

AS501326

How Outcome-Based Design Can Lead to More-Sustainable Projects

Daniel Gameiro

Spacemaker

Justin Taylor

Autodesk

Learning Objectives

- Learn how to set up objectives and key results for sustainability in early phase development.
- Discover ways to optimize massing for density and living qualities with generative design in Spacemaker.
- Learn about data flow between Spacemaker and Revit with reduced data loss.
- Learn about optimizing building performance with real-time feedback in Insight.

Description

Sustainability is emerging as the main value driver of the future of building. Reducing a building's carbon footprint decreases its running costs, improves the workforce's sense of purpose, and raises property value. Buildings become also socially, economically, and environmentally responsible. In turn, they become more profitable, and are healthier places to live and work. In this class, we'll focus on an outcome-based design workflow from schematic design in Spacemaker to design development in Revit and Insight software. The discussion is centered on concrete milestones and frameworks connected to sustainable KPIs in early phase development. We'll explore a small mixed-use plot in central London with views of the River Thames and HMS Belfast.

Speaker(s)

Daniel Gameiro

Technical Sales Specialist | YPN Global Lead

Daniel is a thought leader with 8 years of experience in Real Estate Development and Sales, working with renowned companies such as Reiulf Ramstad Arkitekter, Spacemaker, and Autodesk. In his formative years, he founded a non-profit which developed humanitarian projects in Europe, Africa, and Americas.

His flourishing career at Spacemaker includes spearheading a revolutionized way of working with AI and generative design, instituting outsourcing processes to scale the customer success and technical sales teams, automating pre-sales, and assisting with the acquisition process driven by Autodesk.

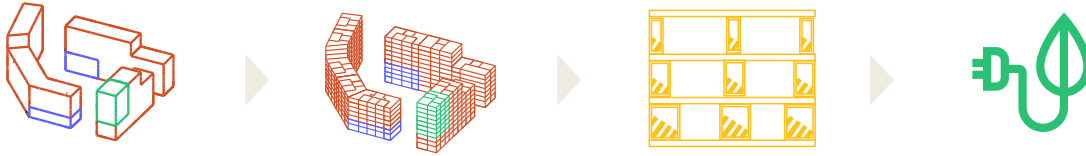
**Justin Taylor**

Principal Sustainability Consultant

Justin has more than 30 years' experience working with Autodesk solutions across the globe. Having previously focused on helping AEC firms digitize their workflows, he is now super excited to join the Autodesk Sustainability Practice and support customers as they strive to meet their Net Zero goals.

He brings along expertise in areas such as reality capture for refurb and retrofit, low carbon design and material circularity, health & wellbeing design and analysis in buildings.

Workflow



Massing distribution	Plan layout	Daylight	Energy
<ol style="list-style-type: none"> 1. Go wide – generative design 2. Go deep – rapid & golden standard analyses 3. Go out – send to revit 	<ol style="list-style-type: none"> 4. Load Spacemaker data 5. Draw plan layouts alternatives 6. Discuss with stakeholders what is the best performing alternative 	<ol style="list-style-type: none"> 7. Limit the scope based on VSC 8. Correlate VSC performance with rooms and window configurations 9. Detail the facades accordingly 	<ol style="list-style-type: none"> 10. Understand baseline 11. Explore optimization opportunities in insight to reduce operational energy 12. Conclude on energy production potential and PV placement
Spacemaker	Revit <> Spacemaker	Spacemaker <> Revit <> Insight	Spacemaker <> Revit <> Insight

MASSING DISTRIBUTION



1. Go wide – Generative design	2. Go deep – Rapid and golden standard analyses	3. Go out - Send info to Revit
<ul style="list-style-type: none"> • Go to explore mode • Use depth of buildings you have experience with • Focus on strategies rather than shape • Keep an open mind 	<ul style="list-style-type: none"> • Compare solutions side-by-side • Identify best mass distribution • Tip: Wind, microclimate and noise are extremely footprint dependent • Map qualities and challenges • Solve challenges • Make it look nice & perform well! 	

0. Project Setup in Spacemaker

To be able to use Spacemaker you will need to hold a license. This can be either be acquired by acquiring

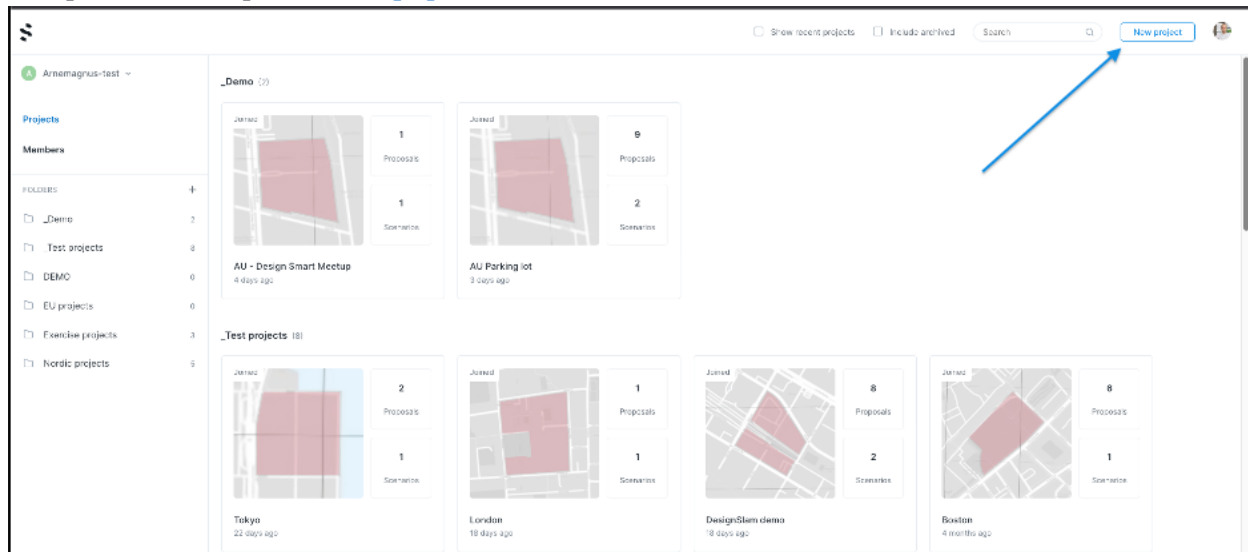
a 30-day free trial license or by buying a license. Both can be done through the Spacemaker product page: <https://www.autodesk.com/products/spacemaker/overview>

Spacemaker is a cloud-based software, which means you do not need to install anything as it runs in your internet browser. We suggest using Chrome to get the best experience.

Creating a project in Spacemaker is done through a short series of steps. Based on the locations of your project Spacemaker will fetch the available data for the site that we have available. Sometimes the data could be less than what you desire and therefore we will also show you how to import your own data.

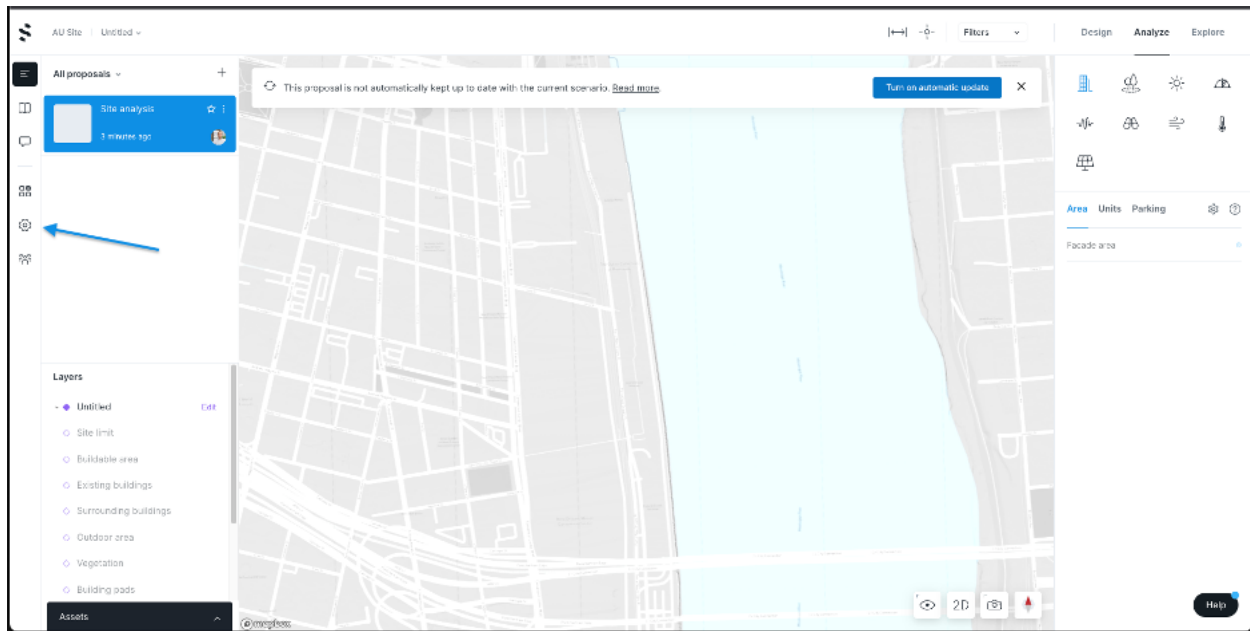
0.1 Creating a new Project

To start a project, simply log into Spacemaker.ai click the **New project** - button in the top right corner and follow the following steps. The latest version of a detailed step-by-step guide can be found through the Spacemaker Help Center, help.spacemaker.ai.



0.2 Project settings

Spacemaker might spend a minute or two fetching the data and assembling your model. The software is helping you to get fast analysis on your sites wherever in the world, but to make the analysis results tailored to your project, I suggest going into the Project settings while waiting for the terrain to load and the surrounding buildings to be added.



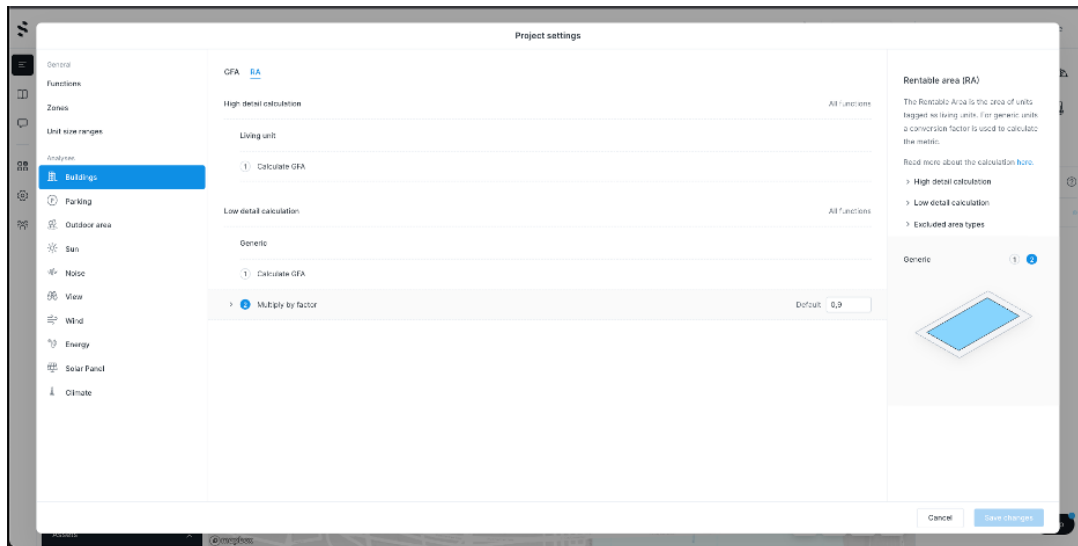
I suggest going into Functions, Geometry & Sun as your bare minimum. Note that the changes you do here will affect all your current and future analyses, and thus retrigger any analyses you might have done in the past if you change these settings at a later stage.

Functions: Add the functions you would need in your project. Be aware that it matters if you create a function under “Residential” or “Other”. Spacemaker will calculate the areas differently based on what category they are in.

Buildings: Depending on the location of your site, the area calculations that Spacemaker provides will differ. I highly suggest familiarizing yourself with how we calculate areas by hovering over the various fields and reading the tooltip in the right bar together with looking at the illustration. See the image below.

Sun: I highly suggest adding a few more dates here as this will help you gain more insights into how your project performs on various dates around the year. Usually, I add the solstice for both the darkest and lightest days of the year, June 21st & December 21st, and the equinox (March 21st). This usually gives an excellent indication of how your project is performing on the darkest, mid, and sunniest day of the year.

// Note // The sun analysis is used in conjunction with several other analyses: Outdoor area (in some regions), Microclimate, and Solar Power analyses.



When you are done reviewing the settings, then press Save changes.

// NOTE // If it is the first time you are using Spacemaker then I suggest you start by familiarizing yourself with the [How to navigate Spacemaker](#) - guide before you start with the next section

0.3 Layers – Adjusting the context of your site

The context of your project is very important to get accurate analyses. Therefore, the next steps are to enrich and add more information. This can be done by clicking on Layers > Edit.



To get the most out of Spacemaker you would need to add a Site limit and a Buildable area. Those are the two minimums, but I highly suggest also reviewing Surrounding buildings, Existing buildings, Roads & Rails, and View to area.

Site limit

A detailed guide on how to add your site limit can be found [here](#), or if you already have your site limit drawn somewhere else and would like to import it, then you can follow this [guide](#).

// NOTE // The site limit is used by several of the analyses and is therefore important to add for Spacemaker to work optimally!

Buildable area:

Buildable area is optional to add, but I suggest adding it as this will be used by our Explore – functionality to create suggestions for how to place buildings on your site.

The easiest way to add this is to copy and paste the site limit.

Surrounding buildings:

Review the surrounding buildings on your site. Depending on the source of the data, the surrounding buildings might lack precision. When that happens the heights are either missing (then the volumes will show up as 3 m / ≈ 9 feet tall) or that *connected* buildings (buildings that consist of several heights but share facades) are showing up as one volume with one height.

A detailed guide on how to edit the buildings can be found [here](#), alternatively, you can import existing buildings. This will be covered in the import section below.

// NOTE // If you would like Spacemaker to analyze the surrounding buildings for your site to assess how your proposal affects the surroundings, then you should select the buildings of interest and tick the “Analyze building”. Analyze will separate these buildings into a category that can be turned on or off inside each analysis.

Existing buildings

If your site already contains buildings that you plan to remove, then *click on the buildings you wish to remove > right-click > Delete*.

Roads & Rails

Spacemaker fetches the road segments with the available metadata from Open Street Map, or a local source if we have that for the area where the project is located. This means that we have the

centerline of the road, its name, and in most cases, its speed limit. If we have a local source for road segments we might also be able to provide the Daily Traffic on the main streets.

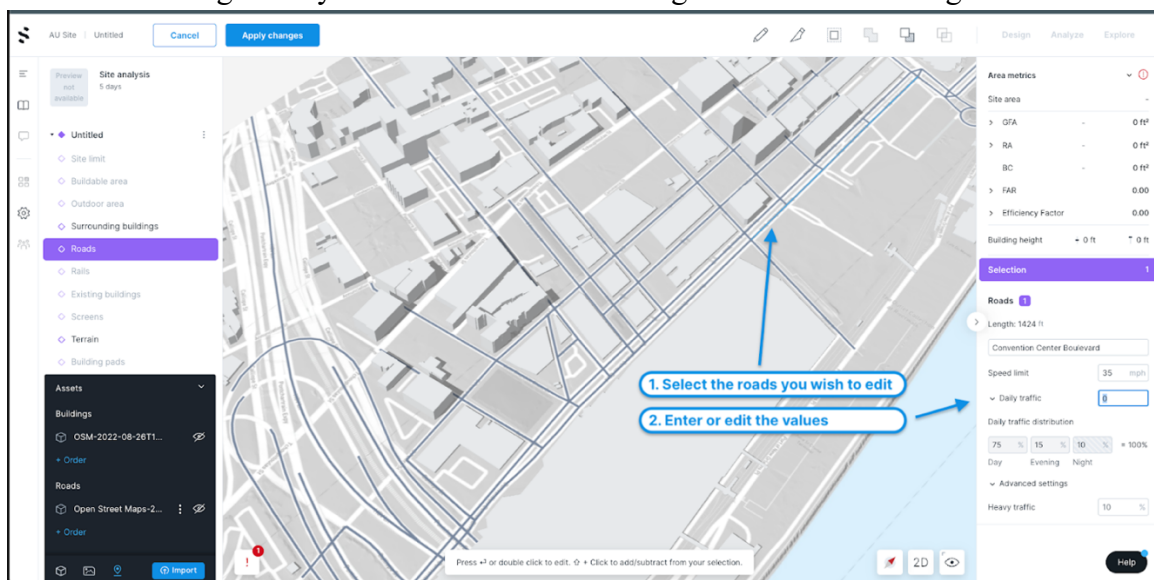
To add roads follow these steps:

Open Assets > Data orders > and click the eye behind the road source. Then select the roads by dragging over the desired area. It does not matter if you select more types of elements. In the right panel, you will see a section that says Assets selection in black. Then choose the layer you want it to be placed into, Roads is the default, and click Place. Finish it all off by clicking on the eye again to turn the asset layer off.



Edit or enrich the road data with the daily traffic numbers to get the noise analysis:

Click on the road segments you wish to edit > and change the values in the right column

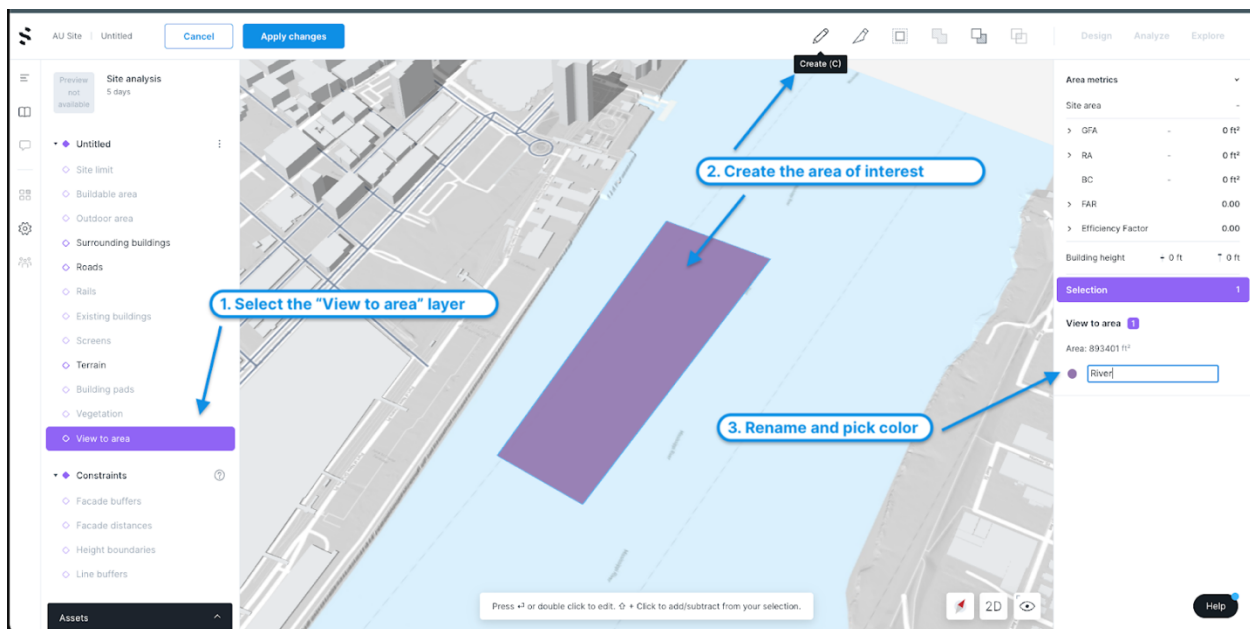


// NOTE // If you get a “geometry validation warning” that some of your geometry is outside of your map area, then you should click on the message and it will preview where that geometry is. *Either delete the geometry entirely or select it and use the Split-tool. The split tool works by clicking on one side of the lines you would like to split and then click again on the other side to make a line that “cuts” through it, making the road segment into two lines. Finish the tool by pressing Enter or clicking again on the last point. Then select the lines that go outside of the map area and delete them.*

To add railways (train, subway, tram), then you need to click on the Rails layer and draw the line segments yourself by using the Create tool and then add the metadata for it in the right panel.

View to area

For Spacemaker to be able to analyze an area of interest you will need to define that for us. This can either be imported the same way as the site limit, or its often easier to just draw it yourself. Click on the View to area - layer in the left panel to be able to create the geometry on that layer. Then use the Create tool to draw a polygon on interest. Finally, give the polygon a name and color.



// NOTE // Spacemaker currently only supports areas that are on the ground surface, meaning that it will not analyze e.g. a building or a forest. *Hack; To be able to analyze a building then copy the building into the Building pads layer and give it the correct height. Then draw an area around it in View to area. This will then alter the terrain to mimic the building and then we can analyze the building.*

0.3 Finish setting up your project

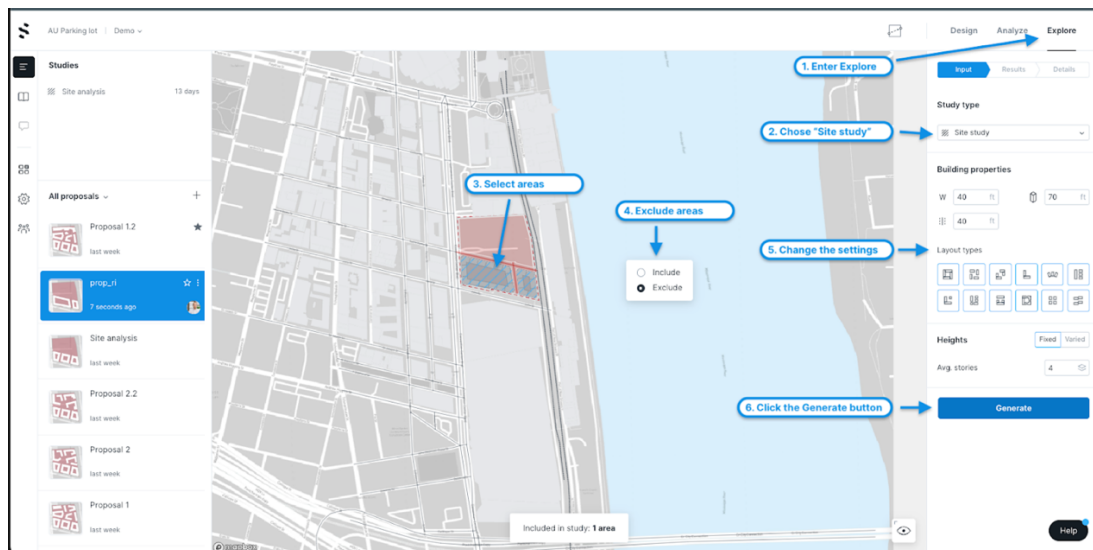
To finish setting up your project and adding all the relevant surrounding information that you have added, *click Apply changes in the top bar, and click Apply in the window that opens.* You can at all times go back and edit the layers.

1. Go Wide

Explore is a toolbox for generating and working with many proposals at once. It will let you [generate new proposals](#), [iterate on proposals you find interesting](#), and [improve the height distribution](#) of buildings to achieve various qualities. With wait times counted in seconds rather than minutes or hours when generating layouts as well as height distributions, Explore will allow you to discover and evaluate more options for your site than ever before!

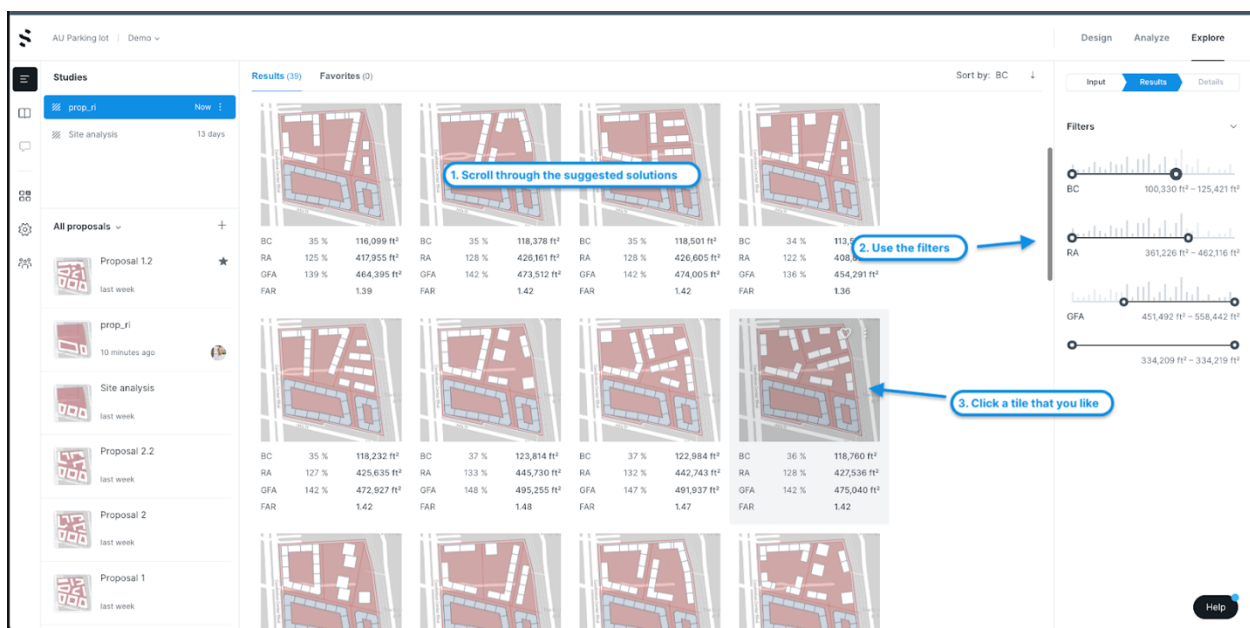
A site study is done through three stages: Input, Results, and Details. Instructions on Input:

- Click on **Explore**(1)
- Change the type of study to a **Site study**(2)
 - Site study: Explore new buildings on your site
 - Height study: Explore alternatives to how heights are distributed in your already existing proposal.
- **Select the areas** (3) on your site that you wish to exclude from generating new solutions on and click **Exclude** (4).
- If you want to change the settings for the study, then **change the settings** (5)
- Click **Generate** (6)



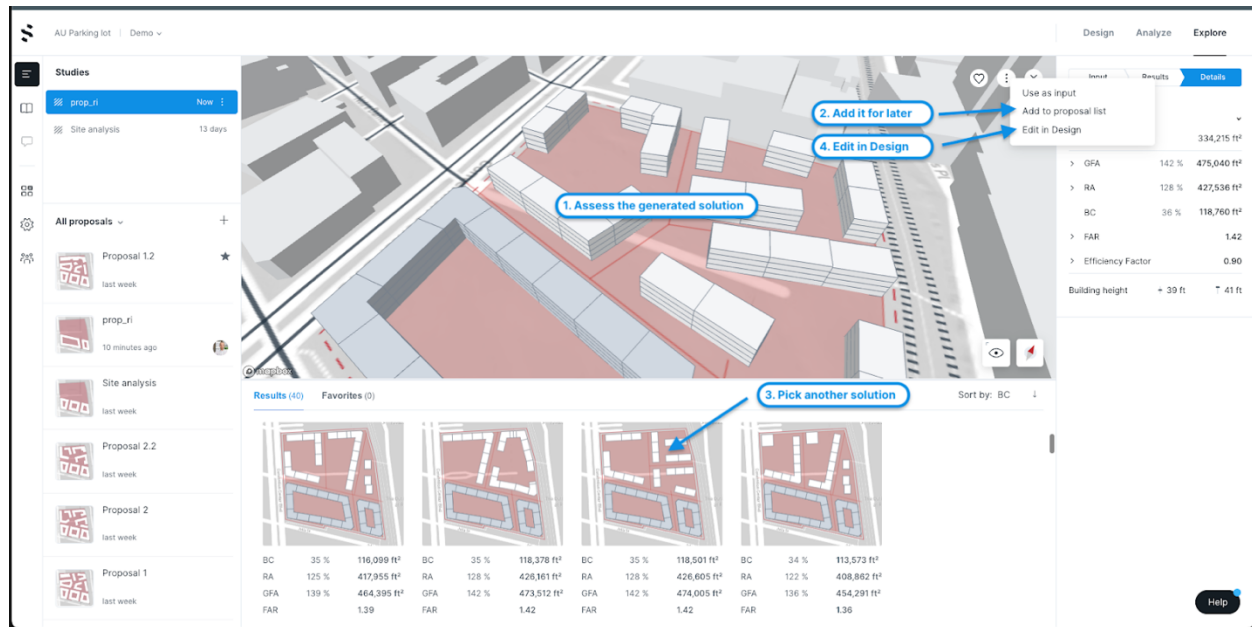
Instruction on Results:

- You will be presented with a **tiled view(1)** of up to 100 solutions for your site. Each tile contains an image and some basic geometric data
- You can use **filters(2)** to limit the number of solutions
- **Click on a tile(3)** that you like to look at it in 3D and with some more details
- At this stage, we are only interested in finding a good starting point! We will edit the design further to make it fit our site and context.



Instruction on Details:

- Look at the proposal in 3D to see if you think that the footprint can work for your site (1).
- If you like it, click on the three-dotted menu, and click “Add to proposal list” (2)
 - This will send that suggestion to the proposal list so that we can work on it later.
- Go ahead and find yourself another tile that you find interesting. (3) Click on the three-dotted menu again, but this time, click on “Edit in Design” (4)
- This will take you straight to Design, where we can work more on the proposals that you have just added.

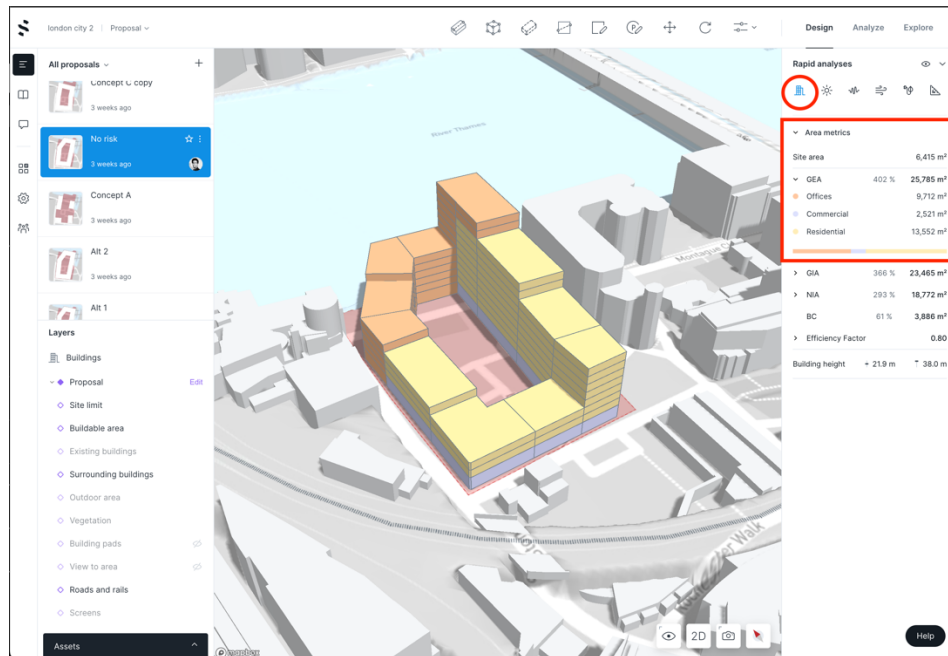


Compare apples to apples

Edit the buildings using the Rapid analyses

Make sure that all proposals you are considering have about the same GEA so that you can conclude on which approach leads to better outcomes in terms of living conditions. Spacemaker has built rapid analyses to aid you as a designer to make informed decisions as you are making your proposal. The real-time AI-powered prediction engines are trained on tens of thousands of simulations providing approximate results nearly instantly. These results are not exact but are close enough to offer valuable insights and support decisions while you design. Detailed guides and short articles and how to use the different rapid analyses can be found [here](#).

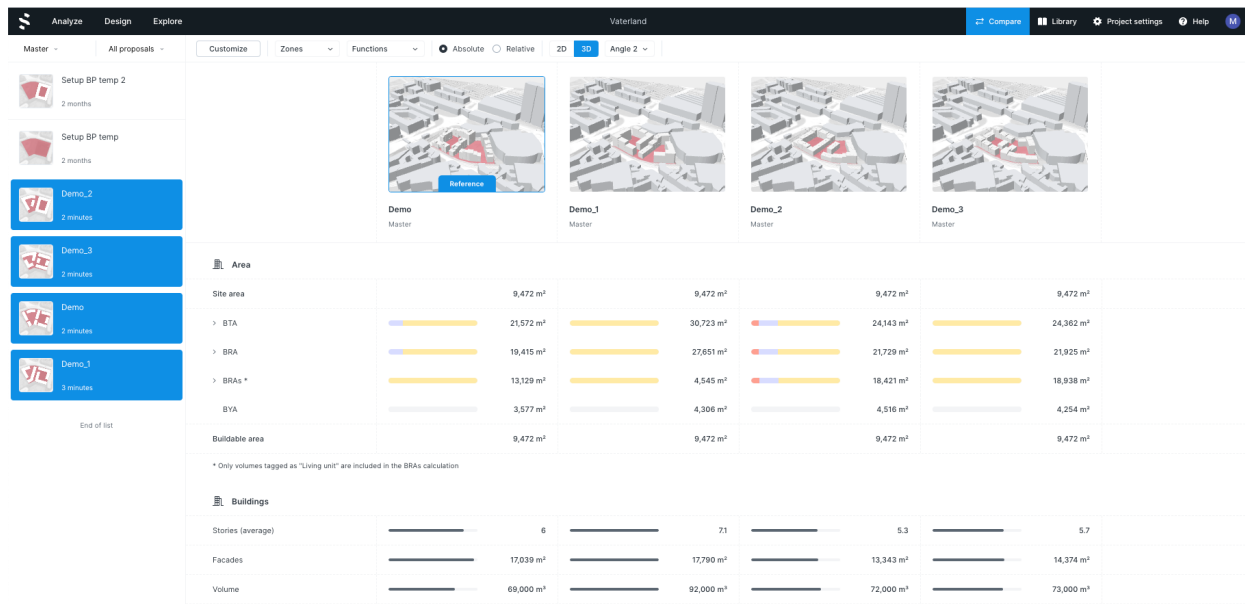
The buildings that you just generated are **line edited buildings**. Which are also the same buildings that you just learned how to work with. Use the techniques of moving, changing heights, widths, and footprints, and see how the analysis results change instantly. Focus on the geometry tab.



Now it is time to compare the solutions side by side. There are two methods: i) **Compare** mode (high level - stats); ii) **Analyze** mode (granular – shown in the demo)

i) Compare

Compare is designed for you to easily see the effects and outcomes of your designs. In this article you will learn how to use tool.



Access Compare

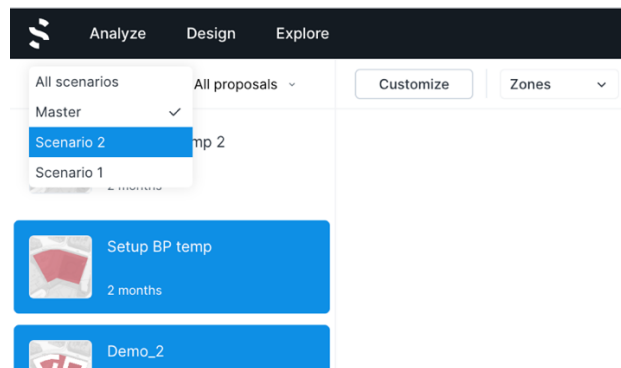
There are three ways to access Compare:

1. To the right in the main navigation bar next to Project settings
2. Through the dropdown menu on a proposal in Mini Library
3. From the more-menu on a specific proposal in the proposal overview page

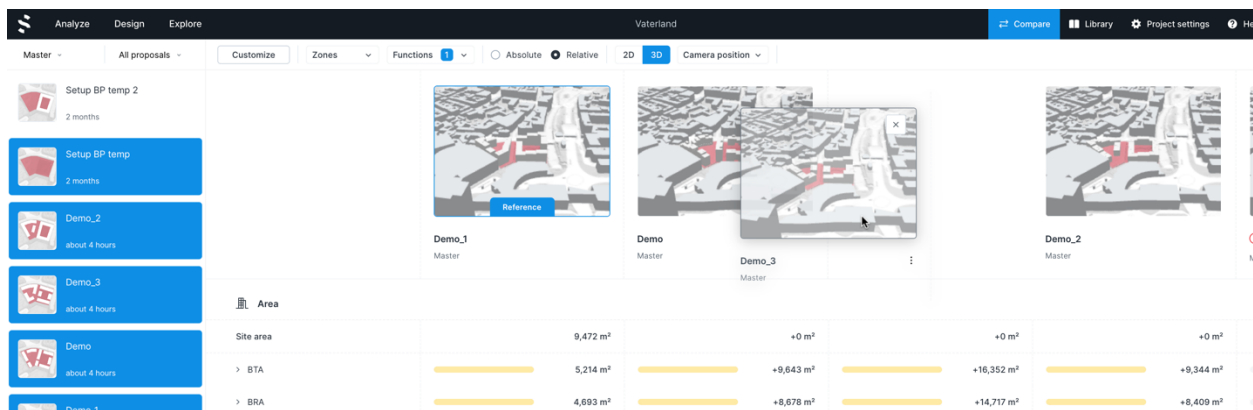
Add and organize proposals

The compare app lets you select up to five proposals at a time.

1. Click to select proposals from the left side menu.
2. To select proposals from a different scenario or folder, simply use the selectors on the top.



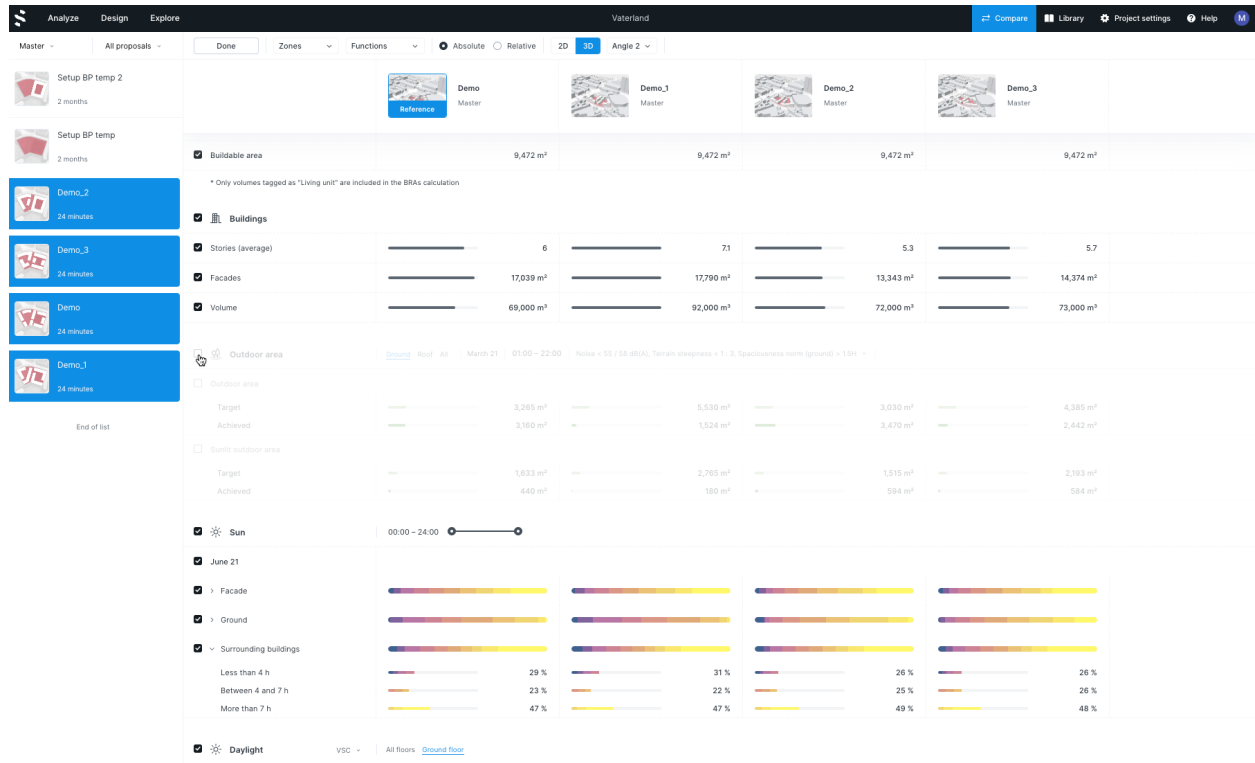
3. Organize your proposals by dragging and dropping the thumbnails. The first proposal will always be the reference.



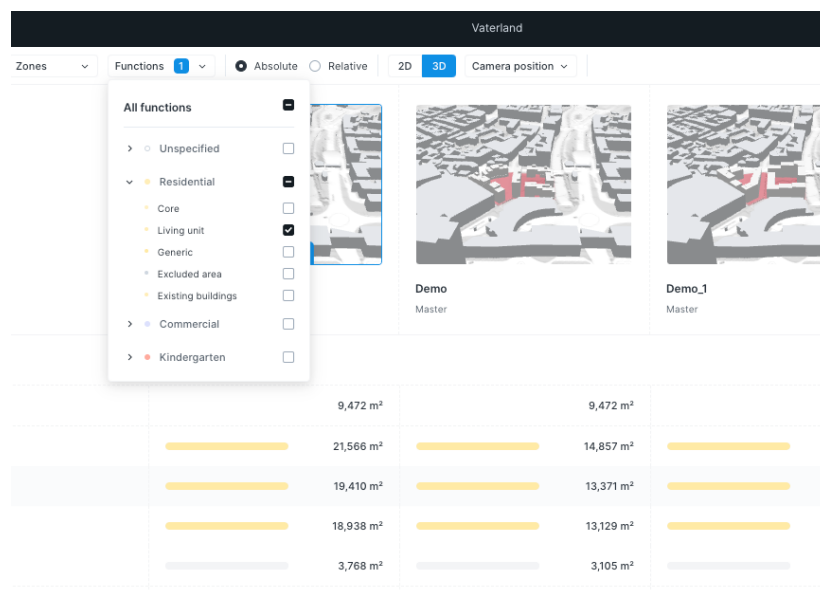
Helpful tools

The top toolbar contains various tools for comparing your proposals.

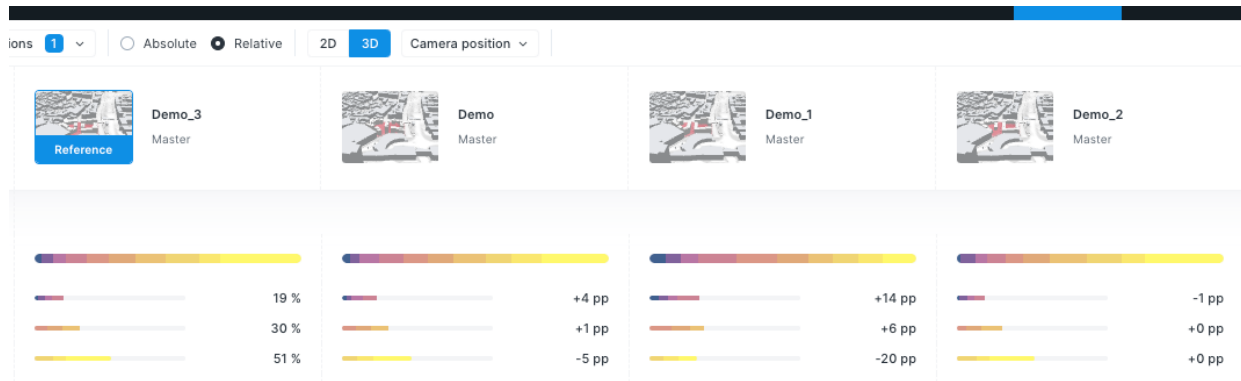
1. **Customize** your statistics by using the customize button. You will then be able to select the relevant statistics for your project.



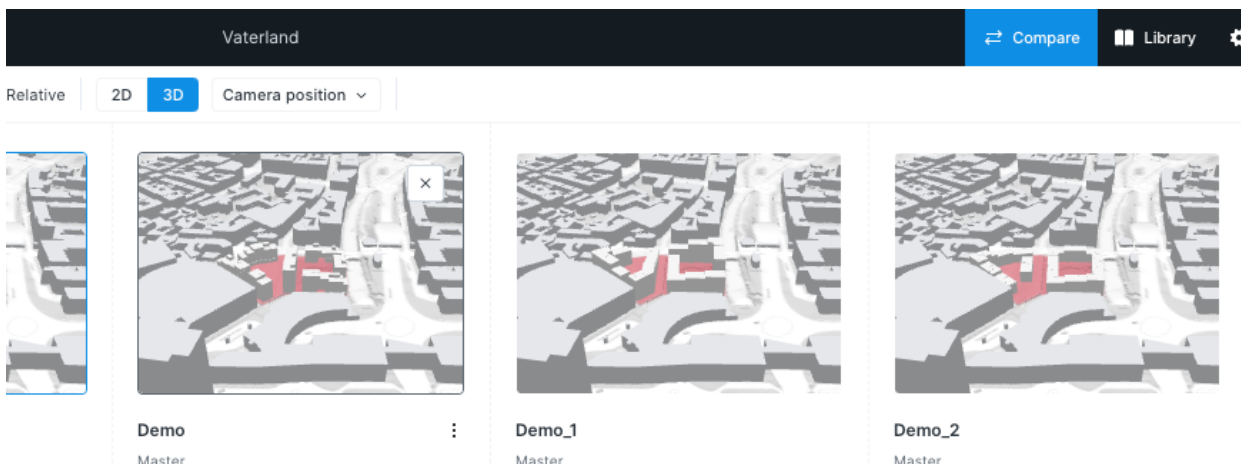
2. **Filter** your statistics on functions and zones by using the filter menus.



3. Select between **absolute and relative statistics**. The relative option will show you an increase or decrease in results relative to your reference proposal.



4. Toggle between **2D and 3D** views to select your preferred angle. To add more 3D views you must use the camera angle function in Analyze or Design.



ii) Analyze

You can view your proposals in 3D and run various analyses to assess risks and opportunities. Select one of the analyses on the right side. The analysis plot in the main view and analytics on the right side will be updated depending on the selected analysis. A full overview over resources for all the analyses has been assembled conveniently at one place in our Help Center in a section covering the Analyze tools.

In this mode it will not be possible to edit the design, but you will be able to inspect, filter and gain more insights for your proposal that you then can apply in Design later or share with the rest of your team.

All of the analyses available in Analyze can be found in the right panel. A full view of guides and documentation can be found in the Help Center under the [“Analyze mode: Assess opportunities and risks”](#)-section.

Buildings

[Guide / Technical documentation](#)

Spacemaker calculates several important measurements that are imperative for your proposals.

Area (Default): You will be able to see important calculations such as your area metrics, facade area, site area, building heights and more. If you have applied several [functions](#) to your site, then the area metrics will also be broken down into these and will calculate the areas based on the factors or way you have specified in the Project settings.

Parking: If you have drawn parking areas in Design, then the stats for those areas will show up under this tab. You can also set specific parking targets in Projects settings, which will then be used to calculate

Outdoor

[Guide / Technical documentation](#)

Outdoor space is important for recreation, play and activities for different age groups. High quality outdoor areas can often be a defining factor when developing a concept. The premises of the outdoor areas are set early in the development phase, as the size and the qualities on the outdoor areas are determined by the placements of buildings.

Quality: The outdoor area analysis calculates the amount of area that is left when you exclude non yellow or red noise levels and if the terrain is steeper than 1:3. Note that the default here is to only look at the ground. I would suggest editing this to “all” to see how the noise also has an impact on the roofs.

Terrain: The terrain steepness analysis addresses the terrain on your site through a steepness ratio. Terrain steepness can be part of project requirements, e.g. an outdoor area could be deemed inappropriate if the terrain is too steep. Furthermore, terrain steepness can show where it is costly

to build. By having to move and level a significant amount of the terrain the projects costs increase.

Sun

[Guide / Technical documentation](#)

Sunlight on buildings and outdoor areas is an important factor to determine high quality of housing. The Spacemaker sun analysis measures the amount of time in sunlight at a given date for points covering the ground and the buildings in a proposal. Depending on your region, the amount of sun on your facade plays an important role of the quality of your proposal.

Daylight

[Guide / Technical documentation](#)

We spend over 80% of our lives within buildings and numerous research studies have demonstrated that access to daylight has profound implications in terms of human health, happiness and productivity. Using the Daylight analyses in Spacemaker you will get insight to indicate daylight performance in your buildings, highlighting facade areas with inappropriate levels of light in order to provide a high-quality living space.

VSC - Vertical Sky Component: The Vertical Sky Component analysis is a measure of how much light reaches the facades from the sky shown as a percentage score. For different points on the facade, the VSC score indicates how much light that would shine through a window placed at those points. The results are divided into color bins indicating the daylight potential. The darkest areas means that achieving reasonable daylight is often impossible and the lightest areas means that daylight conditions are usually satisfactory.

VSC default thresholds	Daylight conditions
$VSC \geq 27\%$	Conventional window design usually satisfactory
$15\% < VSC < 27\%$	Larger windows/changes in layout are usually needed
$5\% < VSC < 15\%$	Difficult to provide adequate daylight
$VSC < 5\%$	Achieving reasonable daylight is often impossible

Obstruction angle: is a geometric measure commonly used as a rule-of-thumb to indicate daylight potential. It measures obstructions, as other buildings or terrain, and calculates the obstruction angle: the angle the obstruction makes above the horizon seen from the facade.

Generally, it is suggested that all facade areas with obstruction angle above 45 degrees, must be examined further to ensure adequate daylight.

Noise

[Guide / Technical documentation](#)

Noise analysis is a powerful tool for decision makers to address problems related to environmental noise. Living in areas with high noise levels is associated with significant adverse health effects. Using the Noise analysis you can find answers to questions such as how likely is it that people will feel annoyed by noise, or how likely is it that residents will be exposed to unhealthy noise levels. You can also obtain information that can guide you in whether or not your designs meet regulatory requirements for issues such as limited noise levels on outdoor areas.

The noise analysis is broken down into three subsections: Total (Default), Road and Rail that shows the effect that each category has on the proposal. You can click on each to see the specific effect that source has on the project.

View

Guide ([Distance](#), [Area](#)) Technical documentation ([Distance](#), [Area](#))

Views from your apartment or the room you are in, either general or a specific view towards something, are highly sought qualities for any given apartment. Spacemaker calculates these views in two ways to give you the insights that you will need to make good decisions. Try using the Inspect tool (i) and click on the facade. It will show an illustration of how the analysis is working and the general length for that given point.

Distance: The view distance analysis in Spacemaker measures the spaciousness around points on facades, giving an indication of how distant the view is. It measures how close you are to attaining 1000 meters (can be changed in settings) of view around each analyzed point.

View to area: The analysis shows how much of your facade that is able to see the area that you defined in Layers as an area of interest and will color the facades for the areas that are able to see these areas. Note that each point is colored as long as it can see the area of interest, independent of the amount of area it can see. In other words, if it only can see a tiny part of the area, it will show as if it can see it.

Wind

[Guide / Technical documentation](#)

The Spacemaker wind analysis is a powerful tool for early phase assessment of your site for various effects caused by wind. One unwanted side-effect is uncomfortable outdoor spaces due to high-wind areas, generally denoted as pedestrian comfort. Our wind analysis can be used to identify such problems and analyse the effect of design changes.

In warmer climates, ventilation through the site can help cool down the urban area at warmer days. With the Spacemaker wind analysis and an automatically provided wind rose local to your site, you can quickly investigate whether your design allows for airflow through your site.

// NOTE // This is the only analysis that you will need to manually trigger as the analysis is computationally heavy and takes a long time to compute. Also note that if you do any changes to the proposal in Design, you will have to run a new analysis.

Comfort: The pedestrian comfort analysis combines the wind flow patterns with the probabilities defined in the wind rose to predict where there will be areas with uncomfortable wind speeds over time. The output is showing areas of what pedestrian activity that would be comfortable.

Direction: The wind flow theme can give important clues to which direction that are causing pedestrian discomfort. Some locations on the site might be prone to wind from a specific direction, which is not always easy to interpret from the comfort analysis results alone.

Microclimate

[Guide / Technical documentation](#)

The microclimate analysis combines the sun and wind analyses with a local weather file and uses UTCI (Universal Thermal Climate Index) to give a comprehensive perceived temperature map of the site, helping you understand how the local climate reacts to the shade and wind conditions your site plan creates.

Comfort: You'll be able to investigate the frequency of all perceived temperature results which is within the "comfortable range." As in the [London guidelines](#) for assessing comfort, the default comfortable range is 0 to 32 degrees Celsius. The comfortable temperature range is adjustable using the analysis settings.

Temperature: This analysis outputs perceived temperature, similarly to when the weather forecast announces a temperature of 20 °C, which feels like 15 °C because of e.g. sun, wind, or humidity. You'll be able to view the typical perceived temperature (50th percentile), the warmest (95th percentile), or the coldest (5th percentile) out of all the results we've calculated, on the date and for the time range you've selected.

Solar Panel (Beta)

[Guide / Technical documentation](#)

The goal of the solar panel analysis is to assess the potential of a site for solar panel electricity generation, providing several outputs with just a few simple inputs. These inputs can be edited through the Project settings. A shortcut to get to the right area is to click on the mechanical wheel in the right panel. Our model takes the shading from existing, surrounding, and proposal buildings into account.

2. Go deep

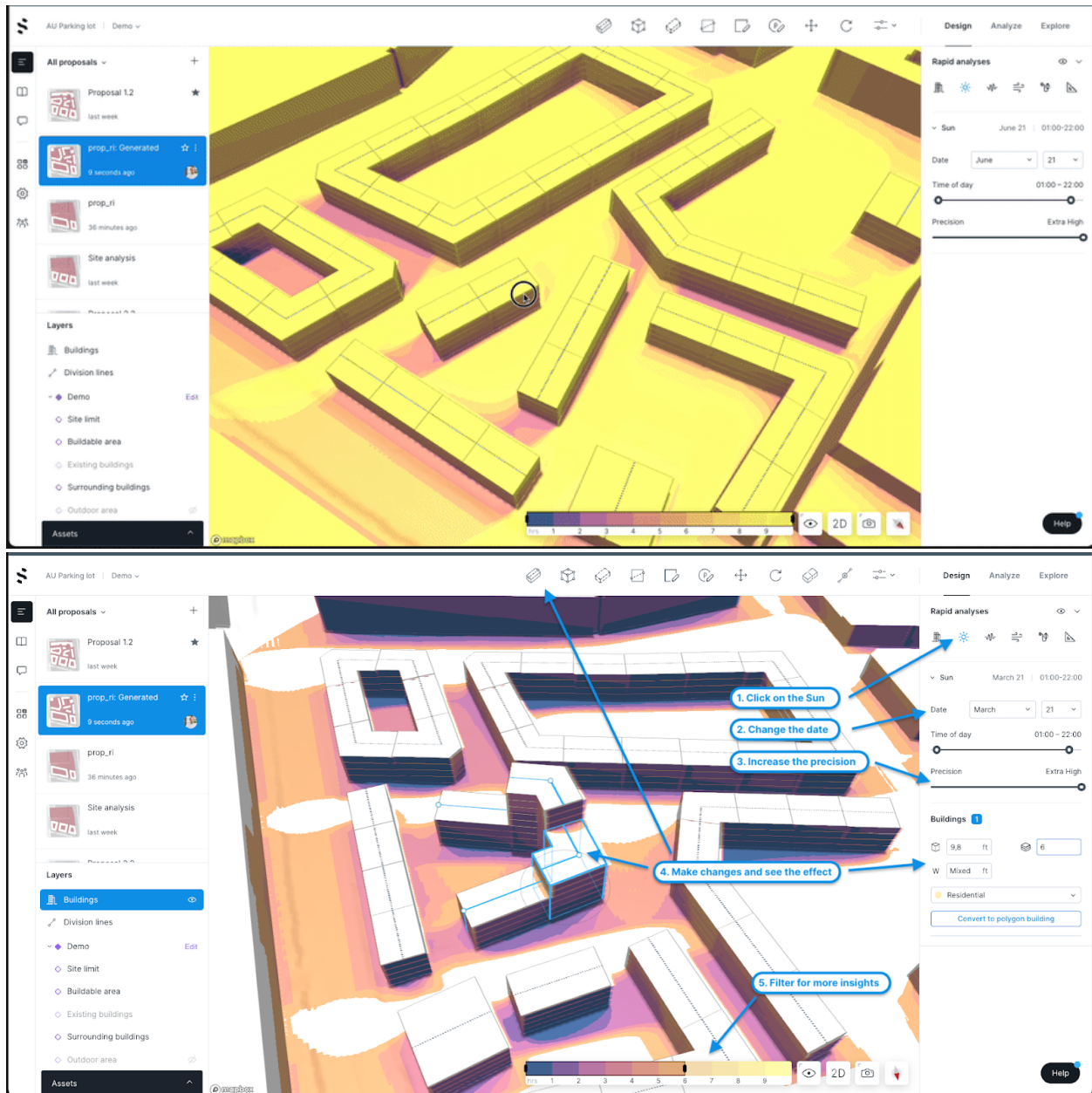
Once you have selected which proposal you want to go forward with, it is time to act upon the insight you collected regarding its qualities and risks. You want to work quick in an outcome-based manner. Spacemaker has built rapid analyses to aid you as a designer to make informed decisions as you are making your proposal. The real-time AI-powered prediction engines are trained on tens of thousands of simulations providing approximate results nearly instantly. These results are not exact but are close enough to offer valuable insights and support decisions while you design. Detailed guides and short articles and how to use the different rapid analyses can be found [here](#).

Rapid analysis: SUN

The rapid sun analysis is made to help you make informed decisions based on how your volumes and buildings affect their surroundings. Try therefore to make several changes to see if you can make some better outdoor areas or ground floor apartment conditions. An in depth guide on how to use the rapid sun analysis can be found [here](#).

Instructions

- Click on the **Rapid analyses for Sun (1)**
- Change some of the parameters
 - **Change the date(2)** to the sun equinox (21 March) to see how the site is performing on the “average day”.
 - I also suggest **increasing the precision(3)** to the maximum value.
- Edit, move, or connect some of your buildings to see the effect in real-time.
- Use the **color filter(4)** to target areas above or below a certain amount of hours of sun

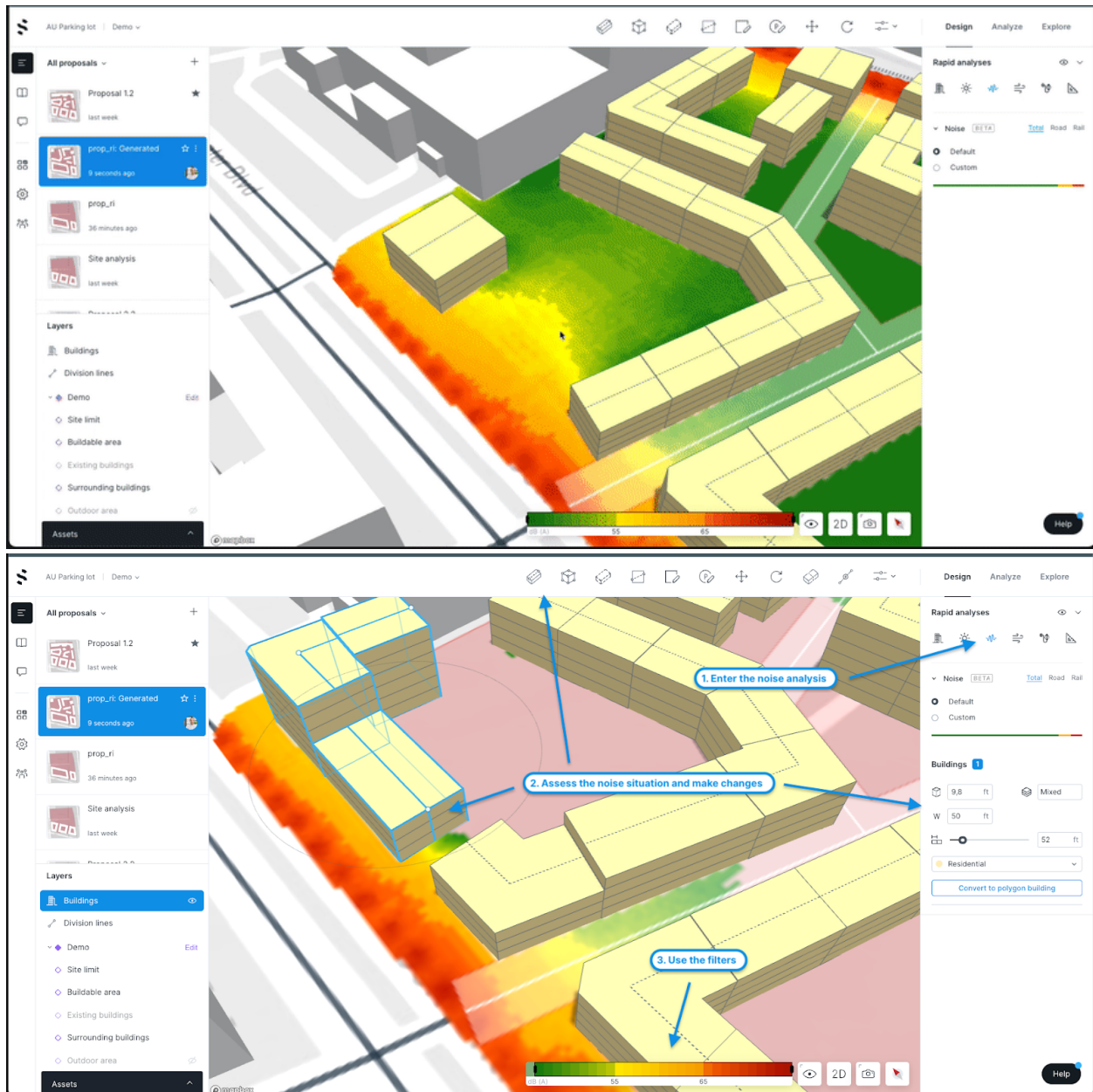


Rapid analysis: Noise

Think of the rapid noise analysis as an acoustician who has a lot of intuition about how noise propagates and provides design advice quickly, and now you have it too. Its real-time AI-powered noise prediction engine is trained on tens of thousands of noise simulations. This analysis provides approximate noise level results nearly instantly. These results are not exact but are close enough to offer valuable insights and support decisions while you design and iterate on your proposal. A more detailed introduction to the tool can be found [here](#).

Instructions

- Click on the **Rapid Noise Analysis(1)**
- Assess where you have challenging noise situations and **make adjustments(2)** to your proposals to try to decrease the amount of noise that enters your proposal. Are there any areas on your site that need a different approach?
- Use the **color filter(3)** to target areas above or below a certain amount of noise on your site.



Rapid analysis: Wind

How many streets and urban areas haven't you experienced that the wind is at uncomfortable high levels! Well, part of the reason is because the designers did not have the time or tools to design around how the wind flow reacts to how the buildings are formed. In addition to be able to run a full computational fluid dynamics (CDF) analysis, we can now also offer you a rapid wind analysis. In other terms, you now have the tools to design and iterate for the wind situation on your site! You can toggle between showing wind speed or comfort. Go to this [guide](#), if you would like to learn more about it.

Instructions;

- Click on the **Rapid Wind analysis (1)**
- Assess your proposal regarding your wind situations and **make adjustments(2)** to your proposals to try to decrease the amount of wind tunnels that is created by the placement of your buildings. Are there any areas on your site that need a tweak?
- Use the **color filter(3)** to target areas above or below a certain amount of noise on your site.
- The default option is to run a [comfort analysis\(4\)](#)
 - The pedestrian comfort analysis combines the wind flow patterns with the probabilities defined in the wind rose to predict where there will be areas with uncomfortable wind speeds over time for a pedestrian. The Lawson LDDC scale then shows you what kind of activity would be fitting for any given point on your facade.
- Try switching over to **Direction (5)** to test specific directions and wind speeds. Personally I like to ramp up the wind speed some, to at least design away the windiest days.



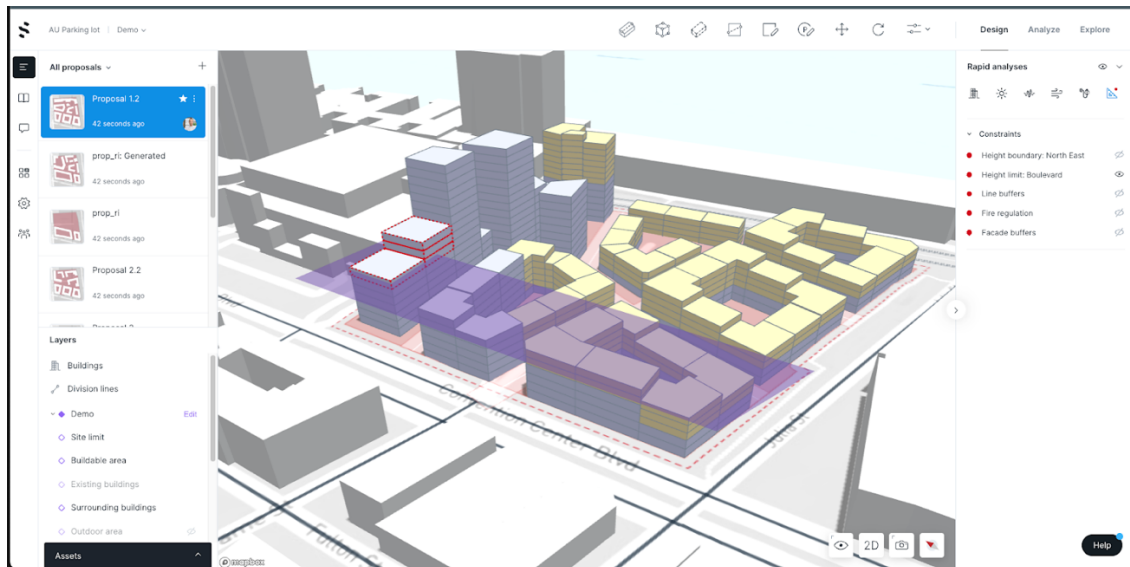
Rapid analysis: Operational Energy

This analysis was not covered in the presentation, but it is very much well worth mentioning. Operational energy is the energy it takes to operate the building - lighting, heating and cooling, powering appliances, etc. There are many factors that affect the operational energy usage of a building, some of which are generally determined in later design phases; think of insulation thickness, window shading, or HVAC efficiency. But critical choices like building form, the primary materials of the walls and roofs, and window-to-wall ratio are made very early in the

design process, often before energy experts are brought into the project. Please read more about the analysis through this [guide](#).

Rapid Analysis: Constraints

We did not have time to cover this feature, but it will help you check your buildings for distances, heights and constraints that you have for your site. To read more about how the feature works, and how you can apply it for your project, then check out this [guide](#).

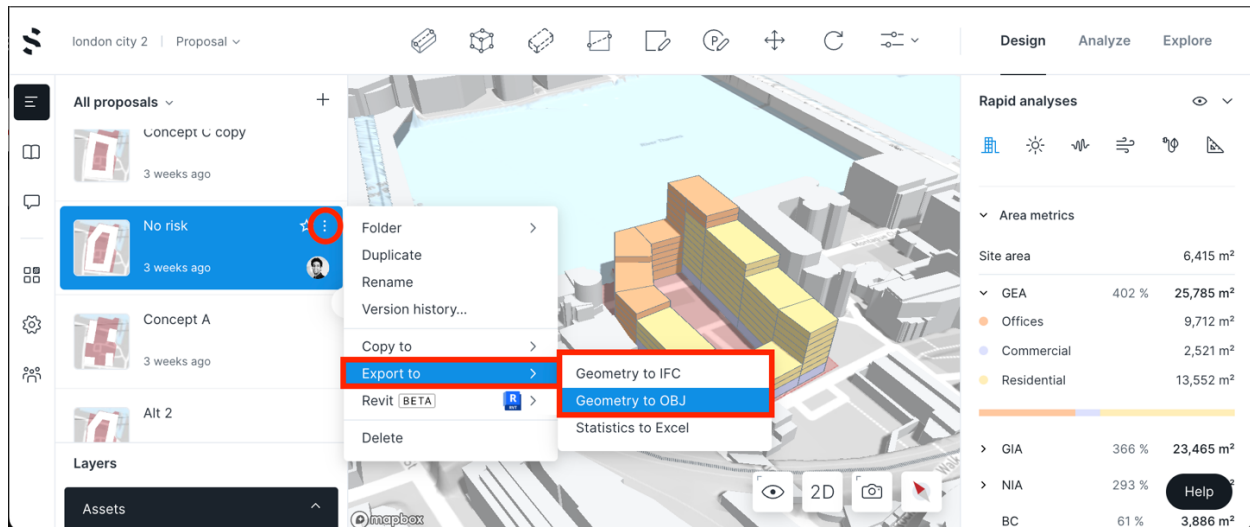


3. Go out

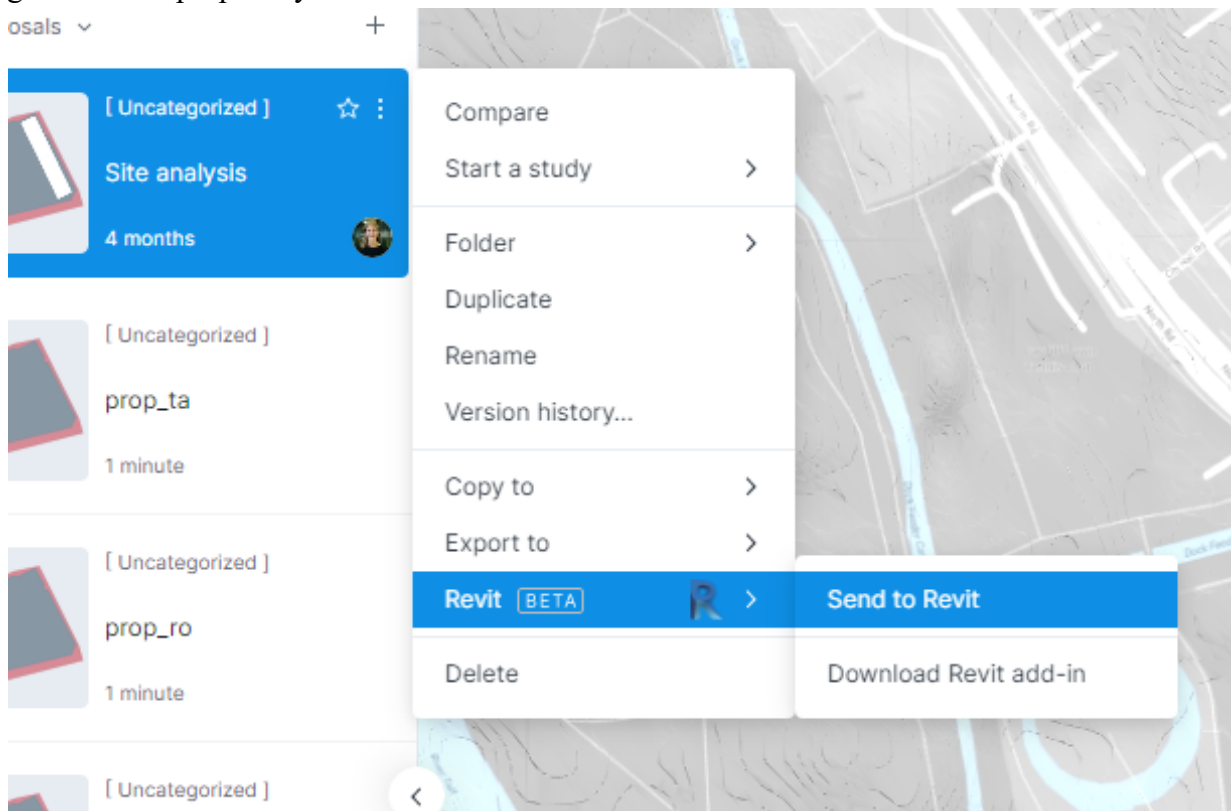
You can export proposal geometries in OBJ and IFC formarts in Analyze and Design modes. Note that if you have imported mesh geometry (beta functionality) to the proposal you're exporting, these geometries will not be included in the export.

You will then be prompted to select a coordinate system, expressed by the projection and the origo. The coordinate system determines where in the world the origo for your project will be placed. This is part of the process Spacemaker refers to as Georeferencing, but it is also referred to as Geographic Location or Geolocalization in other applications. You can also specify what you want your origo coordinates to be. This is especially useful if you're working in a local coordinate system in your drawing software, and want the buildings to be placed relative to that.

If you are uncertain about which projection and origo to use, you can usually find the coordinate system used in your project either in reference documents from the authorities or by looking up your project origo in your software e.g. Revit, Rhino or Sketchup. Generally any BIM-coordinator or Project Manager will know this as well.

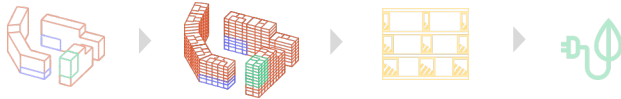


You can also send your proposal to Revit. From the list of your proposals in the left-side panel, right-click the proposal you'd like to work on and choose “Send to Revit” from the menu:



If you have imported mesh geometry (beta functionality) to the proposal you're sending to Revit, these geometries will not be included in the export.

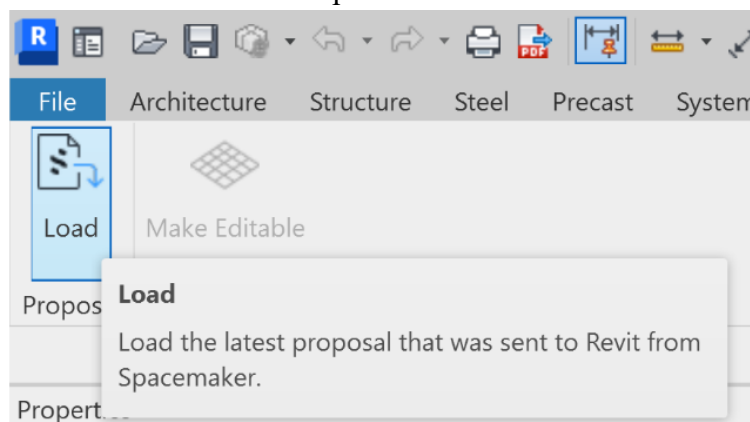
PLAN LAYOUT



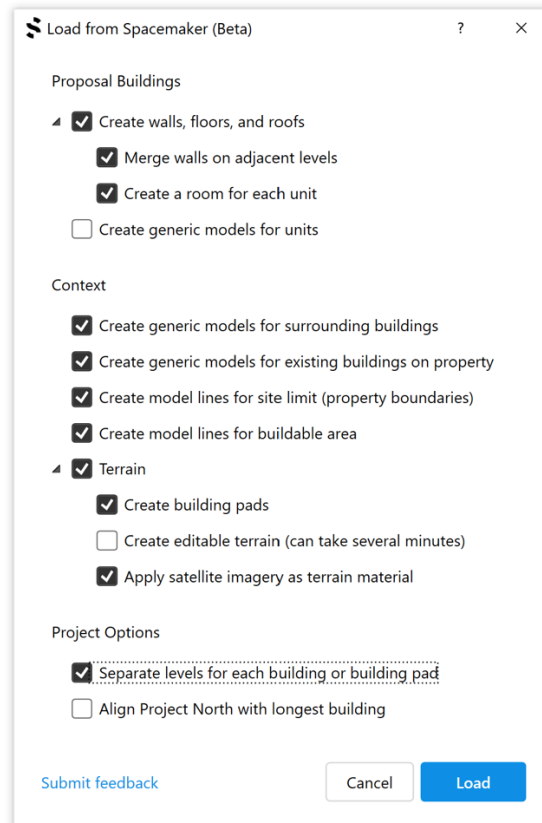
4. Load Spacemaker data	5. Draw plan layouts alternatives in Revit	6. Find the best performing alternative
<ul style="list-style-type: none"> Units as generic models Note that the model will come georeferenced Geometries will be revit native Consider using Spacemaker as the launchpad for all ADSK digital workflows 	<ul style="list-style-type: none"> To import the units back to SM, they must be continuous masses (no gaps often created by walls) without elements like walls, doors, etc. Define uses in the IFC properties 	<ul style="list-style-type: none"> Use Spacemaker to discuss with stakeholders what is the best performing alternative

4. Load Spacemaker Data

Then, open Revit and click “Load” on the "Spacemaker" tab.



When you initiate "Load" you will have the opportunity to choose which elements of a proposal are brought into Revit and how some of the elements are represented. Your choices will be persisted between sessions.



Proposal Buildings: Gathers your proposed building designs. Check one or more of the following boxes to define the level of detail needed

- **Create Walls, Floors, Roofs:** create these native Revit elements
 - **Merge walls on adjacent levels:** Single continuous multi-story walls will be created instead of walls constrained to single levels
 - **Create a room for each unit:** room elements will be created for each Spacemaker building unit, including data for function and location in numbered buildings
- **Create Generic Models for Units:** Building unit volumes will be represented as Generic Model solids (using Direct Shape)

Context: Gathers the buildings around your proposal.

- **Create generic models for surrounding buildings:** Get the existing context building outside of your site limit
- **Create generic models for existing buildings on property:** Get the existing context buildings inside of your site limit
- **Create model lines for site limits (property boundaries):** Each polygon in the 'Site limit' layer in the Spacemaker proposal will be created with model lines in the Revit project.

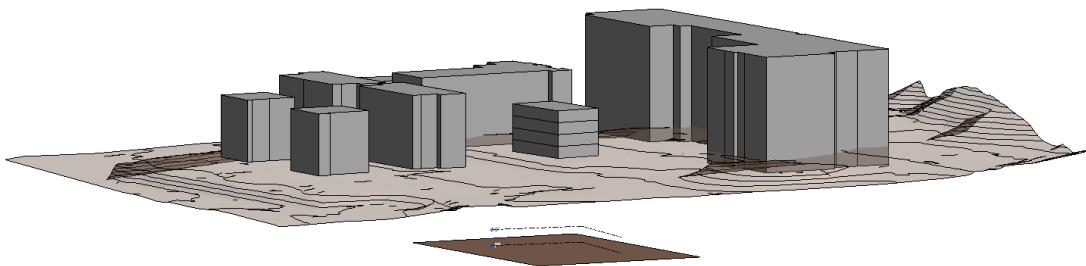
- **Create model lines for buildable area:** Building limits will be created as model lines
- Terrain:** Create a Revit toposurface representing the terrain from the Spacemaker project. Check the following boxes to define the level of detail needed
- **Create building pads:** Building Pad layers will be created as Revit Building Pads
 - **Create editable terrain (can take several minutes):** the toposurface will be created with manipulatable control points. If this option is not selected, then the topography can later be converted to Editable if needed.
 - **Apply satellite imagery as terrain material:** topography will show satellite imagery when in Realistic or rendered views using a new project material called "Terrain Texture." The image for this material will be saved to your "Default path for user files" in Revit settings.

Project Options: Additional settings for element creation

- **Separate levels for each building or building pad:** Levels will be created, named, and numbered for each building or building pad instead of by unique elevation across the proposal
- **Align Project North with longest building:** Existing Revit file's project North will be rotated so that either the North/South line or the East/West line is aligned with longest building edge from the Spacemaker proposal

When you are finished with your selections, press "Load" to complete the process.

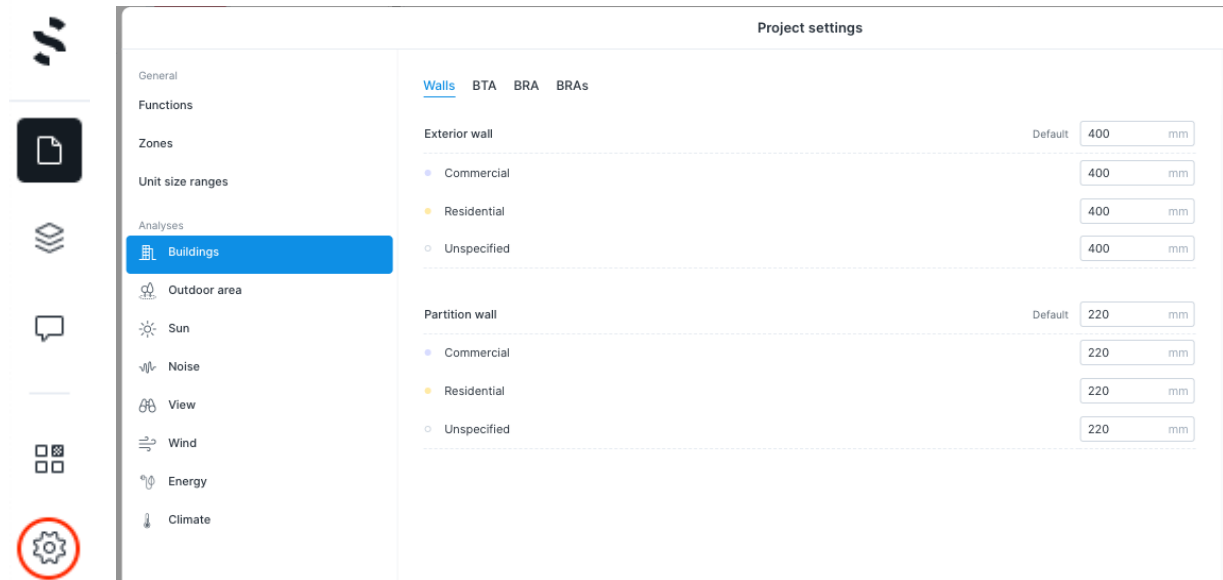
In a 3D view, you should be able to see the buildings included in your proposal, terrain and building limits added to Revit. Note that the building limits are at height 0, often below the terrain.



How to change the wall thickness of the proposal

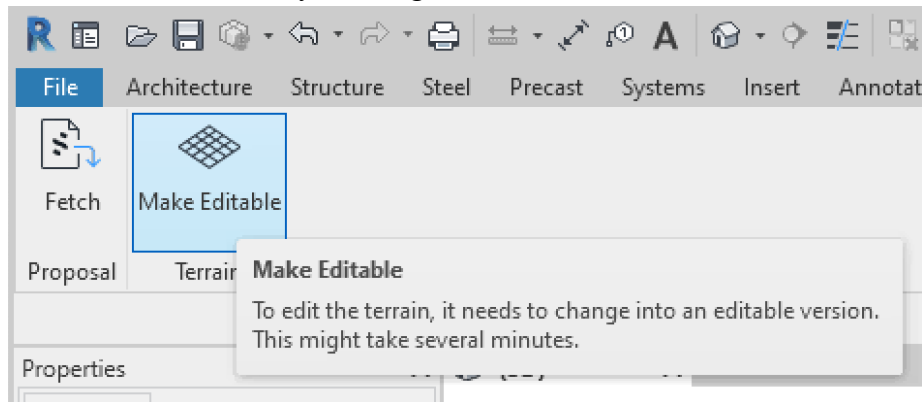
The model that is sent from Spacemaker to Revit uses the configuration in Spacemaker to decide wall thickness for external and interior walls on the proposal buildings.

This setting can be changed in project settings, found by clicking the cog icon in the left navigation (red circle). The wall settings are located under the "Buildings" tab.



How to make the terrain editable

You can make the terrain editable by clicking "Make editable" in the terrain tab.



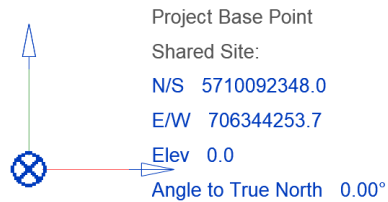
PS: You might experience that Revit has "frozen" but it typically means that it's still processing the operation as large terrains can take some time to load.



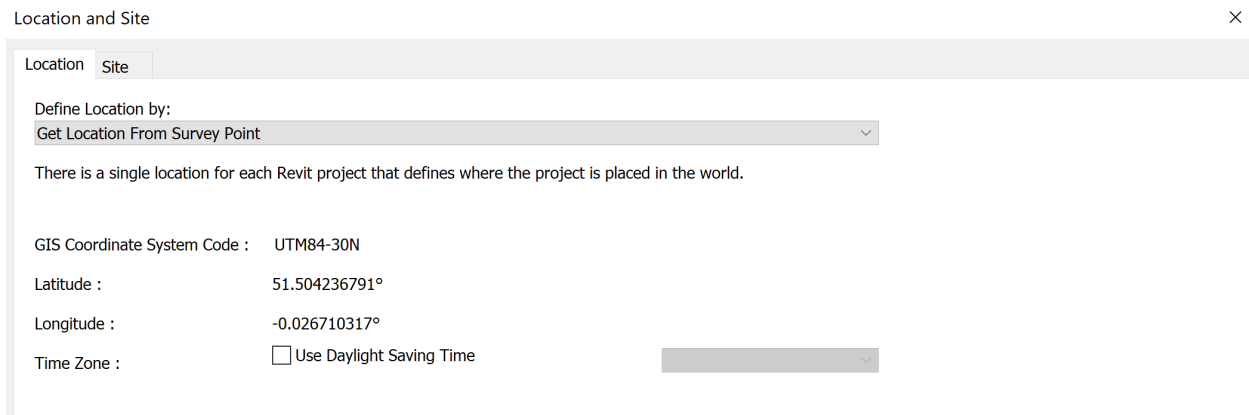
The terrain will be added as Toposurface, and you can use tools in Revit to edit it.

Coordinates

While fetching your Spacemaker proposal, the Revit add-in also synchronizes the project base point, so it is the same as in Spacemaker. Turn on Project Base point under view options in Revit to see the coordinates of the base point.



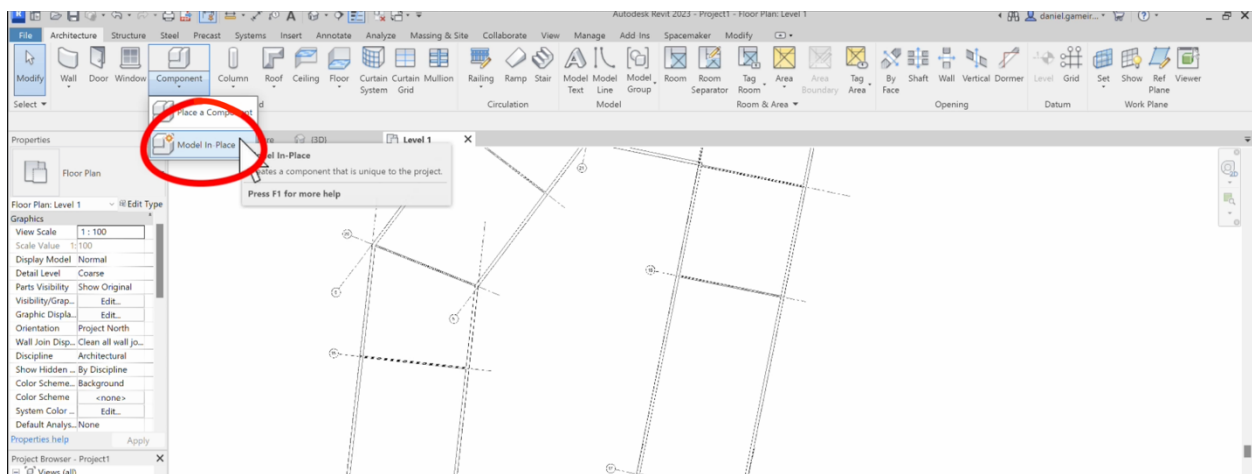
The coordinate system can be viewed in the Location dialog in Revit.



5. Draw plan layouts alternatives in Revit

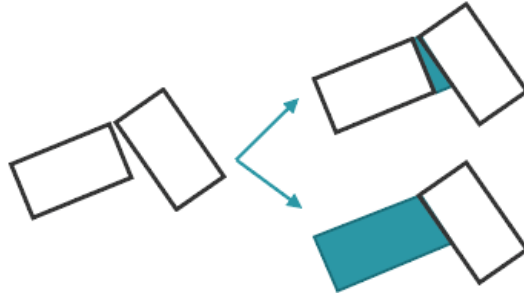


In Spacemaker, units are defined by continuous boxes without any other element such as walls, slabs, roofs, doors, windows, or furniture. You want to model apartments like this in Revit if you want to leverage Spacemaker to understand which plan layout alternative has the most potential.



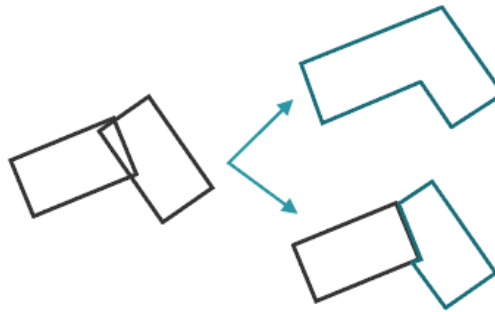
Eliminate unintentional gaps

If you have created volumes that are meant to be built into one but are designed as two ensure these gaps are removed unless they should be there. These gaps can create dark facades in the sun analysis, which can affect the average statistics.



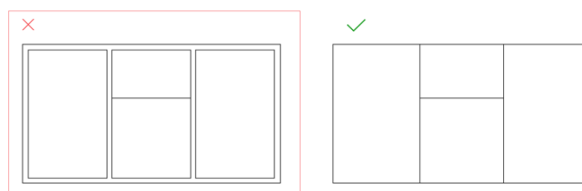
Clean up overlapping geometries

To avoid counting some areas twice in the geometry analyses, overlaps must be removed.

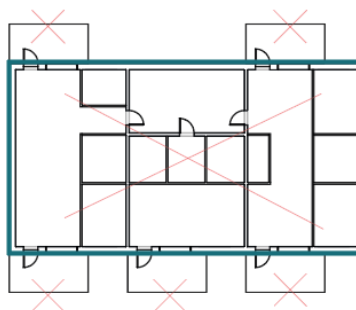


Remove the gap between apartments in plan and section

As Spacemaker only works with volumes, gaps representing partitioning walls or similar will give an incorrect representation of the geometry in Spacemaker and must be removed.



Discard balconies, walls, doors, windows, or any other objects.



Discard duplicated volumes with the same location

Make sure only one single volume in a location is exported, or these will give incorrect analysis results



Tag volumes with functions and area types

If the geometry represents a living unit, core, or a floor or has a commercial function, the geometry can be exported with IFC parameters to correctly assign functions and area types.

More information about which IFC parameters to use here:

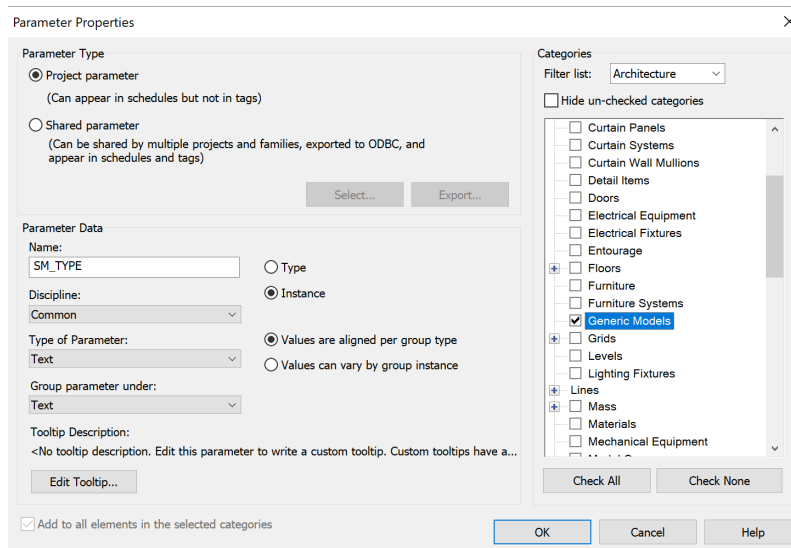
- [Building functions](#)

How you do this depends very much on the software you are using. Check of software specific guides using the links below for tips.

Use model in place and *generic model* as the revit family. Make also sure to define the use of each unit as an IFC parameter which can be defined in Project Parameters. To add an IFC parameter for a function, you have to add the parameter "SM_FUNCTION_NAME". To properly assign a function to a volume, this parameter must be applied to the volume with a value corresponding to the function name described above. For the area type, you have to add the parameter "SM_STRUCTURE_TYPE" and apply the parameter to a volume with a value corresponding to the area types described above.

1. Click "Manage" → "Project Parameters" → "Add"
2. Set "Parameter Properties" for: "Name" to "SM_FUNCTION_NAME", "Discipline" to "Common" "Type of Parameter" to "Text" "Group parameter under" is optional The parameter can be either "Type" or "Instance" Set "Categories" as the type of Revit-category of the geometry that you want to export
3. Click "OK"
4. Click "Manage" → "Project Parameters" → "Add"
5. Set "Parameter Properties" for: "Name" to "SM_STRUCTURE_TYPE", "Discipline" to "Common" "Type of Parameter" to "Text" "Group parameter under" is optional The parameter can be either "Type" or "Instance" Set "Categories" as the type of Revit-category of the geometry that you want to export
6. Click "OK".

7. Select the geometry you want to export and label the geometry in "SM_FUNCTION_NAME" and "SM_STRUCTURE_TYPE" with the desired tag.



Functions

A *function* describes what function the building will be used. The default functions are *Residential*, *Commercial*, and *Unspecified*. You can add new functions and edit the existing functions in [Project settings](#)

When adding functions to your project, you will be able to study the functions separately in Analyze by using the "Filters"-functionality.

Area types

The *area type* describes the type of the unit and will affect how the analyses interpret the area.

The four area types available are *Generic*, *Living unit*, *Core*, and *Excluded area*.

To see how the different area types are interpreted by the Area Analyses, go to [Area analysis](#)

A *Generic* unit type can be used if you have not yet decided on the inside layout of the building. An example of a generic unit can be a larger floor where you want to place apartments and cores at a later stage in the planning. The generic unit is interpreted as a unit with one story.

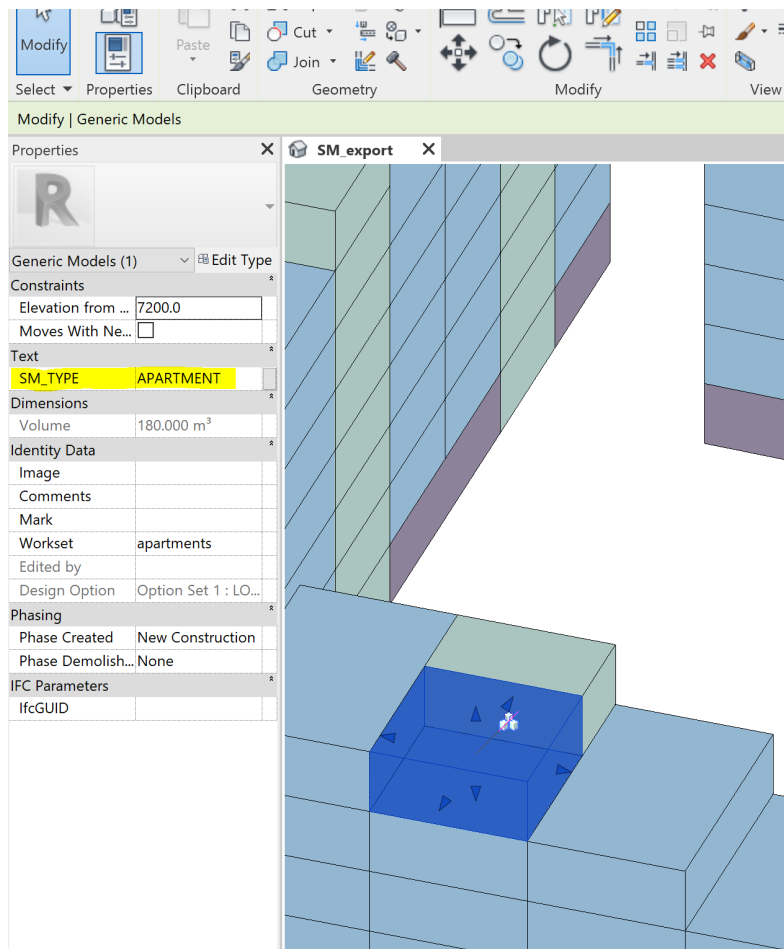
When importing this type of unit use "GENERIC" as the content of the SM_STRUCTURE_TYPE parameter.

A *Living unit* can for example be an apartment or a townhouse unit.

When importing this type of unit, use "LIVING_UNIT" as the content of the SM_STRUCTURE_TYPE parameter.

The area type *Core* is a collective term for stairways, elevators, and corridors. If you have a core spanning several floors, e.g. an elevator shaft, the unit must be split up so that there is one separate core unit for each floor. This is to ensure correct area calculations. Corridors: In order to get corridors within a building, a line edited building must be added with minimum building width of 15 m. When importing cores, use "CORE" as the content of the SM_STRUCTURE_TYPE parameter.

The area type *Excluded area* is interpreted as a volume that should not be included in our analyses. Example use cases for Excluded Area can include the area below ground, bicycle rooms, storage rooms, technical room, etc. When importing excluded areas, use "EXCLUDED_AREA" as the content of the SM_STRUCTURE_TYPE parameter.



Export guide from Revit to Spacemaker

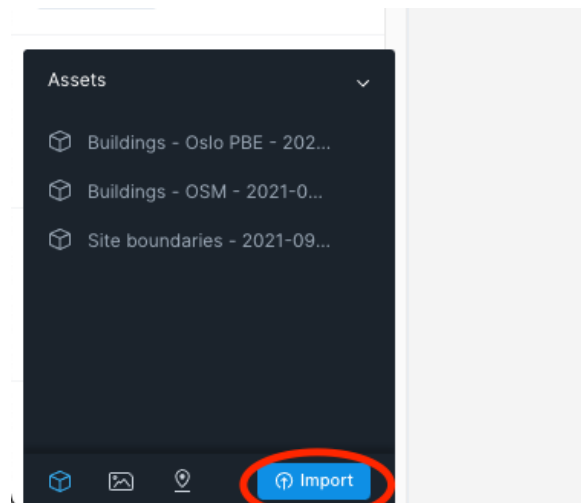
Step-by-step guide for the export workflow.

1. Model the desired volumes following the requirements here. There is no restriction of what types of Revit Categories you are drawing, but “*Generic Model*” is the most commonly used. Note: If you are using “*Mass*” with “*Mass floors*”, the floors will not be exported in the IFC
2. Create a View where only the geometry you want to export is visible
3. Ensure that the geometry is labeled correctly in “SM_FUNCTION_NAME” and “SM_STRUCTURE_TYPE” (described in the section above)
4. Now it is time to export the 3D geometries from a 3D view with only the elements visible you want to export. Go to “File” → “Export” → “IFC”. Select “*Modify Setup*” and be sure that both “*Export only elements visible in view*” (under “*Additional Content*”) and “*Export Revit property set*” (under “*Property Sets*”) are toggled on
5. After changing the filename and the file location, click “*Export*”

Import to Spacemaker

1. Upload geometry

Open “Assets” by clicking on the black tab in the bottom left corner of the screen when in Design. Click on the Upload button within “Assets”, see the bottom right corner. Clicking will open a window where you can either choose to drag-and-drop your file or upload a file by clicking in the center of the screen.



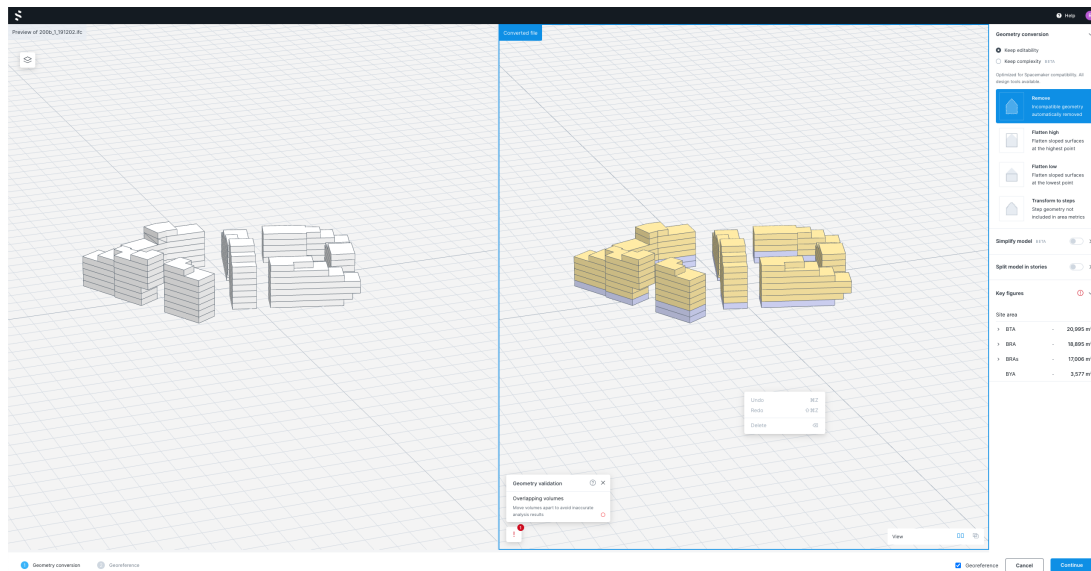
2. Validating geometry

When importing we visualize how we interpret the geometry in your file. This step helps you identify if something is not as it should be. For instance, a building that has balconies could end

up not being shown and this step will help you identify such issues. If something like that happens, we encourage you to check the documentation for our support level in order to ensure your file is compatible. You may also check out our specific guides for exporting from [Revit](#), [Archicad](#), [Rhino](#), and [SketchUp](#).

The step shows you:

- **Preview of the original file.** This is just a render and will help you check the converted file.
- **Converted file** within the support level of Spacemaker. Using this view you can check if everything went as planned or if you need to adapt your model. If you want to remove parts of the geometry you can select and delete it here before continuing to the next step.
- **Geometry errors** check the lower left corner on the right side for any geometry errors. Click to see where the errors are.
- **Geometry conversion.** Select either "Keep complexity" or "Keep editability" to allow for different kinds of geometry requirements for you model.
 - Try out the different sub-modes and see if any of them solve your needs.
- **View Mode** allows you to change from a side-by-side view to an overlay where you can toggle the Preview and Converted Files on/off. This may help diagnose issues in a model.
- **Key figures** for the building volumes can help you diagnose if your model is converted as desired especially in regards to functions. Disabled in "Keep complexity".



OBJ files

For OBJ files you need to define the unit scale and coordinate setup as this is not part of the file. You will be prompted to do this before seeing the screen above. The difference between e.g.

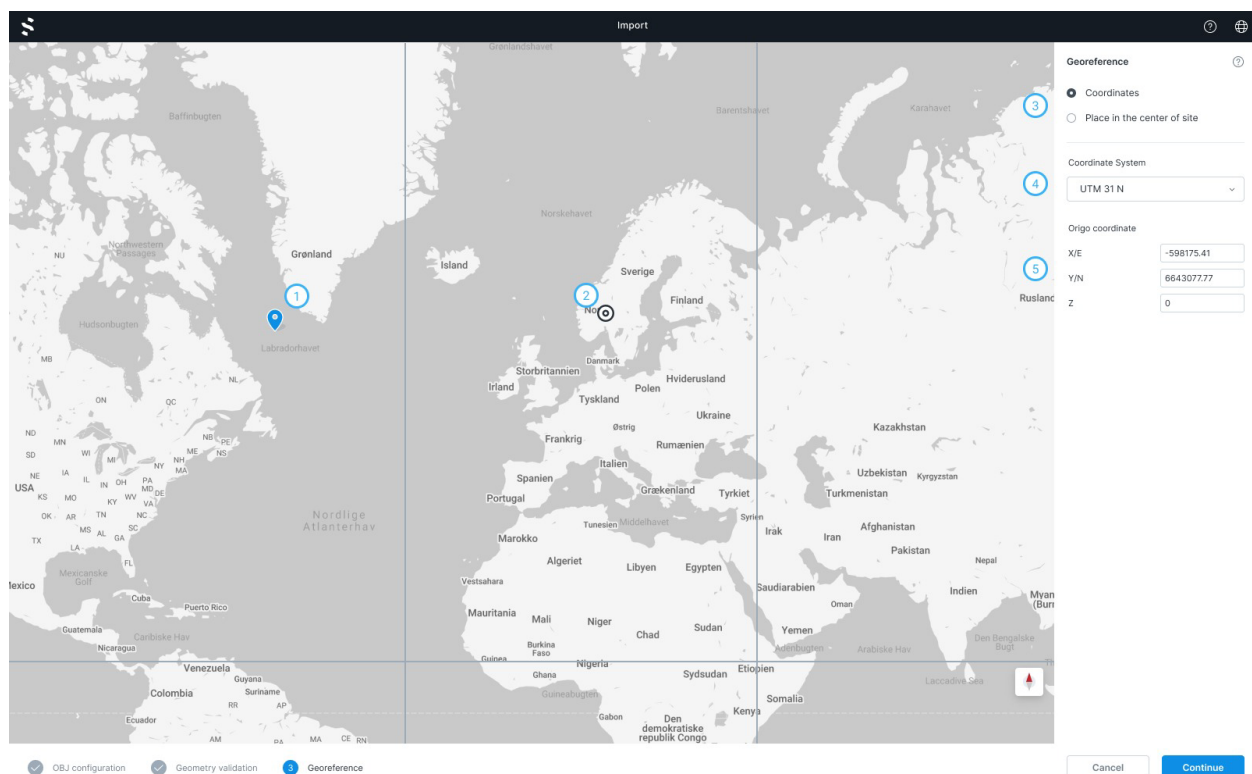
centimeters and meters is of course very large, so using the grid you can fact check your model. The squares in the grid are 10x10 meters.

3. Georeference the model

In order to get accurate analysis Spacemaker works with global coordinates. The final step then is to georeference your geometry i.e. place it in the world.

The step shows you:

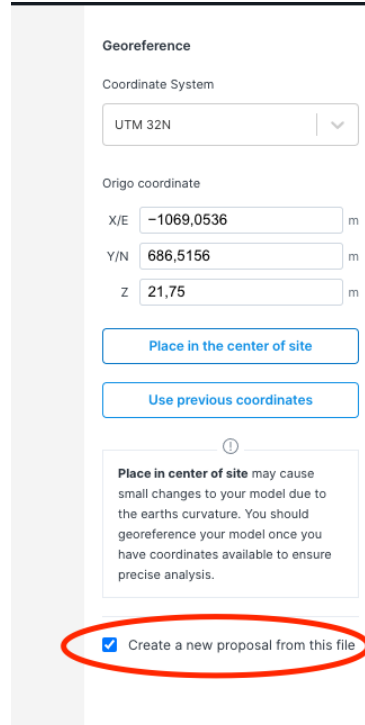
- **Geometry location** is shown with a blue pin
- **The location of the site** is shown with crosshairs.
- **Methods to place geometry.** The default is to use coordinates. If your file contains coordinates these will be entered automatically.
- **Select the coordinate system** using the dropdown.
- **Enter coordinates** for your project origo on the X, Y, and Z-axis.



The georeference step helps you get your geometry placed on site. In most cases, you will see your geometry placed on-site and simply need to confirm, but depending on the configuration used in the software of origin, sometimes you need to take more action.

Below are the main actions for georeferencing.

- **Coordinates** (preferred method) extracts coordinates from the imported file to place the model. If the file is not placed correctly, you may change the coordinate system and/or the coordinates. The example above shows a classic issue where the coordinates are correct, but the system chosen means the geometry is far from the site. Changing the coordinate system would fix this issue.
 - **Place in the center of the site** (alternative method) is a simple way to progress if you are not dependent on having the geometry placed in an exact place. You should georeference your model once you have coordinates available to ensure precise analysis.
- Note: Spacemaker will automatically recognize the coordinate system in this workflow because the Revit file was generated by Spacemaker add-on.



Georeference

Coordinate System

UTM 32N

Origo coordinate

X/E -1069,0536 m

Y/N 686,5156 m

Z 21,75 m

Place in the center of site

Use previous coordinates

Place in center of site may cause small changes to your model due to the earth's curvature. You should georeference your model once you have coordinates available to ensure precise analysis.

☒ Create a new proposal from this file.

When georeferencing later

If you used *Place In The Center of Site* or simply got updated coordinates you can always update the georeference. When in Asses you can use the context menu (the three dots) or right-click, and then select Georeference. From there you can update and publish the change.

4. Place your model in a proposal

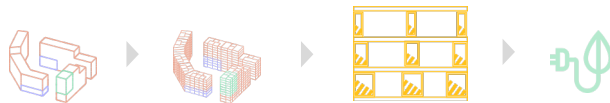
The default when importing is to create a new proposal with the model placed. You can change this by checking on or off the checkbox in the image below:

If you choose to not create a proposal, you can find the model in the Asset component. Go into "Design" to place the model in a proposal.

6. Find the best performing alternative

Similar to the *Go Wide* step you want to explore the solution room as much as possible. Importing and considering several plan layout alternatives based on the same envelope and using Spacemaker to discuss qualities and challenges with the other stakeholders allows you to not leave money on the table and measure granularly trade-offs. The plot in the demo is by the water, hence view was a determining factor, but you want to explore and discuss all qualities in your projects.

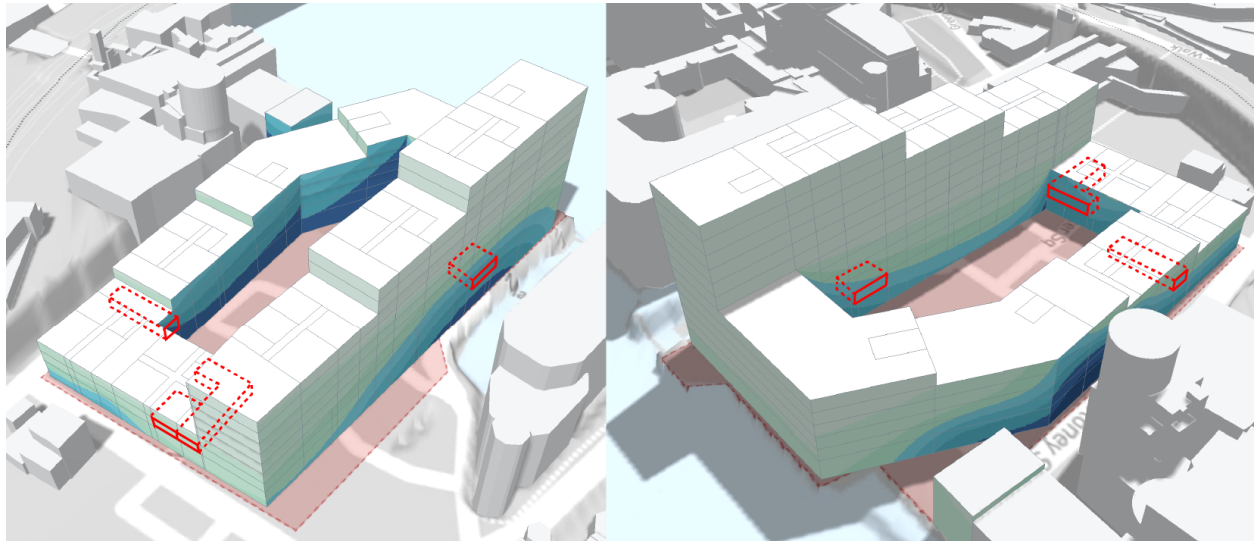
DAYLIGHT



7. Limit the scope	8. Correlate VSC performance with rooms and window configurations	9. Detail the facades accordingly
<ul style="list-style-type: none"> Identify representative apartments in Spacemaker according to the Vertical Sky component analysis 	<ul style="list-style-type: none"> Model representative apartments in Revit to get realistic depth of apartments Run multiple daylight analyses with different window configurations Synthesize VSC-room-window match in a table 	

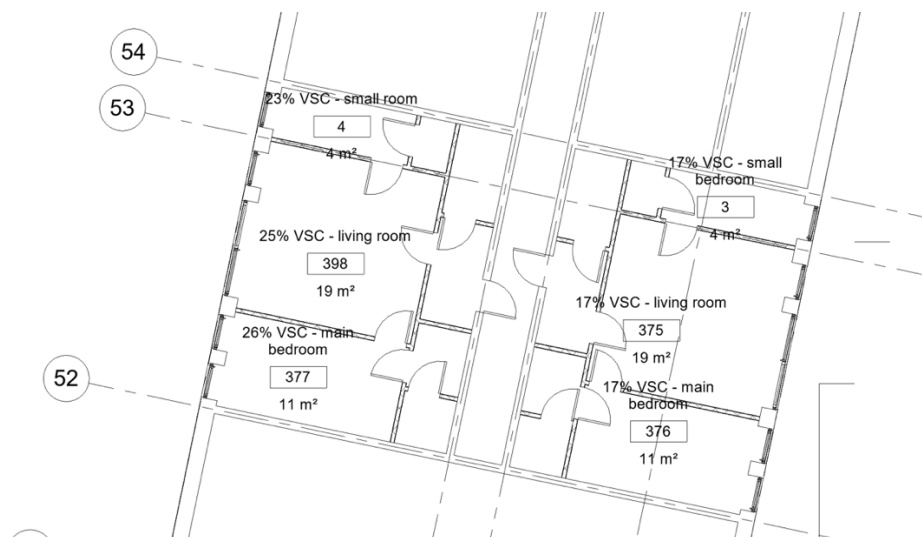
7. Limit the scope

Identify representative apartments in Spacemaker according to the Vertical Sky component analysis.



8.1. Model representative apartments in Revit to get realistic depth of apartments

Time is short in early-phase development; thus you need to be strategic where to spend your time. Focusing on some representative units and defining the depth and width of living rooms will allow you to better access daylight and extrapolate the findings to parts of the projects which you have not modeled.



8.2 Model Setup for Lighting Analysis

Agree on which standard and goals.



Global Certification Standards

Health and wellbeing

BREEAM International New Construction

Table 10: Minimum values of average daylight factor required

Building or area type	Average daylight factor required by latitude (degrees)						Minimum area (m ²) to comply		Other requirements
	≤ 40	40-45	45-50	50-55	55-60	≥ 60	1 credit	2 credits	
Residential dwellings (4 credits available**)									
Kitchen	1.5%	1.7%	1.8%	2.0%	2.1%	2.2%	-	80%	(b) in Table 11 on page 86
Living rooms, dining rooms, studies (including home offices)	1.2%	1.3%	1.4%	1.5%	1.6%	1.6%	-	80%	

Up to four credits - Daylighting (building type dependent)

4 Daylighting criteria have been met using either of the following options:

4.a The relevant building areas meet good practice daylight factors and other criteria as outlined in Table 10 on the next page and Table 11 on page 86

OR

4.b The relevant building areas meet good practice average and minimum point daylight illuminance criteria as outlined in Table 12 on page 86.

Our building is situated in London, UK and as such we have assessed it under the BREEAM method. Visual Comfort is assessed under HEA 01 (health and wellbeing). The daylight requirement is 2% average daylight factor for a residential dwelling in the latitude of London required over a minimum of 80% of the floor area.

Settings for Materials in Revit

Insight Lighting Analysis uses the RGB value of a glazing material in the Appearance tab within the Material Browser, to configure the visual transmittance (VT) percentage.

The RGB value and VT have a simple linear relationship e.g.

- 'Colour' RGB defines the Visual Transmission:

$$VT\% = RGB/255 \text{ (for example (127,127,127) would be 50\% VT)}$$
- 'Colour' RGB when R, G, and B are different define Visual Transmission with weighted RGB:

$$VT\% = ((0.2126 R + 0.7152 G + 0.0722 B) / 255) * 100$$

'Reflectance' affects performance but is only a concern when Reflectance % is close to 1 - VT%. Using a value from window specs, or the default 5 - 15% will yield accurate results. In either case, this should be the Reflectance of the interior side of the glass.

'Sheets of Glass' impacts the Visual Transmittance and should almost never be changed from the default value of '2'. The default value of '2' will have yield standard VT%, as it assumes that a glazing unit is 2-sided. The default value should only be changed in the very rare cases that the Revit element is non-standard, or the window family contains multiple modelled panes, and the VT definition is for the entire assembly.

For more information: [CRITICAL UPDATE - Glazing Materials for Lighting v4+ - Autodesk Community - Insight](#)

Element	Reflectivity	R	G	B
Ceilings	82%	210	210	210
Walls	51%	130	130	130
Floors	20%	50	50	50

Element	VT	R	G	B
---------	----	---	---	---

Glass	75%	190	190	190
-------	-----	-----	-----	-----

Type Properties

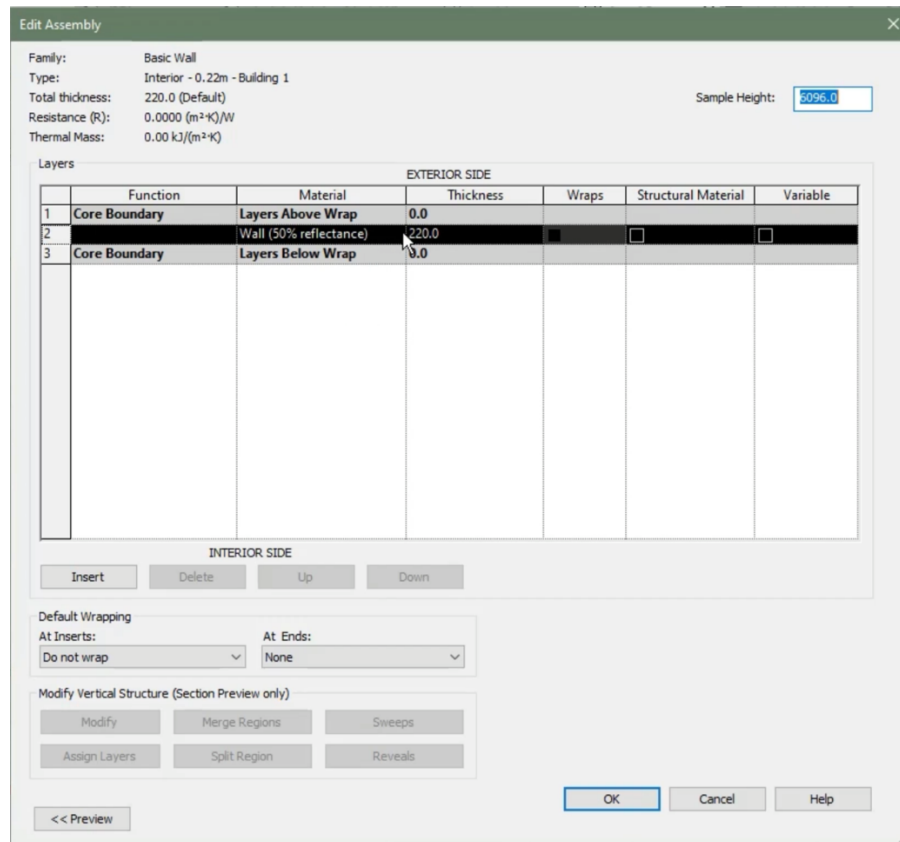
Family: System Family: Basic Wall Load...

Type: Interior - 0.22m - Building 1 Duplicate... Rename...

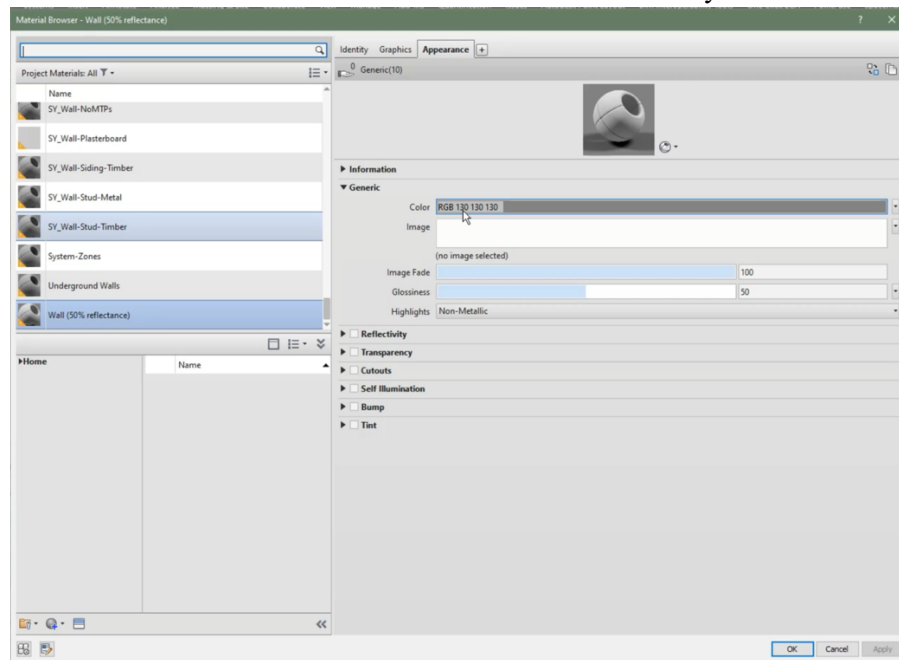
Type Parameters

Parameter	Value	=	^
Construction			
Structure	Edit...		
Wrapping at Inserts	Do not wrap		
Wrapping at Ends	None		
Width	220.0		
Function	Exterior		
Graphics			
Coarse Scale Fill Pattern			
Coarse Scale Fill Color	Black		
Materials and Finishes			
Structural Material			
Analytical Properties			

Edit structure under the construction in the type properties



Edit the outer material to correct reflectivity

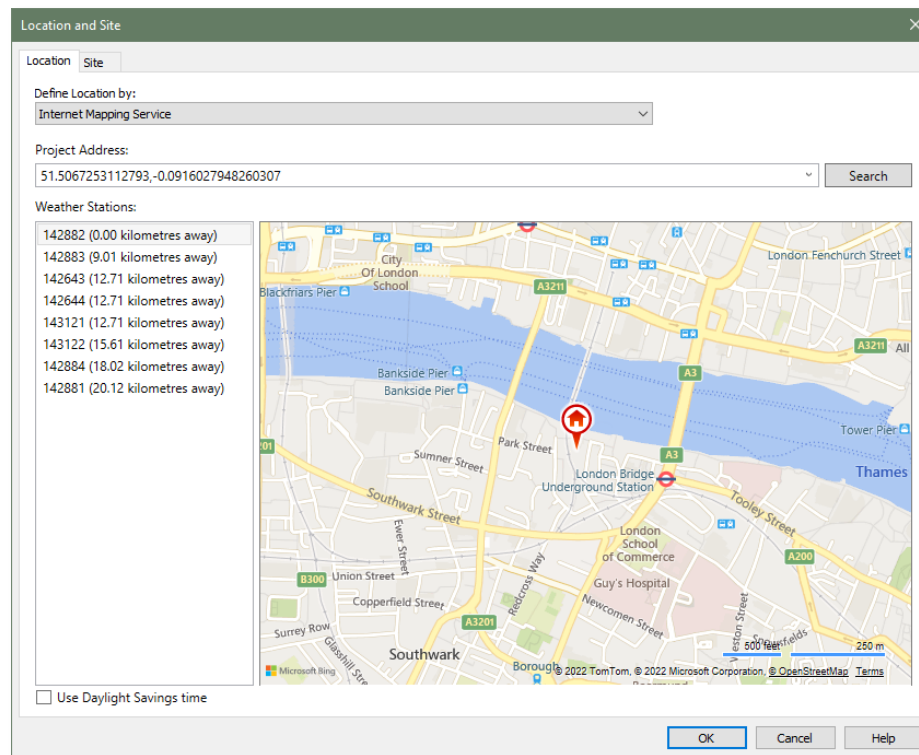


Setup correct RGB to define Reflectivity and VT

Project Geographic Location

Before any modelling begins, it is recommended to first specify its geographic location. This establishes the projects' real-world location. This can be done using the address, nearest major city, or latitude and longitude. For energy analysis, select a nearby weather station from the list.

Note: To see weather stations in the map and list, you must be signed into your subscription-enabled Autodesk account. For more information: [Help | Specify the Geographic Location | Autodesk](#)



Setup location

Rotate True North

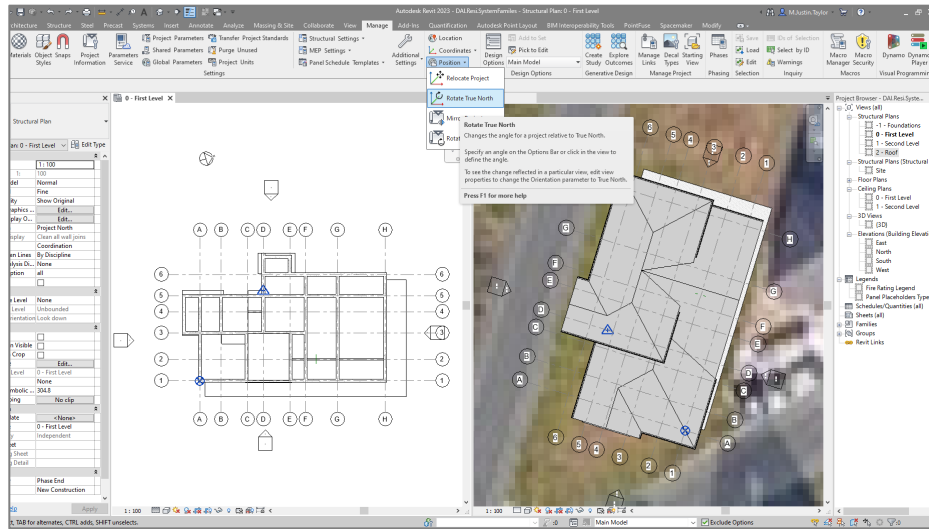
Once the project geographic location has been set, specify the direction of True North. This is the real-world direction based on site condition.

Tips: Once True North has been defined, place a North Arrow annotation symbol in the site plan before switching back to Project North.

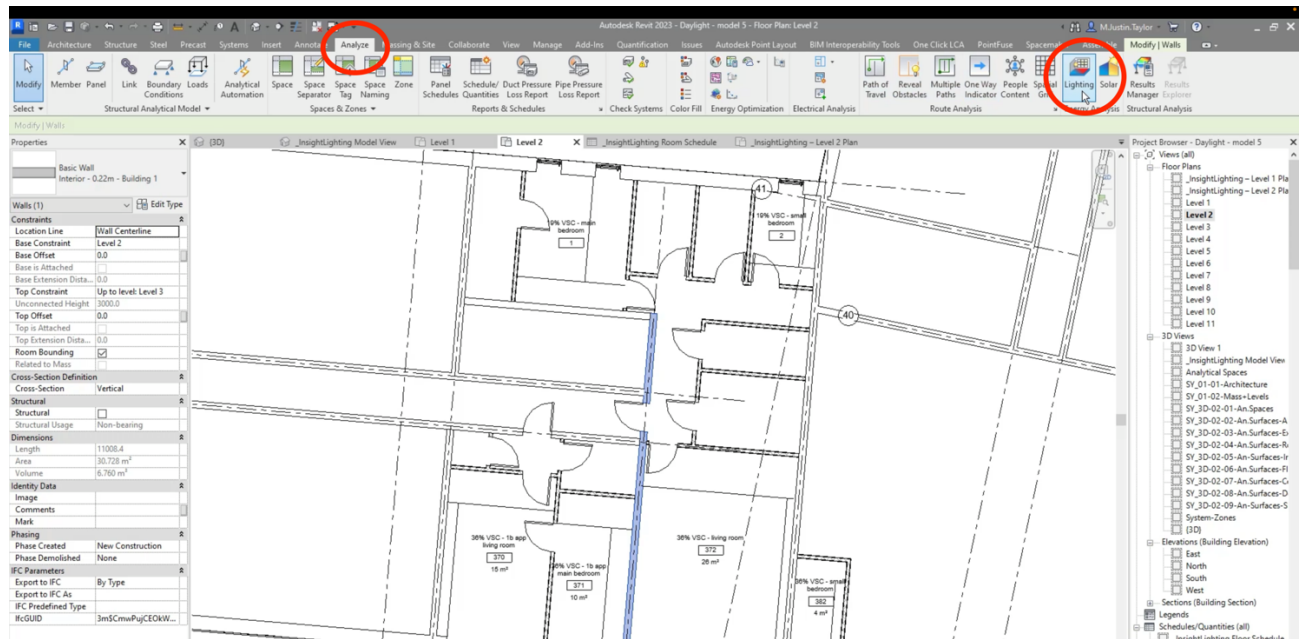
Some users find it less confusing to begin modelling before rotating True North.

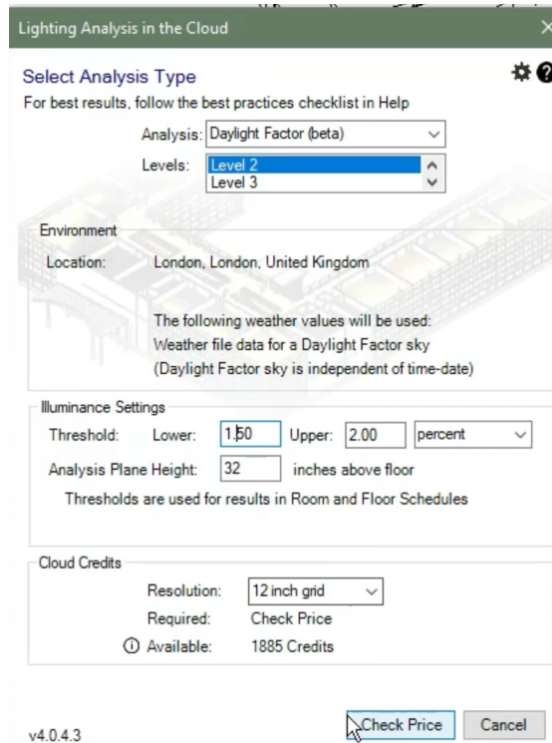
Both project geographic location and true north affect the results of solar studies and energy analysis.

For more information: [Help | Rotate True North | Autodesk](#)



Run Lighting Analysis in the cloud





Lighting Analysis in the Cloud

Select Analysis Type
For best results, follow the best practices checklist in Help

Analysis: Daylight Factor (beta)

Levels: Level 2, Level 3

Environment
Location: London, London, United Kingdom

The following weather values will be used:
Weather file data for a Daylight Factor sky
(Daylight Factor sky is independent of time-date)

Illuminance Settings
Threshold: Lower: 1.50 Upper: 2.00 percent
Analysis Plane Height: 32 inches above floor
Thresholds are used for results in Room and Floor Schedules

Cloud Credits
Resolution: 12 inch grid
Required: Check Price
Available: 1885 Credits

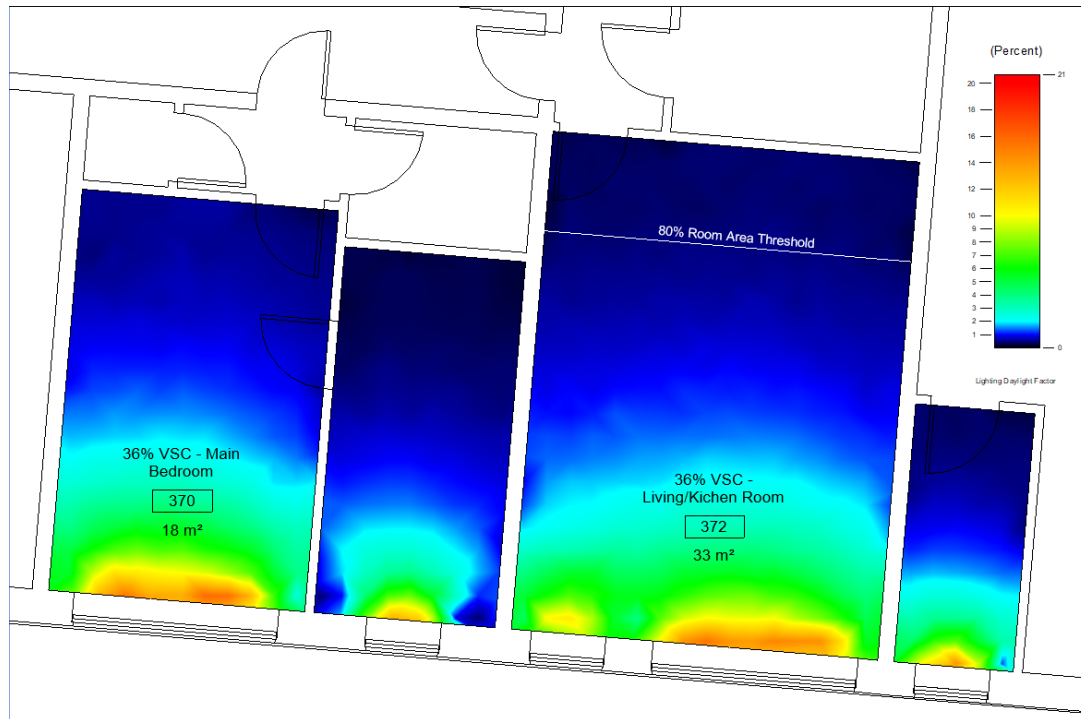
v4.0.4.3 [Check Price](#) [Cancel](#)

Lighting Analysis settings

8.3 Synthesize VSC-room-window match in a table

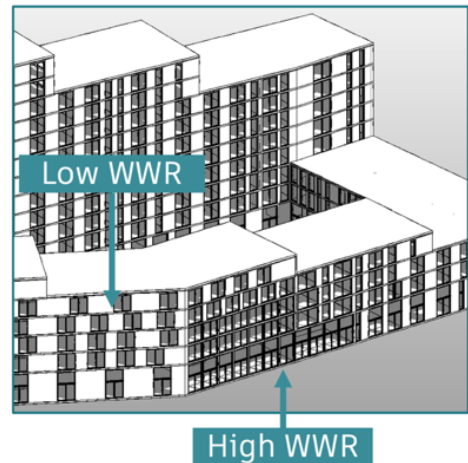
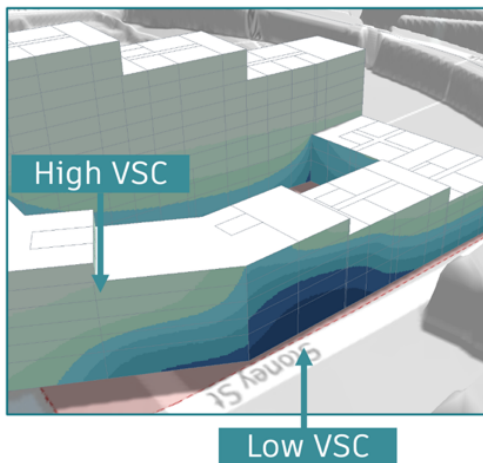
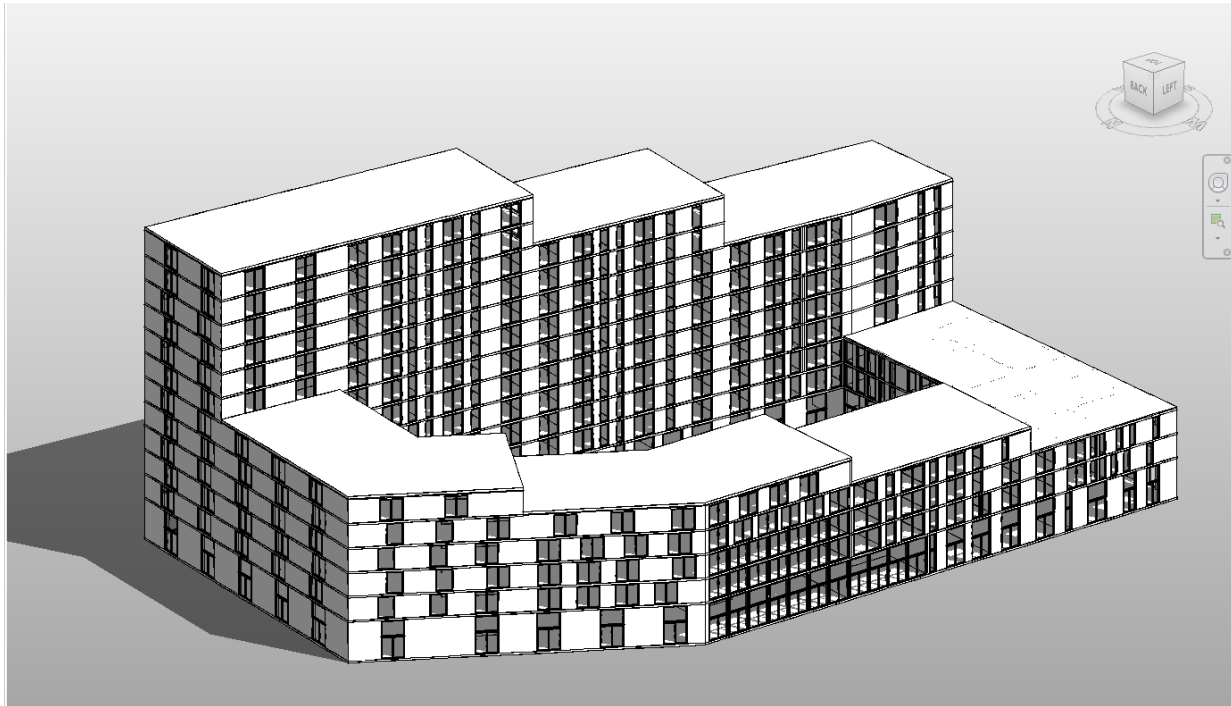
Create several copies of your revit model with different window configurations. Run a daylight analyses for each model and map which window configuration gives a result above the threshold. The table below is only relevant for residential projects with a central corridor typology for building about 16 meters wide located in the London latitude. However, you can develop your own tables for the typologies and geographies where you operate.

<Model 01_InsightLighting Room Schedule>												
Daylight Factor Whole Building Results: London, London, United Kingdom												
13% of points are between 1.5-2.0% (Building ADF is 2.5%)												
Daylight Factor Sky (unshaded horizontal 100%)												
A	B	C	D	E	F	G	H	I	J	K	L	M
Level	Name	Number	Area	Include In Daylighting	Automated Shades	DF Sky threshold results						ADF %
						within threshold	above threshold	below threshold				
						%	Area	%	Area	%	Area	
Level 2	36% VSC - Living/Kichen Room	372	33 m²	<input checked="" type="checkbox"/>	<input type="checkbox"/>	6	2 m²	30	10 m²	63	21 m²	2.1



Room	size	VSC	big window	small window	ADF %
Living room	24 m2	17	2750x2750	1300x2750	2.2
	24 m2	25	2750x2750		2.0
	33 m2	27	2750x2750	1300x2750	2.4
	18 m2	36	2750x2750		3.1
	33 m2	36	2750x2750		2.6
Main Bedroom	14 m2	15	3100x2750		2.4
	14 m2	17	2750x2750		2.2
	15 m2	19		1300x2750 x2	2.8
	14 m2	26		1300x2750 x2	2.6
	12 m2	36		1300x2750	2.6
Small bedroom	5 m2	10		1400x2750	2.0
	6 m2	17		1400x2750	2.0
	6 m2	19		1300x2750	2.2
	6 m2	23		1000x2750	2.2
	6 m2	36		1000x2750	2.5

Apply the table to the whole Revit model.



ENERGY



10. Understand baseline

11. Explore optimization opportunities in insight to reduce operational energy

12. Conclude on energy production potential and PV placement

10. Understand baseline

Insight Energy Analysis allow users to select from three option.

Working from the top down these are:

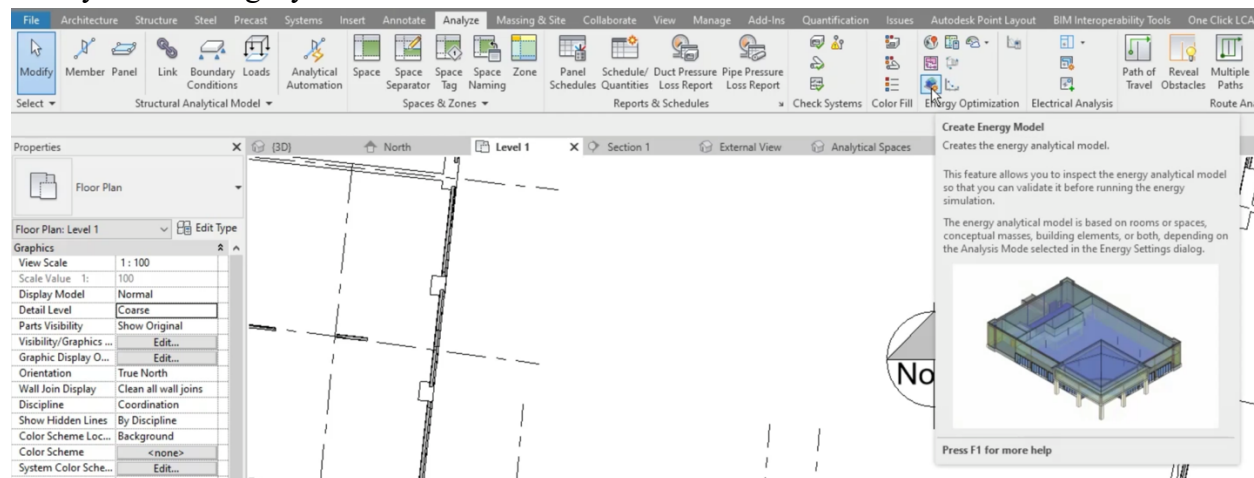
- **Conceptual** – are the default
- **Schematic** - where enabled, override conceptual types
- **Details Elements** - where enabled and where material thermal properties are specified for building elements, override both conceptual types and schematic types.

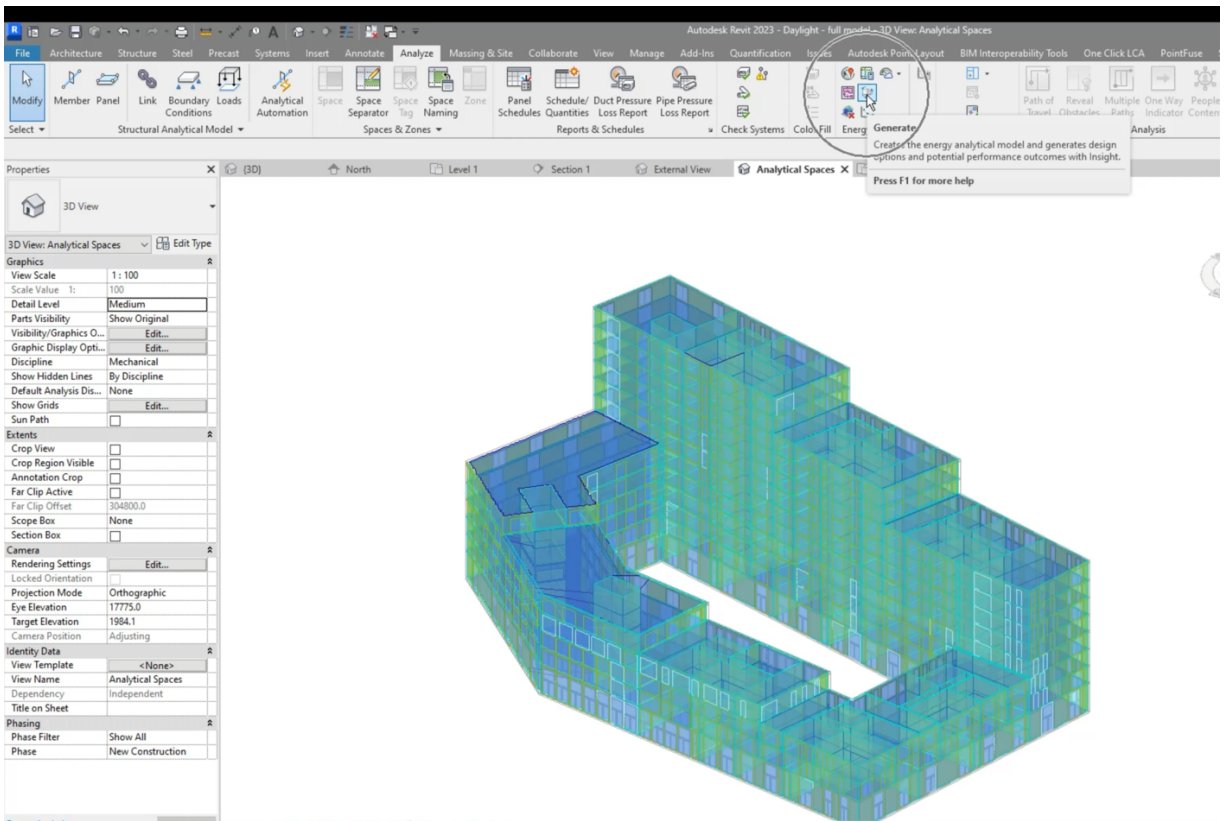
Note: detail elements was the option in this demonstration. For more information: [Help | Advanced Energy Settings | Autodesk](#)

Create the Energy Analytical Model

One of the keys to fast and successful energy optimization is the automatic creation of a complete and accurate energy analytical model directly from an architectural model.

This approach means that no special model authoring is required for analysis. It works with a variety of modeling styles and levels of detail.





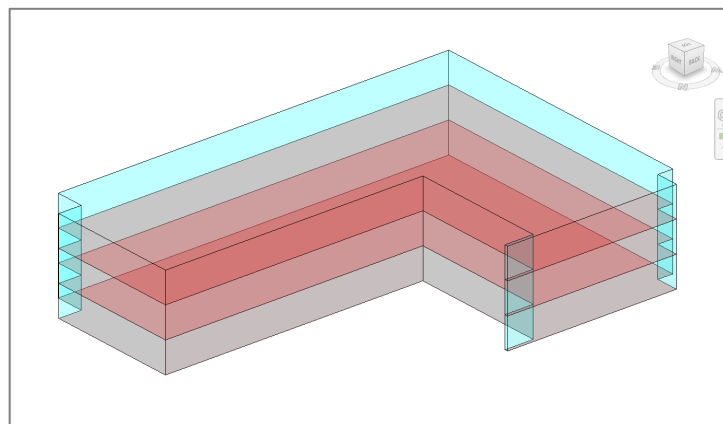
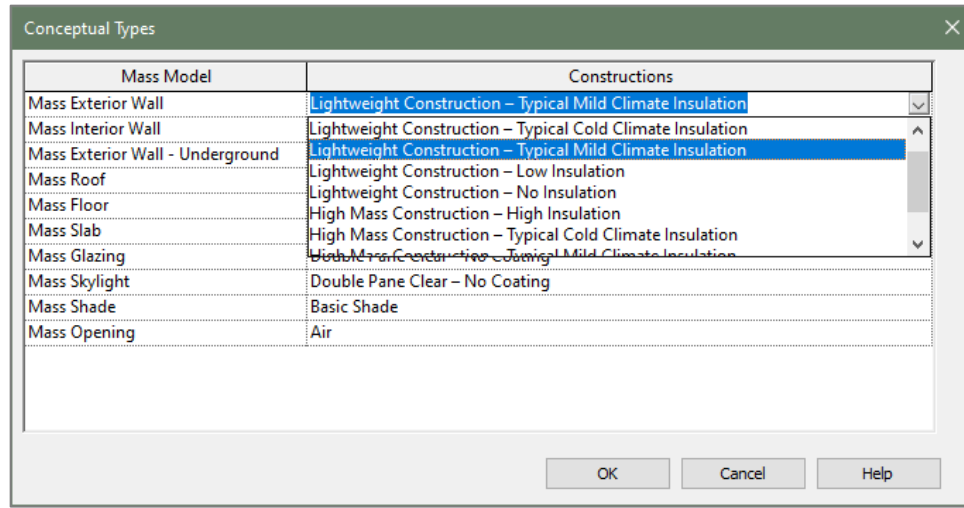
Revit offers 3 approaches for automatically generating an energy analytical model from an architectural model: Massing, Mixed design, Detailed Elements

Massing

One of the keys to fast and successful energy optimization is the automatic creation of a complete and accurate energy analytical model directly from an architectural model.

This approach means that no special model authoring is required for analysis. It works with a variety of modeling styles and levels of detail.

Revit offers 3 approaches for automatically generating an energy analytical model from an architectural model.

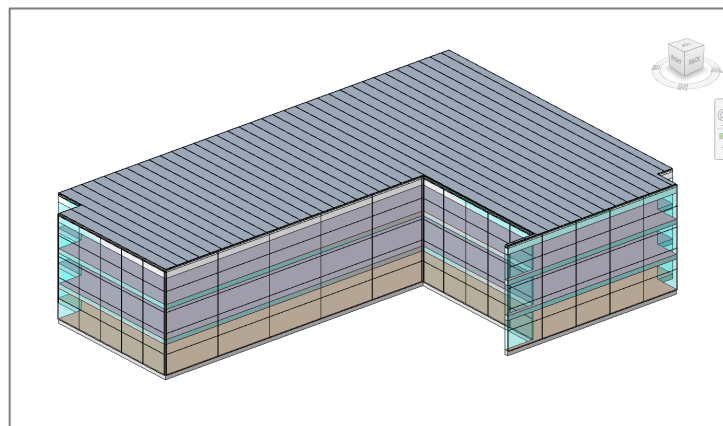
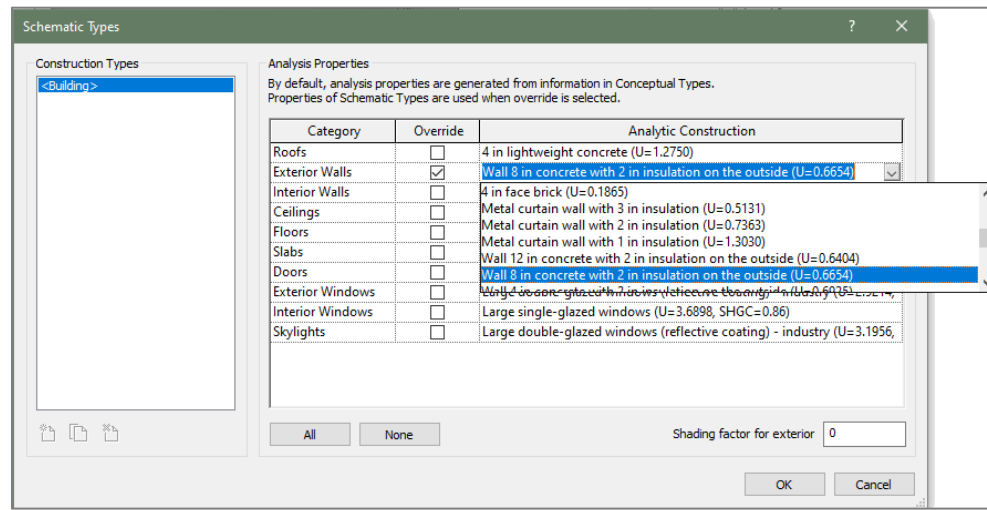


Mixed Design

Schematic thermal property material types define thermal properties for building elements during schematic design.

Subsequent energy analyses then use the corresponding thermal properties, which provide more detailed information than the default conceptual types.

For more information: [Help | Create the Energy Analytical Model: Mixed Design | Autodesk](#)



Detailed Elements

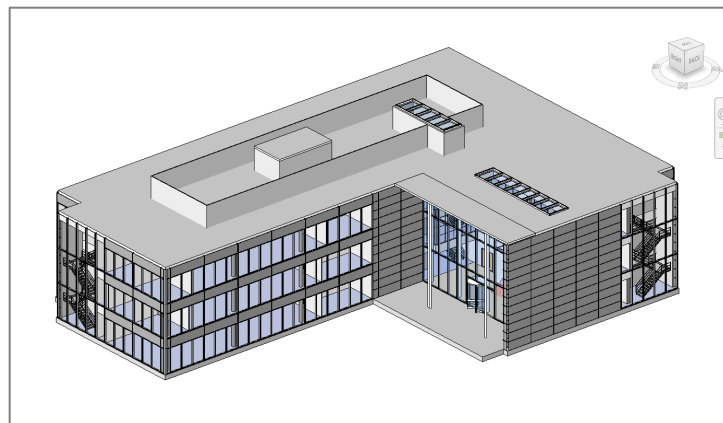
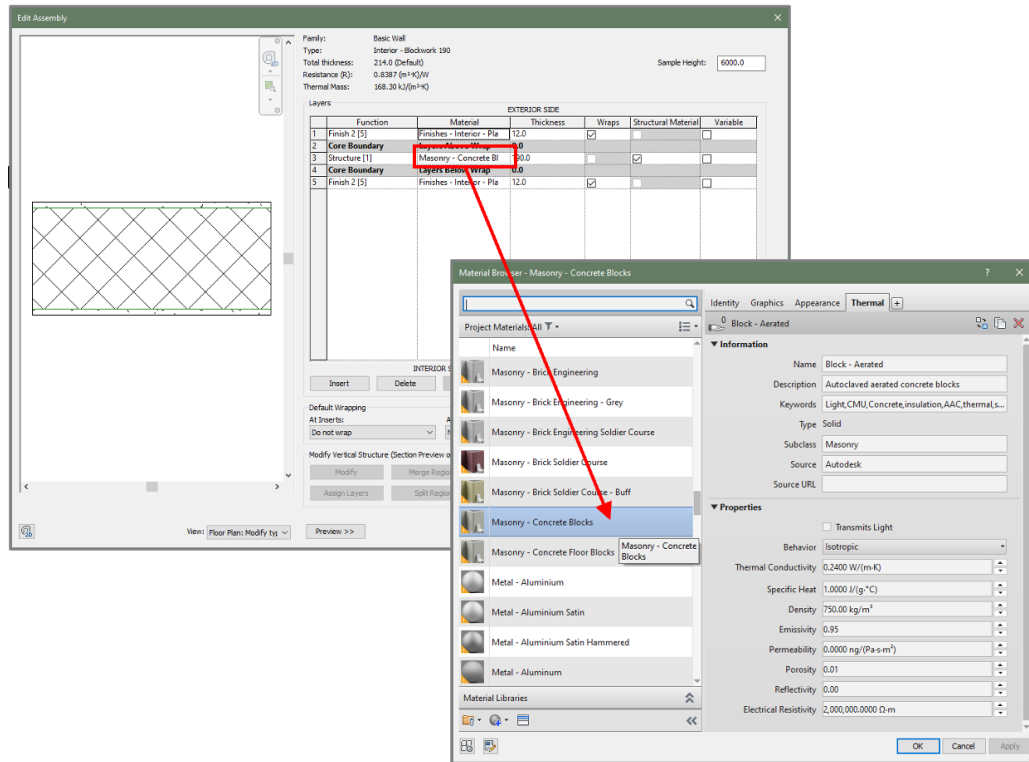
When you want to perform energy analysis for a Revit model that contains building elements such as floors, walls, and roofs, you can use material thermal properties from the detailed elements.

The thermal properties associated with the building elements are then used during energy analysis to provide more realistic results.

Note: This information is only used if the 'use detailed elements' checkbox is enabled. It is important to ensure that all properties are assigned.

For the thermal properties of windows and curtain walls, these are contained in the relevant families Type Properties.

For more information: [CRITICAL UPDATE - Glazing Materials for Lighting v4+ - Autodesk Community - Insight](#)



Energy Model Validation

Using the predefined schedules, check that all the building elements have thermal properties assigned. Orbit the model and visually inspect the building envelope for anything which is obviously missing or where there are large gaps i.e., missing floors, soffits, ceiling voids, roofs, walls, interfaces (shared walls) with adjacent structures.

Fix any gaps by modifying the model e.g., where walls do not meet the underside of a roof, use Attach Top/Base etc.

If the combined analytical spaces and all the analytical surfaces makes seeing the model difficult, you can deselect surfaces in the Visibility Graphics> Analytical model Categories. This will allow you to more clearly see where gaps may exist

	Description	Evaluation Criteria
Circuits Have Rooms	Checks models for closed boundaries in which have no rooms placed.	Identifies any Circuit which does not have a room placed in it.
Glass/Glazing Transparency	Checks models for elements with material that will be considered a solid panel when used for Energy Analysis.	Checks whether the transparency value of materials is set to 3% or lower.
Room Calculation Settings	Checks models for necessary room calculation settings.	Verifies the Compute Volumes options are selected properly under Settings->Area and Volume Computations->Computations and the radio button Areas and Volumes is chosen.
Enclosing Rooms	Checks models for 2d or 3d Room Envelope and compares if another room is overlapping or enclosed within its boundaries.	Uses bounding boxes and intersection points to determine enclosing.
Room Height Levels	Checks models for rooms which height does not go to the appropriate boundary above (level, roof or ceiling).	Compares room height and levels it is associated with.
Room Inner Boundaries	Checks models for rooms with inner boundaries, which can cause problems with energy analysis software.	Determines if inner boundaries exist in a room (such as interior rooms, columns or free-standing walls).

Understanding the Energy Analytical model

When you use the Create Energy Model tool, Revit creates 4 views to help you understand the geometry of the energy analytical model.

- Analytical Spaces view
- System-Zones view
- Analytical Spaces schedule
- Analytical Surfaces schedule

Note: To enhance your understanding of the energy analytical model, create duplicate views of the Analytical Spaces view and adjust the Visibility/Graphics settings. In one duplicate view, for example, you may want to hide all model elements (clear the Visibility check boxes for all items listed on the Model Categories tab) and display only analytical surfaces.

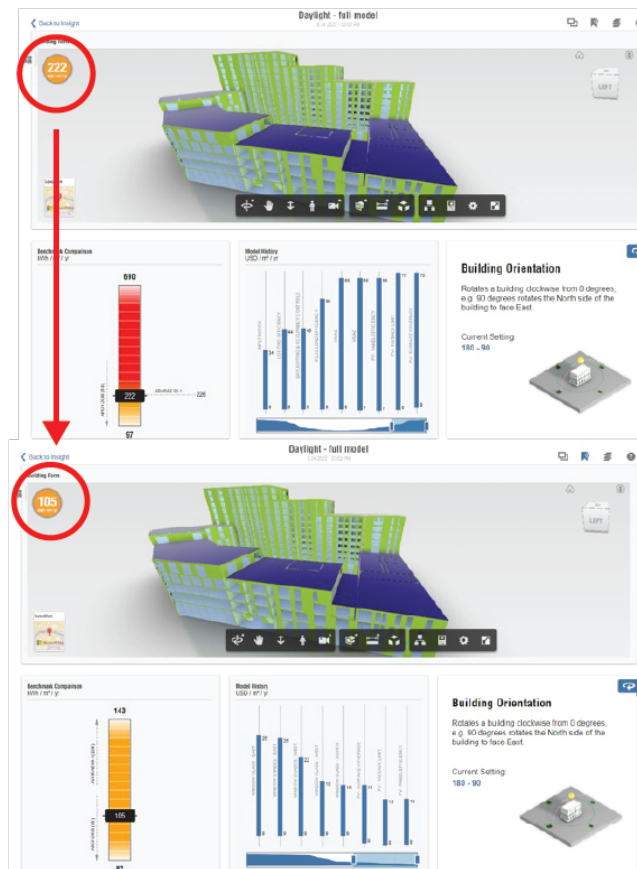
For more information: [Help | Understanding the Energy Analytical Model | Autodesk](#)

11. Explore optimization opportunities in insight to reduce operational energy

After using Energy Optimization for Revit to create an energy analytical model and perform energy analysis, use Autodesk Insight to understand, evaluate, and adjust design and operational factors to improve performance.

- **The Energy Cost Range** represents the performance of your design. Edit factors to improve the performance
- **The Benchmark Comparison** compares your results to common benchmarks. Update geometry/factor settings to improve performance.
- **The Model History** shows the performance history of your model. Click on the bars to view model details. Adjust sliders to limit range

For more information: [Help | Advanced Energy Settings | Autodesk](#)



The Energy Cost Range is a roll-up measure that represents the average performance of your design.

- Roll over the tick marks to better understand the range of performance
- Roll over the square and triangle to understand benchmark comparison.

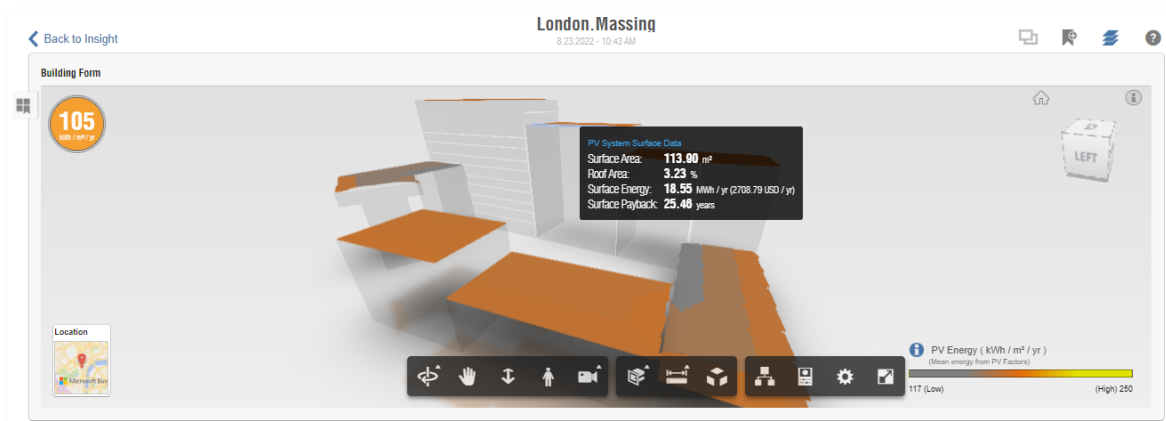
Factor Design Options and Editing, represents the range of performance for factor design options.

- Click and drag the slider to edit the range selection
- When unsure, use a range that best approximates your knowledge of the option



12. Conclude on energy production potential and PV placement

Insight shows us a detail break down of the roofs in the building and the PV potential of each one including payback time. This allows us to make informed decisions on exactly where to place PV arrays and also what percentage of the roof can be utilized.



Project Data:

Revit Net Floor = 216,430m²

Operational energy requirement 109 kWh/m²/yr. = 2,880 MWh/yr.

Potential energy generation through PV 532 kWh/yr.

Looking at the energy requirement of our building and the potential energy that could be generated via PV, we can provide 18.5% of the building's requirement through solar.

Bonus - Revit Analysis Template

Families and Materials

Project templates provide a starting environment and standards for new model.

It's best practice for a template to contain:

- Annotation families
- Title blocks
- Viewport types
- Content (most used system families)
 - Walls
 - Floors
 - Ceilings
 - Roofs
 - Curtain walls
 - Curtain panels
 - Mullion/Profiles
- Views/Schedules/Sheets
- View types/Browser sorting
- Filters
- View templates
- Line styles
- Object styles/Line weights

For more information: [Best Practices: Project Templates | Autodesk Knowledge Network](#)

Energy Model Validation

The Revit template also contains predefined:

- Schedules - configured to help designers ensure that building elements have all the relevant properties applied for performance analysis
- 3D Analytical Spaces and Surfaces Views – allowing designers to validate the analytical model prior to analysis
- Energy Model Validation 3D view and View Filter.

Note: the View Filter only displays the elements which support the energy analysis process in Insight.