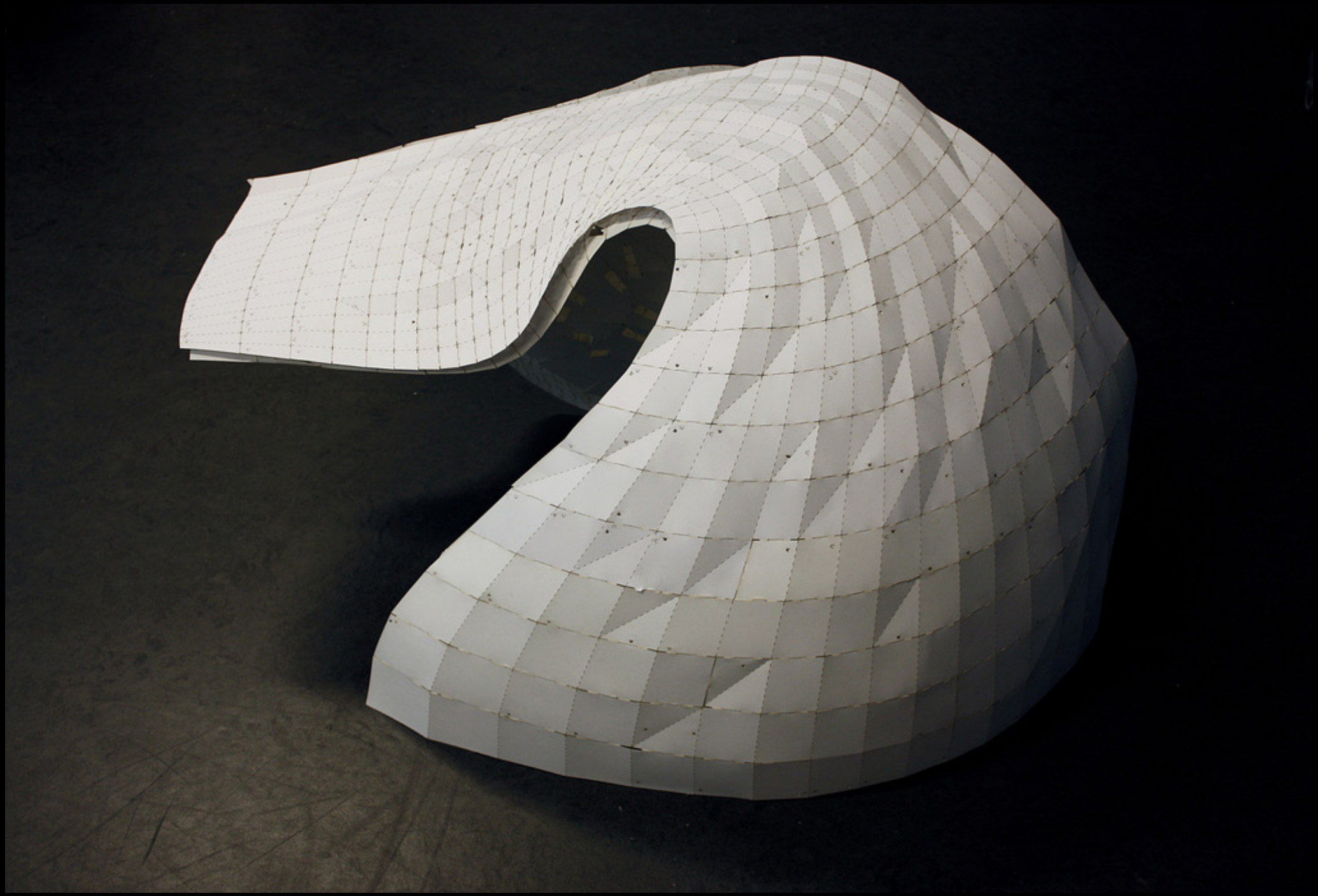
Laser cutter cutting plywood sheet

luka.piskorec@aalto.fi



Waffle structure generated in Rhino Grasshopper

luka.piskorec@aalto.fi

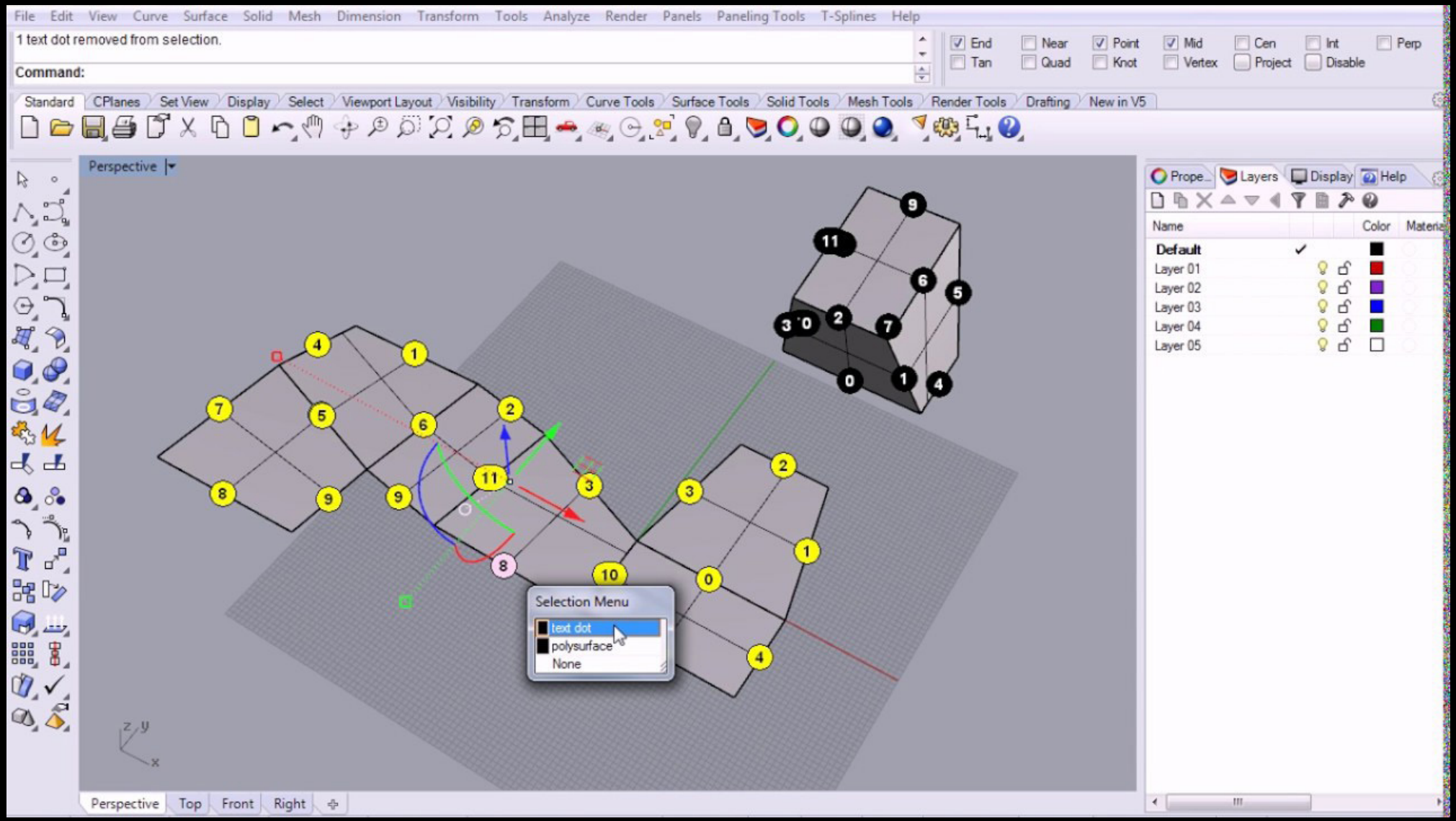


Tessellated free-form surface paper model by Trevor Patt

luka.piskorec@aalto.fi

Tessellated free-form surface paper model by Trevor Patt

luka.piskorec@aalto.fi



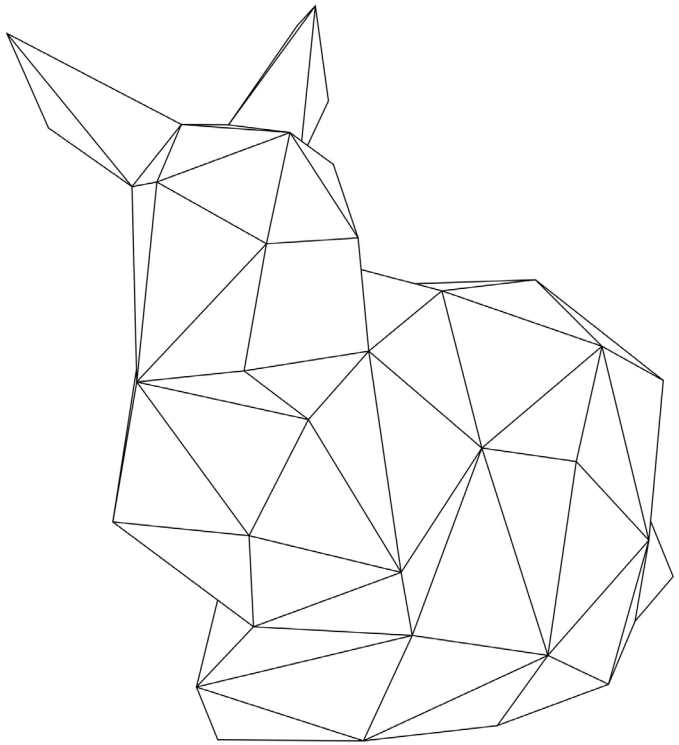
The **UnrollSrf** command flattens (develops) a surface or polysurface with curvature in one direction to a planar surface

luka.piskorec@aalto.fi

Rhino 3D - Digital Crafting Tutorial

instructions for simple shape fabrication

Triangulation

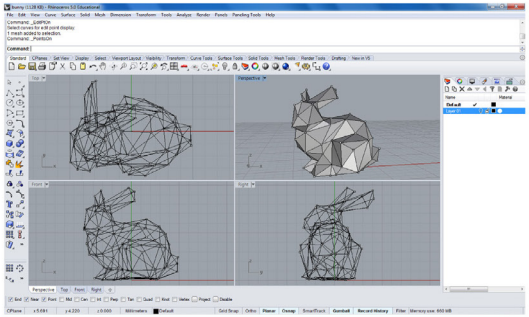


Manuel Kretzer 2016

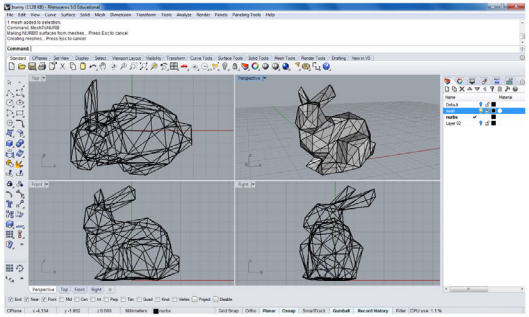
Triangulation tutorial by Manuel Kretzer, 2016 - http://responsivedesign.de/wp-content/uploads/2016/01/tutorial-01_triangulation.pdf

luka.piskorec@aalto.fi

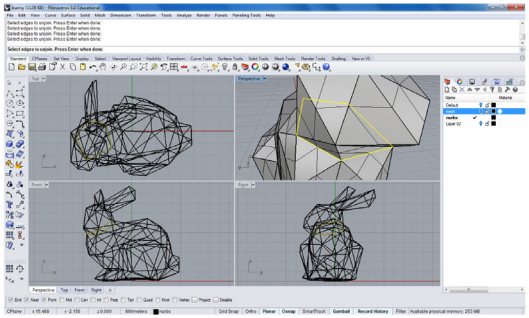
4.
Check the appearance of the geometry. Turn on control points (_PointsOn) to adjust mesh polygons manually and - if desired - transform the geometry.



5.
Use _MeshToNURB to change the MESH back into a NURBS geometry. More info on the command can be found here: http://wiki.mcneel.com/rhino/meshtonurb
Use _TriangulateMesh or _ TriangulateNonPlanarQuads to ensure all mesh polygons are flat and developable.

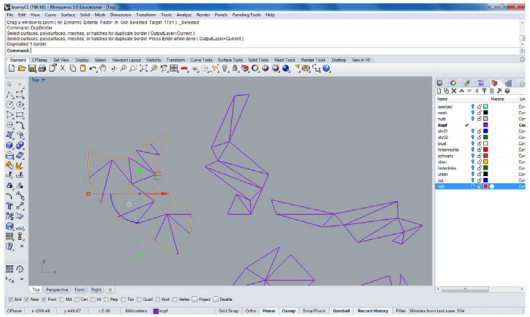


6.
Depending on the complexity of the geometry it might not be developable in one piece. The command _UnjoinEdge can be used in order to break the object into several smaller parts. The command needs to be repeated until all parts can be unrolled without overlaps as shown in the following step.

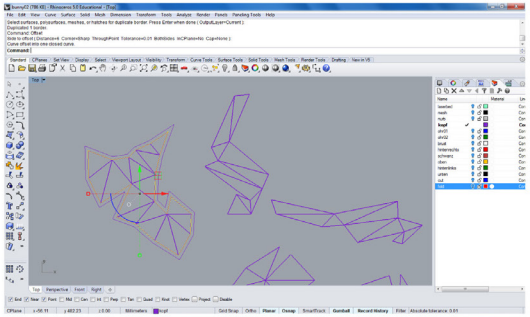


luka.piskorec@aalto.fi

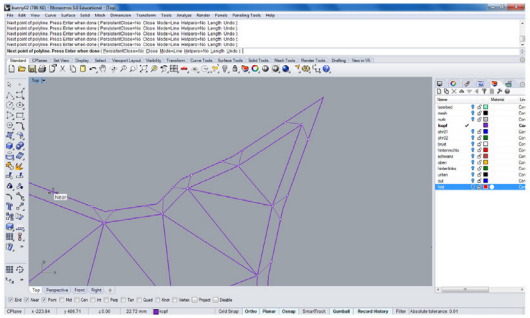
10.
Use _DupBorder to duplicate the borders of each unrolled pattern.



11.
Use _Offset and choose as ‘Distance’ a number large enough for the gluing joints. Depending on the model size 3 - 8 mm should be sufficient.



12.
Use the shifted border as a guide to manually draw the gluing joints. When finished erase the previously created border.



luka.piskorec@aalto.fi

finished object

www.responsivedesign.de

luka.piskorec@aalto.fi

Vaulted Willow by THEVERYMANY, Borden Park, Edmont, Canada, 2014

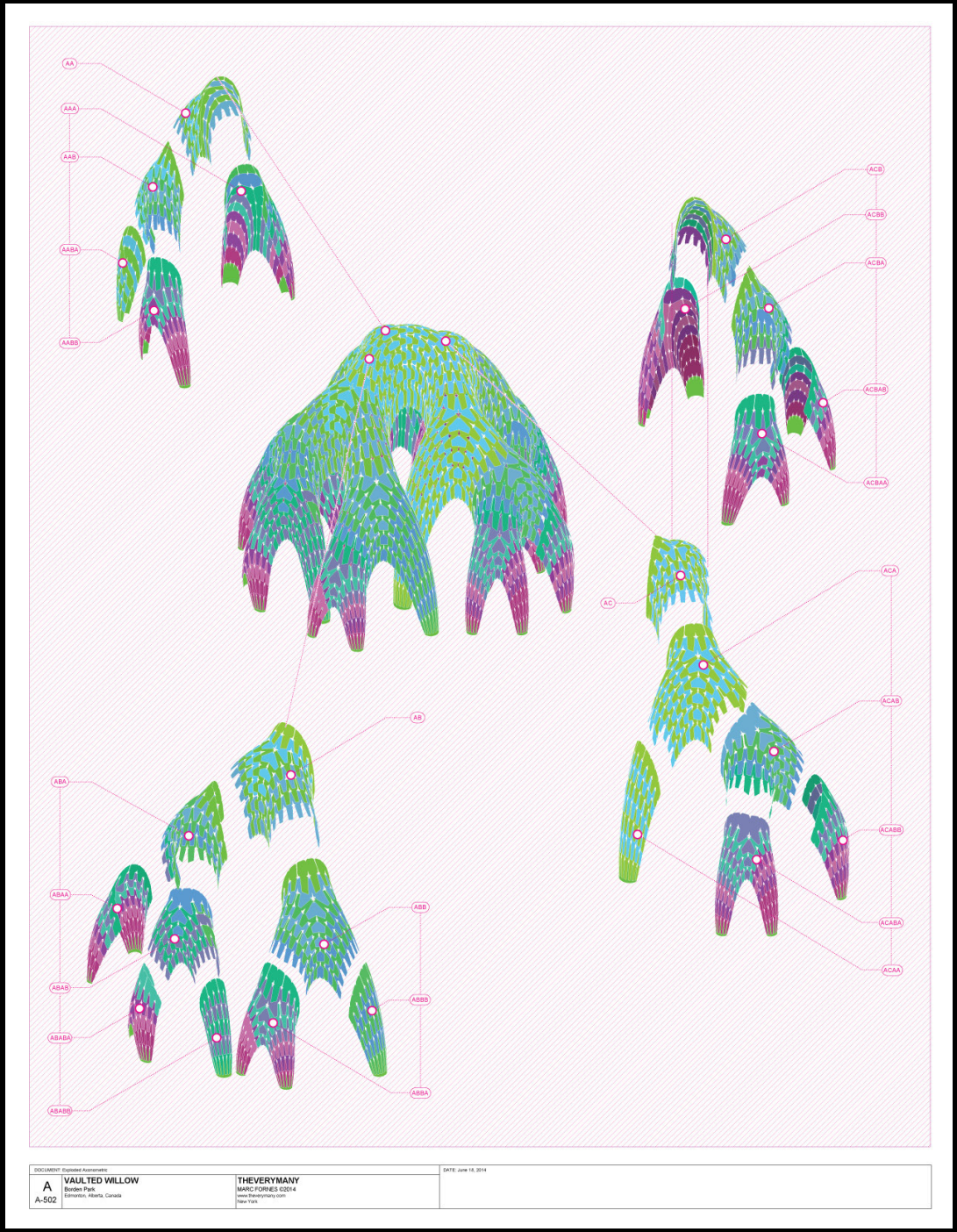
luka.piskorec@aalto.fi

Vaulted Willow by THEVERYMANY, Borden Park, Edmont, Canada, 2014

luka.piskorec@aalto.fi

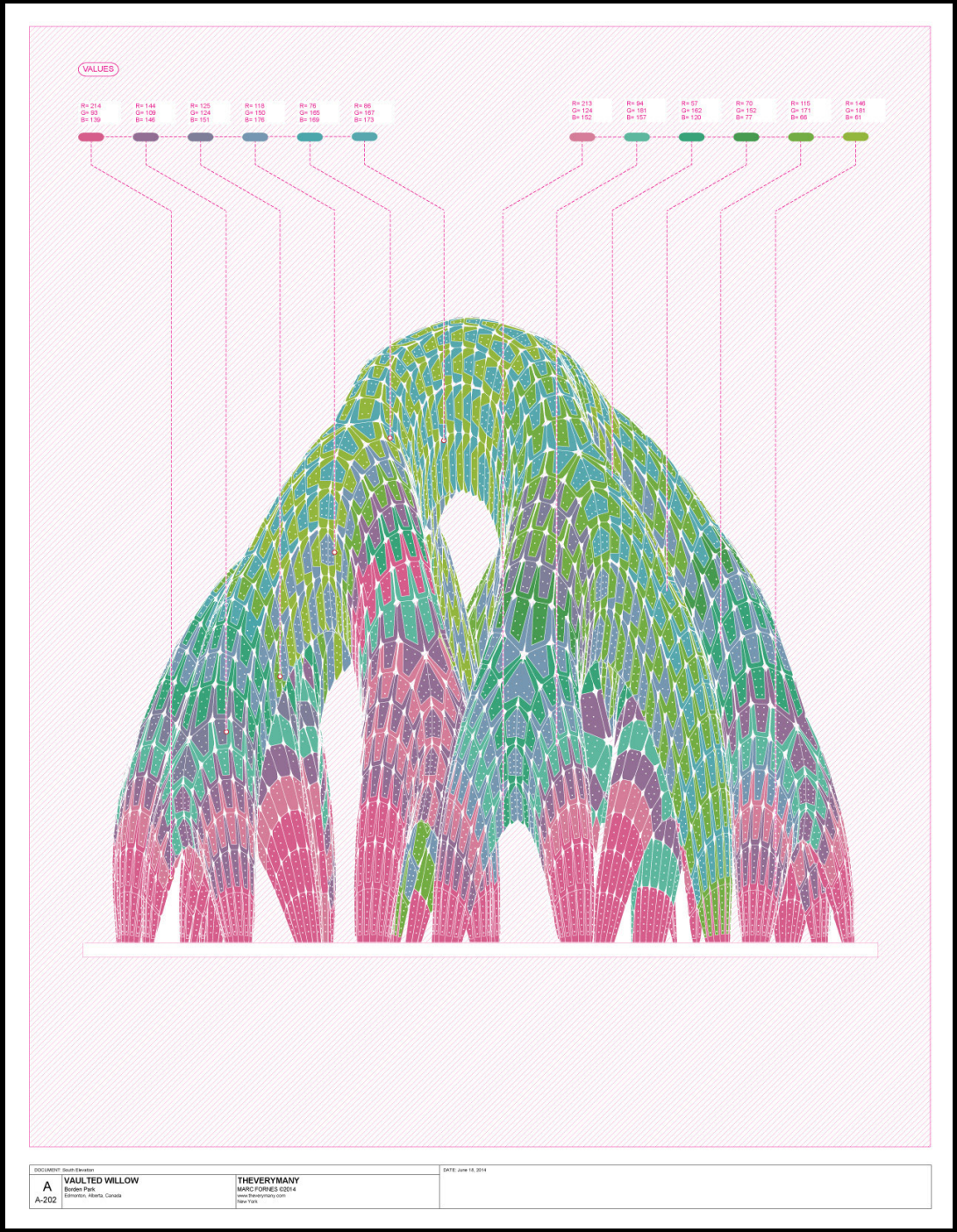
Vaulted Willow by THEVERYMANY, Borden Park, Edmont, Canada, 2014

luka.piskorec@aalto.fi



Vaulted Willow by THEVERYMANY, Borden Park, Edmont, Canada, 2014

luka.piskorec@aalto.fi

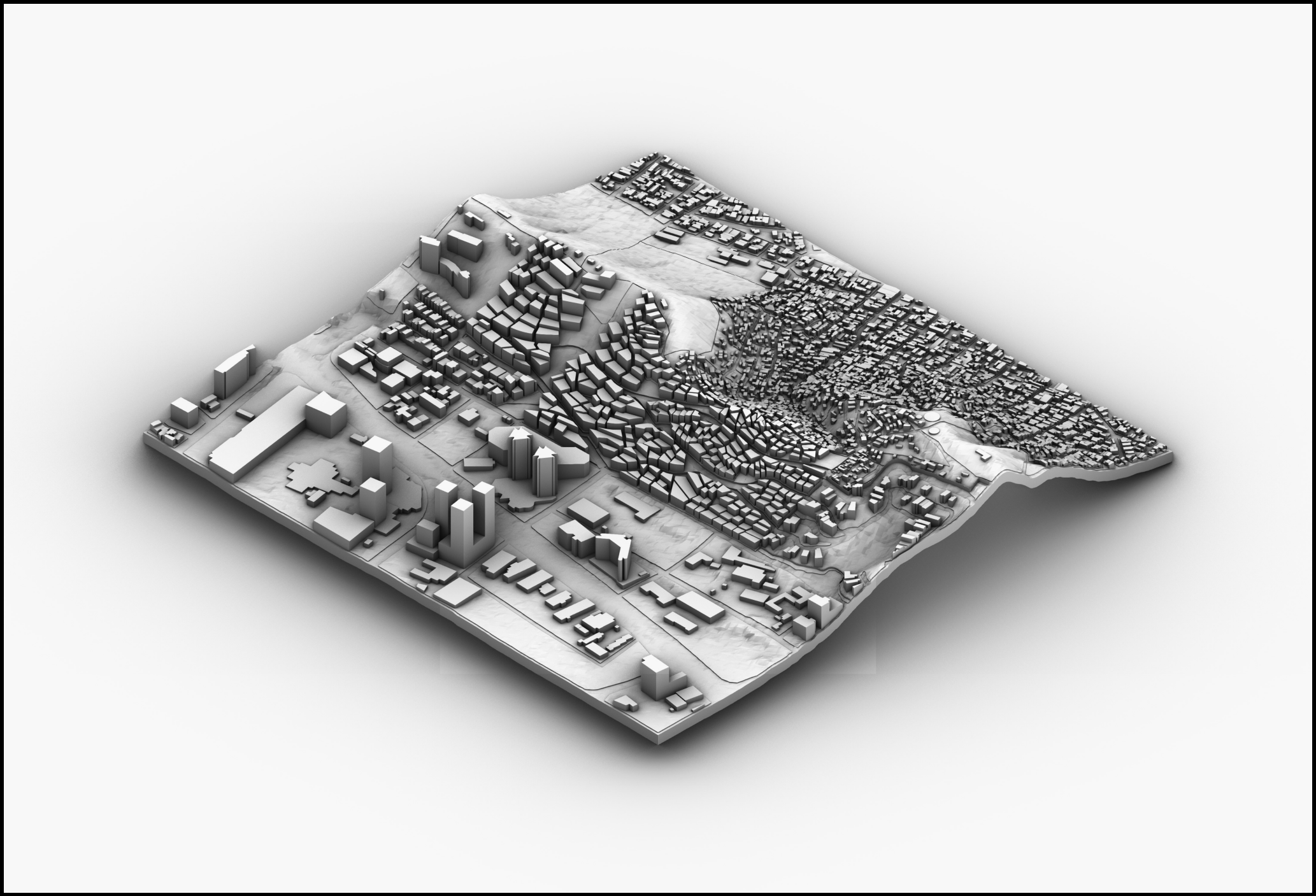


Vaulted Willow by THEVERYMANY, Borden Park, Edmont, Canada, 2014

luka.piskorec@aalto.fi

Vaulted Willow by THEVERYMANY, Borden Park, Edmont, Canada, 2014

luka.piskorec@aalto.fi



Student project by Salvador Hernandez Gazga, Design of Structures, Aalto University, 2018

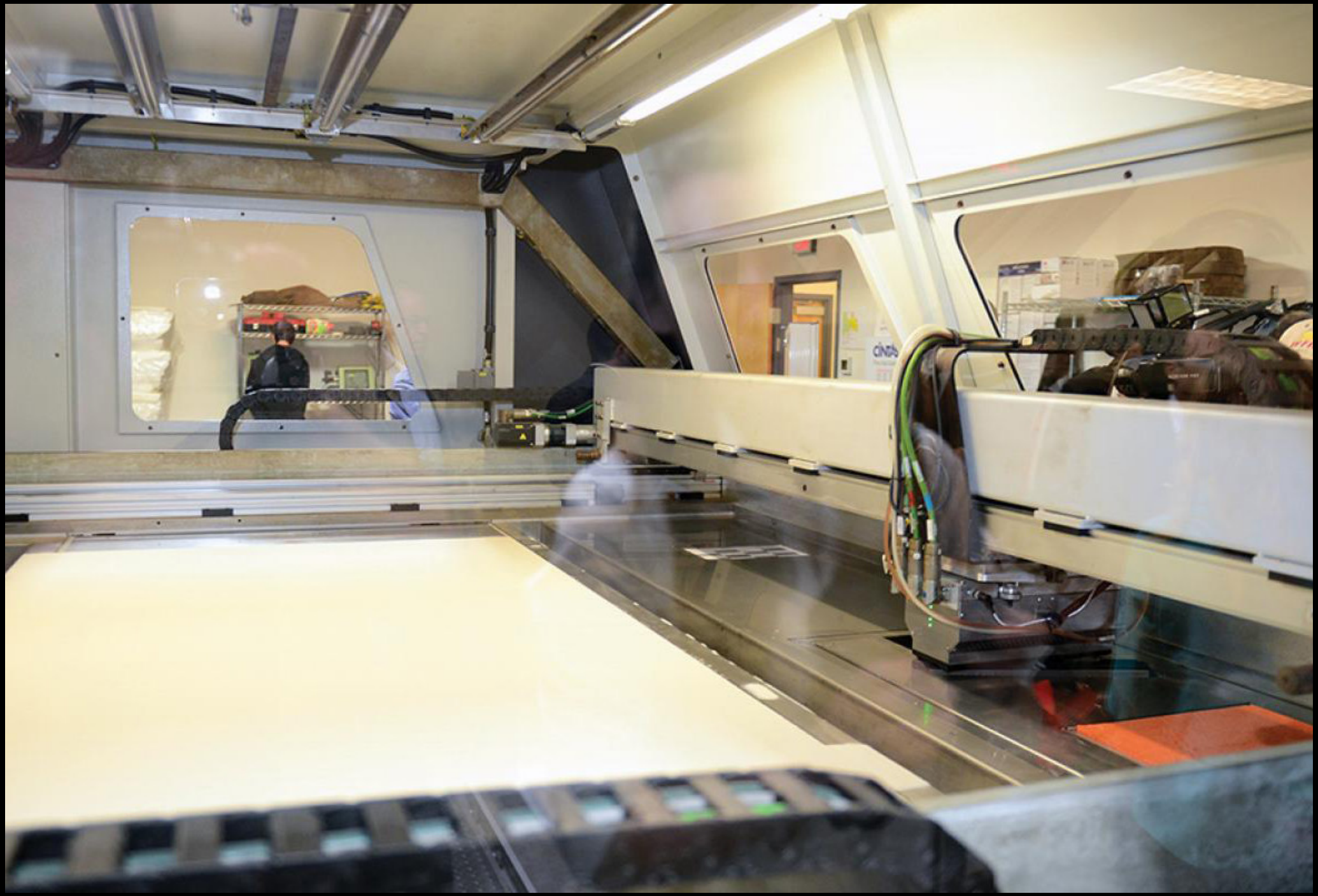
luka.piskorec@aalto.fi

Student project by Salvador Hernandez Gazga, Design of Structures, Aalto University, 2018

luka.piskorec@aalto.fi

Digital Grotesque II, 3D printed architecture by Michael Hansmeyer and Benjamin Dillenburger, 2017

luka.piskorec@aalto.fi



Digital Grotesque II, 3D printed architecture by Michael Hansmeyer and Benjamin Dillenburger, 2017

luka.piskorec@aalto.fi

Digital Grotesque II, 3D printed architecture by Michael Hansmeyer and Benjamin Dillenburger, 2017

luka.piskorec@aalto.fi

Digital Grotesque II, 3D printed architecture by Michael Hansmeyer and Benjamin Dillenburger, 2017

luka.piskorec@aalto.fi

Digital Grotesque II, 3D printed architecture by Michael Hansmeyer and Benjamin Dillenburger, 2017

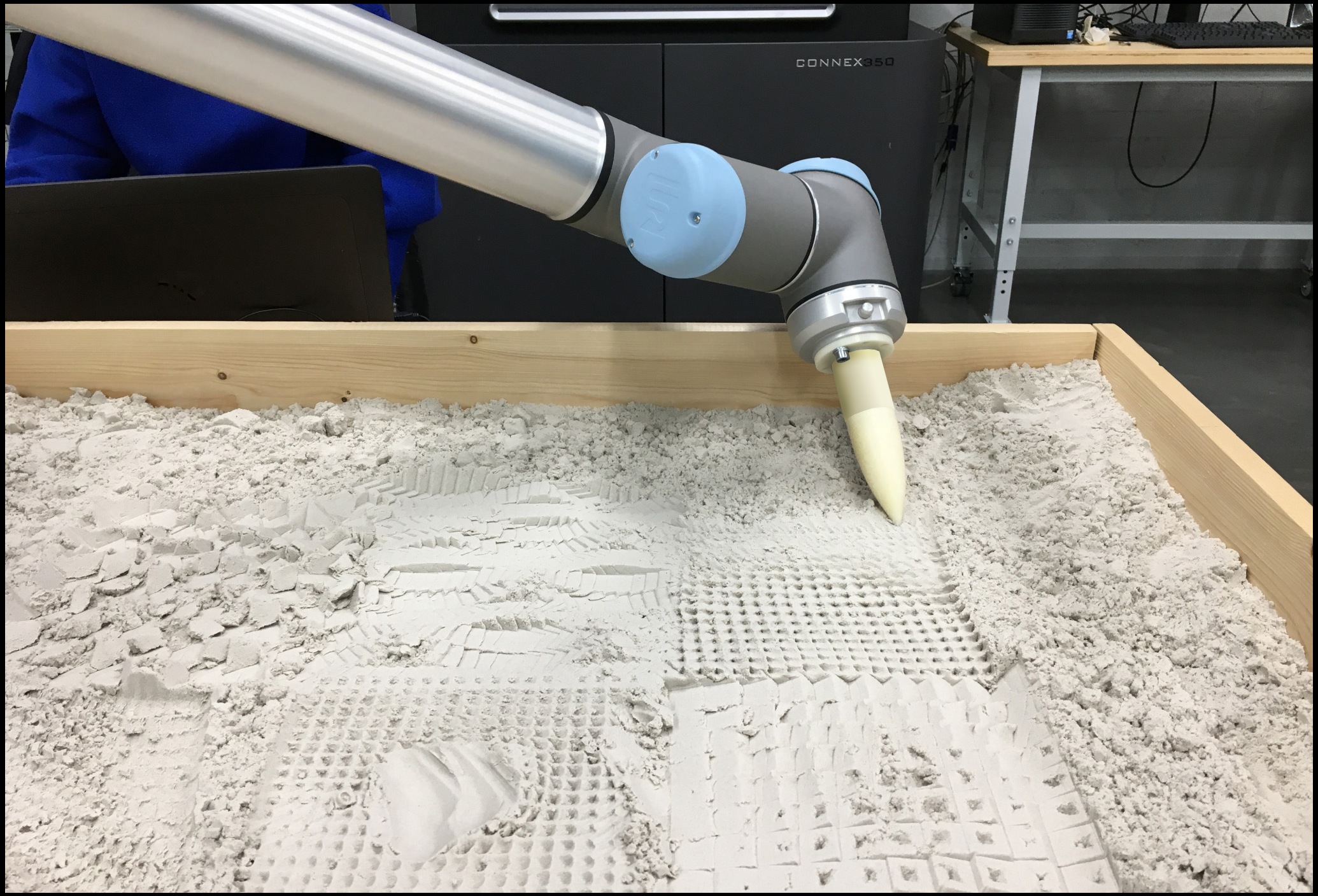
luka.piskorec@aalto.fi

Digital Grotesque II, 3D printed architecture by Michael Hansmeyer and Benjamin Dillenburger, 2017

luka.piskorec@aalto.fi

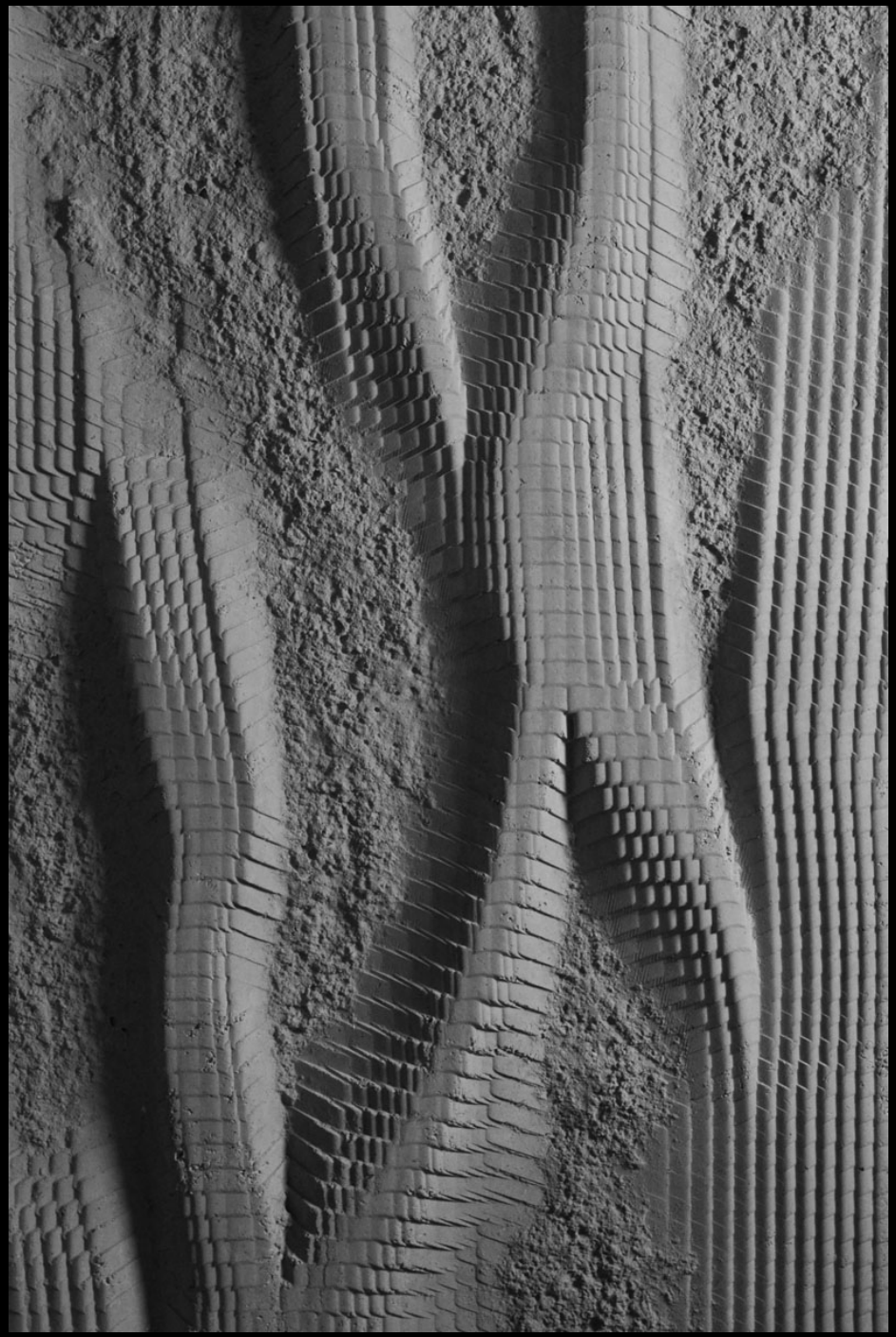
Design od Structures, Aalto University, 2018

luka.piskorec@aalto.fi



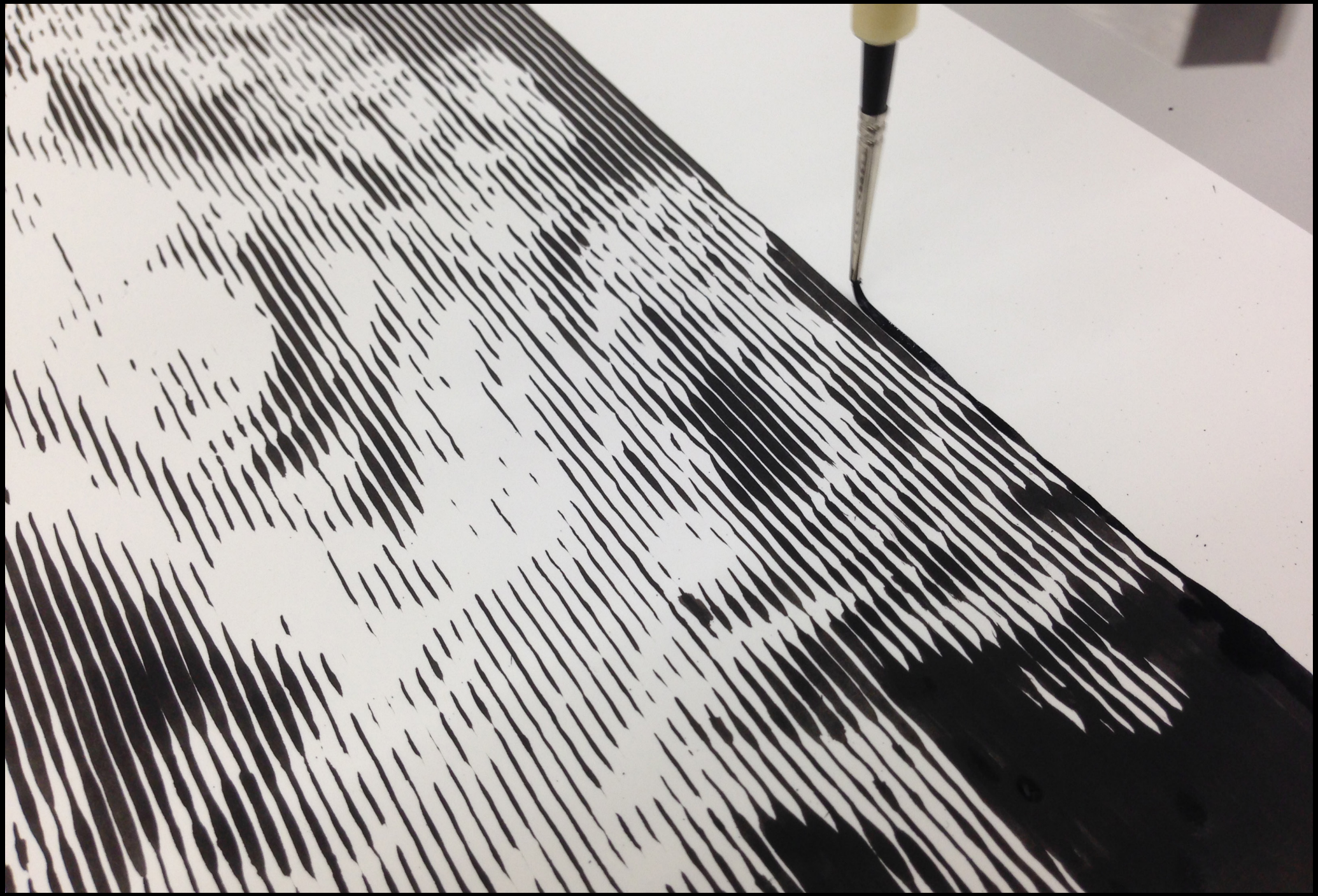
Student project by Tone Thorbjørnsen and Solveig Paulsen, Design od Structures, Aalto University, 2018

luka.piskorec@aalto.fi

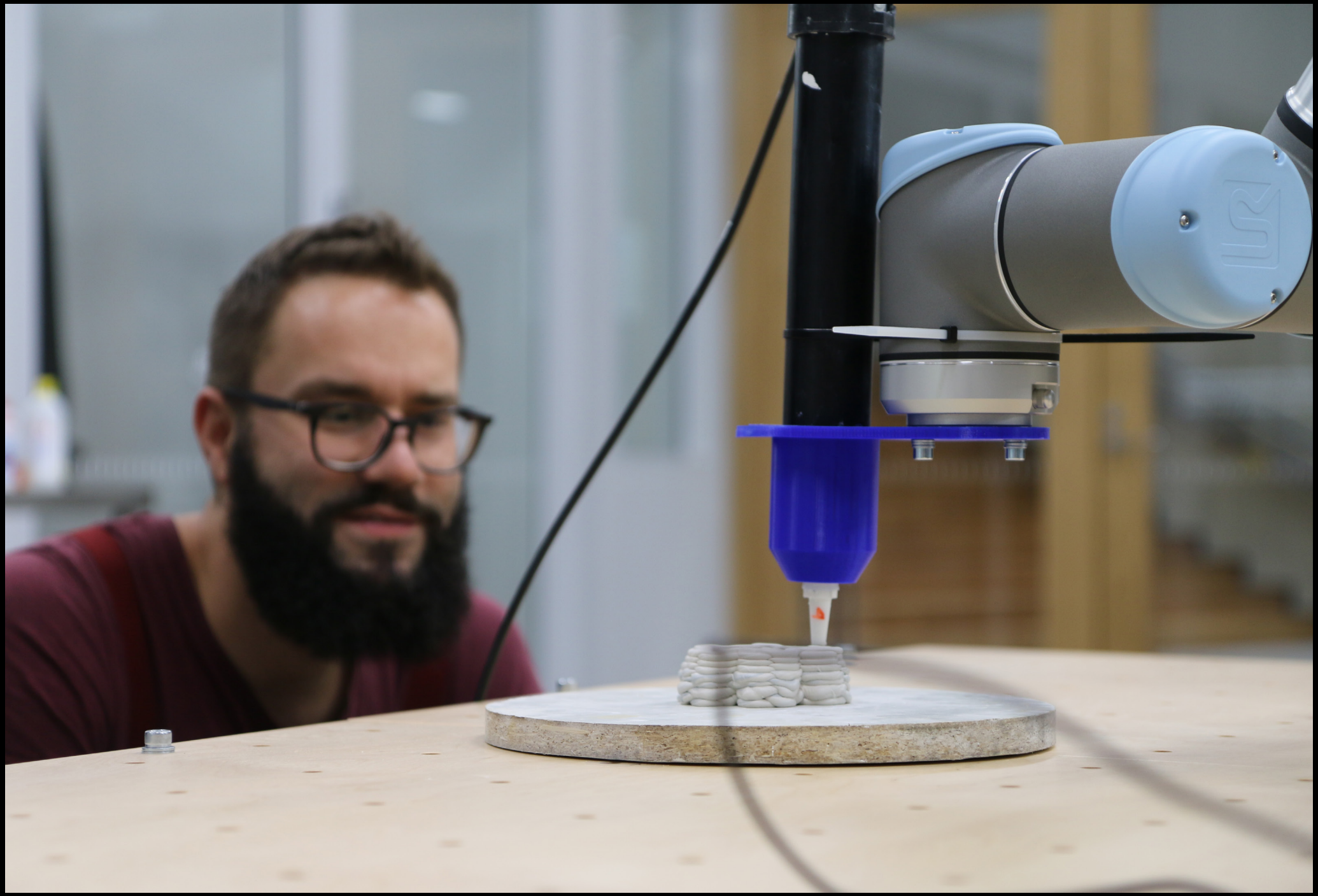


Procedural Landscapes, Gramazio Kohler Research, ETH Zürich, 2011

luka.piskorec@aalto.fi



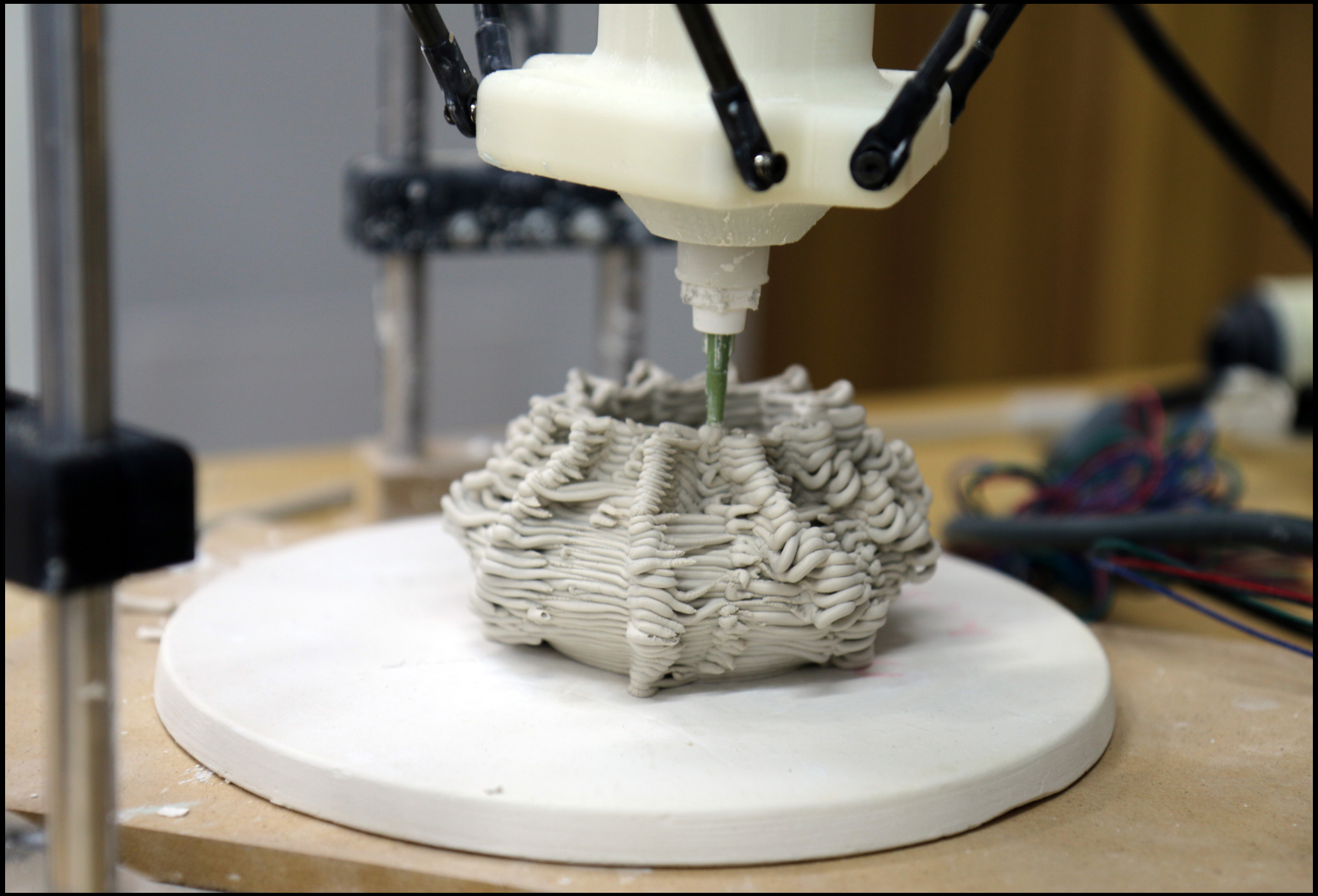
luka.piskorec@aalto.fi



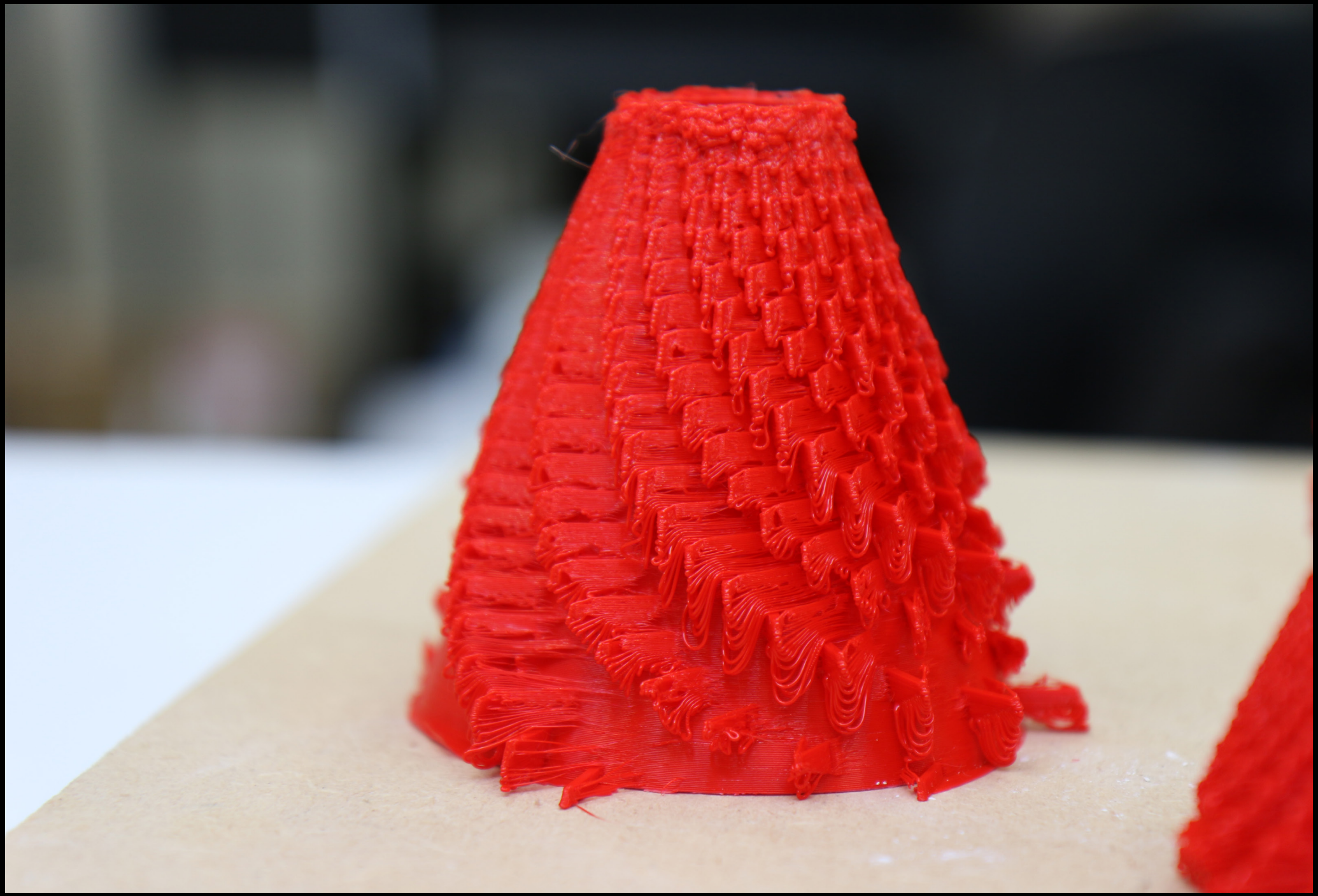
luka.piskorec@aalto.fi

luka.piskorec@aalto.fi

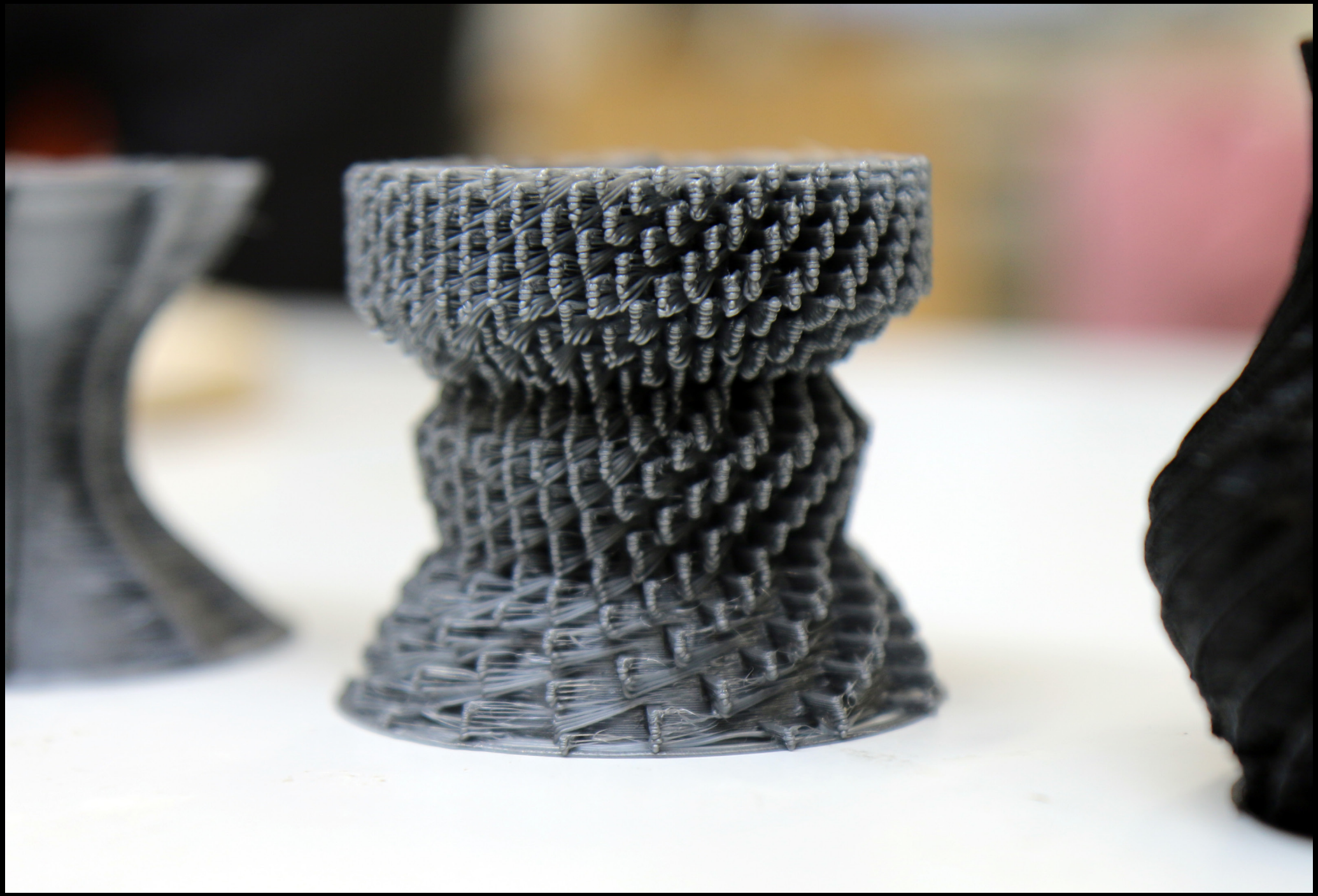
luka.piskorec@aalto.fi



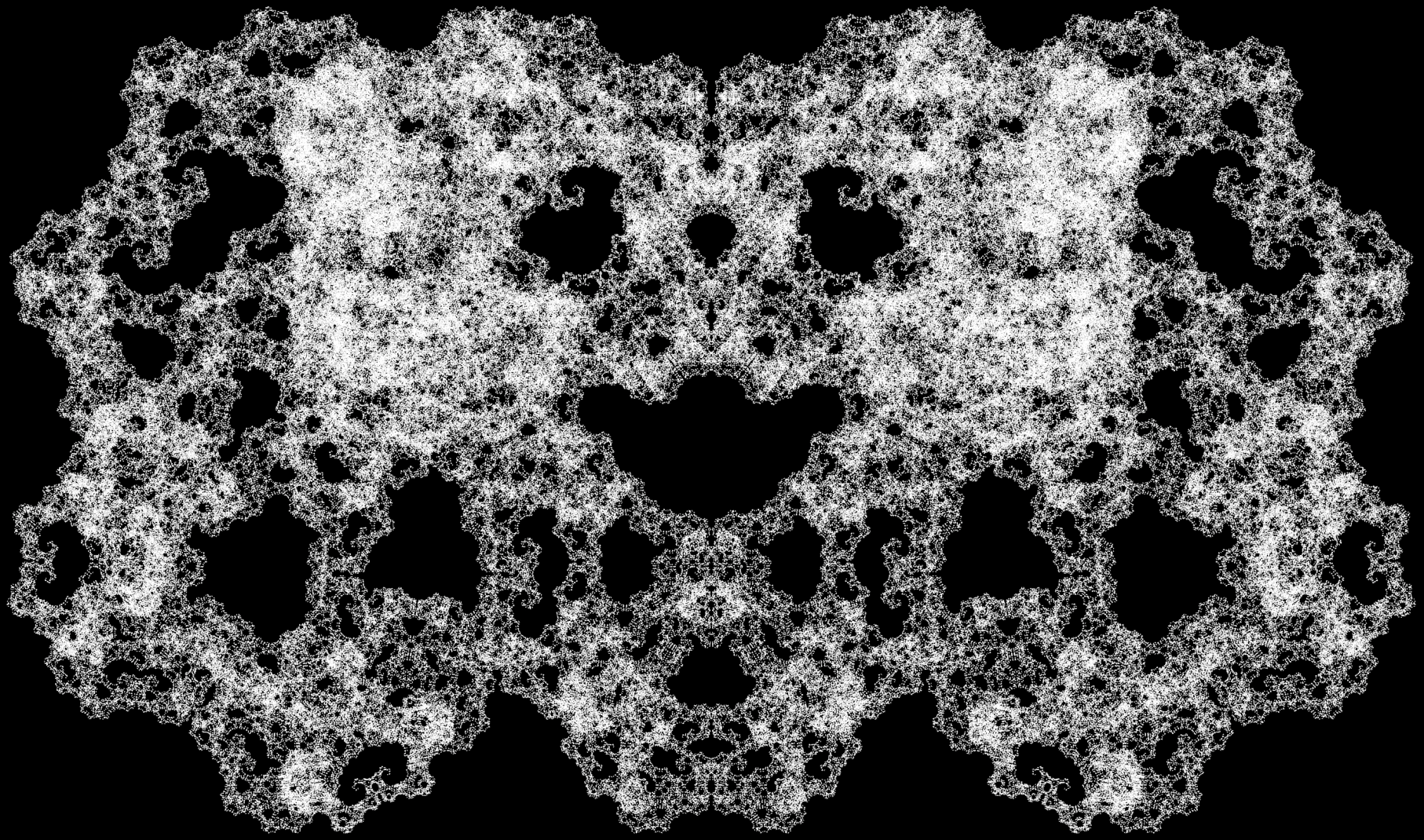
luka.piskorec@aalto.fi



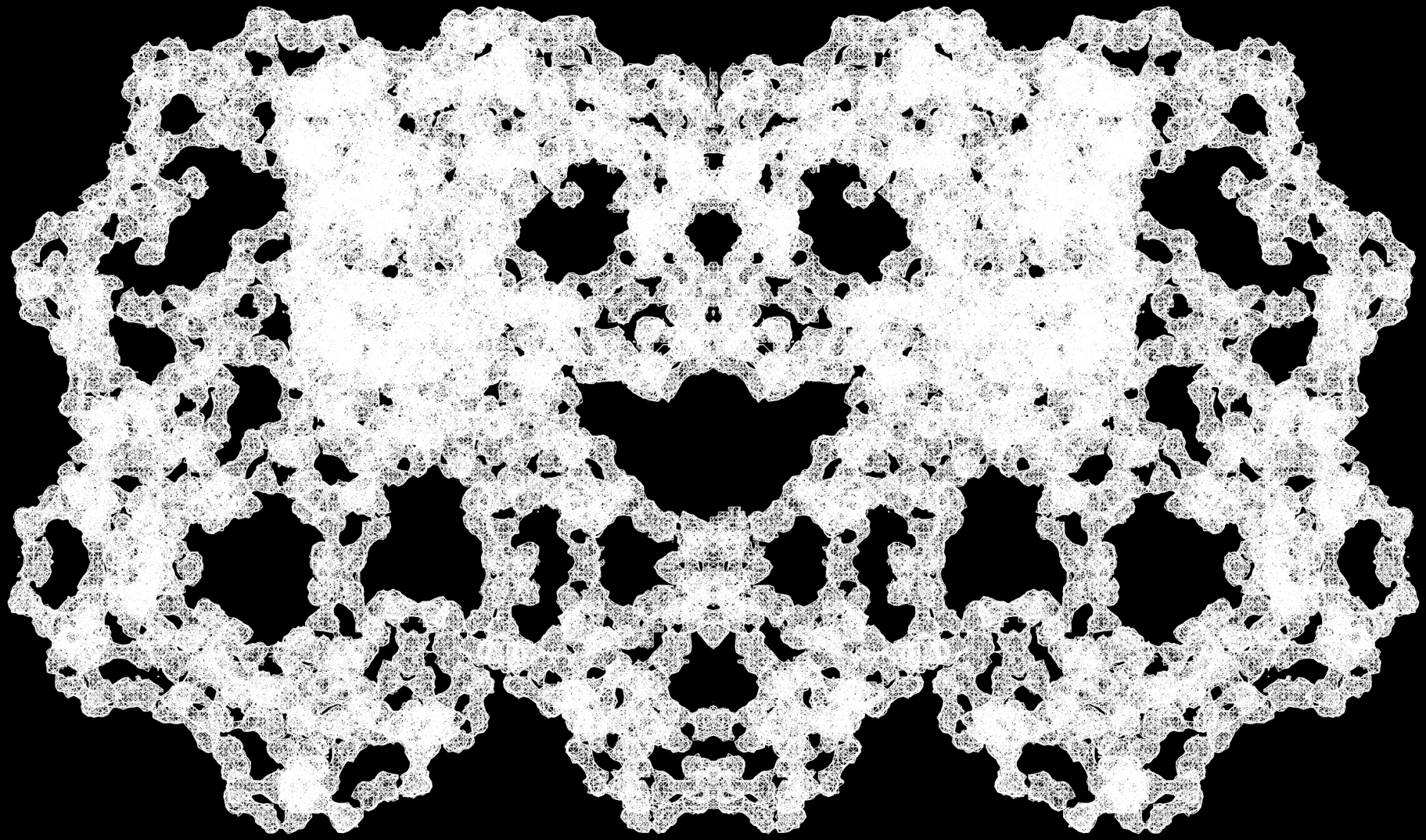
luka.piskorec@aalto.fi



luka.piskorec@aalto.fi



luka.piskorec@aalto.fi



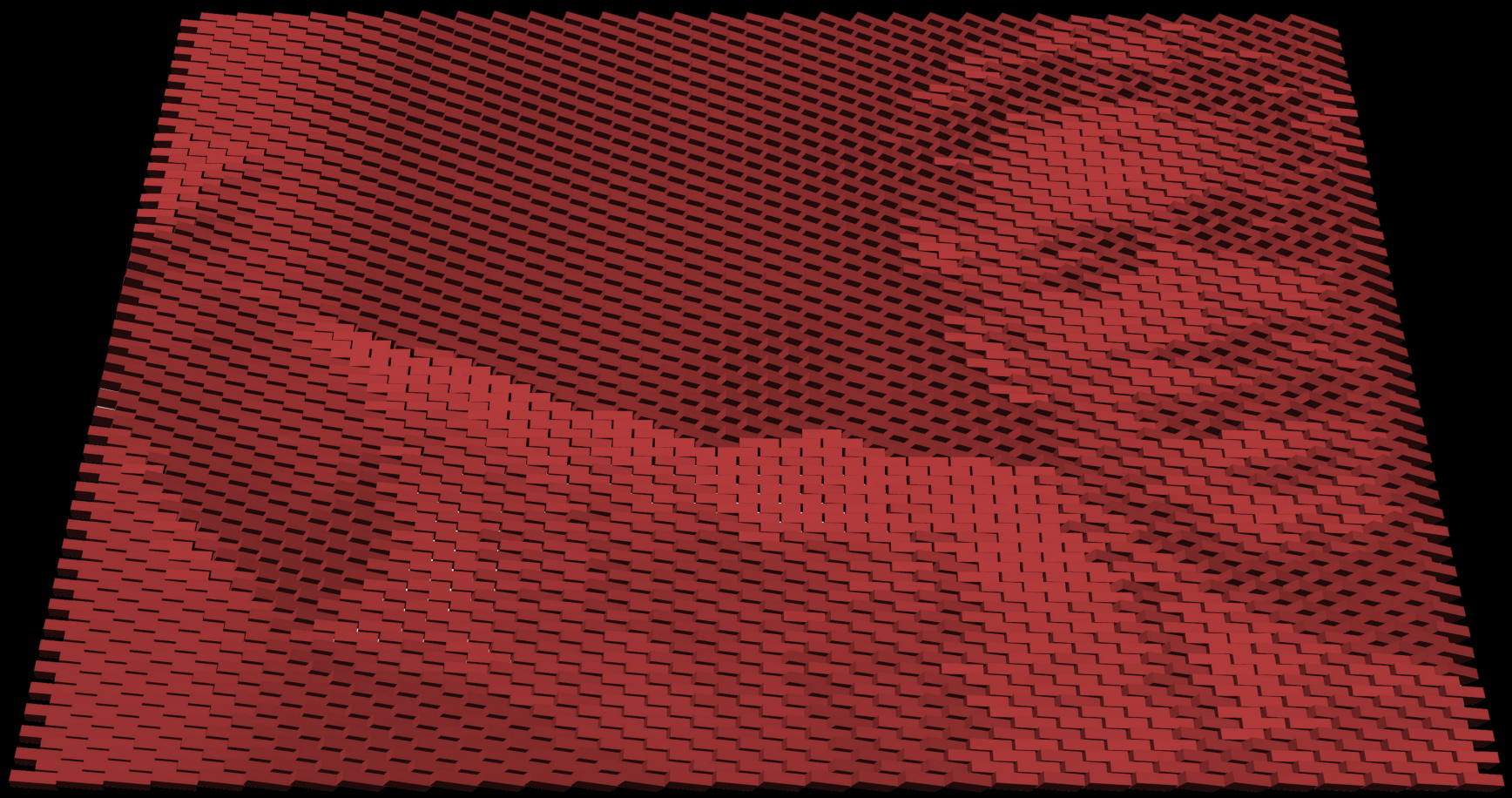
luka.piskorec@aalto.fi

Student project by Sami Markkula, Design od Structures, Aalto University, 2018

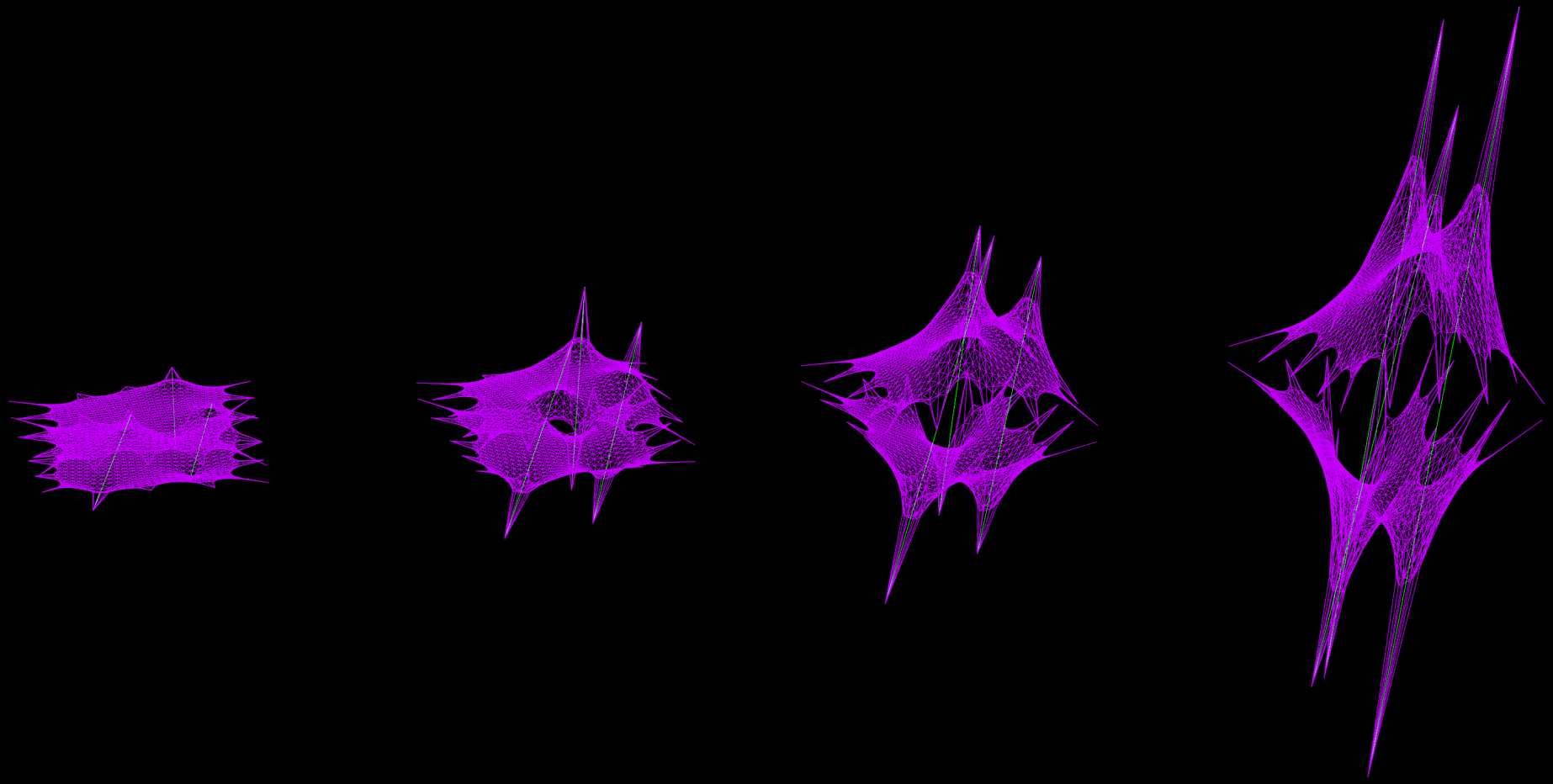
luka.piskorec@aalto.fi

Student project by Sami Markkula, Design od Structures, Aalto University, 2018

luka.piskorec@aalto.fi

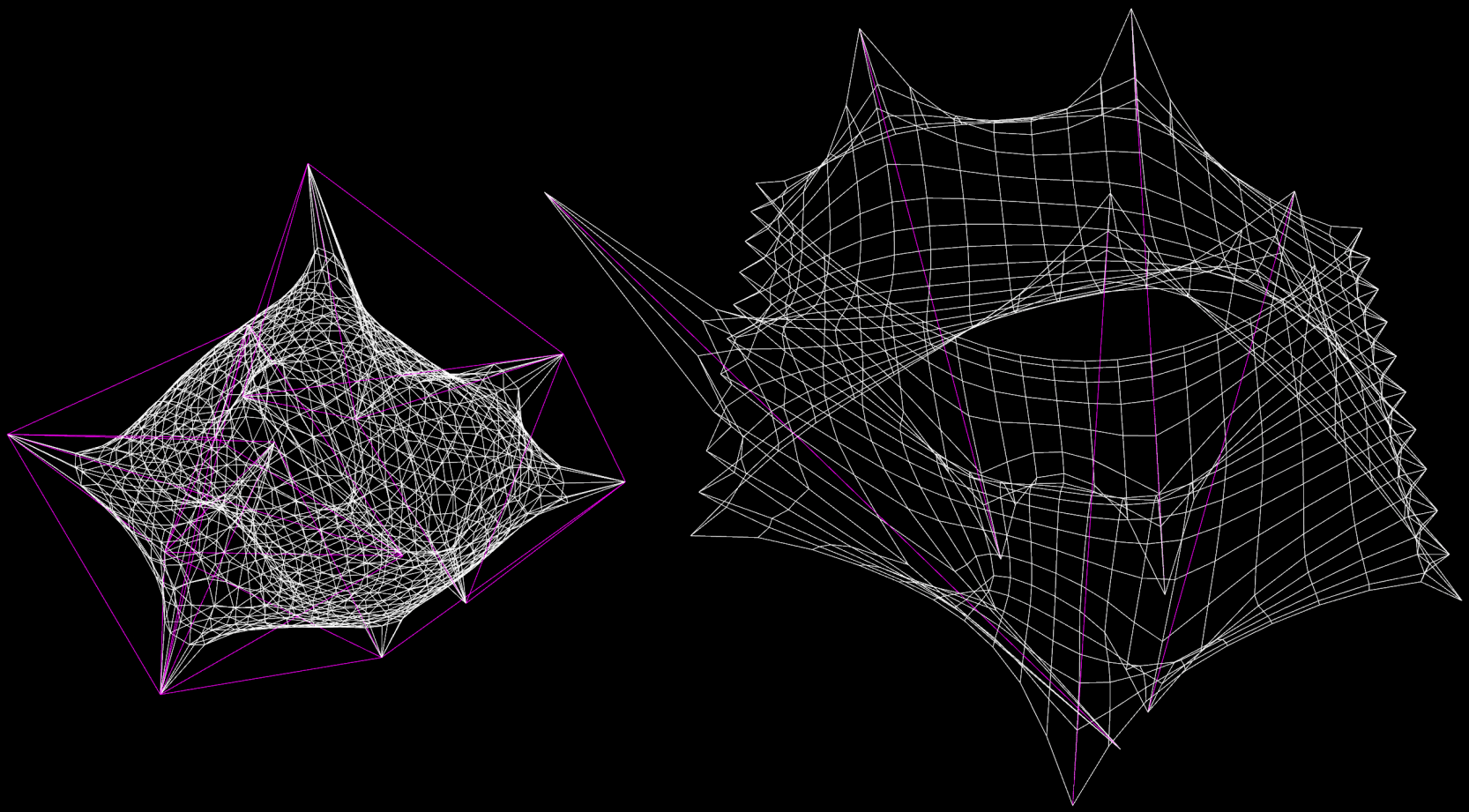


luka.piskorec@aalto.fi



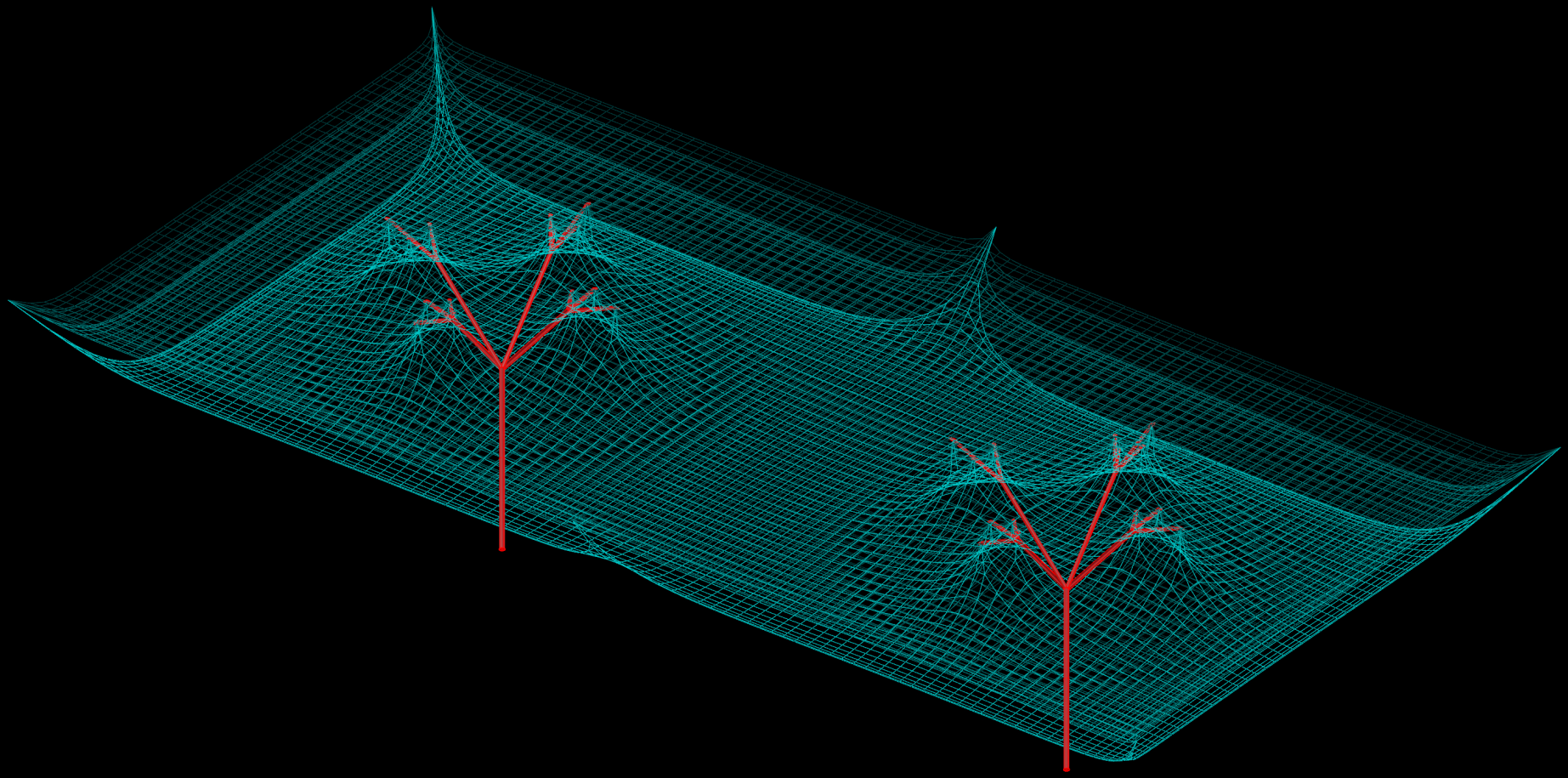
Student project by Tina Cerpnjak and Nikolay Bobrov, Design od Structures, Aalto University, 2018

luka.piskorec@aalto.fi



Student project by Tina Cerpnjak and Nikolay Bobrov, Design od Structures, Aalto University, 2018

luka.piskorec@aalto.fi



Student project by Wang Shuaizhong and Ye Feng, Design od Structures, Aalto University, 2018