

AS500351

Accelerate Your Project Planning and Design Process with Spacemaker

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Spacemaker/ Autodesk

Learning Objectives

- Spacemaker as a product
- Use cases
- How to:
 1. Create project
 2. Setup constraints
 3. Import a 3D model and a site plan
 4. Interpret daylight
 5. Outcome-driven design with Spacemaker

Description

Spacemaker is an easy-to-use software for outcome-driven design in the early stages of AEC projects. The software enables planning and design teams to create an optimal proposal for a building site based on physical data, site constraints, regulations, and local preferences. This class will present a case study in which the Spacemaker team worked with a leading real estate developer to revolutionize the site development process. In this example, Spacemaker was used by NREP Denmark and Årstiderne Arkitekter in developing the 35 000 m2 UN17 Village. The entire project team used Spacemaker's outcome-driven design capabilities to perform design exploration, test regulatory requirements, and optimize site qualities such as wind, sun, daylight, noise, and outdoor areas. The 3D model in Spacemaker served as a single source of truth for the entire project team.

Speaker



Daniel Gameiro is a tech-savvy architect with a 7-year experience in Real Estate Development and Sales in renowned companies like Reiulf Ramstad Arkitekter, Spacemaker, and Autodesk.

He founded a non-profit that developed humanitarian projects in Europe, Africa, and the Americas in his formative years.

His contributions at Spacemaker include the best practice method entitled The Spacemaker Way; instituting outsourcing processes to scale the customer success and technical sales teams; and assisting with the acquisition process driven by Autodesk.

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Spacemaker as a product

Spacemaker is a cloud-based AI software, empowering teams to collaborate, analyze and design real estate sites. From feasibility to site acquisition, Spacemaker empowers you to make confident data and insight-driven decisions, design faster and smarter, and create high-quality, high-value sites. It is a Software as a Service. It has four main facets:

Automated data

Spacemaker lets users automatically create a 3D representation of a site and the world around it, fetching data automatically (terrain, existing/adjacent buildings, roads, and rails including noise, property data etc). And it does it fast; rather than spending a day or two setting this up, it happens in seconds/a few minutes. Then it lets you easily put in place necessary constraints, giving you a strong starting point for work on a site.

AI-powered design AU

You can explore and test feasible strategies to develop a site. Spacemaker allows you to draw proposals as you were doing it by hand, or let our AI generate solutions based on the site and the constraints that have been set. As a side note, you can also import existing proposals (from e.g Revit or Rhino) into Spacemaker. The goal is to broaden your solution room in a way that traditional tools do not allow.

Real-time analysis

Spacemaker allows you to do outcome driven-design. Simulate and predict the impact of your proposals with detailed and accurate analyses of 100+ decisive criteria and constraints in real-time, incl. geometry, outdoor area, sunlight, noise, wind, daylight, view, heat islands, and more.

Collaboration

Work with the entire planning team and regulators in ONE platform on the same digital models. We strongly believe in the power of collaboration and allowing architects, real-estate developers, project managers, engineers, and even planning authorities to collaborate closely as a team, with a fact-based dialogue.

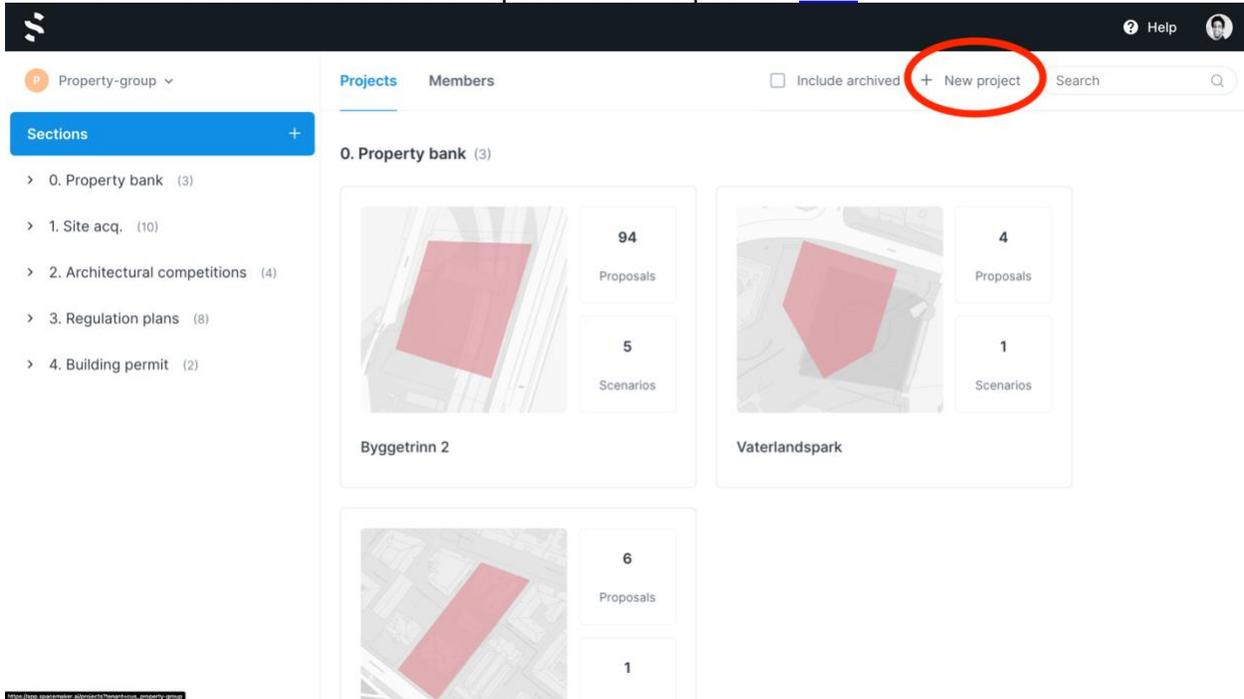
Use-cases

Here is a brief overview of what our platform is used for by our customers:

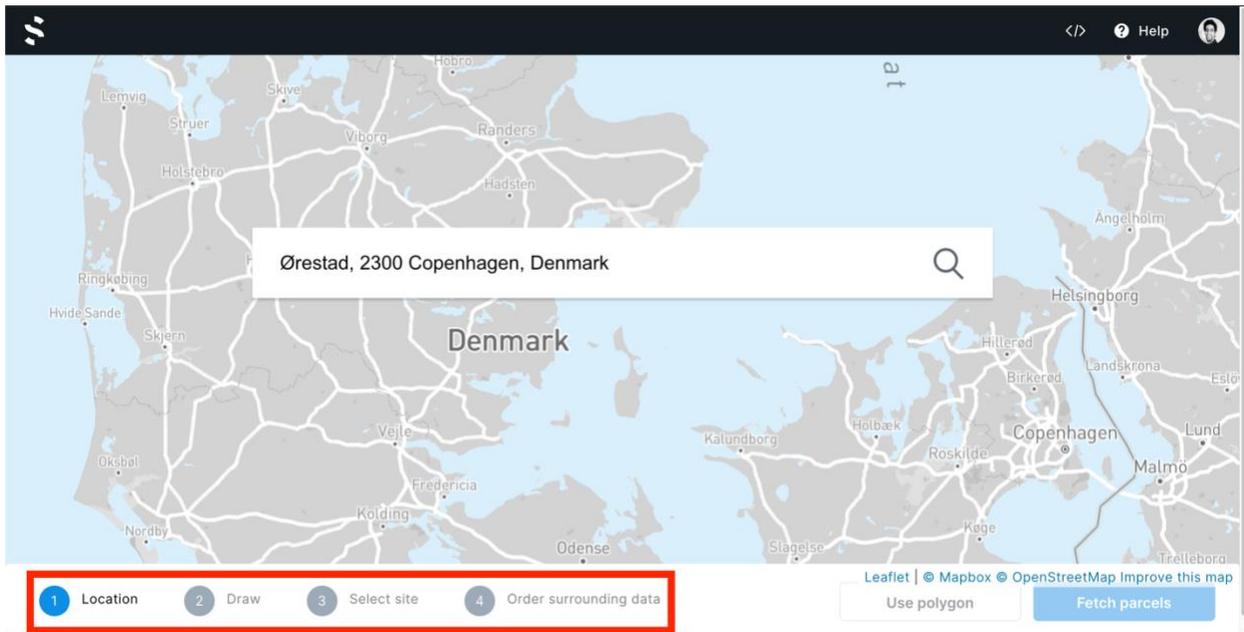
- **Site acquisition.** Spacemaker allows you to understand, screen and evaluate many sites in a very short amount of time.
- **Project or site development.** You can reach the optimal utilization of a site, with the best possible living qualities.
- **Dialogue with planning authorities.** The project team can communicate efficiently and fact-based with the regulator, and iterate fast on the feedback, even during meetings. You can also document how your proposal affects and is affected by neighbouring development projects.

Create a project

See the last version of this article on Spacemaker helpcenter [here](#).



1. Login at [Spacemakerai.com](https://www.spacemaker.ai/projects/new?ref=ai_property_group) and click new project



2. Follow the menu below to order all available data

Setting up constraints

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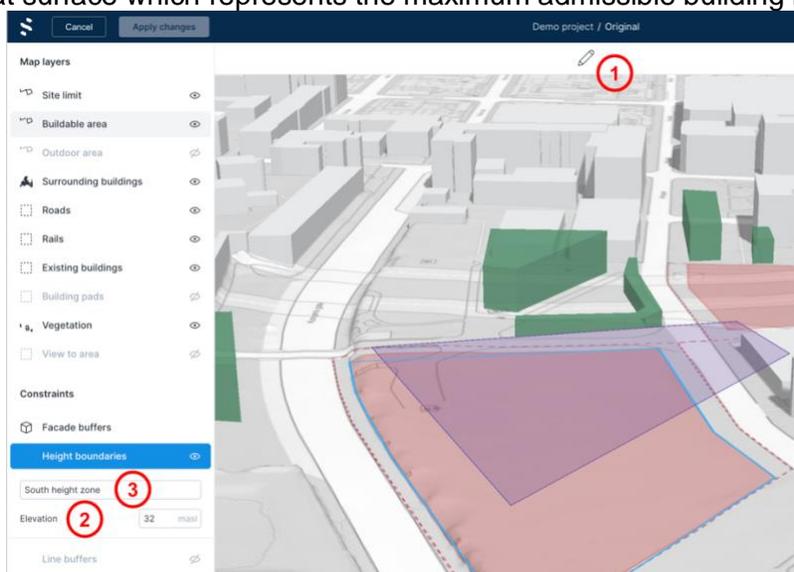
When designing a proposal, it can be painstaking work to make sure that your buildings conform to the different constraints on what is permissible to build on your site. To solve this need in an easier way, we have created a feature that automatically keeps track of a set of geometrical constraints so that you can focus on your design!

The geometrical rules are defined in Setup, and give you insights while you work in Design, by activating the “Constraint review” section in the right side panel. Once the review is activated, any building that violates one of the rules will be marked with a red outline. In addition, the individual rules have 3D visualizations that will help you see exactly how the rules are violated. These visualizations can of course be toggled off when you don’t need them. There are currently three types of rules:

- **Height boundaries:** areas: where buildings cannot exceed a certain height
- **Line buffers:** polylines which the buildings must keep a certain distance from (where the distance is dependent on the heights of the buildings)
- **Facade buffers:** the facades of buildings must keep a certain distance apart (where the distance is dependent on the heights of the buildings)
- **Facade distance:** the facades of buildings must keep a certain distance apart (where the distance is constant)

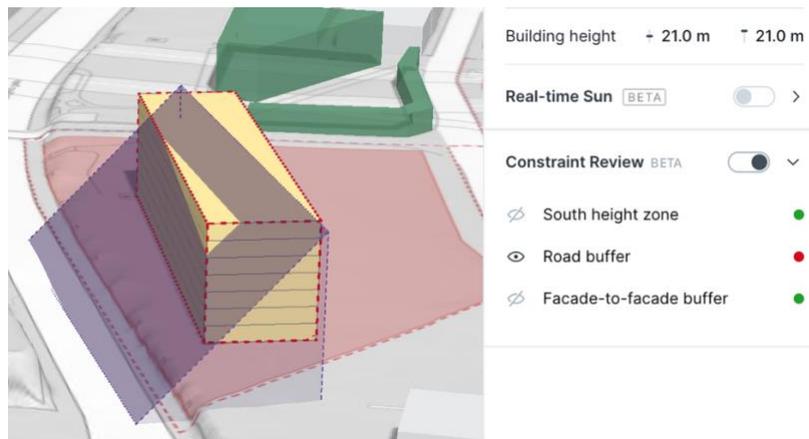
In Setup, the different rule types can be found under “Constraints” in the left side panel. Height zones and line buffers are defined by geometric objects, so to add one of these rules, you select the appropriate rule type and activate the draw tool (1). After drawing your shape, you can set the rule parameters (2) and name the rule (3).

For height boundaries, you draw a polygon and set an elevation in meters above sea level. This defines a flat surface which represents the maximum admissible building height.



For line buffers, you draw a horizontal polyline with one or more segments. The line will default to be positioned at the terrain level, but you can choose to adjust elevation yourself if you want. Since the buffer distance is dependent on building height, each line segment will produce a sloped surface that buildings should not cross. The slope of the surface can be adjusted by changing the “Height ratio” parameter.

This is defined so that at a certain distance (D) from the line, buildings are allowed if they are not taller than D times the height ratio. In other words, the allowed height (H) at distance (D) from the line is given by $H = (\text{height ratio}) * D$. This means that a ratio of 1 results in a 45-degree slope.



Facade buffers are not defined by a static geometric object, but rather between facades on buildings. It is a rule for making sure there is sufficient space between buildings. The minimum distance allowed between buildings facing each other is dependent on the building heights. The only required input is a “Height Ratio”, similar to how line buffers work. The facade buffer rule differs from the previous ones in that it is not a fixed constraint, but rather dependent on the buildings themselves. Therefore it is only visualized in cases where the rule is being violated.

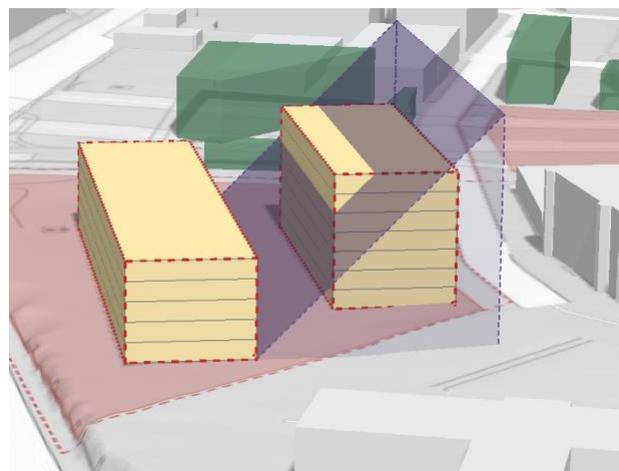
Constraints

 Facade buffers

+ Add facade buffer

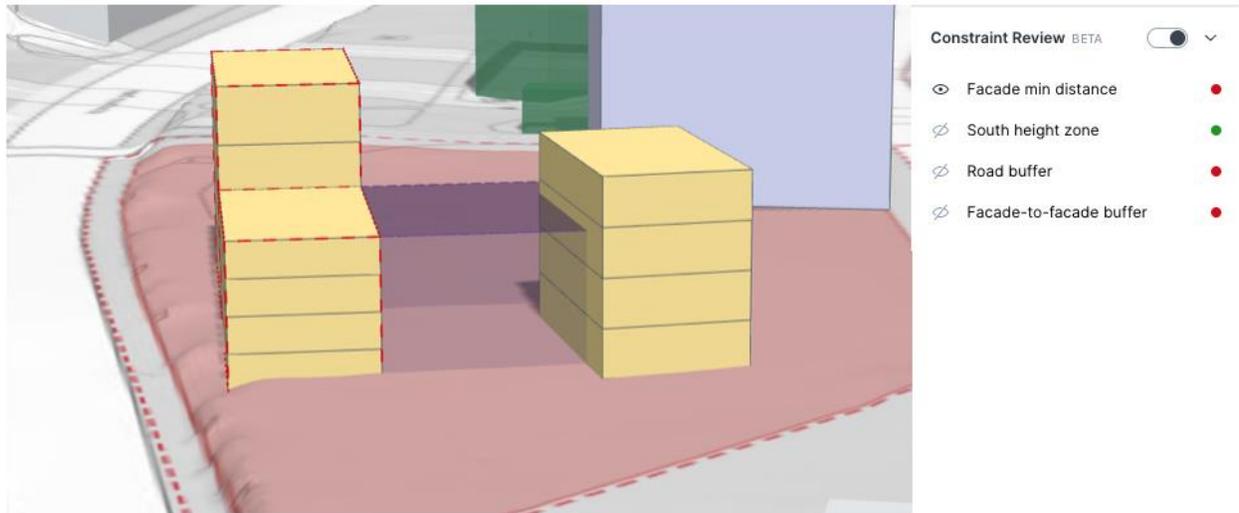
Height boundaries 

Line buffers 

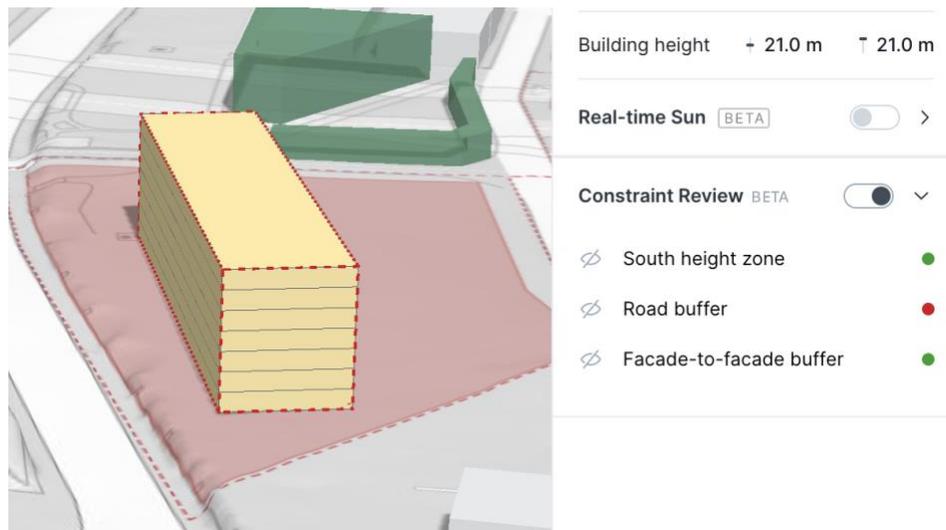


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Facade distance ensures that all facades are separated by more than a defined minimum distance without considering building heights. Like the Facade buffer rule, visualizations only occur at facades that violate this constraint.



Once you have configured the rules you want to adhere to, they will be available in Design under the Constraint review section in the right-side panel. By turning on constraint review, you will see the list of active rules, and all buildings that break any of the rules will be marked with a red outline.



In the list of rules, you can turn on and off the visualization for each rule by clicking on the eye icon. Regardless of visualization, **every rule will have a red or green circle indicating whether that rule is broken by some building in the proposal.** If we turn on visualization for the broken line buffer rule, we can see clearly where and how the rule is broken.

Import a 3D model

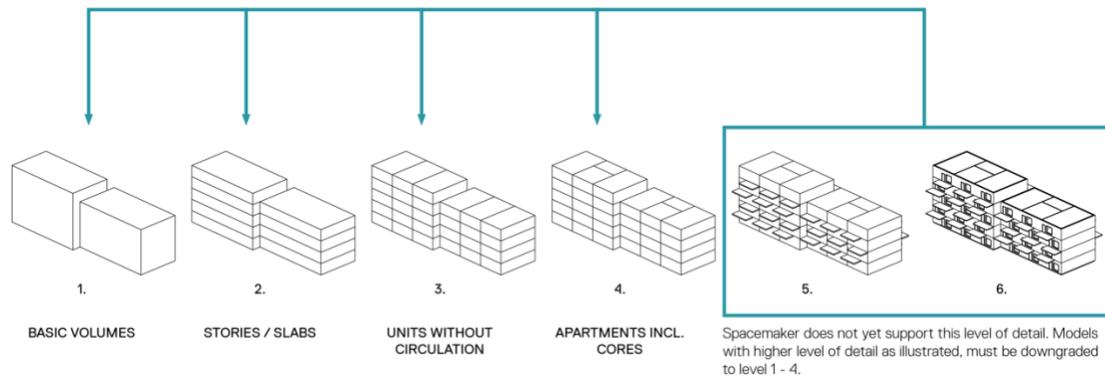
See the last version of this article on Spacemaker helpcenter [here](#).

Spacemakers supports OBJ and IFC imports. In this article we detail the level of support we offer for these formats.

The detail level supported is connected to 2D and 3D view modes. Below you can see how the different views are supported. Spacemaker supports 3D models of the following level of detail:

- Basic volumes
- Stories/slabs
- Units without circulation
- Apartments including core layouts.

As per Sept 2021 models with a higher level of detail as illustrated in point 5 and 6 in the figure below are not yet supported and must be downgraded to level 1 - 4.



You can ensure functions are carried to Spacemaker if you export it with the **IFC parameter "SM_TYPE"**. This parameter must be a text parameter. The supported function tags are the following (case-sensitive):

- APARTMENT
- CORE
- COMMERCIAL
- RESIDENTIAL
- Untagged volumes will be considered "GENERIC".

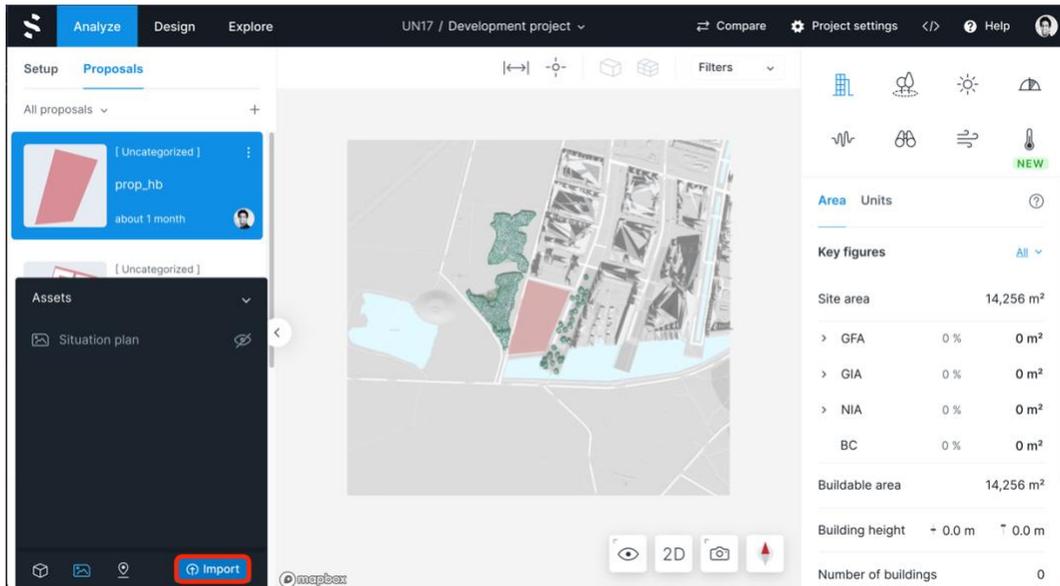
When importing OBJ's you will have to place the volumes on the site and tag them using the capabilities in Modify. Because of limitations in the format, this information does not carry to Spacemaker.

Import a site/ situation plan or even an hand-drawing

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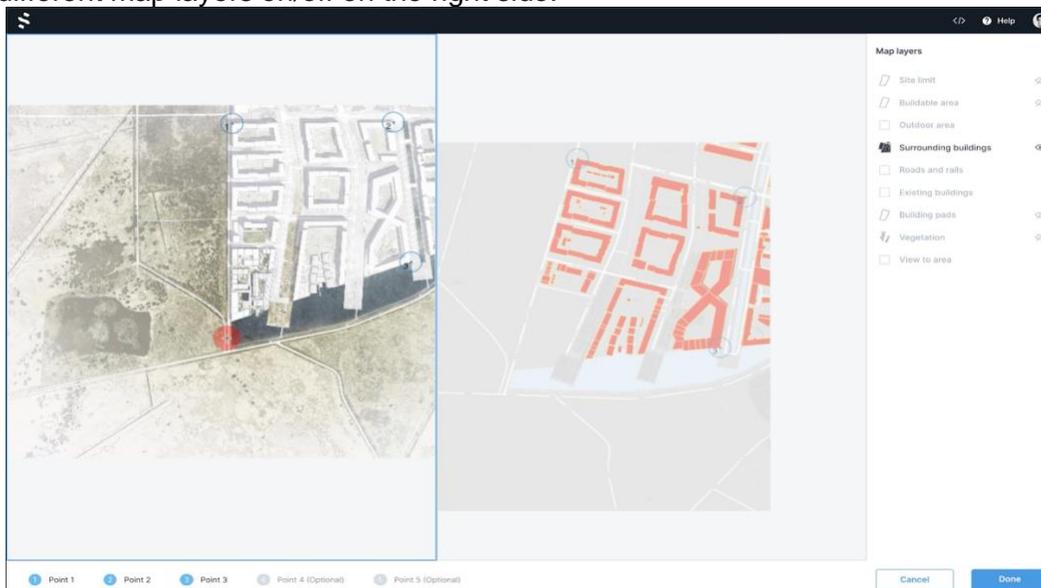
When any relevant illustrations for a site or surrounding sites exist as a PDF-document or as an image (.jpg/.png), the picture can be added as a reference layer and then used as a base layer for drawing buildings or surroundings on the site.

Uploading and geo-referencing images are done through Assets, which is where project related files are managed. Click on Assets to open the panel and click on the upload button.

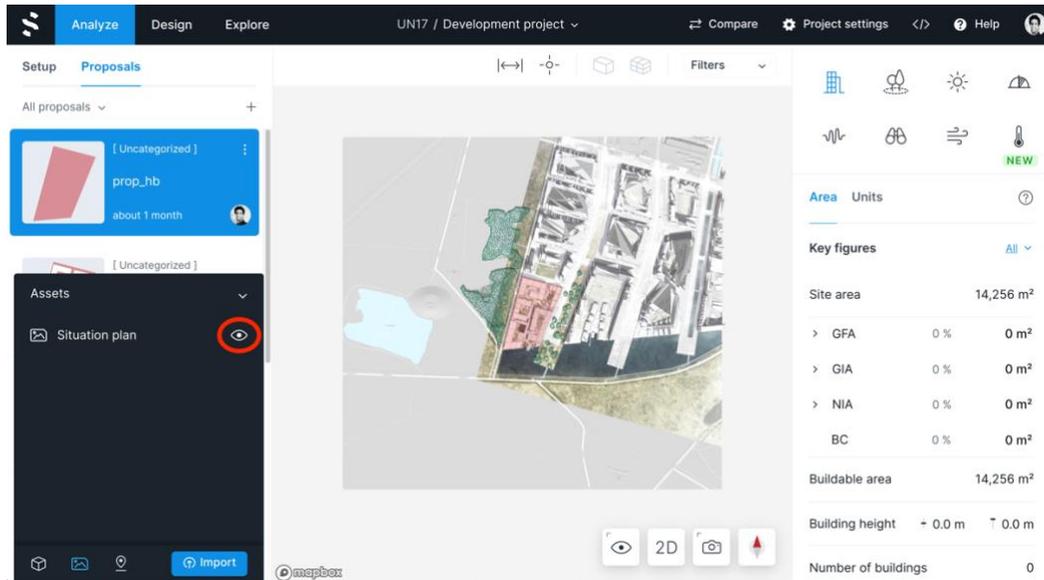


In order for Spacemaker to place the image correctly in relation to the map and the surroundings, you choose 3 to 5 reference points in the image and then mark their placement in the Spacemaker-map. Click a point in the image, and then mark the corresponding placement in the map. Choose points that are clearly visible in both the image and in the map, and distribute the points evenly over the width of the image to get the best results.

Map layers: if you need additional visual cues in order to place the points correctly, you can toggle different map layers on/off on the right side.



When you have marked five points in the image and on the map, choose DONE, and the image starts uploading as a reference layer. When the upload is finished, go back to Assets, click on Images and click on the eye next to the selected file to show the referenced image on the map.



The file cannot be more than 100MB and contain no more than 10.000x10.000 pixels. If the image you are uploading cover much more than your site, the limits may be lower.

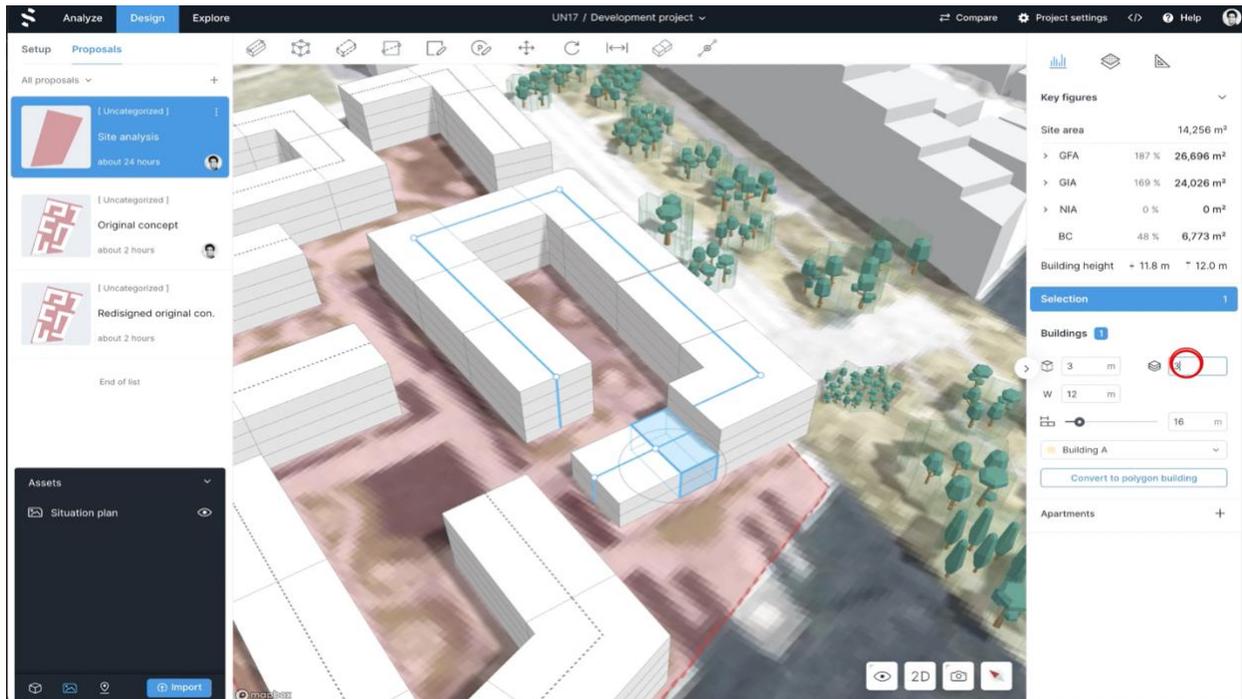
Draw line buildings based on a reference layer

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Creating 3D-volumes on a site is done with our Design function. The first step is to choose the reference layer to be visible in Design.

When the reference layer is visible, buildings can be sketched in their right place with the line edited buildings tool. These are buildings that are based on one or more connected lines. The lines decide the general character of the building, while a set of properties (e.g. width, number of stories, etc.) decides how the exact geometry is produced from the lines. Since line edited buildings follow a logical set of rules in this way, we are able to do things with them that we cannot do for polygon edited buildings, like generating apartment layouts.

To interact with line edited buildings you first need to select it using the left mouse button. You can then change its shape by clicking and dragging the interaction points shown as blue circles.



You can also edit the internal sections of each building. The section walls can be moved by clicking and dragging them. To add a new section, click the "add section" tool in the toolbar, move your mouse to the roof of a building, and click to insert it. Sections can be removed by snapping one section wall to another. If you want to reset your sections to the default ones - head over to "Building properties" in the right menu and interact with the slider controlling the section lengths.

Interpret Daylight in Spacemaker

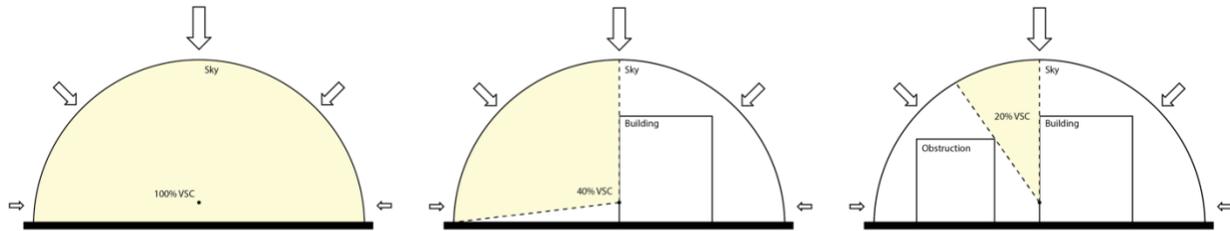
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We spend over 80% of our lives within buildings and numerous research studies have demonstrated that access to daylight has profound implications in terms of human health, happiness and productivity. Some countries have defined requirements to ensure adequate daylight, while most have informative codes and standards requiring "sufficient" daylight without mandatory levels being defined. (Designingbuildings, 2019)

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.

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. VSC is expressed as a percentage. The illuminance on a horizontal surface (e.g. an empty site) without obstruction is defined as 100%, whereas the illuminance on a vertical surface (e.g. a facade or

wall) without obstructions is almost 40%. The reason this is not 50% is due to the sky model used, CIE overcast sky, where the sky at the zenith is three times brighter than at the horizon.



In Spacemaker, the results are divided into color bins indicating the daylight potential, as expressed in the tables below. 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 |

Note that VSC analysis does not take into account window sizes, building materials, room sizes or room functions. The indoor daylight performance is dependent on these factors and the amount of daylight required is usually different for different room functions. The purpose of the Vertical Sky Component analysis is to be an indicator of daylight potential.

Outcome-driven design with Spacemaker

Spacemaker allows you embracing an agile approach to architectural design and planning. The analytical insight is an integral part of the overall decision-making and development processes.

Outcome-driven design emphasizes on integrated and comprehensive optimization of various quantifiable performances of buildings. Spacemaker supports geometry, outdoor, sun, daylight, noise, wind and microclimate analyses as per September 2021. This methodology allied with the cloud benefits permits a transparent collaboration and communication. All stakeholders can visualize data easily, as well as propose and evaluate new solutions together in a meeting, rather waiting weeks for other parties to solve their focus area.

In the highlighted case, the project group identified different areas with very limited access to daylight shown in dark blue. The view qualities are also not aligned with the commercial strategy for the development. The architects could act upon that insight in situ changing the location of typologies and building geometries. The performance of each alternative was validated and the group agreed on the best trade-offs.