Generative Design in Revit for Workspace Layout

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About the speakers

**Tomasz Fudala**

Tomasz has over 17 years of experience in the software industry, including extensive knowledge of structural solutions in the Autodesk portfolio. He holds a Master of Science degree in Structural Engineering from the Cracow University of Technology, Poland—where he is based.

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A registered architect, civil/structural engineer-in-training, sustainability professional, and AEC technology evangelist, Aaron leads the global Building Technical Marketing team for Autodesk. Aaron lives and works in Fort Worth, Texas.
Agenda

• Motivation

• Generative Design in Revit

• Space Planning Use Cases
  o Exercise 1: Desk Layout using Workspace Layout Sample Study
  o Exercises 2a-2d: Standing Desk Layout Studies
    ▪ 2a: Customized Workspace Layout Study
    ▪ 2b: Customized Grid Object Placement Study
    ▪ 2c: New Generative Design Study
    ▪ 2d: Customized Stepped Grid Object Placement Study

• Summary
Motivation
COVID-19 | Current impact on the AEC industry

**PROJECTS**
Volatile demand & expected infrastructure stimulus

**PEOPLE**
Furloughed & laid off employees looking to upskill

**PROCESS**
Remote working & retooling
REMOTE & FLEXIBLE WORK

SPACE PLANNING

PEOPLE MOBILITY

AIR QUALITY
Generative Design in Revit
Computers are very good at performing calculations, i.e. *automation*
From Automation to Optimization

But we can go beyond automation if we provide inputs and constraints and enable the computer to find new solutions, e.g. optimization.
Generative Design

Computers can generate and quickly evaluate a huge number of design variants, enabling us to learn what does and doesn't work—and discover solutions we may not have anticipated—at an accelerated pace.
Generative Design in Revit

Generative design is a design exploration process to quickly generate and evaluate high-performing design alternatives.

- Create and explore generative studies directly in Revit
  - Generate design options
  - Filter and rank results
  - Explore outcomes
  - Evaluate goals
  - Create Revit elements
Generative Design in Revit

Generative Design provides a set of sample study types to demonstrate how this tool can be used to generate outcomes for design challenges.

• Samples studies included
  o Workspace Layout
  o Three box Massing
  o Maximize Window Views
  o Grid Object Placement
  o Stepped Grid Object Placement
  o Randomize Object Placement
Space Planning Use Cases
Space Planning

**The New York Times**

**A Multibillion-Dollar Opportunity: Virus-Proofing the New Office**

Employees going back to work in the coming weeks should be prepared for many changes. Tech, catering and design companies are rushing to sell employers on fever scanners, box lunches and office floor-planning apps for social distancing. But it’s too soon to tell if they will work.

**Fast Company**

**From ‘officles’ to giant sneeze guards: How COVID-19 will change your open office**

Coronavirus won’t kill the open office. But experts share how you should expect it to change.

**CBC**

**What offices might look like in a post-COVID world**

Employees going back to work in the coming weeks should be prepared for many changes.

**Barron’s**

**The End of Open Floor Plans: How Homes Will Look Different After Coronavirus**

Since the pandemic altered what buyers value in their homes, builders are predicting how future homes will change as a result, and what people will want most moving forward.

**ZDNet**

**Will the open office die following COVID-19 pandemic?**

The new normal of work exiting the COVID-19 pandemic may mean the much ballyhooed open office won’t be up to snuff. Here are 4 reasons why COVID-19 may nix the open office.

It's time to start thinking about how work will change when companies bring employees back, and the biggest headache may be the same one you had before the COVID-19 pandemic: The open office floor plan.
In this exercise, you want to determine the best arrangement of desks in a large room using Generative Design in Revit. You plan to use the Workspace Layout study, which generates layout alternatives in rows—suitable for an office space or classroom. Your goals are to maximize the number of desks, maximize views to the outside, and minimize the distance from each desk to the nearest exit.
Space Planning: Exercise 2

Standing Desk Layout using Customized Workspace Layout Study

One of the many challenges facing employers as they begin to repopulate their offices is the need to maintain a safe physical distance between employees.

Using Generative Design in Revit, you will consider this basic problem: How might you configure an open office environment with safety in mind?
Design Goals

SPACING BETWEEN DESKS
Maintain a minimum distance of 6 feet between employees

NUMBER OF DESKS AND THEIR TYPES
Accommodate 32 employees at standing desks; glass panels may be attached to enable back-to-back placement

PARTITIONS
Maintain operability of the moveable partitions currently installed in the open office space
Four Approaches

**EXERCISE 2A:** CUSTOMIZED WORKSPACE LAYOUT STUDY

**EXERCISE 2B:** CUSTOMIZED GRID OBJECT PLACEMENT STUDY

**EXERCISE 2C:** NEW GENERATIVE DESIGN STUDY

**EXERCISE 2D:** CUSTOMIZED STEPPED GRID OBJECT PLACEMENT STUDY
Exercise 2a: Standing Desk Layout using Customized Workspace Layout Study

Demonstrates the use of Dynamo for Revit to customize the existing Workspace Layout study and re-export for use with Generative Design in Revit.
Exercise 2a: Issue

The original Workspace Layout script needs to be adjusted to obtain the correct value of the *Elevation from Level* parameter for generated elements.

The updated script will check to see whether the selected instance of the system furniture family has the Elevation from Level parameter defined.

If the parameter exists and is editable, then the script will retrieve a value of the Elevation from Level parameter from the selected instance and assign that value to newly created instances.
Exercise 2a: Solution

The updated script checks to see whether the selected instance of the system furniture family has the Elevation from Level parameter defined.

If the parameter exists and is editable, then the script will retrieve a value of the Elevation from Level parameter from the selected instance and assign that value to newly created instances.
Exercise 2a: Issue

The Revit sample content desk used for the original Workspace layout study is designed differently than the family you want to use. The placement point is 1.5" inset from both the width and the depth directions from the back-right corner when viewed from the front of the desk.

The *Furniture_System-Standing_Desk-Rectangular_w_Partition.rfa* family you want to use has its origin located in the middle of the desk and that causes your desks are laid out incorrectly, they overlap each other.
Exercise 2a: Solution

The updated script has the translation vector redefined. The vector is calculated based on dimensions of the desk instance.

The desk family has its origin located in the middle of the desk.
Exercise 2a: Result

In this exercise, you found a result that accommodates up to 52 employees positioned at a 45-degree angle in the space. This outcome meets your goal to maintain a 6’ minimum spacing between employees (laterally, as the glass panels enable back-to-back desk placement).

However, the angled layout might not be ideal for egress, and both operable partitions are obstructed. *Perhaps another type of layout should be considered.*
Exercise 2b: Customized Grid Object Placement Study

Demonstrates the use of Dynamo for Revit to customize the existing Grid Object Placement study and re-export for use with Generative Design in Revit.
Exercise 2b: Issue

The original Grid Object Placement study has variables in metric units, while your project uses imperial units. Additionally, the study measures distances between objects from their insertion points, and the ranges provided are relatively small (i.e. 1 to 3, 0.5 to 2). These are important issues.

In fact, if you were to proceed with the default study parameters, you would find it impossible to lay out your desks without clashing.
Exercise 2b: Solution

Update the input nodes:

- Update their names changing unit names from “m” to “ft”
- Update their ranges and default values.

Next, bypass the section where the unit conversion takes place.
Exercise 2b: Result

This time, you have found room for up to 56 employees! But you are concerned that this layout may be uncomfortable, with half of the employees facing away from the windows. And one of the partitions is still obstructed. *We have not yet found an optimal solution.*
Exercise 2c: New Generative Design Study

Demonstrates how to build your own Generative Design study from scratch.

Variable parameters  Parametric model  Design goals

85%  91%  94%
Exercise 2c: Issue

You want to rotate the desks so that every user can see out the windows. And you want to provide more flexibility, e.g. more options to control how desks are laid out.

You want better control the distance between desks and walls in both X and Y directions independently.
Exercise 2c: Solution

Add an option to control the distance between desks and walls in both X and Y directions independently.

Change the way distances between desks are measured. The spacing between desks in both directions will be measured between edges of desks instead of their insertion points.
Exercise 2c: Result

In this exercise, you generated a layout that accommodates 33 employees in groups of three, and both operable partitions are functional. This outcome achieves your goals of maintaining 6’ of separation between employees without installing glass panels, and every employee has a view to the outside.

However, you still have two concerns. Your employees are still lining up directly behind one another, and you would prefer to have an even greater distance between them before removing the glass panels. Also, you would like a better circulation path between the employees’ desk positions and the exits.
Exercise 2d: Customized Stepped Grid Object Placement Study

Demonstrates the use of Dynamo for Revit to customize the existing Stepped Grid Object Placement study and re-export for use with Generative Design in Revit

The used family has two additional parameters (Left Desk and Right Desk) that will help you better manage how this furniture system is set up.
Exercise 2d: Issue

The original Stepped Grid Object Placement study has variables in metric units, while your project uses imperial units. Additionally, the study measures distances between objects from their insertion points, and the ranges provided are relatively small (i.e. 1 to 3, 0.5 to 2).

To keep the unit consistency in the project and the study you need to address this issue.
Exercise 2d: Solution

Update the input nodes:

• Update their names changing unit names from “m” to “ft”
• Update their ranges and default values.

Next, bypass the section where the unit conversion takes place.
Exercise 2d: Result

You have found an optimal solution for your 32 employees in groups of two.

This layout ensures maximum spacing between employees, and both operable partitions in the office space are functional.

You’ve done it!
Summary
Without manually moving a single desk, you have discovered the optimal open office layout to safely accommodate your employees using Generative Design in Revit. Best of all, these customized studies are ready to be utilized on all your office layouts.
Remember—this is designed to be a **hands-on** course with 5 exercises that will teach you how to use Generative Design in Autodesk Revit to perform workspace layout. As a supplement to our AU recording, you’ll find the class content on the Autodesk Knowledge Network (AKN) at the link provided below.

The following materials are included:

- Training Guide
- Datasets
- Step-by-step Instructional Videos

[https://knowledge.autodesk.com/community/article/312821](https://knowledge.autodesk.com/community/article/312821)
Thank you for joining us!