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Generative Design in Revit

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Learning Objectives

- Discover the value of Generative Design in Revit.
- Discover three examples of how customers are using Generative Design.
- Learn about the driving principles for future prioritization.
- Discover the future direction of the product and road map.

Description

Project Refinery graduated in April to become Generative Design in Revit 2021 software. This new suite of tools enables generative design workflows that automate the creation and analysis of design options directly in the Revit context. This briefing will showcase the value that generative design brings to the design process, and show how analyzing more data-backed design options leads to an enhanced design process. We will cover a brief history of Project Refinery (now Generative Design in Revit) and show how customers are using the tools. We will cover the product principles that we use to prioritize new work and future direction. Finally, we will address the future of the product, where we will be investing, and our road map for achieving the future vision.

Speaker(s)

Lilli is an architect with a passion for re-envisioning the way that buildings are designed. After working for several years as an architect, she joined Revit Technology as a fledgling start up and helped grow it to where it is today in almost every architect's tool box. She has gone on to work on many Autodesk tools including Vasari, FormIt, Dynamo, Project Fractal and Project Refinery which recently graduated to a suite of tools for generative design studies in Revit.

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During the course of this presentation, we may make statements regarding future events and/or statements regarding planned or future development efforts for our existing or new products and services. We wish to caution you that such statements reflect our current expectations, estimates and assumptions based on factors currently known to us and that actual events or results could differ materially. Also, these statements are not intended to be a promise or guarantee of future delivery of products, services or features but merely reflect our current

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Why Generative Design?

A stunning 40% of global energy is used by our built environment. Buildings alone consume 25% of our water, and building construction produces 30% of all global waste. Architects and engineers as designers of the built environment have a responsibility to take on these issues. Workflows like generative design have the potential to revolutionize the way we design by using goals and measurable outcomes to guide our designs.

Architectural and engineering services have evolved from drawing by hand on paper and delivering it to others to build buildings. Autodesk digitized this process over 30 years ago with the advent of AutoCAD. We've evolved to Building Information Modeling and more efficient ways to deliver building instructions to the field. What we really want to do next is to pair human intelligence with machine intelligence so that we can use data-backed design decisions to create a better built environment.

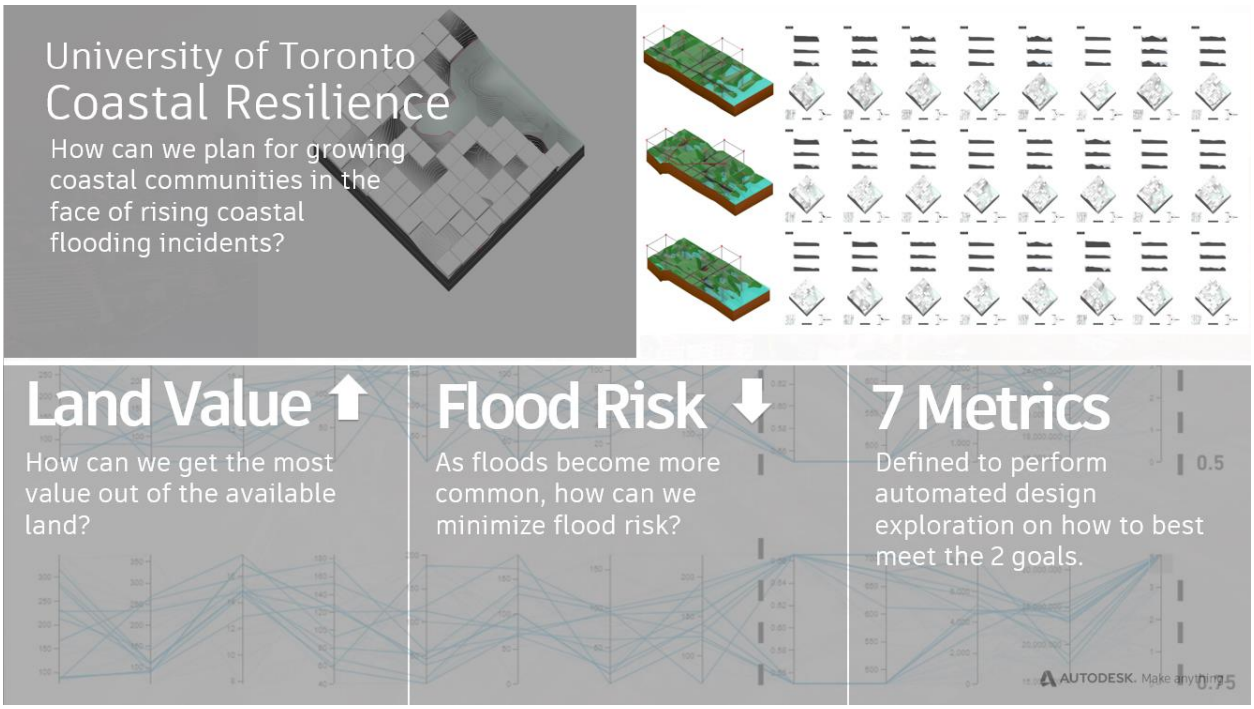
Over the past few years we've been exploring how generative design can help improve design and construction work. Autodesk Research experimented with generative design workflows to help us better optimize space during our Toronto office renovation a few years ago. We surveyed our employees about their preferences for collaboration, lighting, acoustics, and distance to the kitchen. Then used that data to guide the design. Different floor plan layouts are created and the design process keeps track of the scores for each of the preference metrics. These kind of automated design explorations are not new – generative designers have been using automated techniques for decades, but the have mostly been in the realm of research.

Autodesk's mission is to bring new technology to the market so that more people can use it an participate in the design process. You're all are here today to hear about a new suite of generative design tools newly added to Revit 2021 and I imagine you want to understand more about what they are and who's using them. You also may be wondering what new tools are under development and what is on our future roadmap. You may have specific questions about generative design in Revit which hopefully we'll answer but you can also take advantage of our async and live question sessions.This talk will be split into 3 sections:

1. What are people doing with Generative Design?
2. What's new?
3. What's next?

1: What are people doing with Generative Design? : Use Cases

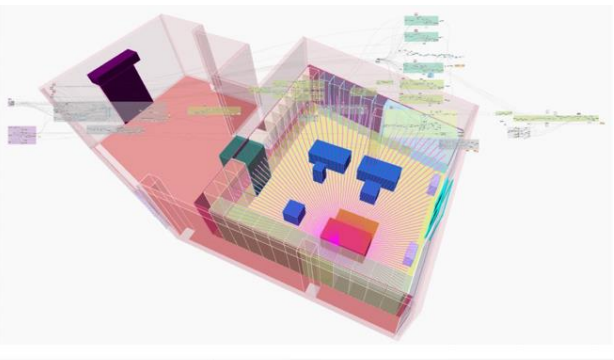
This section covers three customer use cases. Read more about these use cases in the included links:

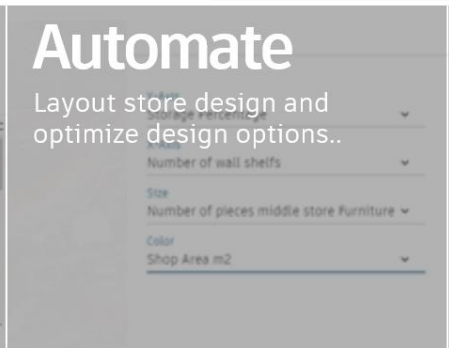


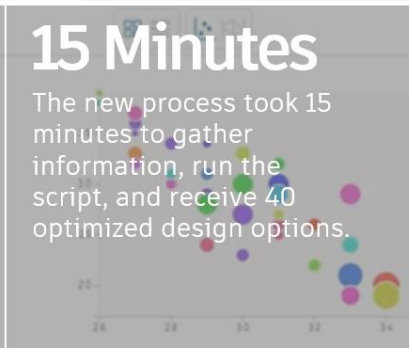
1. **Exploring Design and Coastal Resilience - University of Toronto**. Generative design in Revit was born out of a beta project called Project Refinery. It was developed for a few years as a beta before we released it in Revit 2021. The first project that I'll show you is from a residency we held in Toronto in the summer of 2019 for people interested in learning about generative design. There was a group from the University of Toronto attended this residency and their study highlights the importance of defining goals and using metrics to guide the design process. They came into the residency wanting to study the increasingly pressing problems of rising coastal flooding incidents. Major storms are increasing in frequency – we are experiencing up to 5 times more storms a year. Flood risks cause unpredictability --- one size fits all design and planning solutions no longer work. So they came into the residency with some very big questions: How should the urban and physical landscape evolve in response to rising sea levels? How can we leverage big data to generate resilient architectural typologies? Defining the design goals helped them frame the scope of the project. They could have accounted for an unlimited number of problems, but focusing on the most important goals helped to bound the problem. They decided on 2 key goals which aligned with

their stakeholders in coastal city management: 1. Reduce Flood Risk 2. Increase Land Value. These goals still left many open questions – how would they actually evaluate them? How would they measure flood risk? How would they correlate flood risk to land value and what does it even mean to increase land value? Read more at these links:

a. https://www.linkedin.com/pulse/exploring-generative-design-coastal-resilience-isaac-seah/
b. *https://blogs.autodesk.com/revit/2019/12/16/three-experiments-in-generative-design-with-project-refinery/*

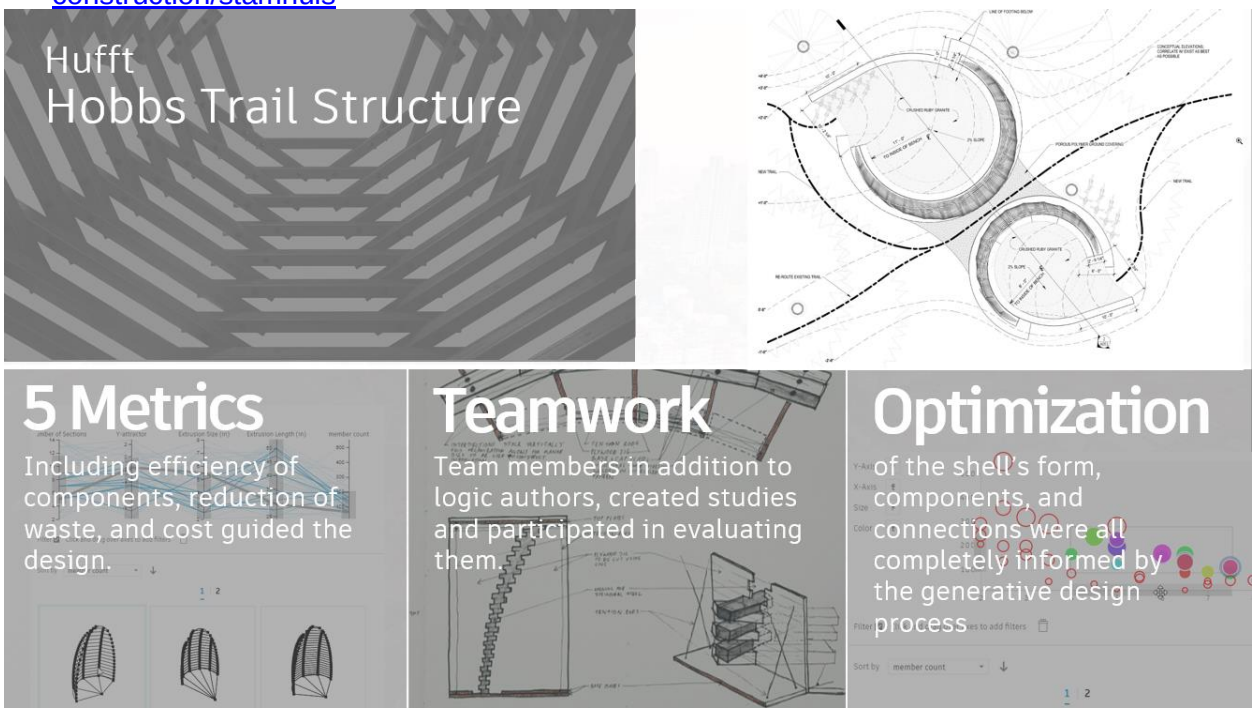






2. **Liquor Store Design – Stamhuis.** The second project I'll show you highlights speed benfits that generative design workflows can offer. Stamhuis, Based in the Netherlands like many of the world's greatest design firms, specializes in retail shop construction and renovation. In retail, cost savings are critical. In order to gain a competitive edge in this space, Stamhuis embraces automation software and emerging tech to boost their own efficiency and add value for their customers. They have investigated prefabrication and VR/AR experiences and recently they took a leap into generative design In December of last year they had no Dynamo experience. But by June they had a talk on a pilot project for the design of a Liquor Store that they delivered at AU London. Inputs to the design included: location and size of cash register area, Ratio between shop and inventory storage, shelf spacing, aisle size, seller's field of vision. It took them 3 days to come up with a computational model in dynamo to create logic for the design. Used generative design workflows to automate and optmize design options. It used to take 4 hours to design a typical liquor store. Now in 15 minutes we can get 40 optimized options. Ron

Rijkers, the project lead, advice for starting to experiment and working with Generative Design and I'll quote*: Just try it, if you don't you won't know the great information that you might be missing." Read more here:*
https://www.autodesk.com/solutions/generative-design/architecture-engineering-construction/stamhuis



3. **Hobbs Trail Structure – Hufft and Evolve Lab**. This final story involves the design of a trail head structure in a state park conservation area in Arkansas. This story highlights using metrics to guide the design process, involving the whole team in the design and using generative workflows to optimize the design. Hufft is a nationally-recognized, award-winning design and fabrication firm. They employs a staff of architects, interior designers, artists and craftsmen. The studio is organized to foster a collaborative process that integrates and designers and builders into one seamless process. Generative design in Revit was used to develop a stacked structural system, derived from a series of solid shell forms to create trailhead and camping structures for the Hobbs State Park Bike Trails System. They began this process by establishing the solid shells form, scale, and structural intention. However, once the modeling efficiency became a clear challenge due to the amount of components and complexity of the form, they decided to explore the use of generative design to assist in the process and called in Evole Lab computational design consultants to join their collaborative team. Evolve Lab helped them create the underlying logic which let them pick a starting shell form from Revit and then rationalize it into a structural system that they could evaluate for number of members, size of members, and amount of waste material. Designers that had not created the logic in Dynamo participated in creating studies and evaluating outcomes using Generative Design in Revit. The process allowed them to rapidly produce design options, providing their client the ability to make informed decisions

based on material and cost parameters. The logic that they developed will also be useful to them in other projects. The optimization of the shell's form, components, and connections were all completely informed by the generative design process. Without this tool, its unsure how long it may have taken to arrive at the same result. This process played a pivotal role in the success of the Hobbs Trails project. Read more here:

a. https://youtu.be/gWrgE8T_Ry8
b. https://www.evolvelab.io/post/is-generative-design-doomed-to-fail

2: What's New?

More Resources on the generative design tools new in Revit 2021.
https://blogs.autodesk.com/revit/2020/04/08/generative-design-in-revit/

and more additions in Revit 2021.1
https://blogs.autodesk.com/revit/2020/09/02/whats-new-for-architects-in-revit-2021-1/

Video on our three new sample files added in Revit 2021.1: https://youtu.be/i-3qhyiuBo4

And what's new in Dynamo 2.6 for Revit 2021.1 https://youtu.be/KH_5JiWi_TU

For a detailed list of What's New in Generative Design, see Revit Help here

For a detailed list of What's New in Dynamo for Revit see Revit help here

3: What's Next?

Please see the presenation for a full view on the roadmap and upcoming work, then visit http://autode.sk/AU20GDinRevitFeedback and tell us what you think about our roadmap!

Here is a summary of the themes on the roadmap that we want to you rank in order of importance:

1. **Study Type Editing** make graph authors more successful in creating design study types for use in Generative Design.
2. **Study Type Sharing** make it easier for graph authors to share generative design study types with Revit designers to run in Generative Design in Revit.

3. **Outcome Sharing** make it easier to export results for sharing with stakeholders and telling data-backed design story
4. **Generative Design in more Autodesk Applications** – extend Generative Design tools to other Dynamo enabled applications including Civil 3D, Robot Structural, and FormIt.
5. **Analysis Tools for Dynamo and Generative Design** – provide access to environmental and other kinds of analysis tools for generative workflows.
6. **Dynamo Usability** – make Dynamo more friendly and easy to use
7. **Dynamo Performance** – make Dynamo faster and more stable.

Resources

AU2020 Courses on Generative Design in Revit

- Generative Design in Revit for Workspace Layout - Tomasz Fudala
- Non-Geeks Guide to Optimizing Daily Workflows with Generative Design - Raquel Bascones Recio
- Using Generative Design and Machine Learning for Faster Analysis Feedback - Varvara Toulkeridou
- Generative Design at Hogwarts: Using Tech Instead of Magic - Jacob Small
- Generative Design für Revit in der Praxis - Lejla Secerbegovic
- Diseño Generativo en Revit para todos los públicos - Raquel Bascones Recio
- Generative Design—Daylighting and CFD: A Practical Application for a Nonprofit - Luc Wing
- Generative Design of Landforms with Dynamo in Civil 3D - Andreas Luka

Past Years Autodesk University Courses on Generative Design and Refinery

- Geometry Systems for AEC Generative Design: Codify Design Intents into the Machine
- MEP Explore: Generative Design for MEP Designers
- Getting Started with Generative Design for AEC
- Using Generative Design in Construction Applications

Dynamo Resources

- Getting Started with Dynamo:
  https://primer.dynamobim.org/
  https://dynamobim.org/learn/
- Dynamo Forum for questions, inspiration:
  https://forum.dynamobim.com/
- Design Script:
  http://designscript.io/DesignScript_user_manual_0.1.pdf
  https://dynamobim.org/wp-content/links/DesignScriptGuide.pdf
  https://github.com/Amoursol/dynamoDesignScript

Generative Design Resources

- Generative Design Primer
  https://www.generativedesign.org/
- Generative Design in Revit Help
- Generative Design general education:
  https://medium.com/generative-design