BUILDSPACE

Enabling Innovative Space-driven Services for Energy Efficient Buildings and Climate Resilient Cities

Digital Twins generation and enrichment in BUILDSPACE Pilots

Step by Step Guidelines Use for BUILDSPACE
Service 1. Digital Twin Generation

July 2025

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101082575.

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1. INTRODUCTION

The development of Digital Twin (DT) technologies in the AECO industry is typically divided into three major components: generation, update, and visualisation. The first two—Digital Twin Generation and Digital Twin Updates—primarily involve data preparation and execution of algorithmic pipelines. These steps require structured point cloud datasets, IFC models, and Python-based scripts to extract, process, and enrich information. While these processes are essential for building the underlying DT, they are largely technical and backend-oriented, offering limited direct interaction for end-users.

Please check the algorithm:

- Digital twin generation: https://github.com/BuildSpaceUOC/Digital-Twin-Generation
- Digital twin update: https://github.com/BuildSpaceUOC/Digital-Twin-Update

By contrast, Digital Twin Visualisation provides the critical interface between data and stakeholders. It transforms the generated and updated DT models into an interactive environment that enables engineers, project managers, and decision-makers to explore, analyse, and verify building information in real time. For this guidance, the focus is placed on the visualisation environment, specifically using the usBIM and usBIM.GeoTwin platforms. These platforms are aligned with buildingSMART openBIM standards and ensure seamless integration of IFC models, point cloud data (PCD), and geolocation metadata.

The guidance introduces step-by-step instructions on how to access, navigate, and interact with the Digital Twin through the usBIM platform. It covers essential functionalities such as:

- Navigating pilot projects via 2D and 3D GIS maps
- Exploring and interacting with the IFC model hierarchy
- Linking PCD and IFC data into federated visualisation for comprehensive analysis

This user-oriented focus ensures that the DT outputs generated in earlier stages can be effectively utilised in practice, enabling improved decision-making and streamlined communication across stakeholders.

2. ACCESS & NAVIGATION

2.1 Navigating pilot projects via 2D and 3D GIS maps

1. Navigate to the GIS map link: https://service.usbim.com/link/sDViT8MXtp7NbxNAWwZi0oTH

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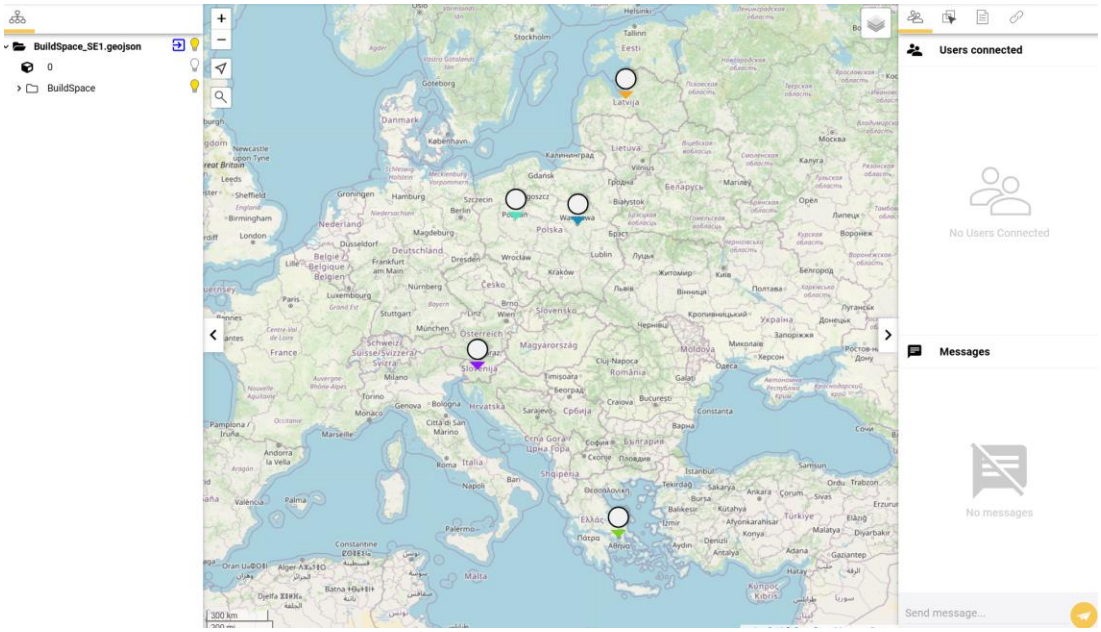
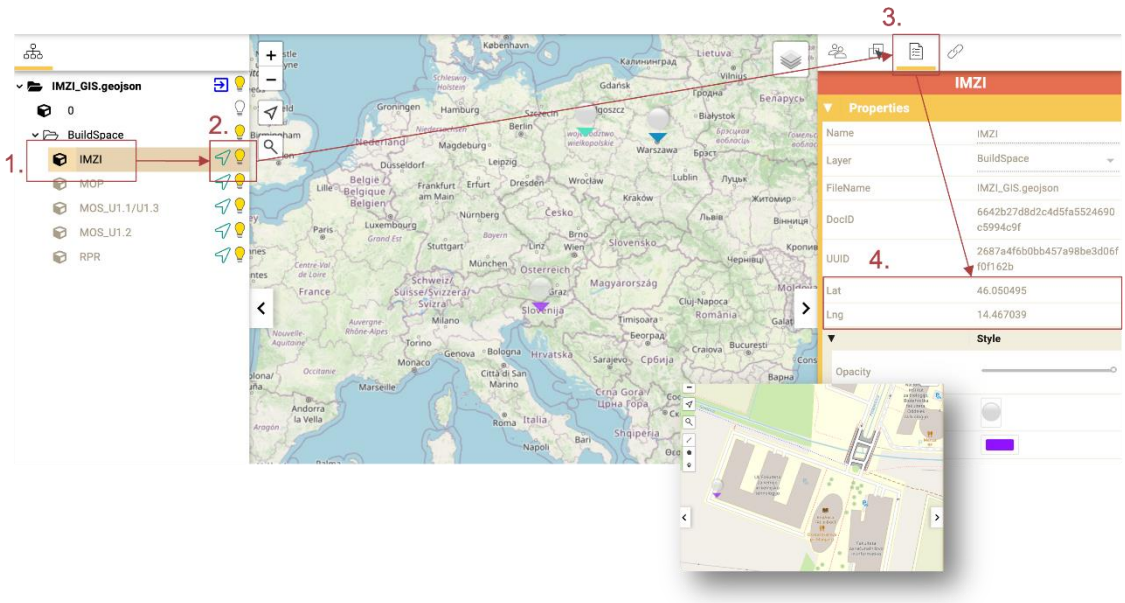


2. Navigate to the project:



3. Link to the 3D visualisation page

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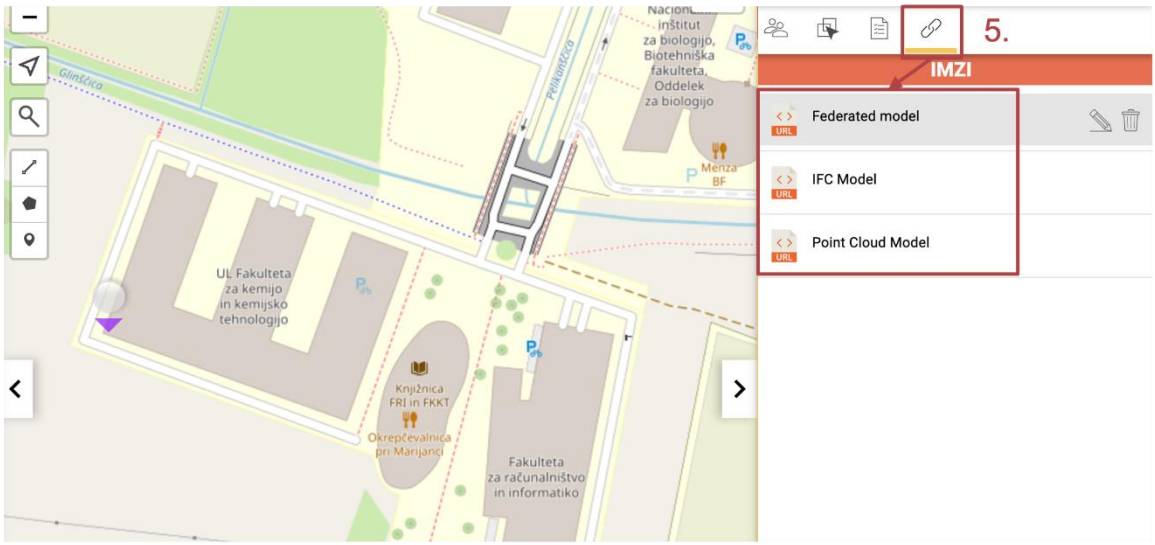

The 2D map interface displays the locations of five buildings across four pilot projects. Taking Pilot 4-IMZI as an example, the building can be navigated by selecting it from the tree table on the left-hand side. As illustrated in the figure above, the GIS map can be navigated through the following steps:

- **a)** Select the project.
- **b)** Click the **'Navigate'** button to visualize the GIS map, which appears as a thumbnail in the bottom-right corner.
- **c)** Click the **'Information'** button.
- **d)** View the corresponding EGNSS geolocation information.
- **e)** Click the **'Link'** button to access the models associated with a specific geolocation. This feature allows users to quickly retrieve and view three key components: PCD, DT and the federated model integrating both PCD and DT data for comprehensive analysis

2.2 Exploring and interacting with the IFC model hierarchy

Explore the pilot IFC models of pilot 1 here:
https://service.usbim.com/link/YEkvj5y2zwsbMMDli5DaISVT
https://service.usbim.com/link/XRGEOqohIoB88a91AoNpPtHe

1. Navigate to the IFC model from the GIS page:

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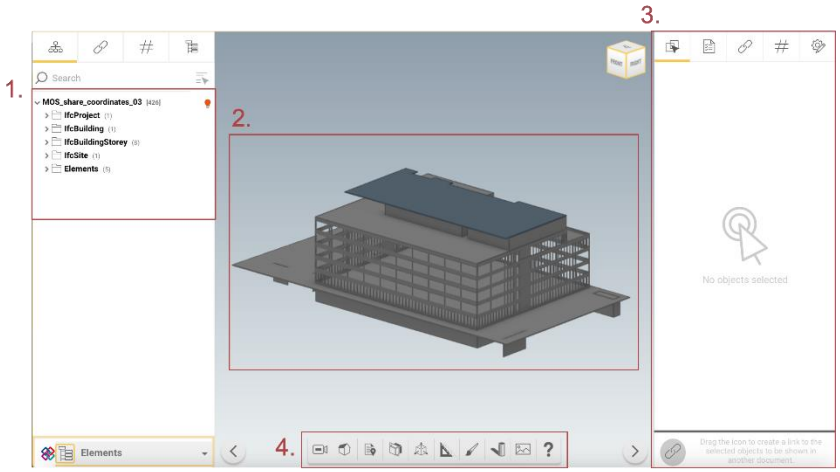
2D GIS map



Main interface introduction

a) **Information structure of the model:** displays the hierarchical structure of the IFC model, allowing users to expand and select specific elements.
b) **Model view:** The central viewport visualizes the 3D representation of the IFC model, where users can navigate, zoom, and interact with different elements.
c) **Information upon selection:** shows detailed information about selected objects.
d) **Toolbar:** The bottom toolbar provides various tools for interacting with the model, such as measurement, sectioning, annotation, and visibility controls.

2. Adjust the camera mode:

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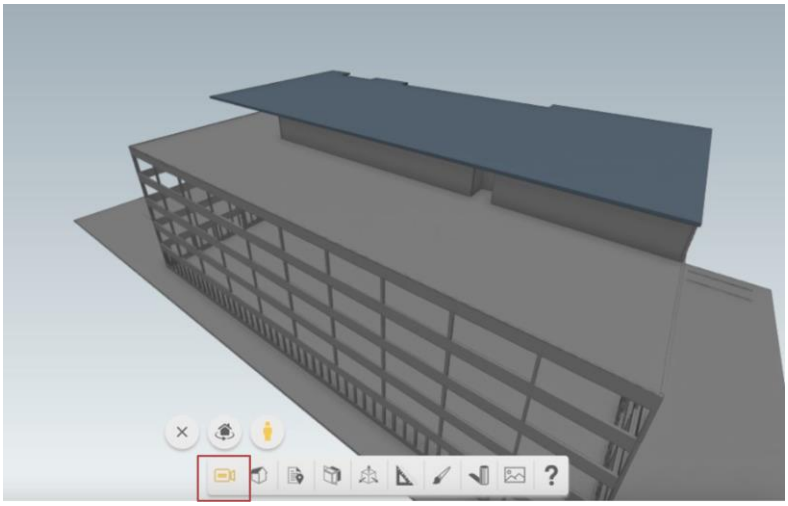
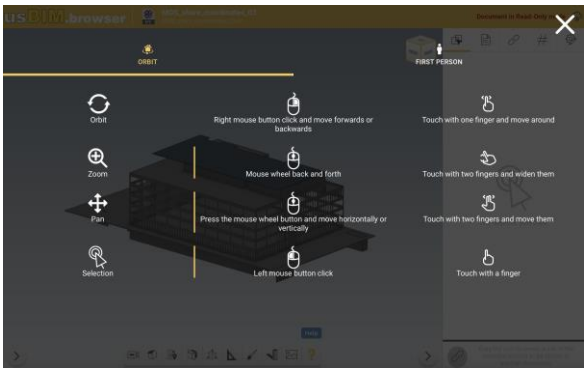
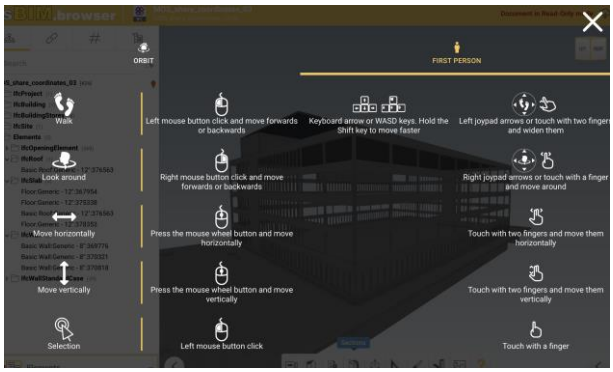


Adjust the camera mode



Orbit mode



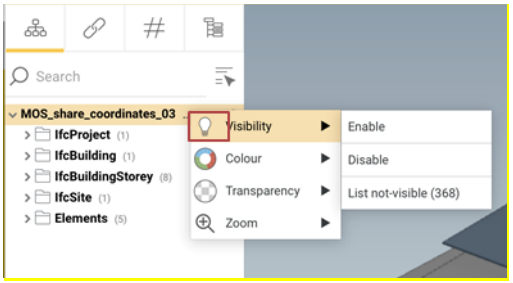
First person mode

Orbit Mode: Click the orbit icon to freely rotate around the model by clicking and dragging with your mouse.

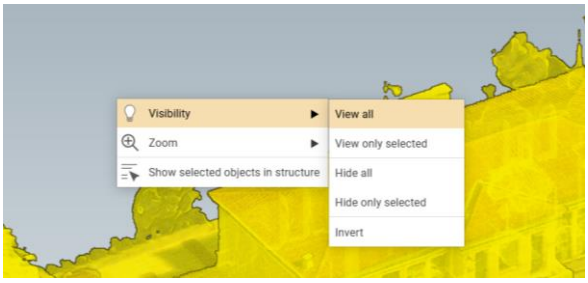
First Person Mode: Select the first-person icon to navigate through the model as if walking inside, using arrow keys or mouse controls.

3. View/ hide the model:

There are various ways to view/hide specific model. Two common-used methods are used:



Set the visibility – method (1.)



Set the visibility – method (2.)

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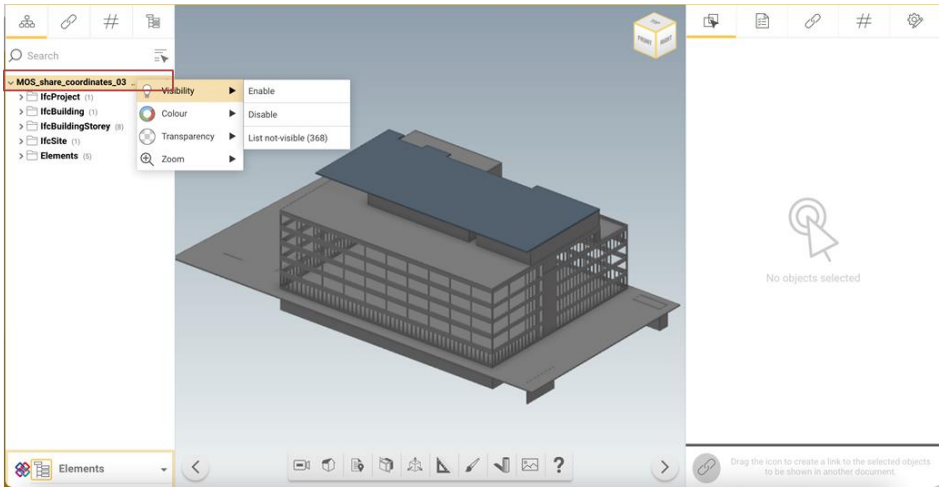
a) Set the visibility through the 'bulb' button in the left-hand side bar

b) Right click any element or any location of the interface to set the visibility of single or multiple elements

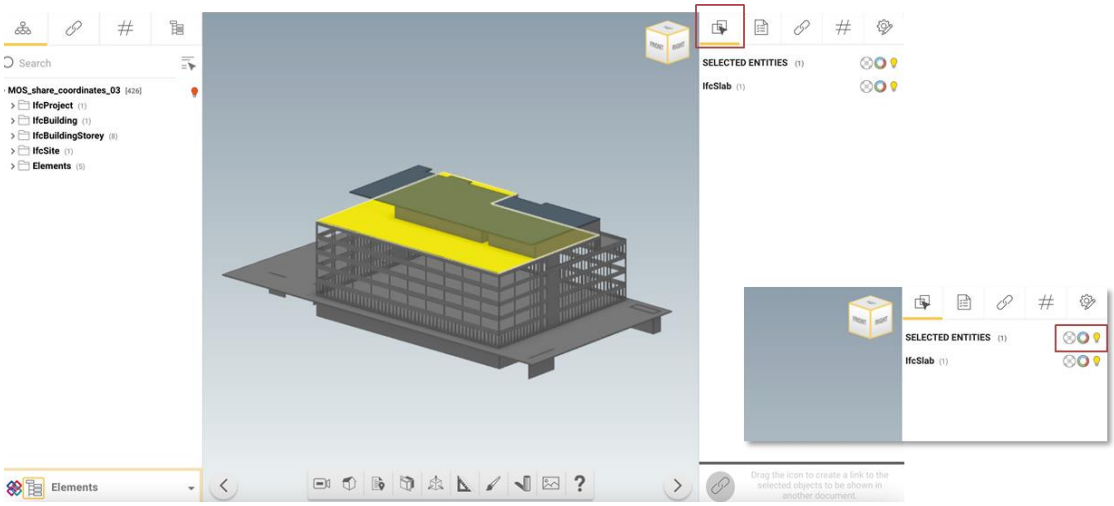
4. Basic setting:



Basic settings

Right-click on to adjust its visibility, change its color, set transparency levels, or zoom in on the selected object for better visualization.

5. Select an element:



Select an element

Click on an element in the 3D model to highlight it, and view its details in the right-hand panel, where you can check its properties, adjust visibility, and modify its appearance.

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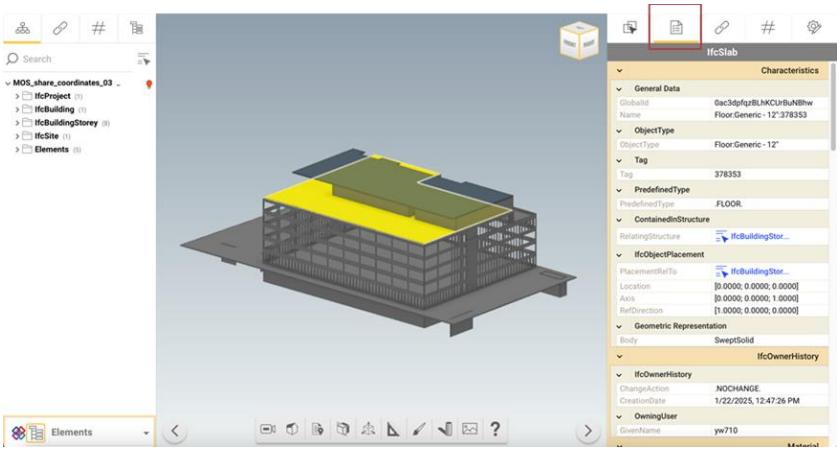
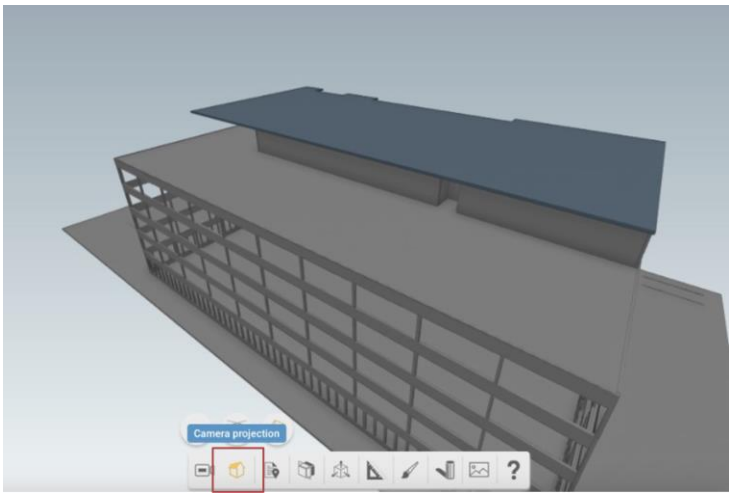
6. Check the element's property



Check the element's property

Click on the properties icon to view detailed information about a selected element, including its type, placement, geometric representation, etc.

7. Adjust the camera projection



Adjust the camera projection

Click the camera projection icon to switch between perspective and orthographic views, adjusting how the model is displayed for better visualization and analysis.

8. Create a section cutting plane

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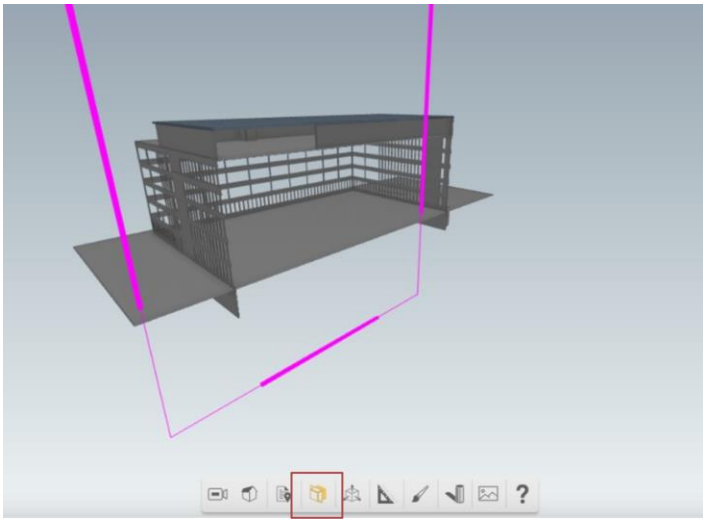
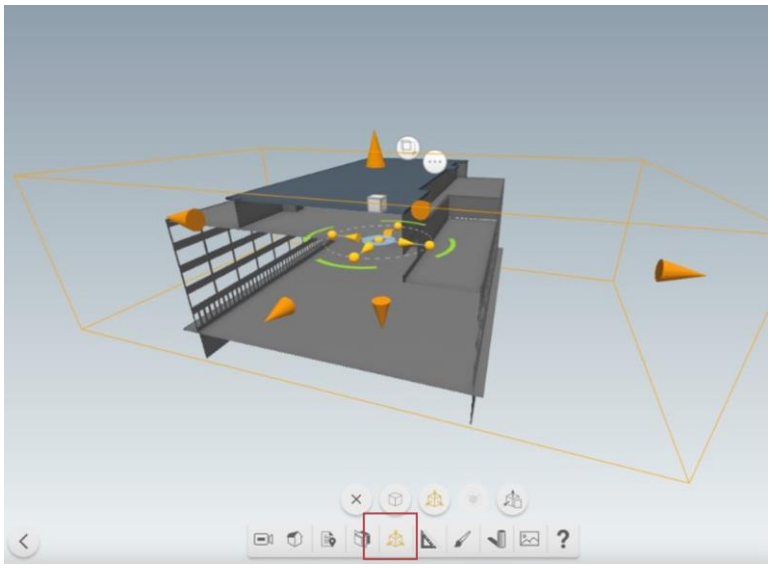


Create a section cutting plane

Click the section icon to create a cutting plane, allowing you to view and analyze the internal structure of the model by slicing through different sections.

9. Create a section box



Create a section box

Click the section box icon to define a 3D clipping region, allowing you to isolate and analyze specific parts of the model by adjusting the boundaries of the section.

10. Make a measurement

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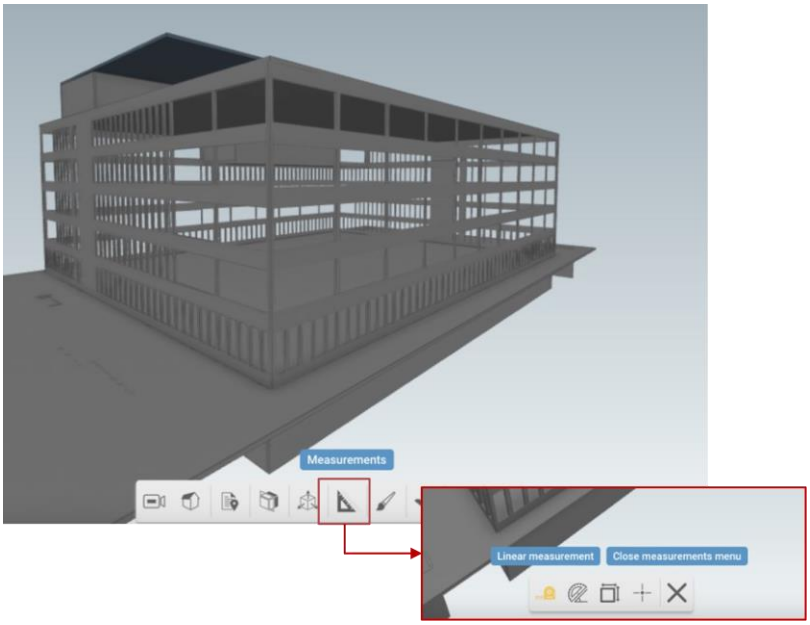

Figure 1. Make a measurement

Linear Measurements: Use the linear measurement tool to measure distances between two points on the model.
Measurement of Angles: Select the angle measurement option to show the angle between two intersecting elements or surfaces.
Measurement of Surface Area: draw a surface to measure its total area, helping to analyze material quantities.
Show Coordinates of a Point: Select a specific point in the model to display its exact coordinates within the 3D space.

1. Linking PCD and IFC data into federated visualisation for comprehensive analysis

Check the federated models for two cases in Pilot 1:
https://service.usbim.com/link/j4KxpbRZuaTF81GxT95tQG4A
https://service.usbim.com/link/PzvScfVBI4CqoJHaKYumfaVm

1. Navigate to the federated model:

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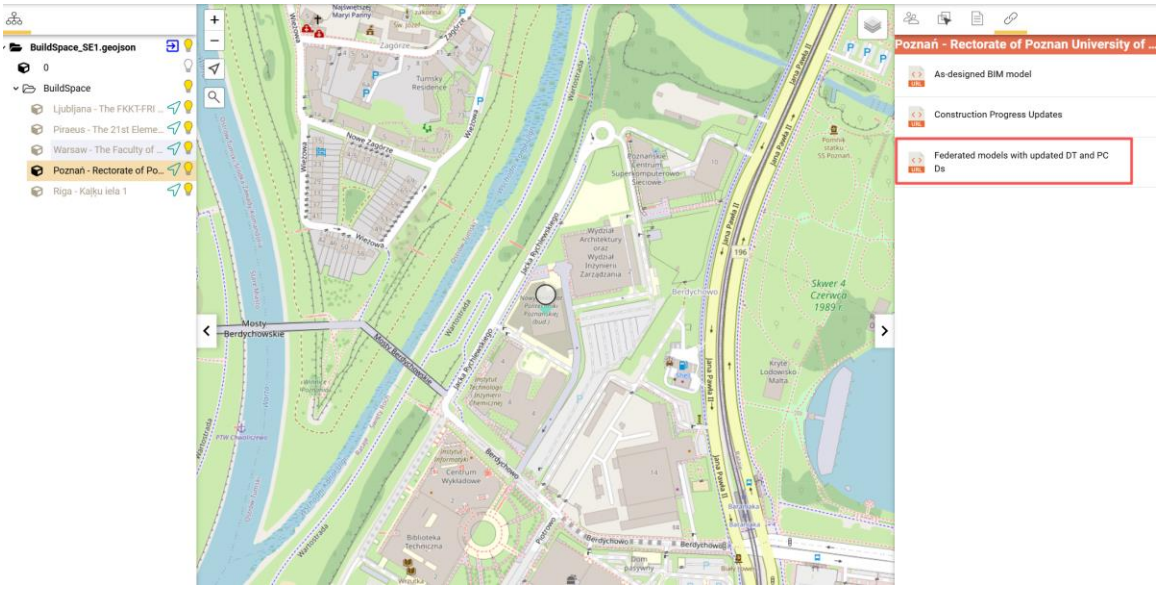

2. Federated model including PCD and IFC:

3. List of the models:

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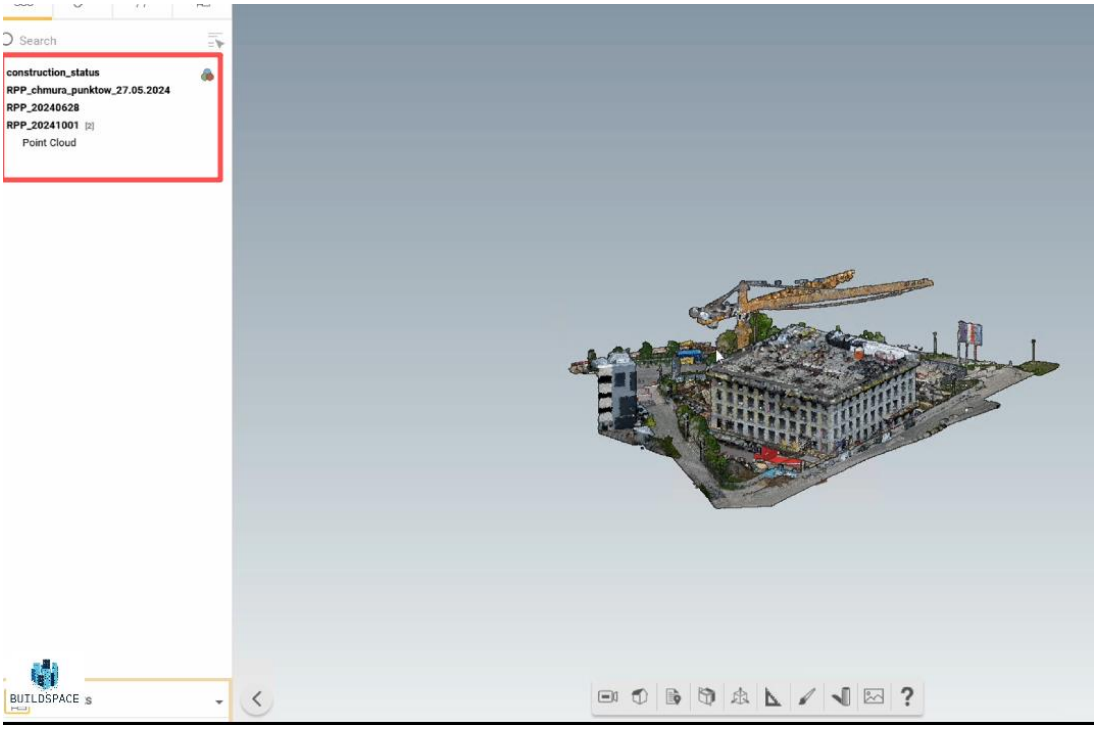
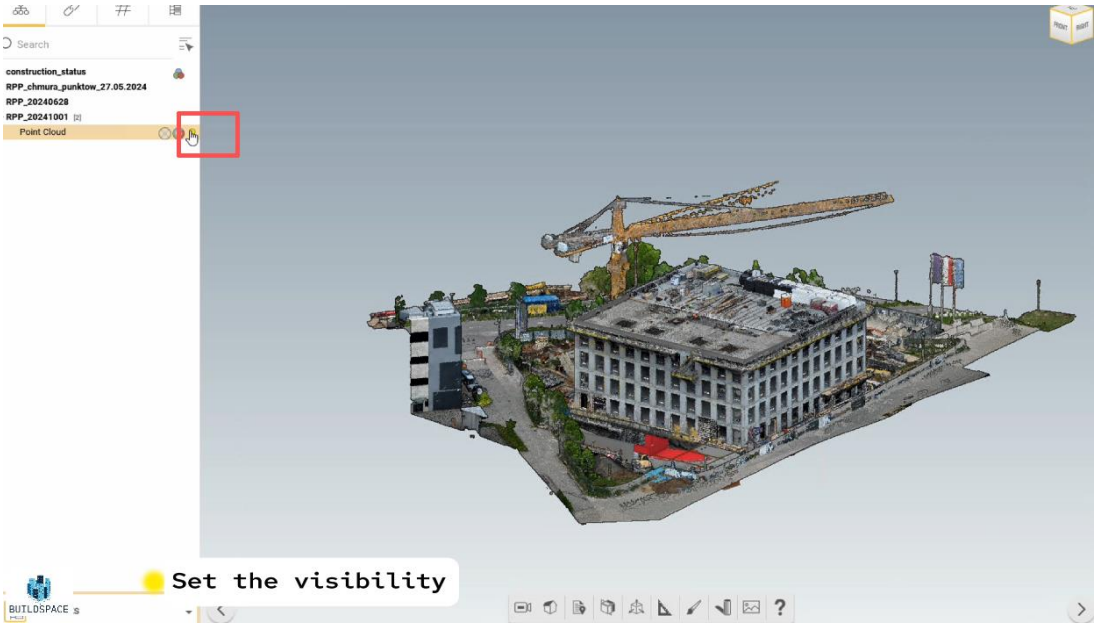


4. Set visibility of the individual model in this federated file:



5. The other functions in this interface are similar with the section 2.2. Users can operate each individual model refer to the operations in the last section, e.g., section box, high/view, check the IFC attributes.

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Section box:

Check the IFC attributes (e.g., construction status):

Set visibility at object level:

Conclusion

This guidance has outlined a step-by-step approach to interacting with Digital Twin (DT) outputs through the usBIM and usBIM.GeoTwin platforms. While DT generation and update processes are largely backend-

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oriented, focusing on data preparation, algorithm execution, and model enrichment, the visualisation stage translates these outputs into an accessible, user-friendly environment.

By following the procedures described, users can:

- Navigate projects via 2D and 3D GIS maps to locate and access pilot models.
- Explore and interact with IFC model hierarchies, adjusting visibility, camera modes, and model properties.
- Integrate point cloud data (PCD) and IFC models into federated views, enabling a more comprehensive understanding of construction progress and building status.

The visualisation environment serves as the bridge between technical data pipelines and end-user engagement. It empowers stakeholders—including engineers, project managers, and decision-makers—to explore DT models interactively, verify project progress, and communicate insights effectively.

Ultimately, this approach ensures that the value of Digital Twin technologies extends beyond data processing, delivering practical, real-time decision support and enhancing collaboration across the AECO sector.

Sample links are included in this document to allow users to conduct further testing and exploration.

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