InCUBE
sustainable building innovations

WP3- D3.3

BIM/CIM Objects development (v1)

Lead beneficiary:

METRO7

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Executive Summary

This document summarizes the main results obtained in T3.2 for the achievement of necessary files that compose Deliverable 3.3. In addition, a short description of the methodology followed for the development of each document is included, as well as images of the contents and the working process followed. An updated (final) version of this report, including any necessary re-adaptations after iterations with other WPs is expected to be delivered by M41 of the project.

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List of Acronyms and Abbreviations

Term	Description
BIM	Building Information Modelling
CAD	Computer-aided Design
CIM	City Information Model
EPC	Energy Performance Certificate
GHG	Greenhouse Gases
GIS	Geographic Information System
IFC	International Foundation Class
LCA	Life Cycle Assessment
PV	Photovoltaic
TLS	Terrestrial Laser Scanning
UAV	Unmanned Aerial Vehicle
WP	Work Package

1 Introduction

This report describes briefly the works and tasks undertaken in Task T3.2 in order to develop BIM/CIM objects of the 3 demo-sites.

The associated task to this Deliverable is T3.2 Building mapping and BIM objects Development. All the BIM modelling framework including SCAN-to-BIM and BIM/CIM platform advancements and the creation of all necessary BIM/CIM models. A coordination document establishes a common and coordinated workflow, defining uses, purposes, and main requirements. Additionally, some templates were developed alongside the document.

The deliverable is composed of:

- Coordination document
- Modular BIM/CIM platform
- Scan-to-BIM IT demo site model (current state and renovation proposal in a unique file)
- Scan-to-BIM ES demo site model (current state and renovation proposal in a unique file)
- Scan-to-BIM NL demo site model (current state and renovation proposal in different files)
- BIM objects library (283 elements to date)
- CIM IT demo site models (urban level + 3 building level)
- CIM ES demo site models (urban level + 4 building level)
- CIM NL demo site models (urban level + 1 building level)

The Deliverable is partially achieved on 29/09/2023, when the BIM models of de IT, NL and ES demo sites are already uploaded to the modular platform, 283 BIM objects created, the internal coordination document updated and CIM of ES demo site is ready, as well as a preliminary draft of CIM models for IT and NL demo sites. The deliverable is completed on 30/10/2023 with the improvement of the contents of IT and NL CIM models. However, all these are live files that will be regularly updated as the project progresses.

2 The modular BIM/CIM platform

The BIM platform comprises four folders for each demo site: BIM modelling, where .rvt files are uploaded; BIM Objects Data, containing information about Revit families; IFC exports, which contains .ifc 3D models; and Point Clouds, where linked .rcp files are stored. These files along with the coordination document, are also stored in the project´s common Teams folder.

In addition, the Modular BIM/CIM platform contains a library of BIM objects,283 elements to date, stored in the BIM Objects Repository folder.

This library includes innovative InCUBE products organized into manufacturer-specific folders. The BIM objects have been developed as Revit families and have been tailored to match the specific features of each demo site building. The required BIM objects have been shared with demo sites to incorporate them into the development of BIM models. As renovation scenarios and innovative actions are developed within other InCUBE tasks, these BIM objects may be reviewed to fully align with demo site requirements and/or will be completed in subsequent revisions as more information may be available.

Furthermore, parameters and features defined for Digital Twins are being completed, with a focus on Digital Twins of Buildings in M20 related to T3.4. Regarding the case of Digital Twins of InCUBE products, preliminary simplified objects have been used in models and will be updated and/or replaced after DT milestone submission for these objects which is scheduled for M19 in T3.3. The BIM files will remain live documents, continuously updated as the project progresses and as decisions regarding renovation scenarios are made.

The Modular BIM/CIM platform also includes the CIM models of the three demo cities: Zaragoza (ES), Trento (IT), and Groningen (NL). Additionally, there is a simplified 2D version of the BIM models available on .json file formats. The CIM model of Zaragoza was initially uploaded to the platform in M15, along with an initial draft of IT and NL. The latter two were fully developed along M16 due to the challenge of finding publicly available, relevant, editable, and updated information for each city. The CIM models will continue to be updated if necessary, and the simplified version of the BIM models will also keep up to date as the project advances. These deliverables will be stored in the CIM repository folder. The following figure shows the organisational structure of the platform and the information contained within each folder. Access rights are allocated to partners based on their specific needs to safeguard the confidentiality, integrity, and prevention of modification of the platform’s information.

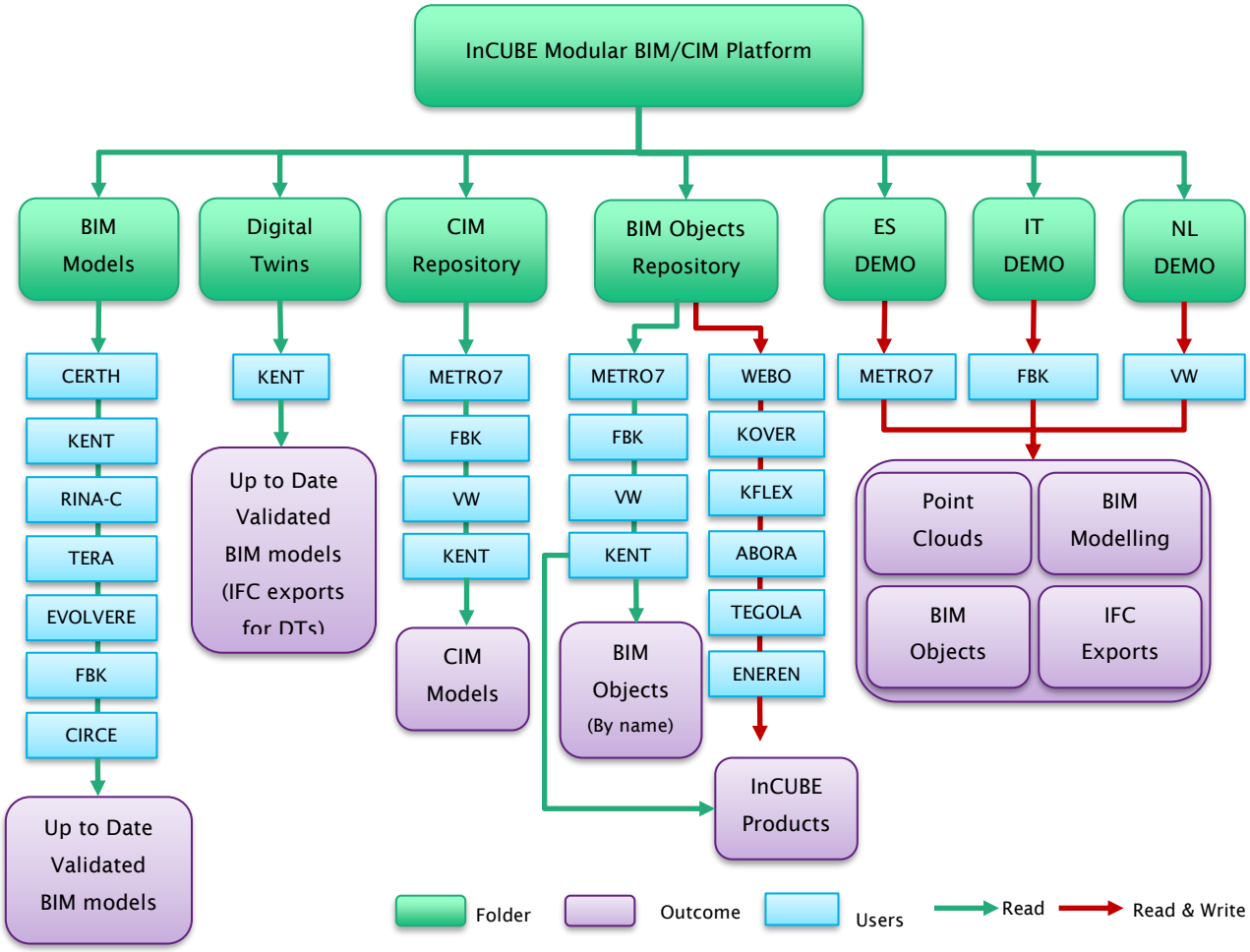


Figure 1 - Folder structure in the BIM/CIM platform

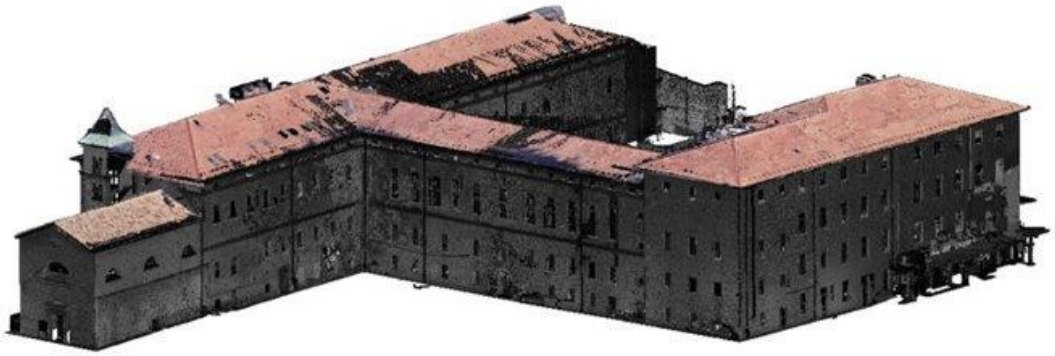
3 IT demo site BIM model

Regarding **IT demo site BIM model** some amendments have been presented in the last months for the Trento demo site, and the final approval is still pending. Regarding the activities of T3.2, two of them have more relevance. The first involves the UAV-based surveying expected for the 3D data acquisition, which has been prevented by some flight restrictions established in the pilot area. An alternative solution was put in place, i.e. a terrestrial laser scanning technology (Leica RTC360) for acquiring facades and indoor spaces (about 359 scans). Missing information has been integrated by processing available aerial images with photogrammetric techniques and realizing a complete 3D model of the building envelope and surrounding spaces. The second amendment interests the PV panels installation, which will not be positioned on the roof of the principal/historical building (surveyed indoors and outdoors with the above-mentioned technologies), as initially foreseen, but on one annexed block (the Palabocchi - B6 block of the Santa Chiara district). Only the envelope of this block was therefore modelled. Regarding the 3D reality-based data acquired and used as a reference for the BIM modelling activities, the 359 TLS scans (roughly aligned on-site) were registered and optimized in Cyclone Register 360, with an overall bundle error of 0.002 m (overlap 61% and strength 60%). The original TLS point clouds (original resolution of 2 mm) counted about 802 million points. The registered point cloud was cleaned (removing outliers and useless areas) and re-sampled at 5 mm resolution, finally featuring about 388 million points. As said, the TLS scans were acquired in the accessible parts (facades and all the indoor spaces – except for the south area on the first floor that was not accessible). Some aerial data available over Trento were processed with photogrammetric techniques to have enough information for the BIM modelling and integrate missing parts. Data fusion techniques and algorithms were employed for merging these multi-resolution 3D data (higher resolution from the TLS source). The final combined model was imported into the BIM environment for the modelling of the pilot site. For the B6 block modelling, 3D reality-based data and available CAD drawings (for integrating missing information of not scanned / not accessible spaces) were employed. The BIM model was built following the level of detail of the source information and the planned interventions for the pilot site. The central interventions will involve:

- The replacement of the windows (currently single and double-glazing windows);
- The renovation of the facades;
- Demolitions of some internal partitioning (the project for the reconfiguration of the interior spaces has been recently approved by the municipality);
- The PV panels installation (the amendment was presented for the installation on the Palabocchi roof);
- A new insulation layer on the roofs (the coverage packages are currently different in the north, central, and south areas of the historical building, and the position of the insulation will probably vary in each case).

- The substitution and installation of new systems in different building areas are still under discussion (air treatment unit, refrigeration unit, collectors, etc.).

In the current state of the Santa Chiara BIM model, the elements mentioned above are more detailed, being the focus of the interventions. The renovation status includes, at the moment, a representation of the approved and more probable changes foreseen in the project to update when more decisions will be taken. About the systems, the current state version includes more relevant elements of the plumbing and heating system (gas plants, fire-fighting, sinks, cabinets, radiators, fan coils, boilers, plumbing manifolds, expansion vessels, refrigeration units) and electrical system (light points, and neon, electrical box, electrical panel, trays).



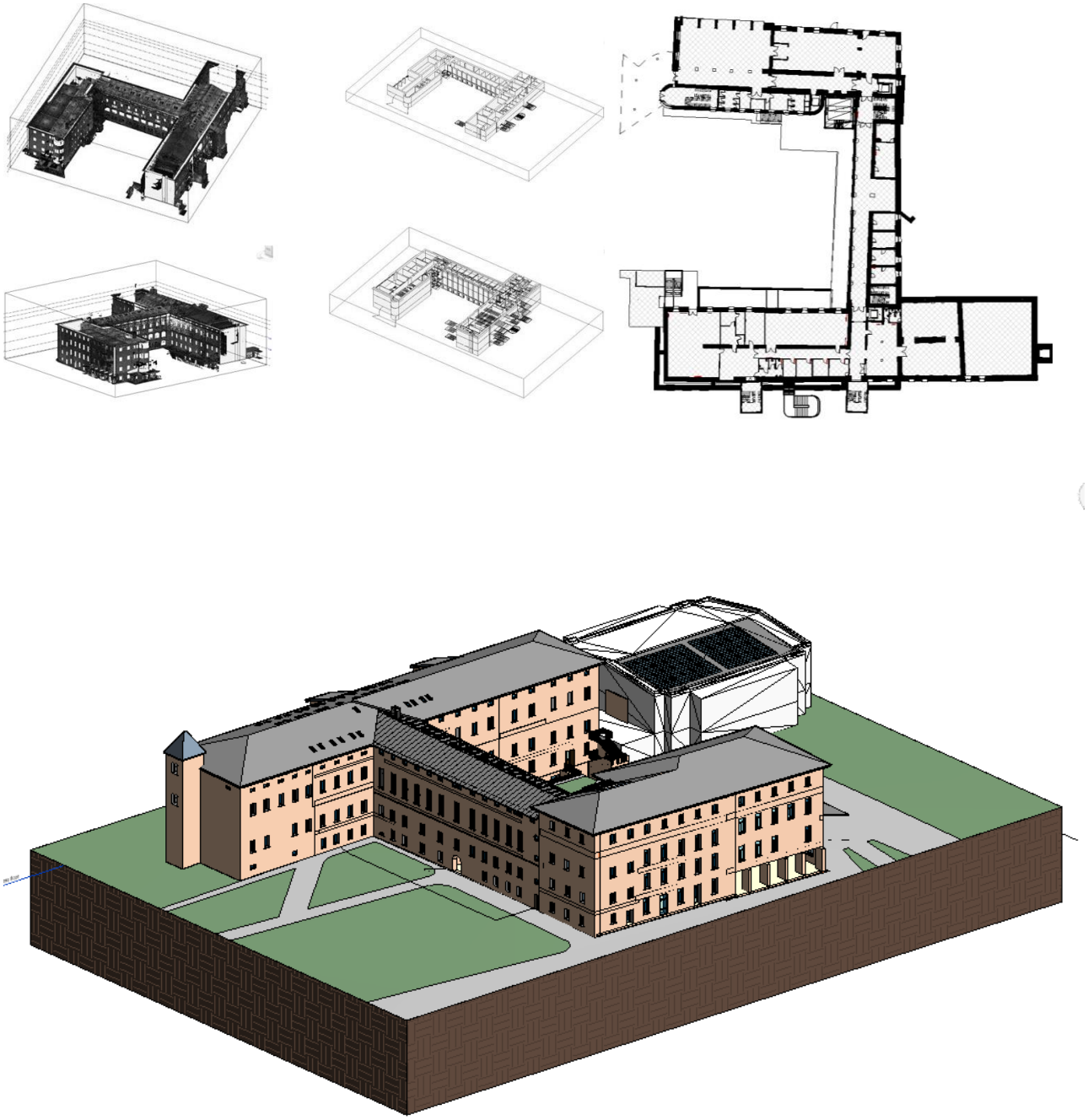


Figure 2 – Some images of the data gathering campaign and BIM 3D models results from IT demo site

4 ES demo site BIM model

The **ES demo site BIM model** contains a detailed definition and 3d model of current state and an initial renovation proposal of the building based on Scan-to BIM methodology. 125 scans have been performed and managed in merged groups, as well as, an UAV flight for aerial photogrammetry purposes (which was not initially considered in InCUBE project proposal). Outdoors point clouds have been combined with the aerial photogrammetric point cloud and indoors point clouds have been merged by staircase and typology (e.g. 4 staircases, pitched roof, foundations and 2 dwellings). In addition, it has been performed an onsite validation of main dimensions and features assessed in the point clouds obtained. In the BIM platform, combined and cleared point clouds have been uploaded from outdoors and common areas. Due to the public dissemination level that the platform may have, dwellings interiors' point clouds have not been shared as they contain images of personal belongings. The BIM model has been linked to the general point cloud and to an external levels and grids file. During the Scan-to-BIM process, decisions have been made in order to define the accuracy expected from the 3d-model attending to its future uses. For example, the levels in the model have been defined according to each of the staircases, dividing them into 4 parts as a slight tilt has been observed in the building. This way the existing deviation is reduced and controlled while transforming current state unevenness into a regular geometry. The interior details point clouds have been used when necessary to define spaces distribution. However, as no relevant renovation works are expected inside dwellings, high definition of details was not required. The BIM model also contains a phase for demolition works needed. Regarding renovation proposal, an initial draft of solutions to be implemented has been included. The BIM model contains the improvement of the envelope (façades, ground floor and roof; the layout of hybrid and PV panels on the pitched roof; the installation of a new lift, the substitution of the staircases and the installation of other elements such as clotheslines guards, equipment installed in façade and rain drainage). The validated BIM objects developed within this task have been incorporated in the 3d model and in those cases where the objects were under revision a generic version has been incorporated. During the development of the renovation design, the families will be enhanced and adapted to actual solutions. Furthermore, digital twins of products may be incorporated.

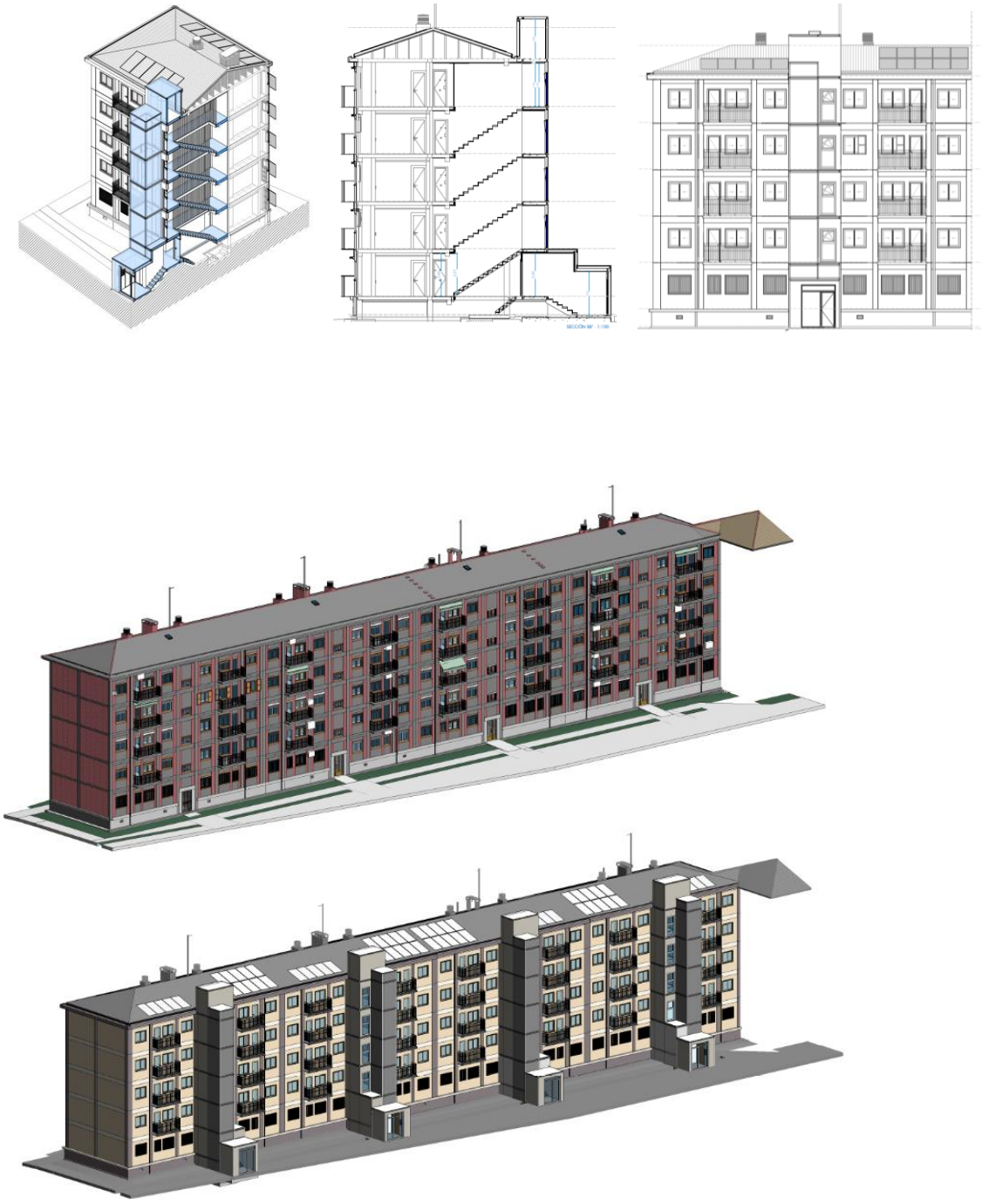


Figure 3 – Some images of the data gathering campaign and BIM 3D models results from ES demo site

5 NL demo site BIM model

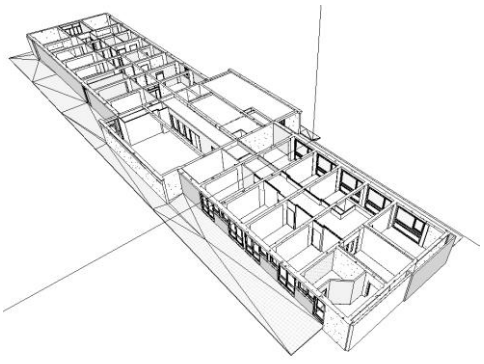
In the **demo case of the NL** the established BIM model is a Revit model, which shows the current state of the building - Van Heemskerckflat.

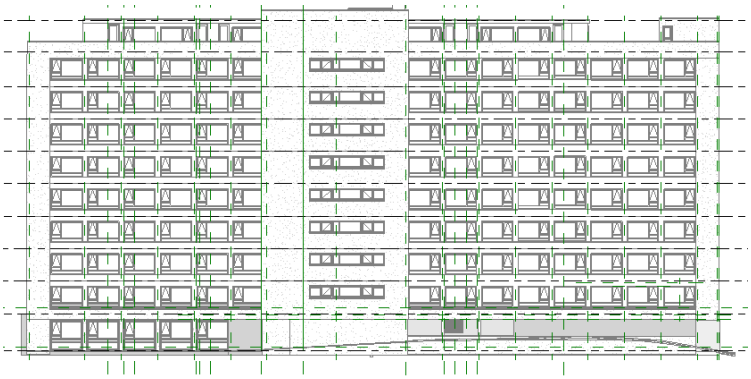
In order to establish the BIM model, the first step was to conduct scans of the inside and outside of the building. In total 431 scans have been undertaken, which formed the basis for the establishment of point clouds. These point clouds are linked to a grid section, which is positioned towards north. Based on the point clouds, we created a detailed 3D model that contains the different parts of the building such as the facades, windows, internal walls and doors.

The BIM model contains 9 different levels (10 including the foundation), with each level consisting of different objects (e.g. floors, walls, roof etc.). Each of these objects is provided with the following parameters: standard nomenclature from Uniclass 2015, object material, and measurements.

The renovation model is to be considered distinct from the current model. The size of this model and thus the building will increase as there will be an expansion of the facades and a complete floor will be added on top. The data we aim to obtain in this model will be the same as the current state model plus the innovation objects from our partner WEBO. These objects are the facades which include PV panels.

The BIM models for the NL demo site will be used beyond the context of the deep renovations. Additionally, we aim to apply the data from these models to control and manage robotic systems. A BIM model would allow us to determine where and how parts can be demolished, where drillings should be made and where an element (e.g. façade element) needs to be placed.





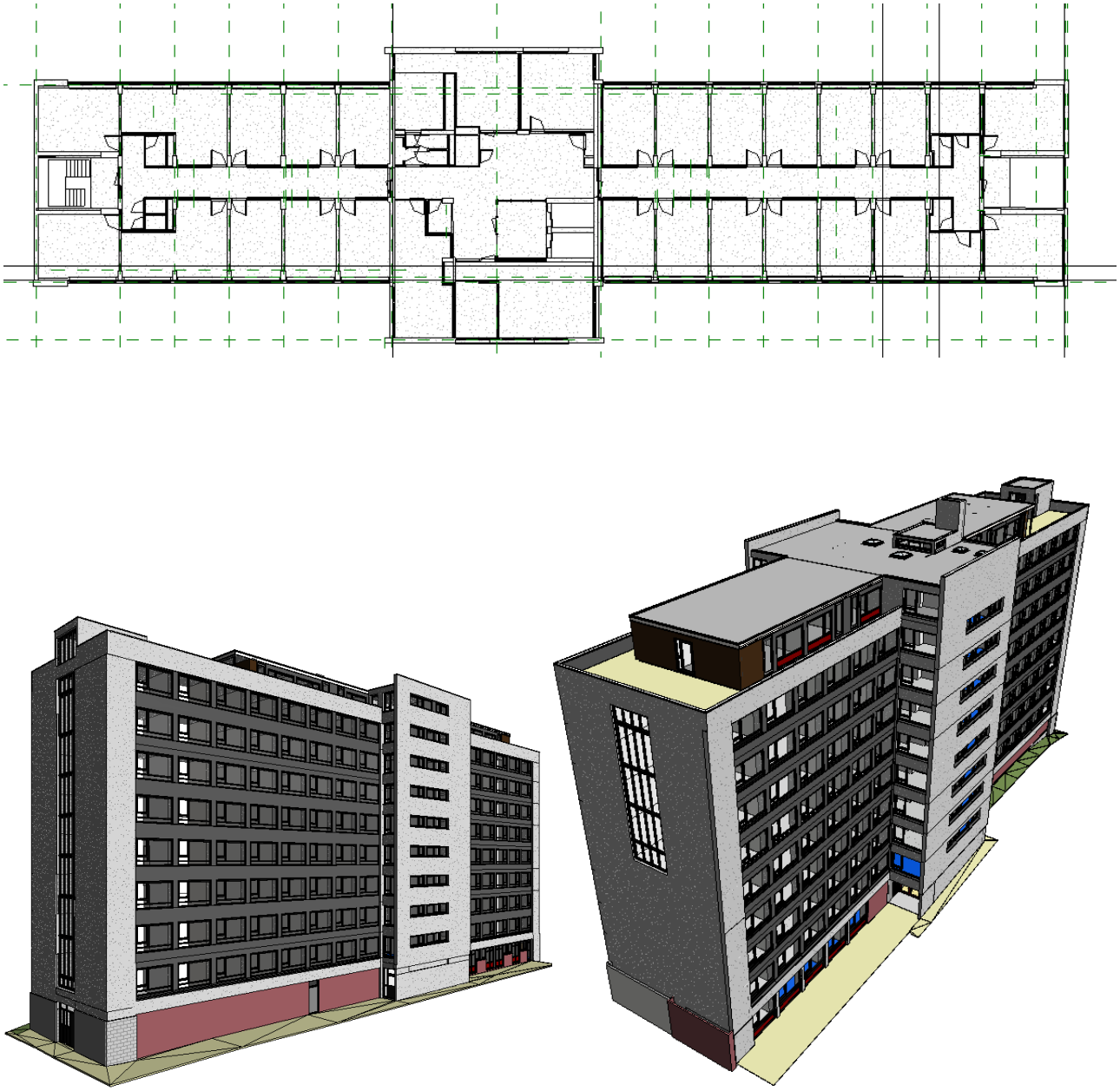
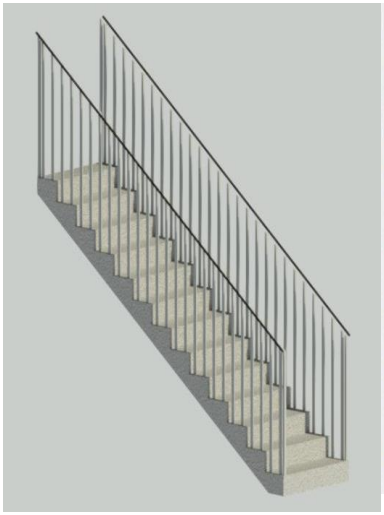


Figure 4 – Some images of the data gathering campaign and BIM 3D models results from NL demo site

6 BIM objects library

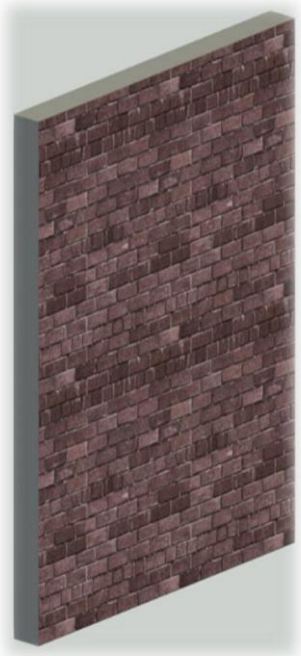
The Modular BIM/CIM Platform serves as an interoperable repository of BIM objects, encompassing both traditional and innovative building solutions developed specifically to address the needs of the InCUBE project´s demo sites. To facilitate the seamless information exchange with developers working on the demo site BIM models, these BIM objects have been meticulously developed in Revit software, utilizing both .rfa and .rvt formats.



IFC Parameters

	Valor
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	

Generic Monolithic Stair



Wall layers

Familia: Muro básico
Tipo: E10a - Brick Facade - 210mm
Grosor total: 0.2100 m (Por defecto)
Resistencia (R): 1.9159 (m²·K)/W
Masa térmica: 219.12 kJ/(m²·K)

Altura de muestra: 6.0000 m

Capas

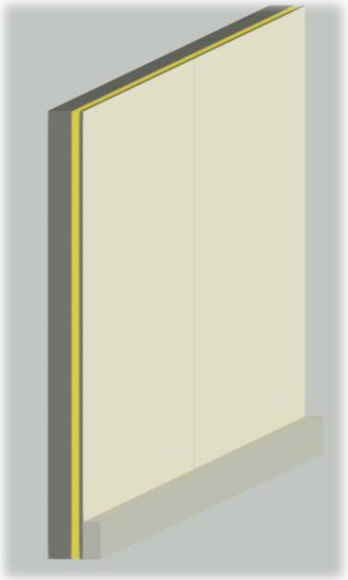
CARA EXTERIOR

	Función	Material	Grosor	Envolventes	Material estructural	Variable
1	**Contorno del núcleo**	**Capas de envolvente por encima**	**0.0000 m**			
2	Estructura [1]	Brick, Common	0.1200 m	■	☐	☐
3	Capa térmica/de aire [3]	Air	0.0400 m	☐	☐	☐
4	Estructura [1]	Brick, Double hollow	0.0400 m	☐	☐	☐
5	**Contorno del núcleo**	**Capas de envolvente por debajo**	**0.0000 m**			
6	Acabado 1 [4]	Gypsum	0.0100 m	☑	☐	☐

CARA INTERIOR

Brick Façade 210mm: Brick 120mm + AirChamber 40mm + DoubleHollowBrick 40 mm + Gypsum 10mm

Figure 5 – Example of stored information for generic products.



Object Parameters

Parámetros de tipo	Parámetro
Sales Representative Contact	
Series	
Technical Information	
Technical Support Contact	
Telephone Contact	
Tender Text URL	
Proceso por fases	
Assembly Place	
Barcode	
Batch Reference	
Container Material	
Container Protection Type	
Installation Date	
Purchase Contact	
Purchase Date	
Serial Number	
Special Instructions	
Supply Date	
Wrapping Material	
Parámetros IFC	
COBie Category	
Gubimclass Code	
Gubimclass Title	
IfcExportAs	
IfcExportType	
Masterformat Code	
Masterformat Title	
Omniclass Code	
Omniclass Title	
Uniclass2015 Code	

KOVER: Industria Innovative Façade with Ledge: rigid insulation 70mm + Tabihaus panel 42mm with mortar external finish and perimetral steel structure.

Object

Restricciones	
Nivel	Level 1
Elevación desde el nivel	0.0000 m
Anfitrión	Nivel : Level 1
Desfase desde el anfitrión	0.0000 m
Texto	
Prescription Manager	
Manufacturer Address	Viale Spagna, 31/33
Manufacturer City	Tribano(Padova)
Manufacturel Postal Code	35020
Manufacturer Country	Italy
Placement Type	
Temperature Classification	Ground
Heat Transfer Dimension	Low Temperature
Heat Transfer Medium	Surface
Body Mass	300 kg
Operating temperatures (e.g., for the ...	+65°C hot water temperature; -3°C s...
Refrigerant type (e.g., R32)	R1234ze
Instantaneous COP / EER	COP 3,14 EER 4,16
Seasonal COP / EER	
Measurement Unit	
Eléctrico - Cargas	
Panel	
Número de circuito	
Mecánica	
Clasificación de sistema	Suministro hidrónico,Retorno hidróni...
Nombre de sistema	
Length	
Mecánico - Flujo	
Ruta crítica	
Datos de identidad	
Imagen	
Comentarios	
Marca	16
Proceso por fases	
Fase de creación	New Construction
Fase de derribo	Ninguno

ENEREN: Multifunctional Heat

Figure 6 – Example of stored information for InCUBE products.

To enrich these BIM objects with relevant data, an extensive study has been carried out to identify the most frequently used and essential information fields or parameters sought after by manufacturing companies and construction professionals for inclusion within a BIM object. This endeavour led to the establishment of a data structure based on standards, referred to as GDO-BIM. GDO-BIM aligns with the overarching IFC criteria, drawing from the Property Sets and Quality Sets found in the IFC schema provided by buildingSMART International, while also integrating project-specific parameters tailored to the unique requirements of the InCUBE project.

Within the repository, BIM objects contain general information (parameters), organized into distinct property sets, including legal identity, classifications, quantity sets, specifications, tendering details, CE mark compliance, logistics, maintenance data, health & safety requirements, and sustainability metrics alongside Life Cycle Assessment (LCA) information. To facilitate the incorporation of this information into the BIM objects, Excel templates have been created. This ongoing process continues to evolve as we refine and expand the dataset.

A	B	C	D	G	H	I	J	K	L	O	Z	AF
				CLASSIFICATIONS				QTY_SET	DEFINITION	TENDERING	LOGISTICS	MANAGEMENT
COUN	REF	CAT	TYPE NAME	IfcExportAs	IfcType	Uniclass2023Code	Uniclass2023Des	Net Weight	Description	Reference	Assembly Place	Service life duration
ES/NL/IT	CODE	REVIT TYPE	BIM Object Name	TEXT	TEXT	CODE	TEXT	kg/m2	TEXT	TEXT	Enumerated value	YEARS
NL	S19a	COLUMN	2021_EN_Column_INCUBE_Steel-I : HEA 140	IfcColumn		EF_20_10_80	Solid structures					50 years
NL	S19b	COLUMN	2021_EN_Column_INCUBE_Steel-I : HEA 160	IfcColumn		EF_20_10_80	Solid structures					50 years
ES	S20a	FLOOR	S20 - Slabs - 200mm	IfcSlab		EF_30_20	Floors	244kg/m2	Precast concrete joists with ceramic vault 200mm			50 years
ES	S20b	FLOOR	S20b - Reinforced Concrete Slab - 150mm	IfcSlab		EF_30_20	Floors	375kg/m2	Reinforced concrete slab 150mm Steel bars B-500S	-		50 years
ES	S20c	FLOOR	S20b - Reinforced Concrete Slab - 200mm	IfcSlab		EF_30_20	Floors	500kg/m2	Reinforced concrete slab 200mm Steel bars B-500S	-		50 years
ES	S21	FLOOR	S21 - Existing balconies - 170mm	IfcSlab		EF_30_20	Floors	425kg/m2	Reinforced concrete slab 170mm Steel bars B-500S	-		50 years
ES	S22	FLOOR	0	IfcSlab		EF_30_20	Floors					50 years
NL	S23	FLOOR	S23 - Reinforced Concrete - 170mm	IfcSlab		EF_30_20	Floors					50 years
ES	S24	STRUCTURA	S24 - Strip Footing - 900x300mm	IfcFooting		EF_20_05_30	Foundations	25KN/m3	Strip footing 900x300mm Steel bars B-500S	-		50 years
ES	S25	STRUCTURA	2021_EN_Footing_INCUBE_Rectangular: 500mm	IfcFooting		EF_20_05_30	Foundations	25KN/m3	Rectangular footing 1800x1000x500mm Steel bars B-500S	-		50 years
ES	S26	STRUCTURA	2021_EN_Footing_INCUBE_W-Cover_Rectangular: 500mm	IfcFooting		EF_20_05_30	Foundations					50 years
ES	S27	FLOOR	0	IfcSlab		EF_20	Structural elements					50 years
NL	S28	FLOOR	0	IfcSlab		EF_20	Structural elements					
ES	S29	STUCTURAL	2021_EN_Plate_INCUBE_W-Anchor-Bolts : 250x250x12mm	IfcMember		EF_20	Structural elements	6,18kg	Anchor plate with bolts 200x200x6mm Steel S275JR	FP56427		50 years
ES	S30	STAIR	E30 - Wooden Stairs w/Stringers	IfcStair		EF_35_10_40	Internal stairs		Metalic stair with ceramic steps Metalic tubular railing	-		50 years
ES	S31	STAIR	0	IfcStair		EF_35_10_30	External stairs					
ES	S32	STAIR	S32 - Existing Concrete and Ceramic Stairs	IfcStair		EF_35_10	Stairs		Concrete stair with ceramic steps Metalic tubular railing	-		50 years
NL	S33	STAIR	S33 - Monolithic Stair	IfcStair		EF_35_10_30 EF_35_10_	0					50 years
IT	S34	BEAM	0	IfcBeam		EF_20_10_80	Solid structures			-	-	100 years
ES	E1	FLOOR	E1 - Insulation with Mechanical Joints - 100mm	IfcSlab		EF_30_20	Floors	30 Kg/m3	XPS insulation with mechanical joints 2600x600x100mm	DANOPREN PR 100		DS (70)
ES	E2	FLOOR	E2 - Tile Pavement - 40mm	IfcSlab		EF_30_20	Floors		Tile pavement 250x250x40mm	-	-	25 years
NL	E3	FLOOR	E3 - Suspended floor - 230mm	IfcSlab		EF_30_20	Floors					
ES	E4	ROOF	E4 - Ceramic Tile Roof - 150mm	IfcRoof		EF_30_10_64	Pitched roofs		Ceramic base 50mm with ceramic tile 100mm Total thickness 150mm	-	-	50 years
ES	E5	ROOF	E5 - Existing Roof with new insulation - 350mm	IfcRoof		EF_30_10	Roofs		Ceramic base 50mm with XPS insulation 120mm with ceramic tile 100mm Total thickness 270mm	Onsite		50 years
IT	E6	ROOF	0	IfcRoof		EF_30_10	Roofs		Existing roof covering: tiles,	-	-	50 years
IT	E7a	ROOF	E7-IT - Existing Roof - 338mm	IfcRoof		EF_30_10	Roofs			-	-	50 years
IT	E7b	0	0	IfcRoof		EF_30_10	Roofs			-	-	50 years
IT	E8	PANEL / CUR	E8 - Additional Insulation - 180mm	IfcRoof		EF_30_10	Roofs		Addiotional insulation of 180 mm added on the inside	K Flex K Rock CNX		50 years
IT	E8a	ROOF	0	IfcRoof		EF_30_10	Roofs		Renovated roof with the additional insulation layer	K Flex K Rock CNX		50 years
IT	E8b	ROOF	0	IfcRoof		EF_30_10	Roofs		Renovated roof with the additional insulation layer	K Flex K Rock CNX		50 years
IT	E8c	ROOF	0	IfcRoof		EF_30_10	Roofs		Renovated roof with the additional insulation layer	K Flex K Rock CNX		50 years
NL	E9	ROOF	0	IfcRoof		EF_30_10	Roofs					
ES	E10a	WALL	E10a - Brick Facade - 210mm	IfcWall		EF_25_10_25	External walls		Brick 120mm with air charber 40mm with double hollow brick 40mm with internal finish gypsum 10mm Total thickness 210mm	Onsite		50 years
									External finish mortar 10mm with brick 120mm with air charber 20mm with double hollow brick 40mm with internal finish gypsum 10mm			

Figure 7 – Parameters data template for generic objects

7 City Information Models

Moreover, the Modular BIM/CIM Platform has undergone expansion to encompass City Information Modelling (CIM) data from the three demo sites, Zaragoza, Trento and Groningen. **These City Information Models (CIM)** for each demo city, serves as repositories of urban-level building information. The development of CIM models for these cities was achieved using Geographic Information Systems (GIS), which combines spatial and attribute data.

The attribute data within these CIM models comprises of open data and publicly accessible information related to various aspects of the buildings. This information encompasses data such as their location (country, city, coordinates), unique identification details, typology (cadastral reference, use, year of construction, height), and energy performance data (including EPC certificates, GHG emissions, and energy consumption figures):

CIM	ES	IT	NL
Archivos (geojson)	ES_CIM	IT_CIM	NL_CIM
x_coord	X	X	X
y_coord	X	X	X
Country	X	X	X
City	X	X	X
Cad_Ref	X	X	X
Type	X	X	X
Use	X	X	X
Const_Year	X	-	-
EPC Data	X	-	-
Number of floors	X	X	X
Height	X	X	X
Roof Area	-	-	-
Perimeter	X	X	X
Floor plan area	X	X	X
Facade area	X	X	X
Dettached facade area	X	X	X
Envelope Area	X	X	X

Table 1 Summary of attribute data compiled in CIM models. X represent parameters included for each demo site CIM model

12.275 m | 0,8963547°W 41,6476504°N | 15 m | Selected Features: 0

ES_Demo

Field: Add Calculate | Selection: Select By Attributes Zoom To Switch Clear Delete Copy

	nationalCa	MEAN_Year_	FIRST_curr	FIRST_offi	MEAN_value	FIRST_valu	MEAN_areaV	FIRST_area	FIRST_EPC_	MEAN_GHGco	MEAN_EneCo	CONCATENAT	FIRST_Buil
1	0774608XM8107D	1996	1_residential	grossFloorArea	1684	m2	980	m2	2023ZEVV-000152080	44,3	210,54	Bloque: Vivienda indiv...	Existente
2	0774608XM8107D	1996	1_residential	grossFloorArea	1684	m2	980	m2	2023ZEVV-000152080	44,3	210,54	Bloque: Vivienda indiv...	Existente
3	000100200XM61D	2021	1_residential	grossFloorArea	815	m2	1041	m2	2022ZEVU-000139073	37,92	147,42	Unifamiliar	Existente
4	000100200XM61D	2021	1_residential	grossFloorArea	815	m2	1041	m2	2022ZEVU-000139073	37,92	147,42	Unifamiliar	Existente
5	000100200XM61D	2021	1_residential	grossFloorArea	815	m2	1041	m2	2022ZEVU-000139073	37,92	147,42	Unifamiliar	Existente
6	000100200XM61D	2021	1_residential	grossFloorArea	815	m2	1041	m2	2022ZEVU-000139073	37,92	147,42	Unifamiliar	Existente
7	000100200XM61D	2021	1_residential	grossFloorArea	815	m2	1041	m2	2022ZEVU-000139073	37,92	147,42	Unifamiliar	Existente
8	000100300XM71C	1986	1_residential	grossFloorArea	790	m2	738	m2	2021ZEVU-000121200	90,58	310,5	Unifamiliar	Existente
9	000100300XM71C	1986	1_residential	grossFloorArea	790	m2	738	m2	2021ZEVU-000121200	90,58	310,5	Unifamiliar	Existente
10	000100300XM71C	1986	1_residential	grossFloorArea	790	m2	738	m2	2021ZEVU-000121200	90,58	310,5	Unifamiliar	Existente
11	000100300XM71C	1986	1_residential	grossFloorArea	790	m2	738	m2	2021ZEVU-000121200	90,58	310,5	Unifamiliar	Existente
12	000100300XM71C	1986	1_residential	grossFloorArea	790	m2	738	m2	2021ZEVU-000121200	90,58	310,5	Unifamiliar	Existente
13	000100300XM71C	1986	1_residential	grossFloorArea	790	m2	738	m2	2021ZEVU-000121200	90,58	310,5	Unifamiliar	Existente
14	000100300XM71C	1986	1_residential	grossFloorArea	790	m2	738	m2	2021ZEVU-000121200	90,58	310,5	Unifamiliar	Existente
15	000100300XM71C	1986	1_residential	grossFloorArea	790	m2	738	m2	2021ZEVU-000121200	90,58	310,5	Unifamiliar	Existente

0 of *2.000 selected | Load All | Filters: | 100 %

Figure 8 – Attribute table of Zaragoza's CIM

The CIMs play a pivotal role in advancing the development of digital twins and enhancing our understanding of the current status of the demo buildings at city level. All three CIMs contain information along the Z-axis, enabling its visualization in both 2D and 3D formats.

The creation of these CIMs involved a comprehensive calculation, analysis, and data treatment, drawing from various geographic and alphanumeric data. These datasets were meticulously integrated into the buildings layer of each city, as shown in the following Figure.

Figure 9 – Trento and Groningen CIM. 3D visualisations

At demo level, the 3D-BIM models, from the core to the façade of the building were integrated into the 3D-CIM representation. However, for the 2D versions of each demo, a more simplified version was created. These 2D version include attribute fields to be monitored and completed as part of the digital twin development process:

Building area	Attribute	Attribute name
(G) Ground	(W) Wall (RS) Renovation Status	G_W_RS
	(I) Insulation (RS) Renovation Status	G_I_RS
(SF) Structural Floo r	(W) Wall (RS) Renovation Status	SF_W_RS
	(SF) Structural Floor (N) Number of (B)Balconies	SF_N_B
	(SF) Structural Floor (B) Balcony (RS)Renovation Status	SF_B_RS
(R) Roof	(R) Roof (I) Insulation (RS) Renovation Status	R_I_RS
	(R) Roof (PV) panels (RS) Renovation Status	R_PV_RS
(F) Floor	(F) Floor (N) Number of (EW) External Walls	F_N_EW
	(F) Floor (EW) External Walls (RS) Renovation Status	F_EW_RS
	(F) Floor (N) Number of elements. Eg. doors/windows	F_N_Element
	(F) Floor (T) Type of elements - could be doors/windows, floor/wall/doors	F_T_Element
	(F) Floor (RS) Renovation Status of elements. Eg: doors/windows, floor/wall/doors	F_RS_Element
	(F) Floor (RS) Renovation Status of the (CS) Common Stair	F_RS_CS

(B) Building level	(LCA) Renovation LCA of the building	**B**_LCA
	(LCC) Renovation LCC of the building	**B**_LCC
	(EF) Energy forecasting of the building	**B**_EF
	(RPA) Renovation percentage	**B**_RPA
	(RS) Renovation status of the (E) elevator	**B**_RS_E
	(C) Consumption of the (E) elevator	**B**_C_E
	(OEP) Overall production of energy of the building	**B**_OEP

Table 2 Attribute fields considered to be completed for digital twin development process organized by building components' categories.

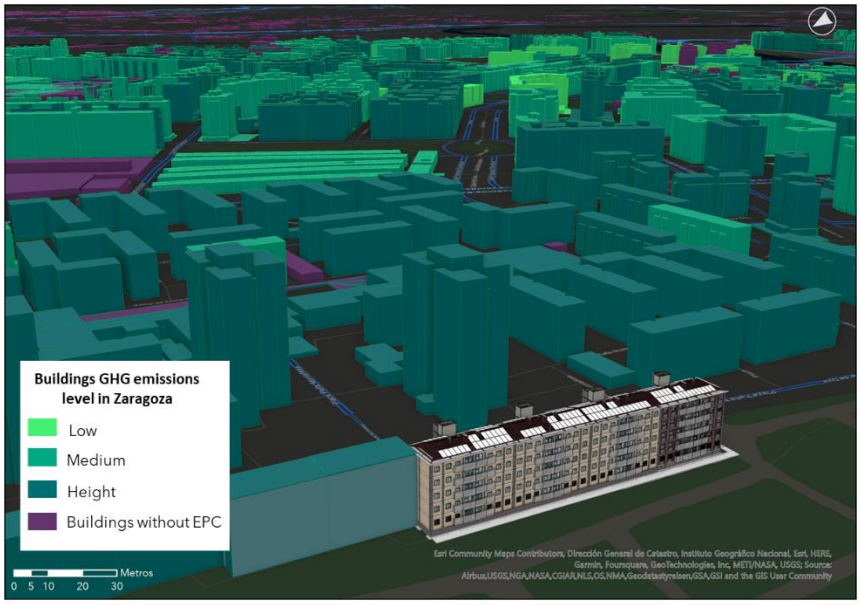


Figure 10 – Zaragoza demo 3D-BIM model integrated into the 3D-CIM representation

8 Conclusion

This report provided a description of the InCUBE BIM modelling framework including the SCAN-to-BIM activities and the development of the BIM/CIM platform. Moreover, BIM and CIM models that were created for each demo site have been presented.

As Deliverable 3.3 is a compilation of different types of components and files created within Task 3.2, this document summarizes and records the different works undertaken and the results obtained, organized by type of outcome and demo-site related. These files are expected to be live during the progress of InCUBE project as innovations and renovation proposals are developed. The access to the different items will be regulated in order to avoid uncontrolled modifications.

An updated (final) version of this report, including any necessary re-adaptations after iterations with other WPs is expected to be delivered by M41 of the project.