InCUBE

sustainable building innovations

Webinar – Building Information Modelling

12/12/2023

This project is funded by the European Union's 'Horizon Europe Research & Innovation programme' under grant agreement no. 101069610. This publication reflects the authors' view only and the European Commission is not responsible for any use that may be made of the information it contains.

AGENDA

- Welcome & Introduction
- About InCUBE
- What is Building Information Modelling?
- BIM Tools and Technologies
- 3D Surveying: Data gathering for BIM
- BIM Case Studies
- Q&A Session
- Closing Remarks

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INTRODUCTION

Philo Tamis

Moderator

New Energy Coalition
Drivers of Change

Beatriz Gimeno Frontera

CEO Architect

metro 7

Guillermo Martinez

BIM Director

VAN WIJNEN

Elisa Mariarosaria Farella

Researcher

FONDAZIONE BRUNO KESSLER

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UNLOCKING THE EU RENOVATION WAVE

An inclusive toolbox for accelerating and smartening deep renovation

InCUBE envisions to unlock the EU renovation wave through **cutting-edge standardised and integrated processes** based on industrialisation, innovative renewable energy technologies, digitalisation, and new market entrants. InCUBE strives for **social inclusion, upskilling, and supporting women** in the construction industry.

The InCUBE solutions will be demonstrated in 3 large-scale demo sites: Zaragoza (ES), Trento (IT) and Groningen (NL).

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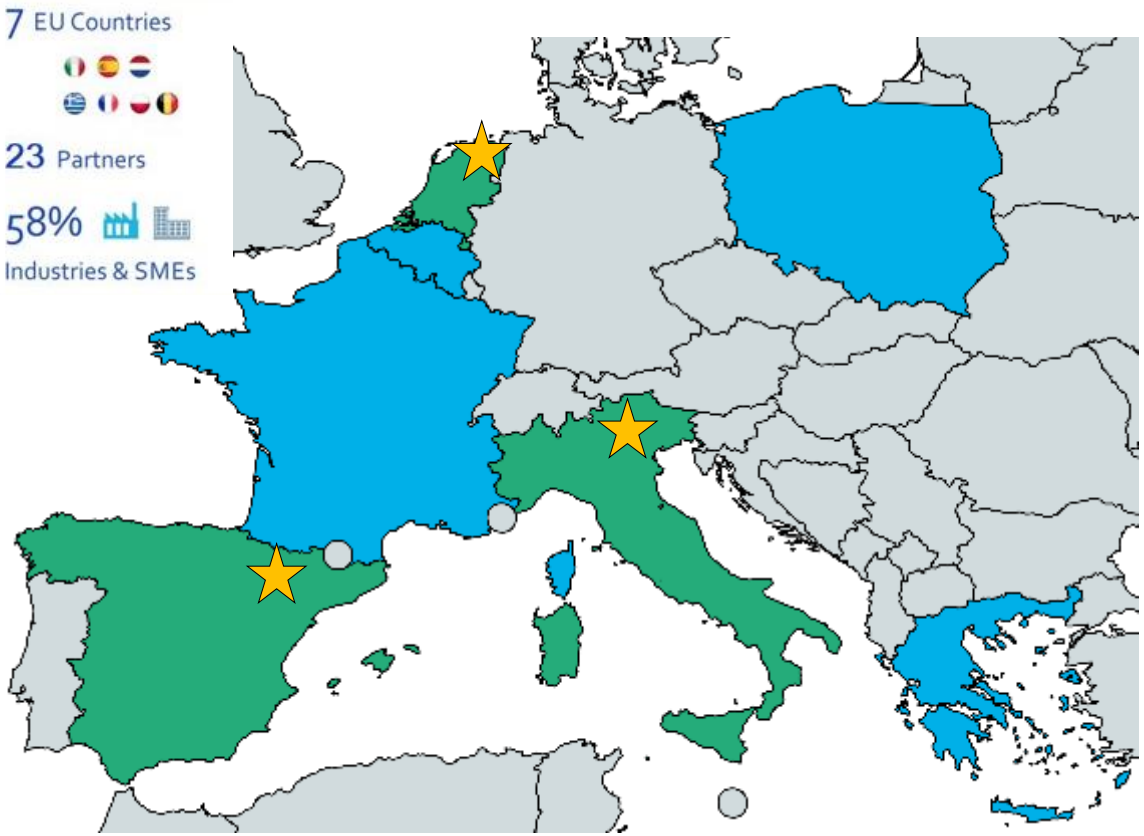
ABOUT

InCUBE brings together **23 high-profile partners** and two affiliated entities from **7 European countries**.



Funded by	European Union
Programme	Horizon Europe Research & Innovation
Start project	July 2022
End project	June 2026
Budget	~€10 million
EU Funding	~€8 million

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KEY EXPECTED OUTCOMES

35%+

Reduction of waste streams and time needed on-site

30%+

Reduction in renovation costs

50%+

Reduction in working time with hazardous activities

20%+

Energy performance gap between as-built and as-designed.

940 tCO_2 eq/yr

Greenhouse gas reductions

62%+

Energy savings per year

2000+ users

In two Renewable Energy Communities

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THE PROBLEM AND THE NEED

Low rates of productivity & user satisfaction in the construction sector	• Market up-take of new, sustainable materials • Industrialisation of deep renovation • Upskilling workforce under a gender mainstreaming approach
Poor or no integration of solutions	• Improved integration of solutions and digitalisation of products and processes • More attractive and affordable solutions
Limited information of building whole life cycle	• Integration of building related information • Buildings and their users as active nodes of the energy system
Highly complex, fragmented and project-based process	• Bring together different actors of the construction sector • Workflow optimisation

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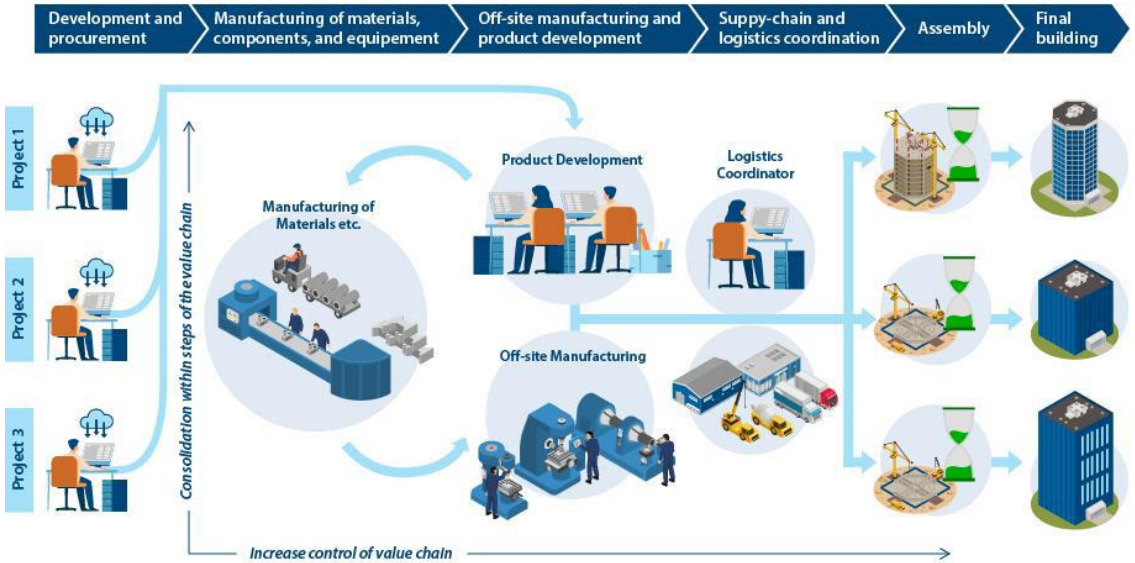
PROJECT PROCESS OPTIMISATION

Present

Future



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INNOVATIONS

InCUBE envisions to unlock the EU renovation wave through cutting-edge standardised and lean integrated processes based on **4 key pillars of innovation.**

INDUSTRIALISATION

NEW TECHNOLOGIES AND MATERIALS

DIGITALISATION

NEW MARKET ENTRANTS

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#1 INDUSTRIALISATION

InCUBE's process innovations support the **industrialisation of re novation** through solutions for:

- Off-site manufacture
  - BIM-based Design of Prefab Modules
- On-site installation and automation
  - BIM-connected Robotic Systems (Demolition, Construction and Drilling)
  - Personal Protective Equipment (PPE) Monitoring System
- Circular construction
  - Construction Waste Sorting Robot
  - Waste Tracking and Management

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#2 NEW TECHNOLOGIES AND MATERIALS

InCUBE's product innovations support the **utilisation of new technologies and materials** such as:

- Envelope material solutions
  - Prefab & Modular Facades
  - K-ROCK CNX – Mineral wool board
- Renewable energy generation solutions
  - BIPV pre-installed on Prefab Facades
  - Tegosolar® BIPV Shingles
- Solutions for renewable energy storage
  - Smart Borehole Thermal Energy Storage
- Advanced Heating, Ventilation and Air Conditioning Solutions
  - Low temperature Ground Source Heat Pump connected to District Heating & Cooling
- Cross-Cutting Solutions
  - Low Temperature 100% RES District Heating & Cooling

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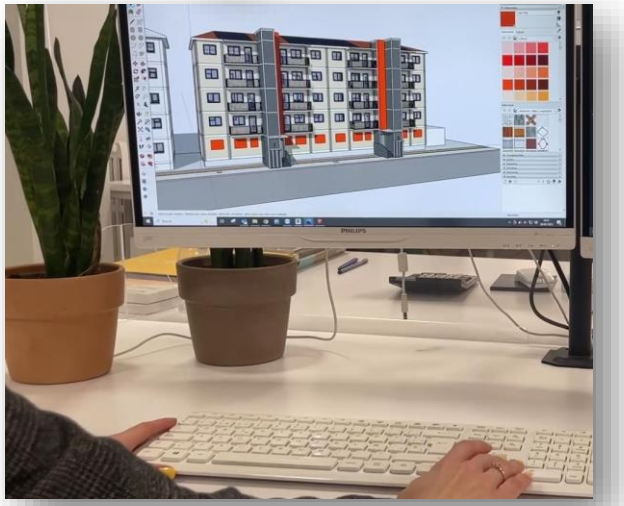
#3 DIGITALISATION

InCUBE's software innovations support the **digitalisation of products and processes** such as:

- Supporting for 3D building modelling & Digital Twins
- Enhanced energy assessment and integrated energy management
- Dynamic life cycle evaluations & Decision-Making Tool optimising renovation planning
- Ensuring enhanced workers safety and increased efficiency
- Offering augmented next-generation training and assistance
- Smart Building Energy Management Systems focussed on energy communities
- Enhancing the optimal management of distributed renewable energy sources
- Optimising workflow and construction & retrofitting works



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#4 NEW MARKET ENTRANTS

InCUBE's business innovations **support new entrants** through:

- Renovation Marketplace for sharing information, knowledge and experiences
- Novel Business Models including the formation of Renewable Energy Communities
- Improve the gender mainstreaming in the construction and energy sectors to smarten and accelerate systems, products and operations
- Training Modules with best practices for upskilling the current and potential workforce

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INTRODUCING ESTUDIO

Metro7: Spanish architectural firm and construction company

PASSIVHAUS

SUSTAINABILITY

SMART BUILDINGS

WELL

DESIGN

INNOVATION

InCUBE:

- Leading building mapping and BIM objects development tasks
- Coordinating Spanish demo site pilot and solutions
- Lean implementation: IPD, A3 and LSP driven renovation

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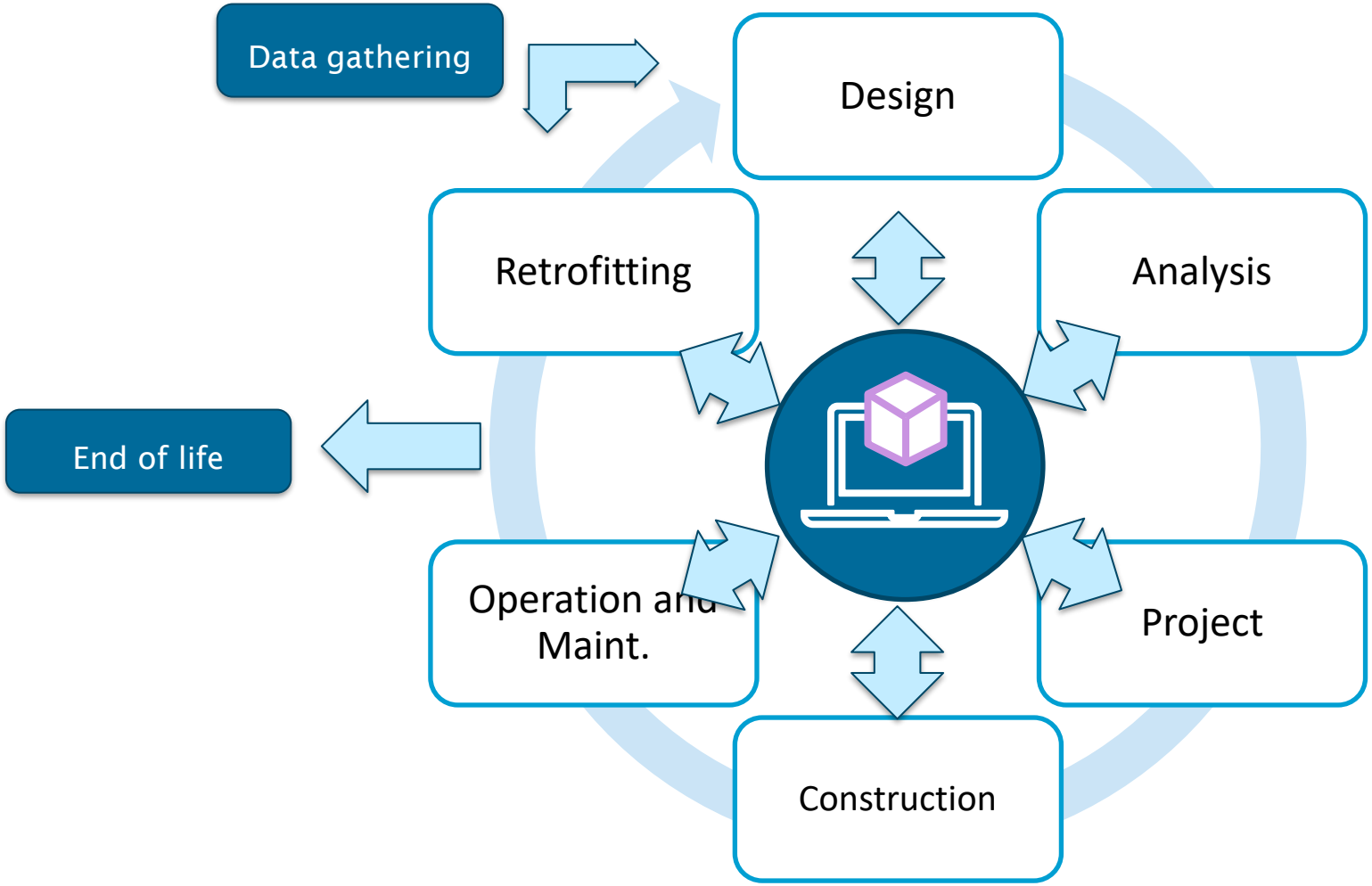
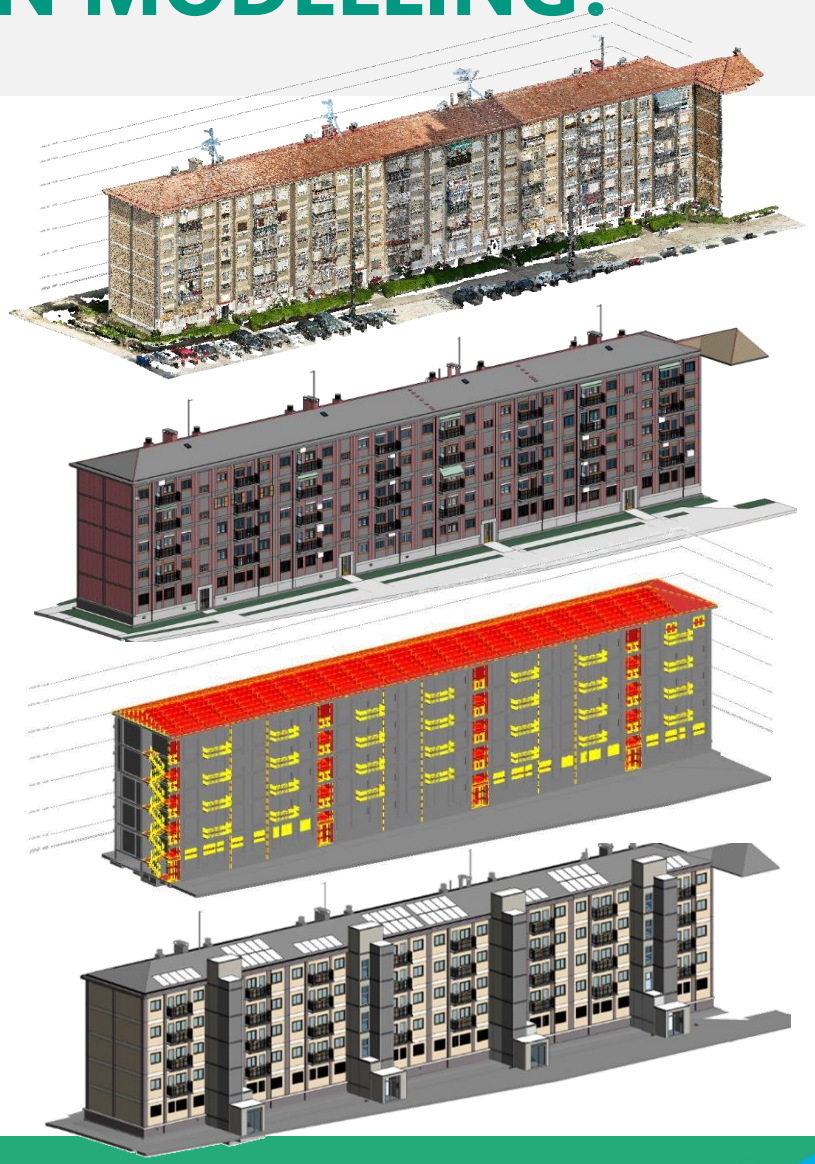
WHAT IS BUILDING INFORMATION MODELLING?





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WHAT IS BUILDING INFORMATION MODELLING?

- Digital representation of a building. NOT only 3D modelling
- Allows creating and managing building assets
- Multi-disciplinary data
- Move up to city level: CIM

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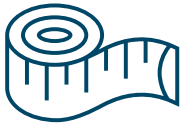
WHAT IS BUILDING INFORMATION MODELLING?

Building Execution Plan (BEP)

KEY ELEMENTS BEFORE STARTING

GOALS



SCOPE

INTERNAL COORDINATION

LEVEL OF DEFINITION

SOFTWARE

COLLABORATIVE

ROLES

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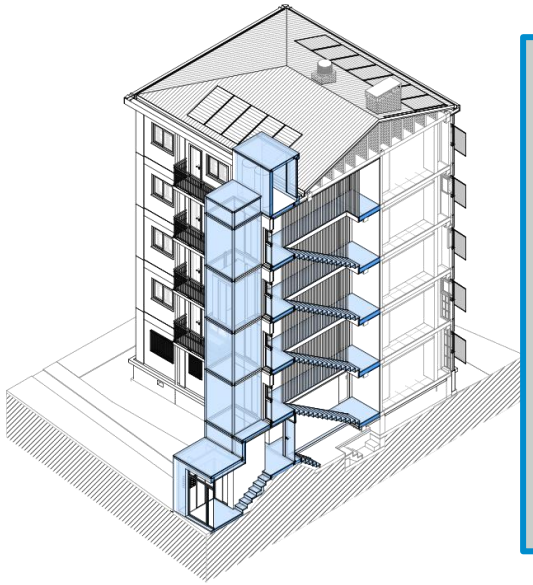
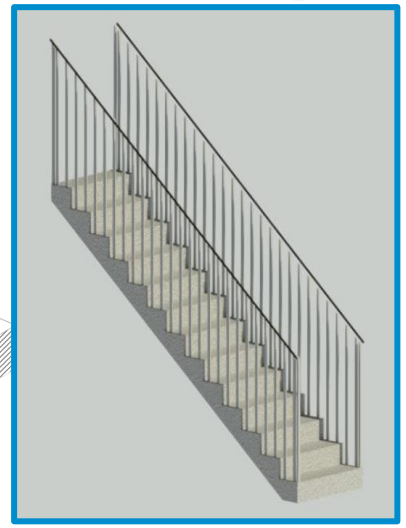
WHAT IS BUILDING INFORMATION MODELLING?

PLENTY OF INFORMATION





Parámetro	
Purchase Contact	
Purchase Date	
Serial Number	
Special Instructions	
Supply Date	
Wrapping Material	
Parámetros IFC	
COBie Category	IfcStair
Gubimclass Code	
Gubimclass Title	
IfcExportAs	IfcStair
IfcExportType	Stair
Masterformat Code	C2010
Masterformat Title	Stairs
Omniclass Code	20.30.70.21
Omniclass Title	Stairs
Uniclass2015 Code	Ss_35_10
Uniclass2015 Title	Stair and ramp structure system
UNSPSC Code	30162103
UNSPSC Title	Concrete Stairs
Propiedades de Green Building	
Atmospheric Acidification Per Unit	
BREEAM Credits	

AVOID INFORMATION LOSS:

- Changing discipline
- Changing software
- Over-information
- Understand future uses

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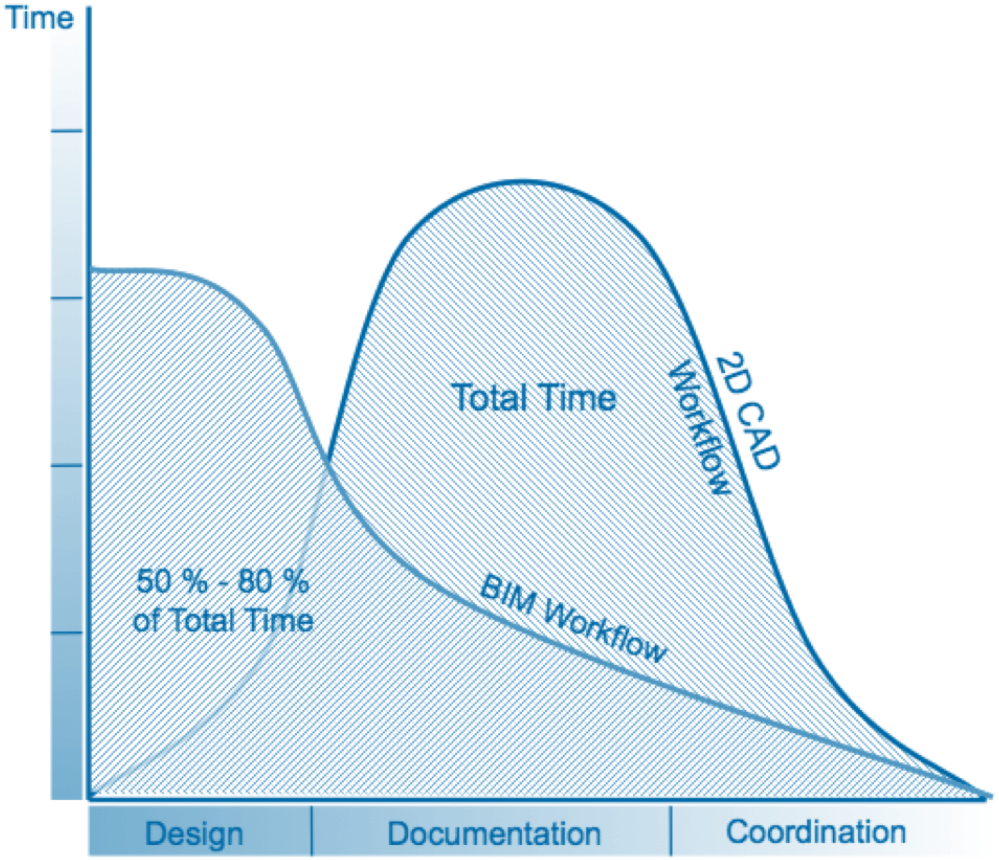

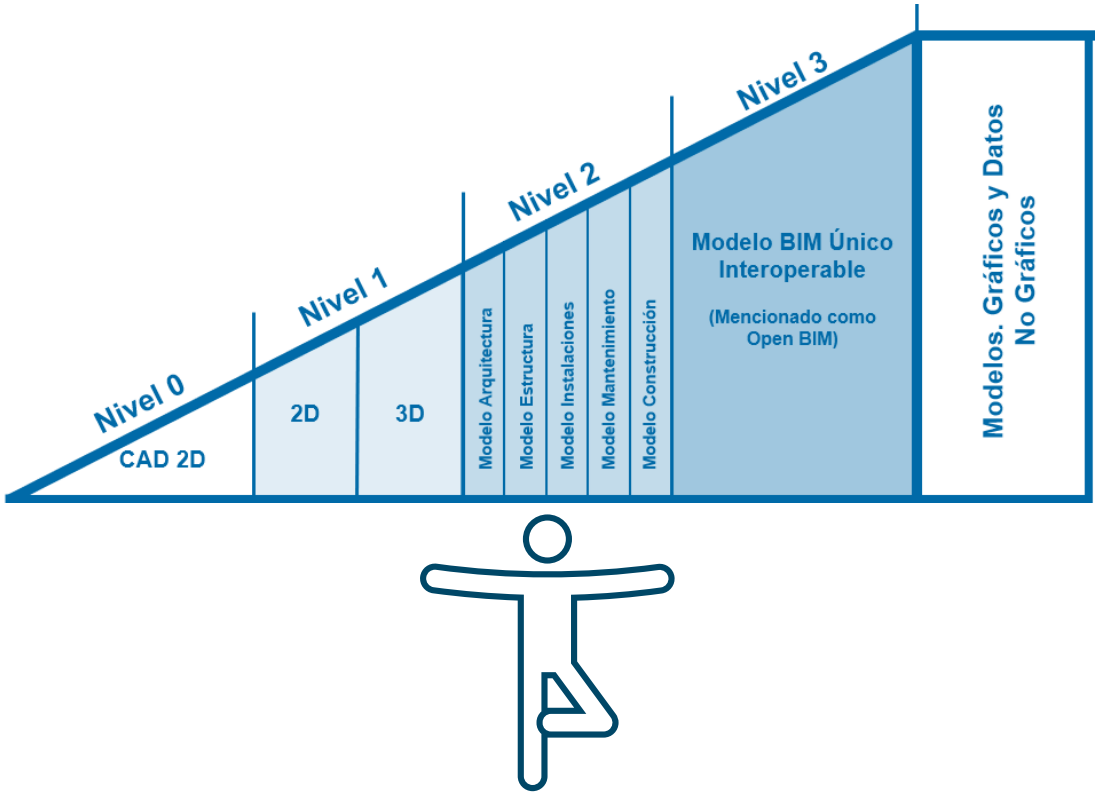

DATA SURVEY: more detail, less time, although initially is longer

CHOOSE BEST INTEGRATION SCOPE

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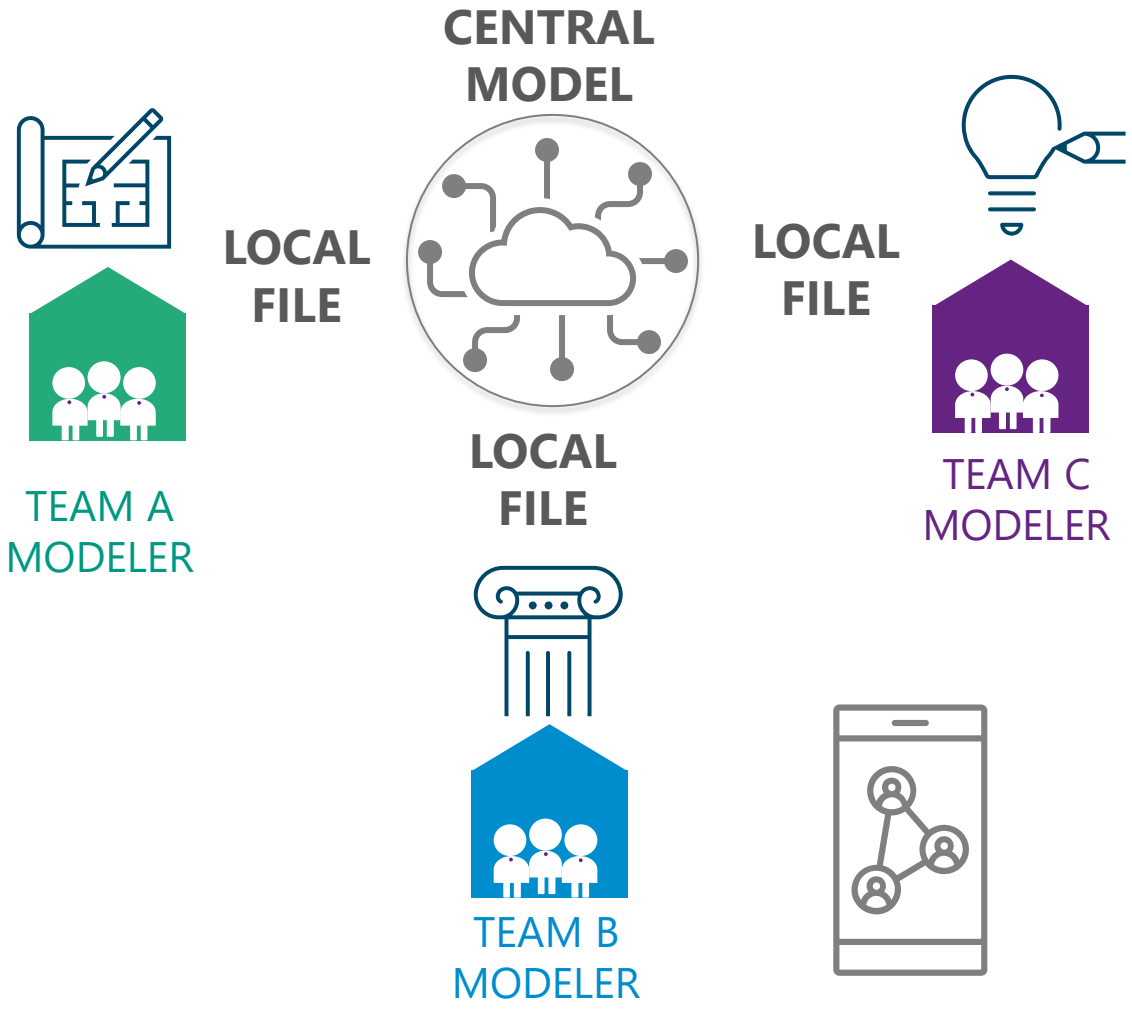

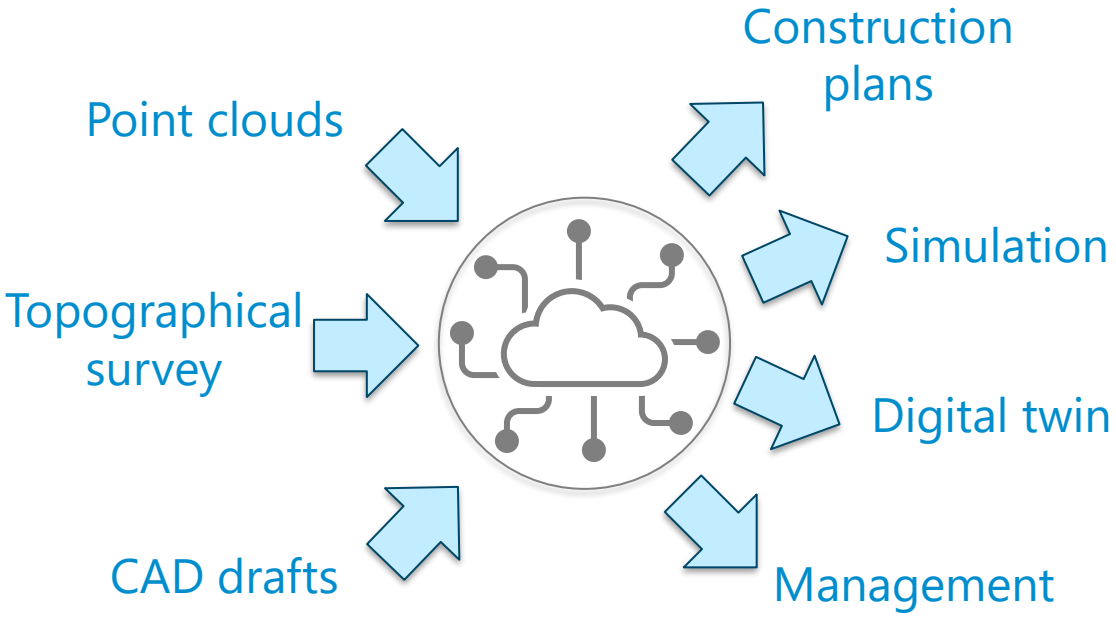

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WHAT IS BUILDING INFORMATION MODELLING?

GEOMETRY

VIRTUAL SIMULATION

DYNAMIC ANALYSIS

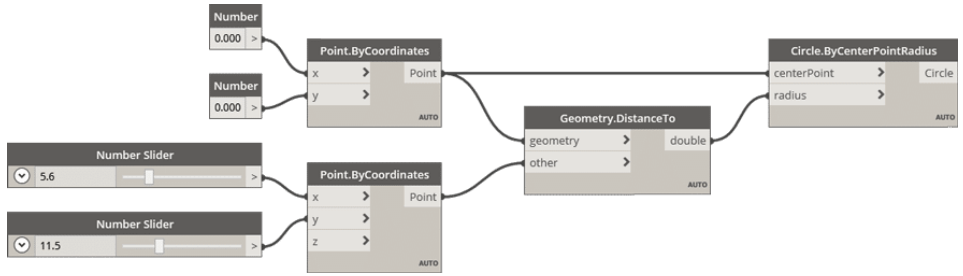
Common file: IFC

INTEROPERABILITY BETWEEN DISCIPLINES

PROCESS AUTOMATIZATION

Specialized commercial software

InCUBE Suite



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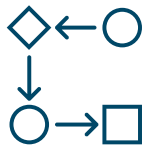
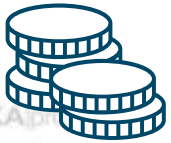


1D
PROTOCOLS

2D
VECTOR

3D
MODEL

4D
TIME



5D
COST

6D
PERFORMANCE

7D
OPERATION

8D
RISK

9D
LEAN

10D
INDUSTRIALIZATION

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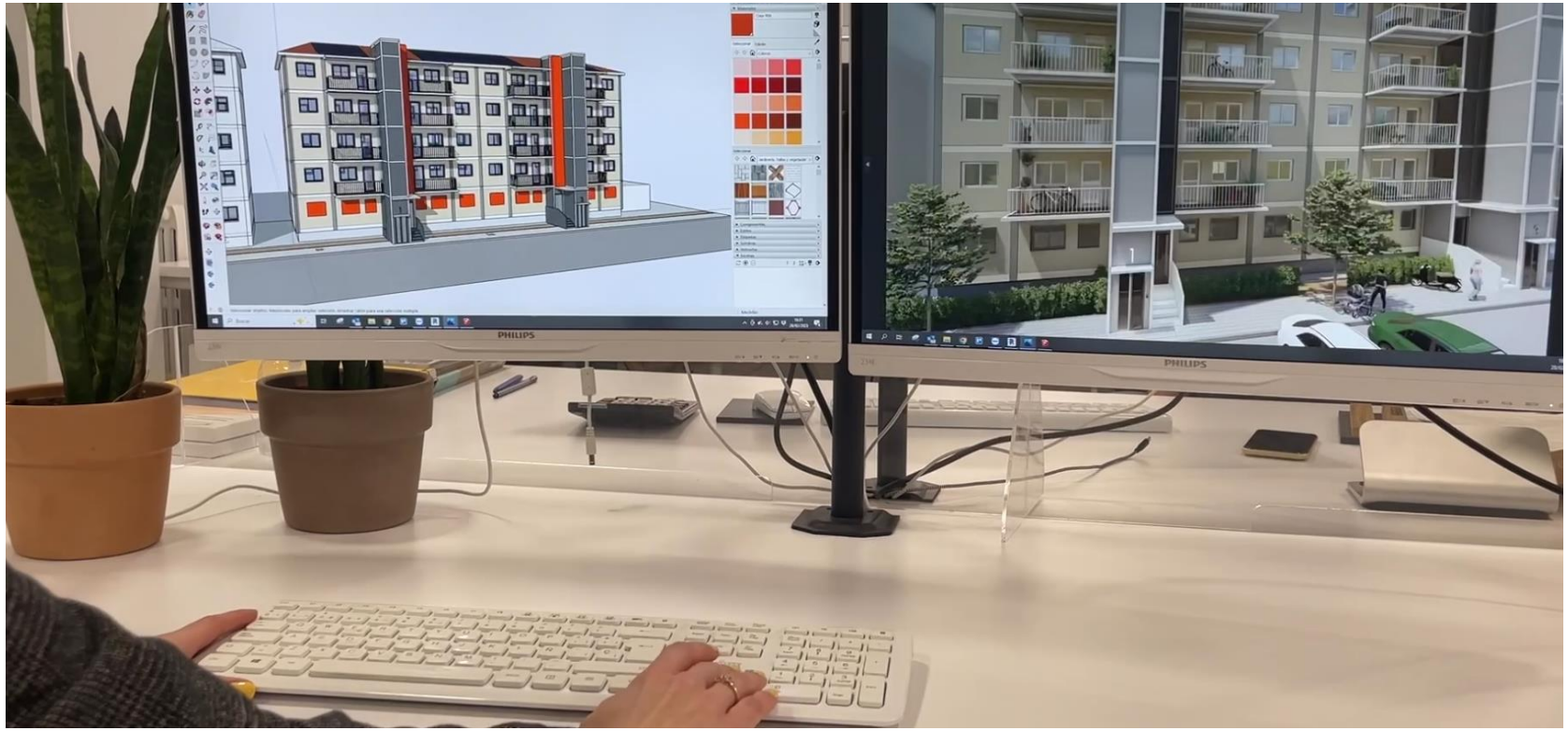
WHAT IS BUILDING INFORMATION MODELLING?

- Visualization: VR/AR
- Real time
- Better communication
- Easier to understand



Modelling adapted to expected uses

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INTRODUCING VAN WIJNEN

VAN WIJNEN

VAN WIJNEN

Construction group
More than 2400 employees
27 branches throughout the Netherlands.

- Active in project development
- Residential construction
- Renovation
- Circularity

InCUBE

- Coordination of Dutch demo site renovation and solutions
- Research compatibility BIM and robots
- BIM based products

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BIM SOFTWARE AND TOOLS

AUTHORING

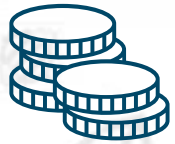
CLOUD-BASED APP

CLASH DETECTION

PLANNING

COMMUNICATION

ASSENT MANAGEMENT



BUDGET MANAGEMENT

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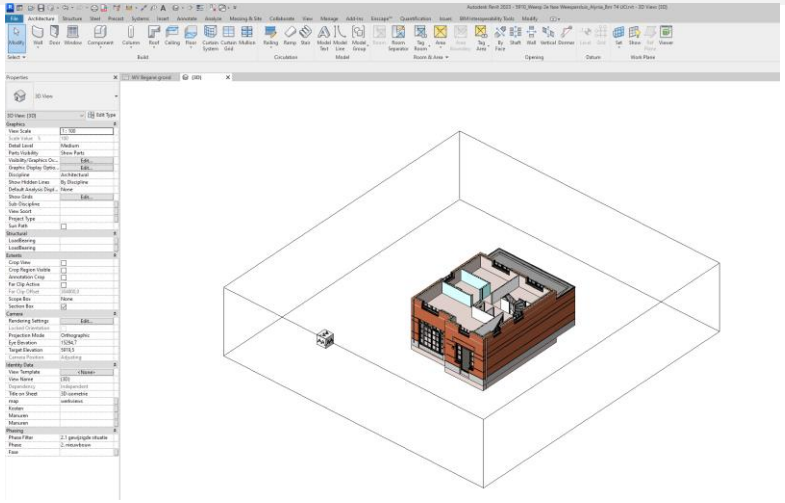
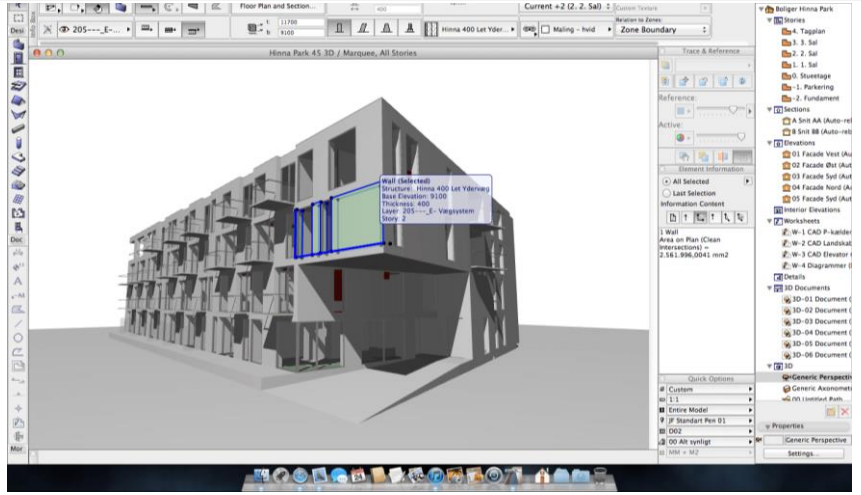
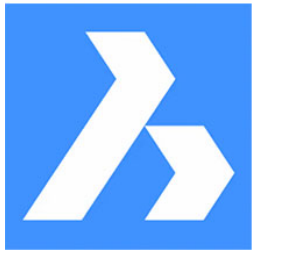
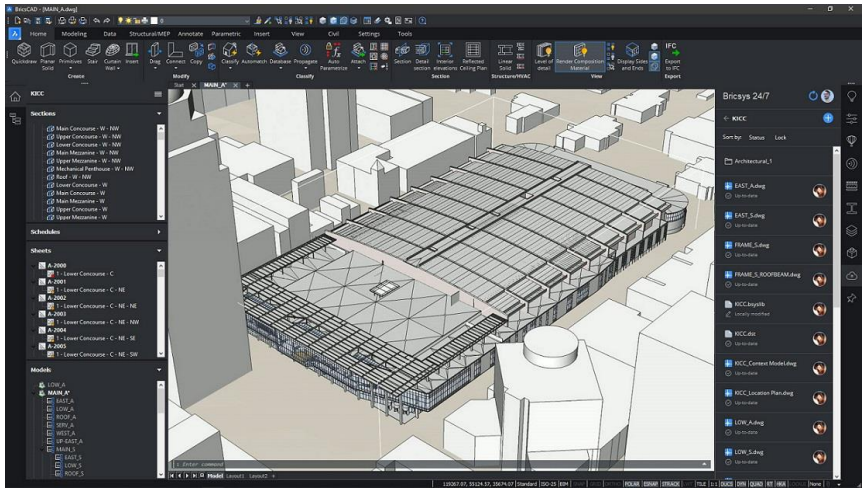
BIM SOFTWARE AND TOOLS

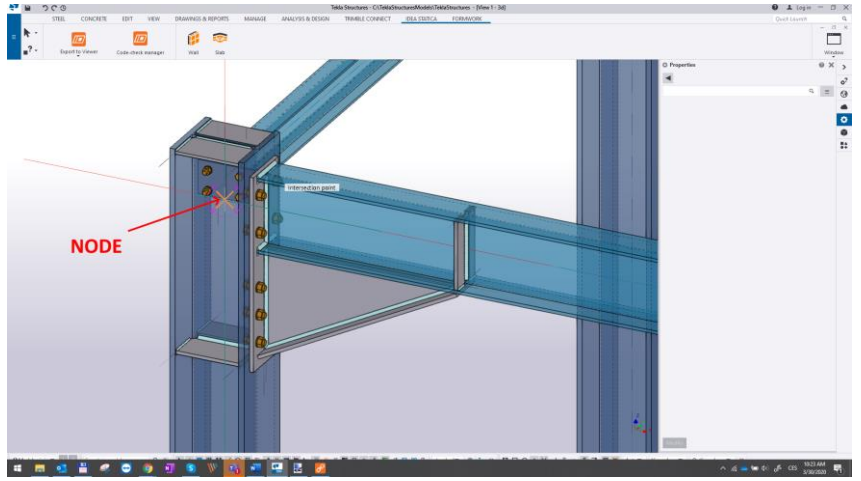
Authoring











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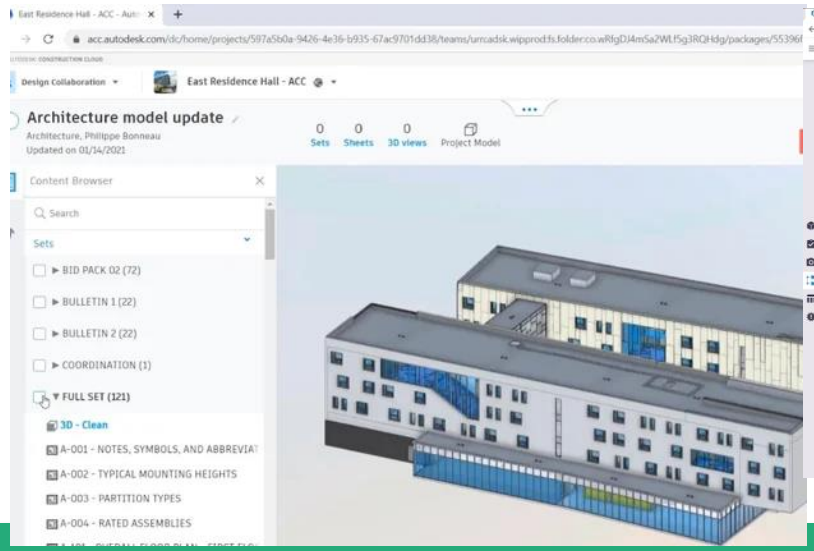
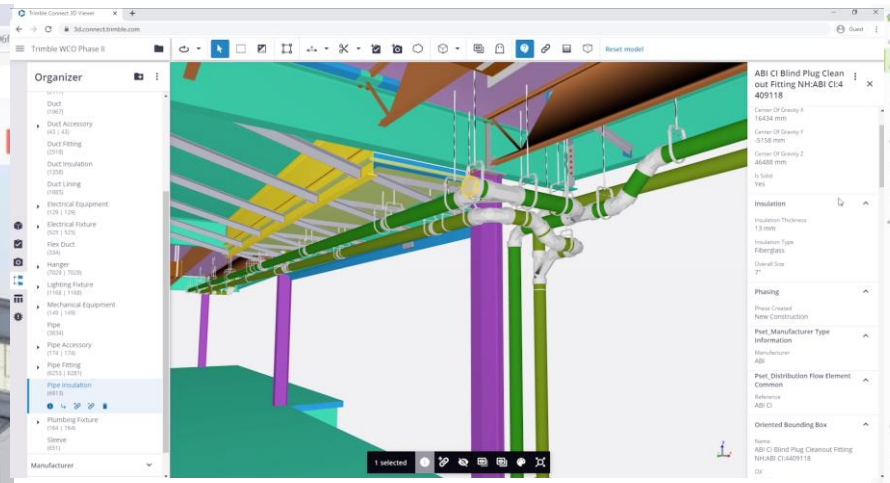
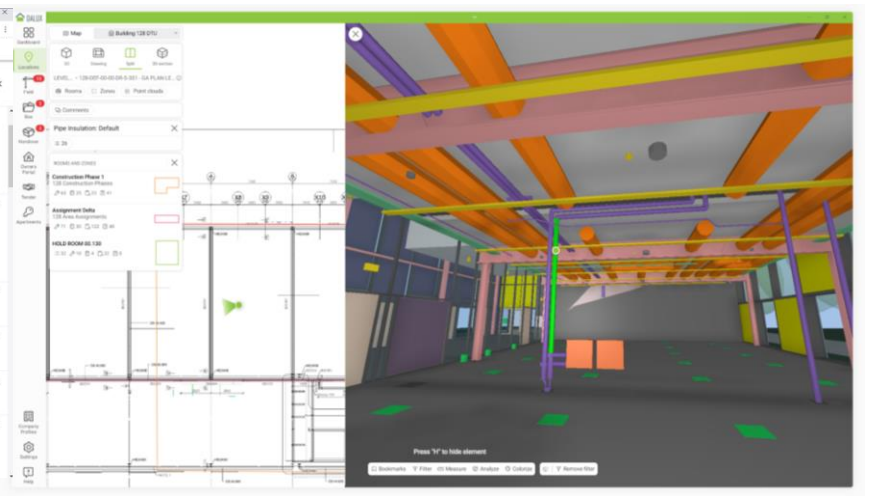
BIM SOFTWARE AND TOOLS

Cloud-based app







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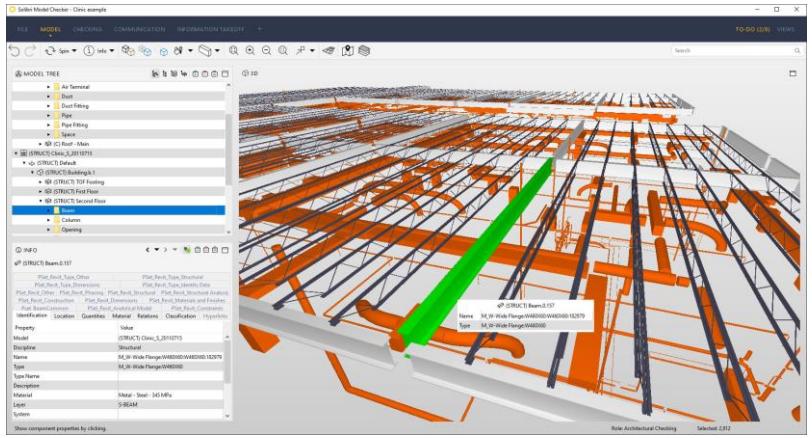
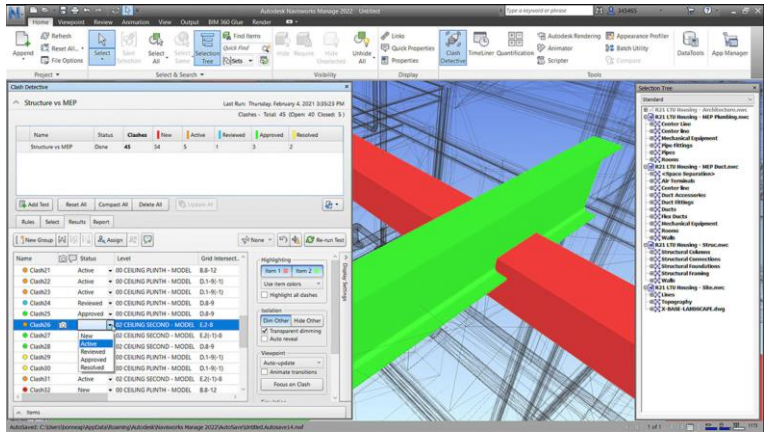
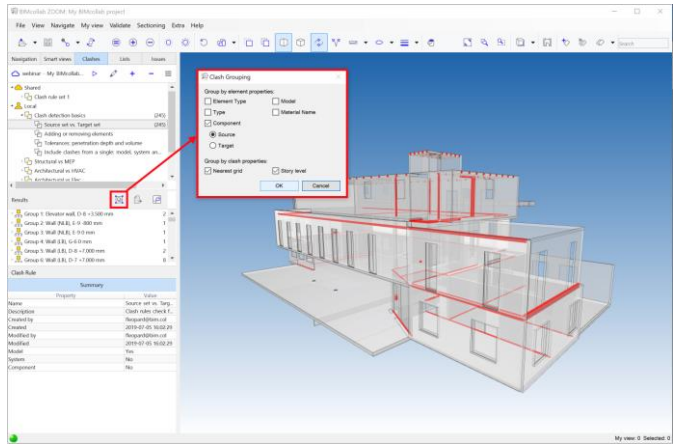
BIM TOOLS AND TECHNOLOGIES

Clash detection







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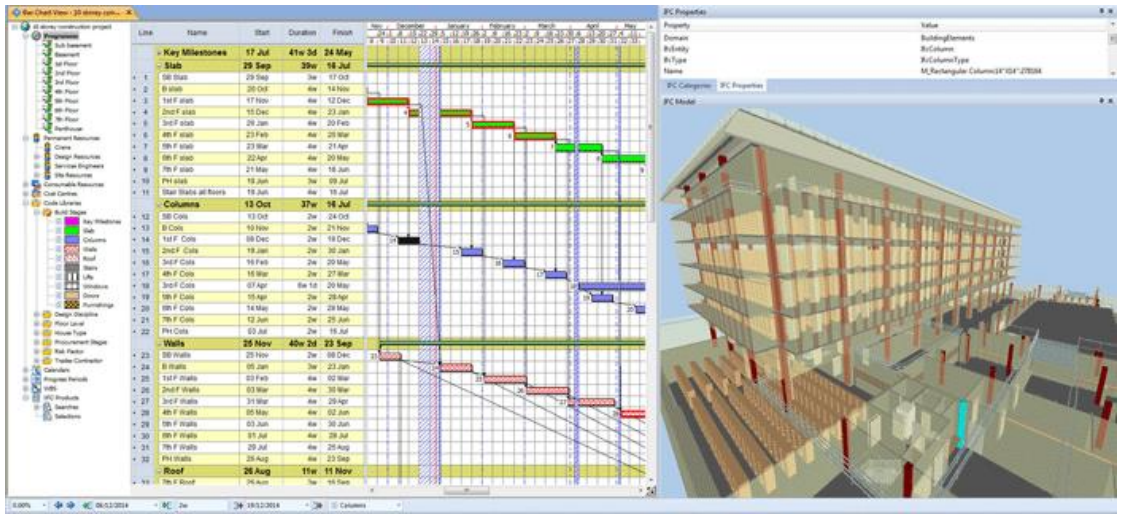
BIM TOOLS AND TECHNOLOGIES

Communication

BIMcollab
BCF MANAGER

Planning

Asta Powerproject®



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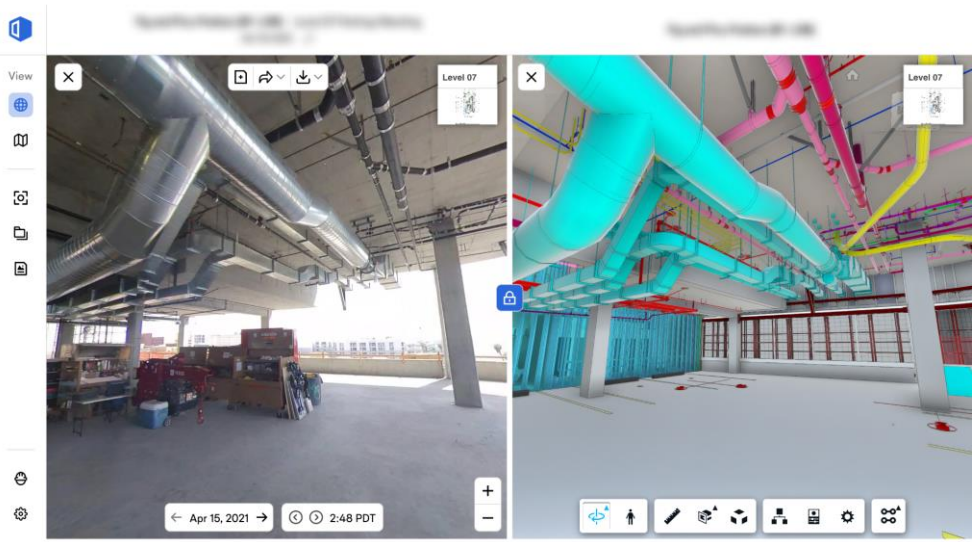
BIM TOOLS AND TECHNOLOGIES

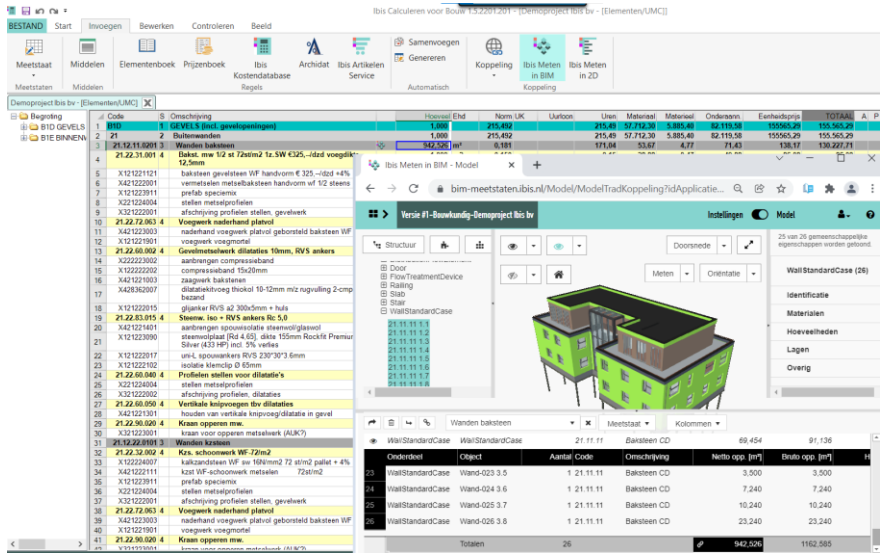
Asset management

OPENSPACE®



Budget management

IBIS
SOFTWARE VAN BRINK



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INTRODUCING FBK AND 3DOM UNIT

FONDAZIONE BRUNO KESSLER

Bruno Kessler Foundation (FBK) is a **public research center** of the Autonomous Province of **Trento** (Italy)

Some **600** employees (more than **350 researchers**, some **100 PhD students**) divided in 2 big research areas: Science & Technologies + Humanities

3DOM (3D Optical Metrology):

Expertise in photogrammetry, 3D modeling, metrology, machine learning, sensor integration & characterization

Applied research work in the fields of Photogrammetry, Industrial Metrology, 3D Mapping, Geomatics

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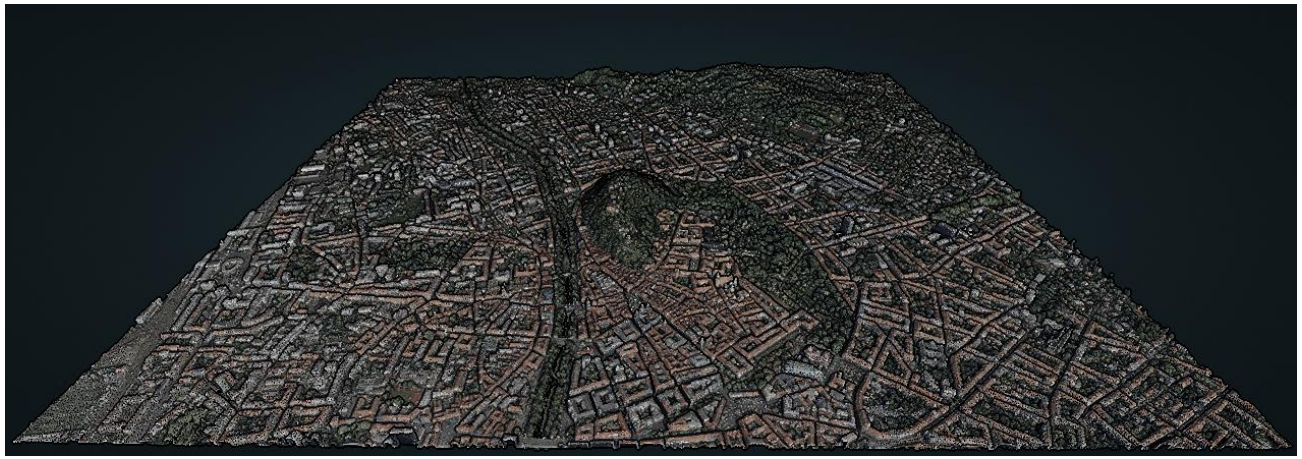
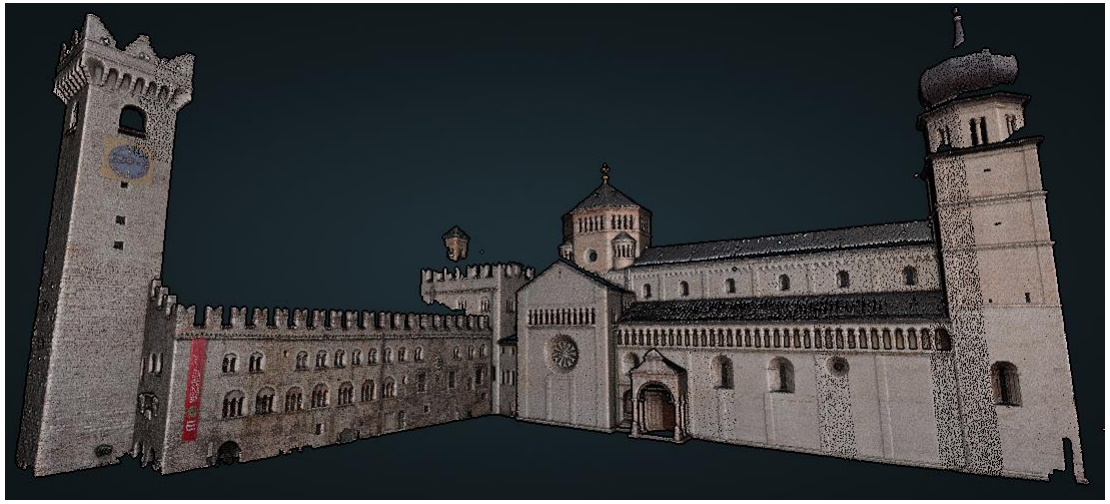
3D REALITY-BASED SURVEYING DATA





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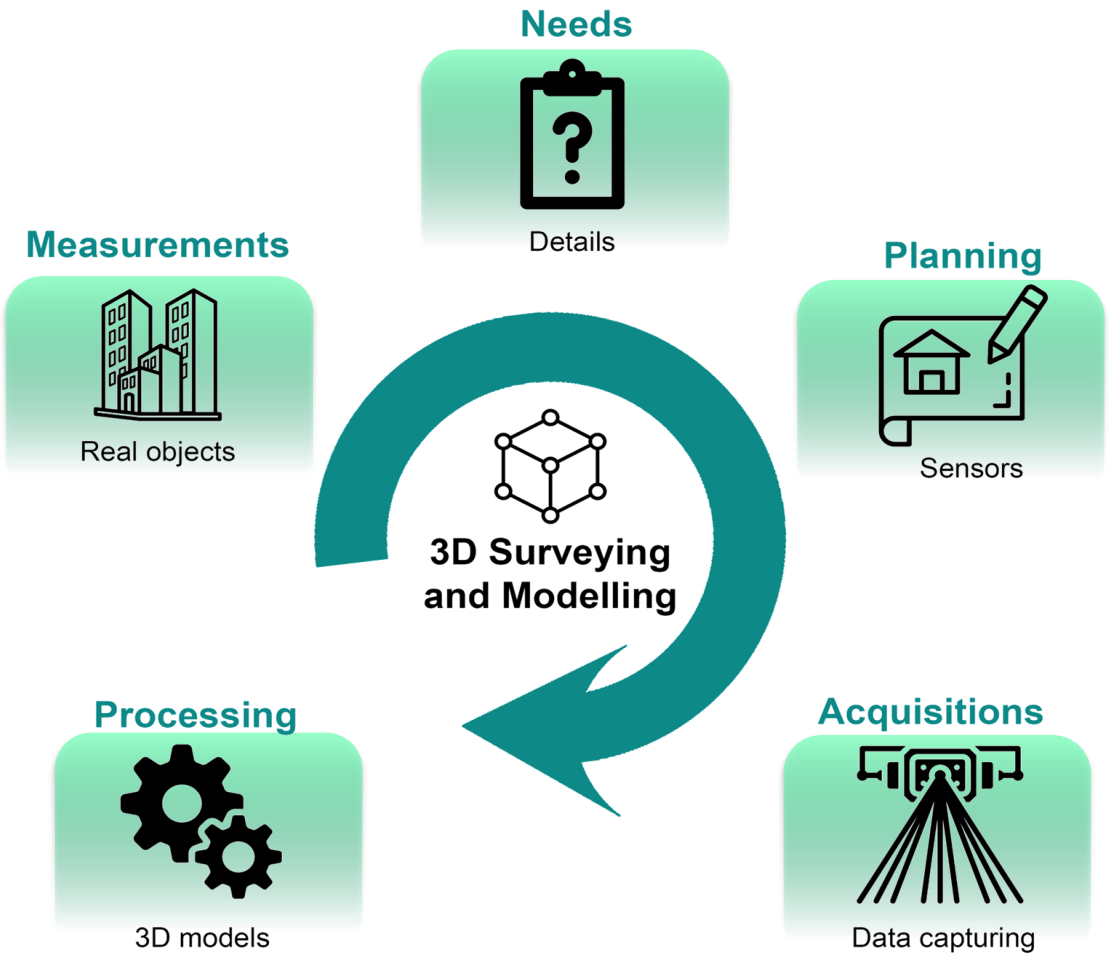

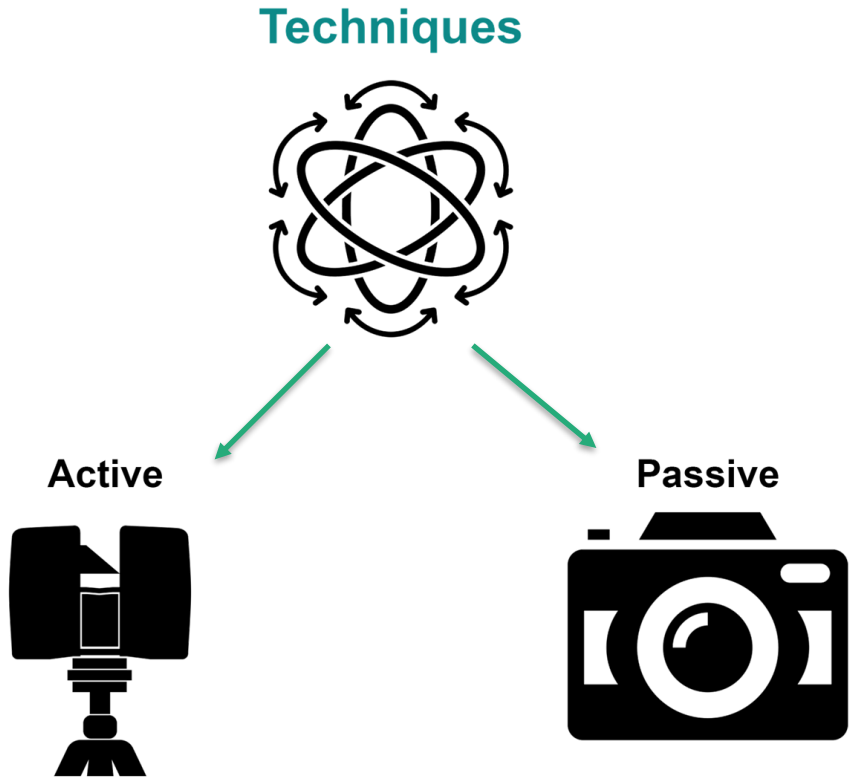

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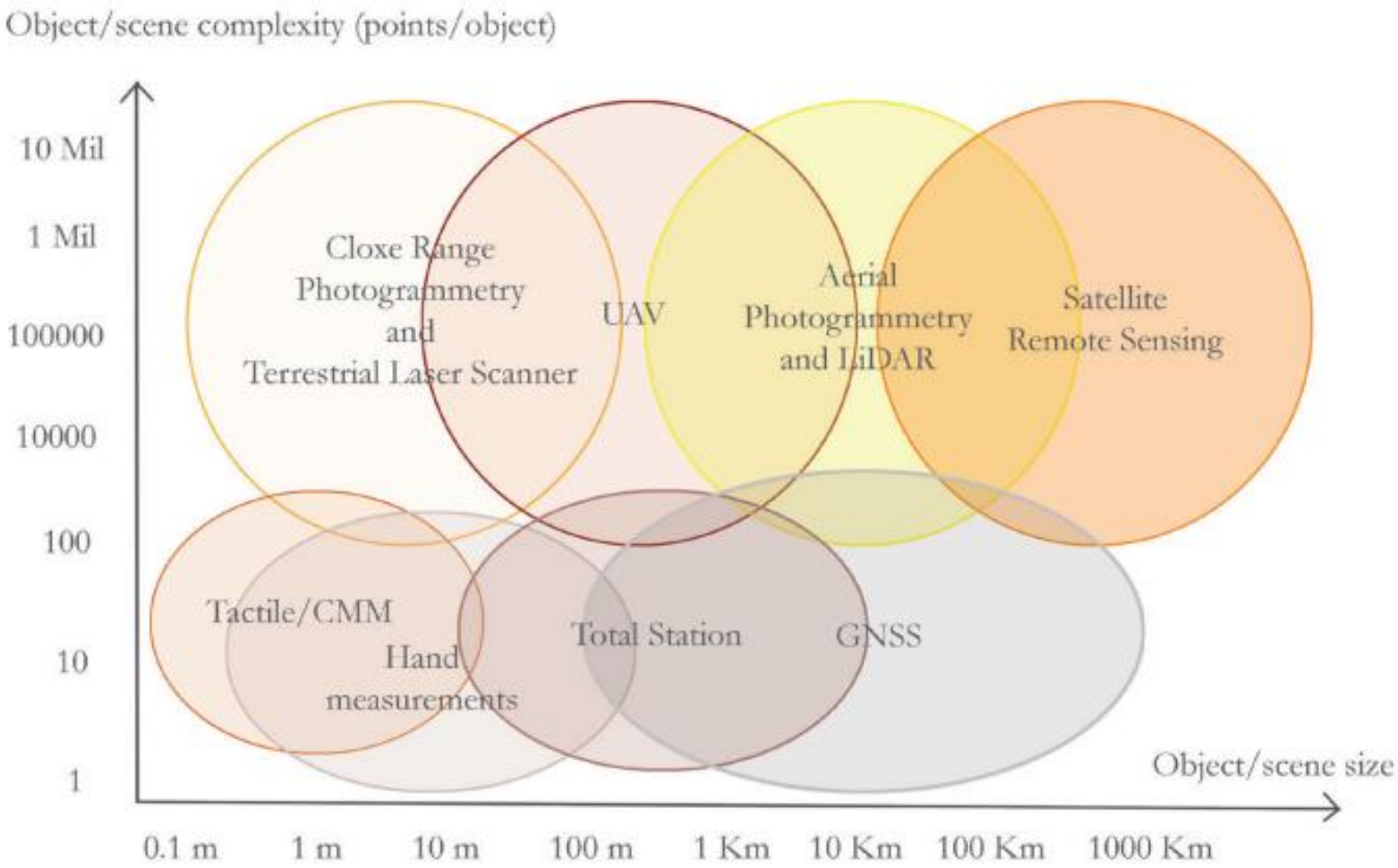
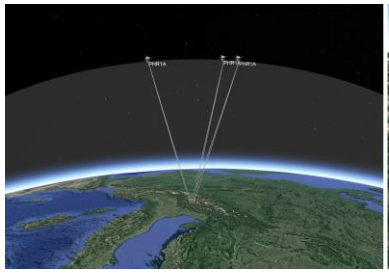
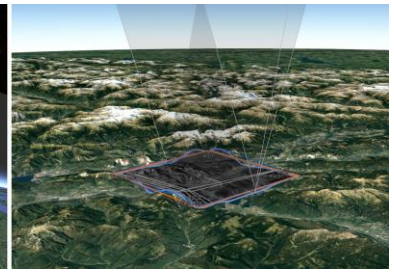
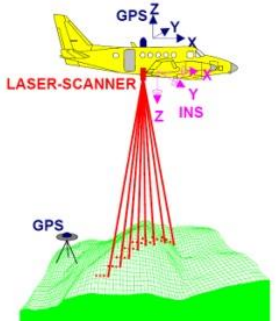
SENSORS/SCALE/DETAIL









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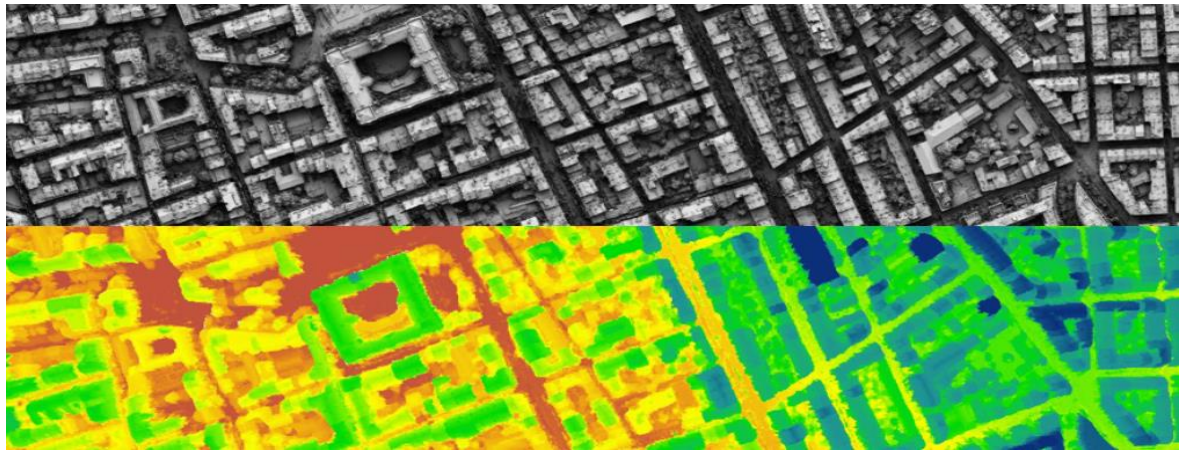
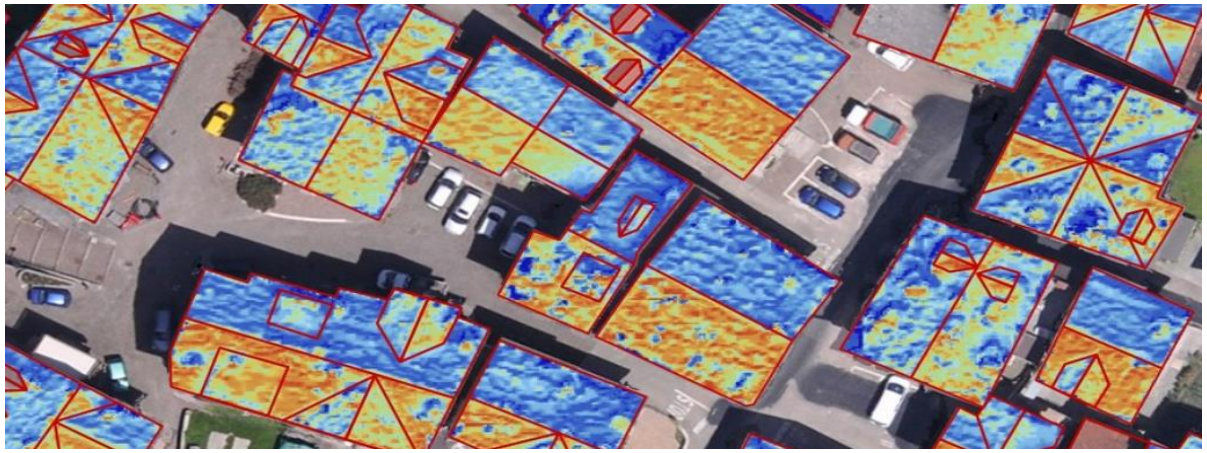
3D MODELLING – SOME APPLICATIONS

- Landscape/Terrain analyses

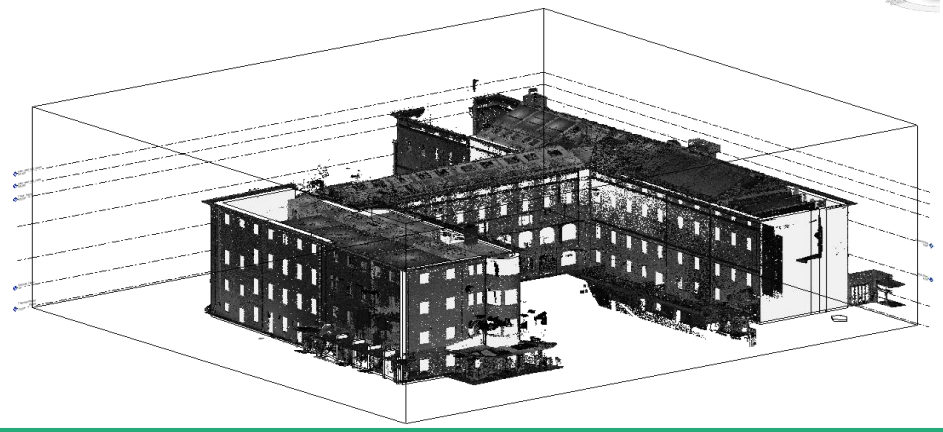


- LoD1-2 extraction

- Solar mapping



- BIM modelling



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BIM FROM 3D DATA: DEMO TRENTO SITE

SURVEY PHASE

- Geometrical building's data survey (referring to the existing conditions)
- Technological systems survey and detection

REGISTRATION AND ALIGNMENT OF SCANS AND PHOTOGRAMMETRIC IMAGE ORIENTATION

POINT CLOUD FOR BIM

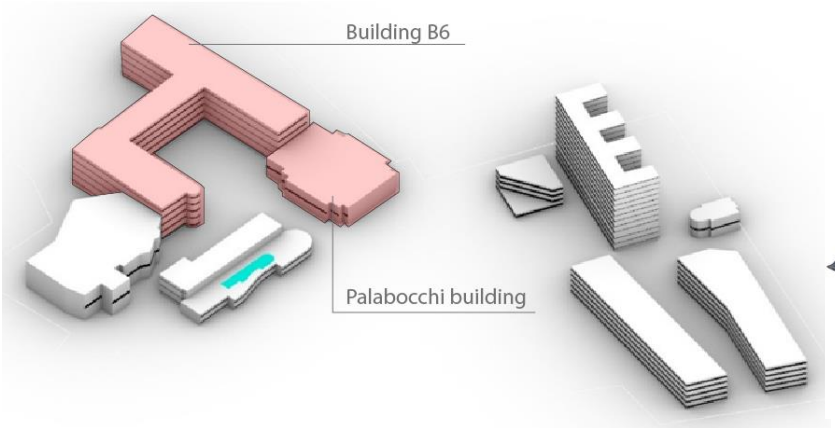
BIM PROJECT FILE

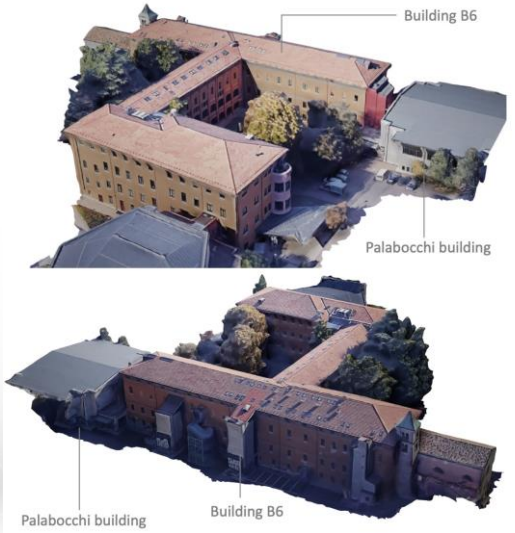
gbXML

BEM FILE FOR ENERGY ANALYSIS

Workflow

Santa Chiara district





Needs

- Different level of details
- 3D data manageable in BIM environment

Techniques

- Hybrid data (active and passive sensors)

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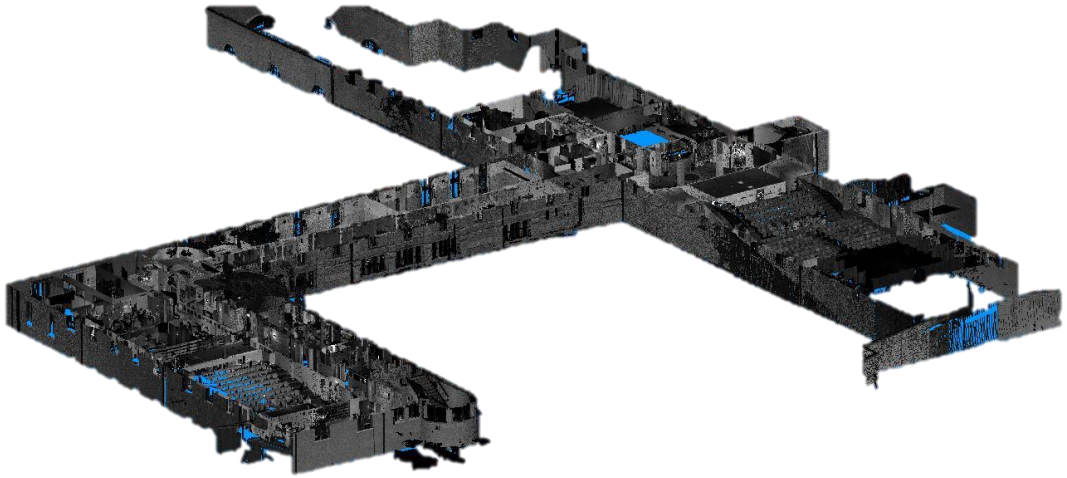
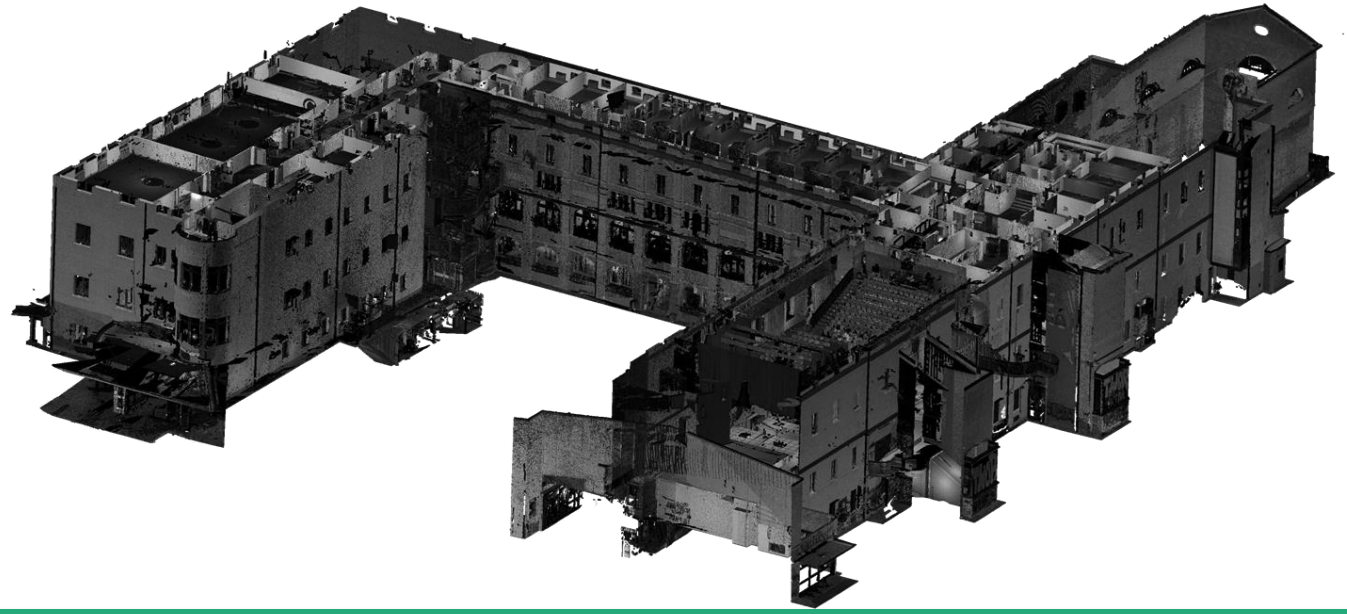
BIM FROM 3D DATA: DEMO TRENTO SITE

Terrestrial laser scanning (Leica RTC60)

- Acquisition and co-registration of 359 scans and panoramic images





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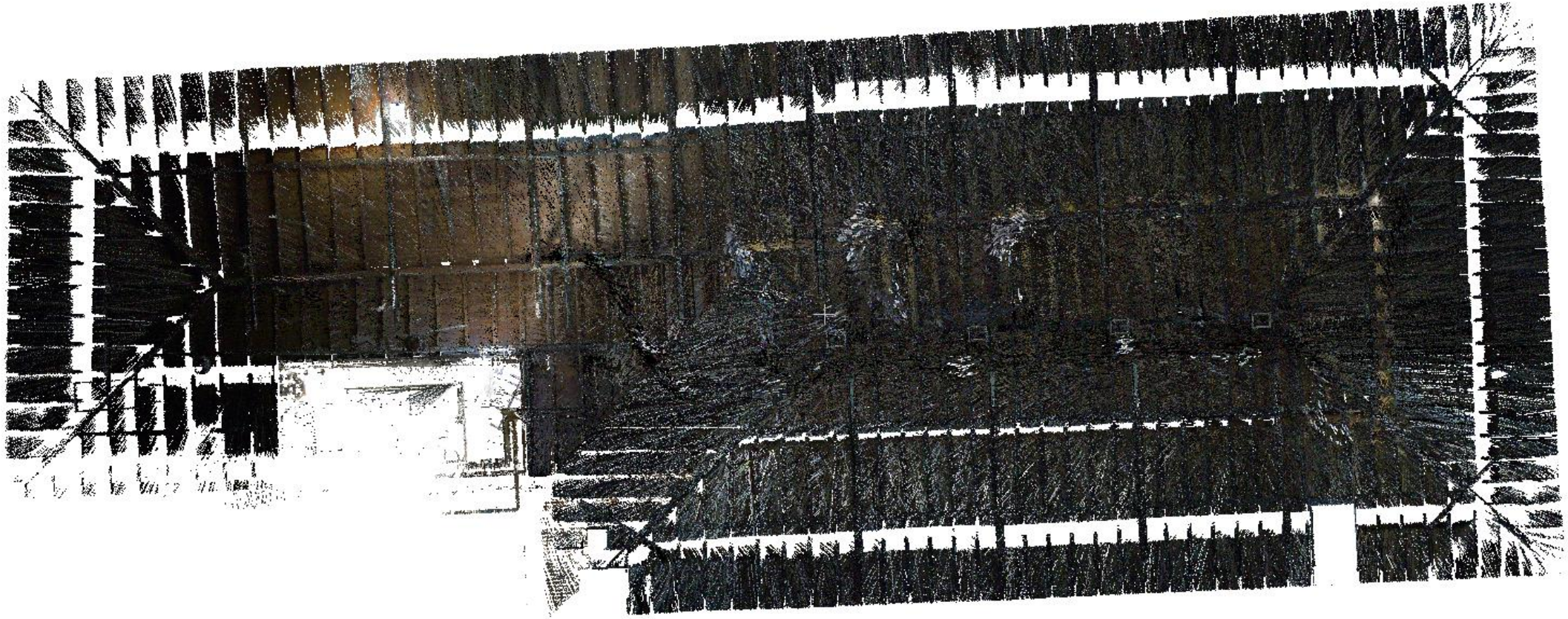
BIM FROM 3D DATA: DEMO TRENTO SITE

Mobile mapping laser scanning (Leica BLK2GO)

- 3 scans



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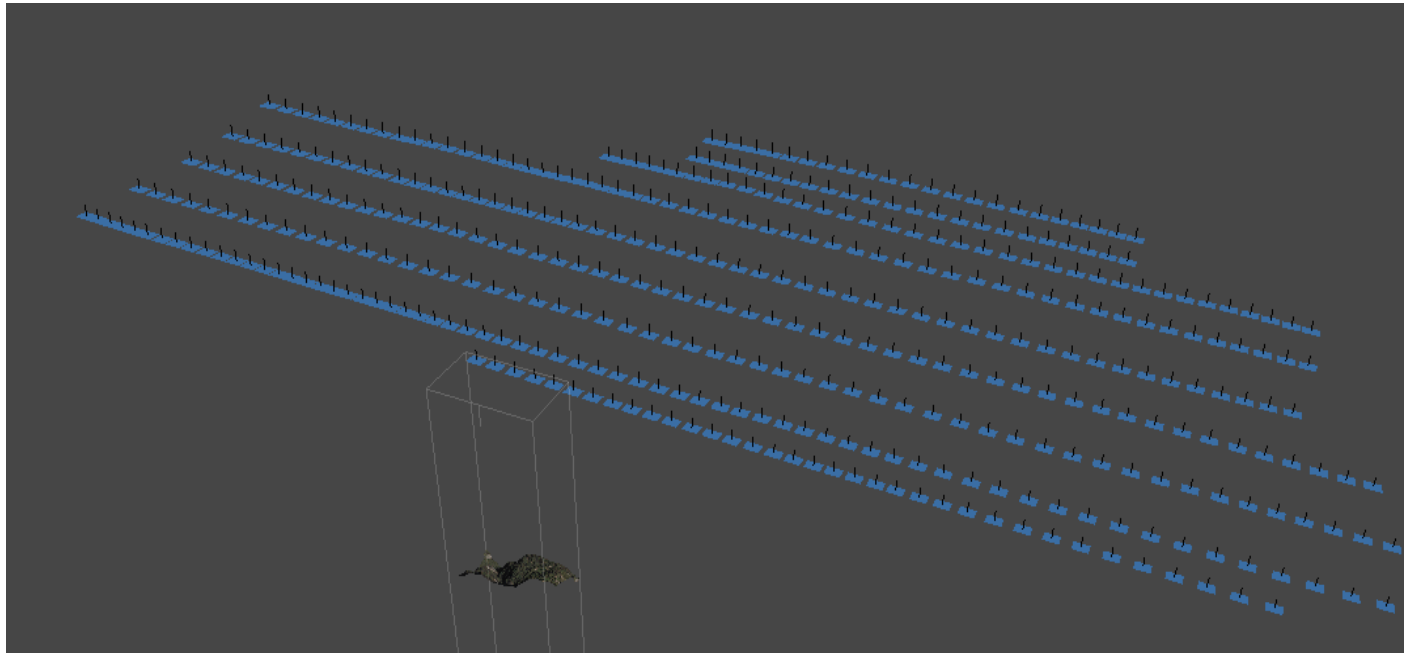
BIM FROM 3D DATA: DEMO TRENTO SITE

Aerial point cloud

- Processing of available aerial data over Trento



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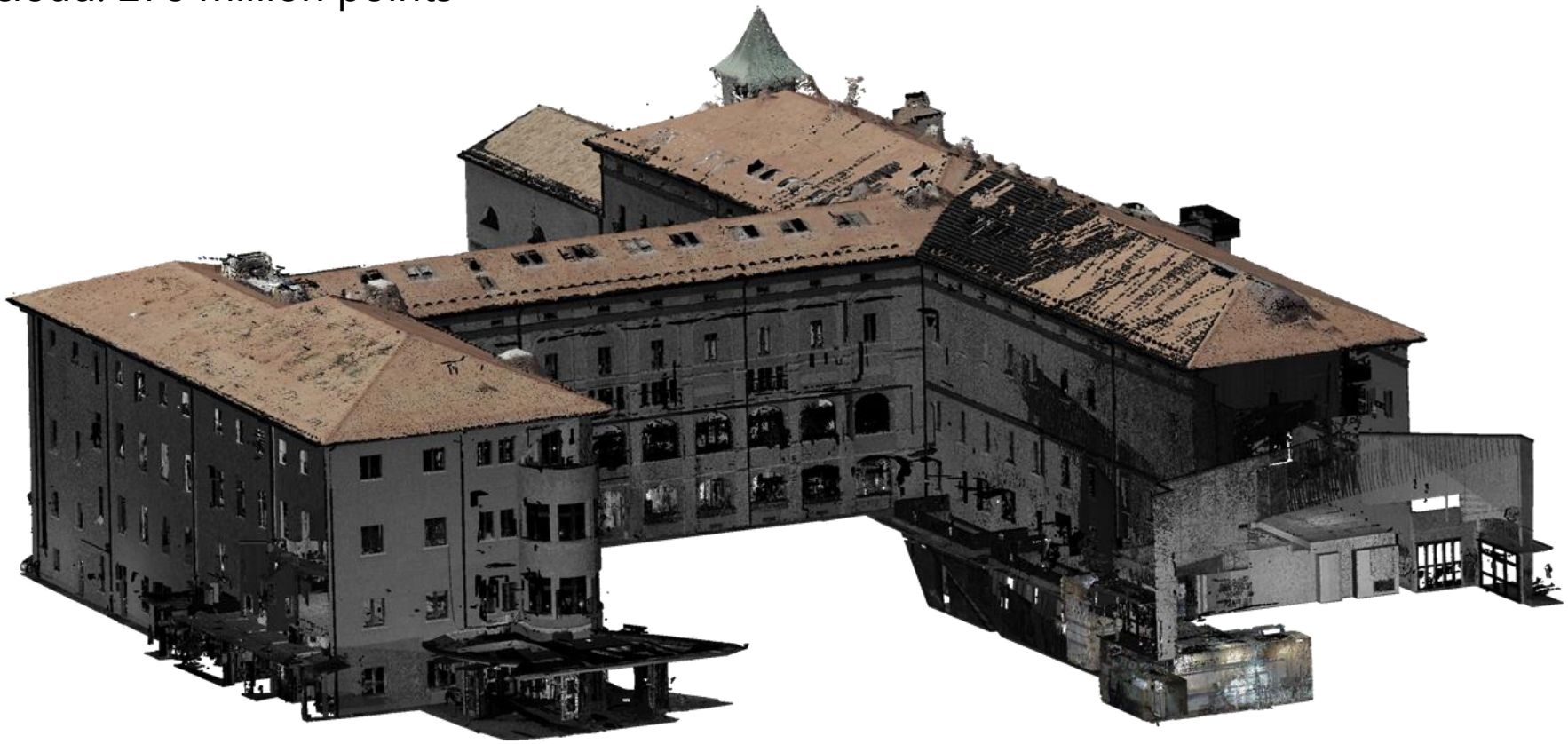
BIM FROM 3D DATA: DEMO TRENTO SITE

Data cleaning, co-registration, and merging

- Final point cloud: 278 million points



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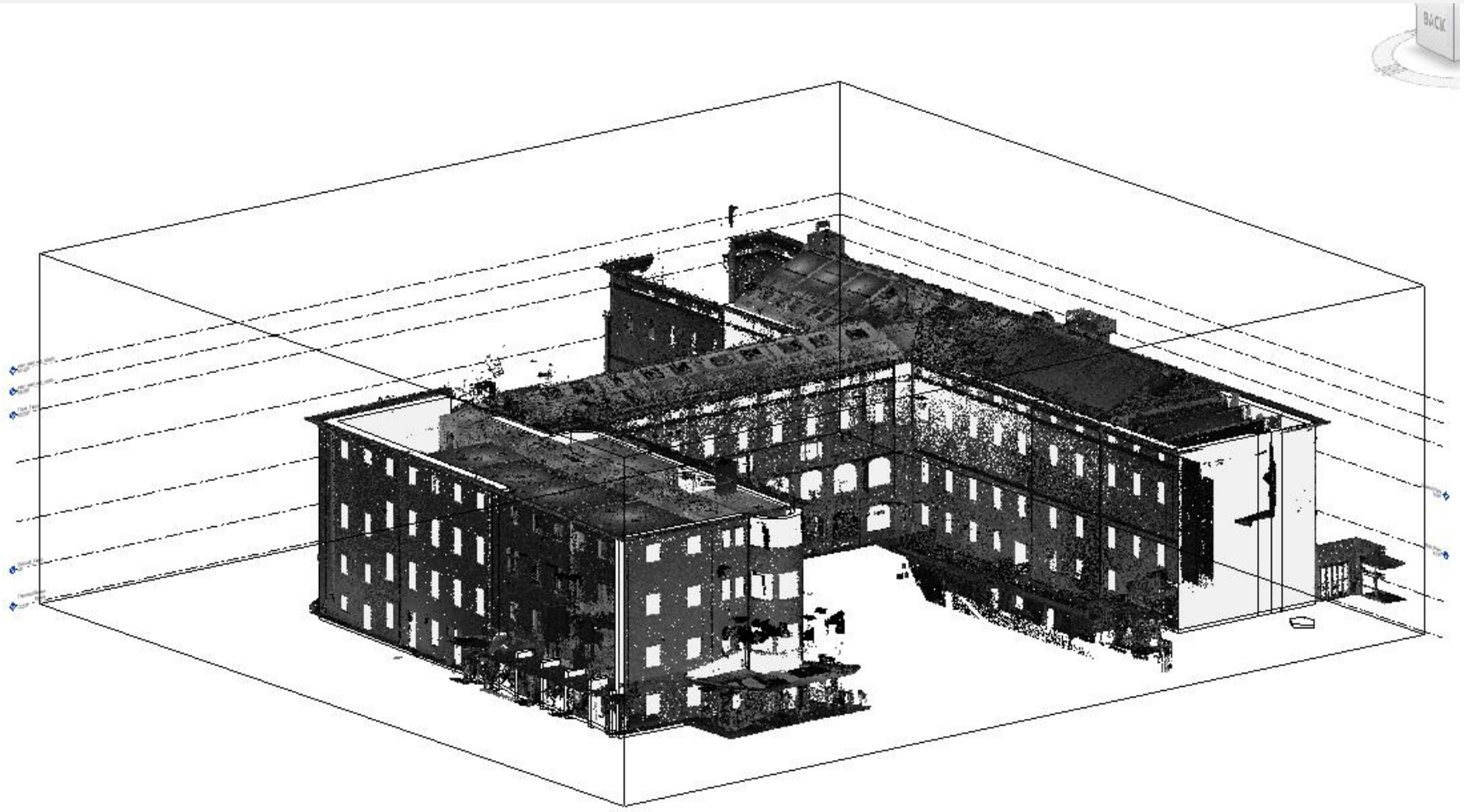
BIM FROM 3D DATA: DEMO TRENTO SITE

BIM



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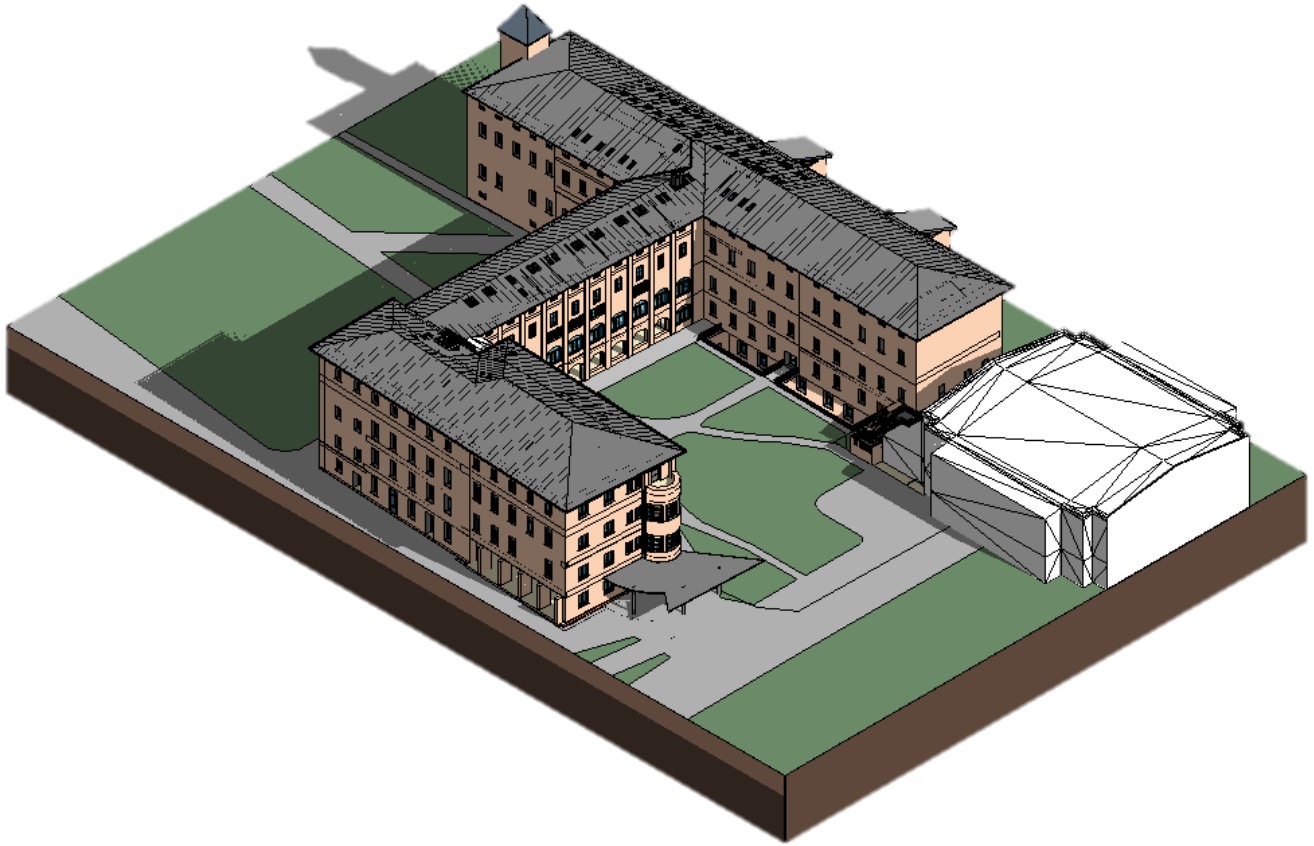
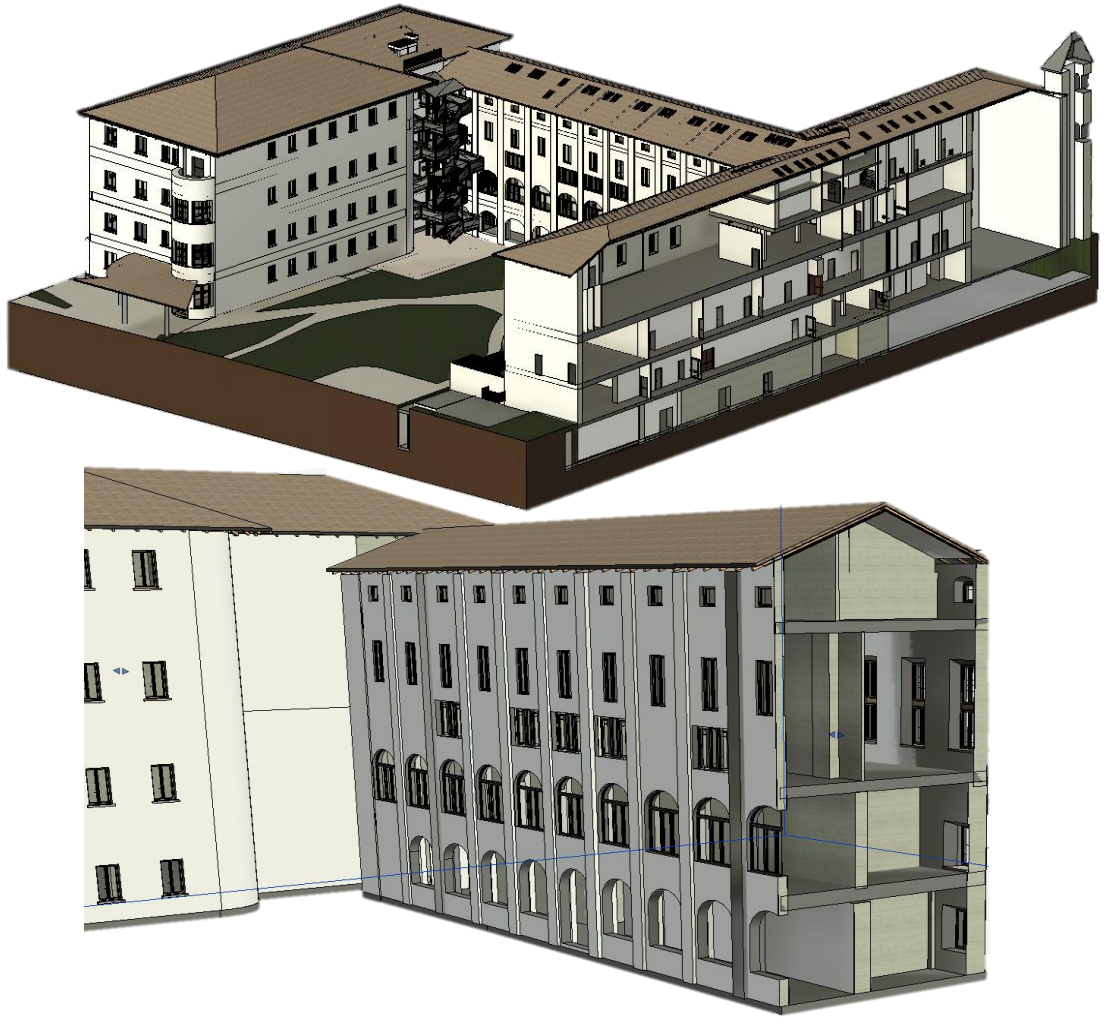
BIM FROM 3D DATA: DEMO TRENTO SITE

BIM





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RESEARCH EXPERIENCE

Research experiences and outlook

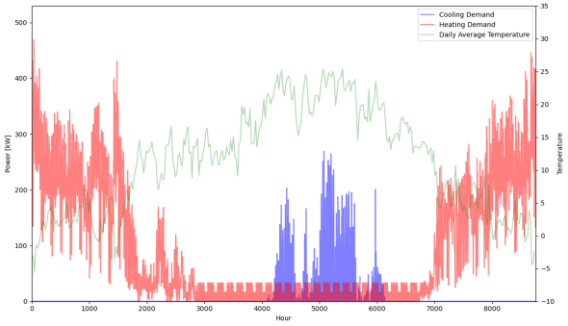
- New dataset shared with the R&D community

  [Roman, O., Farella, E.M., Rigon, S., Remondino, F., Ricciuti, S. and Viesi, D., 2023. From 3D surveying data to BIM to BEM: the InCUBE dataset. *The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences*, *48*, pp.175-182.]

  https://github.com/3DOM-FBK/InCUBE

Aim / tasks

- Developing and testing automated procedure and algorithms for BIM modelling (Scan-to-BIM)
- Improve the BIM to BEM process for more effective energy analyses



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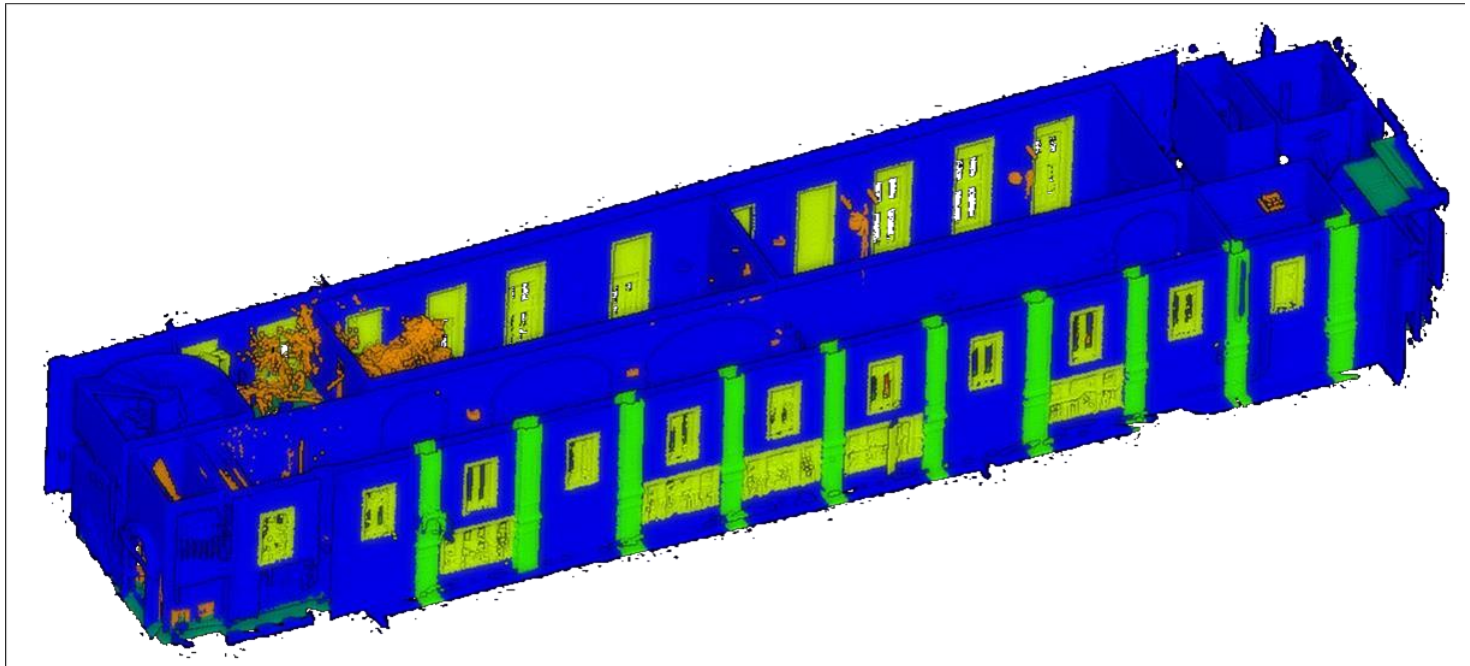
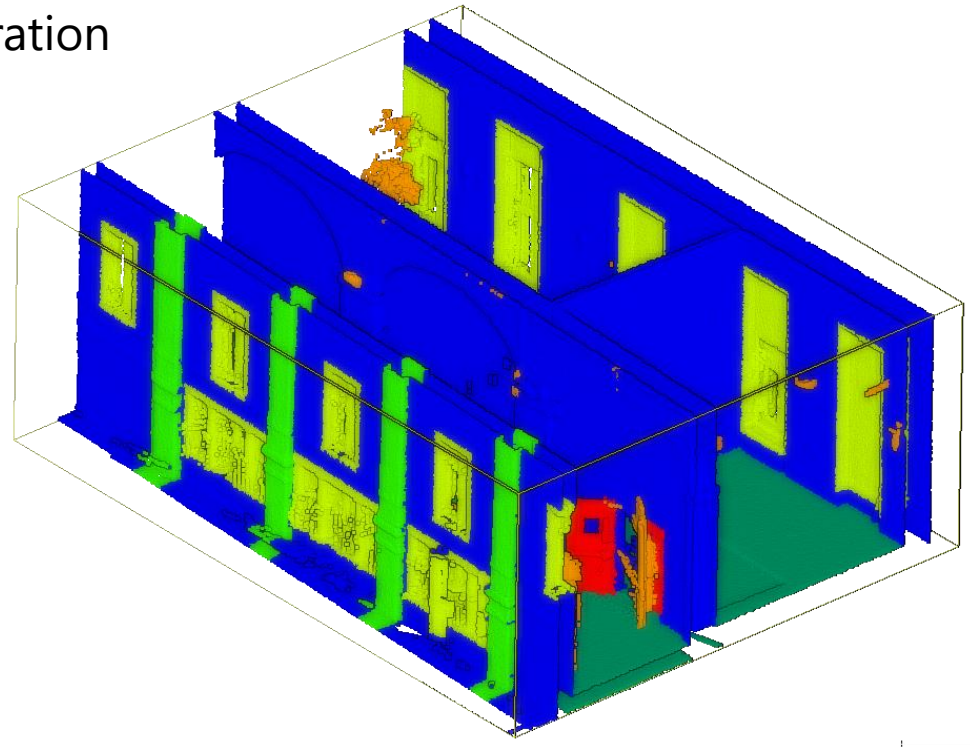
RESEARCH EXPERIENCE

Research experiences and outlook

AUTOMATIC POINT CLOUD CLASSIFICATION

- Classes based on BIM realization
- Results with successful metrics to support automation in BIM generation





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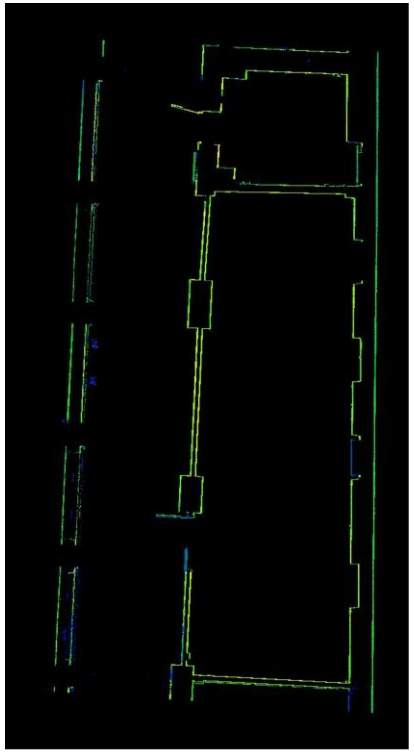
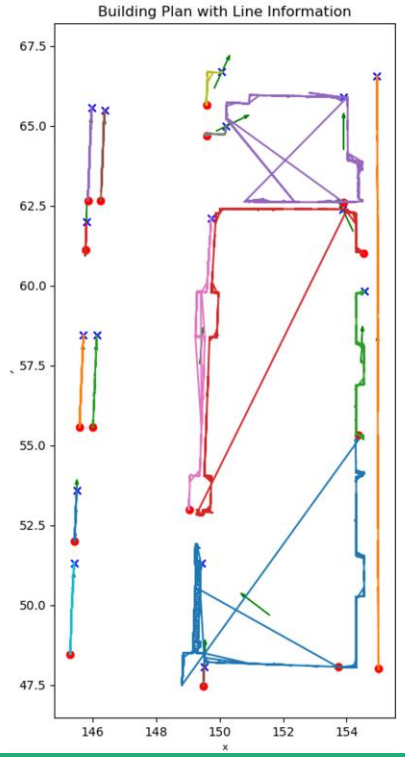
RESEARCH EXPERIENCE

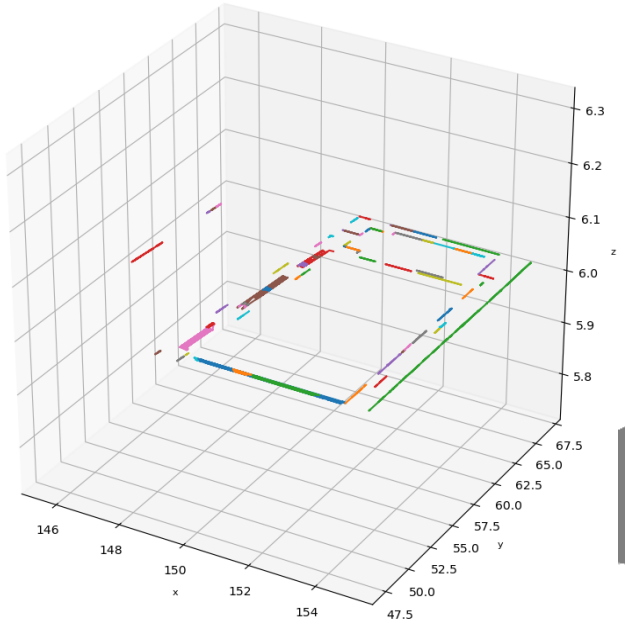
Research experiences and outlook

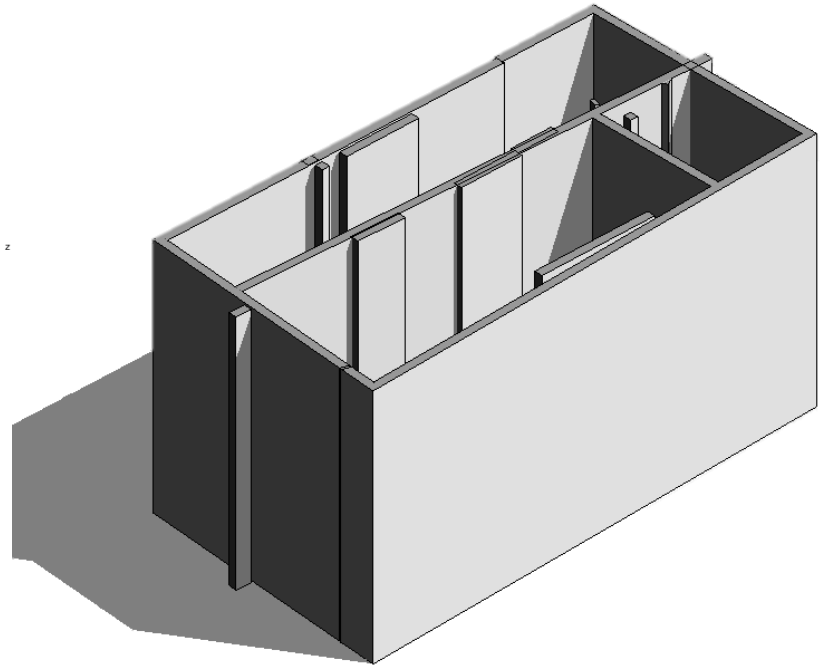
AUTOMATIC WALLS EXTRACTION

- C# Add-in for Revit environment enables the semi-automatic reconstruction.









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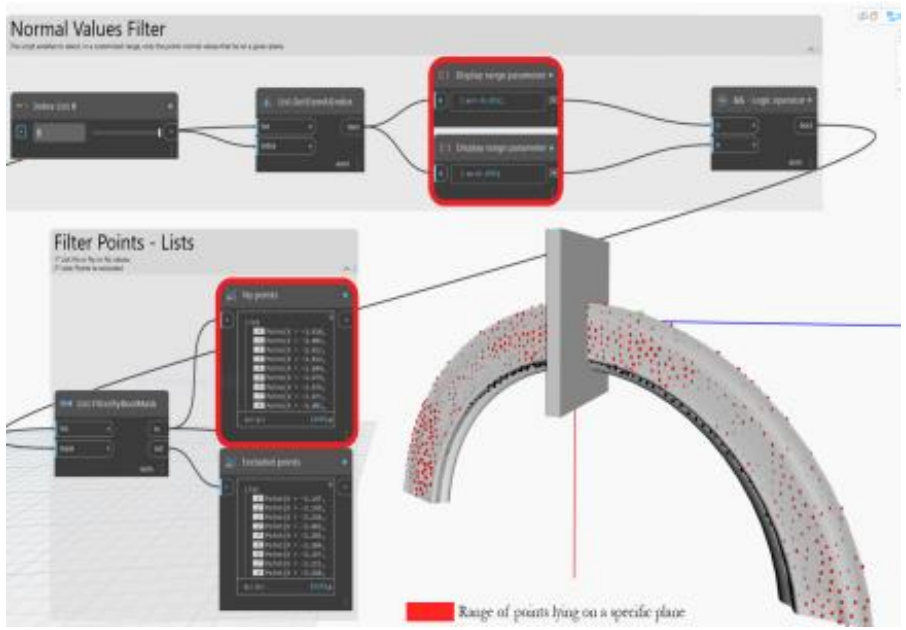
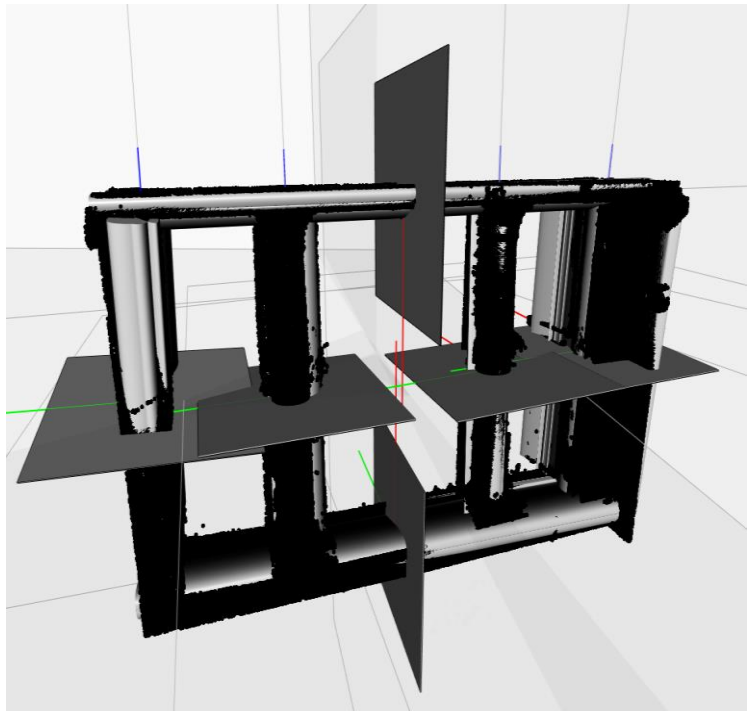
RESEARCH EXPERIENCE

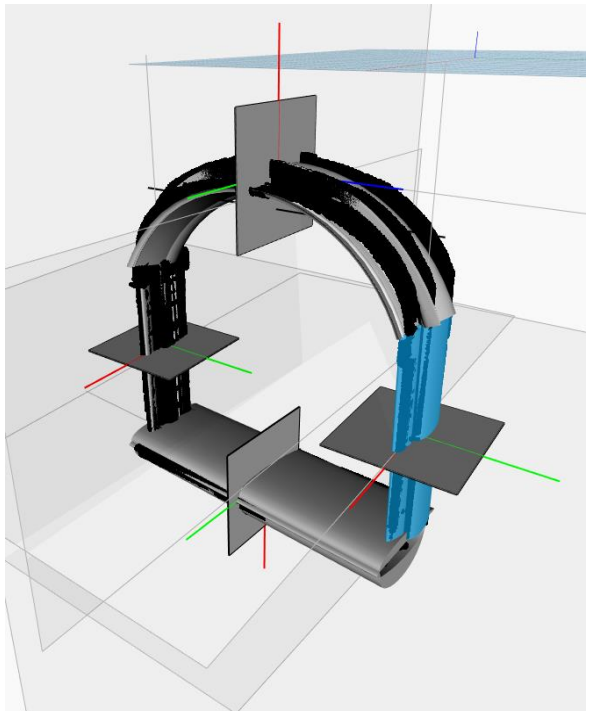
Research experiences and outlook

SEMI-AUTOMATIC MODELLING OF ARCHITECTURAL ELEMENTS IN BIM ENVIRONMENT

- Semi-automatic procedure based on Visual Programming Language (VPL) in Dynamo for single objects.







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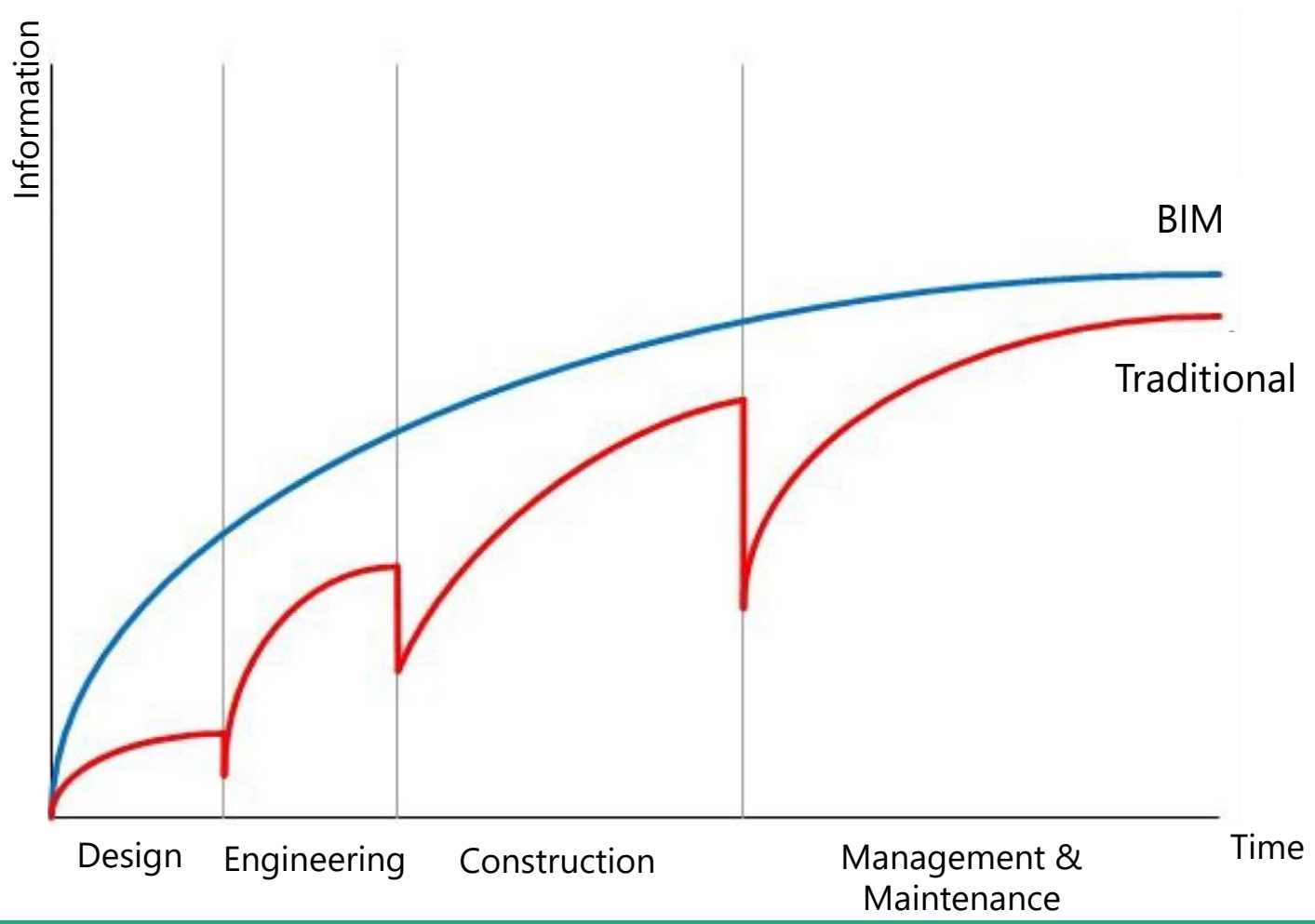
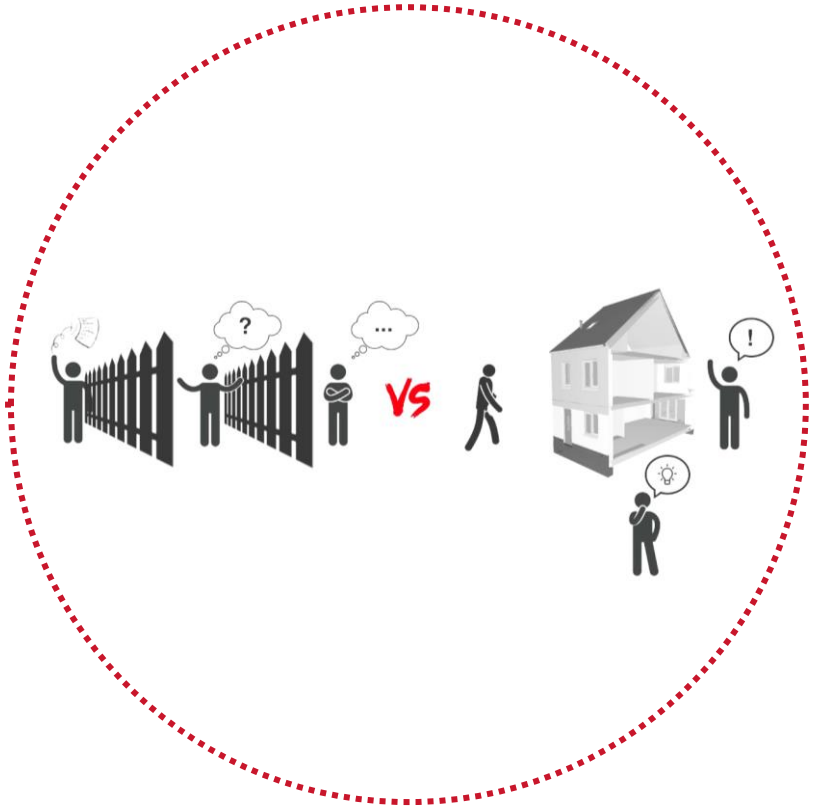
BIM CASE STUDIES





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BIM CASE STUDIES

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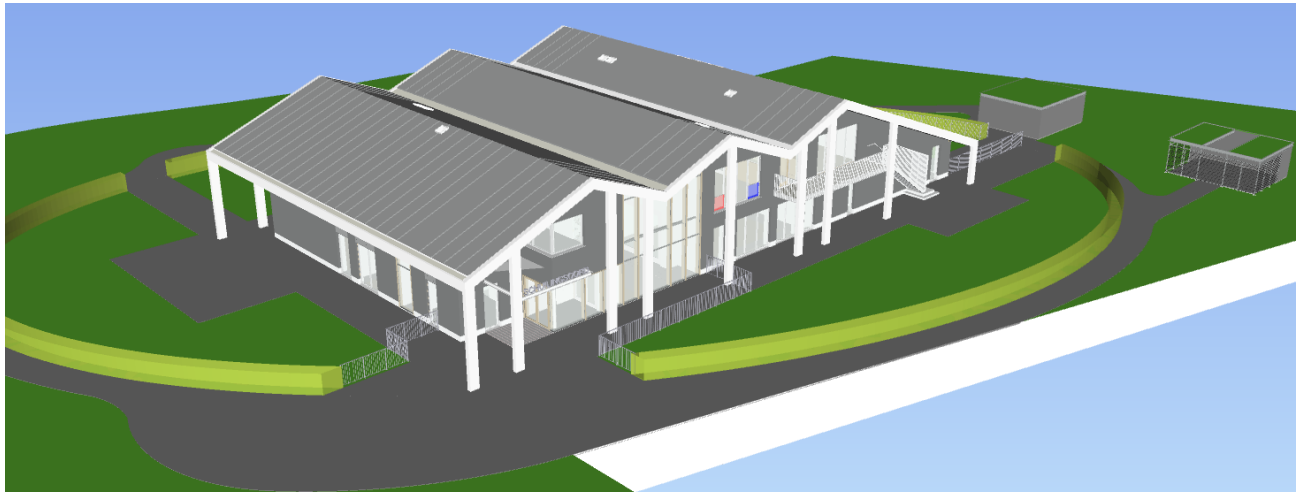
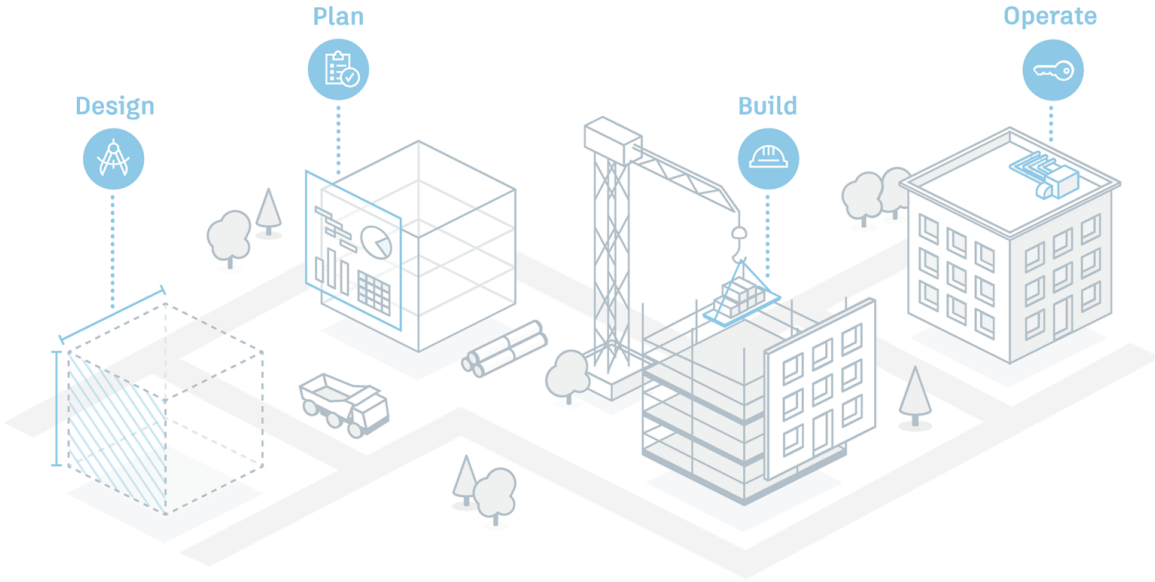
BIM CASE STUDIES

School project

- Upgrade Investment +/- €3500
- Engineering 3 weeks faster
- Reduced errors during construction





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