Connecting FormIt and Dynamo for Predesign Formal Thinking

David R Beach, AIA

Associate Professor of Architecture

Drury University

AUTODESK UNIVERSITY

About the speaker

Teach all the digital things…

David R. Beach is an architect and Associate Professor of Architecture at the Hammons School of Architecture at Drury University. Specializing in digital design technology, David is an advocate of full digital immersion as part of a traditional design process leveraging technology to inform process, collaboration, and decision making through analysis. David teaches in the architectural design studios, the Center for Community Studies working at the urban design scale, and both the introductory and advanced digital design technology courses. The application elements of David's current research can be found at the Autodesk Design Academy, and on his blog and YouTube Channel: The Architect's Digital Design Guide - which combined have over 6 million minutes of viewership, and are outlets for work and information directly related to questions received from students and practitioners. David has given 8 presentations at AU, and has completed over 25 major conference presentations in the last 10 years.

Learning Objectives:

CONTEXT:

Learn how to generate a context model and contextual data for a design project in FormIt.

DYNAMO:

Learn how to use Dynamo to develop formal design strategies to respond to both analytical data and visceral design thinking.

VR:

Learn how to push the model to virtual reality for early design-process exploration and communication.

FABRICATION:

Learn how to export the model for fabrication, including CNC cutting (site) and 3D printing (design and context).

Key Disruptions:

- Virtual Reality
- Simulations (design considerations)
- Visual Programming (Dynamo)
- Digital Fabrication
- Artificial Intelligence

The Robots are Coming:

- 1,100 square meters or 11,840 square feet for a total cost of $160,000
- This equates to $13.51 per square foot
- Assuming a low average cost on current construction methods in the United States, $200 per foot for 11,840 square feet would yield a cost of $2,368,000
- That is a cost reduction of 93.2%. Also known as “free buildings”

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The Nope Anomaly:

- 38 square meters – 410 square feet (about the size of a hotel room) for $10,134.
- That is $24.72 per square foot.
- Or a cost savings from a conservative estimate on a small structure – perhaps $150 per square foot – $61,500.
- This is a cost reduction of 83.5%.

The Auto Indicator:

- Construction: 1.8 Trillion-Dollar Industry
- Reduction of 80%? 60%? 40%? of revenue.
- Precedent: Detroit

Current Ford CEO Mark Fields said of the 1980's:

"We (auto manufacturers) went through a huge transformation. . . . We had to say goodbye to almost 50 percent of the hourly workforce and almost 40 percent of the salaried workforce. The key thing about the transformation is that we did not miss a unit of production during this time and quality went up."

(Cutcher-Gershenfeld, Brooks, and Mulloy 2015, 74)

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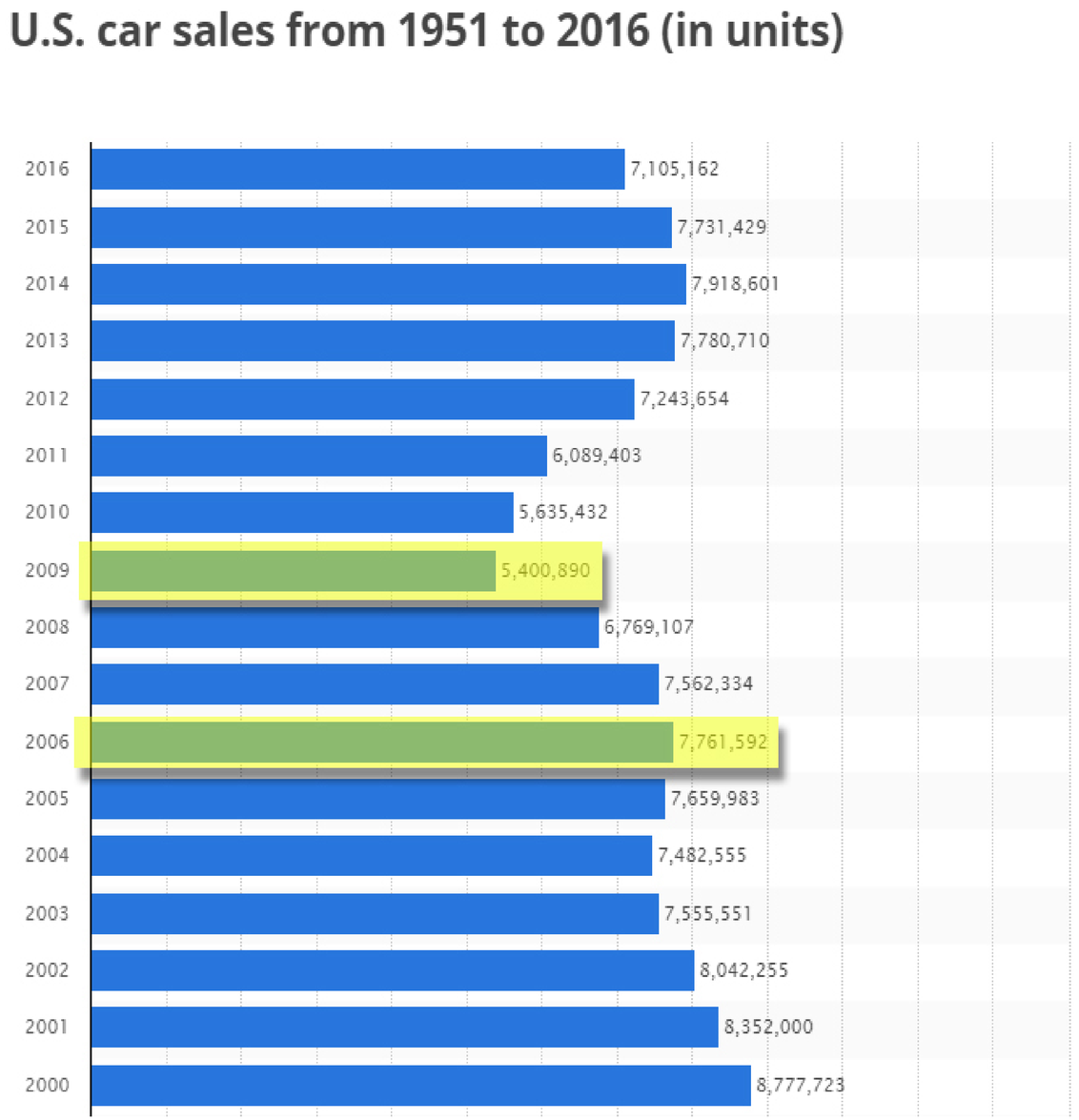
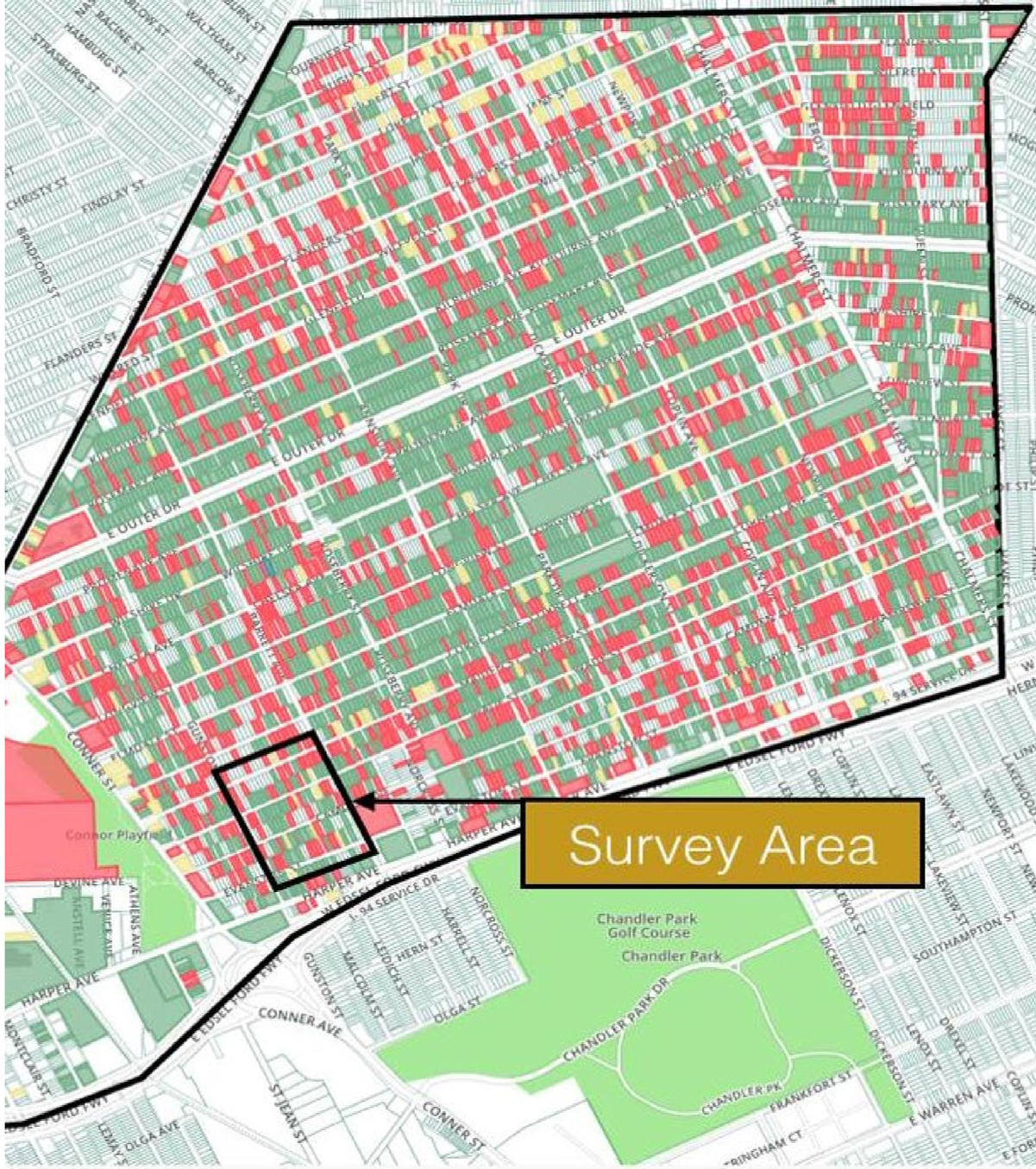


- *SOURCE: [HTTPS://WWW.STATISTA.COM/STATISTICS/199974/US-CAR-SALES-SINCE-1951/](https://www.statista.com/statistics/199974/us-car-sales-since-1951/)*

Survey Area
E OUTER DR
HARPER AVE
CHALMERS ST
CONNER ST
Gethsemane Cemetery
Connor Playfield
CHARLEMAGNE AVE
FRENCH RD
DEVINE AVE
ST PATRICK ST
SANFORD ST
WHITHORN ST
FINDLAY ST
CHRISTY ST
MINDEN ST
COLLEGE ST
NASHVILLE ST
ELMO ST
ALGONAC AVE
GUNSTON ST
BRADFORD ST
FLANDERS ST
PHILIP ST
EASTLAWN ST
NEWPORT ST
LAKEWOOD ST
W EDSON ST
I-94 SERVICE DR
E EDSEL FORD FWY

The Auto Indicator:

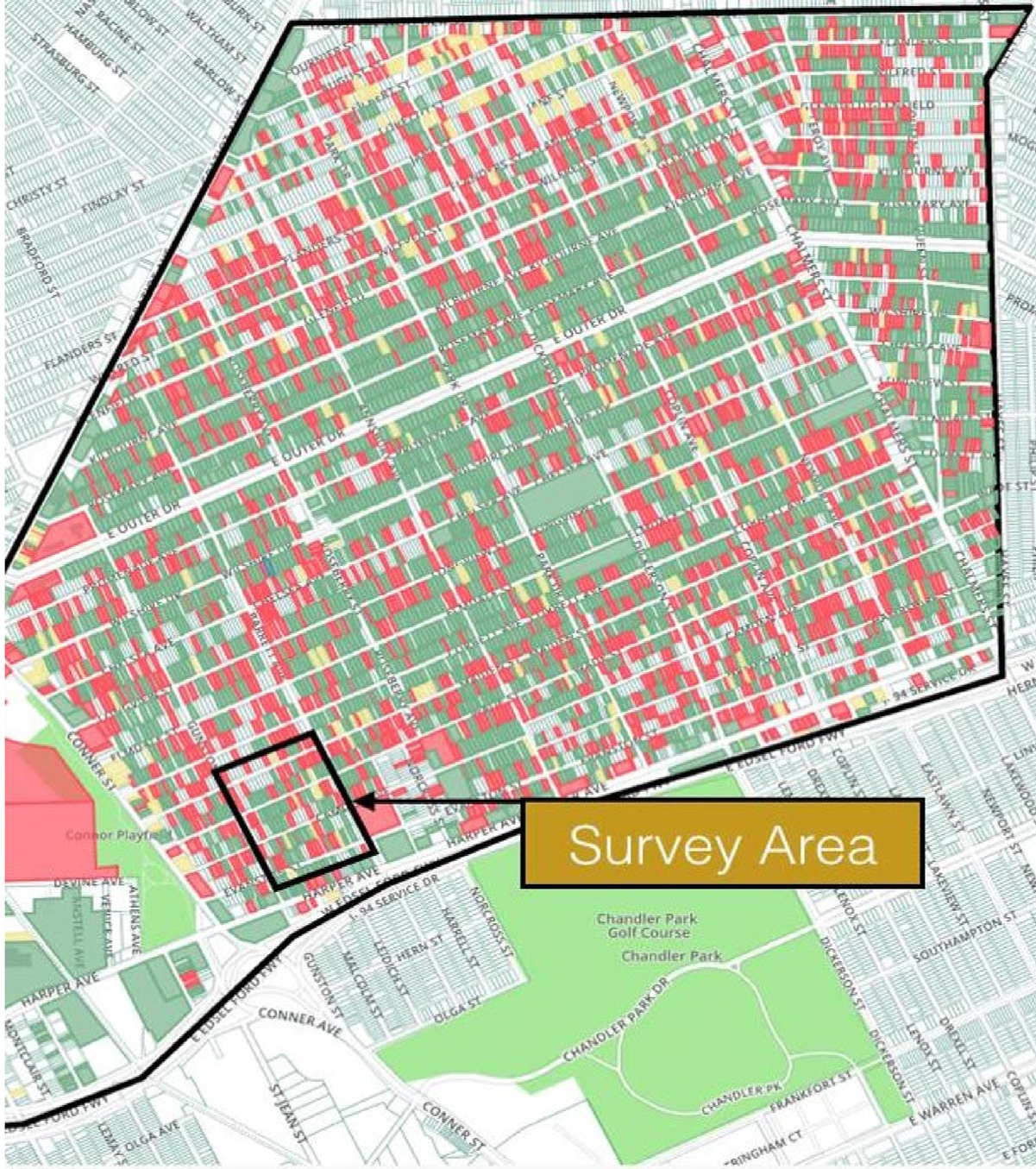
- 122 million workers in the US that rely on construction - 5.7% of the national workforce.
- Auto was 65% of Detroit's workforce.
- A 40% reduction in construction economy could be a 1 in 20 lots abandoned nation wide.



- *Source: Loveland Detroit - https://makeloveland.com*

The Auto Indicator:

- Lacked of diversity in its market
- Lacked planning for the displacement of workers
- Lacked the education opportunities to prepare displaced workers for new/modified positions within their career
- Lacked leadership with sustained empathy to anticipate the socioeconomic impact of changes



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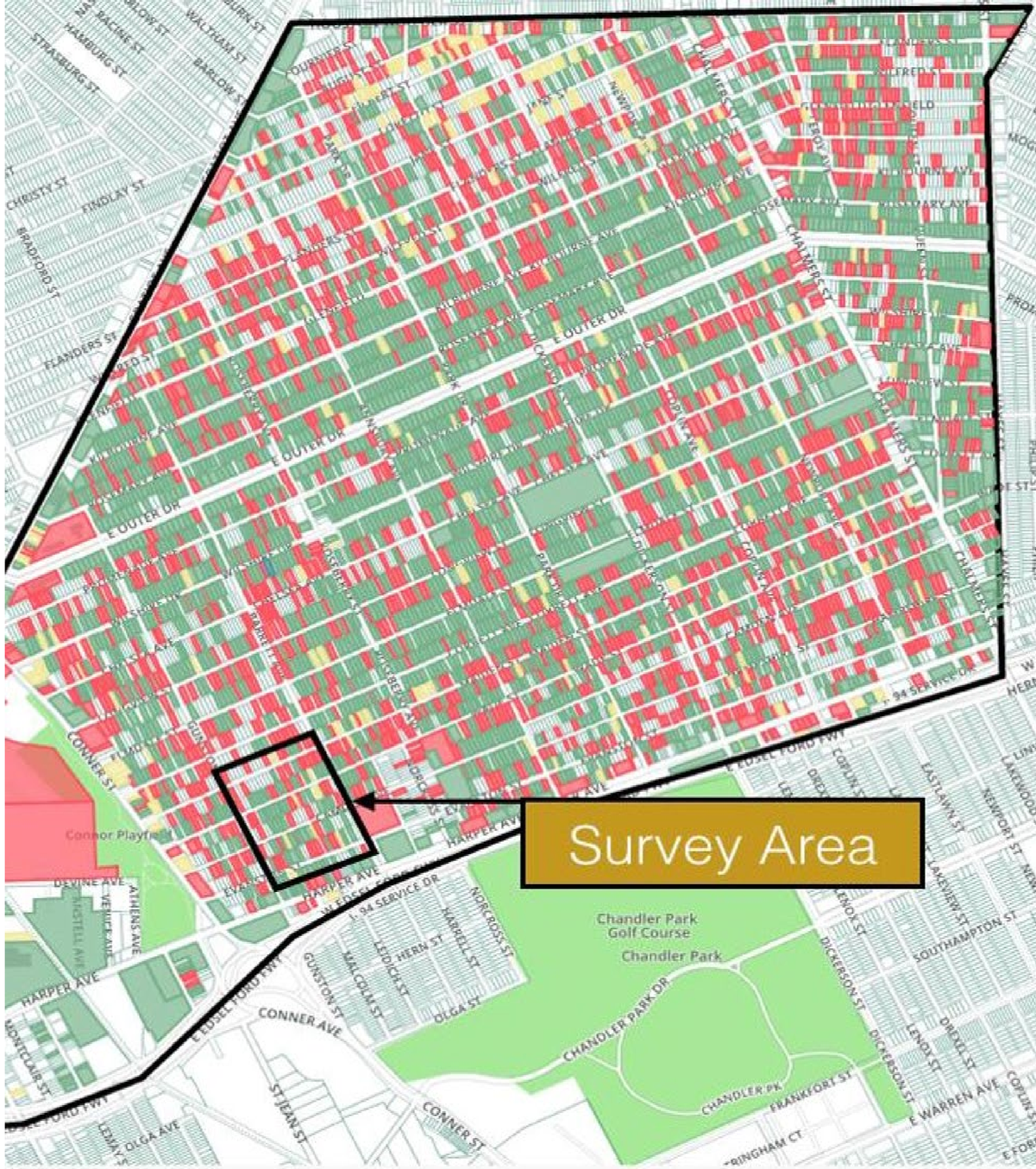
The Auto Indicator:

- Diversify work and opportunity
- Plan for changing modalities of construction
- Help with the education of the construction community on the positive outcomes of digital fabrication
- Leadership within the AE and Construction community to begin navigating the disruptions coming



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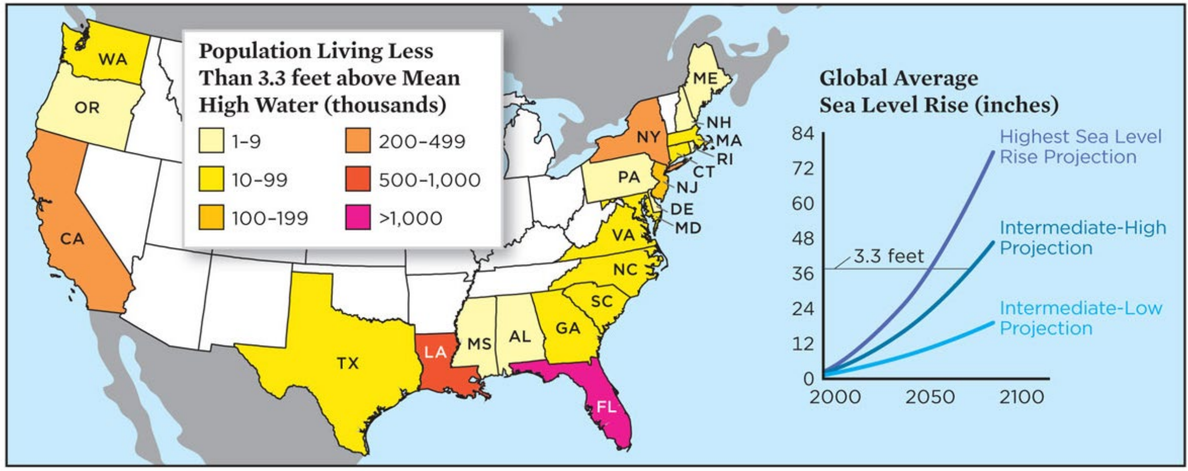
The Auto Indicator:

- Pump the brakes?
- Open Source…
- Mass Customization
  - 1.8 Meter rise in sea levels by 2100
  - 1 Million displaced from Florida alone
  - (only property owners of lots below sea level)
- Perhaps we will design and construction methods that involve rapid adaption, open source mentalities, with rapid adaptive construction methods including massive reduction in costs….

FIGURE 2. Coastal States at Risk from Global Sea Level Rise



People in states with low-lying coastlines have been subject to severe flooding and damage from coastal storms in recent years. Although all coastal states are vulnerable, Florida, Louisiana, New York, and California have the most residents living on land less than 3.3 feet above high tide. Depending on our future emissions—and the resulting ocean warming and land ice loss—global average sea level could rise to the 3.3-foot mark within this century.

SOURCES: NOAA 2012A; STRAUSS ET AL. 2012.

© Union of Concerned Scientists 2015; www.ucsusa.org/sealevelrisescience

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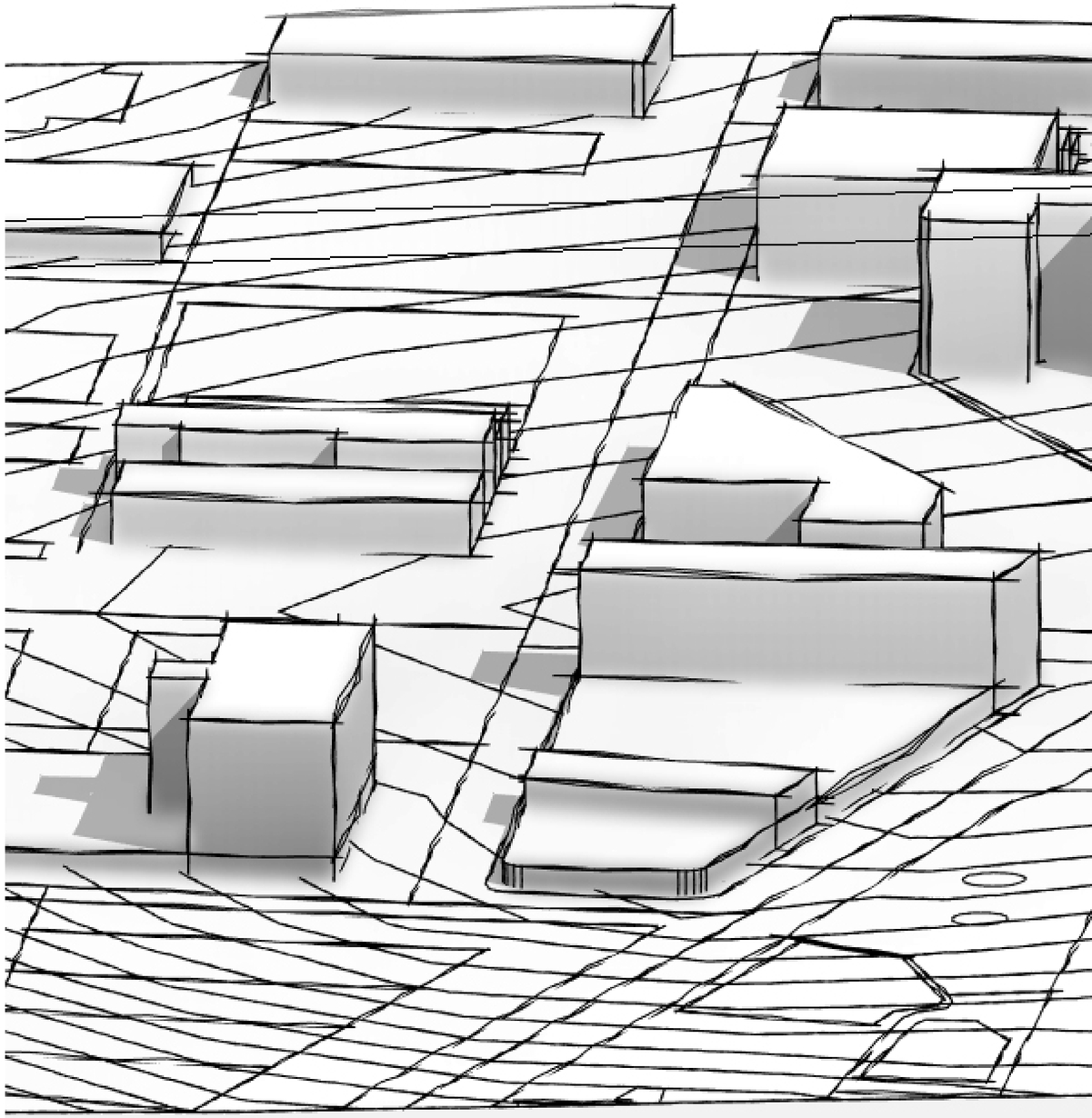
Step One – Sites:

- Data from CADMAPPER
- Development in Revit
  - Scale
  - Layer modifications
  - Conversion of mesh to topo surface
  - Satellite merger



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Step one video link:

https://youtu.be/rLYPMAh0u6M

Step Two – FormIt Context:

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- FormIt:
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  - As-Built conditions
  - Finding heights
  - Photo Modeling

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Step two video link:

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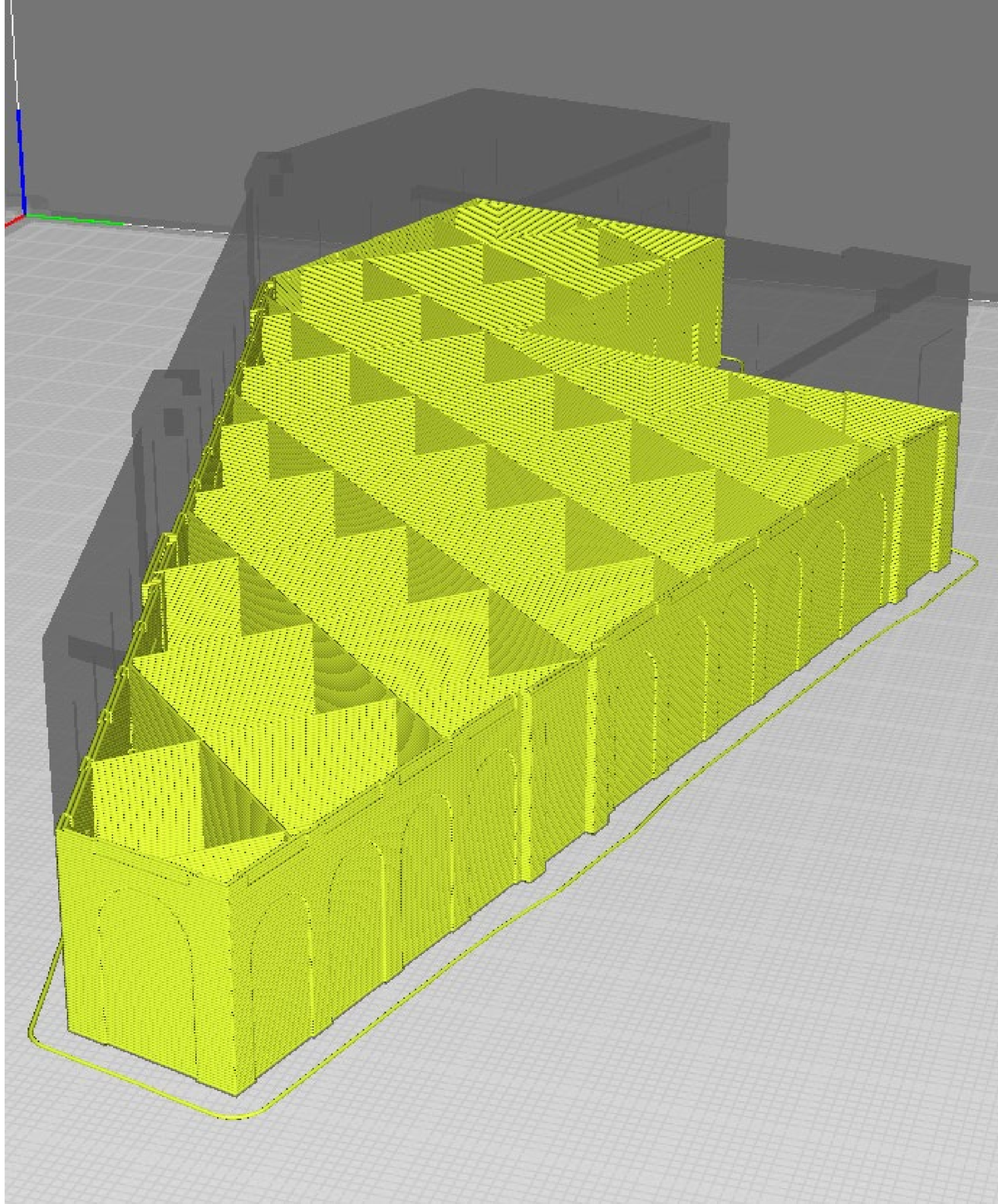
Step Three – FormIt Fabrication:

- In FormIt – check for water tight model.
- Export as *stl
- Import into slicing software (Cura is used in this example)
- Verify and modify scale
- Verify layers and tool path.



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- Establish site and weather stations.
- Take particular note of wind directions.
- Create massing based on square footage and potential programming.
- Set levels – this will let FormIt and Insight know what volume to run the simulations on.
- Run sun simulations to establish BTU’s on surfaces.

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Step four video link:

- https://youtu.be/F9OJX8gWWYs

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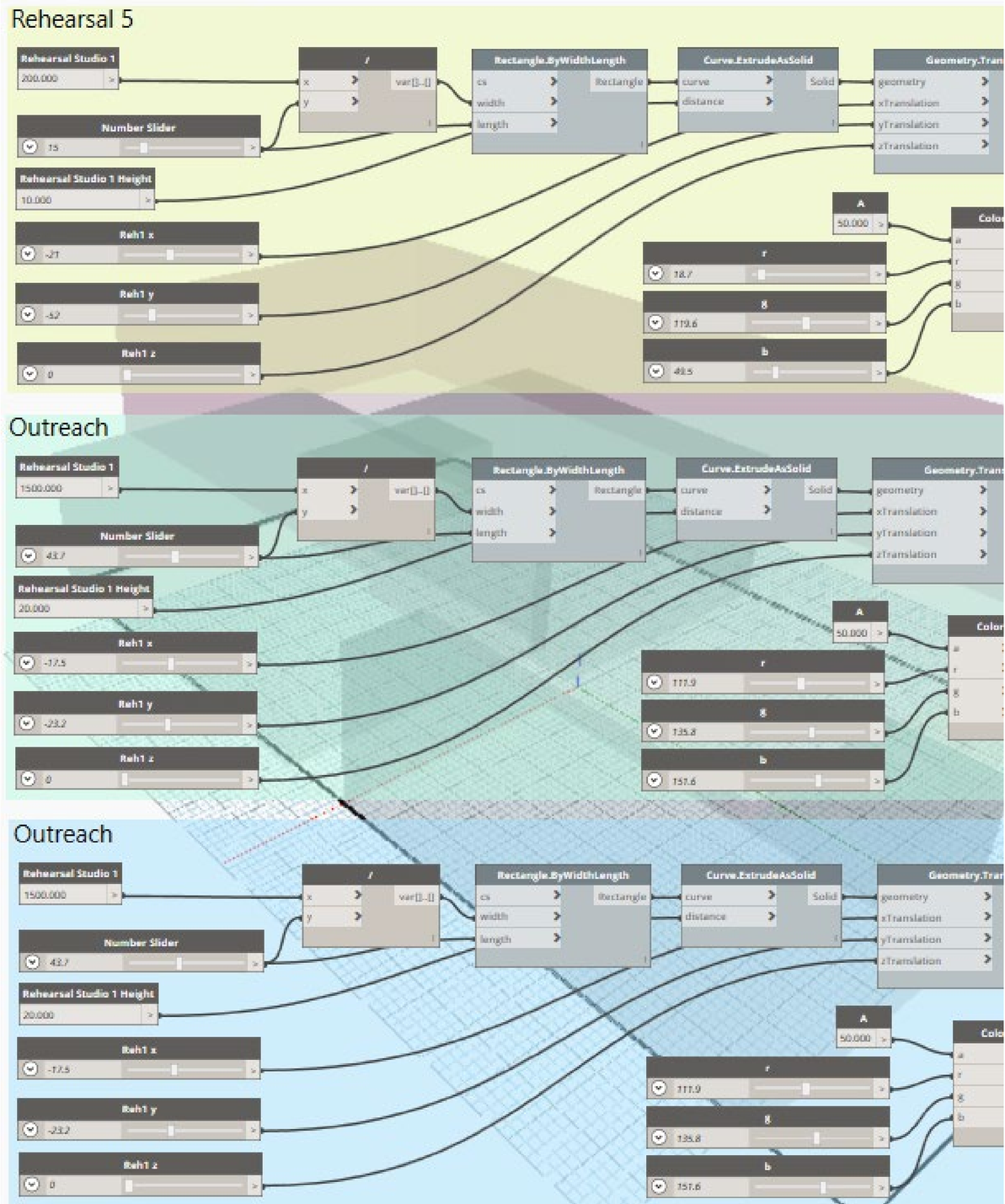
Step Five - Dynamo:

- Construction of base-site
- Construction of programmable programming sliders
- Replication in Dynamo
- Push to FormIt – adapt…
- Print



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Step five video link:
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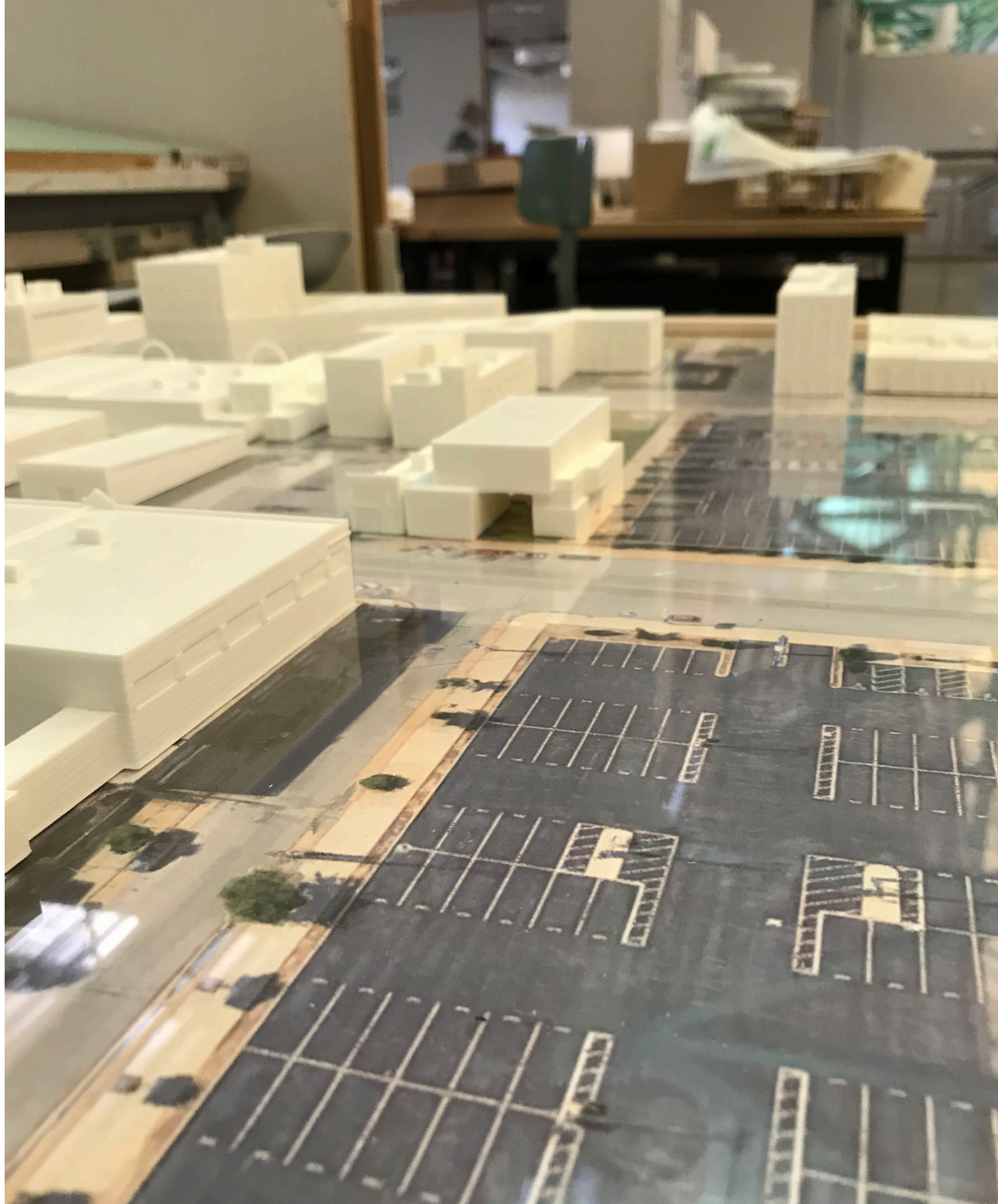
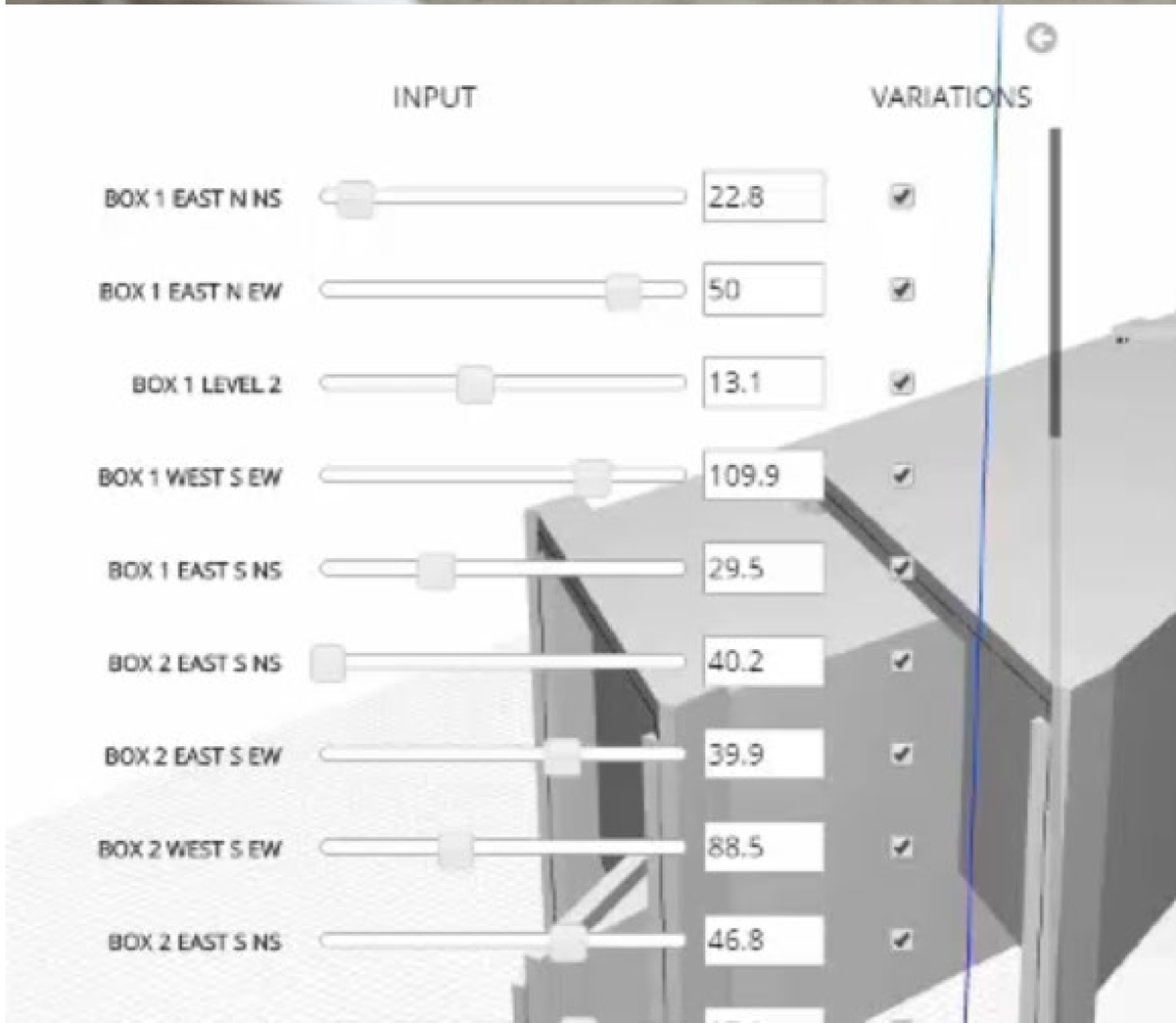


Step Five - Fractal:

- Develop script in Dynamo Studio
- Publish script online
- Build iterations in Fractal
- Push scripts back out of Fractal
- View! Analyze! VR!
- Print



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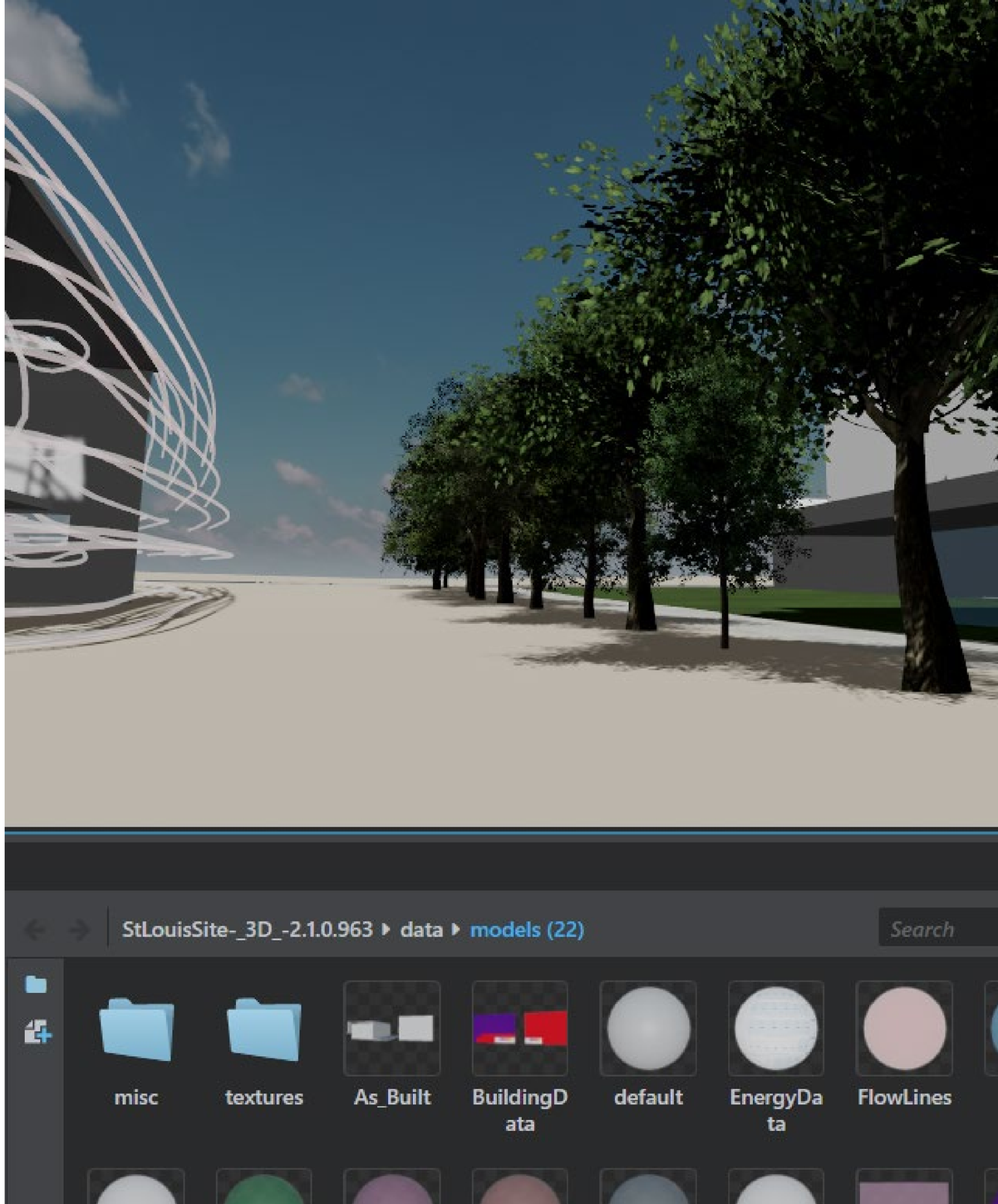
Step six video link:
https://youtu.be/d2LbaSPfDCA

Step - 7 the Last One:

- Push the Revit site file to Go Live
- Open the *.lvsc file in 3ds Max Interactive
- Push files from FormIt to 3ds Max using the *.obj format.
- Rotate (unless you always remember to adjust your settings), and scale up by 1200%.
- Link the 3ds Max and Interactive
- Send all!
- Postion, Play, VR – Gold.



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