

3D SCANNING & 3D PRINTING

2/21/2019

GINGER CHICOS AND JUAN PINTO





#2 Contractor
in Connecticut
ENGINEERING NEWS-RECORD 2017

Gilbane BUILDING CONNECTICUT
since **1944**

CONNECTICUT CONSTRUCTION INDUSTRIES ASSOCIATION
CCIA Platinum Award
for safety excellence 2017

 18 LEED APs in CT

100 Local Team Members
supported by
772 additional employees
in our Northeast Offices

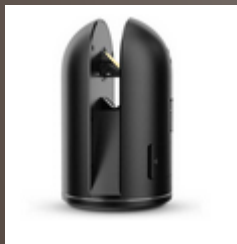
TYPES OF 3D SCANNERS

MOST COMMONLY USED IN CONSTRUCTION

- LASER PULSE (LIDAR)
- STRUCTURED LIGHT
- PHOTOGRAMMETRY

TYPES OF 3D SCANNERS

- **LASER PULSE (LIDAR)**
CALCULATES DISTANCES BASED ON HOW LONG IT TAKES LASER TO LEAVE AND BOUNCE BACK TO THE SCANNER



TYPES OF 3D SCANNERS

- **LASER PULSE (LIDAR)**
 - **PROS**
 - RESOLUTION
 - ACCURACY 99.9+%
 - DISTANCE BETWEEN SCANS
 - **CONS**
 - CANNOT SCAN SHINY OR TRANSPARENT SURFACES
 - TIME DURATION OF EACH SCAN

TYPES OF 3D SCANNERS

- **STRUCTURED LIGHT**
PROJECTS LIGHT PATTERNS ONTO
OBJECTS AND EXAMINES THE EDGES THE
PATTERN TO CALCULATE DISTANCE
FROM SCANNER TO OBJECT



TYPES OF 3D SCANNERS

- **STRUCTURED LIGHT**
 - **PROS**
 - SPEED PER SCAN
 - RESOLUTION
 - **CONS**
 - SENSITIVITY TO TOO MUCH LIGHT EXPOSURE
 - SHORT DISTANCE BETWEEN SCANS
 - ACCURACY 99% (OVER 100FT, WILL HAVE 1 FT DISCREPANCY)

TYPES OF 3D SCANNERS

- **PHOTOGRAMMETRY**
ANALYZES SEVERAL PHOTOGRAPHS OF STATIC OBJECTS TAKEN FROM DIFFERENT VIEWPOINTS TO COMPUTE DISTANCES



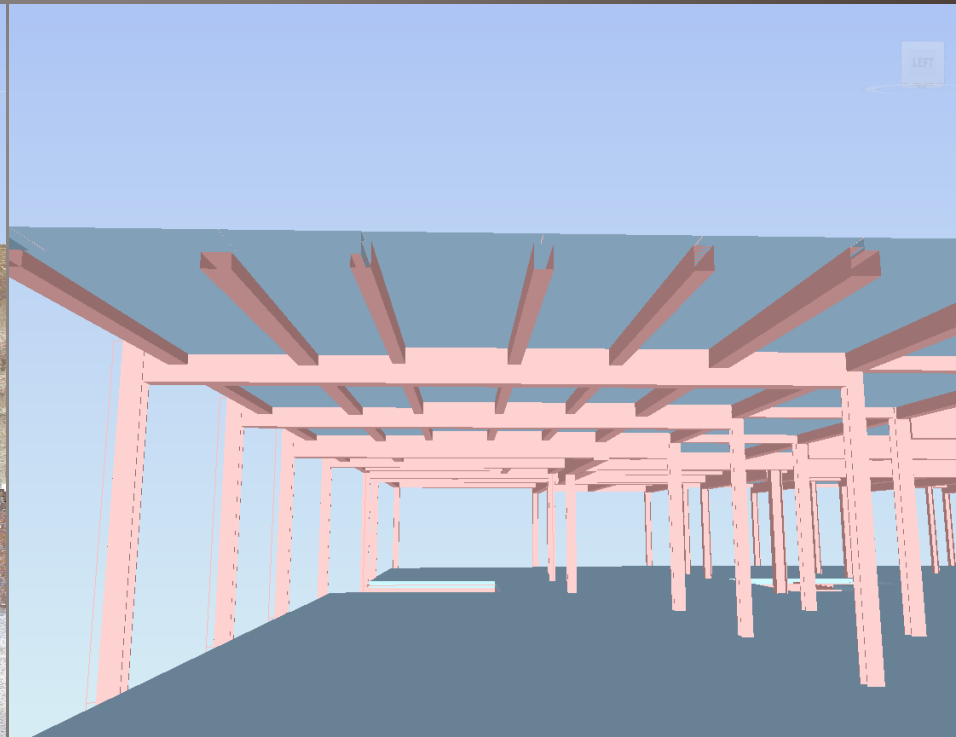
TYPES OF 3D SCANNERS

- **PHOTOGRAMMETRY**
 - **PROS**
 - PRECISION
 - ACQUISITION SPEED
 - **CONS**
 - NEED POWERFUL COMPUTER TO RUN ALGORITHMS
 - DEPENDENT ON THE QUALITY OF PHOTOGRAPHS

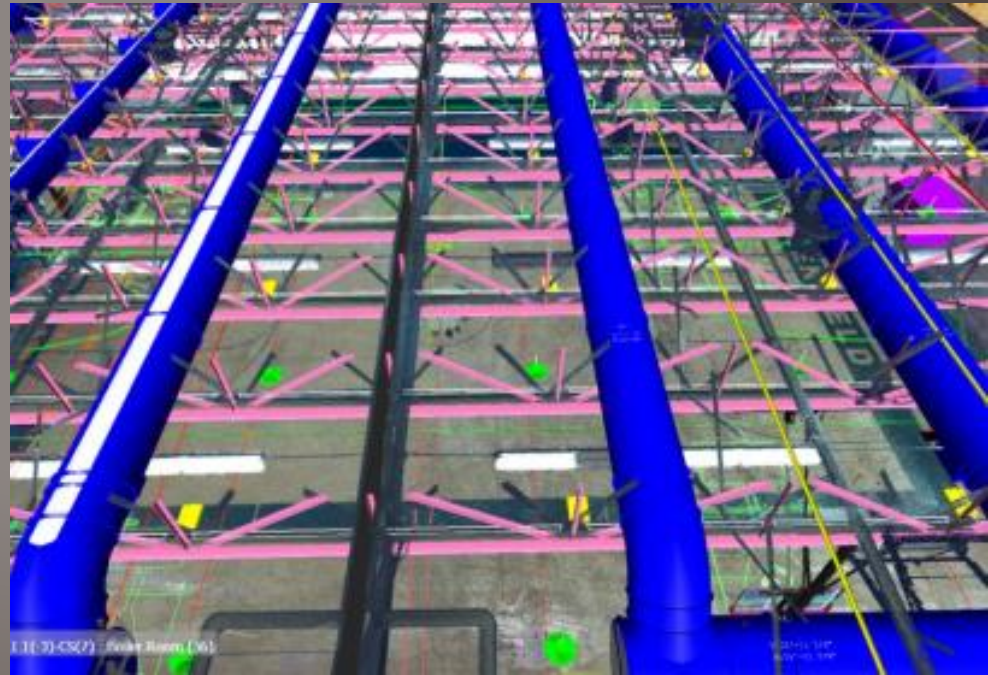
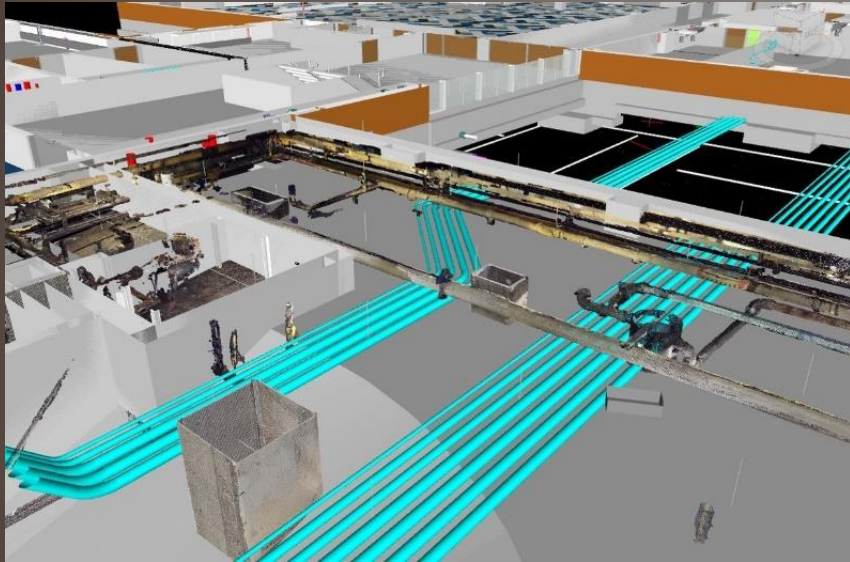
WHY 3D SCAN?

- **SAVES TIME AND EFFORT**
- **DATA CAN BE SHARED AND REVIEWED AT ANY TIME**
- **NOT DEPENDENT ON INCORRECT (NON-EXISTING) AS-BUILTS**

EXAMPLES OF 3D SCAN



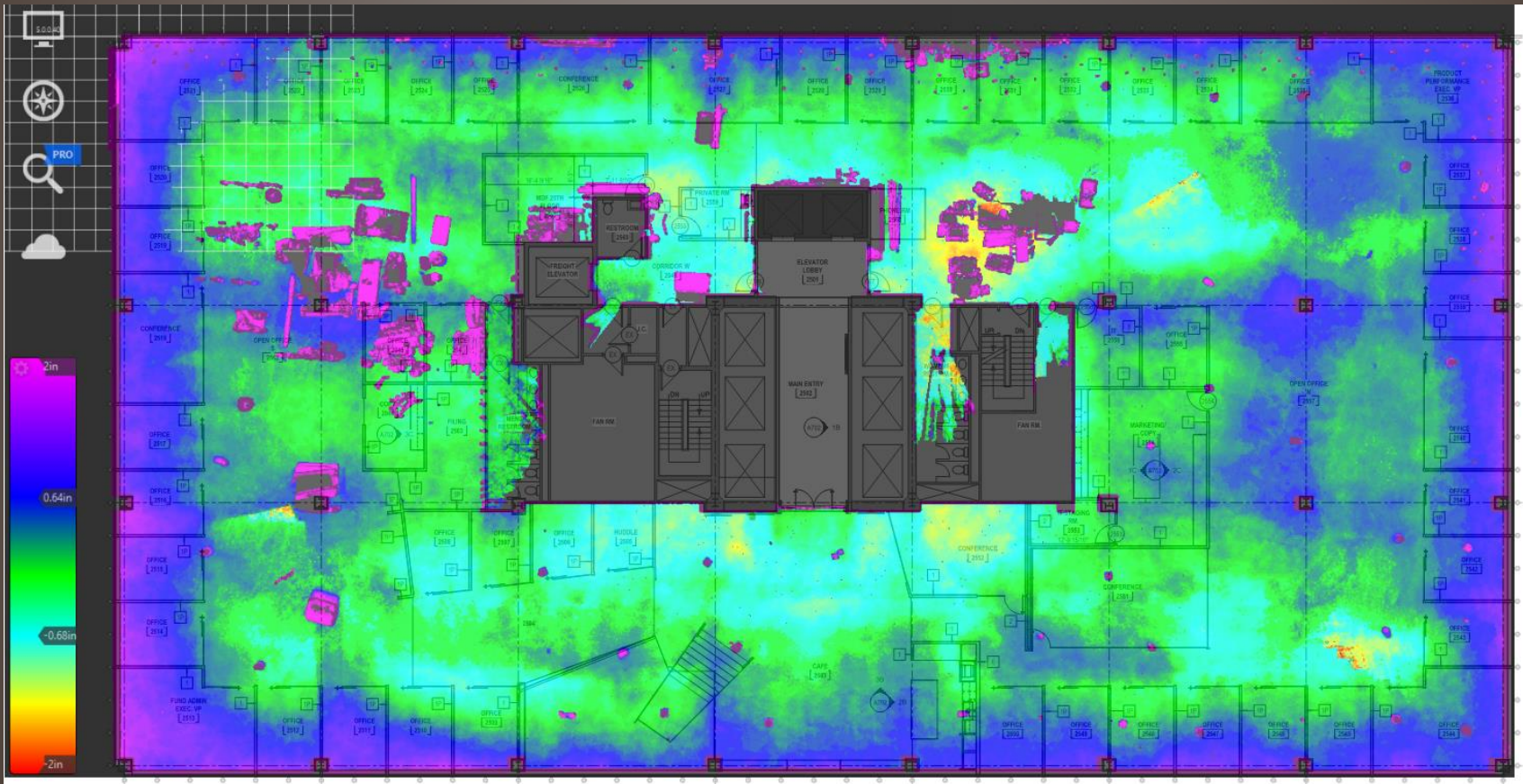
EXAMPLES OF 3D SCAN



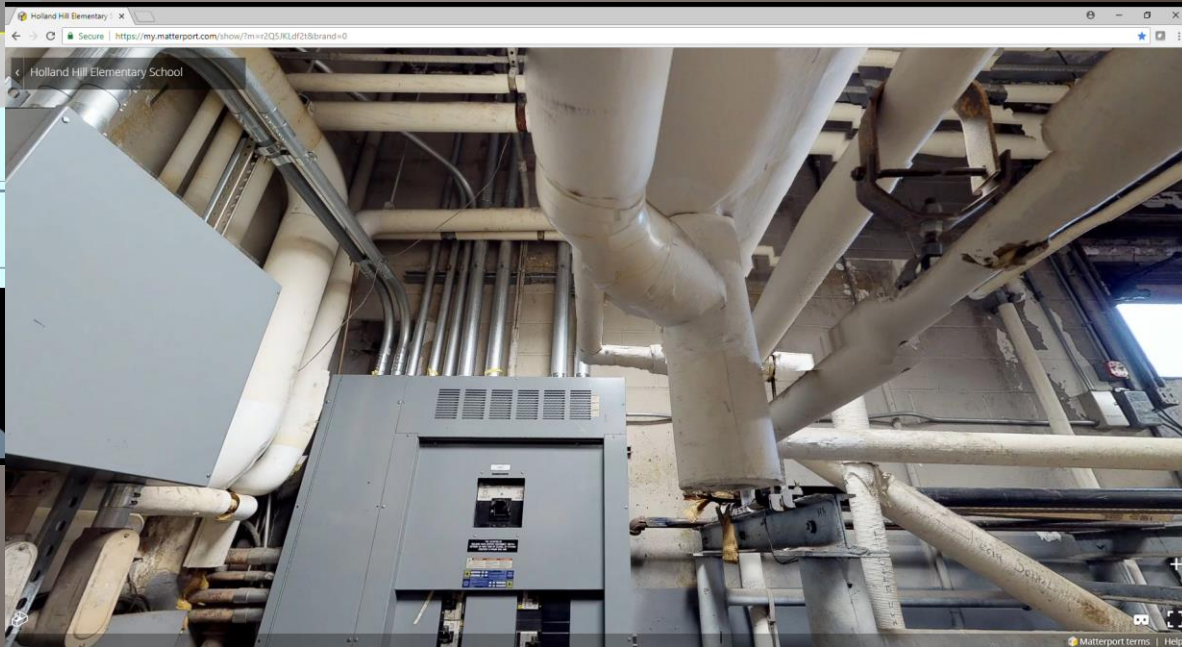
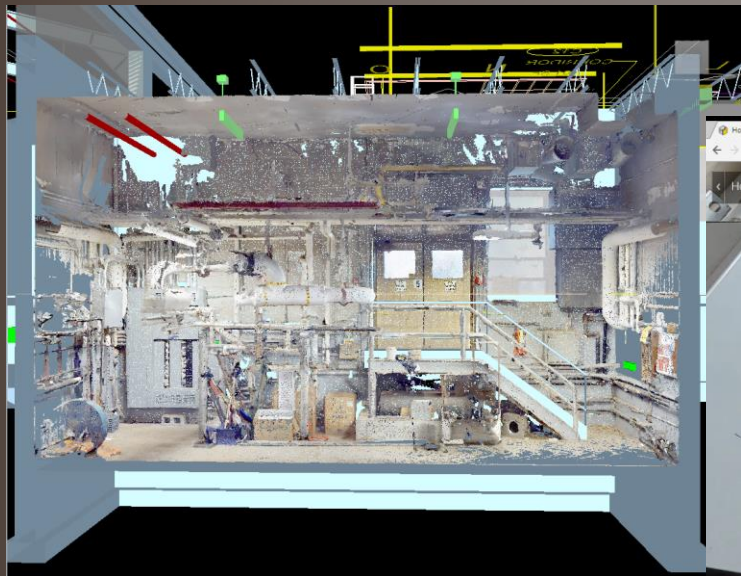
EXAMPLES OF 3D SCAN



EXAMPLES OF 3D SCAN



EXAMPLES OF 3D SCAN



EXAMPLES OF 3D SCAN



3D PRINTING

3D PRINTING

- THE ABILITY TO MANIFEST AN IDEA IN A “SHORT” AMOUNT OF TIME

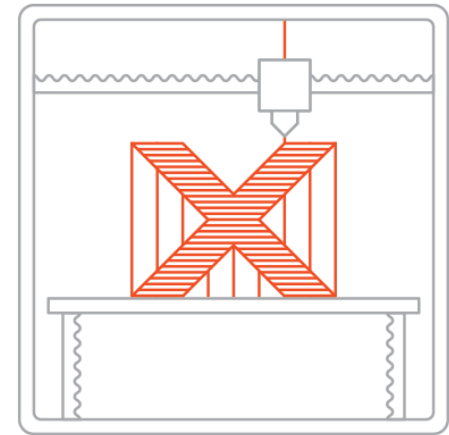
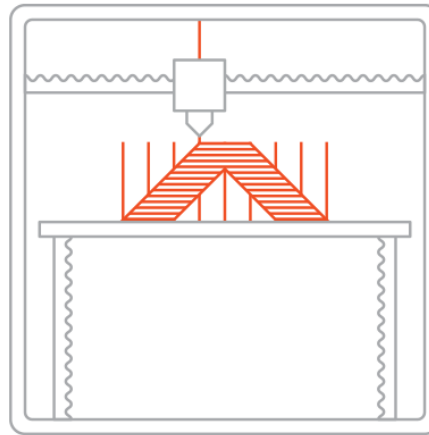
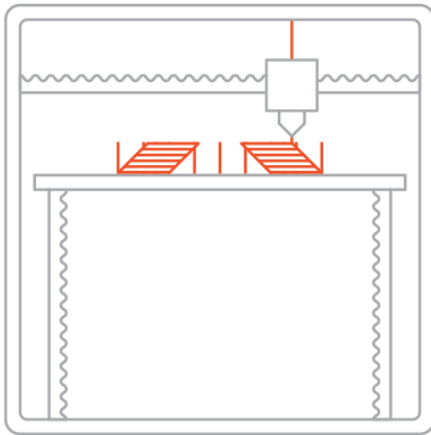


<https://massivit3d.com/solutions/3d-printers/>

3D PRINTING

TYPES OF 3D PRINTING

- **FUSED DEPOSITION MODELING (FDM OR FFF)**

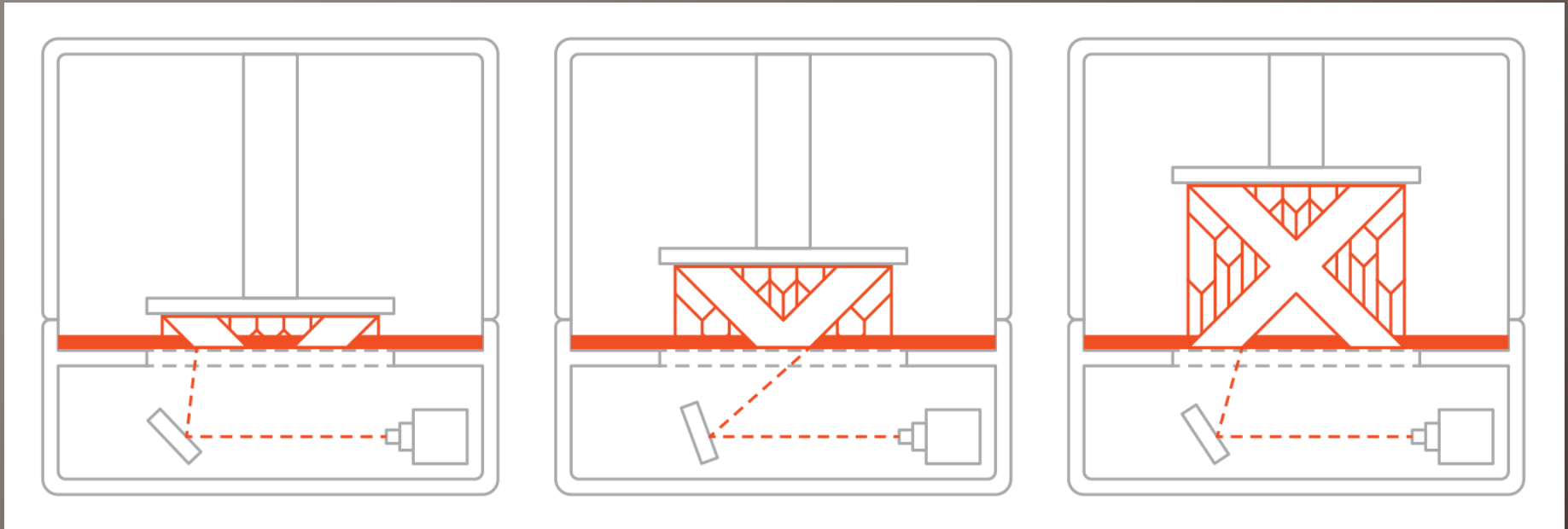


<https://www.3dhubs.com/knowledge-base/introduction-fdm-3d-printing>

3D PRINTING

TYPES OF 3D PRINTING

- **STEREOLITHOGRAPHY (SLA)**

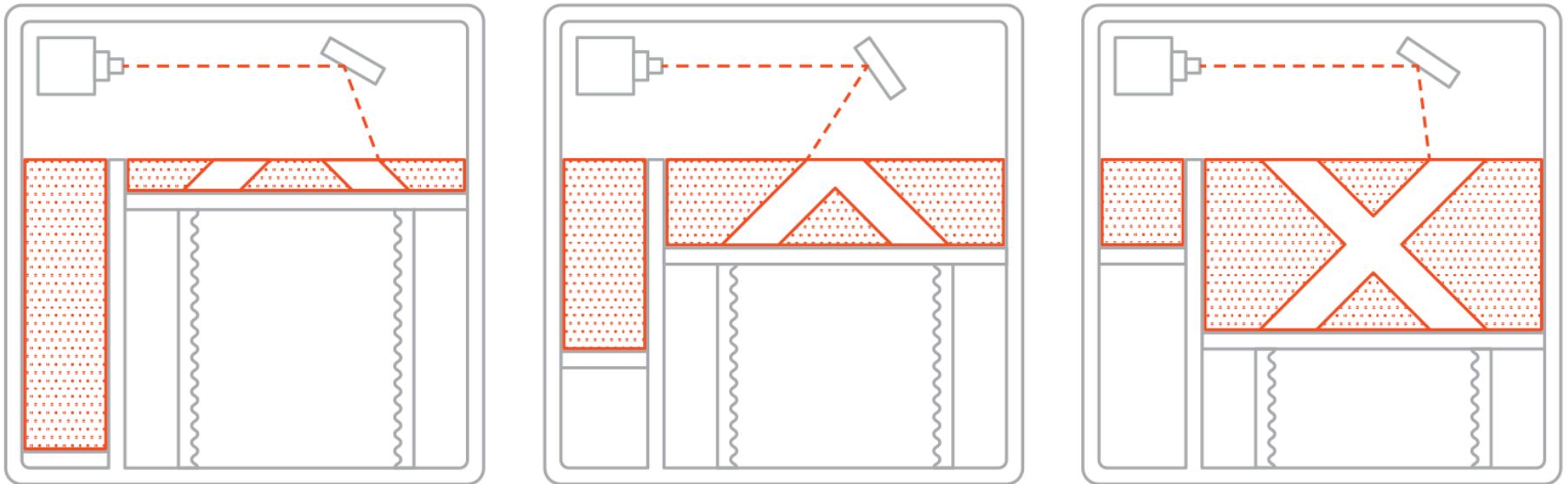


<https://www.3dhubs.com/knowledge-base/introduction-fdm-3d-printing>

3D PRINTING

TYPES OF 3D PRINTING

- **SELECTIVE LASER SINTERING (SLS)**

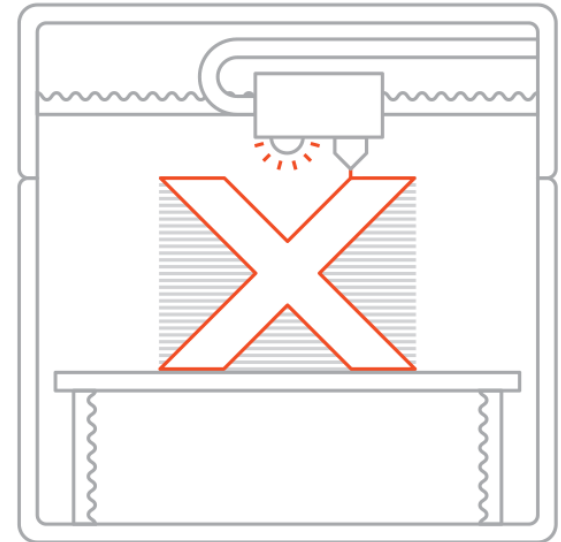
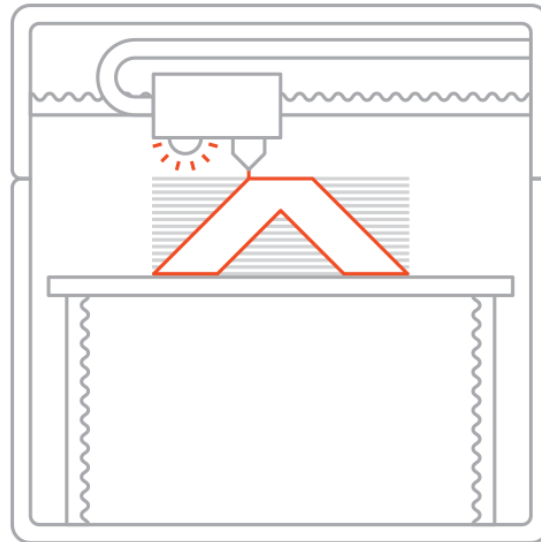
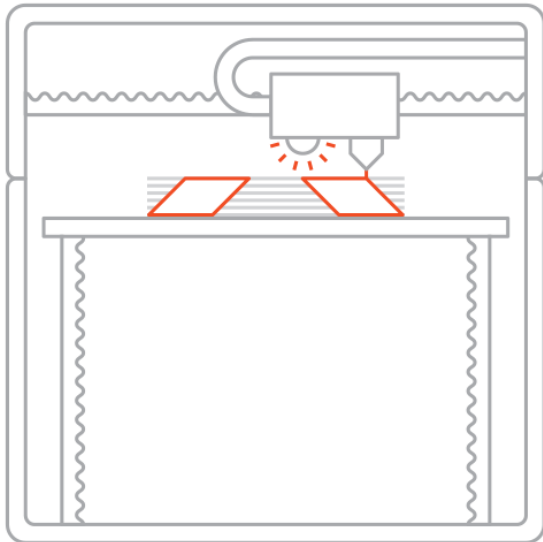


<https://www.3dhubs.com/knowledge-base/introduction-fdm-3d-printing>

3D PRINTING

TYPES OF 3D PRINTING

- MATERIAL JETTING (MJ)



<https://www.3dhubs.com/knowledge-base/introduction-fdm-3d-printing>

3D PRINTING

FUSED DEPOSITION MODELING (FDM OR FFF)

PROS:

- **EASIEST TO USE**
- **WIDE RANGE OF MATERIALS**
- **MOST COMMONLY AVAILABLE**
- **ECONOMICAL**
- **BEST FOR PROTOTYPING**
- **LAYER RESOLUTION .1MM TO .3MM**



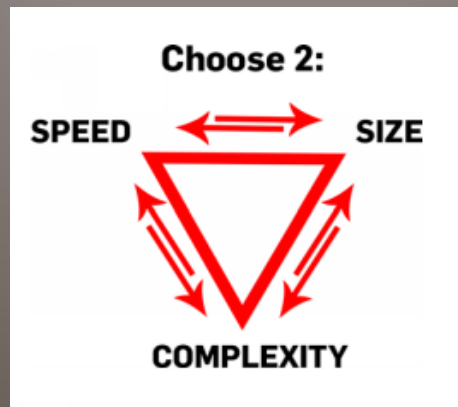
3D PRINTING

FUSED DEPOSITION MODELING (FDM OR FFF)

CONS:

- LOWER FINISH RESOLUTION THAN SLA
- ONLY SINGLE OR DUAL COLOR
- MAX. PRINTING SIZE IS LIMITED (AVERAGE IS

8"X8"X8")



A GROWING TREND

- **SITE LOGISTIC PLANNING**
- **UNDERSTAND YOUR BUILDING**
- **ENHANCE YOUR PRESENTATION**
- **LEAVE BEHIND A STATEMENT**

BECOMING HOUSEHOLD TECHNOLOGY

WHY USE 3D PRINTING?



**RECOGNIZABLE
MEMENTOS**

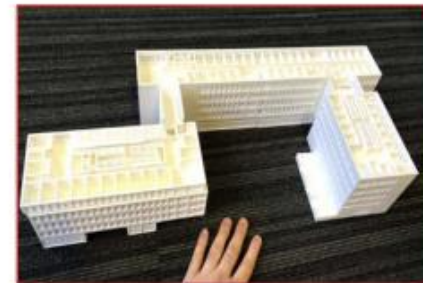
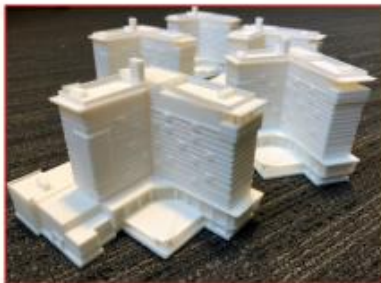
3D PRINTING

Cost: Internal vs. 3rd Party



Material Cost: \$35/spool of Filament

Shipping Cost: \$25-200, depends on speed & weight



3D PRINTING



PRICE RANGE \$150 UP TO \$10,000

https://www.productchart.com/3d_printers/

3D PRINTING

THE EXPLOSIVE GROWTH OF 3D PRINTING

THE WEEK

HOW IT WORKS ▾

3D printers replace ink with everything from plastic to chocolate to concrete, and instead of spitting out a flat ink-on-paper product, they stack thousands upon thousands of extremely thin printed layers on top of each other to create complex three-dimensional objects.

THEN AND NOW ▶



1996

Z402

Cost: \$50,000
Weight: 300 pounds
Speed: 0.014 mm/second

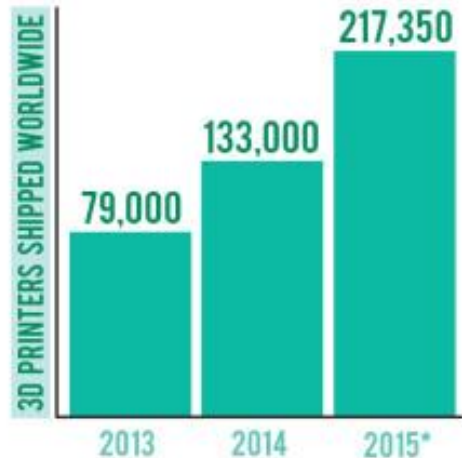


2014

DA VINCI 1.0

Cost: \$499
Weight: 52 pounds
Speed: 150 mm/second

3D PRINTING IS BIG BUSINESS ▾



SIZE OF THE 3D PRINTING MARKET

2013

\$3.1 BILLION

2020*

\$21 BILLION

*Projected

<https://www.rolanddga.com/es/blog/2016/06/02/22/56/cool-3d-printing-infographic>

3D PRINTING

PRINTING TIME

HIGH
Complexity

- Interior walls
- Windows
- Multiple Floors



HIGHER

Failure Rate

LOW
Complexity

- Window Indents
- Skybridges
- Blocks



(Depends on size.)

LOW

Failure Rate

3D PRINTING

COMMON TERMS

- **FDM**
- **FILAMENT- PLASTIC MATERIAL**
- **CURA- COMPUTER SOFTWARE**
- **HOT-END**



HOW DOES IT WORK?

SLICING SOFTWARE



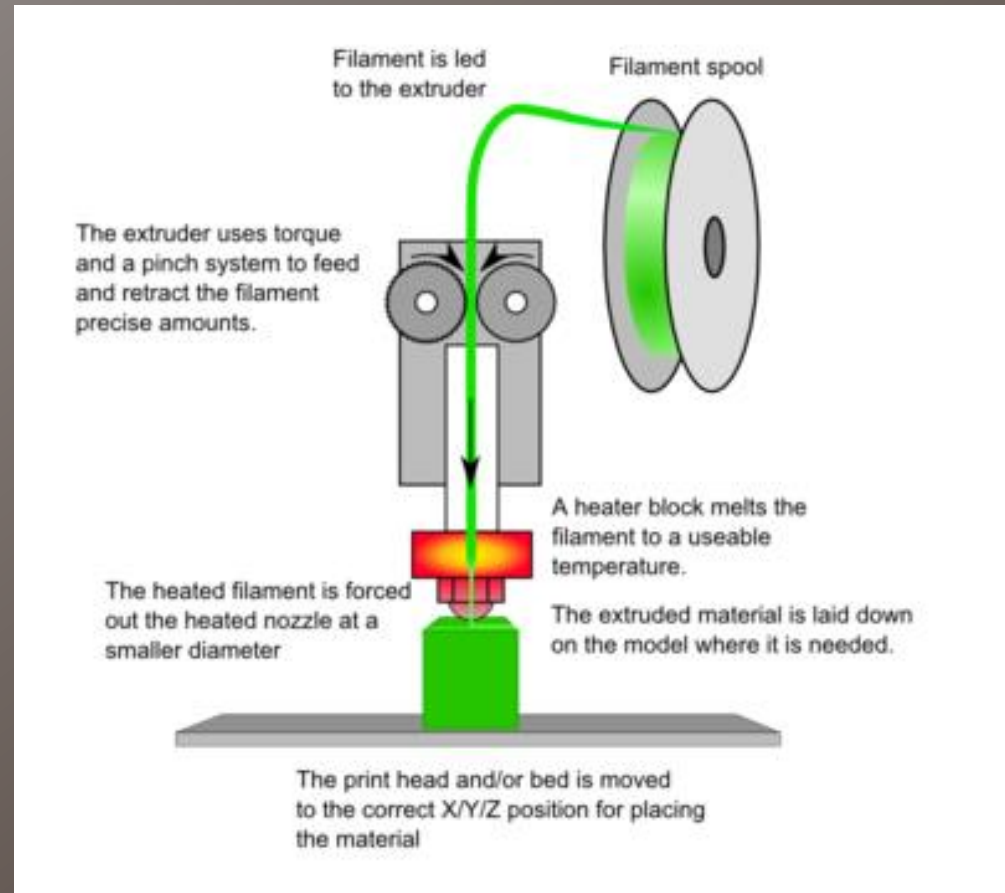
3D PRINTER



FILAMENT
SPOOL



HOT-END



HOW DOES IT WORK?

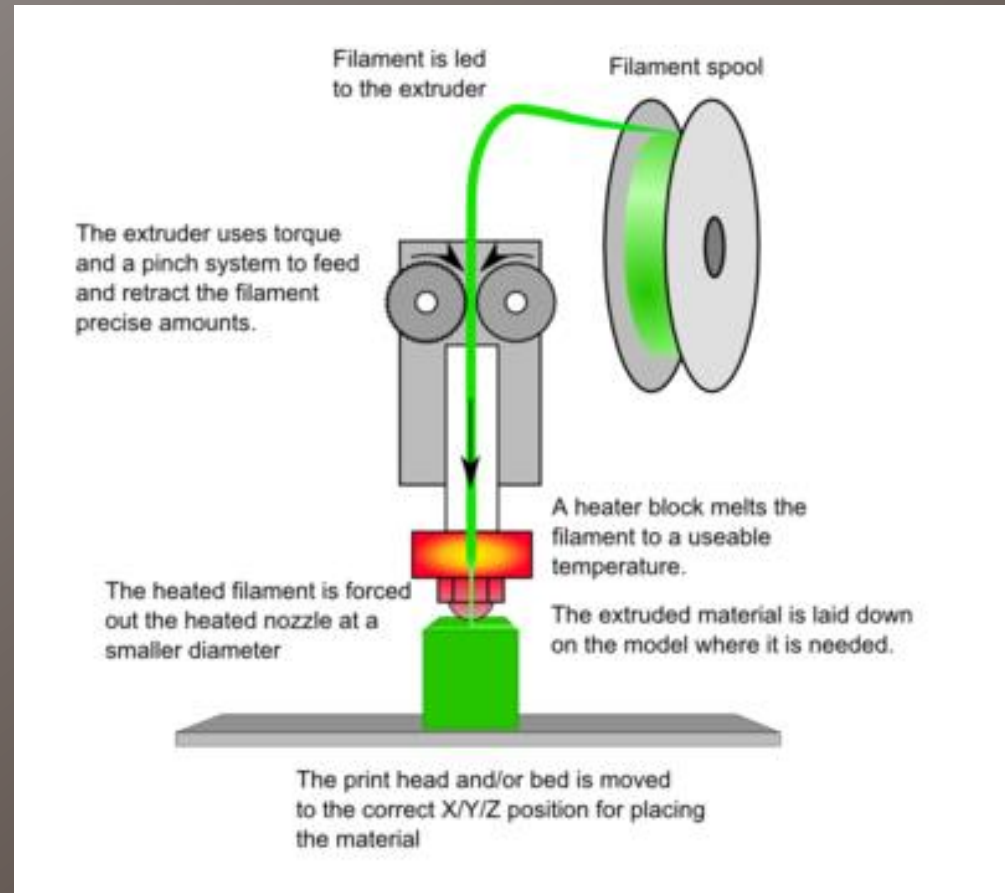
HOT-END



**BED PLATE-
LAYER**



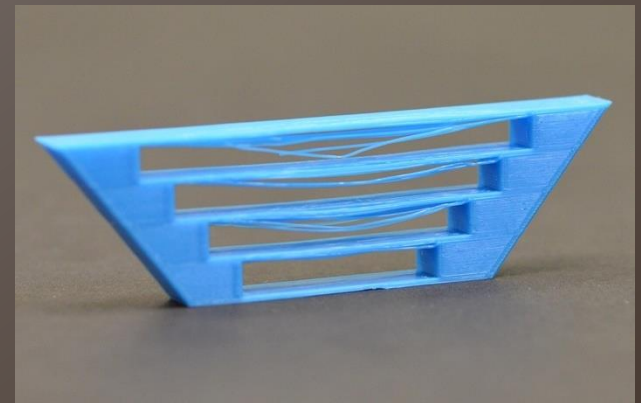
**RAPID
COOLDOWN**



HOW DOES IT WORK?

FACTORS TO CONSIDER:

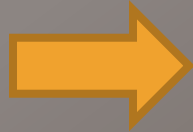
- **OVERHANGS- CANTILEVERS, WALL OPENINGS, “BRIDGING”**
- **VOIDS**
- **THICKNESS- WALLS, SPIRES, COLUMNS**



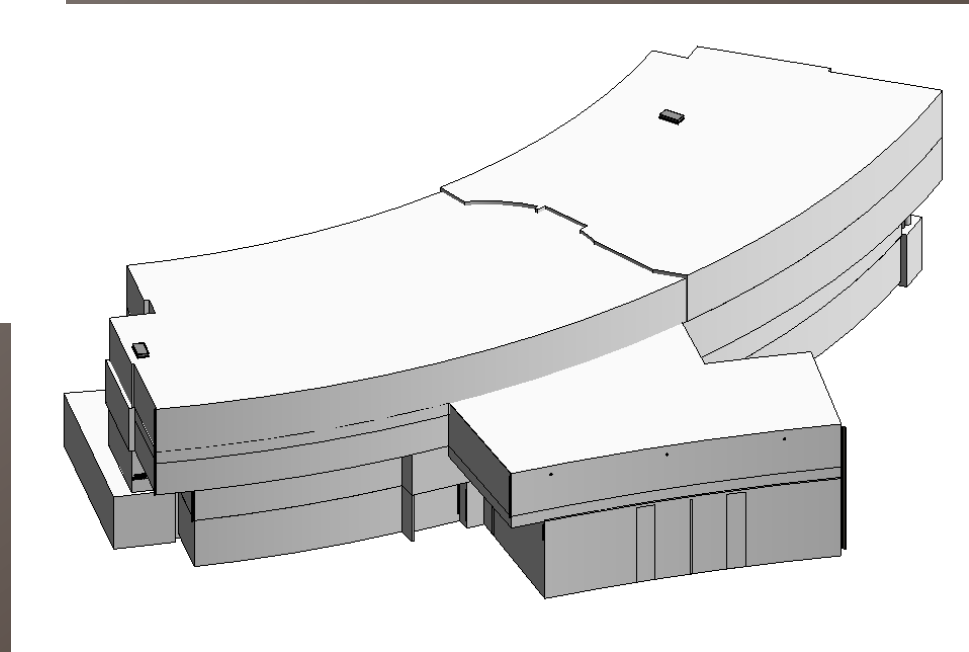
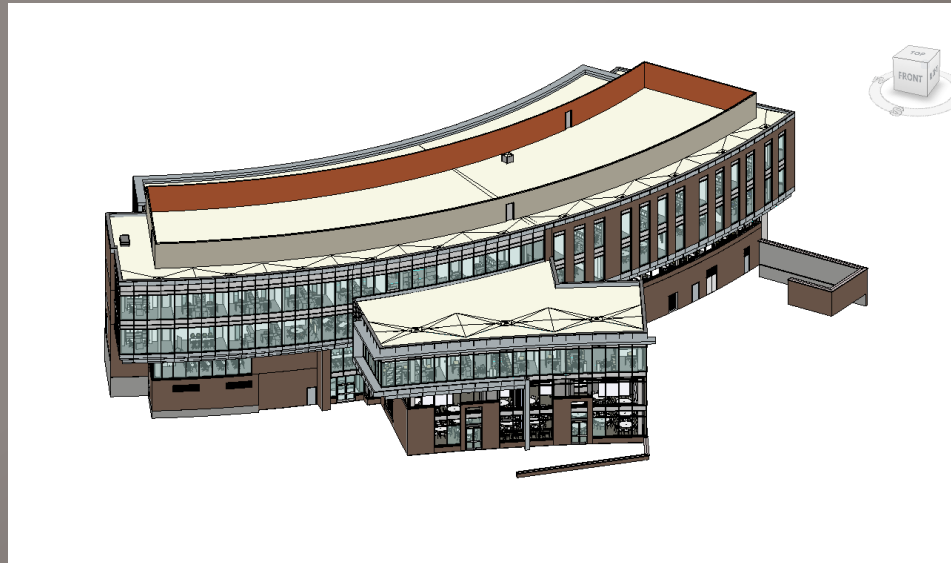
CASE STUDY

HOW DOES IT WORK?

DESIGN IDEA

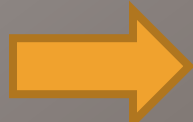


COMPUTER MODEL



HOW DOES IT WORK?

COMPUTER MODEL



“SLICING SOFTWARE”

cura Prepare Monitor

Robo 3D R1 #2

Material: PLA

Print Setup: Recommended Custom

Profile: GBCO Profile - 0.2mm

Quality

- Layer Height: 0.3 mm

Shell

- Wall Thickness: 0.8 mm
- Top/Bottom Thickness: 0.6 mm
- Top Thickness: 0.6 mm
- Top Layers: 3
- Bottom Thickness: 0.6 mm
- Bottom Layers: 3

Infill

- Infill Density: 10 %
- Infill Pattern: Grid
- Infill Overlap Percentage: 10 %
- Infill Overlap: 0.03 mm
- Skin Overlap Percentage: 5 %
- Skin Overlap: 0.02 mm
- Infill Wipe Distance: 0.2 mm

Material

- Printing Temperature: 200 °C
- Build Plate Temperature: 60 °C
- Diameter: 1.75 mm
- Flow: 100 %

Ready to Save to File

R3DR12_DSOB
180.6 x 188.6 x 55.4 mm

09h 28min
58.92m / - 176g

Save to File

HOW DOES IT WORK?

SLICING SOFTWARE



3D PRINTER

The screenshot displays the Cura software interface. The main window shows a 3D model of a part being sliced into layers. The interface includes a menu bar (File, Edit, View, Settings, Extensions, Plugins, Preferences, Help) and a toolbar on the left. The right sidebar contains several panels:

- Layer view**: Shows a color scheme and line type dropdown.
- Print Setup**: Includes a material dropdown (PLA), a compatibility check link, and print setup options (Recommended, Custom).
- Quality**: Shows layer height (0.3 mm) and shell settings (Wall Thickness: 0.8 mm, Top/Bottom Thickness: 0.6 mm, Top Thickness: 0.6 mm, Top Layers: 3, Bottom Thickness: 0.6 mm, Bottom Layers: 3).
- Infill**: Shows infill density (10%), infill pattern (Grid), infill overlap percentage (10%), infill overlap (0.03 mm), skin overlap percentage (5%), skin overlap (0.02 mm), and infill wipe distance (0.2 mm).
- Material**: Shows printing temperature (200 °C), build plate temperature (60 °C), diameter (1.75 mm), and flow (100%).

At the bottom right, the software indicates it is "Ready to Save to File" and shows a print time of 13h 02min and a weight of 81.74m ~ 244g. A "Save to File" button is visible.

HOW DOES IT WORK?

SLICING SOFTWARE

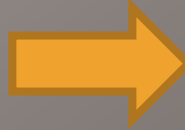


3D PRINTER

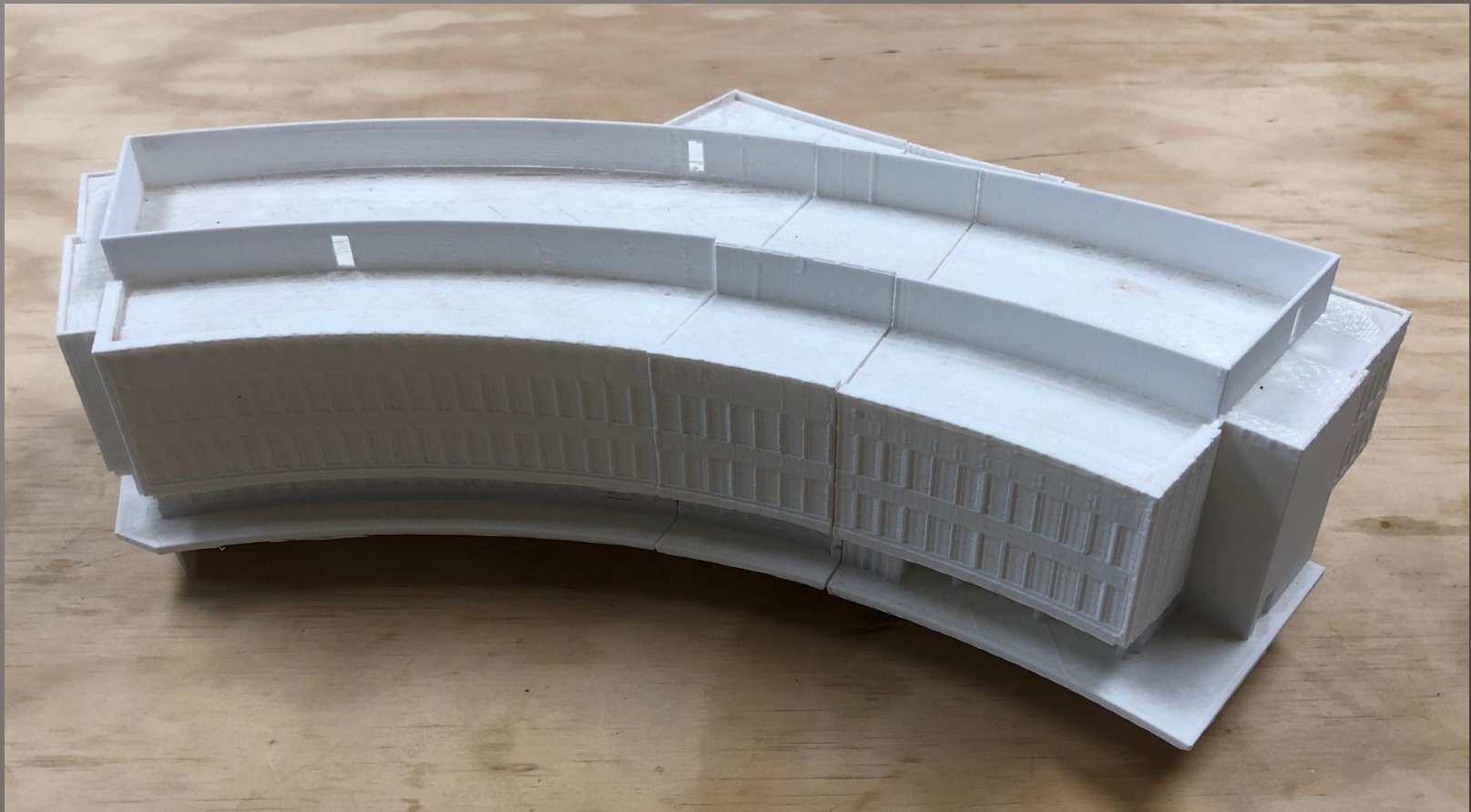


HOW DOES IT WORK?

3D PRINTER



PRESENTATION

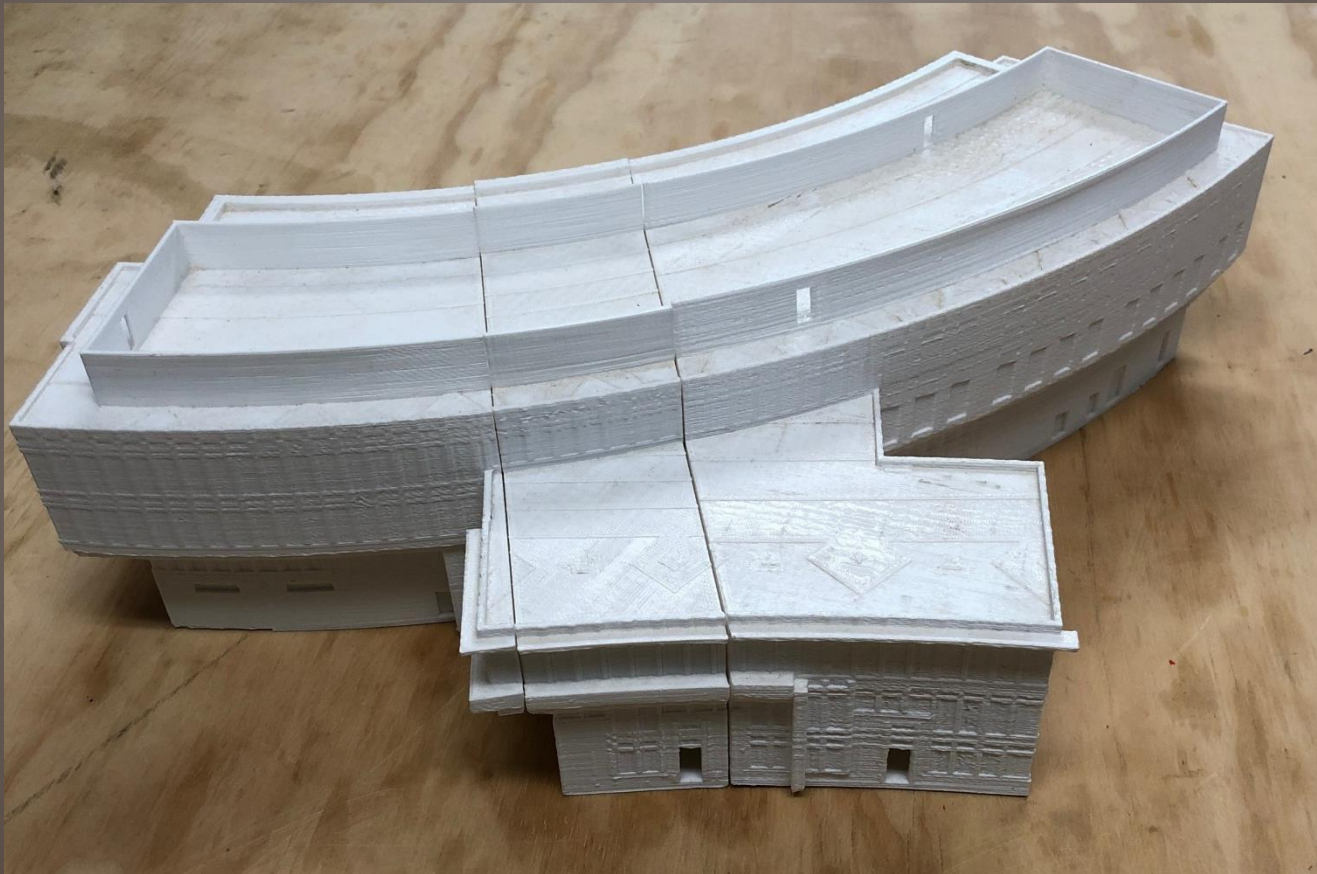


HOW DOES IT WORK?

3D PRINTER



PRESENTATION

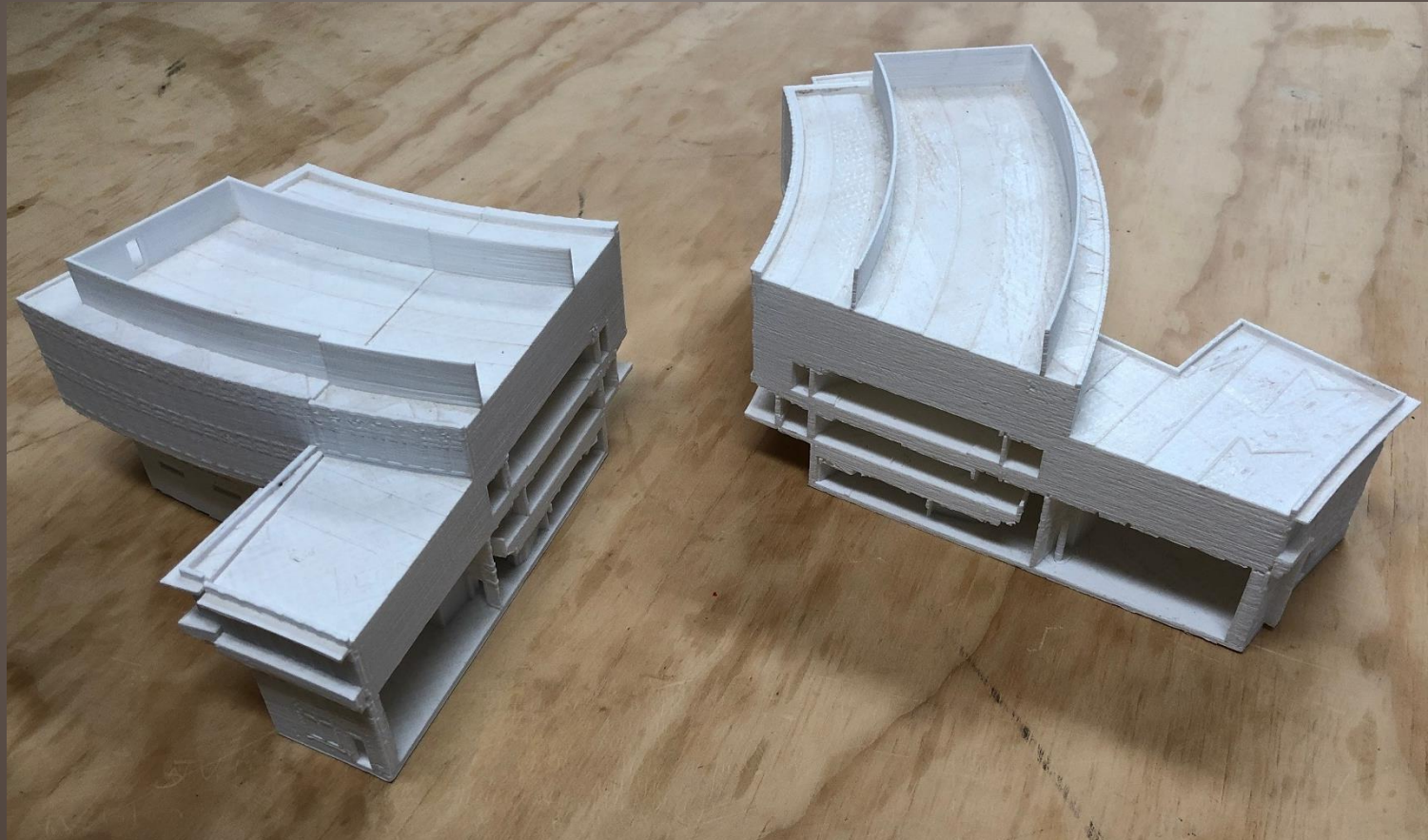


HOW DOES IT WORK?

3D PRINTER



PRESENTATION



HOW DOES IT WORK?

3D PRINTER



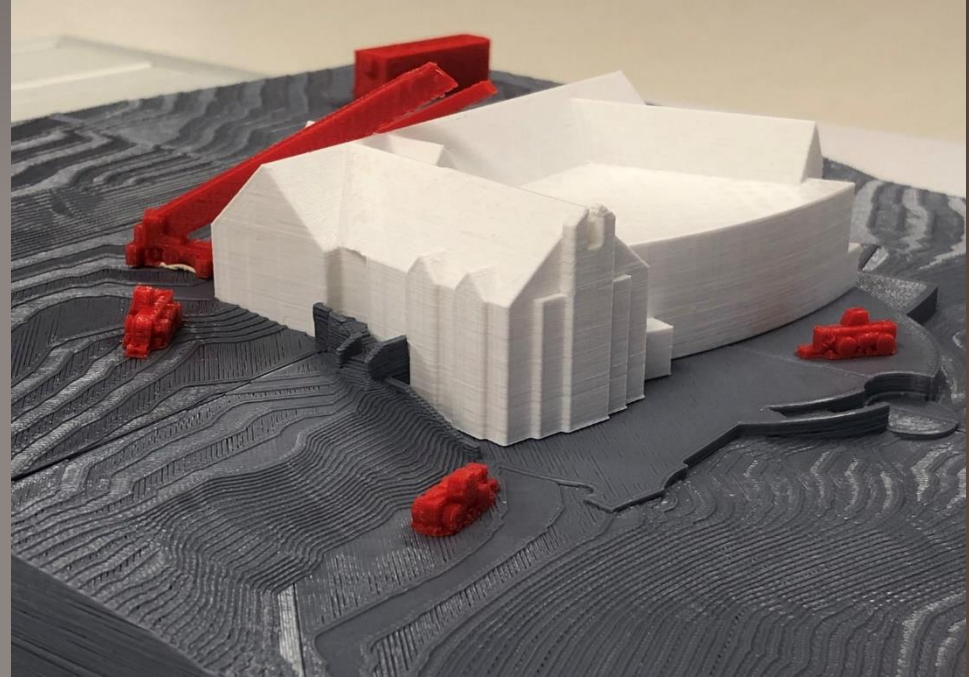
PRESENTATION



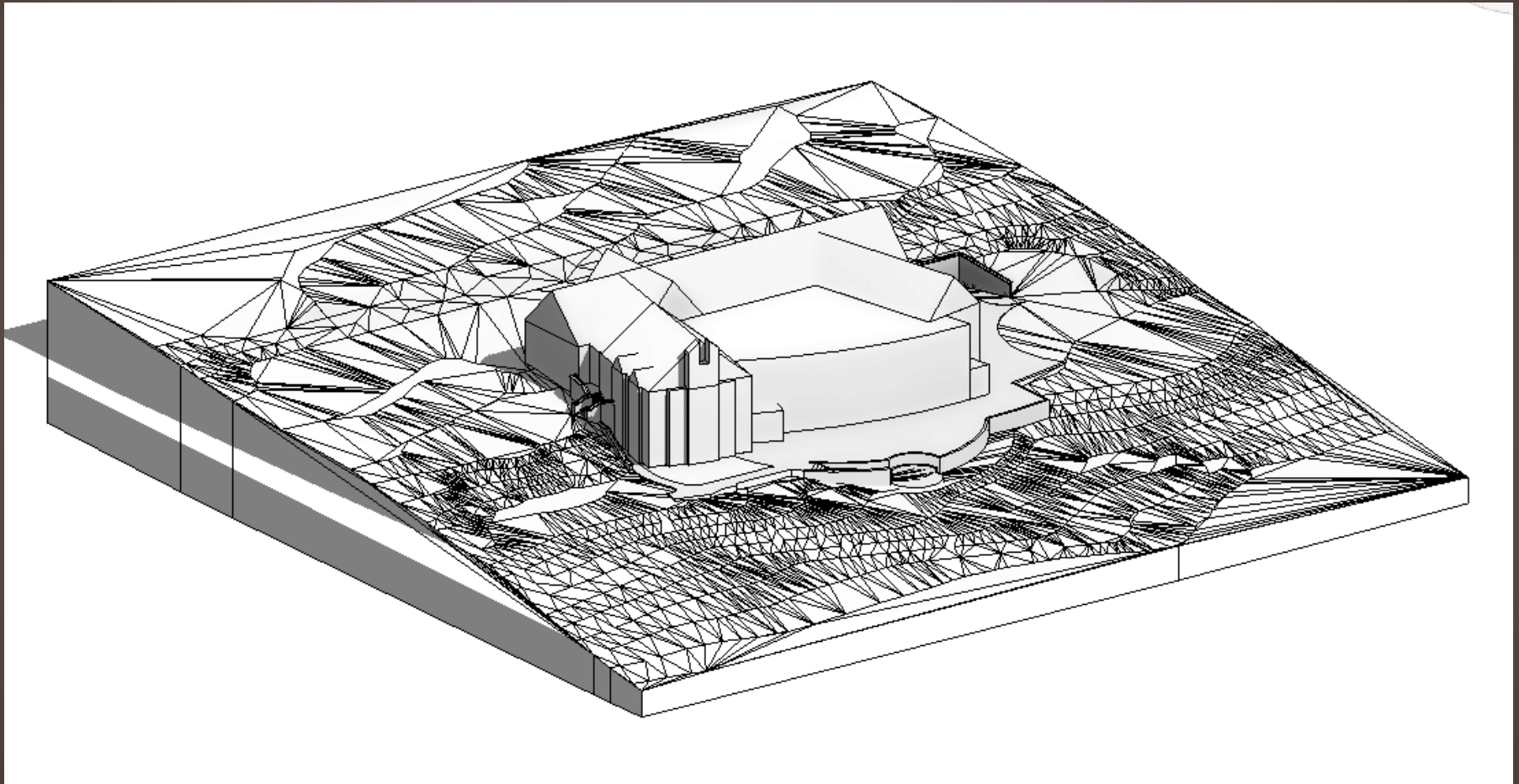
CASE STUDY

SITE LOGISTIC PLANNING

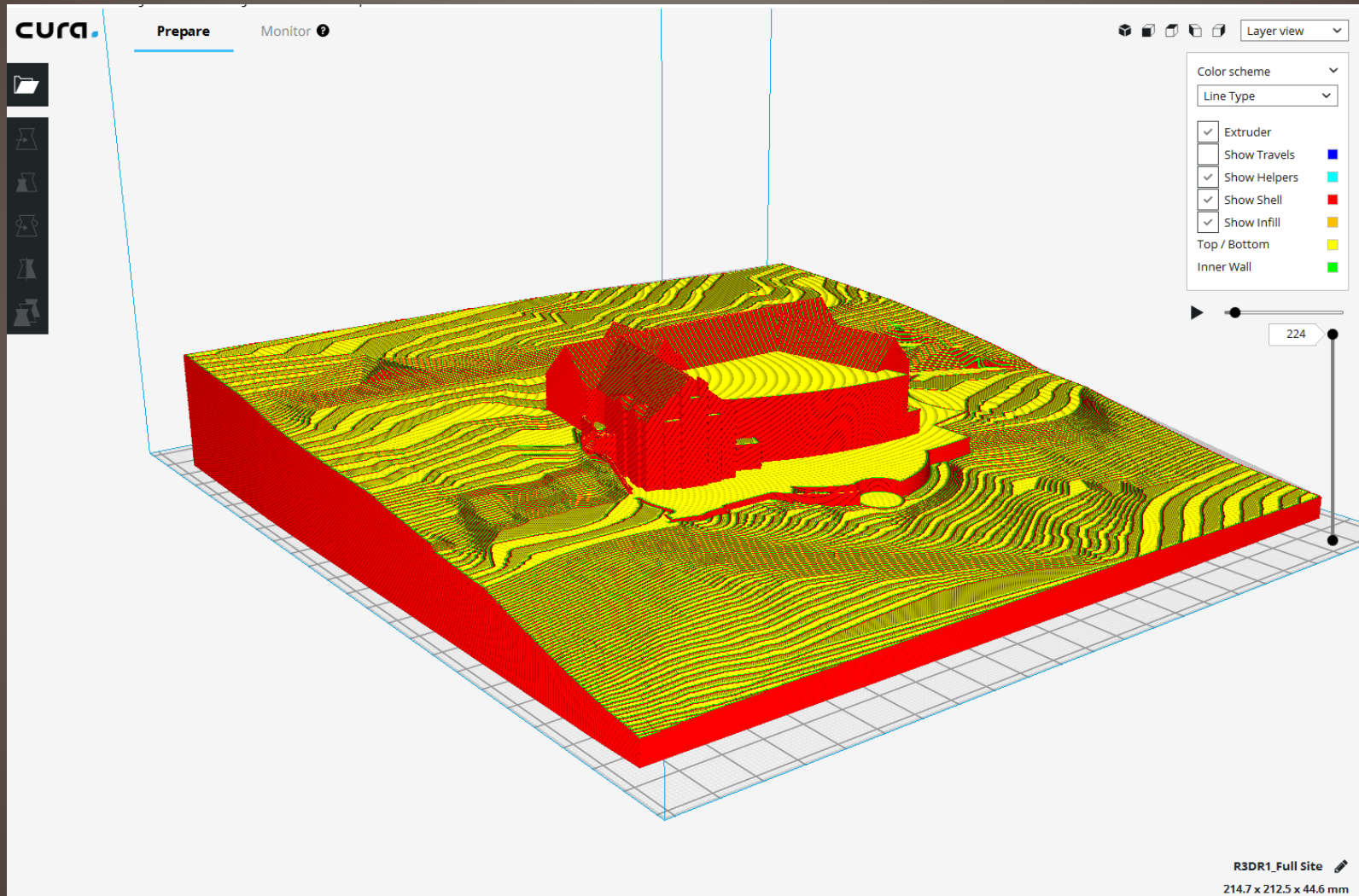
- **UNDERSTANDING YOUR SITE**
- **TRAILER AND EQUIPMENT PLACEMENT**
- **UNFORESEEN CONFLICTS**
- **CONSTRUCTION SEQUENCING**



SITE LOGISTIC PLANNING

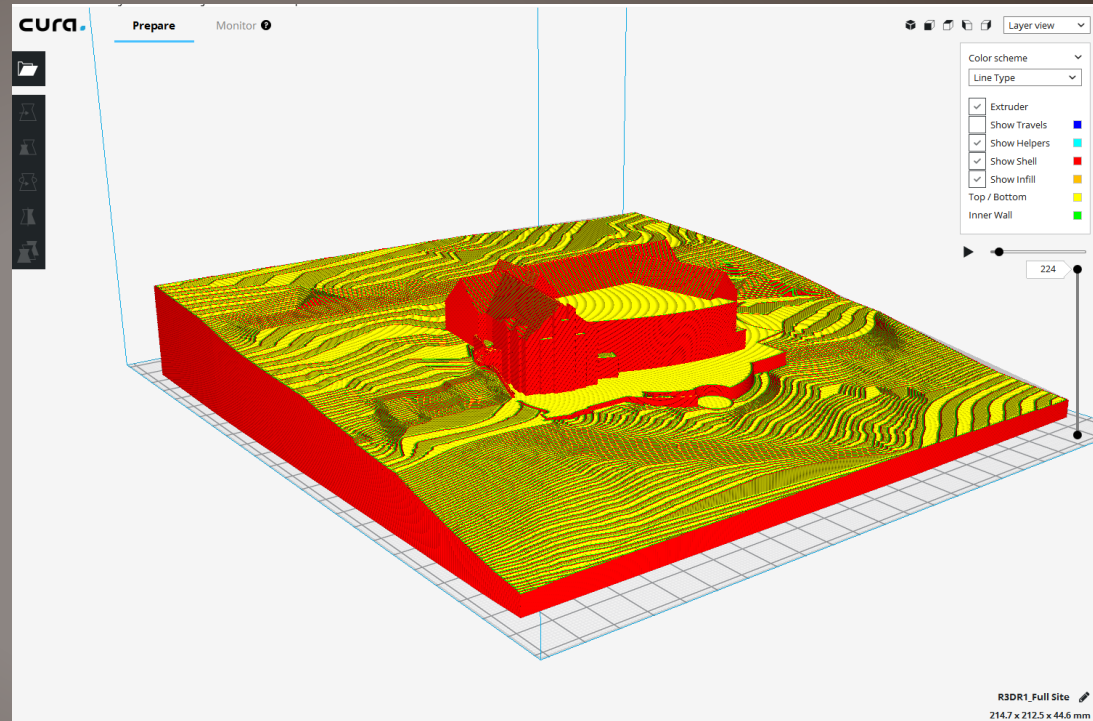


SITE LOGISTIC PLANNING

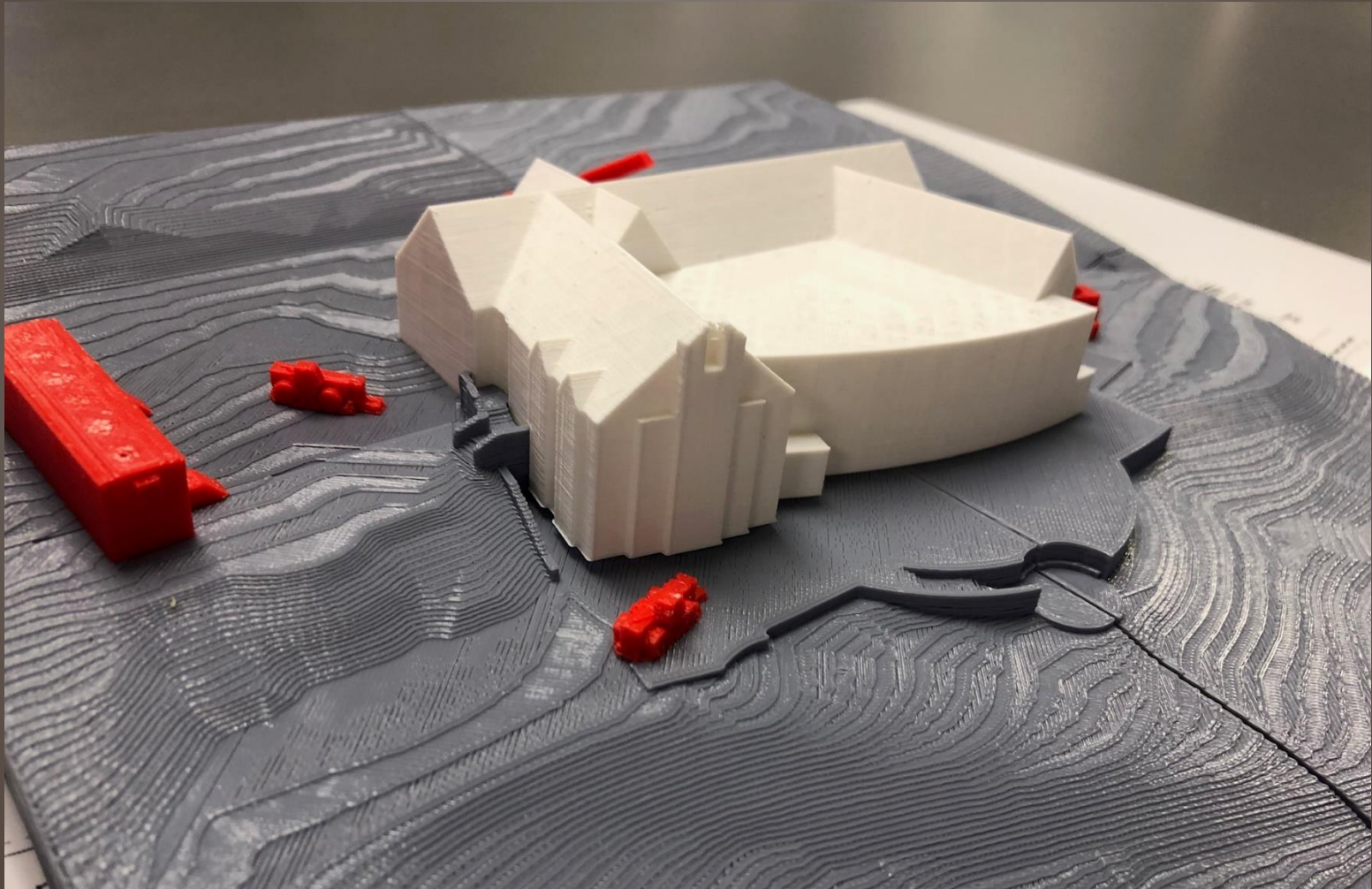


SITE LOGISTIC PLANNING

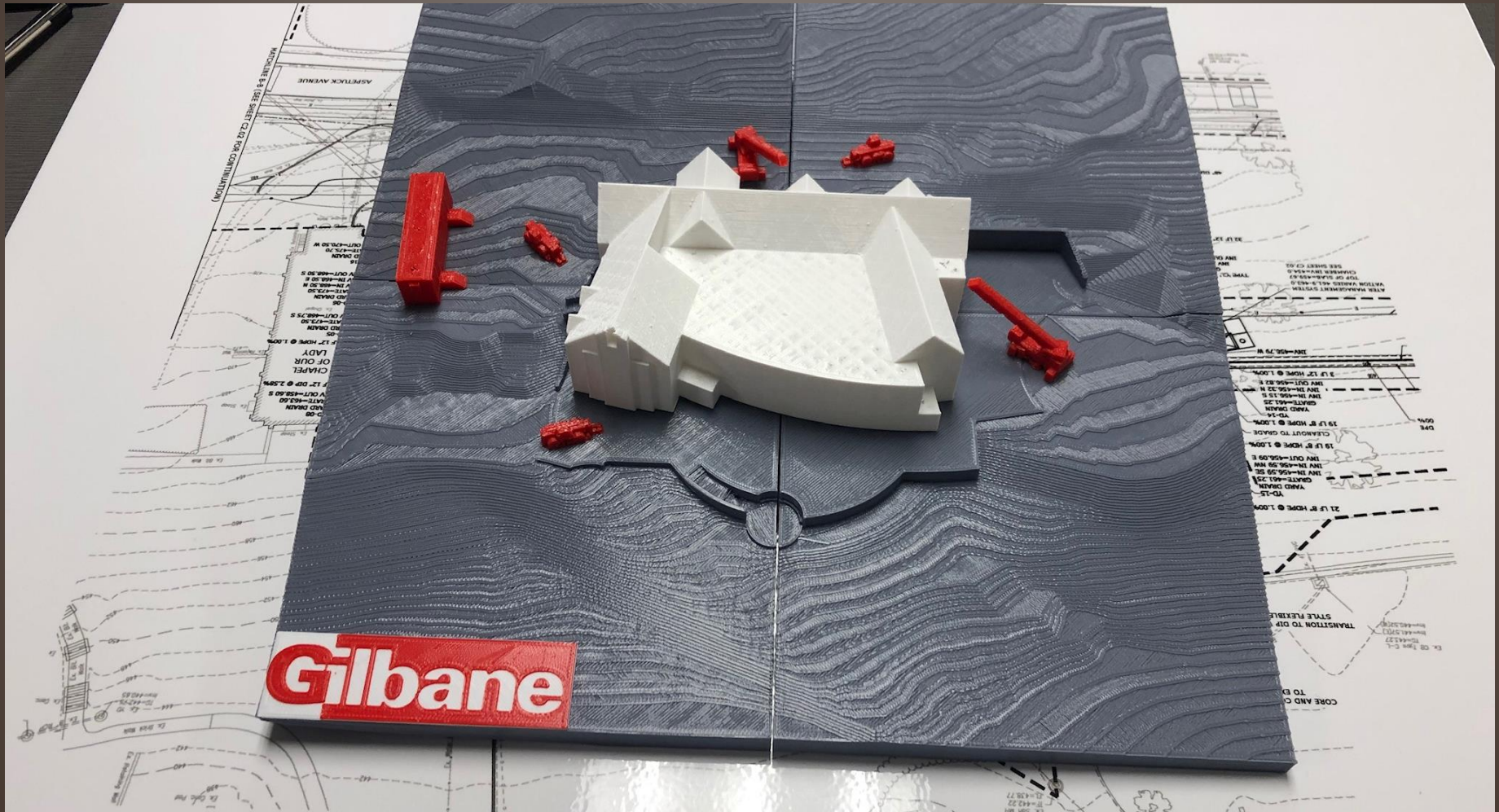
- **SIZE 12"X12" BROKEN INTO 6"X6"**
- **LAYER HEIGHT= .3MM**
- **8-10 HOUR PER PRINT**
- **5 PRINTS TOTAL**
- **TOTAL TIME OF 45-50 HOURS OF PRINTING**



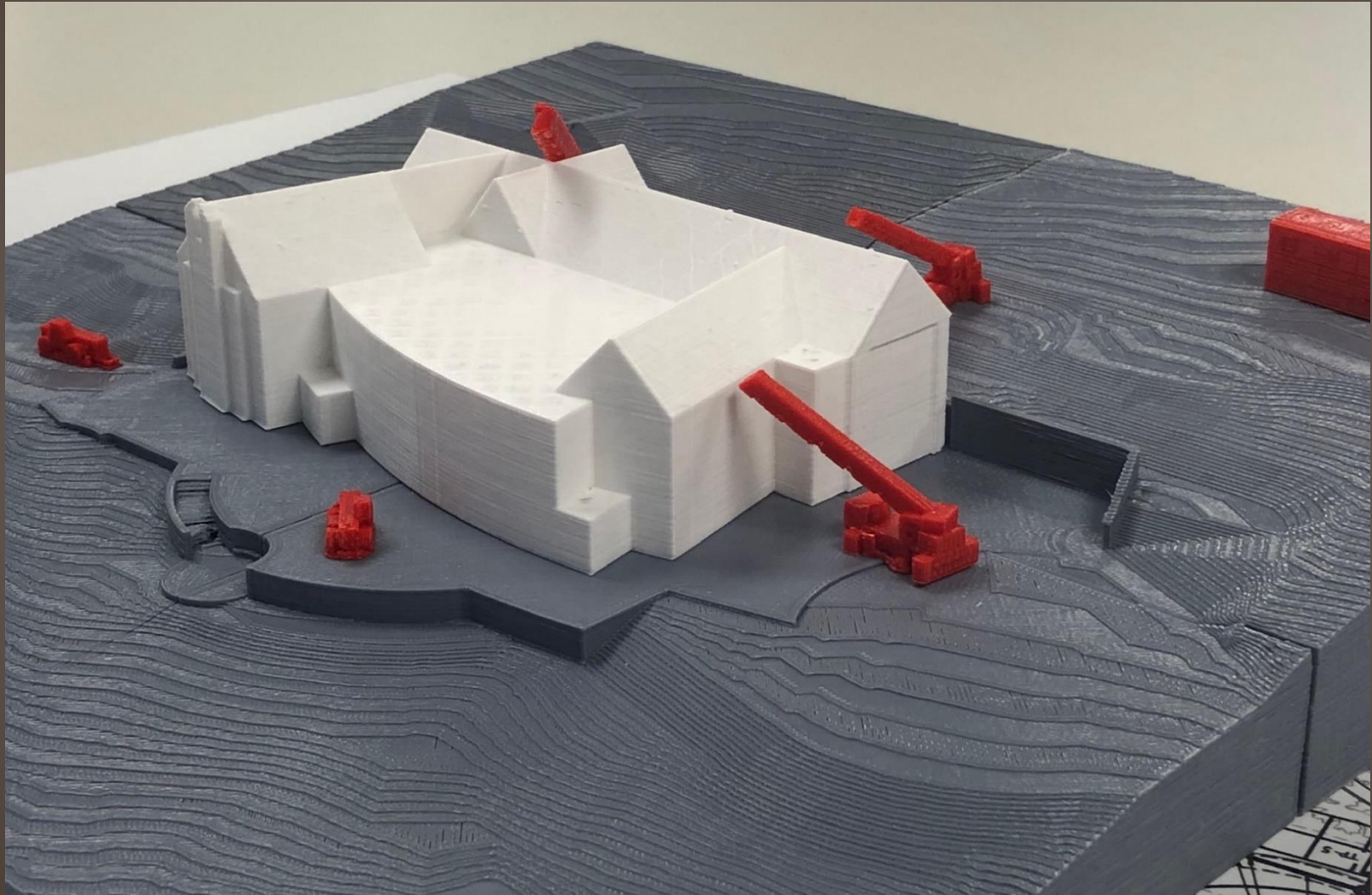
SITE LOGISTIC PLANNING



SITE LOGISTIC PLANNING



SITE LOGISTIC PLANNING



FUTURE OF 3D PRINTING?

FUTURE OF 3D PRINTING?

- REMOTE CONTROL PRINTING
- WEB MONITORING
- EMERGENCY **CANCEL!**

The screenshot displays the OctoPrint web interface. On the left, the 'State' panel shows the printer is 'Operational' and has completed printing 'R3DR12_DSOB.gcode'. A progress bar indicates 100% completion. Below this is a 'Files' section with a search bar and a list of files, including 'R3DR12_DSOB.gcode' and 'Robo camera Count (1).stl'. On the right, the 'Temperature' control panel features a graph and a table. The graph shows 'Actual T: 12.8°C' and 'Actual Bed: 13.6°C' with a green octopus mascot overlaid. The table below provides controls for 'Tool' and 'Bed' temperatures, including target settings and offset adjustments.

	Actual	Target	Offset
Tool	12.8°C	off °C	0 °C
Bed	13.6°C	off °C	0 °C

FUTURE OF 3D PRINTING?

- **CONCRETE PRINTING**
- **SAME CONCEPT OF X,Y,Z PRINTING-
MUCH LARGER SCALE**
- **CONSISTENCY**



FUTURE OF 3D PRINTING?

- **STEEL PRINTING**
- **CONSTRUCTION OF ORGANIC SHAPES**



<https://mx3d.com/projects/bridge-2/>

COMMENTS OR QUESTIONS?