



HOUSEFUL

D4.13: BIM Models and Material Passport of the Spanish and Austrian demos: Demo 2 and Demo 3

Public version

WP 4, T 4.1

April 2021 (M36)

Authors:

Díez Bernabé Glòria (ITeC), Alfaro Garrido Licinio (ITeC),
Pla Cuyàs M Elena (ITeC), Silva Gandola Laura, Borbón
Fuentevilla Manuel (ITeC), Álvarez Díaz Sonia (CARTIF),
Greil Richard (Turntoo)



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 776708. The views expressed in this publication are the sole responsibility of the author/s and do not necessarily reflect the views of the European Commission.

Technical References

Project Acronym	HOUSEFUL
Project Title	Innovative circular solutions and services for new business opportunities in the EU housing sector
Project Coordinator	Sergio Martínez Lozano Centro tecnológico Leitat smartinez@leitat.org
Project Duration	1 May 2018 – 31 October 2022 (54 Months)

Deliverable No.	D4.13
Dissemination Level	PU ¹
Work Package	WP 4 - Large scale Demo Building
Task	T 4.1.1- Material Passports integrating BIM for baseline definition and potential evaluation of deconstruction scenarios.
Lead beneficiary	2 (ITeC)
Contributing beneficiary(ies)	3 (CARTIF), 4 (ALCN), 5 (AHC), 9 (GWR), 10 (TURNTOO), 11 (NEUES LEBEN)
Due date of deliverable	30 April 2021 (M36)
Actual submission date	5 May 2021 (M37)

¹ PU = Public

PP = Restricted to other programme participants (including the Commission Services)

RE = Restricted to a group specified by the consortium (including the Commission Services)

CO = Confidential, only for members of the consortium (including the Commission Services)



Versions

Version	Person	Partner	Date
1	Sonia Álvarez	CARTIF	31 October 2020
2	M. Elena Pla	ITeC	29 April 2021
3	Richard Greil	Turntoo	12 May 2021
4	Tommaso Giomi	ITeC	27 June 2023



Table of Content

0	Abstract	9
1	Houseful BIM Execution Plan	10
1.1	Scope and Objectives	10
1.2	Project information.....	10
1.2.1	Buildings to be modelled	10
1.2.2	BIM Team contacts.....	10
1.2.3	BIM Modelling milestones	11
1.2.4	BIM Requirements.....	11
1.3	BIM Uses and levels of development.....	11
1.4	Resources	12
1.4.1	Software	12
1.4.2	Common Data Environment	12
1.5	Information management	12
1.6	Naming of BIM Objects	12
2	Suggestions to reduce errors in the exportation process	13
2.1	General suggestions before starting to model	13
2.1.1	REVIT IFC exporter	13
2.1.2	Project units.....	13
2.1.3	Survey Point and Project Base Point	13
2.2	Problems detected in the walls when obtaining the quantities of the materials	14
2.2.1	Geometric errors (walls)	14
2.2.2	Properties (walls).....	16
3	Demo 2 – Ronda Arraona 30 - Sant Quirze	18
3.1	BIM Modelling.....	18
3.1.1	Gathering and analysis of information.....	18
	Building description	¡Error! Marcador no definido.
	Recognition of building systems and materials.....	¡Error! Marcador no definido.
3.1.2	Geolocation of the building.....	¡Error! Marcador no definido.
3.1.3	Naming of BIM Element types.....	18
3.1.4	Location of BIM Element types.....	20
3.1.5	Classification according to Omniclass table 21 and NLSfb.....	21
3.1.6	BIM Modelling.....	22
3.1.7	Exporting to IFC.....	24



- 3.1.8 Validating Madaster requirements..... 25
- 3.1.9 Quantity take-off from Materials and Elements 25
 - 3.1.9.1 Filling in Demo 2 Material Import..... 26
- 3.2 Material Passport..... 27
 - 3.2.1 Prepare source data for upload in Madaster platform..... 28
 - 3.2.2 Upload source data in Madaster platform 29
 - 3.2.3 Set-up products in Madaster 30
 - 3.2.4 Validate uploaded source data in Madaster platform 31
 - 3.2.5 Enrich products in Madaster platform..... 32
 - 3.2.6 Obtain Material Passport in Madaster platform 32
- 4 Demo 3 – KasernStrasse 2 - Fehring 34
 - 4.1 BIM Modelling..... 34
 - 4.1.1 Gathering and analysis of information 34
 - Building description 34
 - Recognition of building systems and materials..... 34
 - 4.1.2 Geolocation of the building..... 36
 - 4.1.3 Naming of BIM Element types 37
 - 4.1.4 Location of BIM Element types..... 39
 - 4.1.5 Classification according to Omniclass table 21 and NLSfb 40
 - 4.1.6 BIM Modelling..... 41
 - 4.1.7 Exporting to IFC..... 42
 - 4.1.8 Validating Madaster requirements..... 42
 - 4.1.9 Quantity take-off from Materials and Elements 44
 - 4.1.9.1 Filling in Demo 3 Material Import..... 44
 - 4.2 Material Passport..... 45
 - 4.2.1 Prepare source data for upload in Madaster platform..... 45
 - 4.2.2 Upload source data in Madaster platform 46
 - 4.2.3 Set-up products in Madaster 47
 - 4.2.4 Validate uploaded source data in Madaster platform..... 48
 - 4.2.5 Enrich products in Madaster platform..... 49
 - 4.2.6 Obtain Material Passport in Madaster platform 49
- 5 General conclusions..... 50
 - 5.1 BIM modelling conclusions from Demos 2 and 3 Existing buildings 51
- 6 References 51



List of Tables

Table 1.1: Information about the Buildings for Demos 2 and 3.	10
Table 1.2: BIM Team Contacts.	10
Table 1.3: Milestones for BIM Modelling.	11
Table 1.4: BIM software used in Demos 2 and 3 of Houseful project.	12
Table 3.5: List of documents - Demo 2 Existing. iError! Marcador no definido.	
Table 3.6: Naming of BIM element types.	19
Table 3.7: Coding of BIM element types.	20
Table 3.8: Classification of BIM Types according to Omniclass table 21 and NLSfb.	22
Table 3.9: "Casco sheet" in <i>Houseful_T4.1.1_MaterialImport_Demo2</i>	26
Table 3.10: "Product Type" sheet in <i>Houseful_T4.1.1_MaterialImport_Demo2</i>	27
Table 3.11: Uploaded source of data Demo 2 in Madaster platform	28
Table 3.12: Example of Madaster Excel upload file (volume information).	28
Table 3.13: Additional data: product composition.	29
Table 4.14: List of documents - Demo 3 Existing. ... iError! Marcador no definido.	
Table 4.15: Naming of BIM element types.	37
Table 4.16: Coding of BIM element types.	39
Table 4.17: Classification of BIM Types according to Omniclass table 21 and NLSfb.	40
Table 4.18: "Casco sheet" in <i>Houseful_T4.1.1_MaterialImport_Demo3</i>	44
Table 4.19: "Product Type" sheet in <i>Houseful_T4.1.1_MaterialImport_Demo3</i>	45
Table 4.20: Uploaded source of data Demo 3 in Madaster platform	45
Table 4.21: Additional data: product composition.	46
Table 5.22: Challenges solved or pending after modelling the Existing buildings out from Demos 2 and 3.	51



List of Figures

Figure 2.1: Location menu in Revit	14
Figure 2.2: <i>Attach Top/Base</i> command in the project browser in Revit	14
Figure 2.3: External wall with the right height to avoid overlapping with the floor. 15	
Figure 2.4: New external wall created at the front of the slab aligned with the external side of the existing walls on the upper and lower levels.	15
Figure 2.5: Overlap of an exterior wall with a roof	15
Figure 2.6.: Overlap of an interior wall with a roof	15
Figure 2.7: interior and exterior wall connection	16
Figure 2.8: interior and exterior wall connection with a complex geometry	16
Figure 2.9: Wall function	16
Figure 2.10: Incorrect <i>Export As</i> definition for a floor.	17
Figure 3.11: Recognition of elements and materials in "T4.1 HOUSEFUL demo audit_AHC D2_WIP.xlsx".	iError! Marcador no definido.
Figure 3.12: Reference point to geolocate the building. iError! Marcador no definido.	
Figure 3.13: Location of wall types in the 3D view (in yellow).	21
Figure 3.14: Location of wall types in the 3D view (also in yellow).	21
Figure 3.15: 3D Google picture (left), BIM model of Existing building (right).	22
Figure 3.16: BIM model of Existing building from South West view.	23
Figure 3.17: Classification properties in BIM elements (Roof).	24
Figure 3.18: Classification properties in BIM elements (Window).	24
Figure 3.19: Classification properties in BIM elements (Foundation).	24
Figure 3.20: BIM model for Material Passport (left), BIM model for Material Import spreadsheets (right).	25
Figure 3.21: Vision & mission of Madaster.	27
Figure 3.22: Madaster Building tab for Demo 2.	29
Figure 3.23: Madaster Dossier tab: active source files (IFC & Excel).	29
Figure 3.24: Madaster Product (example of a product existing of 1 material).	30
Figure 3.25: Madaster Product (example of a product existing of multiple materials).	30
Figure 3.26: Madaster Product (example of a product search criteria).	31



Figure 3.27: Source data element (from IFC file) automatically linked to Madaster Product set-up.31

Figure 3.28: Source data upload results31

Figure 3.29: Madaster dossier: Material Passport Demo 2 (in pdf & Excel format) .32

Figure 3.30: Madaster Material Passport Demo 2 (cover page)33

Figure 4.31: Recognition of elements and materials in "4.1 HOUSEFUL demo audit_Cambium.xlsx".36

Figure 4.32: Reference point to geolocate the building.**iError! Marcador no definido.**

Figure 4.33: Location of wall types in the 3D view (in green, red and purple).39

Figure 4.34: Location of wall types in the 3D view (in green).40

Figure 4.35: Present picture (left), BIM model of Existing building (right).41

Figure 4.36: BIM model of Existing building from the main entrance view.41

Figure 4.37: Classification properties in BIM elements (Door).....42

Figure 4.38: Classification properties in BIM elements (Wall).42

Figure 4.39: BIM model under filter (left), BIM model remained for Material Passport (right).....43

Figure 4.40: Madaster Building tab for Demo 3.....46

Figure 4.41: Madaster Dossier tab: active source files (IFC & Excel).47

Figure 4.42: Madaster Product (example of a product existing of 1 material).47

Figure 4.43: Madaster Product (example of a product existing of multiple materials).47

Figure 4.44: Madaster Product (example of a product search criteria).48

Figure 4.45: Source data element (from IFC file) automatically linked to Madaster Product set-up.48

Figure 4.46: Source data upload results49

Figure 4.47: Madaster dossier: Material Passport Demo 2 (in pdf & Excel format) .50

Figure 4.48: Madaster Material Passport Demo 3 (cover page)50



0 Abstract

The present deliverable is comprised within task 4.1 “Circular economy audit: Baseline calculation” of Houseful project to provide an overall and exhaustive circular economy audit of the initial status of the four Frontrunner buildings under water, waste, energy and material vectors and in the following four dimensions: technological, social, environmental and economic.

Deliverable 4.13 is focused on a specific subtask of task 4.1 to assess the circularity possibilities of the building materials using Material Passport methodology for Demos 2 and 3. The present deliverable is complementary to Deliverable 4.3 which dealt on Demos 1 and 4.

The sections in Deliverable 4.13 describe the different steps that lead to the creation of the BIM models of Existing buildings from Demos 2 and 3.



1 Houseful BIM Execution Plan

1.1 Scope and Objectives

The Scope and Objectives of the BIM Execution Plan for Houseful Frontrunner Buildings were described in section 1.1 and 1.2 of Deliverable 4.3.

1.2 Project information

1.2.1 Buildings to be modelled

DEMO	Nº2	Nº3
Building Name	Ronda Arraona 30	Kasernstrasse 2
Country	Spain	Austria
Building Location	Sant Quirze	Fehring
Building Description	Social housing	Social housing
Building Owner	AHC ²	Cambium
Construction Year	2003	1960
Total building surface (m2) Gross area	1597,64	5924,92
Refurbishing Start Date	To be defined	To be defined
Refurbishing End Date	To be defined	To be defined

Table 1.1: Information about the Buildings for Demos 2 and 3.

1.2.2 BIM Team contacts

Responsibility	Company	Name	E-Mail	Phone
BIM Modelling	ITeC	M Elena Pla	epla@itec.cat	+34 93 3093404
BIM Modelling	ITeC	Manuel Borbon	mborbon@itec.cat	
BIM Modelling	ITeC	Tatiana Quintero	tquintero@itec.cat	
Required data for Material Passport	ITeC	Gloria Díez	gdiez@itec.cat	
Specification and standardization under IFC / Exporting to IFC	CARTIF	Sonia Álvarez	sonalv@cartif.es	+34 983 546 504

Table 1.2: BIM Team Contacts.

² Agència de l'Habitatge de Catalunya.



1.2.3 BIM Modelling milestones

The BIM modelling of the buildings demo 2 and demo 3 is going through the following milestones according to actions defined in the T4.1.1 Implementation Plan.

Num.	Milestone	Deliverable
6.1	Gathering of information needed for BIM modelling Related to demo buildings	CAD files Available documents
6.2	Gathering of information needed for BIM modelling Related to Houseful solutions	Available documents
7	Requirements for BIM modelling and IFC export	Houseful BEP in D4.3
8.1	BIM modelling. Demo 2	*.RVT files
8.2	BIM modelling. Demo 3	*.RVT files
9	Export *.RTV files to *.IFC file Demo 2	*.IFC files
10	Export *.RTV files to *.IFC file Demo 3	*.IFC files

Table 1.3: Milestones for BIM Modelling.

1.2.4 BIM Requirements

The BIM Requirements were the same than in Demos 1 and 4. They are stated in section 1.2.4 of Deliverable 4.3.

For the generation of the Material Passport from IFC models, it is necessary that the IFC files are correctly defined to obtain the list of material quantities as accurately as possible. In order to be able to generate better defined IFC models, a specific section with BIM modelling suggestions has been created to reduce errors when exporting models to the IFC file format (see section 2).

1.3 BIM Uses and levels of development

The BIM Uses and levels of development for Demos 2 and 3 have been the same than in Demos 1 and 4. They are stated in section 1.3 of Deliverable 4.3.

1.4 Resources

1.4.1 Software

Software	Version	Operative System	Responsible party
Autodesk Revit	2019	Windows 10	ITeC
Autodesk Revit	2019	Windows 10	CARTIF
IFC Exporter (plug-in)	19.3.0.0	Windows 10	ITeC / CARTIF
TCQ	5.6	Windows 8	ITeC

Table 1.4: BIM software used in Demos 2 and 3 of Houseful project.

The software solutions used are the same, but have evolved into newer versions compared to Demos 1 and 4.

1.4.2 Common Data Environment

The BIM Modelling team members worked in the Houseful CDE to share the models and necessary information:

<https://houseful.cloud.icube.global/index.php/f/5163>

1.5 Information management

The naming of files has been carried out with the same criteria than in Demos 1 and 4 and according to section 1.6 of Deliverable 4.3.

1.6 Naming of BIM Objects

BIM Objects such as Building storeys, BIM Elements, BIM Materials, Construction Stages of elements, Property Sets and Processes have been carried out with the same criteria than in Demos 1 and 4 and according to section 1.6 of Deliverable 4.3.



2 Suggestions to reduce errors in the exportation process

This section tries to reflect in a summarized way, the basic suggestions for the proper modelling of BIM models in order to generate IFC files with the least possible errors. These suggestions focus primarily on obtaining the quantities of materials available in a model from an IFC and are focused on the use of Revit software, but most of them could be applied to other BIM software. For more general guidelines about the generation of BIM models, the OptEEmAL BIM guidelines³ can be consulted.

2.1 General suggestions before starting to model

2.1.1 REVIT IFC exporter

The IFC exporter is continually updated. The latest version of the IFC exporter must always be installed:

<https://apps.autodesk.com/RVT/en/List/Search?isAppSearch=True&searchboxstore=RVT&facet=&collection=&sort=&query=ifc+exporter>

2.1.2 Project units

The project units will be defined using the International System of Units metric system (SI) and should be set to the same format (meters or millimetres) before exporting to IFC file format.

2.1.3 Survey Point and Project Base Point

The Survey Point and the Project Base Point is recommended placed at the same point, adding the latitude and longitude in the Project Location in Revit selecting the Location menu from the project browser in Revit (Figure 2.1).

³ G. I. Giannakis, K. Katsigarakis, G. N. Lilis and S. Álvarez Díaz, "GUIDELINES for OptEEmAL BIM Input Files," February 2019. [Online]. Available: https://www.opteemal-project.eu/files/guidelines_for_opteemal_bim_input_files_v11.pdf [Accessed Oct 2020].



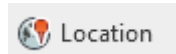


Figure 2.1: Location menu in Revit

2.2 Problems detected in the walls when obtaining the quantities of the materials

2.2.1 Geometric errors (walls)

- Avoid creating curved walls. If a curved wall is needed, use small straight sections of walls instead a curved wall.
- Avoid joining walls to slabs or roofs with the *Attach Top/Base* command (Figure 2.2), there could be problems with the exportation to IFC. On sloping roofs could be necessary attach the walls with the roofs. In this case, check first if there are any problems with the exportation to IFC generating an example.



Figure 2.2: *Attach Top/Base* command in the project browser in Revit

- If it is necessary to join a wall with a slab or other elements (as floor, roof, column), it is necessary to create a new wall to avoid problems with the exportation to IFC (see 2.3 and 2.4).

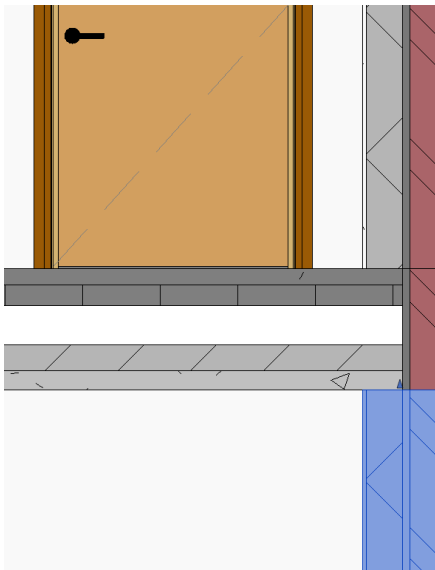


Figure 2.3: External wall with the right height to avoid overlapping with the floor.

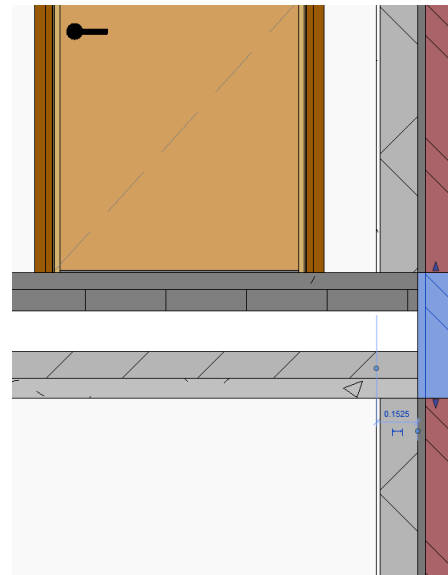


Figure 2.4: New external wall created at the front of the slab aligned with the external side of the existing walls on the upper and lower levels.

- Avoid overlaps between walls/floors/roofs (as shown in figures 2.5 and 2.6). In addition to the collision errors, other problems could be appearing such as quantities errors of the wall materials.

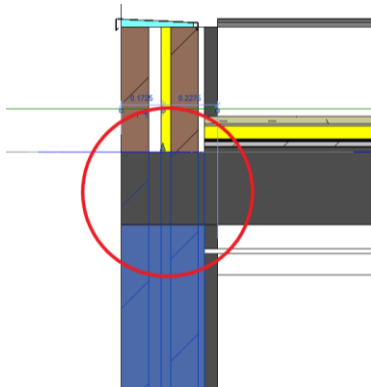


Figure 2.5: Overlap of an exterior wall with a roof

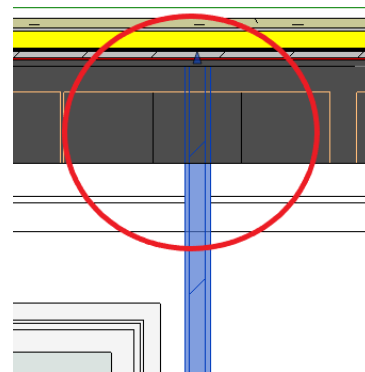


Figure 2.6: Overlap of an interior wall with a roof

- Avoid joining interior walls with exterior walls (Figure 2.7).
- The problem defined before (joint of interior and exterior wall) could be appearing with the exterior wall unions. Run an IFC export test to check the model and if the walls are not exported, unjoin the walls. Check complex unions in the IFC to verify a correct exportation (Figure 2.8).

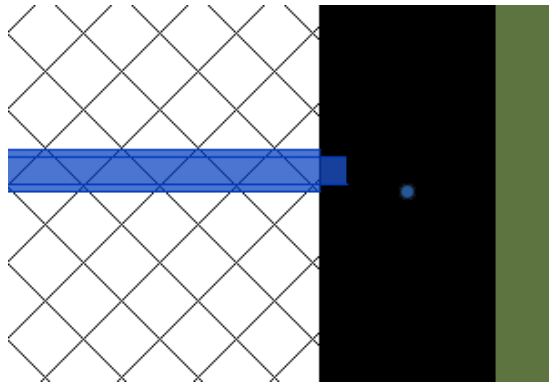


Figure 2.7: interior and exterior wall connection

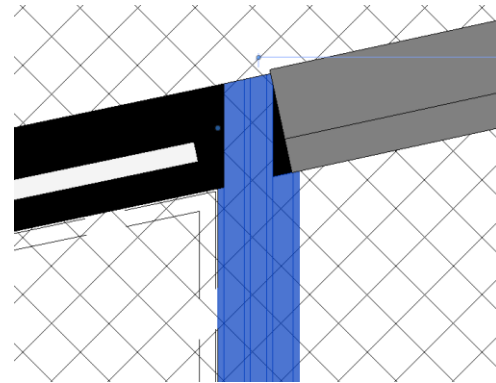


Figure 2.8: interior and exterior wall connection with a complex geometry

- Avoid duplicating elements, such as doors/Windows located in the same place. Collision and quantities errors could be appearing in the model if there are duplicated elements. Check that the openings are well modelled in the Revit families.
- Avoid walls overlapping door/Windows.

2.2.2 Properties (walls)

- Check that the function of the elements (walls/slabs/roofs...) is defined correctly (exterior, interior...) as shown in 2.9. **Error! No se encuentra el origen de la referencia..**

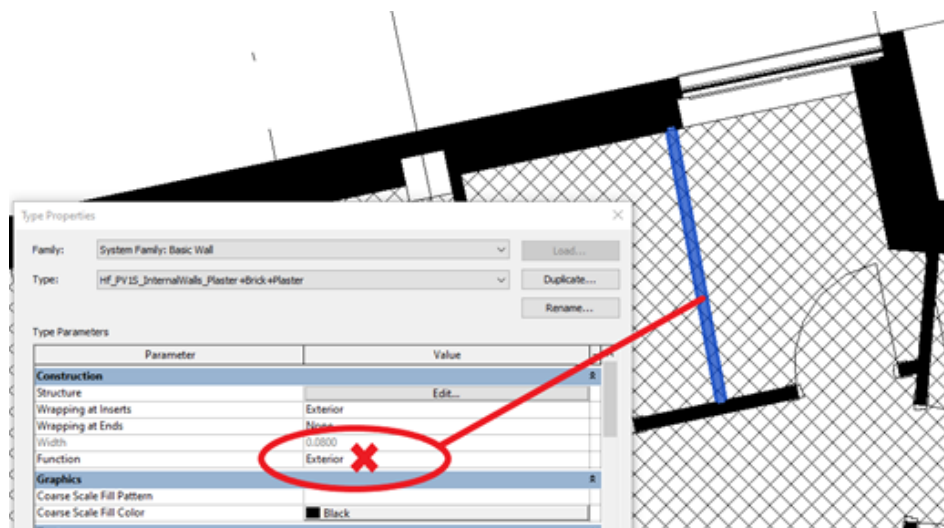


Figure 2.9: Wall function

- Export the elements to the correct IFC class. A floor cannot be exported to IfcCovering because it is a IfcSlab (Figure 2.10).

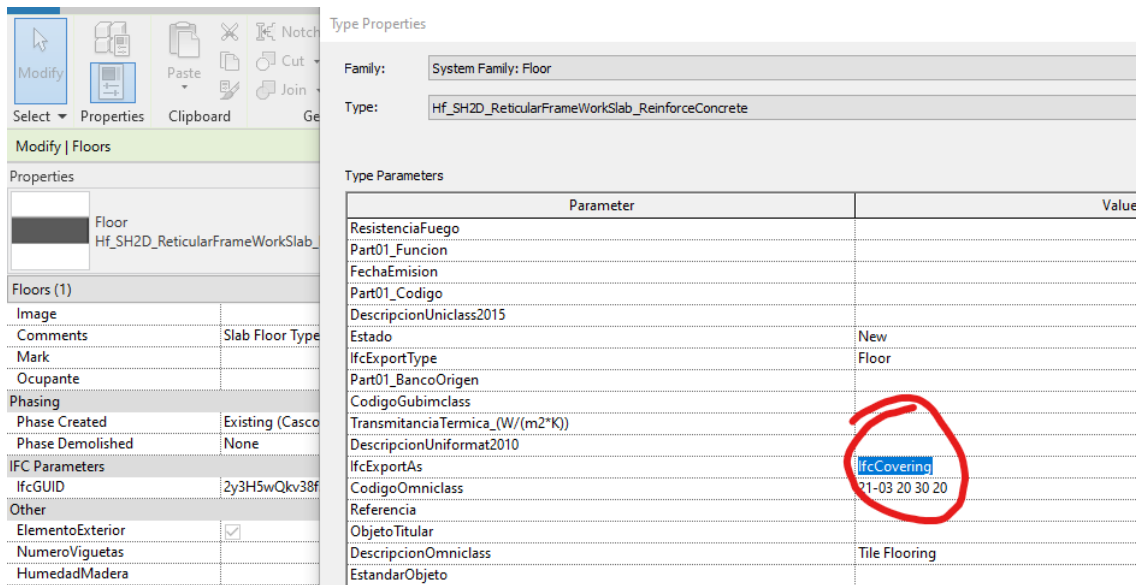


Figure 2.10: Incorrect *Export As* definition for a floor.

3 Demo 2 – Ronda Arraona 30 - Sant Quirze

3.1 BIM Modelling

3.1.1 Gathering and analysis of information

Confidential section: This section is only available to members of the consortium and Commission Services.

3.1.2 Naming of BIM Element types

The different types of elements that make up the building were named for proper modeling and easy identification according to the table below:

Classification	Category/ Element	Type
Structural Foundation	Wall/Structural Framing	Hf_SH1S_ExternalWallsNoVentileted_ReinforceConcre
	Foundation/ well	Hf_SFSW_Well_Reinforced Concrete
Envelope	Wall (Façade)	Hf_EF1S_ExternalWall_Materials
	Roof	Hf_ERMS_Roof_Materials
	Floor (Screed)	Hf_SH1D_Slab+Joist_HP_Materials Hf_SH1D_Slab+Joist_HP_Materials
Structural	Floor (Slab)	Hf_SH1D_Slab+Joist_HP_Materials
		Hf_SH2D_ReticularFrameWorkSlab_Materials
	Structural Framing (Joist/ Beam fill)	Hf_SH1D_BeamFill_Materials Hf_SH2D_BeamFill_Material_NUnits Hf_SH1D_Beam_Joist_Material
		Wall
	Stairs	Hf_SSSR_Stairs_Materials
Partitions	Doors	Hf_PD1S_InternalDoorSwinging_Materials
		Hf_PD1S_InternalDoor2Swing_Steel
		Hf_PD1S_IntenalDoorSwing_Steel
		Hf_PD1S_InternalDoor_Steel
	Wall (Internal walls)	Hf_PV1S_InternalWall_Materials
	Windows	Hf_EL1S_ExternalLattice_Aluminum
		Hf_EW2S_ExternalWindows2VSwinging_Materials



Classification	Category/Element	Type
	Floor	Hf_PH1S_Floor_Materials
	Ceilings	Hf_PHMS_Ceiling_Materials
Railings	Railing	HF_StairRailings

Table 3.5: Naming of BIM element types.

The code and meaning of the acrostic for each BIM Element type is stated in the following table:

Coding	Element	Description	
Hf_SIXX_YYYY_Materials	Hf	Houseful	
Envelope (SIXX)	Facade (EF)	(EF1S) Envelope FacadeOne Sheet (EFMS) Envelope Facade Multiple Sheet Envolvente Fachada multiple o una hoja	
	Roof (ER)	(ER1S) Envelope Roof One Sheet (ERMS) Envelope Roof Multiple Sheet	
	Screed (ES)	(ES1S) Envelope Screed One Sheet (ESMS) Envelope Screed Multiple Sheet	
Structure (SIXX)	Floors (Slab)	(SH1D) Structural Horizontal One direction (SH2D) Structural Horizontal 2 directions	
	Joist / Profile (Joist)	(SITR) Structural Incline Truss Rectangular (SISB) Structural incline Steel Beam	
	Wall	(SV1S) Structural Vertical One sheet (SVMS) Structural Vertical Multiple sheet	
	Stairs	(SSSR) Structural Stairs Section Rectangular	
Partitions (SIXX)	Doors	(PD1S) Partition Door one sheet (PD2S) Partition Door Two Sheet	
	Wall (Internal walls)	(PV1S) Partition Vertical One Sheet (PVMS) Partition Vertical Multiple Sheet	
		Windows	(EW1S) Envelope Windows one sheet (EW2S) Envelope Windows two sheets (EW3S) Envelope Windows three sheets
	Floors /Ceilings		(PH1S) Partition Horizontal one sheets (PHMS) Partition Horizontal Multiple



Coding	Element	Description
		sheets
Structural Foundation	SF/SH	Structural Foundation
Structural Foundation (SIXX)	Foundation/well	(SFSW) Structural Foundation Structural Well
Railings (SIXX)	Railings	StairRailings
Envelope (YYYY)	Facade	ExternalWall
	Roof	Roof
	Screed	Screed
Structure (YYYY)	Floor(slab)	Slab
	Beam/Profiles	Beam Profile
	Walls	ExteriorWall or InternalWallStructural
	Stairs	Stairs
Partitions (YYYY)	Doors	Door
	Walls/Indoor walls	Internal Wall
	Windows	ExternalWindows1Fixed ExternalWindows2VSwinging ExternalWindows3VSwinging
	Floors	Floor
	Ceilings	Ceilings
Structural Foundations (YYYY)	Wells	Wells

Table 3.6: Coding of BIM element types.

3.1.3 Location of BIM Element types

The naming and coding of the BIM Elements allow to locate the elements easily without error. Here there are some examples of how the modeler can identify and position the types of elements in the model. The colors represent each type of wall or floor as shown in the figures.



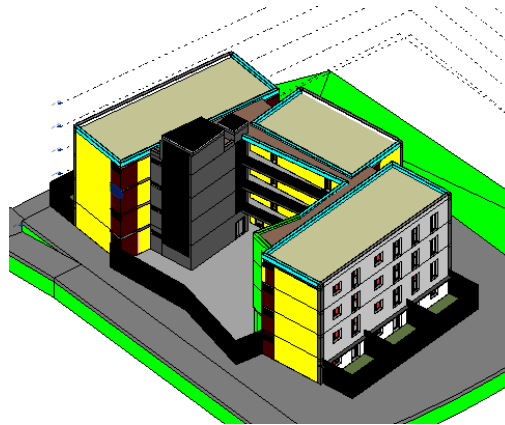


Figure 3.11: Location of wall types in the 3D view (in yellow).



Figure 3.12: Location of wall types in the 3D view (also in yellow).

3.1.4 Classification according to Omniclass table 21 and NLSfb

Once the BIM Types were identified with the respective material similarity to the Madaster list of materials, the final step before starting modeling will be to relate these types to the (global) Omniclass (table 21) classification and (Dutch) NLSfb classification standards required to import the project information into the Madaster platform. This task was achieved in the table shown in figure below. (This was needed because the Madaster platform was not yet adjusted for the local Spanish and/or Austrian classification codes).

Hf_PHS1_Ceiling_Mortar	45.00	21-03 20 50 70, Ceiling Painting and Coating	21-03 20 50 70	Ceiling Painting and Coating	45.00	21-03 20 50 70	Generic (in Ceiling finishes)
Hf_SFSW_Well_Reinforce Concrete	17.00	21-01 10 10 90, Standard Foundation Supplementary Components	21-01 10 10 90	Standard Foundation Supplementary Components	17.00	21-01 10 10 90	Generic (in Pile foundations)
Hf_SSSR_Stairs_ReinforceConcrete	24.10	21-02 10 80 10, Stair Construction	21-02 10 80 10	Stair Construction	24.10	21-02 10 80 10	Stairs
Hf_SB1D_BeamFill_Brickwork	28.00	21-06 10 20 20, Space Frames	21-06 10 20 20	Space Frames	28.00	21-06 10 20 20	Generic (in Building frames)
Hf_EWMS_Windows_1VSwing2VFixed_Aluminium+	31.20	21-02 20 20 10, Exterior Operating Windows	21-02 20 20 10	Exterior Operating Windows	31.20	21-02 20 20 10	Windows
Hf_EDMS_ExtenalDoor1Swing2VFixed_Aluminum	31.30	21-02 20 50 10, Exterior Entrance Doors	21-02 20 50 10	Exterior Entrance Doors	31.30	21-02 20 50 10	Doors
Hf_PD1S_InternalDoor_Steel	32.30	21-03 10 30 25, Interior Sliding Doors	21-03 10 30 25	Interior Sliding Doors	32.30	21-03 10 30 25	Doors
Hf_ERVB_RailingVertical_Steel	31.40	21-02 20 80 50, Exterior Balcony Walls and Railings	21-02 20 80 50	Exterior Balcony Walls and Railings	31.40	21-02 20 80 50	Fonts
Hf_PFWC_WC_Porcelain	53.00	21-04 20 10 20, Domestic Water Equipment	21-04 20 10 20	Domestic Water Equipment	53.00	21-04 20 10 20	Generic (in Water)
Hf_PFWH_WashingHand_Porcelain	53.00		21-04 20 10 20				
Hf_PFSW_Shower_Porcelain	53.00		21-04 20 10 20				
Hf_PFSK_Sink_Steel	53.00		21-04 20 10 20				
Hf_PFTP_TapShower_Brass	53.00		21-04 20 10 20				
Hf_PFTP_TapWashingHand_Brass	53.00		21-04 20 10 20				
Hf_PFTP_TapWc_Brass	53.00		21-04 20 10 20				
Hf_PFTP_TapSink_Brass	53.00		21-04 20 10 20				
Hf_PPIH_DomesticWaterPipesD12_Cooper	53.00		21-04 20 10	Domestic Water Distribution	53	21-04 20 10	Water
Hf_PPIH_DomesticWaterPipesD18_Cooper	53.00		21-04 20 10				
Hf_PPIH_DomesticWaterPipesTapsD1/2" _Brass	53.00		21-04 20 10				

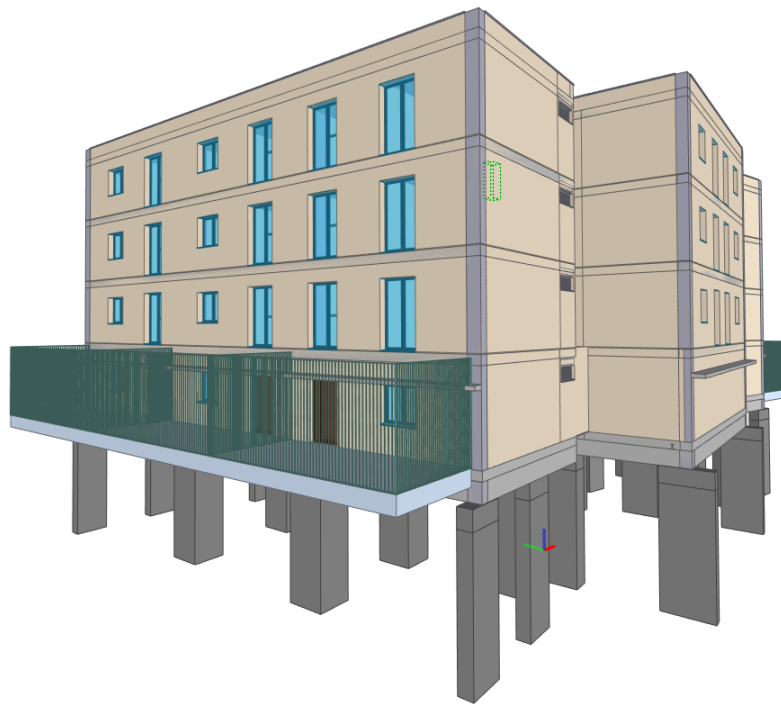
Table 3.7: Classification of BIM Types according to Omniclass table 21 and NLSfb.

3.1.5 BIM Modelling

After going through the previous steps to structure all the necessary BIM data, the modelling was carried out with Revit 2019.



Figure 3.13: 3D Google picture (left), BIM model of Existing building (right).

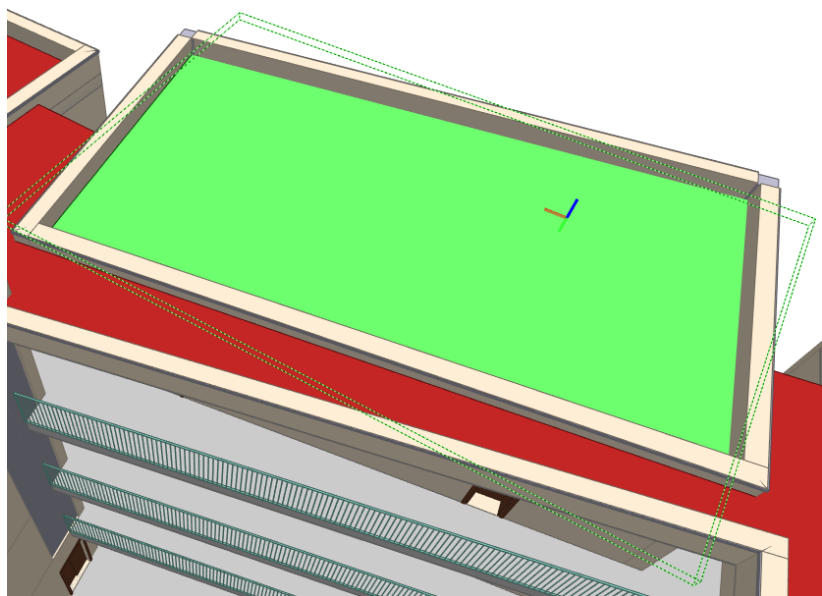


Activo	Clase	Tipo / Elemento
<input checked="" type="checkbox"/>	Ubicación	Default
<input checked="" type="checkbox"/>	Edificio	
<input checked="" type="checkbox"/>	Nivel del edificio	Level -1
<input checked="" type="checkbox"/>	Elementos constructivos indeterminados (Proxies)	
<input checked="" type="checkbox"/>	Cimientos	
<input checked="" type="checkbox"/>	Otros	
<input checked="" type="checkbox"/>	Nivel del edificio	Level 0
<input checked="" type="checkbox"/>	Nivel del edificio	Level 1
<input checked="" type="checkbox"/>	Nivel del edificio	Level 2
<input checked="" type="checkbox"/>	Otros	
<input checked="" type="checkbox"/>	Elementos constructivos indeterminados (Proxies)	
<input checked="" type="checkbox"/>	Ventanas	
<input checked="" type="checkbox"/>	Puertas	
<input checked="" type="checkbox"/>	Escaleras	
<input checked="" type="checkbox"/>	Espacios	
<input checked="" type="checkbox"/>	Nivel del edificio	Level 3
<input checked="" type="checkbox"/>	Otros	
<input checked="" type="checkbox"/>	Elementos constructivos indeterminados (Proxies)	
<input checked="" type="checkbox"/>	Escaleras	
<input checked="" type="checkbox"/>	Ventanas	
<input checked="" type="checkbox"/>	Puertas	
<input checked="" type="checkbox"/>	Espacios	
<input checked="" type="checkbox"/>	Nivel del edificio	Level 4
<input checked="" type="checkbox"/>	Otros	
<input checked="" type="checkbox"/>	Revestimiento	Floor:HF_SH2D_ReticularFrameWorkSlab_ReinforceConcrete:736380
<input checked="" type="checkbox"/>	Revestimiento	Floor:HF_SH2D_ReticularFrameWorkSlab_ReinforceConcrete:708460
<input checked="" type="checkbox"/>	Revestimiento	Floor:HF_SH2D_ReticularFrameWorkSlab_ReinforceConcrete:706704
<input checked="" type="checkbox"/>	Revestimiento	Floor:HF_SH2D_ReticularFrameWorkSlab_ReinforceConcrete:680080
<input checked="" type="checkbox"/>	Revestimiento	Floor:HF_SH2D_ReticularFrameWorkSlab_ReinforceConcrete:680060
<input checked="" type="checkbox"/>	Elementos constructivos indeterminados (Proxies)	
<input checked="" type="checkbox"/>	Puertas	
<input checked="" type="checkbox"/>	Proyecto	0001

Propiedades	Localización	Clasificación	Relaciones	Valor
Sin propiedades				

Figure 3.14: BIM model of Existing building from South West view.

Besides the geometry modelling, the BIM elements were named and enriched with properties regarding to Omniclass table 21 and NLSfb classification systems (see following pictures).



Activo	Clase	Tipo / Elemento
<input checked="" type="checkbox"/>	Nivel del edificio	Level 1
<input checked="" type="checkbox"/>	Nivel del edificio	Level 2
<input checked="" type="checkbox"/>	Nivel del edificio	Level 3
<input checked="" type="checkbox"/>	Nivel del edificio	Level 4
<input checked="" type="checkbox"/>	Muros	
<input checked="" type="checkbox"/>	Cubiertas	
<input checked="" type="checkbox"/>	Cubierta	Basic Roof:HF_ERMS_External
<input checked="" type="checkbox"/>	Cubierta	Basic Roof:HF_ERMS_External
<input checked="" type="checkbox"/>	Forjado	Basic Roof:HF_ERMS_External

Propiedades	Localización	Clasificación	Relaciones	Valor
Element Specific				
Profile				
BaseQuantities				
Ecob_Pset_5D_Roof				
Ecob_Pset_General_Roof				
Ecob_Pset_RoofProperties				
Houseful_Pset_Roof Existing				
Assembly Code		21-02 30 10 50		
ConstructiveSystem		Envelope Roof		
Family and Type		Basic Roof: HF_ERMS_ExternalRoof_Gravel		
NLSfbCode		47.00		
Omniclass Code		21-02 30 10 50		
Omniclass Description		Low-Slope Roofing		
Irc_Export_Roof				
Pset_ManufacturerTypeInformation				
Pset_RoofCommon				
Pset_SlabCommon				

Figure 3.15: Classification properties in BIM elements (Roof).

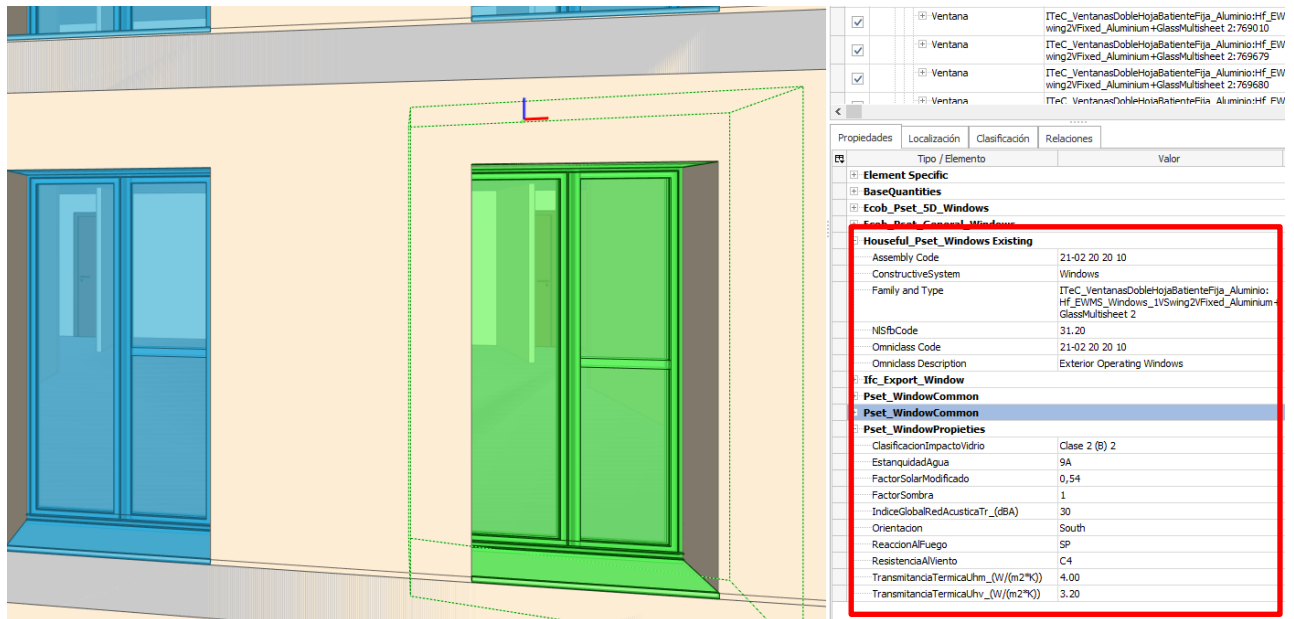


Figure 3.16: Classification properties in BIM elements (Window).

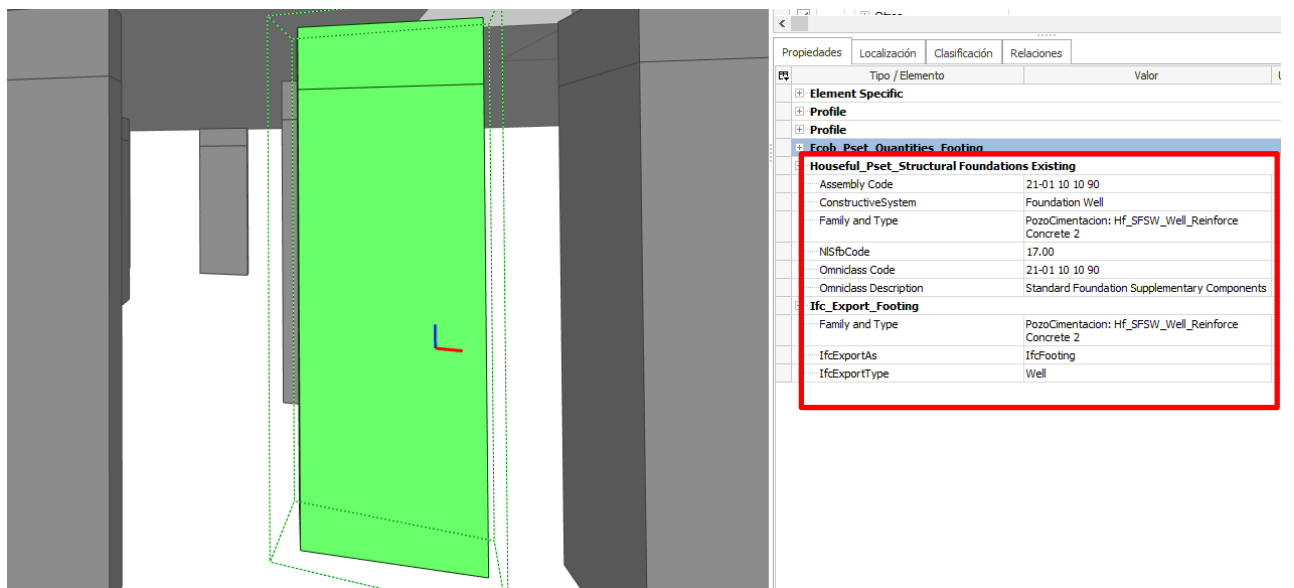


Figure 3.17: Classification properties in BIM elements (Foundation).

3.1.6 Exporting to IFC

The export from the BIM modelling tool into IFC files was done according to the requirements for source files stated in section 3.1 of *Madaster Quick Reference Guide* (see section 2.2.4 in Deliverable 4.3) and section 2 of present document developed according to CARTIF's indications after reconsidering the conclusions of IFC exporting process with Demos 1 and 4.

3.1.7 Validating Madaster requirements

After the inconveniences found in Demos 1 and 4 (see conclusions from Demos in Houseful Deliverable 4.3), where difficulties were experienced to include Base Quantities in all the BIM Elements, the BIM model was validated again prior to submitting it into the Madaster platform. This validation is achieved by opening the models in a BIM Viewer (BIM Collab Zoom) and filtering the elements under a customized Smart view named "Madaster" with specific functions to verify whether every element in the model is defined in terms of:

- a. Materials according to Madaster Material database
- b. Types according to IFC schemes
- c. Classification under NL-Sfb or Unifomat codes
- d. Base Quantities (with main dimensions such as Area, Volume, Height, Width)
- e. Belonging to a Phase or Stage (optional)

The validation was done with the BIM model of the existing building from Ronda Arraona. The Materials, IfcTypes and Classifications were confirmed. However, with the export of Base Quantities difficulties were experienced again in writing these in Footings, Floors, Ceilings, Doors, Windows, Railings, Stairs, Slabs and Columns.

Even if the recommendations from section 2 had been followed, the only BIM elements fully validated by Madaster filter were Walls, Spaces, Members and Roofs.

Given the situation, the BIM model of the existing building in Demo 2 had to be split in two models: one with BIM elements fulfilling Madaster filter conditions and another one formed by BIM Elements to be imported into Material Passport by other means (quantity take offs of the elements poured into the Material Import spreadsheet). You may see both models below, left and right respectively.

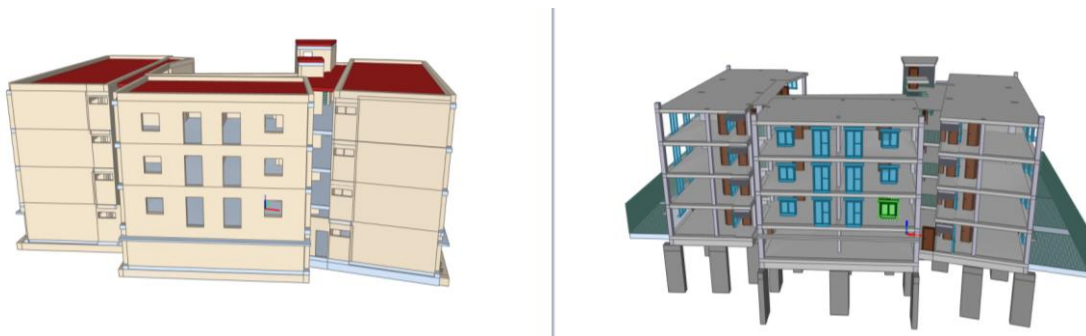


Figure 3.18: BIM model for Material Passport (left), BIM model for Material Import spreadsheets (right).

3.1.8 Quantity take-off from Materials and Elements

The process of the quantity take-off workflow for Materials and Elements in the existing building of Demo 2 had to be done for the BIM Elements whose Base Quantities could not be read in the Material Passport platform. The quantities were taken directly from the BIM Model and loaded into the Material Import sheet (Houseful_T4.1.1_MaterialImport_Demo2.xlsx).

The take-off from BIM elements was used for defining the classification, position and amount from all the building elements that had to be considered in the Material Passport of the project.

The hypothesis, estimations and calculation procedures used for getting the information for not modelled materials/objects are based on ITeC’s knowledge, using a reference budget for residential housing, and dimensioning it to the amount of housing units in the project.

3.1.8.1 Filling in Demo 2 Material Import

The assembling of calculations from non-modelled elements and take-offs from modelled elements resulted in the two sheets, being “Casco” and “Product Type” of Material Type of Demo 2.

	A	B	C	D	E
1	Material/Product	Classification	Buildinglayer	Material	Volume (m3)
71	Hf_PD1S_Door_Wood 95x210cm	21-03 10 30 10	Level -1	Wood	2,4927
72	Hf_ED1S_Door_Wood 200x205cm	21-02 20 50 10	Level 0	Glass	0,383
73	Hf_ED1S_Door_Wood 200x205cm	21-02 20 50 10	Level 0	Aluminum	0,0017
74	Hf_ED1S_Door_Wood 200x205cm	21-02 20 50 10	Level 0	Wood	0,1838
75	Hf_ED1S_Door_Wood 140 x 210cm	21-02 20 50 10	Level 0	Brass	0,0001
76	Hf_ED1S_Door_Wood 140 x 210cm	21-02 20 50 10	Level 0	Wood	0,1542
77	Hf_ED1S_Door_Wood 140 x 210cm	21-02 20 50 10	Level -1	Brass	0,0001
78	Hf_ED1S_Door_Wood 140 x 210cm	21-02 20 50 10	Level -1	Wood	0,3083
79	Hf_SH2D_Slab_Wood 2	21-01 40 20	Level 2	Teak	202,57
80	Hf_SH2D_Slab_Wood 2	21-01 40 20	Level 2	Wood	97,23
81	Hf_StairsRailings 1100mm	21-02 20 80 50	Stairs	Steel	0,332976597
82	Hf_StairsRailings 1100mm	21-02 20 80 50	Level 0	Steel	0,034396332
83	Hf_StairsRailings 1100mm	21-02 20 80 50	Level 2	Steel	0,012638318
84	Hf_ERMS_Roof_Slate+Mortar+Wood Wool	21-02 30 10 10	Level 2	Mortar	97,34
85	Hf_ERMS_Roof_Slate+Mortar+Wood Wool	21-02 30 10 10	Level 2	Slate	39,22
86	Hf_ERMS_Roof_Slate+Mortar+Wood Wool	21-02 30 10 10	Level 2	Wood wool/mi	46,36
87	ITeC_Escalera1TramoResidencialVivienda_ChapaAcero	21-02 10 80 10	Level -1	Steel	0,08
88	Hf_SSSR_Stairs_ReinforceConcrete 0.19TDx32RHcm 2	21-02 10 80 10	Level -1	Natural stone	0,25
89	Hf_SSSR_Stairs_ReinforceConcrete 0.19TDx32RHcm 2	21-02 10 80 10	Level -1	Reinforced con	2,92
90	Hf_SSSR_Stairs_ReinforceConcrete 17.4TDx32RHcm	21-02 10 80 10	Level -1	Natural stone	0,06
91	Hf_SSSR_Stairs_ReinforceConcrete 17.4TDx32RHcm	21-02 10 80 10	Level -1	Reinforced con	0,44
92	Hf_SSSR_Stairs_ReinforceConcrete 17.4TDx32RHcm	21-02 10 80 10	Level 0	Natural stone	0,83
93	Hf_SSSR_Stairs_ReinforceConcrete 17.4TDx32RHcm	21-02 10 80 10	Level 0	Reinforced con	9,7
94	Hf_SSSR_Stairs_ReinforceConcrete 17.4TDx32RHcm	21-02 10 80 10	Level 1	Natural stone	0,87
95	Hf_SSSR_Stairs_ReinforceConcrete 17.4TDx32RHcm	21-02 10 80 10	Level 1	Reinforced con	10,04
96	Hf_SSSR_Stairs_ReinforceConcrete 27TDx17RH	21-02 10 80 10	Level -1	Natural stone	0,56
97	Hf_SSSR_Stairs_ReinforceConcrete 27TDx17RH	21-02 10 80 10	Level -1	Reinforced con	6,43
98	Hf_SSSR_Stairs_ReinforceConcrete 33TDx15RH cm	21-02 10 80 10	Level 0	Natural stone	0,42
99	Hf_SSSR_Stairs_ReinforceConcrete 33TDx15RH cm	21-02 10 80 10	Level 0	Reinforced con	4,28
100	Hf_SSSR_Stairs_ReinforceConcrete 33TDx18RH cm	21-02 10 80 10	Level 0	Natural stone	0,04
101	Hf_SSSR_Stairs_ReinforceConcrete 33TDx18RH cm	21-02 10 80 10	Level 0	Reinforced con	0,37
102	Hf_SSSR_Stairs_ReinforceConcrete 48TDx20RH cm	21-02 10 80 10	Level 0	Natural stone	0,16
103	Hf_SSSR_Stairs_ReinforceConcrete 48TDx20RH cm	21-02 10 80 10	Level 0	Reinforced con	1,3
104	Hf_SITR_Profile_100x160 mm	21-06 10 20 20	Level 0	Wood	21,6311
105	Hf_SISB_Beam_Steel	21-02 10 10 10	Level 0	Steel	0,0165
106	Hf_EW2S_ExternalWindows1Fixed_Wood 100 x 200cm	21-02 20 20 10	Level 0	Glass	0,4
107	Hf_EW2S_ExternalWindows1Fixed_Wood 100 x 200cm	21-02 20 20 10	Level 0	Wood	1,55
108	Hf_EW2S_ExternalWindows2VSwinging_Wood 190 x 160cm	21-02 20 20 10	Level 0	Glass	0,26

Table 3.8: “Casco sheet” in *Houseful_T4.1.1_MaterialImport_Demo2*.



1	Material	Level	Percentage (%) of material in product	Volume (m3) of material in product
2	Bulk concrete floor	Level -1		33,32282472
3	Mortar	Level -1		41,67717528
4	Plaster	Level -1		8,322824716
5	Stone wool	Level -1		16,67717528
6	Brass	Level -1	0,31%	
7	Wood	Level -1	99,69%	
8	Brass	Level 0	0,37%	
9	Wood	Level 0	99,63%	
10	Brass	Level 0	0,37%	
11	Wood	Level 0	99,63%	
12	Brass	Level 0	0,32%	
13	Wood	Level 0	99,69%	
14	Brass	Level -1	0,22%	
15	Wood	Level -1	99,78%	
16	Brass	Level -1	0,23%	
17	Wood	Level -1	99,77%	
18	Brass	Level 1	0,29%	
19	Wood	Level 1	99,71%	
20	Brass	Level -1	0,29%	
21	Wood	Level -1	99,71%	
22	Brass	Level 2	0,26%	
23	Wood	Level 2	99,74%	
24	Brass	Level 0	0,38%	
25	Wood	Level 0	99,62%	
26	Brass	Level 0	0,36%	
27	Wood	Level 0	99,65%	
28	Brass	Level 0	0,32%	
29	Wood	Level 0	99,68%	
30	Brass	Level -1	0,32%	
31	Wood	Level -1	99,68%	
32	Brass	Level -1	0,25%	
33	Wood	Level -1	99,75%	
34	Wood	Level 0	99,09%	
35	Wood	Level -1	100,00%	
36	Mortar	Level 0	40,00%	
37	Natural stone	Level 0	40,00%	
38	Sand	Level 0	20,00%	
39	Bulk concrete floor	Level -1	33,33%	

Table 3.9: "Product Type" sheet in *Houseful_T4.1.1_MaterialImport_Demo2*.

3.2 Material Passport



Figure 3.19: Vision & mission of Madaster.

The Material Passport of Demo 2 has been initiated with the submitted files in several occasions (in the period between June and September 2020) and Turntoo has given feedback about these files until it was confirmed that all materials and quantities of the existing Demo 2 building were imported properly into the Madaster platform.

3.2.1 Prepare source data for upload in Madaster platform

To create the Material Passport for Demo 2, Turntoo received the following two types of data from ITEC:

- 1. Source data:** building data that can be uploaded automatically into the Madaster platform

File name:	File format:	Description:
20200318_Demo2_20200921_Green.ifc	IFC	Contains modelled elements of the existing building (fulfilling Madaster filter conditions).
MaterialImportTemplate_Omniclass_en_Demo2_200916_UPLOAD.xlsx	Excel	Contains modelled elements of the existing building (not fulfilling Madaster filter conditions).

Table 3.10: Uploaded source of data Demo 2 in Madaster platform

Before this data was uploaded into the Madaster platform, the following preparations were executed:

- Volume information was manually calculated (based on provided weight of the element and specific weight of materials) and added for each element that did not contain volume information in the Excel file.

A	B	C	D	E	F	G	H
Material/Product	Classification	Building Layer	Volume (m3)	Area (m2)	Length (m)	Amount	Weight (kg)
HF_PH51_Ceiling_Mortar	21-03 20 50 70	Level 0	1,2688917				
HF_PH51_Ceiling_Mortar	21-03 20 50 70	Level 1	1,2688917				
HF_PH51_Ceiling_Mortar	21-03 20 50 70	Level 2	1,2688923				
HF_PH51_Ceiling_Mortar	21-03 20 50 70	Level 3	1,2688923				
HF_PH51_Ceiling_Plaster	21-03 20 50 70	Level 0	7,1176103				
HF_PH51_Ceiling_Plaster	21-03 20 50 70	Level 1	7,0626676				
HF_PH51_Ceiling_Plaster	21-03 20 50 70	Level 2	7,0868808				
HF_PH51_Ceiling_Plaster	21-03 20 50 70	Level 3	7,0629017				
HF_EDMS_ExternalDoor1Swing2VFixed_Aluminum	21-02 20 50 10	Level 0	0,2547985				
HF_EDMS_ExternalDoor1Swing2VFixed_Aluminum	21-02 20 50 10	Level 0	0,1562484				
HF_EDMS_ExternalDoor2Swing_Aluminum+GlassMultipleSheets	21-02 20 50 10	Level 0	0,0293673				
HF_EDMS_ExternalDoor2Swing_Aluminum+GlassMultipleSheets	21-02 20 50 10	Level 0	0,0472926				
HF_EDMS_ExternalDoor2Swing_Aluminum+GlassMultipleSheets	21-02 20 50 10	Level 0	0,0273386				

Table 3.11: Example of Madaster Excel upload file (volume information).

Adding volume information allows a better visual insight into the overview of existing materials and products used in Demo 2 in Madaster’s “Building” tab (see figure 3.22).

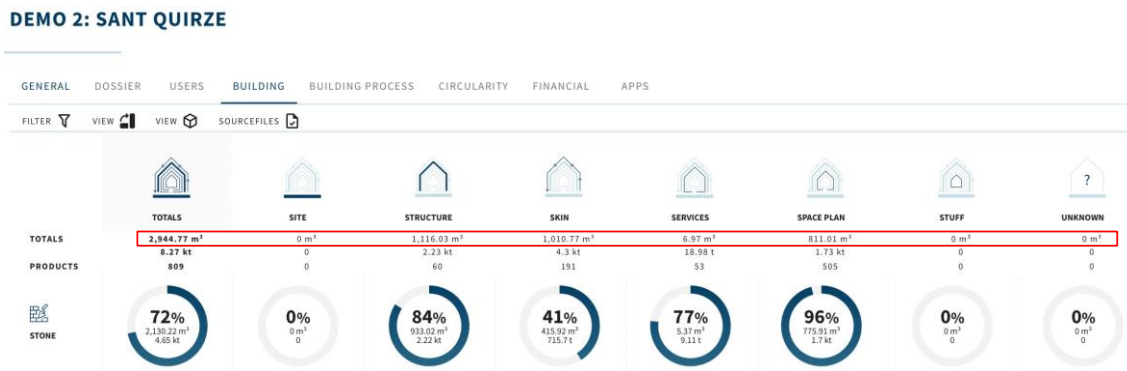


Figure 3.20: Madaster Building tab for Demo 2.

2. Additional data: building data that cannot be uploaded automatically into Madaster, but is used to enrich the Material Passport of Demo 2 in Madaster

File name:	File format:	Description:
"Product Type" sheet in Houseful_T4.1.1_MaterialImport_Demo2 (see table 3.10).	Excel	Contains product composition information for each element of Demo 2.

Table 3.12: Additional data: product composition.

Material circularity information is not separately provided specifically for Demo 2. Instead, material circularity data from Demo 1 and Demo 4 are applied (see also section 3.2.3 below).

3.2.2 Upload source data in Madaster platform

After completing these source data preparations, two separate data source files (1 IFC and 1 Excel file) were uploaded in the Madaster platform. Subsequently, these files were set to 'active', meaning that their data is used in the Materials Passport in Madaster.

SOURCE FILE (BIM OR EXCEL)

Name	Size	Classification method	Date exported	Tags	Owner	Active
20200318_Demo2_20200921_Green.ifc 20190808_0900(x64) - Exporter 19.3.0.0 - Alternate UI 19.3.0.0; IFC2X3	14MB	Omniclass	21-09-2020 13:37			<input checked="" type="checkbox"/>
MaterialImportTemplate_Omniclass_en_Demo2_200916_UPLOAD.xlsx Microsoft Excel (16.0300)	58KB	Omniclass	18-09-2020 16:43			<input checked="" type="checkbox"/>

Figure 3.21: Madaster Dossier tab: active source files (IFC & Excel).

3.2.3 Set-up products in Madaster

To provide a more detailed and more accurate overview of applied materials and products in the Material Passport of Demo 2, so called "Products" have been set-up in Madaster. A product could exist of one material (e.g., Wooden floor) or multiple underlying materials (e.g., reinforced concrete pillar). Based on the source data provided, the Madaster system distinguishes four types of products:

Volume: m3 information needed to create product in Madaster.

Area: m2 information needed to create product in Madaster.

Length: m1 information needed to create product in Madaster.

Quantity: number of elements needed to create product in Madaster.

As described in section 3.2.1 of this document, ITeC provided Turntoo additional information (see table 3.10) about the product composition of all elements applied in Demo 2. Based on this overview and available source data, Turntoo set-up products for all elements of Demo 2.

HF_SH2D_RETICULARFRAMEWORKSLAB_REINFORCECONCRETE

PRODUCT INFORMATION CIRCULARITY ENVIRONMENT BILL OF MATERIALS SEARCH CRITERIA DOSSIER				
EDIT				
Name	Type	Value	Mass	
Reinforced concrete (houseful)	Material	100%	2400 kg	

Figure 3.22: Madaster Product (example of a product existing of 1 material).

HF_PV1S_EXTERNALWALLS_PLASTER+BRICK+PLASTER 15CM

PRODUCT INFORMATION CIRCULARITY ENVIRONMENT BILL OF MATERIALS SEARCH CRITERIA DOSSIER				
EDIT				
Name	Type	Value	Mass	
Brickwork, Masonry (Houseful)	Material	90.06%	1531.0200000000002 kg	
Plaster (Houseful)	Material	9.94%	178.92 kg	

Figure 3.23: Madaster Product (example of a product existing of multiple materials).

Besides the product's composition, each Madaster product also contains a "search criteria". This is useful in Madaster's automated matching process during source file upload. For Demo 2 each product in Madaster was set-up with the exact same naming as provided (by ITeC) in the source data. By providing the exact same description also in each of the product's search criteria section, the automated matching process in Madaster will ensure that most source data elements will be automatically matched with products created in the Madaster database.

HF_SH2D_RETICULARFRAMEWORKSLAB_REINFORCECONCRETE

PRODUCT INFORMATION	CIRCULARITY	ENVIRONMENT	BILL OF MATERIALS	SEARCH CRITERIA	DOSSIER	FINANCIAL
EDIT						
Search criterium					Matching type	
HF_SH2D_ReticularFrameWorkSlab_ReinforceConcrete					Contains	

Figure 3.24: Madaster Product (example of a product search criteria).

3.2.4 Validate uploaded source data in Madaster platform

When Demo 2 source data is uploaded, the Madaster platform will automatically check and match elements (from the Excel and IFC source data files) with items in its own material and product databases. When an element from the source files is recognised (due to search criteria), the Madaster system will automatically link this item to a specific Madaster material or product.

Element	Materials	Product / material	Quantity
--- Basic Wall:HF_PV15_InternalWalls_Plaster+Brick+Plaster:718850	Plaster,Brickwork,Plaster	--- HF_PV15_InternalWalls_Plaster+Brick+Plaster	1/1
--- Basic Wall:HF_PV15_InternalWalls_Plaster+Brick+Plaster:719351	Plaster,Brickwork,Plaster	--- HF_PV15_InternalWalls_Plaster+Brick+Plaster	1/1
--- Basic Wall:HF_PVMS_InternalWalls_Plaster+Brick+Polyurethan+BRICK+Plaster:716813	Plaster,Brickwork,Plaster,Polyurethan foam 30,Brickwork,Plaster,Brickwork,Plaster	HF_PVMS_InternalWalls_Plaster+Brick+Polyurethan+BRICK+Plaster	1/1
--- Basic Wall:HF_PVMS_InternalWalls_Plaster+Brick+Polyurethan+BRICK+Plaster:716817	Plaster,Brickwork,Plaster,Polyurethan foam 30,Brickwork,Plaster,Brickwork,Plaster	HF_PVMS_InternalWalls_Plaster+Brick+Polyurethan+BRICK+Plaster	1/1
--- Basic Wall:HF_PVMS_InternalWalls_Plaster+Brick+Polyurethan+BRICK+Plaster:713892	Plaster,Brickwork,Plaster,Polyurethan foam 30,Brickwork,Plaster,Brickwork,Plaster	HF_PVMS_InternalWalls_Plaster+Brick+Polyurethan+BRICK+Plaster	1/1

Figure 3.25: Source data element (from IFC file) automatically linked to Madaster Product set-up.

In case an element is not recognised, Madaster will not be able to match it. After the automated matching process, non-assigned elements can be linked manually.

Finally, the two source files, containing their individual elements, have been linked (automatically and where needed manually) with products that have been set-up in Madaster. The results are shown below.

QUALITY OF SOURCEFILES

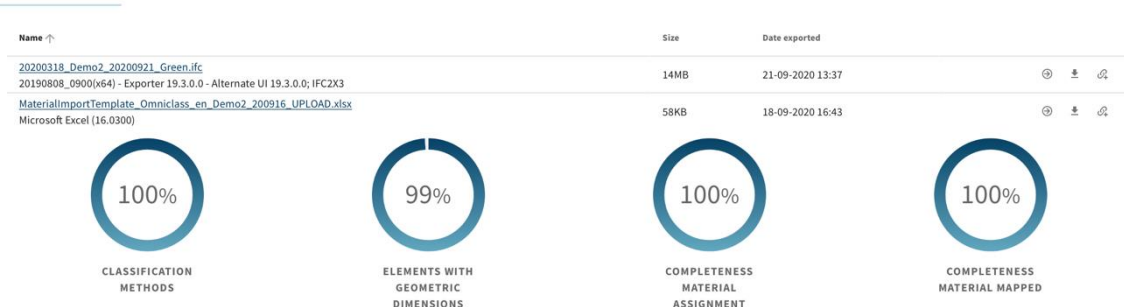


Figure 3.26: Source data upload results



3.2.5 Enrich products in Madaster platform

As indicated in section 3.2.1, compared to Demo 1 & 4, Turntoo did not (yet) receive additional 'circular' information such as:

- Lifespan in years
- Feedstock sources (% recycled, rapidly renewable or virgin)
- End of life scenario ((% recycled, landfill or incineration)
- Level of disassembly (CHECKLIST REUSABILITY)

for all elements applied in Demo 2.

Instead, material circularity information, as provided for Demo 1 & 4, has been used to calculate the existing building's level of circularity (in the platform's "Circularity" tab). See section 2.2.5 of Deliverable 4.3.

3.2.6 Obtain Material Passport in Madaster platform

After the upload of source data elements and the set-up, validation and enrichment of products in Madaster with existing circularity data, all relevant input data is available to in the Madaster platform to finally publish the Material Passport for Demo 2. A Material Passport can be generated as often as desired, while a digital version (in both pdf and Excel format) is stored in the building's Dossier tab (see figure 3.29). Depending on the user's access rights a Material Passport can be viewed, downloaded, or deleted.

GENERAL DOCUMENT



	Name	Size	Last modified
	Demo 2: Sant Quirze, 2021/05/12 EN.pdf	2MB	12-05-2021 12:01
	Demo 2: Sant Quirze, 2021/05/12 EN.xlsx	76KB	12-05-2021 12:00

Figure 3.27: Madaster dossier: Material Passport Demo 2 (in pdf & Excel format)

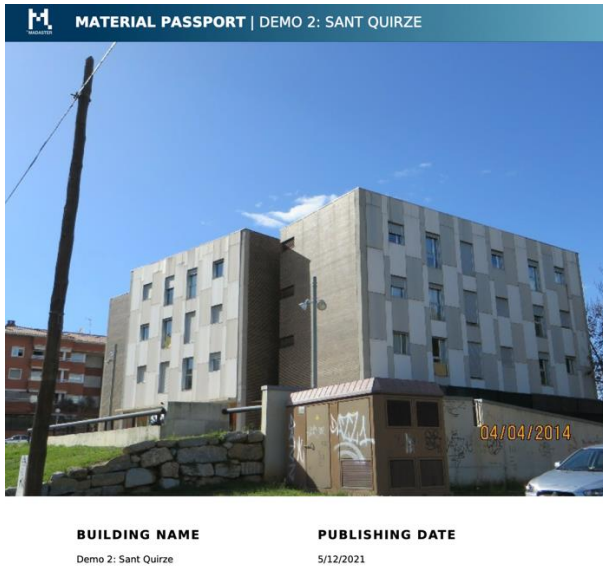


Figure 3.28: Madaster Material Passport Demo 2 (cover page)

The Material Passport will be completed when the renovation project of Demo 2 is finished and the New and Demolition BIM models and quantities are defined together with the Houseful Solutions. The renovation project of Demo 2 is expected to be finished by the end of June 2021. According to the established plan, the final stage of Material Passports for Demos 2, 3 and Houseful Solutions will be explained in D4.10 in M48

4 Demo 3 – KasernStrasse 2 - Fehring

4.1 BIM Modelling

4.1.1 Gathering and analysis of information

Confidential section: This section is only available to members of the consortium and Commission Services.

Building description

It is an old headquarters building in T shape made up of four floors and a two-sided roof cover. There is a longitudinal module and a transversal one. The first one is less deep than the second one. The access hall is on the ground floor. The main entrance is on the north façade in the landing of the main staircase (between levels -1 level 0). Once we ascend to level 0, we reach a main distribution artery that runs through the entire length of the floor. From the entrance to the right, we find a community bathroom with toilets showers and changing rooms. The community kitchen and the rest of the rooms of this module on this level are dedicated to homes with different size of useful areas.

The second entrance to the building is on its West which is reached from the main staircase outside the building and is located next to the second community bathroom of the building. From there we reach a corridor that meets the access branch that leads to the main arterial communication of the building to reach the rest of homes also with different size of useful areas. The third entrance to the building is on a landing also located between the ground floor and the basement.

There are no entrances in level 1. It is equally distributed as ground floor and it is accessed through the 2 main stairs.

The general distribution in level -1 is similar as the ground floor (level 0) and first floor (level 1). Differently from these, there are 2 social rooms: there is a gym in the transversal module and a meeting room in the longitudinal one.

The basement floor is on 2 levels and its main distribution is the same as all the rest. The technical premises are located on this level: the facilities that provide comfort to the building. In the main module there are the technical premises of the installations and some rooms, all with natural light. In the past in the current boiler room there was the tank room and nowadays it contains the community biomass boiler.

Recognition of building systems and materials

Confidential section: This section is only available to members of the consortium and Commission Services.



The description of the building systems is as follows:

Foundations: Up to date, there is no available information about the foundation system.

Structure and shell: Porticoed structure formed by walls with a sloping or horizontal finish (depending on the direction of the walls).

Horizontal structural elements made up with 25 cm solid reinforced concrete slab floor.

Vertical structural elements made up of 30-50 cm thick load bearing walls excepting some 85 cm load bearing buttresses supporting wherever roof trusses are supported.

Internal stairs made of 20 cm reinforced concrete slab.

Stairs next to the boiler room are made of steel sheet.

Sloped roof structure is made of timber trusses distributed every 3,4 to 4,0 m with 2 cm plates for supporting upper and lower roof covers.

Envelope: The façade is made up of one bearing leaf of stone masonry 30-50 cm thick covered with lime plaster on both sides. A curtain wall system is projected to cover a glasshouse which is meant to be on the main entrance of the North façade.

30° sloped, T-shaped roof with sound absorbing wooden panels.

Mass concrete floors with rockwool insulation.

Partitions: Plaster-coated limestone masonry partitions.

Ceilings: Gypsum and rockwool continuous boards that cannot be registered.

Windows and doors

Internal doors (Doors): Wood

External doors (Home entrances and balcony doors): Wood

Main entrance door: Dark anodized aluminum.

Windows: Wooden windows with single glass and wooden shutters.

Services: Electricity and water facilities in the basement floor.

The compilation of items that form the building were collected in a file, separated by elements, types and materials as well as the thickness of each layer and the stage to which the element belongs or is intended to be assembled according to the available draft of the project. The file also contains the thermal properties of the materials.



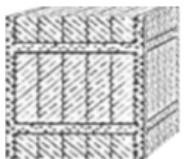



Envelope Elements					Representative picture	Layers from inside to Tl
External Wall A						
If needed, add additional external wall components						Lime plaster Solid brick masonry Light concrete full stones plaster U-value [W/m²·K]
Layers from inside to o	Thickness	Conductivity [W]	Density [kg]	Specific heat [J]		
plaster	0,012	0,87	849	910		
Light concrete full stones	0,29	0,583	1000	900		
plaster	0,012	0,87	849	910		
U-value [W/m²·K]				1,5		
Description						
In the attic						
If needed, add additional roof components						Layers from inside to Tl U-value [W/m²·K]
Roof A						
Layers from inside to o	Thickness	Conductivity [W]	Density [kg]	Specific heat [J]		
Plastering mortar made of lim	0,005	0,87	849	910		
Mineral bonded wood wool b	0,05	0,11	1314	1260		
Wooden frame	0,024	0,15	750	2600		
rafters with air	0,1	0,528	750	2600		
wooden frame	0,024	0,15	750	2600		
U-value [W/m²·K]				0,88		
Description						
Roof						
If needed, add additional ground floor components						Layers from inside to Tl U-value [W/m²·K]
Ground floor A						
Layers from inside to o	Thickness	Conductivity [W]	Density [kg]	Specific heat [J]		
Reinforced concrete	0,2	2,3	2400	960		
bulk	0,04	0,7	-	-		
acoustic insulation	0,02	0,04	60	-		
screed concrete	0,05	1,4	1850	960		
topping	0,01	0,26	1700	-		
U-value [W/m²·K]				1,13		
Description						
In the cellar						
If needed, add additional internal floor components						Layers from inside to Tl Plastering mortar made of Mineral bonded wood wool Wooden frame rafters with air wooden frame U-value [W/m²·K]
Internal floor A						
Layers from inside to o	Thickness	Conductivity [W]	Density [kg]	Specific heat [J]		
Plastering mortar made of lim	0,005	0,87	849	910		
Reinforced concrete	0,2	2,3	2400	960		
bulk	0,04	0,7	-	-		
acoustic insulation	0,02	0,04	60	-		
screed concrete	0,05	1,4	1850	960		
topping	0,01	0,26	1700	-		
U-value [W/m²·K]				0,91		
Description						

Figure 4.29: Recognition of elements and materials in "4.1 HOUSEFUL demo audit_Cambium.xlsx".

The document was provided by Reinberg and it was completed with descriptive documents of the project such as plans and details.

Once processed all the available information, the building materials and systems were named and related to the Madaster list of materials to be recognized in the Material Passport database.

4.1.2 Geolocation of the building

The geolocation of the model reflects the position of the building regarding the World. There are different Global coordinate systems. In this case, the UTM (Universal Transversal Mercator) system has been used.



4.1.3 Naming of BIM Element types

The different types of elements that make up the building were named for proper modeling and easy identification according to the table below:

Classification	Category/Element	Type
Foundation	Non modelled	Not available information
Envelope	Walls (Façade)	Hf_EF1S_ExternalWall_Materials
	Roof	Hf_ERMS_Roof_Materials
	Floor (Screed)	Hf_ES1S_Screed_Materials/Hf_ESMS_Floor_Materials
Structural Horizontal and Vertical	Floor (Slabs)	Hf_SH1D_Floor_Materials
		Hf_SH2D_Floor_Materials
	Structural framing/ (Joist)	Hf_SITR_Profile_100x160 Hf_SISB_Beam_Steel
	Walls	Hf_SV1S_InternalWallStructural_Materials Hf_EF1S_ExternalWall_Materials
Stairs	Hf_SSSR_Stairs_Material	
Partitions	Doors	Hf_PD1S_Door_Material
	Walls (Internal Walls)	Hf_PV1S_InternalWall_Materials
	Windows	Hf_EW1S_ExternalWindows1Fixed_MaterialDimensions
		Hf_EW2S_ExternalWindows2VSwinging_MaterialDimensions
		Hf_EW3S_ExternalWindows3VSwinging_MaterialDimensions
Floors	Hf_PH1S_Floor_Materials	
Ceilings	Hf_PHMS_Ceiling_Materials	
Barandillas	Railings	HF_StairRailings_RailingHeight

Table 4.13: Naming of BIM element types.

The code and meaning of the acrostic for each BIM Element type is stated in the following table:

Coding	Element	Description
Hf_SIXX_YYYY_Materials	Hf	Houseful



Coding	Element	Description
Envelope (SIXX)	Facade (EF)	(EF1S) Envelope FacadeOne Sheet (EFMS) Envelope Facade Multiple Sheet
	Roof(ER)	(ER1S) Envelope Roof One Sheet (ERMS) Envelope Roof Multiple Sheet
	Screed (ES)	(ES1S) Envelope Screed One Sheet (ESMS) Envelope Screed Multiple Sheet
Structural (SIXX)	Floor (Slab)	(SH1D) Structural Horizontal One direction
		(SH2D) Structural Horizontal 2 direction
	Structural framing (Joist)	(SITR) Structural Incline Truss Rectangular (SISB) Structural incline Steel Beam
	Wall	(SV1S) Structural Vertical One sheet (SVMS) Structural Vertical Multiple sheet
	Stairs	(SSSR) Structural Stairs Section Rectangular
Partitions (SIXX)	Doors	(PD1S) Partition Door One sheet
		(PD2S) Partition Door Two Sheet
	Walls (Internal Walls)	(PV1S) Partition Vertical One Sheet
		(PVMS) Partition Vertical Multiple Sheet
	Windows	(EW1S) Envelope Windows one sheet
		(EW2S) Envelope Windows two sheets
(EW3S) Envelope Windows three sheets		
Floors/Ceilings	(PH1S) Partition Horizontal one sheets	
	(PHMS) Partition Horizontal Multiple sheets	



Coding	Element	Description
Railings (SIXX)	Railings	StairRailings
Envelope (YYYY)	Facade	ExternalWall
	Roof	Roof
	Screed	Screed
Structure (YYYY)	Slab	Slab
	Beam/Profile	Beam Profile
	Wall	ExteriorWall / InternalWallStructural
	Stair	Stairs
Partition (YYYY)	Doors	Door
	Wall (Internal wall)	Internal Wall
	Windows	ExternalWindows1Fixed ExternalWindows2VSwinging
	Floors	Floor
	Ceilings	Ceilings

Table 4.14: Coding of BIM element types.

4.1.4 Location of BIM Element types

The naming and coding of the BIM Elements allow to locate the elements easily without error. Here there are some examples of how the modeler is able to identify and position the types of elements in the model. The colors represent each type of wall or floor as shown in the figures.

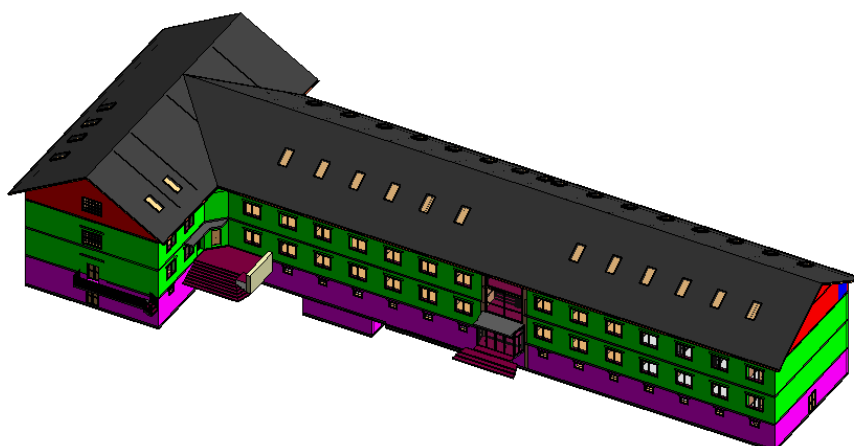


Figure 4.30: Location of wall types in the 3D view (in green, red and purple).

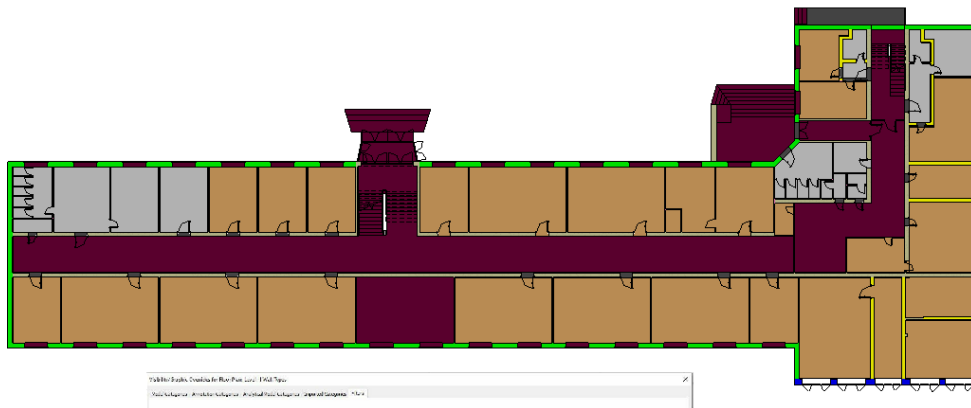


Figure 4.31: Location of wall types in the 3D view (in green).

4.1.5 Classification according to Omniclass table 21 and NLSfb

Once the BIMTypes were identified with the respective material similarity to the Madaster list of materials, the final step before starting modeling will be to relate these types to the Omniclass (table 21) classification and NLSfb classification standards required to import the project information into the Madaster database. This task was achieved in the table shown in figure below.

Column1	Column3	Column4	Column9	Column92
Window Material Takeoff				
Family and Type	Type	ConstructiveSystem	NISfbCode	Assembly code
Claraboya: Hf_EW2S_ExternalWindows1Fixed_Wood 100 x 200cm	Hf_EW2S_ExternalWindows1Fixed_Wood 100 x 200cm	Windows	31.20	21-02 20 20 10
Claraboya: Hf_EW2S_ExternalWindows1Fixed_Wood 100 x 200cm	Hf_EW2S_ExternalWindows1Fixed_Wood 100 x 200cm	Windows	31.20	21-02 20 20 10
Level 2: 68				
ITeC_VentanasDobleHojaBatiente_Madera: Hf_EW2S_ExternalWindows2VSwinging_Wood 190 x 160cm	Hf_EW2S_ExternalWindows2VSwinging_Wood 190 x 160cm	Windows	31.20	21-02 20 20 10
ITeC_VentanasDobleHojaBatiente_Madera: Hf_EW2S_ExternalWindows2VSwinging_Wood 190 x 160cm	Hf_EW2S_ExternalWindows2VSwinging_Wood 190 x 160cm	Windows	31.20	21-02 20 20 10
ITeC_VentanasDobleHojaBatiente_Madera: Hf_EW2S_ExternalWindows2VSwinging_Wood 190 x 160cm	Hf_EW2S_ExternalWindows2VSwinging_Wood 190 x 160cm	Windows	31.20	21-02 20 20 10
Level -1: 18				
ITeC_VentanasDobleHojaBatiente_Madera: Hf_EW2S_ExternalWindows2VSwinging_Wood 190 x 160cm	Hf_EW2S_ExternalWindows2VSwinging_Wood 190 x 160cm	Windows	31.20	21-02 20 20 10
ITeC_VentanasDobleHojaBatiente_Madera: Hf_EW2S_ExternalWindows2VSwinging_Wood 190 x 160cm	Hf_EW2S_ExternalWindows2VSwinging_Wood 190 x 160cm	Windows	31.20	21-02 20 20 10
ITeC_VentanasDobleHojaBatiente_Madera: Hf_EW2S_ExternalWindows2VSwinging_Wood 190 x 160cm	Hf_EW2S_ExternalWindows2VSwinging_Wood 190 x 160cm	Windows	31.20	21-02 20 20 10
Level 0: 117				
ITeC_VentanasDobleHojaBatiente_Madera: Hf_EW2S_ExternalWindows2VSwinging_Wood 190 x 160cm	Hf_EW2S_ExternalWindows2VSwinging_Wood 190 x 160cm	Windows	31.20	21-02 20 20 10
ITeC_VentanasDobleHojaBatiente_Madera: Hf_EW2S_ExternalWindows2VSwinging_Wood 190 x 160cm	Hf_EW2S_ExternalWindows2VSwinging_Wood 190 x 160cm	Windows	31.20	21-02 20 20 10
ITeC_VentanasDobleHojaBatiente_Madera: Hf_EW2S_ExternalWindows2VSwinging_Wood 190 x 160cm	Hf_EW2S_ExternalWindows2VSwinging_Wood 190 x 160cm	Windows	31.20	21-02 20 20 10
Level 1: 117				
ITeC_VentanasUnaHojaBatiente_Aluminio: Hf_EW2S_ExternalWindows1HSwinging_Wood 100 x 75cm	Hf_EW2S_ExternalWindows1HSwinging_Wood 100 x 75cm	Windows	31.20	21-02 20 20 10
ITeC_VentanasUnaHojaBatiente_Aluminio: Hf_EW2S_ExternalWindows1HSwinging_Wood 100 x 75cm	Hf_EW2S_ExternalWindows1HSwinging_Wood 100 x 75cm	Windows	31.20	21-02 20 20 10
Level -1: 60				
M_Window-Casement-Triple-Awning-Triple: Hf_EW2S_ExternalWindows3VSwinging_Wood 230 x 160cm	Hf_EW2S_ExternalWindows3VSwinging_Wood 230 x 160cm	Windows	31.20	21-02 20 20 10
M_Window-Casement-Triple-Awning-Triple: Hf_EW2S_ExternalWindows3VSwinging_Wood 230 x 160cm	Hf_EW2S_ExternalWindows3VSwinging_Wood 230 x 160cm	Windows	31.20	21-02 20 20 10
Level 0: 2				
M_Window-Casement-Triple-Awning-Triple: Hf_EW2S_ExternalWindows3VSwinging_Wood 230 x 160cm	Hf_EW2S_ExternalWindows3VSwinging_Wood 230 x 160cm	Windows	31.20	21-02 20 20 10
M_Window-Casement-Triple-Awning-Triple: Hf_EW2S_ExternalWindows3VSwinging_Wood 230 x 160cm	Hf_EW2S_ExternalWindows3VSwinging_Wood 230 x 160cm	Windows	31.20	21-02 20 20 10
Level 1: 4				
M_Window-Casement-Triple-Awning-Triple: Hf_EW2S_ExternalWindows3VSwinging_Wood 230 x 160cm	Hf_EW2S_ExternalWindows3VSwinging_Wood 230 x 160cm	Windows	31.20	21-02 20 20 10
M_Window-Casement-Triple-Awning-Triple: Hf_EW2S_ExternalWindows3VSwinging_Wood 230 x 160cm	Hf_EW2S_ExternalWindows3VSwinging_Wood 230 x 160cm	Windows	31.20	21-02 20 20 10
Level 2: 2				
M_Window-Casement-Triple-Awning-Triple: Hf_EW3S_ExternalWindows3VSwinging_Wood 185x177	Hf_EW3S_ExternalWindows3VSwinging_Wood 185x177	Windows	31.20	21-02 20 20 10
M_Window-Casement-Triple-Awning-Triple: Hf_EW3S_ExternalWindows3VSwinging_Wood 185x177	Hf_EW3S_ExternalWindows3VSwinging_Wood 185x177	Windows	31.20	21-02 20 20 10
Level 2: 4				
M_Window-Casement-Triple-Awning-Triple: Hf_EW3S_ExternalWindows3VSwinging_Wood 236 x 180cm	Hf_EW3S_ExternalWindows3VSwinging_Wood 236 x 180cm	Windows	31.20	21-02 20 20 10
M_Window-Casement-Triple-Awning-Triple: Hf_EW3S_ExternalWindows3VSwinging_Wood 236 x 180cm	Hf_EW3S_ExternalWindows3VSwinging_Wood 236 x 180cm	Windows	31.20	21-02 20 20 10
Level -1: 10				
M_Window-Casement-Triple-Awning-Triple: Hf_EW3S_ExternalWindows3VSwinging_Wood 240x160 cm	Hf_EW3S_ExternalWindows3VSwinging_Wood 240x160 cm	Windows	31.20	21-02 20 20 10
M_Window-Casement-Triple-Awning-Triple: Hf_EW3S_ExternalWindows3VSwinging_Wood 240x160 cm	Hf_EW3S_ExternalWindows3VSwinging_Wood 240x160 cm	Windows	31.20	21-02 20 20 10
Level 0: 8				

Table 4.15: Classification of BIM Types according to Omniclass table 21 and NLSfb.

4.1.6 BIM Modelling

After going through the previous steps to structure all the necessary BIM data, the modelling was carried out with Revit 2019.

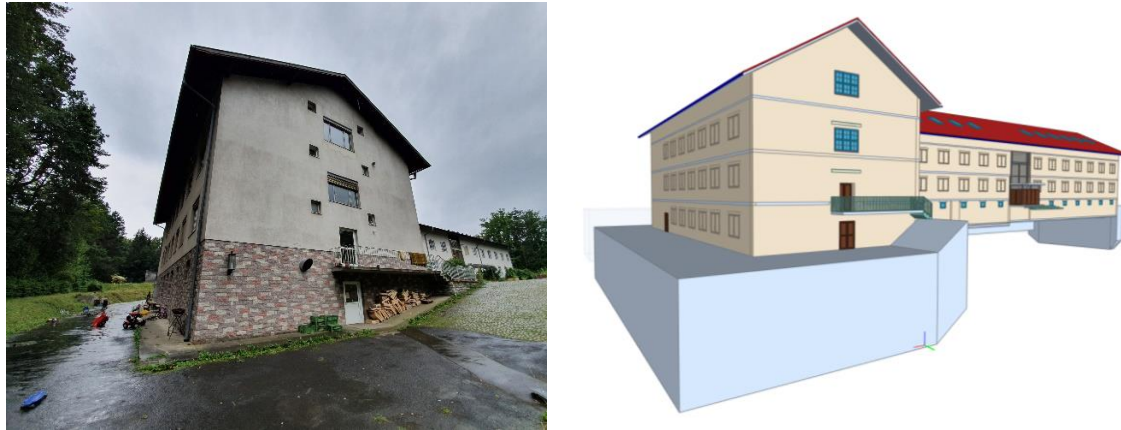


Figure 4.32: Present picture (left), BIM model of Existing building (right).

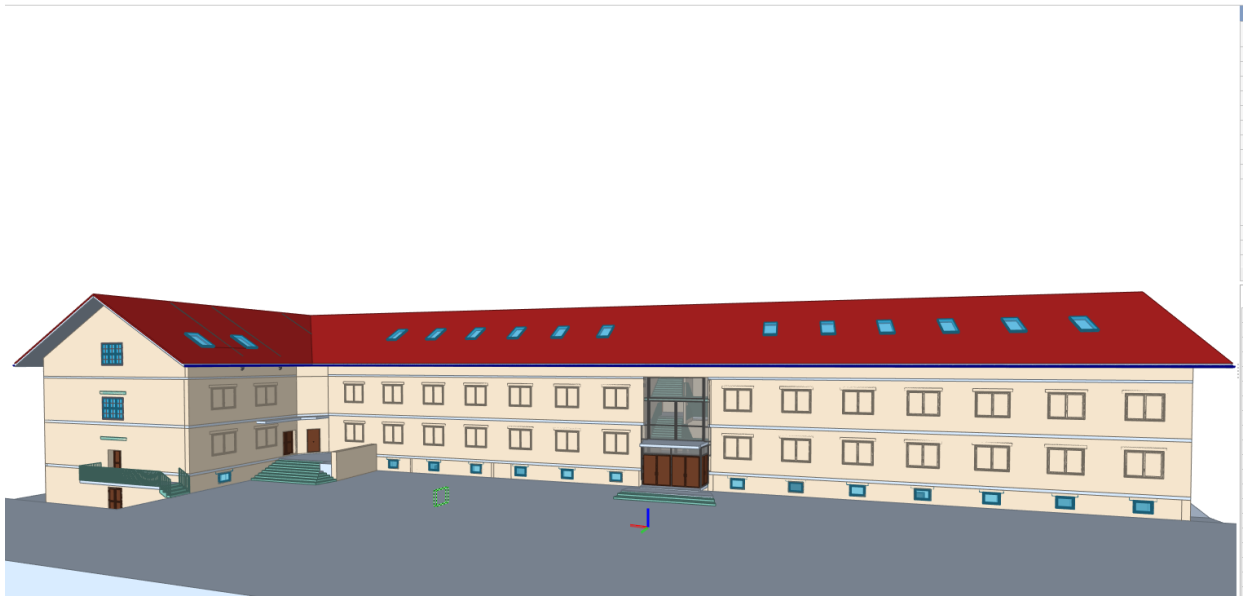


Figure 4.33: BIM model of Existing building from the main entrance view.

Besides the geometry modelling, the BIM elements were named and enriched with properties regarding to Omniclass (table 21) and NLSfb classification systems (see following pictures).

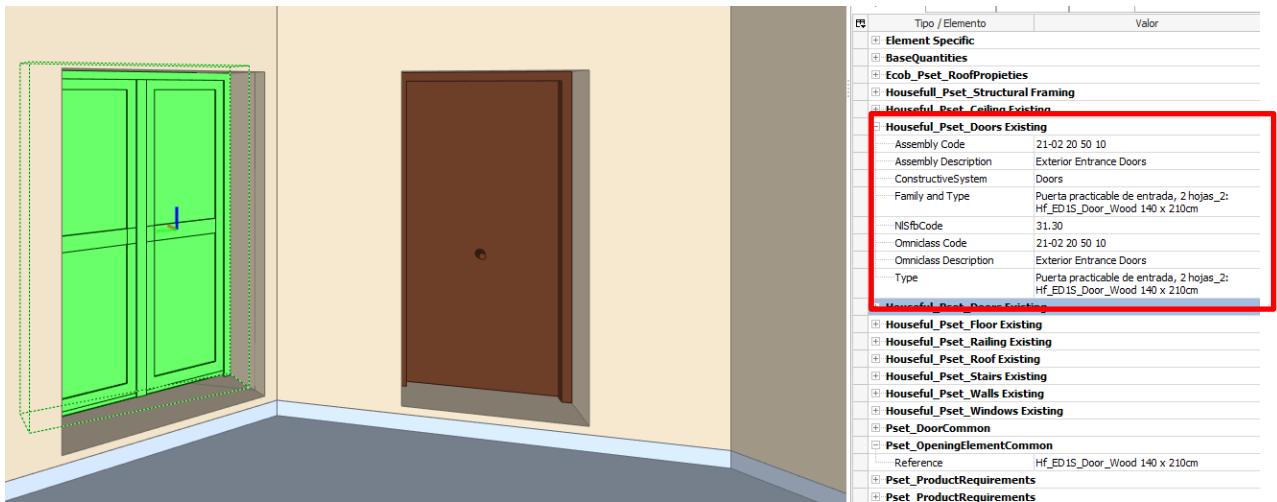


Figure 4.34: Classification properties in BIM elements (Door).

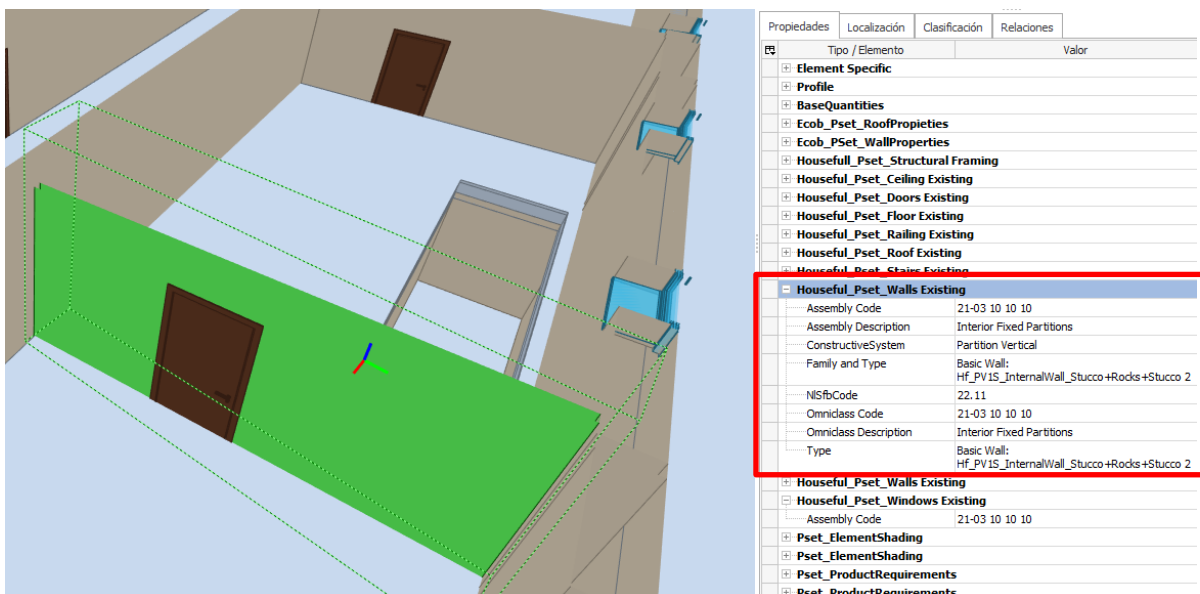


Figure 4.35: Classification properties in BIM elements (Wall).

4.1.7 Exporting to IFC

The export from the BIM modelling tool into IFC files was done according to the requirements for source files stated in section 3.1 of *Madaster Quick Reference Guide* (see section 2.2.4 in Deliverable 4.3) and section 2 of present document developed according to CARTIF's indications after reconsidering the conclusions of IFC exporting process with Demos 1 and 4.

4.1.8 Validating Madaster requirements

After the inconveniences found in Demos 1 and 4 (see conclusions from Demos in Houseful Deliverable 4.3), where difficulties were experienced to include Base

Quantities written in all the BIM Elements, the BIM model was validated again prior to submitting it into the Madaster platform. This validation is achieved by opening the models in a BIM Viewer (BIM Collab Zoom) and filtering the elements under a customized Smart view named "Madaster" with specific functions to verify whether every element in the model is defined in terms of:

- a. Materials according to Madaster Material database
- b. Types according to IFC schemes
- c. Classification under NL-Sfb or Unifomat codes
- d. Base Quantities (with main dimensions such as Area, Volume, Height, Width)
- e. Belonging to a Phase or Stage (optional)

The validation was done with the BIM model of the existing building from Demo 4. The Materials, IfcTypes and Classifications were confirmed. However, with the export of Base Quantities there was trouble again in writing them into Ceilings, Doors, Windows, Railings, Stairs, Assemblies and Roofs. Unlike in Demo 2 where Roofs positively filtered, in this model the Roof did not meet the requirements because it is a sloped one and the export tool does not write the Base Quantities efficiently.

Even if the recommendations from section 2 had been followed and revised after Demo 2, in Demo 3 the BIM elements fully validated by Madaster filter were Walls, Slabs, Beams and Members.

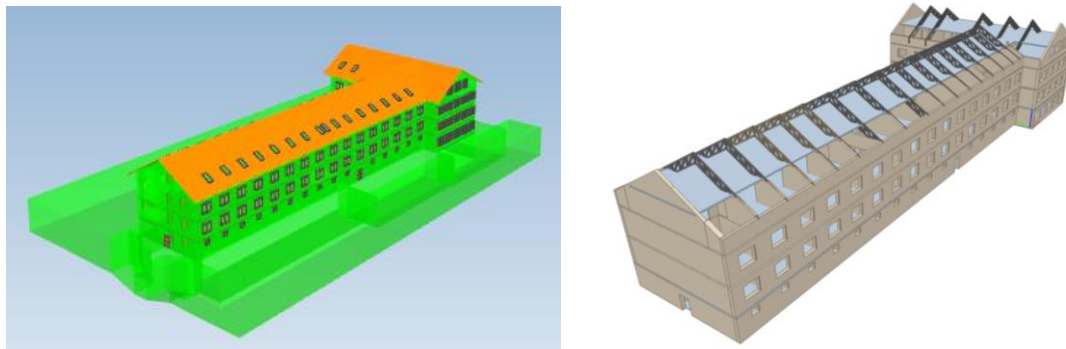


Figure 4.36: BIM model under filter (left), BIM model remained for Material Passport (right).

Similar to Demo 2, the BIM model of the existing building Demo 3 also had to be split in two models: one with BIM elements fulfilling Madaster filter conditions and another one formed by BIM Elements to be imported into Material Passport by other means (quantity takes off of the elements poured into the Material Import spreadsheet).

With the experience acquired so far in the HOUSEFUL project, it can be confirmed that it is hard to fulfil all the conditions of the Madaster view set filter in the Revit application, particularly for the recognition of the Quantities which depend mostly on the Export tool of the BIM Modelling program. For the moment, after working thoroughly in the BIM Models of the four Demos it has not been possible to obtain all BIM elements exported with Base Quantities up to the full.

4.1.9 Quantity take-off from Materials and Elements

The process of the quantity take-off workflow for Materials and Elements in the Existing building of Demo 3 was done for the BIM Elements whose Base Quantities could not be read in the Material Passport platform. The quantities were taken directly from the BIM Model and loaded into the Material Import sheet (Houseful_T4.1.1_MaterialImport_Demo3.xlsx).

The take-off from BIM elements was used for defining the classification, position and amount from all the building elements that had to be considered in the Material Passport of the project.

The hypothesis, estimations and calculation procedures used for getting the information for not modelled materials/objects are based on ITeC’s knowledge, using a reference budget for residential housing, and dimensioning it to the amount of housing units in the project.

4.1.9.1 Filling in Demo 3 Material Import

The assembling of calculations from non-modelled elements and take-offs from modelled elements resulted in the two sheets Casco and Product Type of Material Type of Demo 3.

1	Material/Product	Classification	Buildinglayer	Material	Volume (m3)	Area (m2)
2	Hf_PHMS_Ceiling_Bulk+Stone wool+Mortar+Topping	21-03 20 50 70	Ceilings	Bulk concrete floor		48,66
3	Hf_PHMS_Ceiling_Bulk+Stone wool+Mortar+Topping	21-03 20 50 70	Ceilings	Mortar		60,83
4	Hf_PHMS_Ceiling_Bulk+Stone wool+Mortar+Topping	21-03 20 50 70	Ceilings	Plaster		12,17
5	Hf_PHMS_Ceiling_Bulk+Stone wool+Mortar+Topping	21-03 20 50 70	Ceilings	Stone wool		24,33
6						145,98
7	Hf_PHMS_Ceiling_Bulk+Stone wool+Mortar+Topping	21-03 20 50 70	Ceilings	Bulk concrete floor		47,13
8	Hf_PHMS_Ceiling_Bulk+Stone wool+Mortar+Topping	21-03 20 50 70	Ceilings	Mortar		58,91
9	Hf_PHMS_Ceiling_Bulk+Stone wool+Mortar+Topping	21-03 20 50 70	Ceilings	Plaster		11,78
10	Hf_PHMS_Ceiling_Bulk+Stone wool+Mortar+Topping	21-03 20 50 70	Ceilings	Stone wool		23,57
11	Level 0: 144					141,4
12	Hf_PD1S_Door_Wood 58x185	21-03 10 30 10	Doors	Brass		0,0006
13	Hf_PD1S_Door_Wood 58x185	21-03 10 30 10	Doors	Wood		0,1605
14						0,1611
15	Hf_PD1S_Door_Wood 65x190	21-03 10 30 10	Doors	Brass		0,0041
16	Hf_PD1S_Door_Wood 65x190	21-03 10 30 10	Doors	Wood		1,1263
17						1,1305
18	Hf_PD1S_Door_Wood 65x190	21-03 10 30 10	Doors	Brass		0,0041
19	Hf_PD1S_Door_Wood 65x190	21-03 10 30 10	Doors	Wood		1,118
20						1,1221
21	Hf_PD1S_Door_Wood 65x190	21-03 10 30 10	Doors	Brass		0,0006
22	Hf_PD1S_Door_Wood 65x190	21-03 10 30 10	Doors	Wood		0,2633
23						0,2638
24	Hf_PD1S_Door_Wood 70x200	21-03 10 30 10	Doors	Brass		0,0003
25	Hf_PD1S_Door_Wood 70x200	21-03 10 30 10	Doors	Wood		0,0812
26						0,0815
27	Hf_PD1S_Door_Wood 70x200	21-03 10 30 10	Doors	Brass		0,0003
28	Hf_PD1S_Door_Wood 70x200	21-03 10 30 10	Doors	Wood		0,1152
29						0,1155
30	Hf_PD1S_Door_Wood 80x210	21-03 10 30 10	Doors	Brass		0,0003
31	Hf_PD1S_Door_Wood 80x210	21-03 10 30 10	Doors	Wood		0,095
32						0,0953

Table 4.16: "Casco sheet" in Houseful_T4.1.1_MaterialImport_Demo3.



Notes	Product	Type product	Type Product2	Material	Level	Percentage (%) of material in product
Existing	Hf_PHMS_Ceiling_Bulk+Stone wool+Mortar+Topping	Volume	Ceilings	Bulk concrete floor	Level -1	33,32%
Existing	Hf_PHMS_Ceiling_Bulk+Stone wool+Mortar+Topping	Volume	Ceilings	Mortar	Level -1	41,68%
Existing	Hf_PHMS_Ceiling_Bulk+Stone wool+Mortar+Topping	Volume	Ceilings	Plaster	Level -1	8,32%
Existing	Hf_PHMS_Ceiling_Bulk+Stone wool+Mortar+Topping	Volume	Ceilings	Stone wool	Level -1	16,68%
Existing	Hf_PD1S_Door_Wood 58x185	Volume	Doors	Brass	Level -1	0,31%
Existing	Hf_PD1S_Door_Wood 58x185	Volume	Doors	Wood	Level -1	99,69%
Existing	Hf_PD1S_Door_Wood 65x190	Volume	Doors	Brass	Level 0	0,37%
Existing	Hf_PD1S_Door_Wood 65x190	Volume	Doors	Wood	Level 0	99,63%
Existing	Hf_PD1S_Door_Wood 70x200	Volume	Doors	Brass	Level 0	0,37%
Existing	Hf_PD1S_Door_Wood 70x200	Volume	Doors	Wood	Level 0	99,63%
Existing	Hf_PD1S_Door_Wood 80x210	Volume	Doors	Brass	Level 0	0,32%
Existing	Hf_PD1S_Door_Wood 80x210	Volume	Doors	Wood	Level 0	99,69%
Existing	Hf_PD1S_Door_Wood 85x190	Volume	Doors	Brass	Level -1	0,22%
Existing	Hf_PD1S_Door_Wood 85x190	Volume	Doors	Wood	Level -1	99,78%
Existing	Hf_PD1S_Door_Wood 85x200	Volume	Doors	Brass	Level -1	0,23%
Existing	Hf_PD1S_Door_Wood 85x200	Volume	Doors	Wood	Level -1	99,77%
Existing	Hf_PD1S_Door_Wood 90x200	Volume	Doors	Brass	Level 1	0,29%
Existing	Hf_PD1S_Door_Wood 90x200	Volume	Doors	Wood	Level 1	99,71%
Existing	Hf_PD1S_Door_Wood 90x210	Volume	Doors	Brass	Level -1	0,29%
Existing	Hf_PD1S_Door_Wood 90x210	Volume	Doors	Wood	Level -1	99,71%
Existing	Hf_PD1S_Door_Wood 105x200	Volume	Doors	Brass	Level 2	0,26%
Existing	Hf_PD1S_Door_Wood 105x200	Volume	Doors	Wood	Level 2	99,74%
Existing	Hf_PD1S_Door_Wood 70x210cm	Volume	Doors	Brass	Level 0	0,36%
Existing	Hf_PD1S_Door_Wood 70x210cm	Volume	Doors	Wood	Level 0	99,65%
Existing	Hf_PD1S_Door_Wood 80x210cm	Volume	Doors	Brass	Level 0	0,32%
Existing	Hf_PD1S_Door_Wood 80x210cm	Volume	Doors	Wood	Level 0	99,68%
Existing	Hf_PD1S_Door_Wood 95x210cm	Volume	Doors	Brass	Level -1	0,25%
Existing	Hf_PD1S_Door_Wood 95x210cm	Volume	Doors	Wood	Level -1	99,75%
Existing	Hf_ED1S_Door_Wood 200x205cm	Volume	Doors	Aluminium	Level 0	0,91%

Table 4.17: "Product Type" sheet in Houseful_T4.1.1_MaterialImport_Demo3.

4.2 Material Passport

Turntoo initiated the Material Passport process of Demo 3 with the BIM model and Material Import sheets from the existing building and provided feedback and corrections on the delivered files (in the period august and october 2020) until it was confirmed that all materials and quantities had entered in the Madaster platform.

4.2.1 Prepare source data for upload in Madaster platform

To create the Material Passport for Demo 3, Turntoo received the following two types of data from ITEC:

- 1. Source data:** building data that can be uploaded automatically into the Madaster platform

File name:	File format:	Description:
demo3_20201014_Green.ifc	IFC	Contains modelled elements of the existing building (fulfilling Madaster filter conditions).
MaterialImportTemplate_Demo3_20201014_Upload1.xlsx	Excel	Contains modelled elements of the existing building (not fulfilling Madaster filter conditions).

Table 4.18: Uploaded source of data Demo 3 in Madaster platform



Before this data was uploaded into the Madaster platform, the following preparations were executed:

- II. Volume information was manually calculated (based on provided weight of the element and specific weight of materials) and added for each element that did not contain volume information in the Excel file (see example in table 3.13).

Adding volume information allows a better visual insight into the overview of existing materials and products used in Demo 3 in Madaster’s “Building” tab (see figure 4.39).



Figure 4.37: Madaster Building tab for Demo 3.

- 2. **Additional data:** building data that cannot be uploaded automatically into Madaster, but is used to enrich the Material Passport of Demo 3 in Madaster

File name:	File format:	Description:
“Product Type” sheet in Houseful_T4.1.1_MaterialImport_Demo3 (see table 4.16).	Excel	Contains product composition information for each element of Demo 3.

Table 4.19: Additional data: product composition.

Material circularity information is not separately provided specifically for Demo 3. Instead, material circularity data from Demo 1 and Demo 4 are applied (see also section 4.2.3 below).

4.2.2 Upload source data in Madaster platform

After completing these source data preparations, two separate data source files (1 IFC and 1 Excel file) were uploaded in the Madaster platform. Subsequently, these files were set to ‘active’, meaning that their data is used in the Materials Passport in Madaster.



SOURCE FILE (BIM OR EXCEL)

Name	Size	Classification method	Date exported	Tags	Owner	Active
 MaterialImportTemplate_Demo3_20201014_Upload1.xlsx Microsoft Excel (16.0300)	55KB	Omniclass	16-10-2020 08:22			<input checked="" type="checkbox"/>
 demo3_20201014_Green.ifc 20190808_0900(x64) - Exporter 19.3.0.0 - Alternate UI 19.3.0.0; IFC2X3	15MB	Omniclass	13-10-2020 12:19			<input checked="" type="checkbox"/>

Figure 4.38: Madaster Dossier tab: active source files (IFC & Excel).

4.2.3 Set-up products in Madaster

To provide a more detailed and more accurate overview of applied materials and products in the Material Passport of Demo 3, so called “Products” have been set-up in Madaster. A product could exist of one material (e.g., Wooden floor) or multiple underlying materials (e.g., reinforced concrete pillar). Based on the source data provided, the Madaster system distinguishes four types of products:

Volume: m3 information needed to create product in Madaster.

Area: m2 information needed to create product in Madaster.

Length: m1 information needed to create product in Madaster.

Quantity: number of elements needed to create product in Madaster.

As described in section 4.1.9.1 of this document, ITeC provided Turntoo additional information (see table 4.16) about the product composition of all elements applied in Demo 3. Based on this overview and available source data, Turntoo set-up products for all elements of Demo 3.

HF_SH2D_RETICULARFRAMEWORKSLAB_REINFORCECONCRETE

PRODUCT INFORMATION		CIRCULARITY	ENVIRONMENT	BILL OF MATERIALS	SEARCH CRITERIA	DOSSIER
EDIT 						
Name	Type	Value	Mass			
Reinforced concrete (houseful)	Material	100%	2400 kg			

Figure 4.39: Madaster Product (example of a product existing of 1 material).

HF_PV1S_EXTERNALWALLS_PLASTER+BRICK+PLASTER 15CM

PRODUCT INFORMATION		CIRCULARITY	ENVIRONMENT	BILL OF MATERIALS	SEARCH CRITERIA	DOSSIER
EDIT 						
Name	Type	Value	Mass			
Brickwork, Masonry (Houseful)	Material	90.06%	1531.0200000000002 kg			
Plaster (Houseful)	Material	9.94%	178.92 kg			

Figure 4.40: Madaster Product (example of a product existing of multiple materials).



Besides the product’s composition, each Madaster product also contains a “search criteria”. This is useful in Madaster’s automated matching process during source file upload. Also, for Demo 3, each product in Madaster was set-up with the exact same naming as provided (by ITeC) in the source data. By providing the exact same description also in each of the product’s search criteria section, the automated matching process in Madaster will ensure that most source data elements will be automatically matched with products created in the Madaster database.

HF_SH2D_RETICULARFRAMEWORKSLAB_REINFORCECONCRETE



Figure 4.41: Madaster Product (example of a product search criteria).

4.2.4 Validate uploaded source data in Madaster platform

When Demo 3 source data is uploaded, the Madaster platform will automatically check and match elements (from the Excel and IFC source data files) with items in its own material and product databases. When an element from the source files is recognised (due to search criteria), the Madaster system will automatically link this item to a specific Madaster material or product.

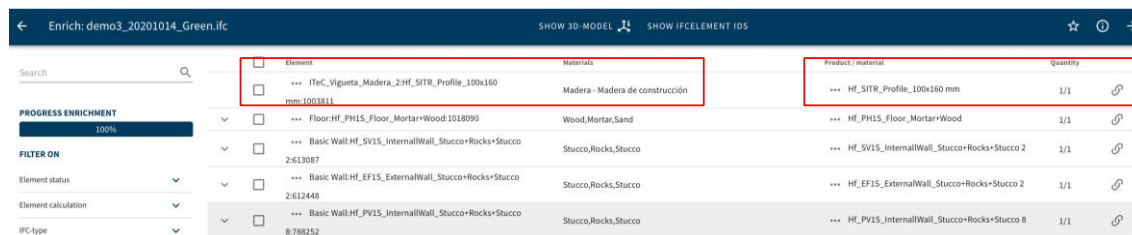


Figure 4.42: Source data element (from IFC file) automatically linked to Madaster Product set-up.

In case an element is not recognised, Madaster will not be able to match it. After the automated matching process, non-assigned elements can be linked manually.

Finally, the two source files, containing their individual elements, have been linked (automatically and where needed manually) with products that have been set-up in Madaster. The results are shown below.

QUALITY OF SOURCEFILES



Figure 4.43: Source data upload results

4.2.5 Enrich products in Madaster platform

As described previously, compared to Demo 1 & 4, Turntoo did not (yet) receive additional 'circular' information such as:

- Lifespan in years
- Feedstock sources (% recycled, rapidly renewable or virgin)
- End of life scenario ((% recycled, landfill or incineration)
- Level of disassembly (CHECKLIST REUSABILITY)

for all elements applied in Demo 3.

Instead, material circularity information, as provided for Demo 1 & 4, has been used to calculate the existing building's level of circularity (in the platform's "Circularity" tab). See section 2.2.5 of Deliverable 4.3.

4.2.6 Obtain Material Passport in Madaster platform

After the upload of source data elements and the set-up, validation and enrichment of products in Madaster with existing circularity data, all relevant input data is available to in the Madaster platform to finally publish the Material Passport for Demo 3. A Material Passport can be generated as often as desired, while a digital version (in both pdf and Excel format) is stored in the building's Dossier tab (see figure 4.46). Depending on the user's access rights a Material Passport can be viewed, downloaded, or deleted.

GENERAL DOCUMENT

Name	Size	Last modified
 Demo 3: Cambium Community Center (Fehring) (DEMO 3: CAMBIUM FEHRING (H2020-HOUSEFUL-DEMO 3 CASCO-DEMO 3)), 2021/05/12 EN.pdf	2MB	12-05-2021 12:51
 Demo 3: Cambium Community Center (Fehring) (DEMO 3: CAMBIUM FEHRING (H2020-HOUSEFUL-DEMO 3 CASCO-DEMO 3)), 2021/05/12 EN.xlsx	65KB	12-05-2021 12:50

Figure 4.44: Madaster dossier: Material Passport Demo 2 (in pdf & Excel format)



Figure 4.45: Madaster Material Passport Demo 3 (cover page)

The Material Passport will be completed when the renovation project is delivered and the New and Demolition BIM models and quantities are defined together with the Houseful Solutions. According to the established plan, the final stage of Material Passports for Demos 2, 3 and Houseful Solutions will be explained in D4.10 in M48.

5 General conclusions

This section will be completed when the BIM models of existing and new Material Passports of the 4 demos are finished. However, some common issues can be described in advance regarding the work that has been done.

5.1 BIM modelling conclusions from Demos 2 and 3 Existing buildings

From the conclusions and challenges set in precedent demos, in this third and fourth attempts the BIM modelling has been carried out even more carefully to get the maximum amount of BIM elements successfully filtered by the Madaster Smart view. Unfortunately, there were many BIM classes after going through the filter that had to be excluded from the BIM model for Madaster platform.

The table in sections 1.4.29 and 1.4.29 of D4.3 has been updated.

Obstacles	BIM Elements concerned	Cause	Challenge
Export IFC tool does not write Base Quantities on specific elements	In Demos 2 and 3 Existing building, all elements have had Base Quantities exported	--	The obstacle seems to be solved.
Madaster Smart View does not recognise Base Quantities on some elements even if written	Ceilings, Doors, Windows, Railings, Stairs, Assemblies and (sloped) Roofs	They might be written in a different way than expected (e.g. Spanish from the BIM modelling that can't be changed)	Check out again with Madaster if they can broaden the filter for reading Base Quantities
Some arbitrary elements in certain types lack Base Quantities and other don't	An accurate BIM modelling seems to have sorted out this problem	--	The obstacle seems to be solved.

Table 5.20: Challenges solved or pending after modelling the Existing buildings out from Demos 2 and 3.

For incoming Demos 2 and 3 New, Demolition and Houseful Solutions, further research can be done to ease the workflow for getting Material Passports from BIM models.

6 References

[Houseful Project](#)

[Madaster Platform Quick Reference Guide](#)

[IFC4 Addendum 2 \(IFC4 Add2\)](#)



[IFC2x3](#)

[BIMeInitiative – Model Uses Table](#)

[eCOB Standard for creating BIM objects](#)

[AEC \(UK\) BIM Protocol – Project BIM Execution Plan](#)

[Opteemal](#)

