



LESS THE BETTER: OPTIMIZING ADDITIVE MANUFACTURE WORKFLOWS FOR CONCRETE WALL CONSTRUCTION

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Outline

Introduction

Method

Wall optimization

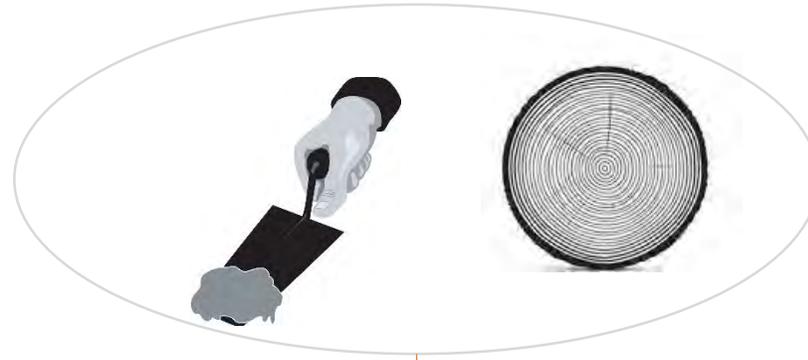
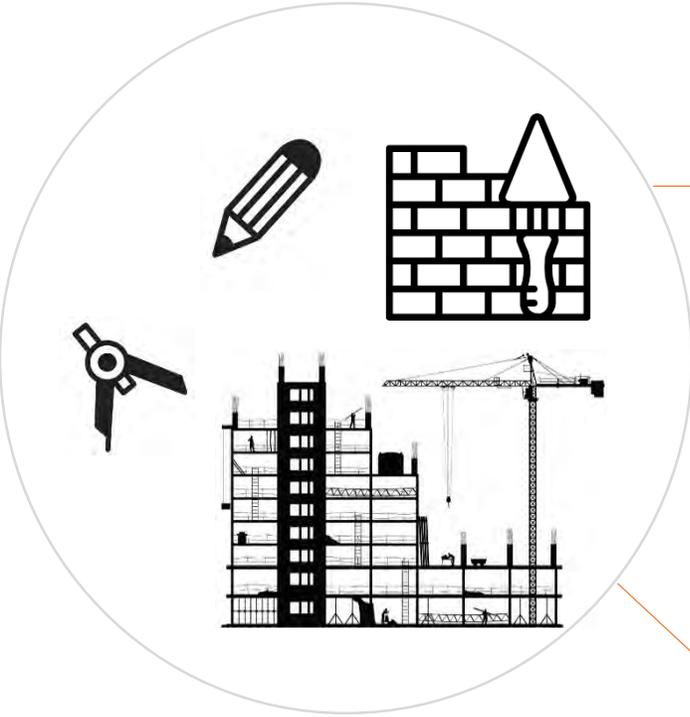
Clay 3D printing

Convert to G-code

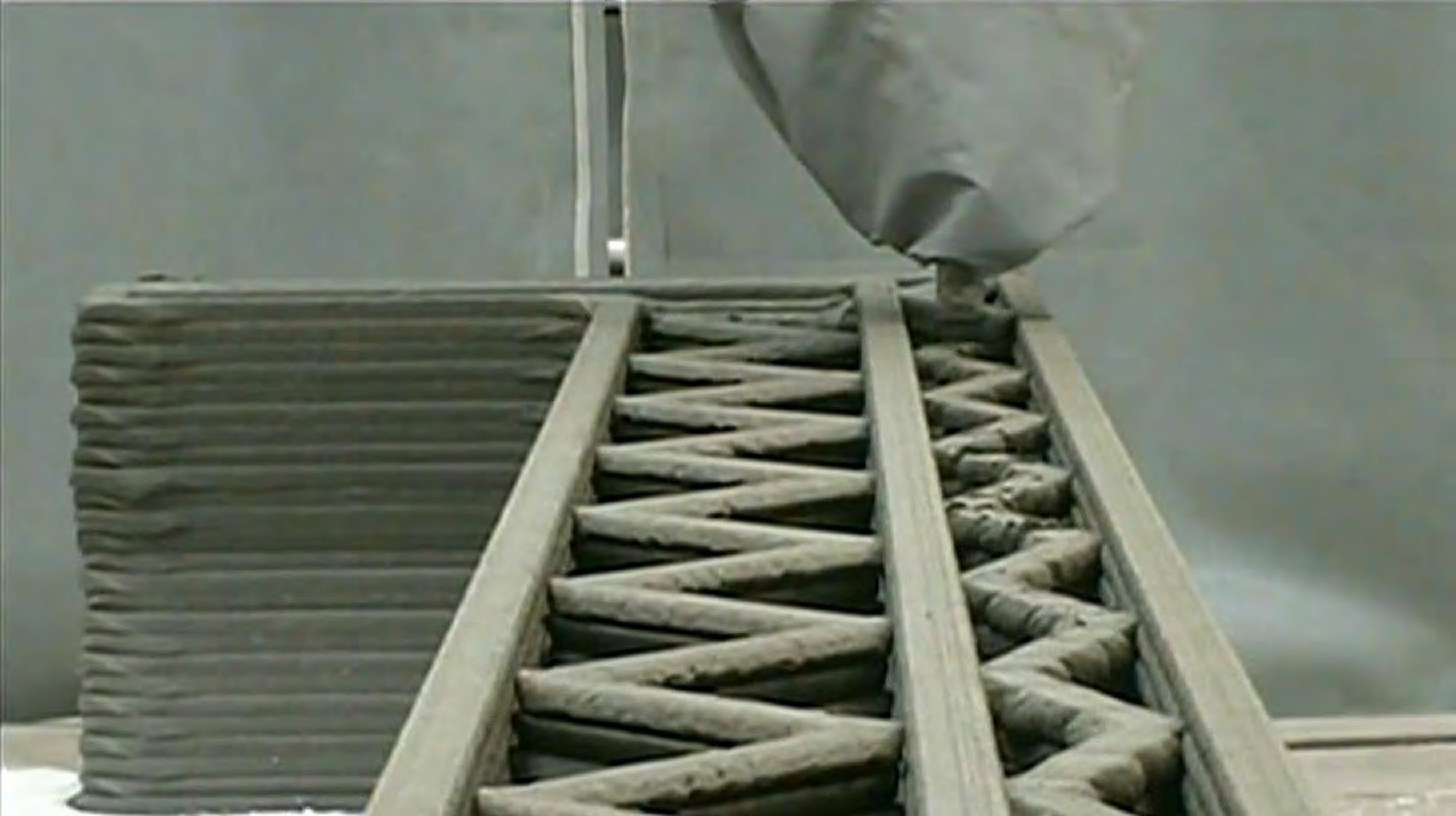
Conclusion

Future direction



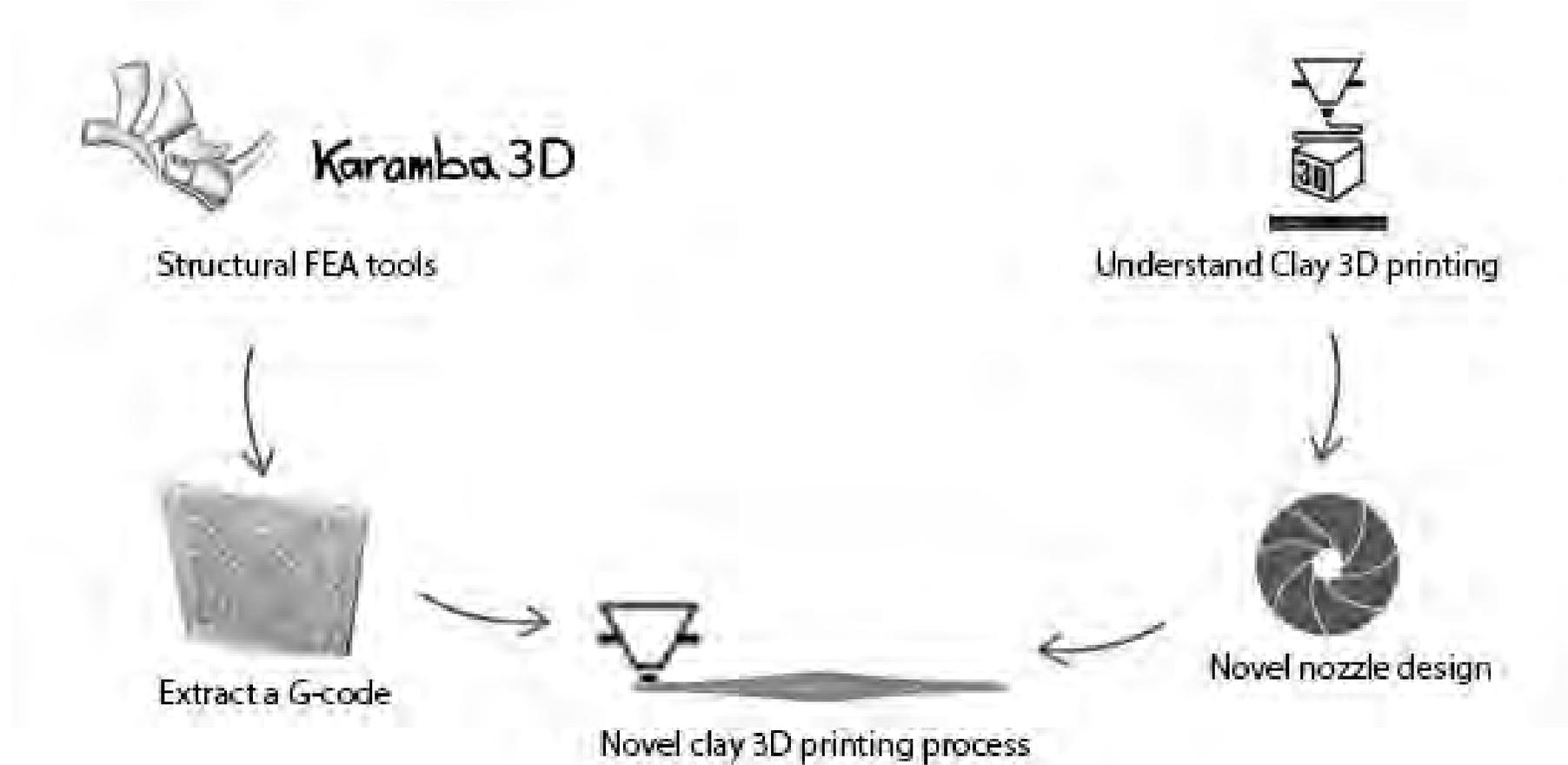






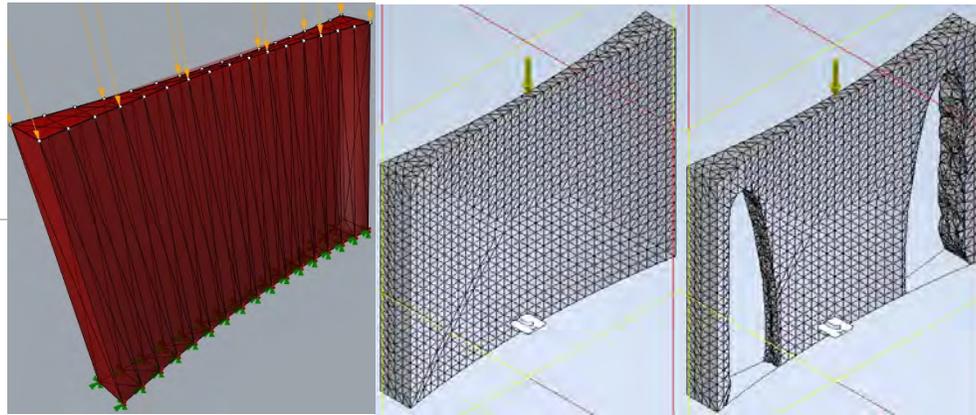
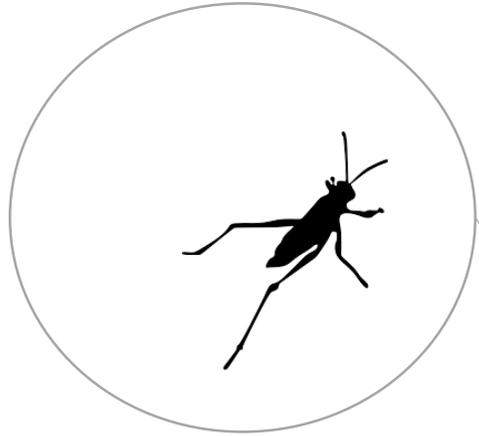


Method



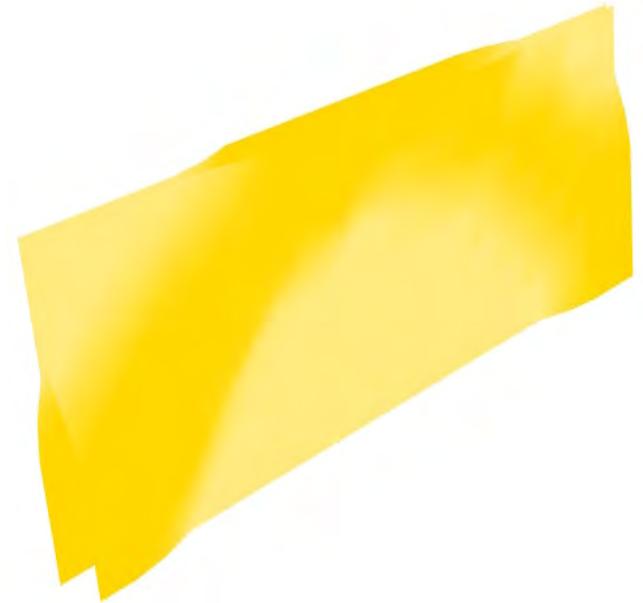
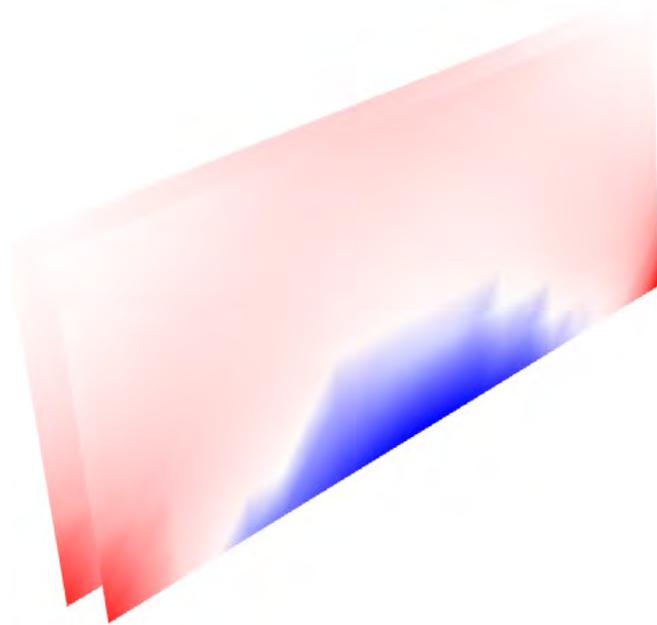
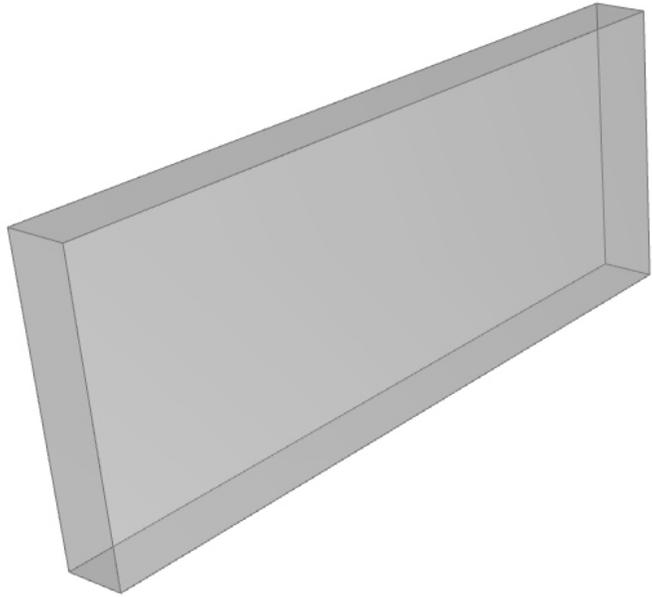


Wall optimization





Wall optimization

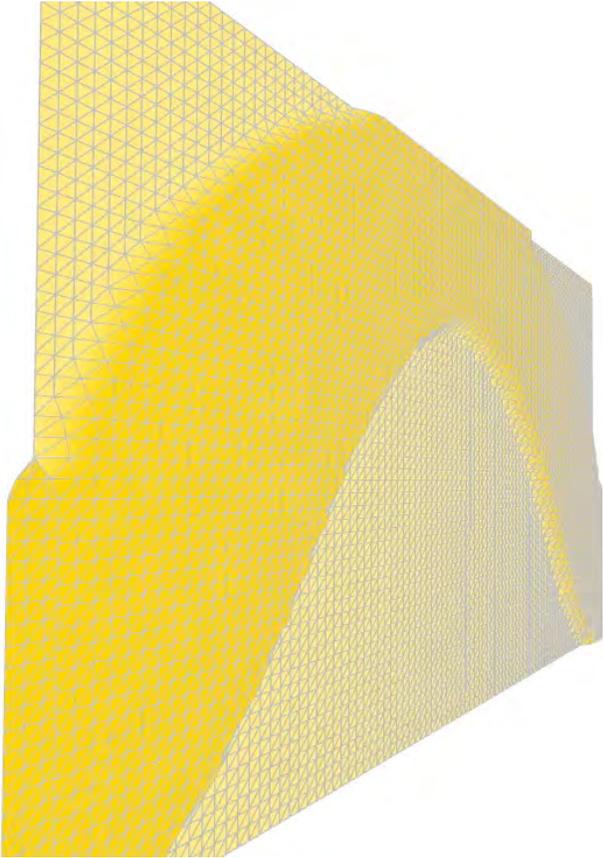


Karamba 3D



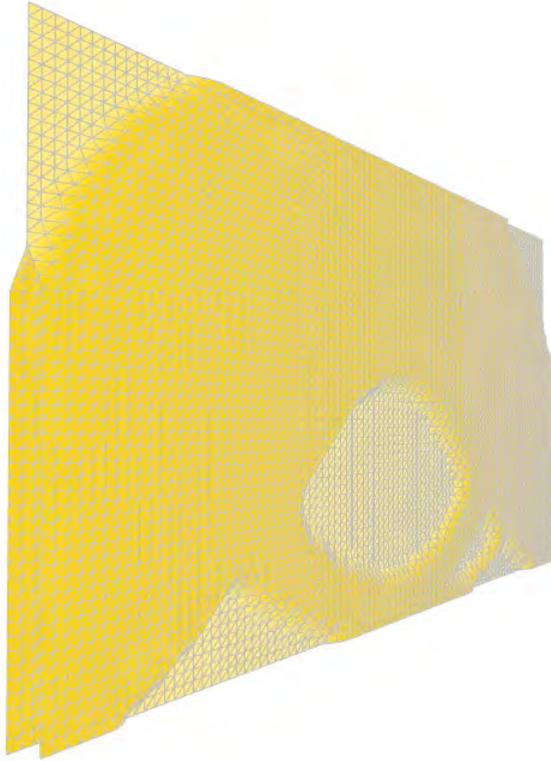


Wall optimization



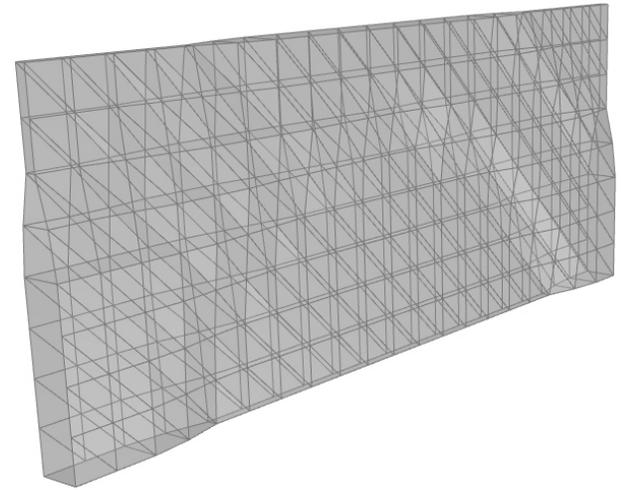
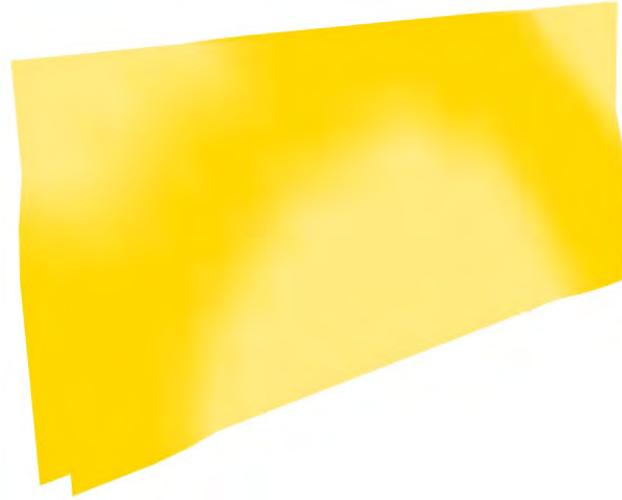
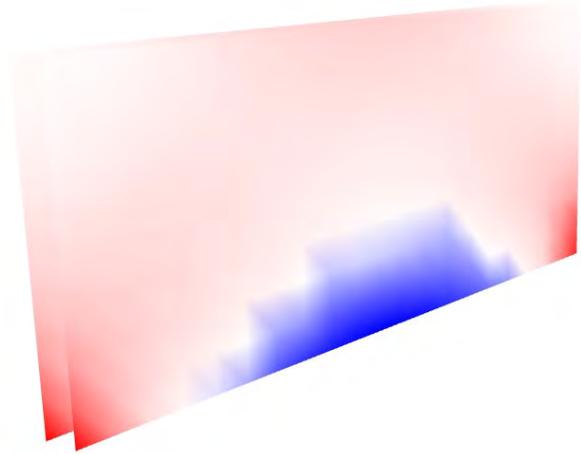
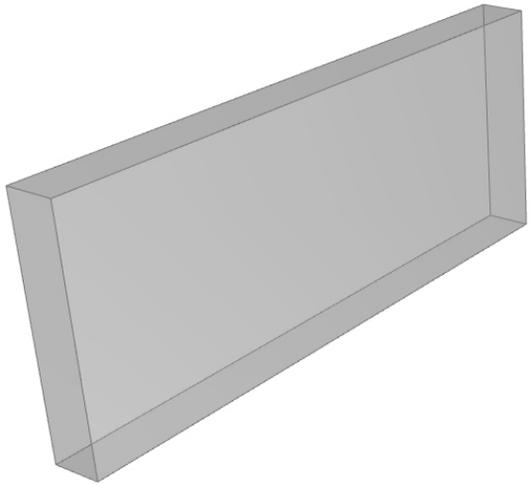


Wall optimization





Wall optimization





Clay 3D printer





Clay 3D printer

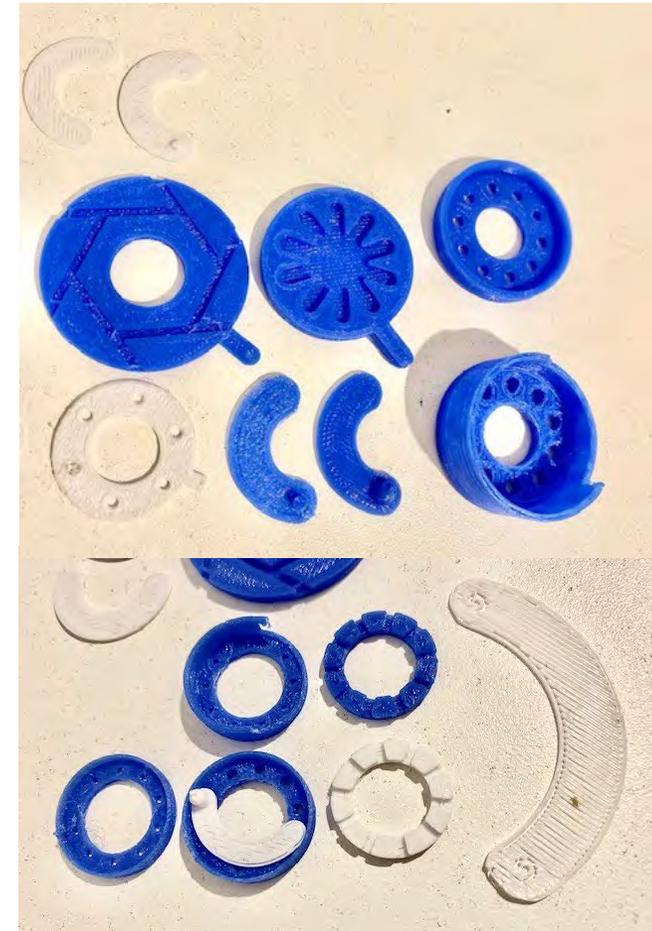
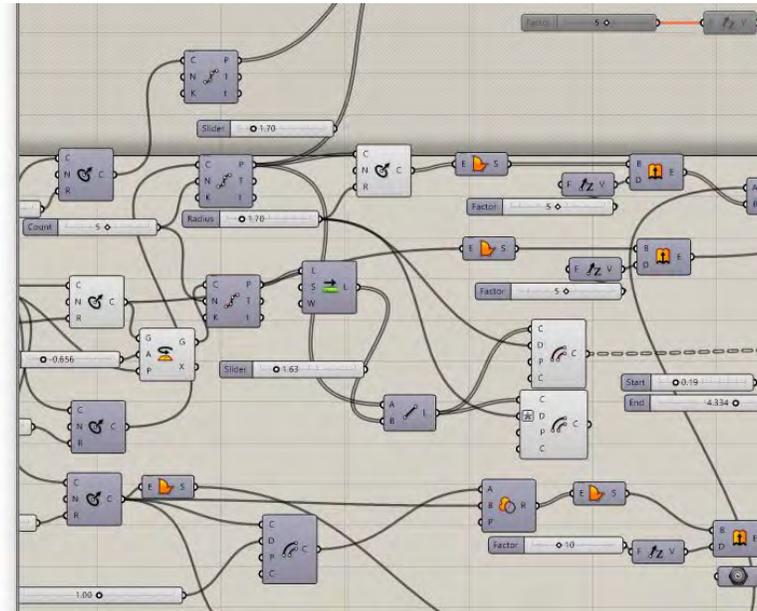


+



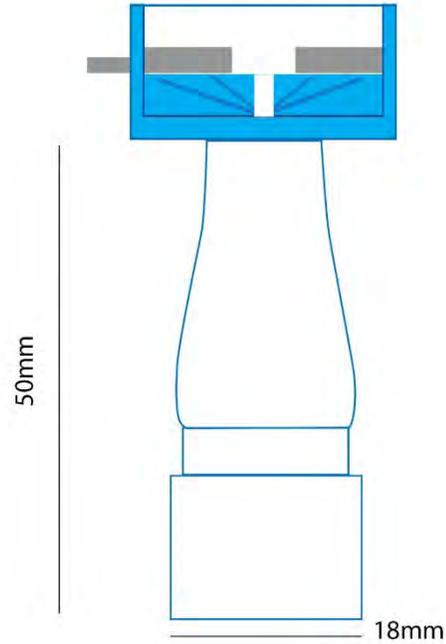
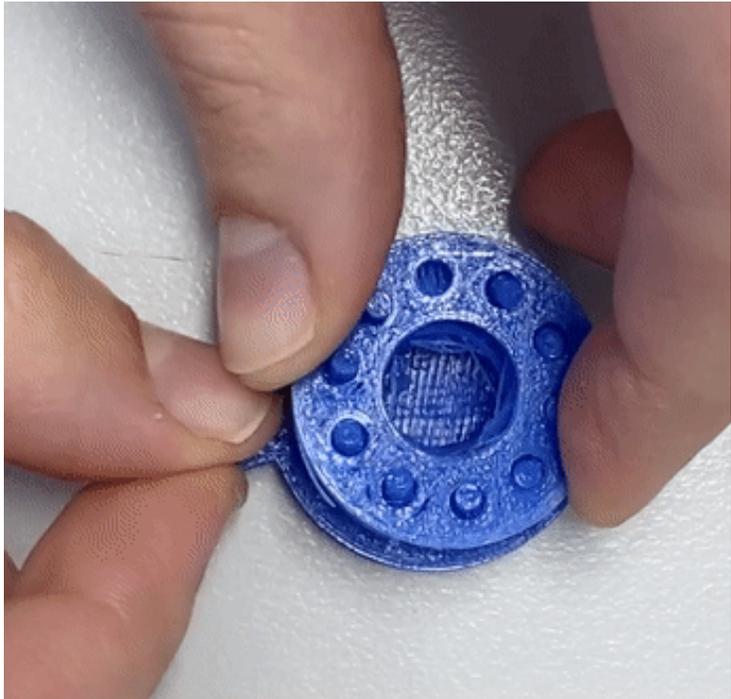


Clay 3D printer





Clay 3D printer





Clay 3D printer



After loading the new nozzle into the machine, the progress started.
Oops, it's too loose

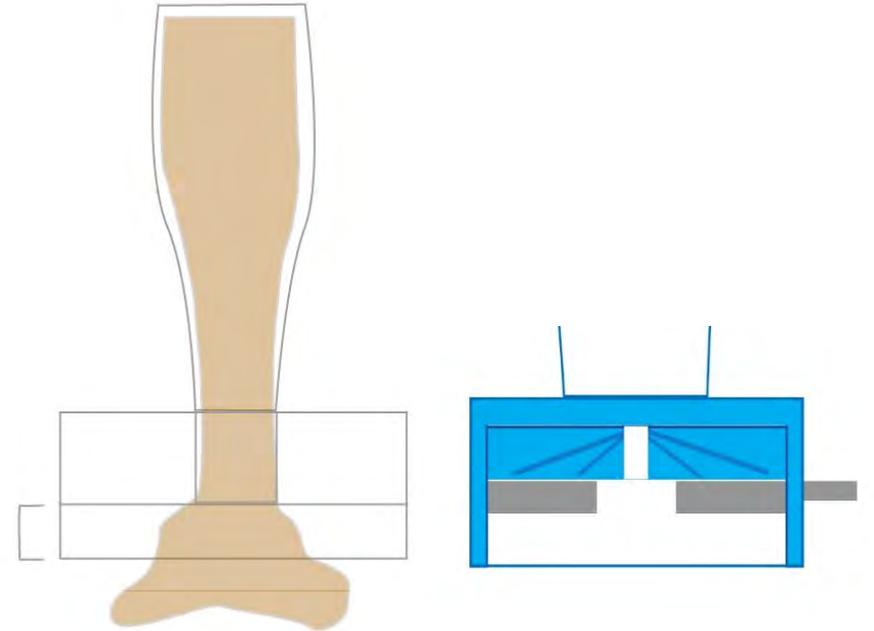




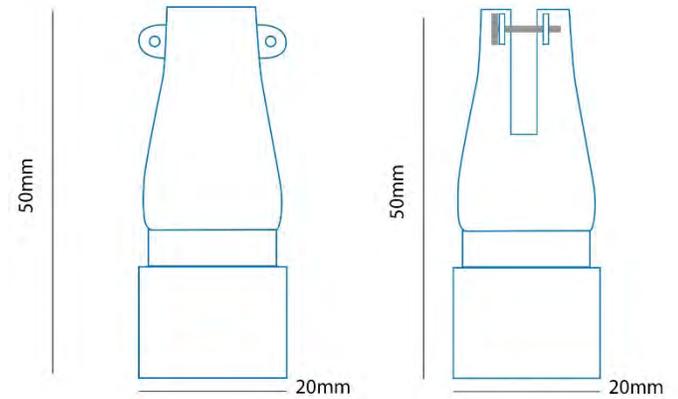
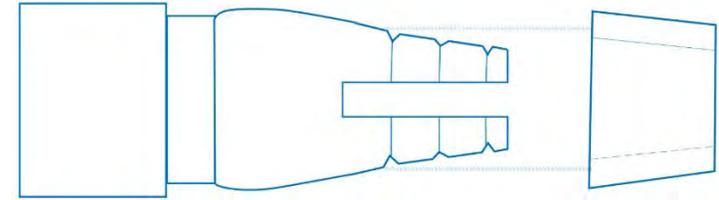
Clay 3D printer

Additional issues:

- Not close enough to the surface
- Multiple parts
- Not smooth when opening and closing



Clay 3D printer





Convert to G-code



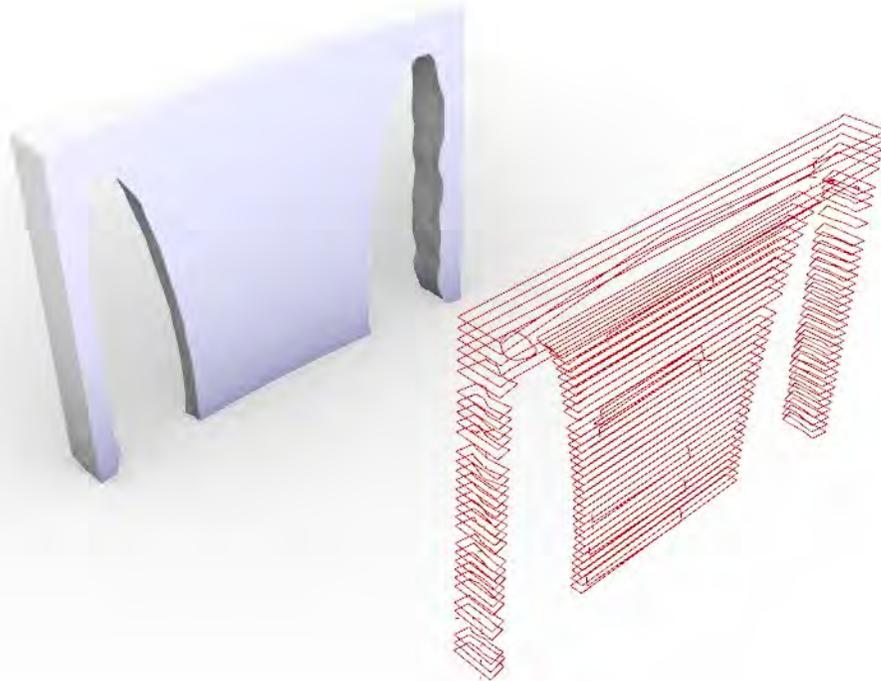
Xylunis

printer volume domain box	printer volume domain box
XY tolerance (mm)	XY tolerance (mm)
layer height (mm)	layer height (mm)
extrusion width (mm)	extrusion width (mm)
filament diameter (mm)	filament diameter (mm)
extrusion multiplier	extrusion multiplier
extruder temperature (C)	extruder temperature (C)
print speed (mm/sec)	print speed (mm/sec)
XY rapid speed (mm/sec)	XY rapid speed (mm/sec)
Z rapid speed (mm/sec)	Z rapid speed (mm/sec)
retraction speed (mm/sec)	retraction speed (mm/sec)
retraction distance (mm)	retraction distance (mm)
C	C





Convert to G-code

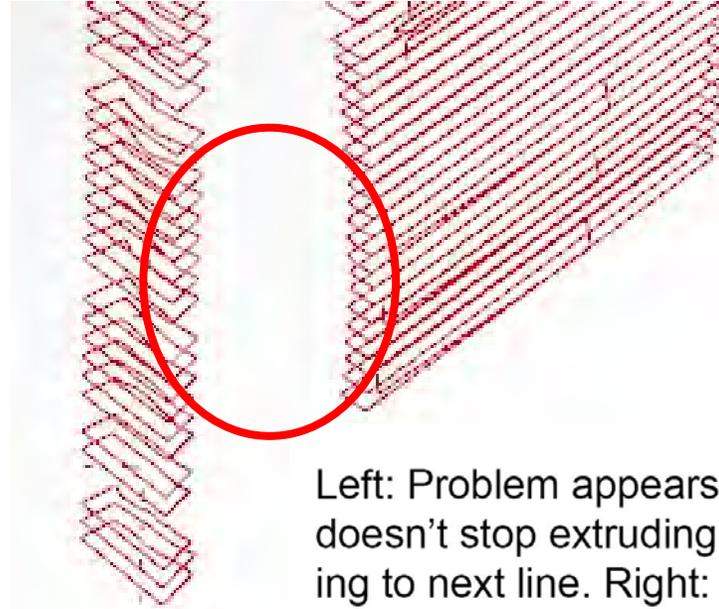


```
0 G21
1 M107
2 G20
3 G52 E0
4 M82
5 M106
6 M104 S0
7 M105 S0
8 G1 Z10 F180000
9 G52 E0
10 G1 F60000 E-150
11 G1 Z4.08 F180000
12 G1 X88.6194895508952 Y30.9282641215085 F180000
13 G1 E0 F60000
14 G1 X88.9652103448742 Y30.9238054613593 E0.209299440142447 F960
15 G1 X88.9741093507271 Y30.9232099780641 E0.222331092121061
16 G1 X89.2059281338745 Y30.9154498802072 E0.365678836035284
17 G1 X89.433873533165 Y31.0076905510051 E0.6285772195023596
18 G1 X89.8242890460473 Y31.0379845931453 E0.759770905200813
19 G1 X90.0661488312714 Y31.0441058317767 E0.909585277976106
20 G1 X90.6526523322669 Y30.9876526733647 E1.2768924654244
21 G1 X91.373428944228 Y31.0175457645008 E1.7265950003439
22 G1 X91.3663864137343 Y31.1063218775537 E1.79210993903505
23 G1 X91.3779489541204 Y129.038968564653 E31.6622721223491
24 G1 X90.8905037470943 Y129.055304501117 E31.9662053734223
25 G1 X90.0176132317771 Y129.05417247872 E32.5106086216237
26 G1 X89.8609351912019 Y129.042843442159 E32.6146495613059
27 G1 X89.7576546374795 Y129.055663189383 E32.6733367380419
28 G1 X89.2858542389236 Y129.057835455565 E32.9674433037473
29 G1 X89.0388890044373 Y129.03481155481 E33.1251564187245
30 G1 X89.0141642756053 Y129.033229228972 E33.1374818831854
```





Convert to G-code

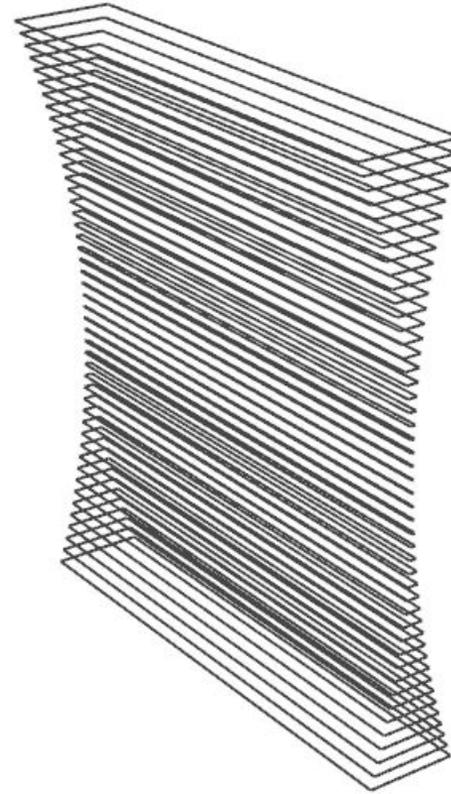
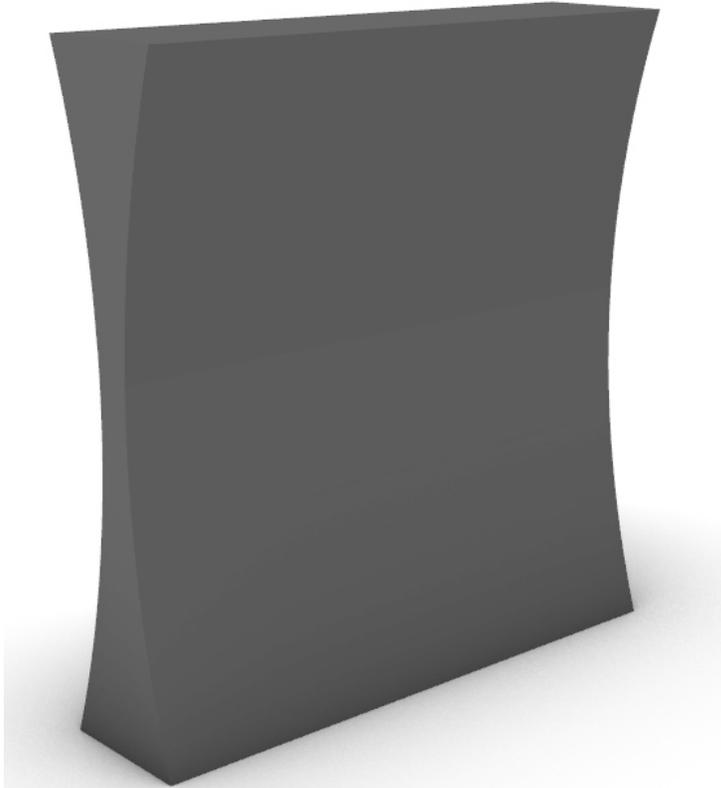


Left: Problem appears that the printing path doesn't stop extruding material when it's moving to next line. Right: the model has gabs in between which the printer wouldn't stop extruding.



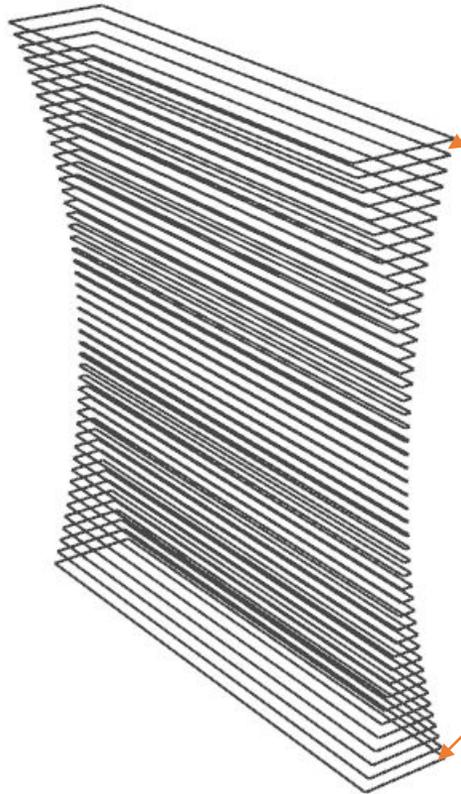


Convert to G-code

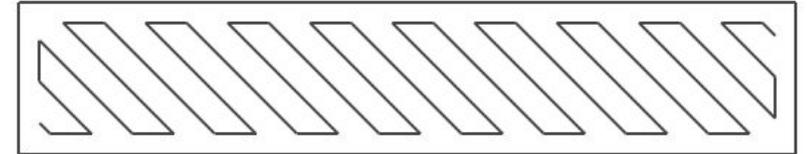
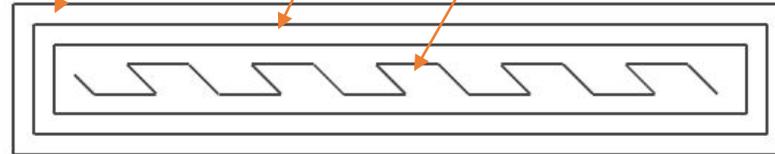




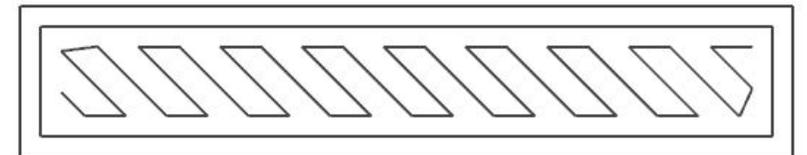
Convert to G-code



Layer Height	<input type="text" value="2.58"/>
Extrusion Width	<input type="text" value="3"/>
Perimeter Wall Count	<input type="text" value="1"/>
Infill Ratio (0-1)	<input type="text" value="0.00"/>

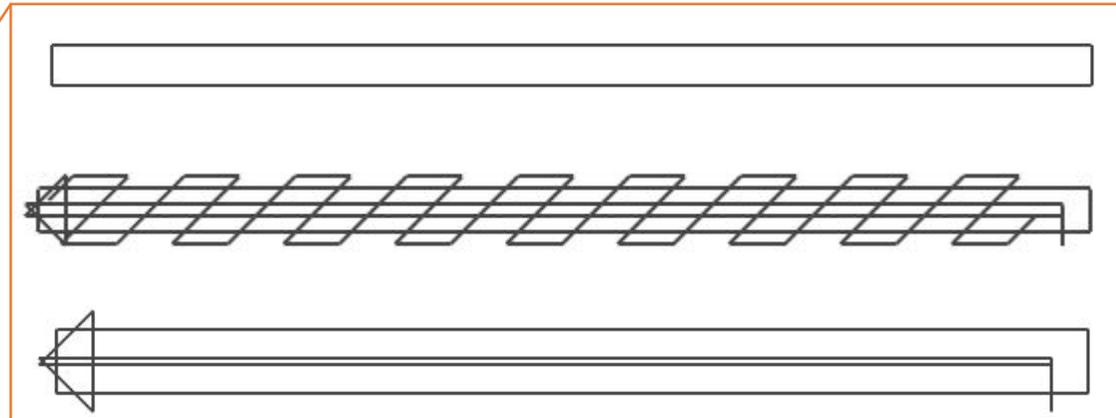
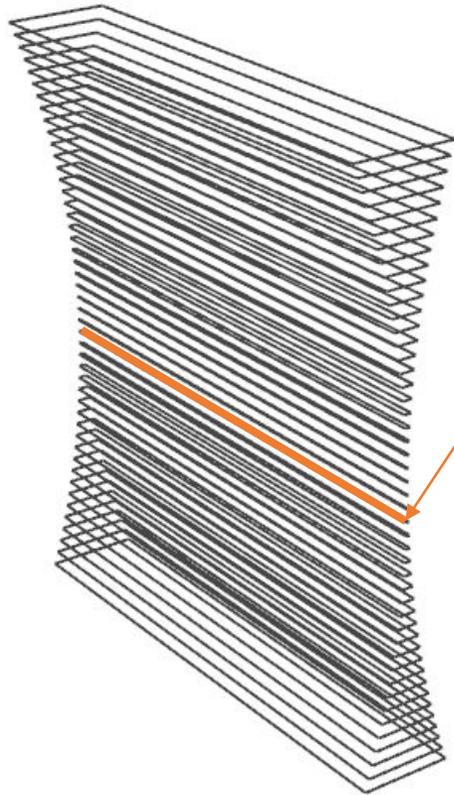


Different results from different variables





Convert to G-code

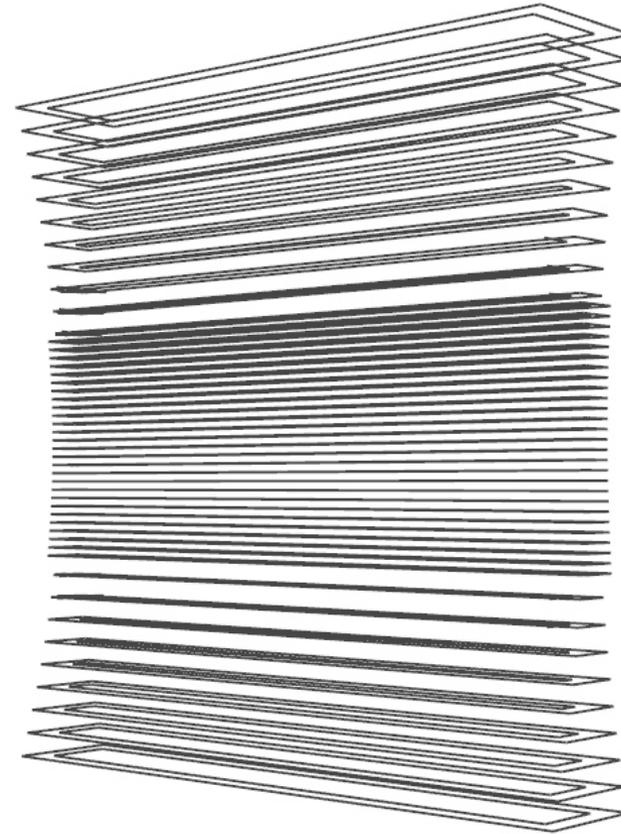
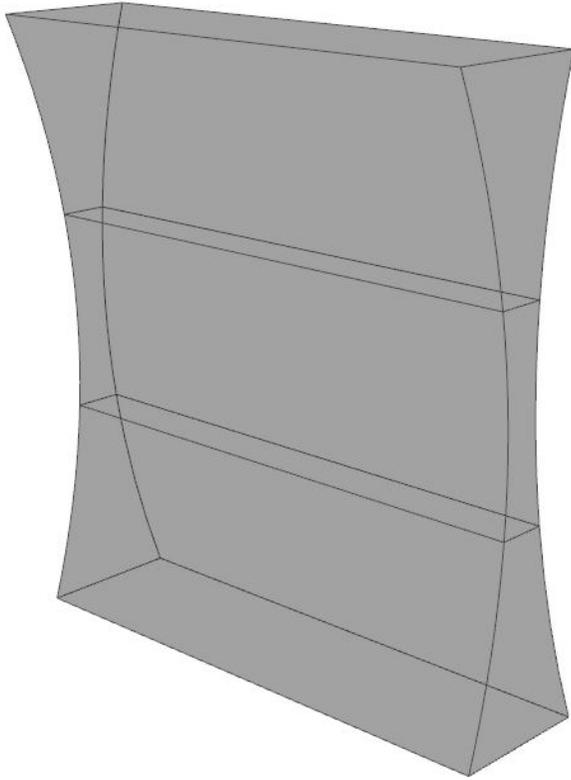


Different results from different variables





Convert to G-code

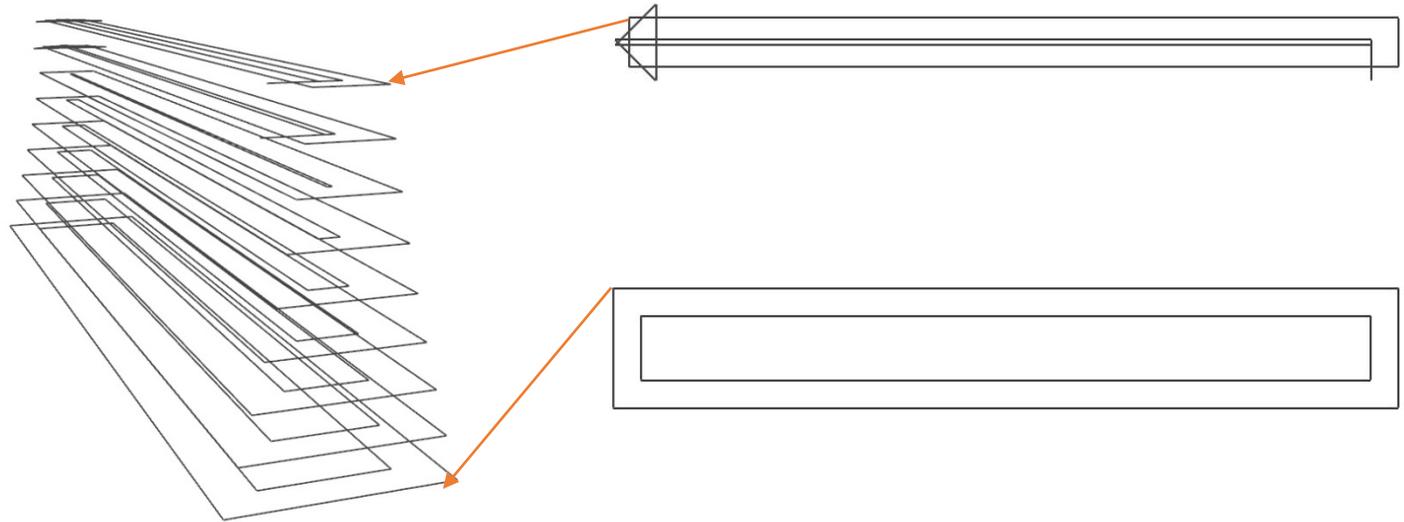
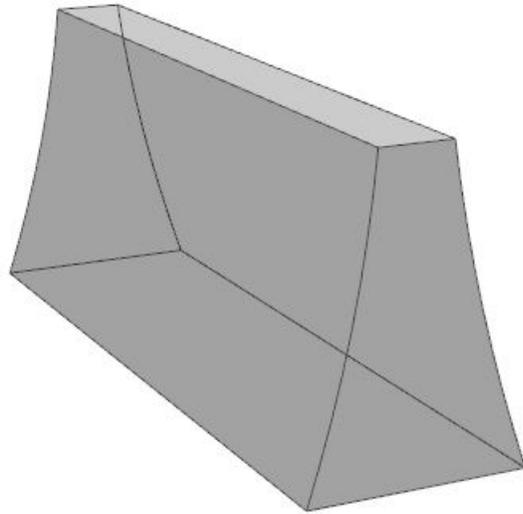


Break the wall into 3 parts to differentiate thicknesses along the model





Convert to G-code

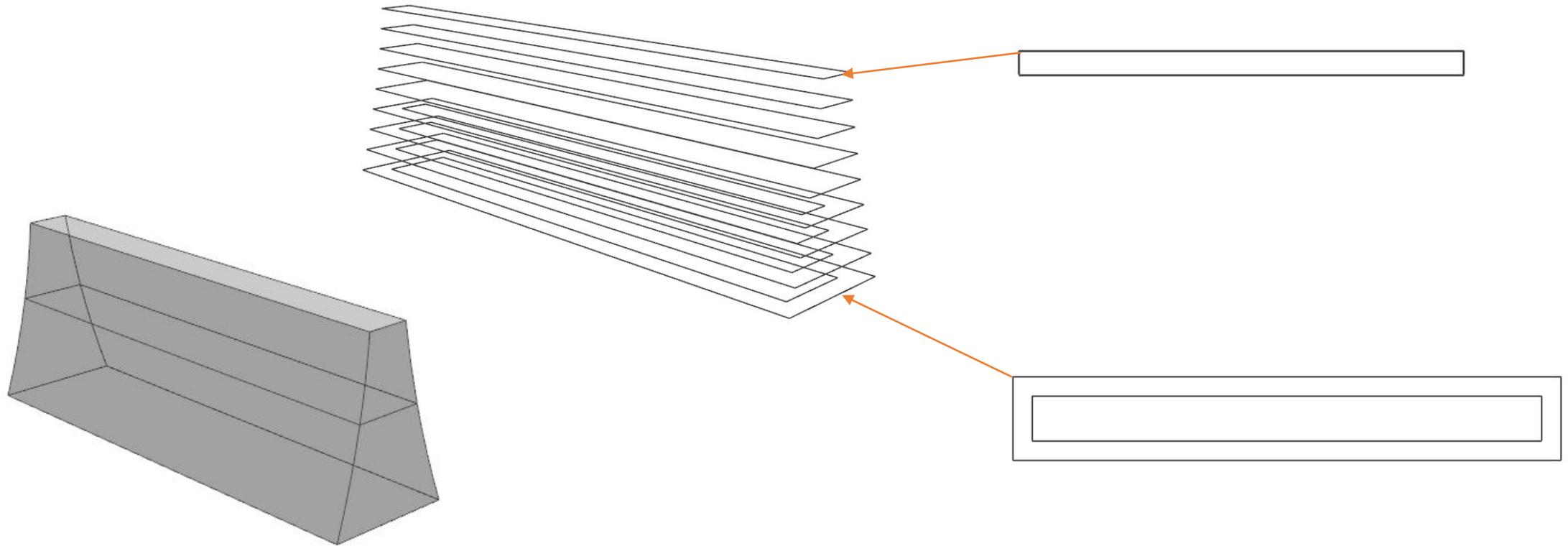


Printing paths remain intersecting in the narrow parts





Convert to G-code



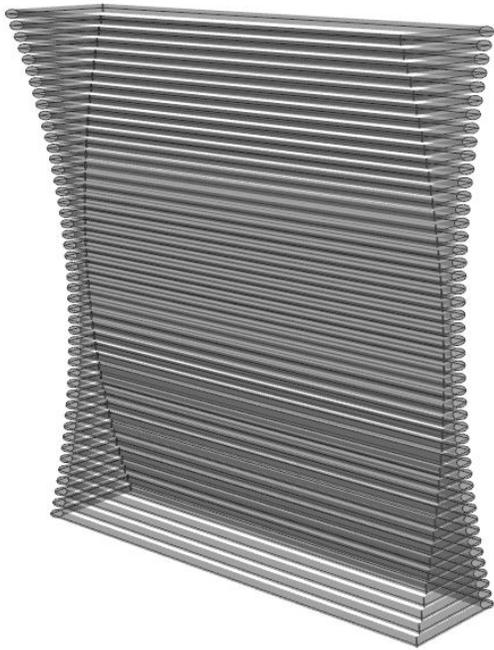
Break each sub-model into 2 parts, with different variables



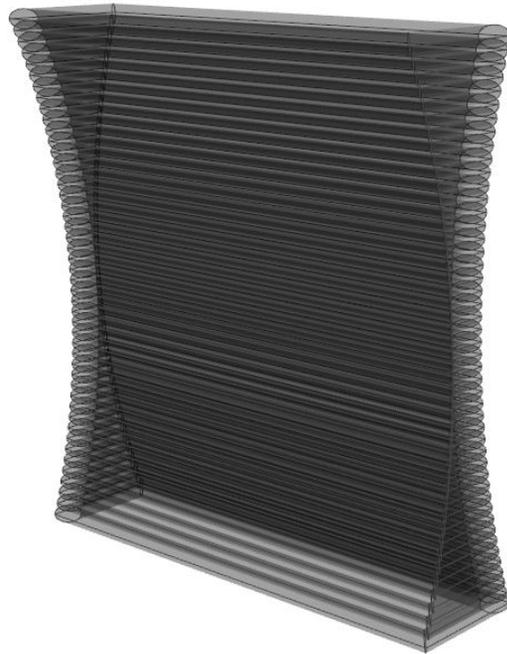


Convert to G-code

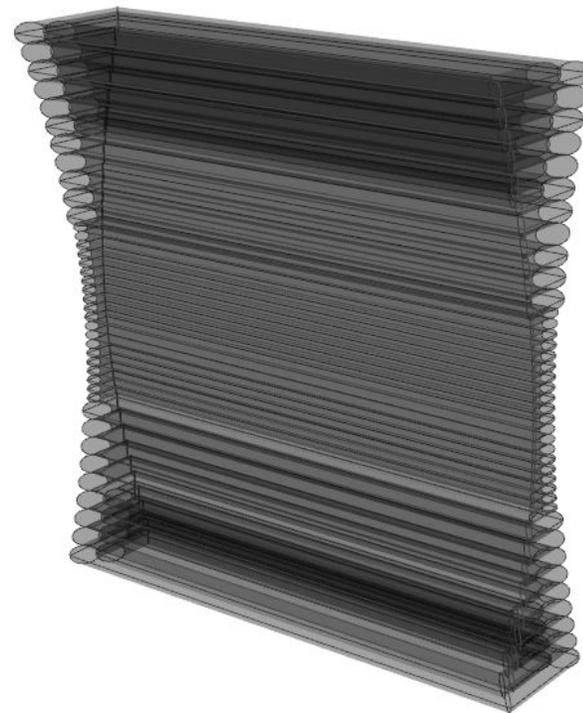
47 layers, 2mm



47 layers, 4mm

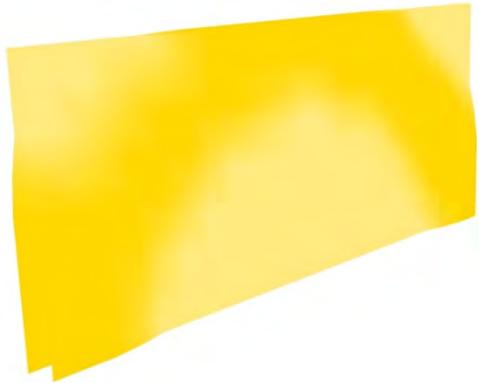


40 layers, 2mm, 4mm

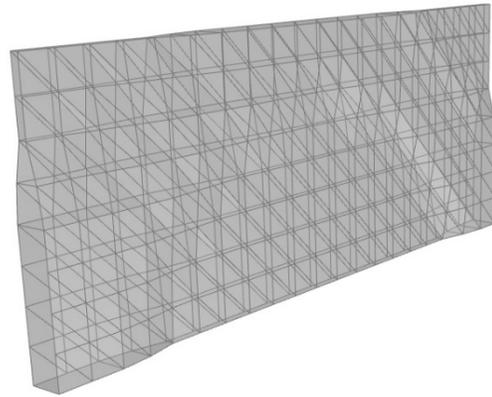




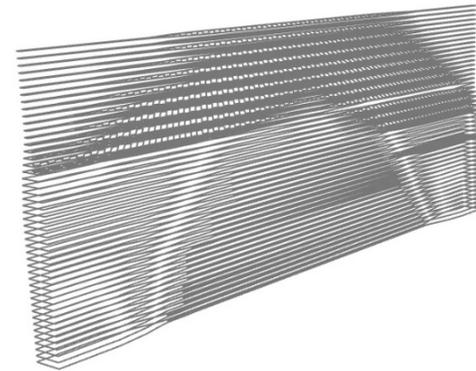
Convert to G-code



Mesh from Karamba



Breb

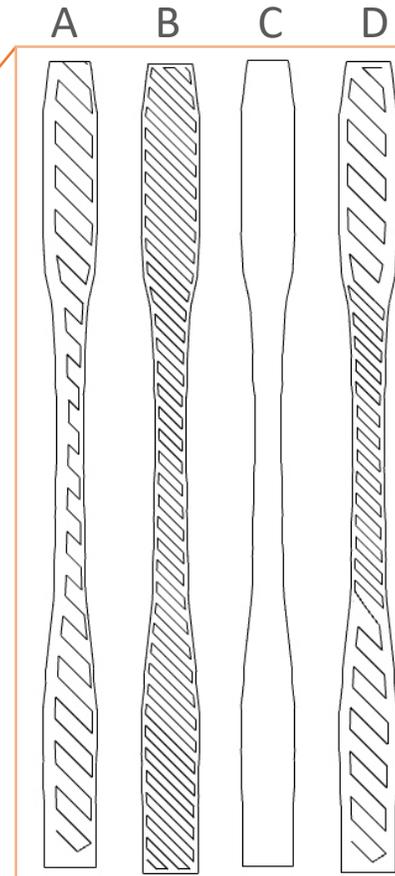
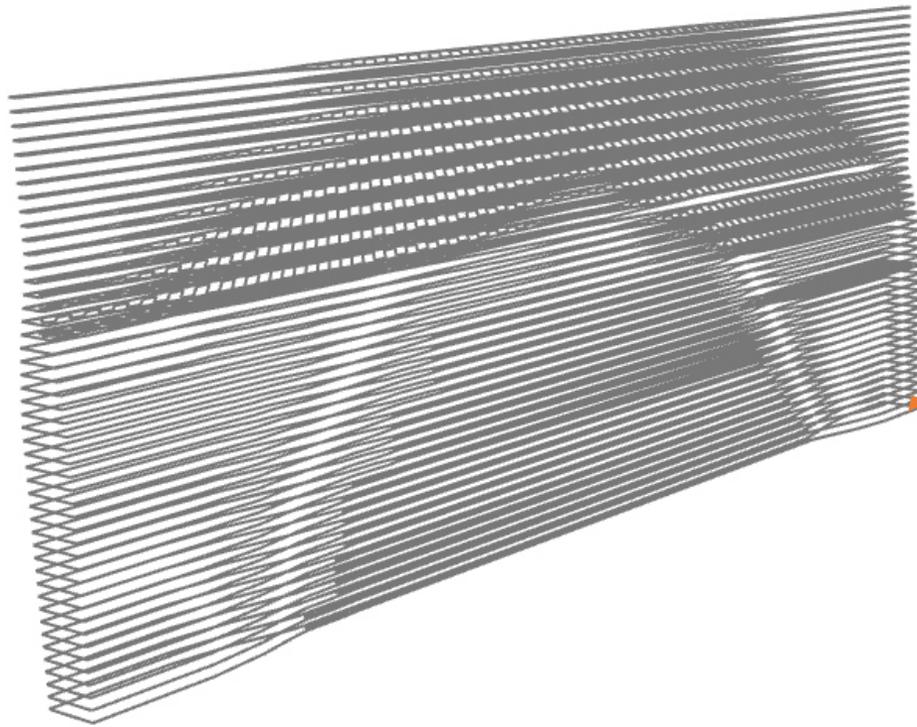


G-code





Convert to G-code

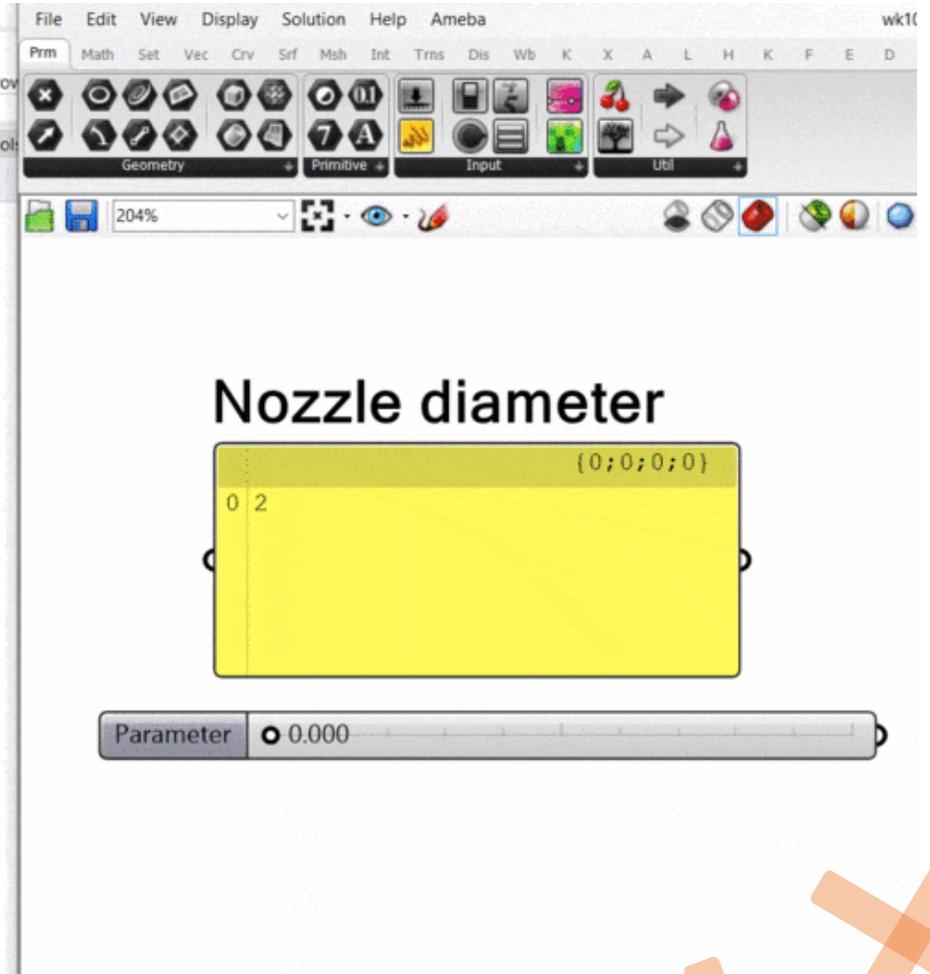
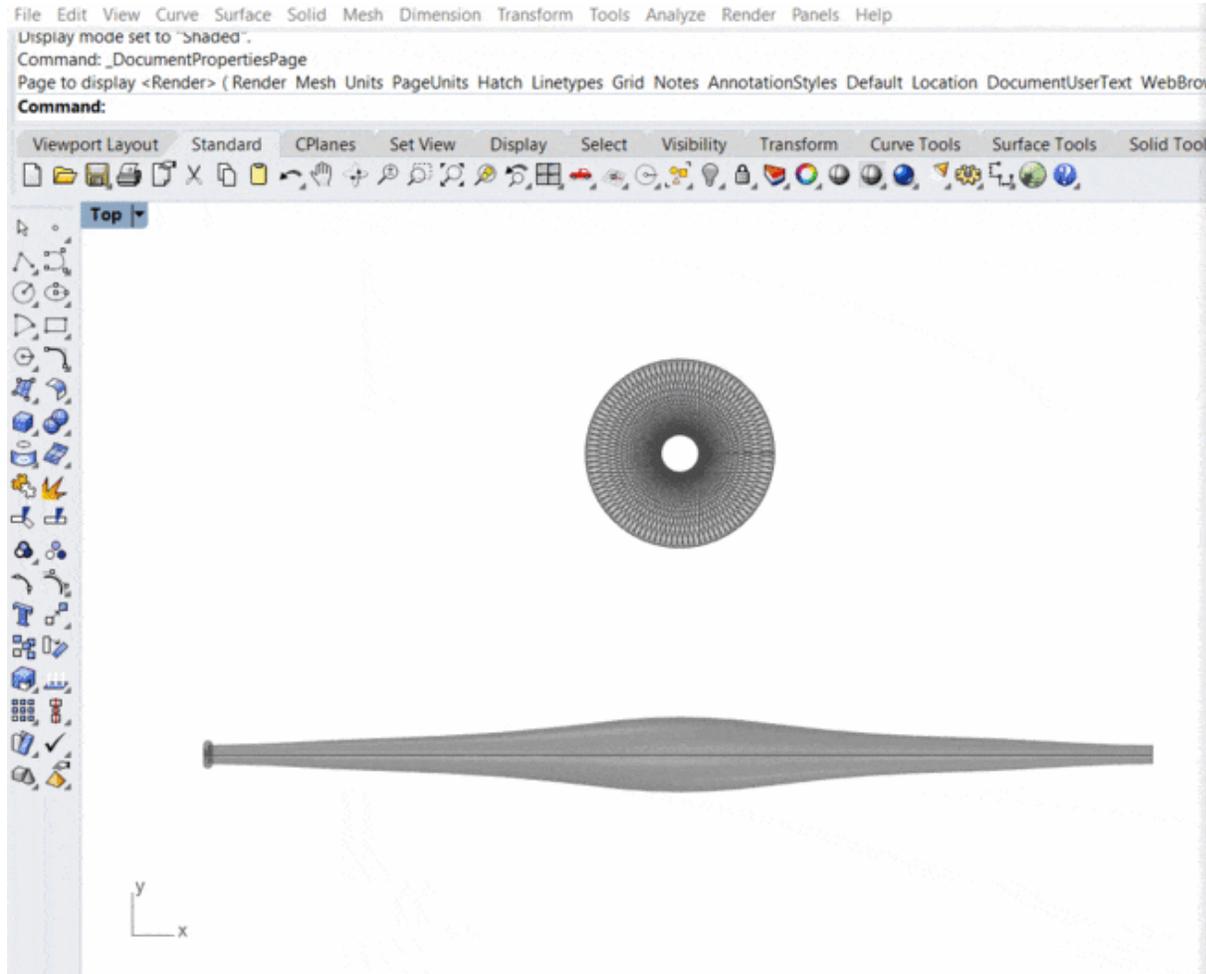


Shape B: 1mm nozzle, with 60% infill. Lines length: 2008.8mm

Shape D: 1mm & 3mm nozzle, 30% & 60% infill ratios. Lines length: 1546mm

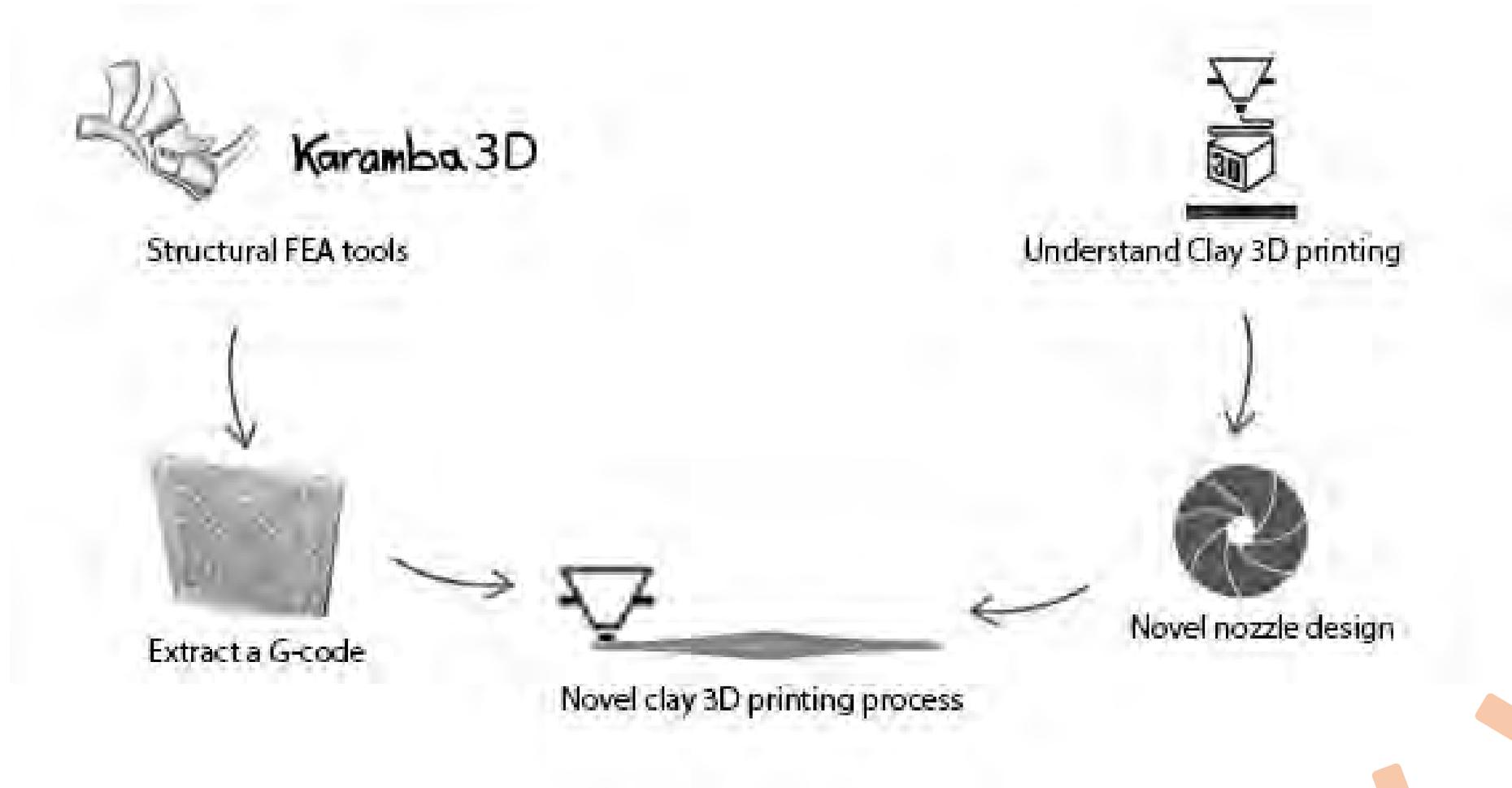
Saved printing time: about 25%

Convert to G-code





Conclusion





Superstructure Printer, 2030

As inspired by Disrupt to Stabilize:
How Youth are Shaping a Fractured World Panel
World Economic Forum 2018



Thank you

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