



Med-EcoSuRe



BEEP



Convegno
Med-EcoSuRe

UNIVERSITA' **Ostenibilita'**

la transizione digital-green dei
luoghi del sapere

Napoli, Mostra d'Oltremare
Venerdi, 25 marzo 2022

The BEEP Project A methodology for built heritage energy and environmental improvement

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@MedEcoSure

enibcmed.eu/projects/med-ecosure



SOLARTYS



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Summary

- The context «Energy Efficiency of Built Heritage»
- The themes and challenges of the BEEP Project
- Italian case study Palazzo Maffei Borghese
- Partner case studies
- Beep main results

 www.enicbcmed.eu/projects/beep  @BEEPenicbcmed  @BEEP_EniCbcMed



PROJECT PARTNERS



ENI CBC Med European program

The European program ENI CBC Med is the largest cross-border cooperation initiative (CBC) implemented under the European Neighborhood Instrument (ENI). With its two general objectives, ENI CBC MED aims to:

- Promote social and economic development
- Address common environmental challenges



BEEP project priority



B.4.3 - Support cost-effective and innovative energy renovations relevant to building types and climatic zones, with a focus on public buildings



BEEP

Instituto Valenciano de la Edificaci3n

Minnucci Associati

ISPCNR

Lebanese Center for Energy Conservation

The Cyprus Institute

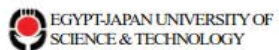
Center for Cultural Heritage Preservation

Egypt-Japan University of Science & Technology

The Royal Scientific Society, National Energy Research Center

The Consortium

PROJECT PARTNERS



Paris 15.03.2022



The themes and challenges



Energy efficiency for built heritage



Heritage BIM



Numerical Simulation and built heritage



HBIM and BPS interoperability



EPC Energy Performance Contract





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Energy Efficiency of Built Heritage

- Under the momentum of the European Green Deal, the Cultural Heritage stakeholders led by Europa Nostra have developed the European Cultural Heritage Green Paper in which heritage is finally framed in its dimension as a key resource and driver for the fight against climate change.

In recent years, conservation theory has finally begun to recognise energy efficiency as a strategy to protect cultural heritage

Europa nostra, European Cultural Heritage Green Paper

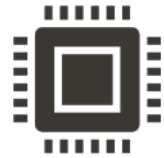


Climate Heritage
NETWORK



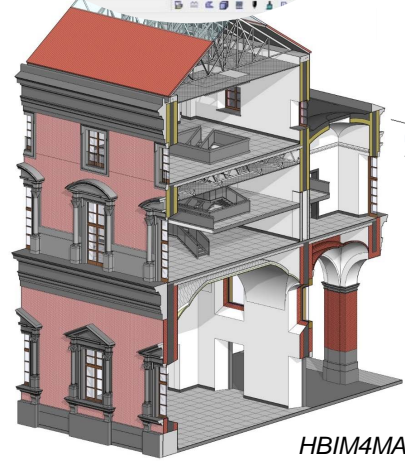
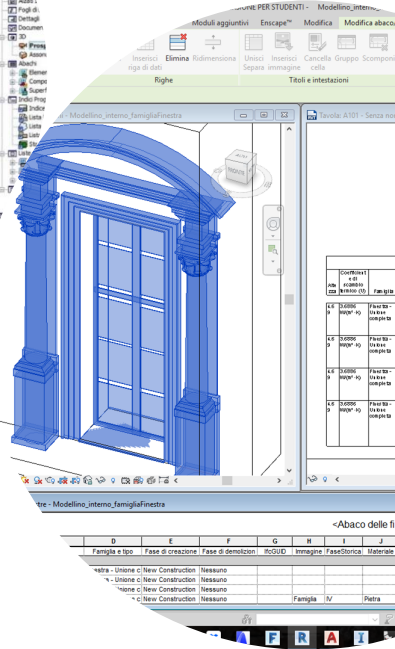
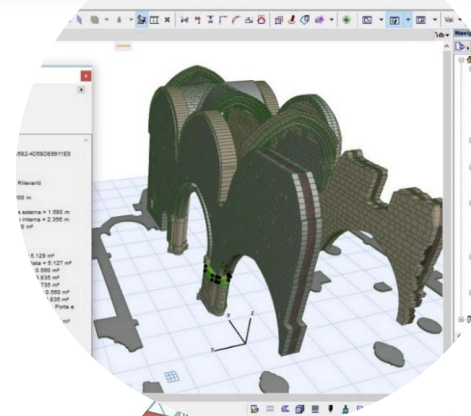


Heritage - BIM



Heritage Building Information Modeling (HBIM) represents one of the most interesting lines of research for the digital management of the knowledge produced during the conservation process of architectural heritage

BIM, due to its characteristic of being a digital system embedding multiple representations of the same reality seemed to us to be the tool with the greatest potential to optimize the conservation and maintenance of heritage assets addressing problems of heterogeneity accessibility and management of information.

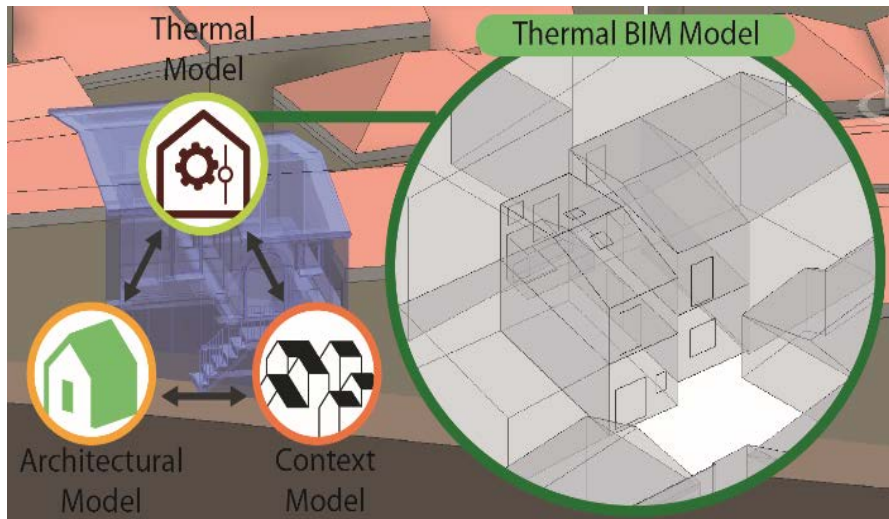


HBIM4MANN Project, BHiLAB - ISPC CNR



BPS and Built Heritage

Building Performance Simulation (BPS) allows the study and optimisation of energy performance in an interrelated way, through the creation of a behavioural model of a given historical urban fabric, building or wall element, reduced to a certain level of abstraction

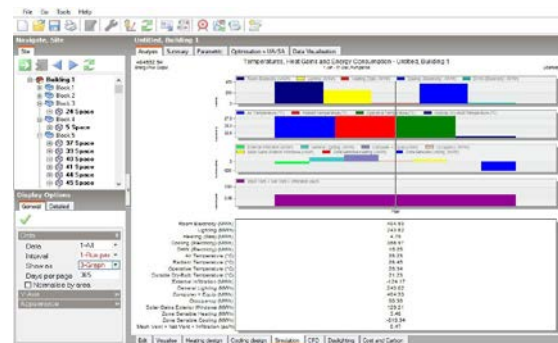
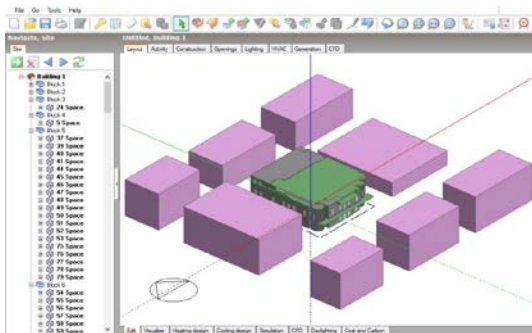
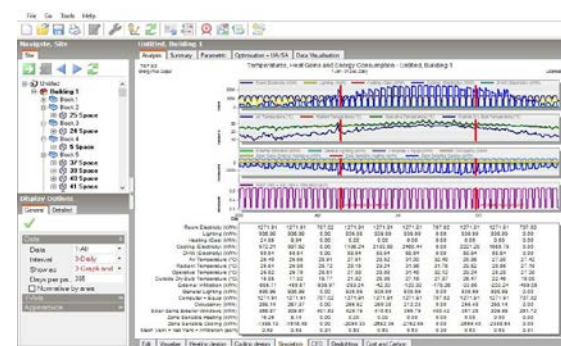
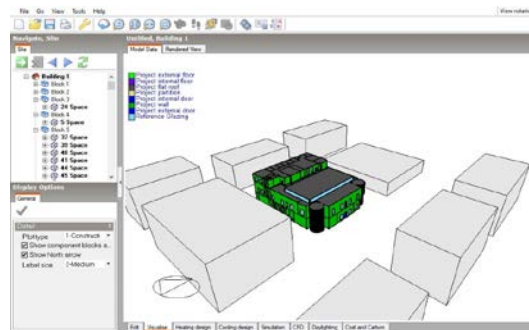




BPS and Built Heritage

Numerical simulations are one of the most promising tools for application to Built Heritage for:

- understand and analyze complex phenomena,
- allowing innovative applications in the restoration process and in pre-diagnostic and diagnostic non-destructive analyzes of cultural heritage
- ensure feedback on the energy and environmental implications of conservation choices also in relation to the evolution of degradation phenomena

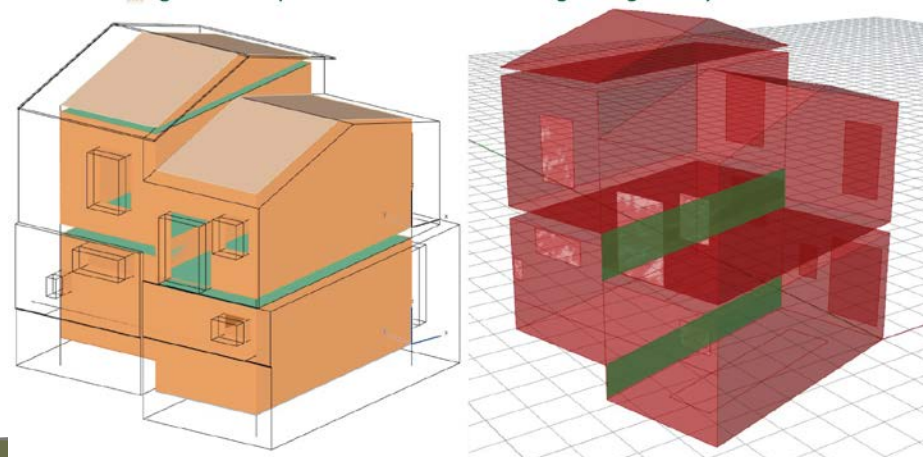
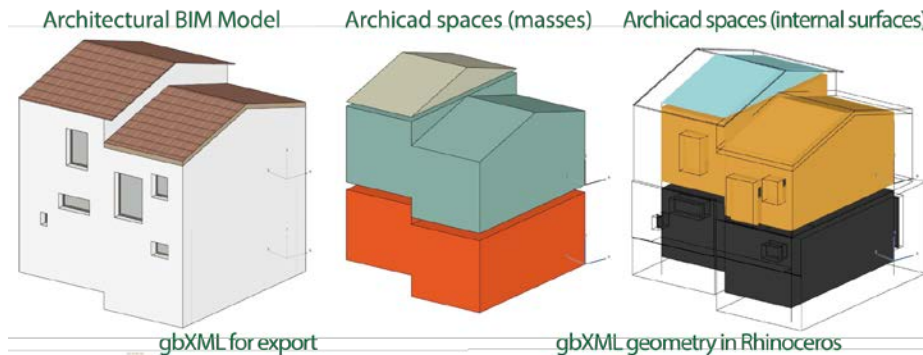




HBIM and BPS interoperability

- Data transfer (which mainly takes place through two open file formats, the Industry Foundation Classes - IFC standard and Green Building Extensible Markup Language - gbXML), is still not very efficient, especially on historic buildings.

METRICS Project, BHiLAB - ISPC CNR





EPC Energy Performance Contracting

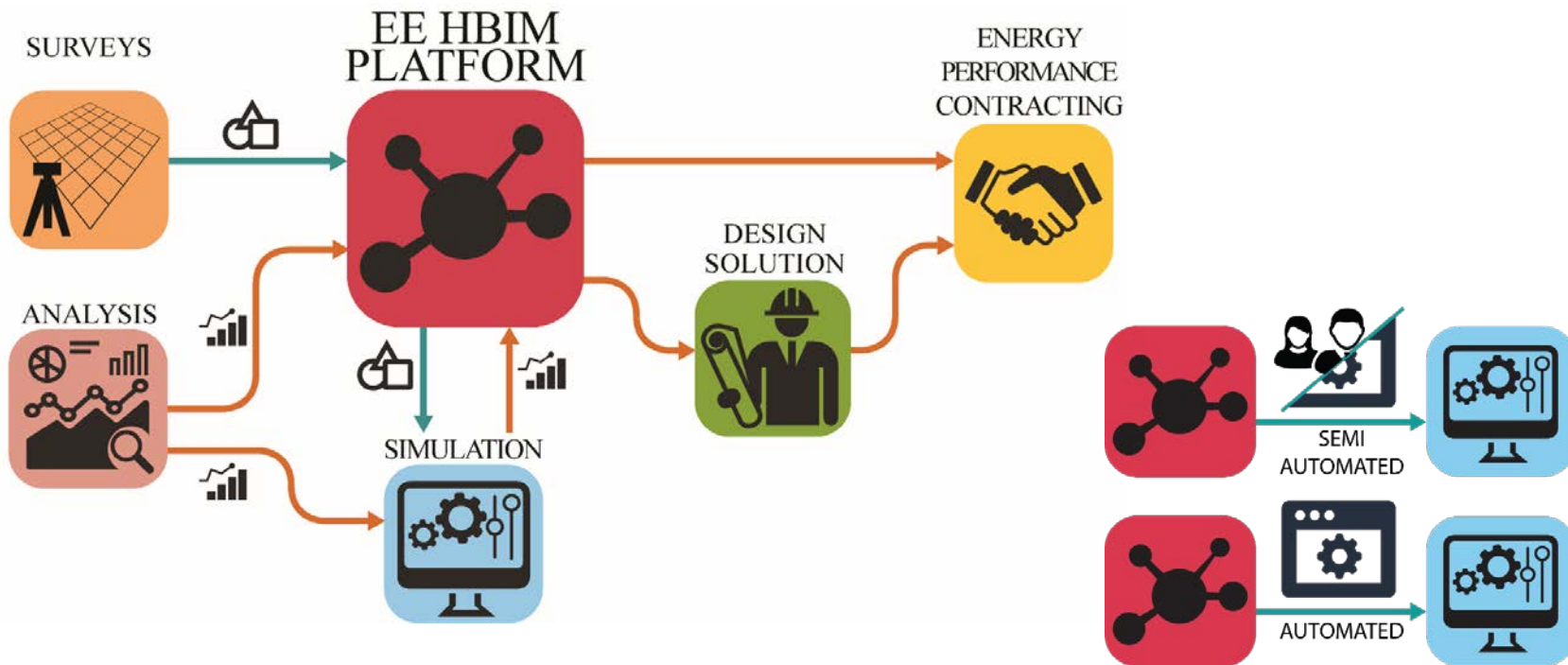
The financial support will come from the intervention of private funds through the Energy Performance Contracting EPC too, based on the energy savings obtained from the retrofit of buildings.

The EPC involves an Energy Service Company (ESCO) that provides the financing of the interventions





BEEP Workflow





Italian case study – Palazzo Maffei-Borghese

Name of Building: Palazzo Maffei Borghese

Location: Via del Clementino, 91, Roma Campo Marzio

Floor area: 6.340,00 m²

Volume: 24000 m³

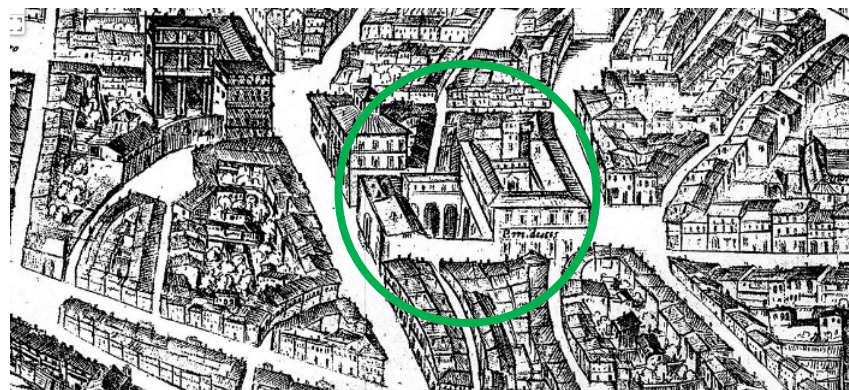
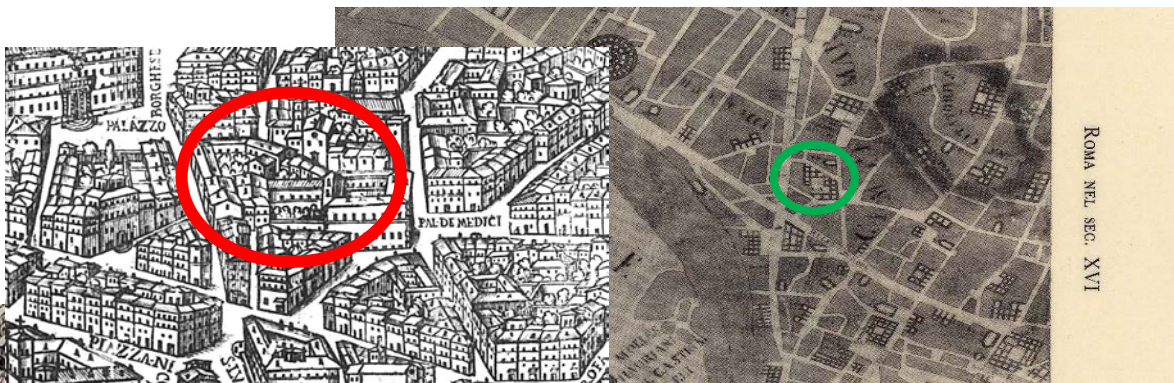
Original use, present or future use: Offices of the Avvocatura Generale dello Stato

Year: year 1400-1700



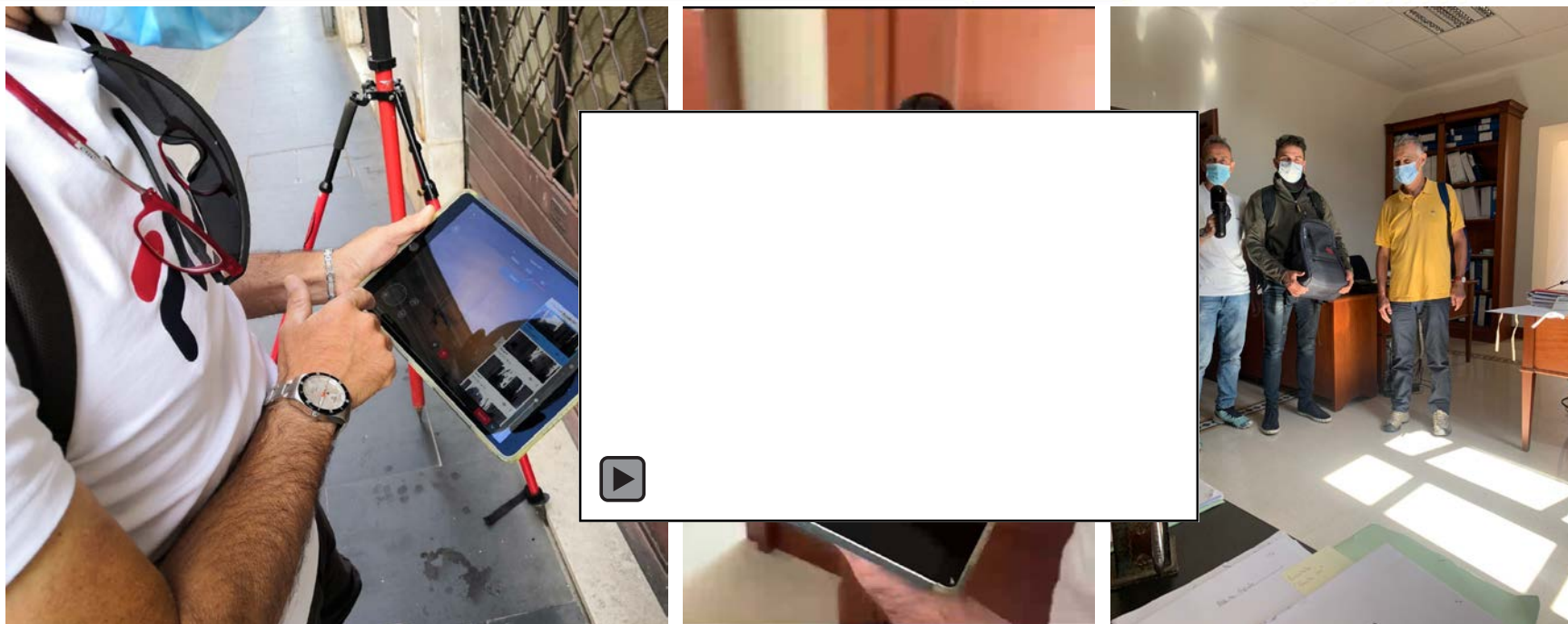
Analysis phase

- Preliminary analysis;
- **Historical and architectural analysis;**
- Geometric survey;
- General conservation state;
- Energy and environmental analysis;



Plan of Rome, Bufalini 1551.

View of Rome, Antonio Tempesta 1593.



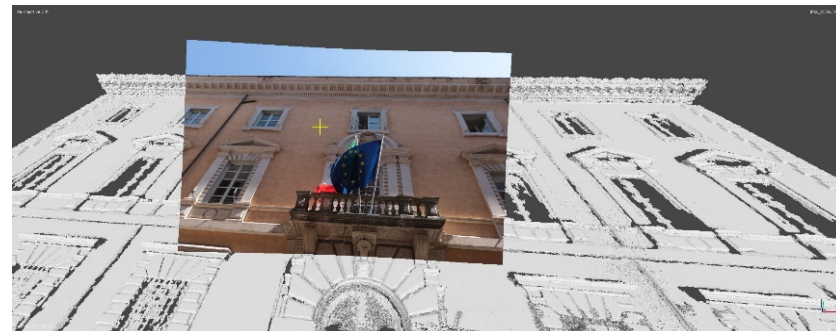
Geometric survey

- Preliminary analysis;
- Historical and architectural analysis;
- **Geometric survey;**
- General conservation state;
- Energy and environmental analysis;

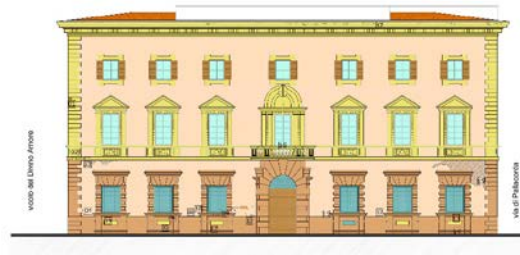


Geometric survey

- The analysis of the state of conservation was performed with the support of a rapid photogrammetric survey to obtain accurate information on the current state of the surfaces.



- Preliminary analysis;
- Historical and architectural analysis;
- **Geometric survey;**
- Energy and environmental analysis;
- General conservation state.



Vicolo del Divino Amore

Loss of component: fall or loss of parts	Crack: vertical in facade, likely visible on the facade, reaching into the interior of one or two windows	Bleeding: appearance of fluid, caused by increased saturation in the face of plaster resulting from the absorption of air the water absorption	Detachment: loss of substance and detachment of several layers
01	02	03	05
11	04	06	07
12	04	07	07

Biological colonization: common to the wall and most significant wall in the facade, particularly in the upper part and lower part of the facade.

Chipping: loss of plaster, called *scagliola*, from the edge of a brick

Electric equipment: cable

MATERIALS		CAUSES	
Stucco	Glass	Natural or anthropogenic cause	Intrinsic cause
T Travertino	Roof tiles	Water runoff	Chemical action
Masonry made of calcareous covered with plaster layer	Double glazed window	Wind action	Porous structure
Timber window frame	Grid	Thermal stresses	Mechanical properties of masonry
		Biological processes	Mechanical properties of plaster
			Mechanical properties of stone

DEGRADATION	
Bleaching	Chipping
Detachment	Crack
Staining	Graffiti
Electric equipment/cable	Biological colonization
	Loss of component

GENERAL CONSERVATION STATE ANALYSIS-PALAZZO DEL CLEMENTINO-BIN PPI

Date: 31/07/2020 Scale: 1:100 SH: 03

Vicolo del Divino Amore

via del Clementino

MATERIALS		DEGRADATION	
Stucco	Glass	Deposit	Chipping
Travertino	Roof tiles	Detachment	Crack
Masonry made of calcareous covered with plaster layer	Double glazed window	Staining	Loss of component
Timber window frame	Grid	Piercing	Disintegration
		Impact damage	

CAUSES	
Natural or anthropogenic cause	Intrinsic cause
Water runoff	Thermal stresses
Wind action	Biological processes
	Porous structure
	Mechanical properties of masonry

01	02	09	07	06	15	17	10
04	03	11	05	13	14	16	18
08	15	18	05	19	14	16	18
12	15	18	05	19	14	16	18

Feeling: shuffling, coming off a particle, penetration of superficial layer

Blowing: wind of decomposition or breaking, movement and loss of substance, appearance

Chipping: loss of plaster, called *scagliola*, from the edge of a brick

Detachment: loss of substance and detachment of several layers

Crack: vertical facade, likely visible on the facade, reaching into the interior of one or two windows

Deposit: accumulation of organic material or carbonaceous substance, yellow or reddish, also calcareous, irregular particles with a water stain, stains of component systems

Disintegration: disintegration of fragments or aggregate of grains

Loss of component: fall or loss of parts

GENERAL CONSERVATION STATE ANALYSIS-PALAZZO DEL CLEMENTINO-BIN PPI

Date: 31/07/2020 Scale: 1:100 SH: 01

- Preliminary analysis;
- Historical and architectural analysis;
- Geometric survey;
- Energy and environmental analysis;
- General conservation state.

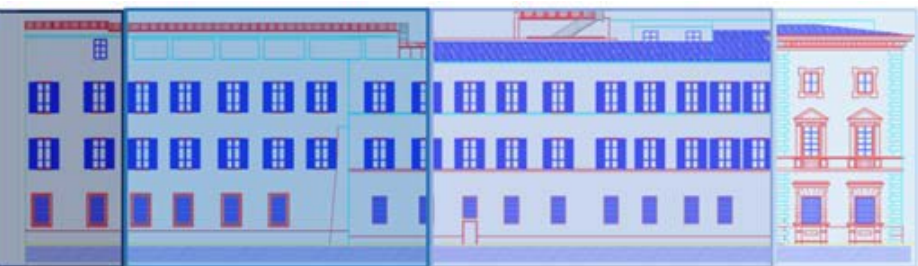
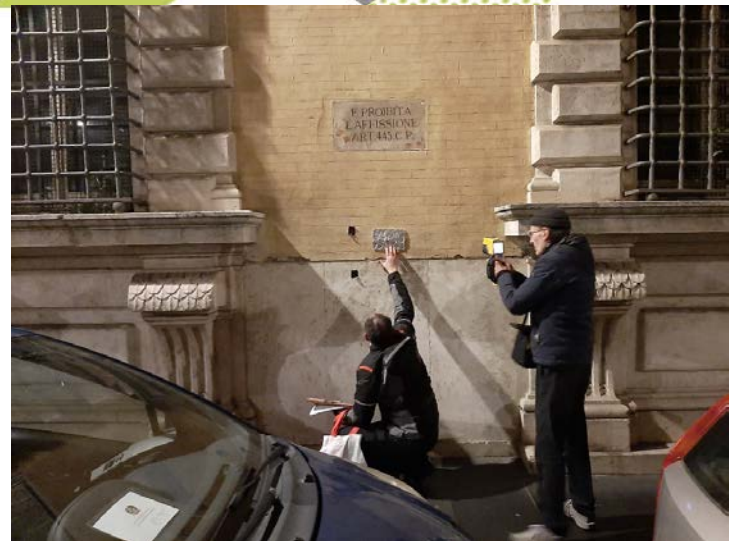
General conservation state



Energy and environmental analysis

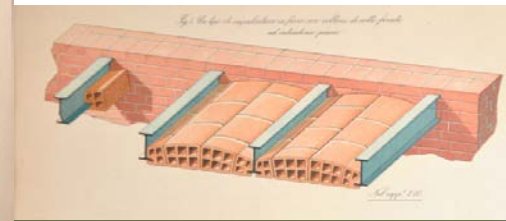
- Preliminary analysis;
- Historical and architectural analysis;
- Geometric survey;
- **Energy and environmental analysis;**
- General conservation state.

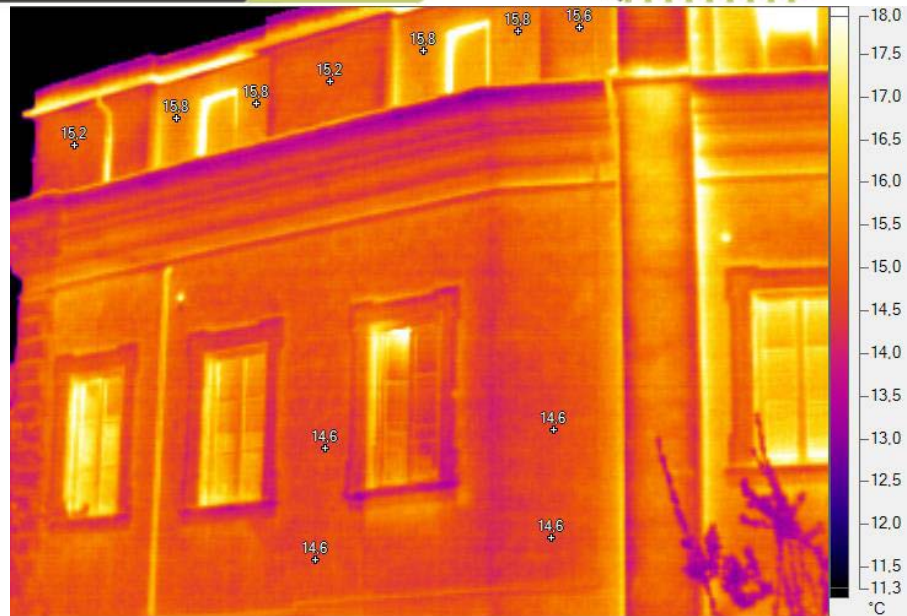
- Starting from a first hypothesis of homogeneous wall stratigraphy, we carried out a thermographic survey to verify this hypothesis and subsequently a thermofluximetric campaign with to collect transmittance data on each different wall typology highlighted.
- (quella storica principalmente di due tipi, a sacco con paramenti di tufo ed in tufo piena)



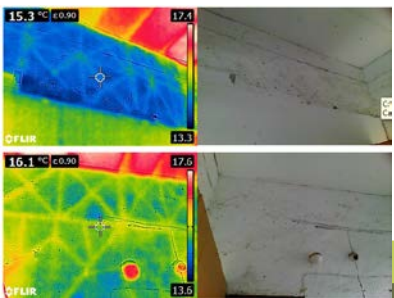
- Sezione 1
- Sezione 2
- Sezione 3
- Sezione 4

Prospetto Vicolo del Divino Amore

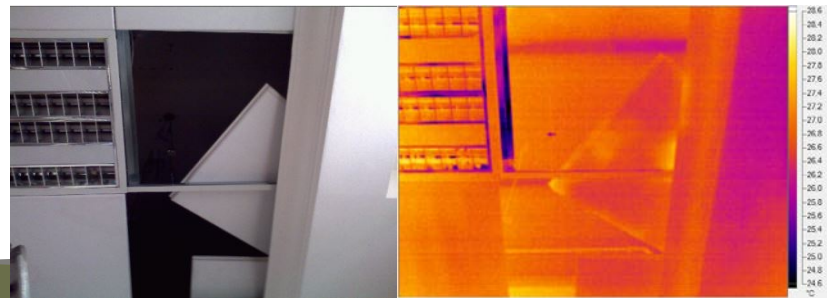


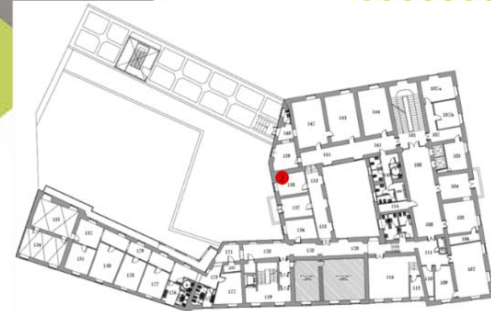


Energy and environmental analysis

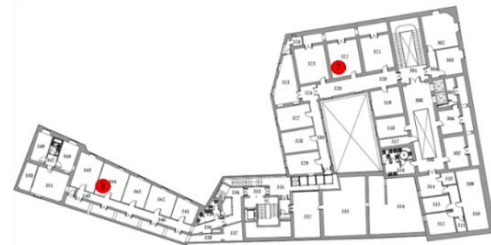


Thermal bridges;
Air cracks;
Materials emissivity;
Capillary rise of water (estimated);
Irregularities in the installation of the materials, any infrared visible degradation in the internal layers.





Piano Primo



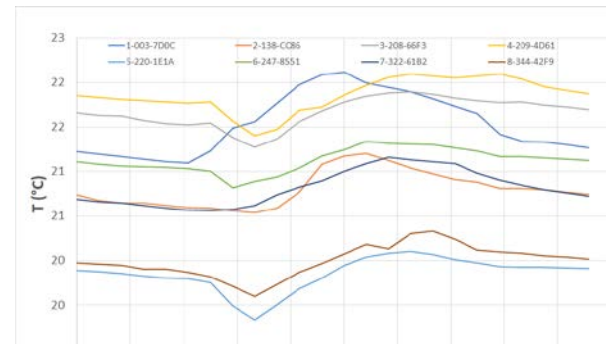
Piano Terzo

Energy and environmental analysis



Internal environmental monitoring, which lasted about a year, was undertaken to support both the input data for the energy model and further calibration with ambient temperatures

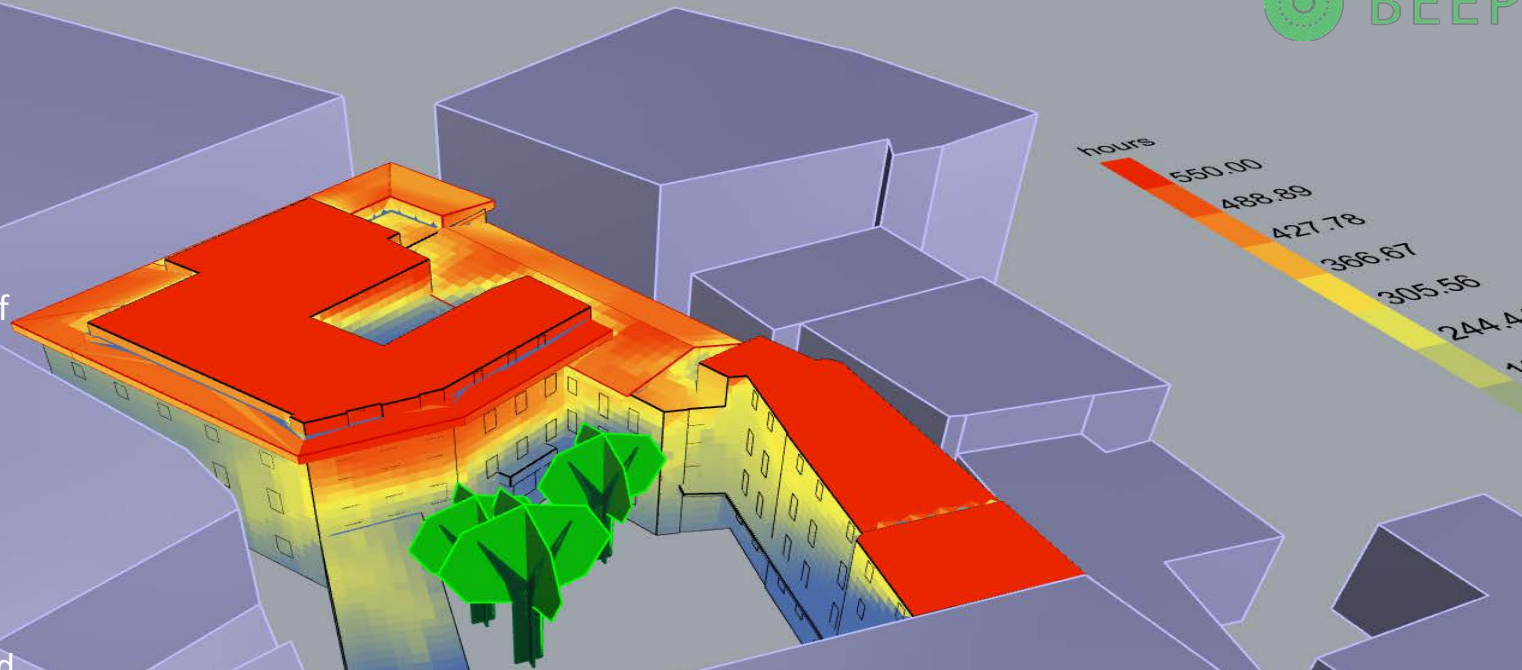
The results show a very massive behavior of the building with less than 2 °C of daily thermal excursion in winter and summer.



Energy and environmental analysis



For an optimised planning of the positioning of the measurements point of the heat flux meter analysis on Palazzo Maffei-Borghese (Clementino), an additional numerical simulation of the sunshine hours on the building was performed during the winter months.



Breakdown of one of the elevation into sections and management scheme of the heat flow meter analyses

Piano	Localizzazione									
	Vicolo del Divino amore				Via del Clementino			Via di Pallacorda		
	Sezione 1	Sezione 2	Sezione 3	Sezione 4	Sezione 5	Sezione 6	Chiostrina interna	Sezione 7	Sezione 8	Sezione 9
copertura	K	J	FALDA	FALDA	FALDA	X	Y	FALDA	Y	W
terzo	A						I		G	
secondo	A	B	D	G	G	G	G	G	G	
primo	A	A	C	F	F	F	F	F	F	
terra	A	A	C	E	E	E	E	E	E	L





Energy and environmental analysis



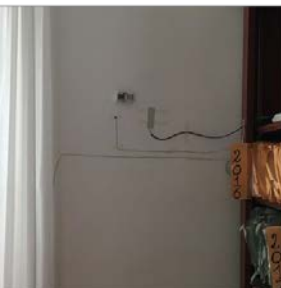
Misura n. 1 - Stanza 220



Misura n. 2 - Stanza 116



Misura n. 3 - Stanza 127



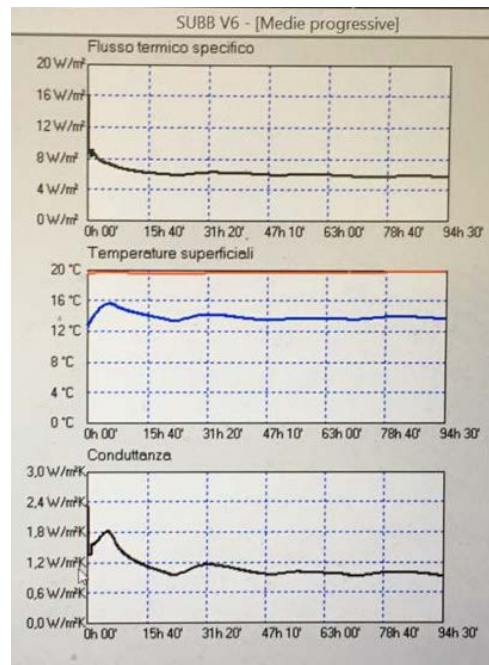
Misura n. 4 - Stanza 234



Misura n. 5 - Stanza 105



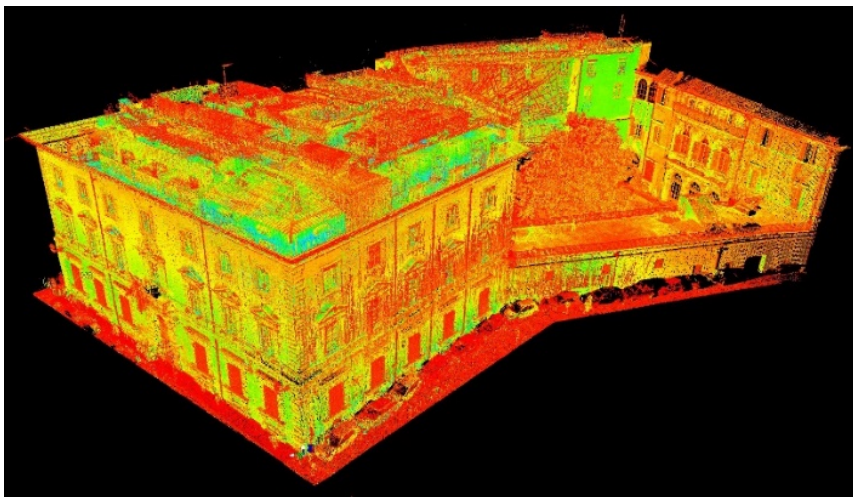
Misura n. 6 - Stanza 209





Energy Efficiency Heritage Building Information Model (EE-HBIM)

- With the building point cloud ready and the Model Element Table defined, we started the interoperability activities to guide the modeling phase.





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BEEP partner interoperability workflow



Partner	BIM authoring tool	Dynamic simulation software	Exchange file format
BEN – ISPC CNR	Graphisoft ArchiCAD	Logicalsoft Thermolog	IFC
PP1 – MASI			
PP2 – IVE	Autodesk Revit	Cypertherm He Plus	IFC
PP3 – Cyl-EEWRC	Autodesk Revit	DesignBuilder	gbXML
PP5 – CCHP			
PP6 – LCEC			
PP7 – E-JUST			
PP4 - NERC	Graphisoft ArchiCAD	TRNSYS	IFC

Summary of the tools used by each partner



European Union



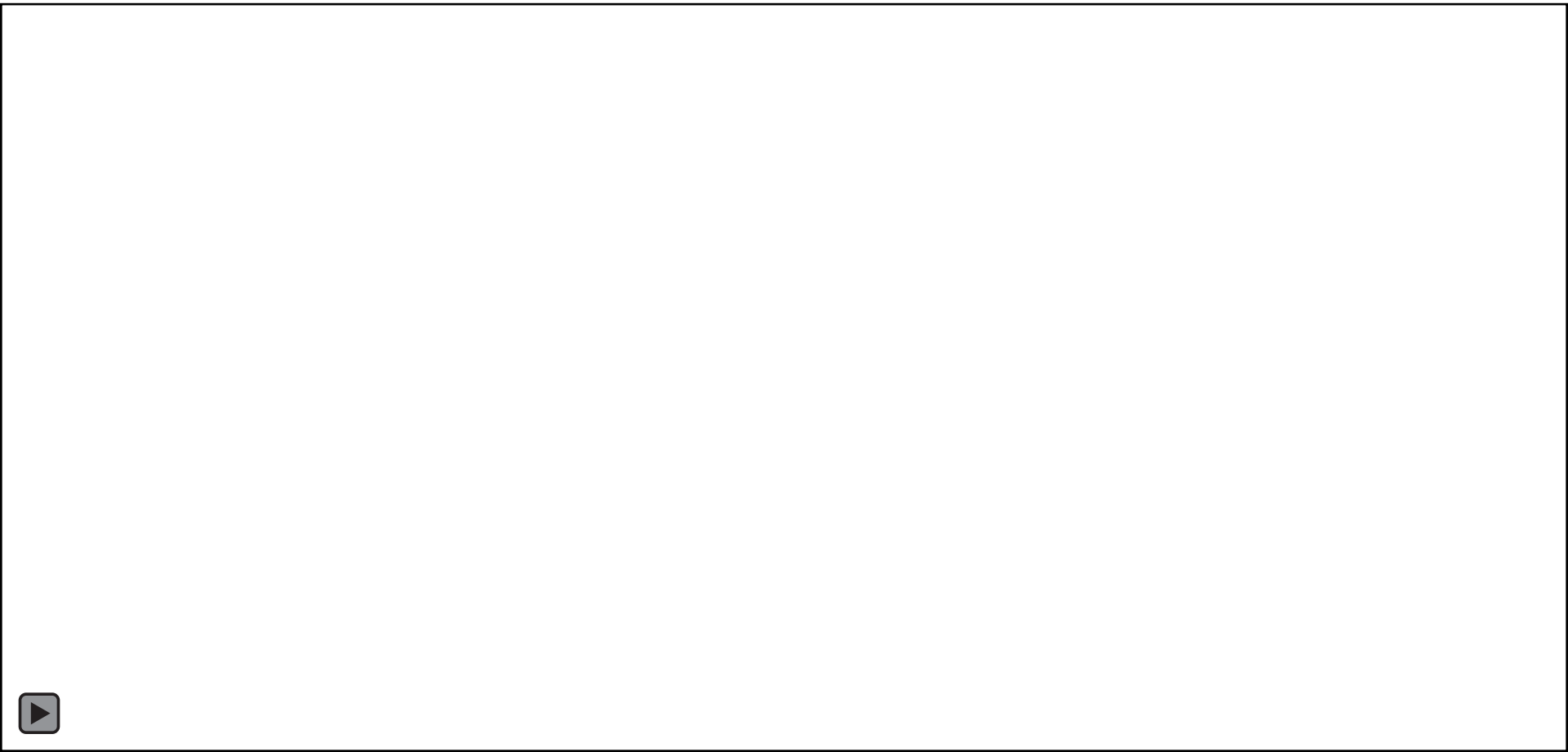
Ministero della Sanità
Dipartimento di Prevenzione
Epidemiologia e Controllo delle Infezioni



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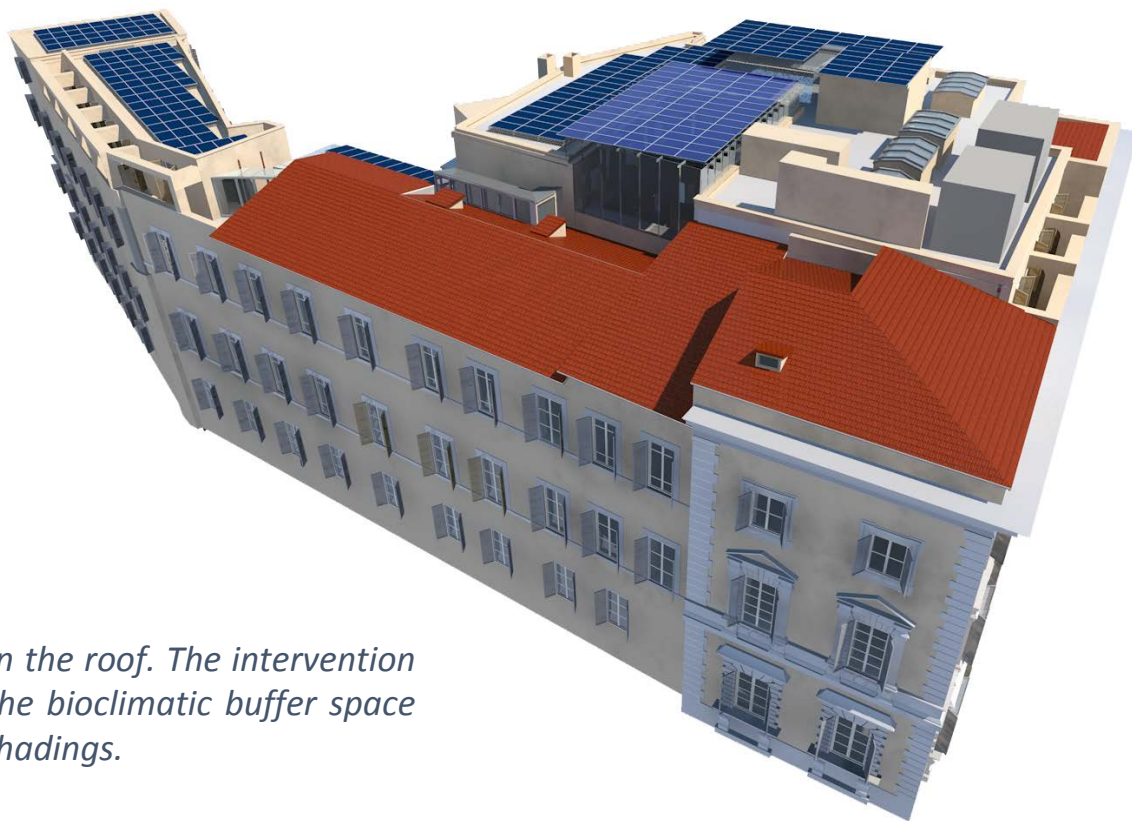
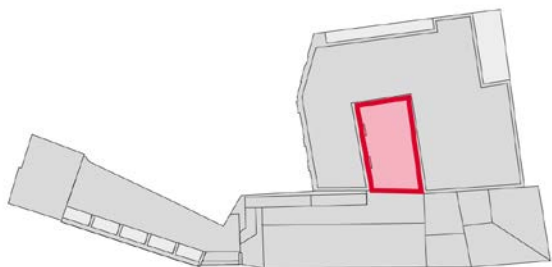


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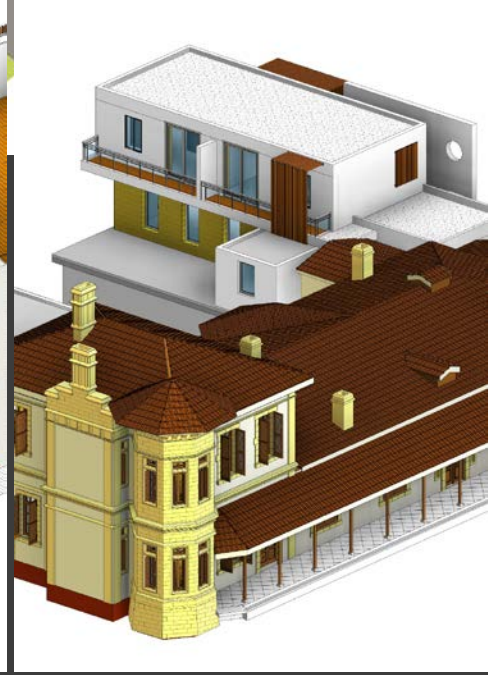
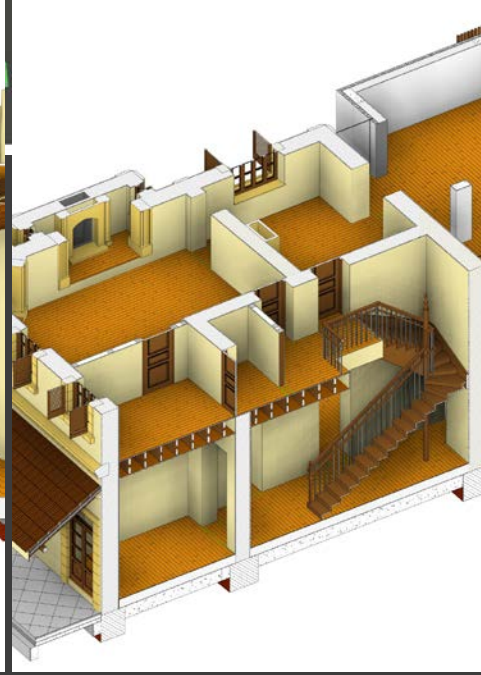




Development of the energy concept with Design Intervention Scenarios



Render view of the photovoltaic panel system on the roof. The intervention view includes also the intervention IT1P07 on the bioclimatic buffer space and the IT1P08 with the restoration of window shadings.



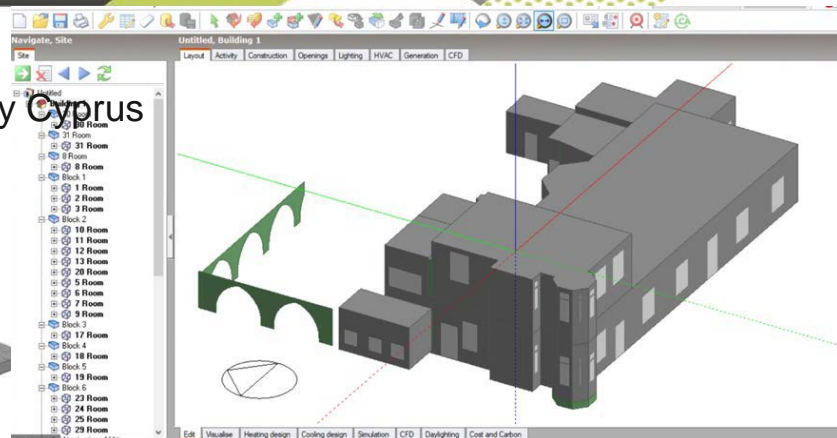
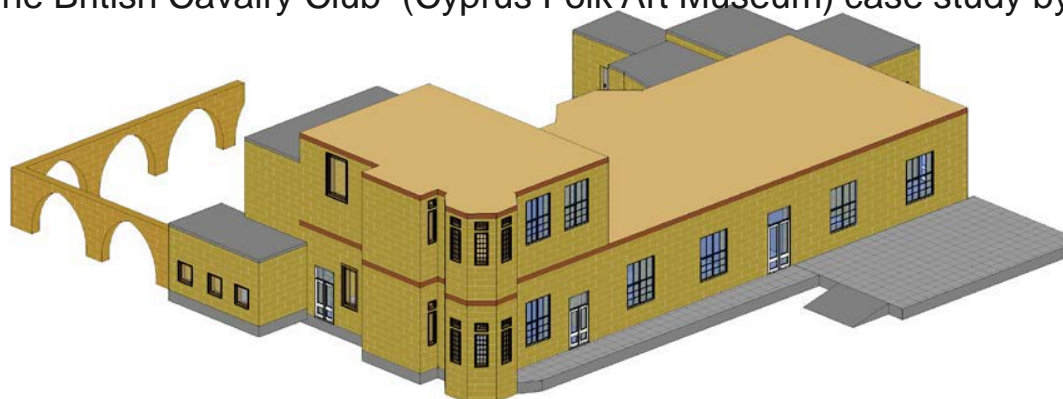
EEHBIM – Cyprus: The British Cavalry Club





Revit To Design Builder Workflow

The British Cavalry Club (Cyprus Folk Art Museum) case study by Cyprus



gbXML import to DesignBuilder

The BIM model



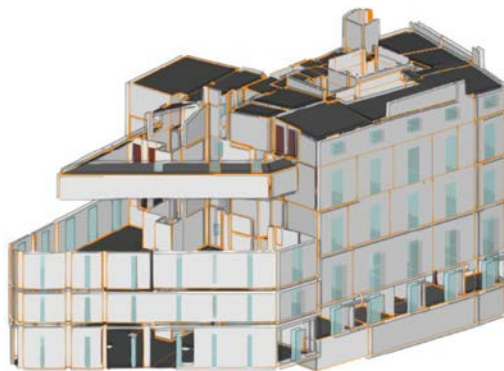
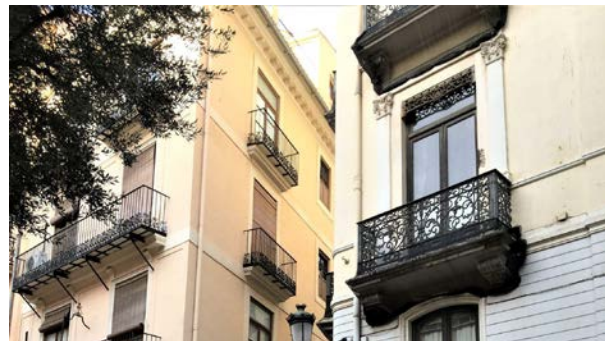
Room/space Volumes dialogue box.



gbXML Check – Spider Web.

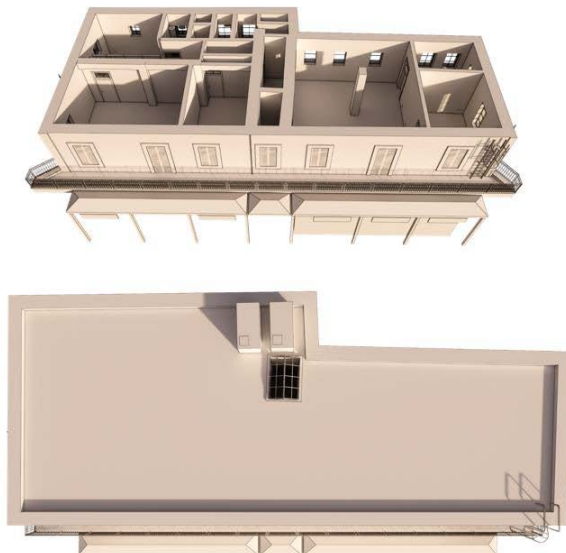


Palacio de Calatayud in Valencia. SPAIN

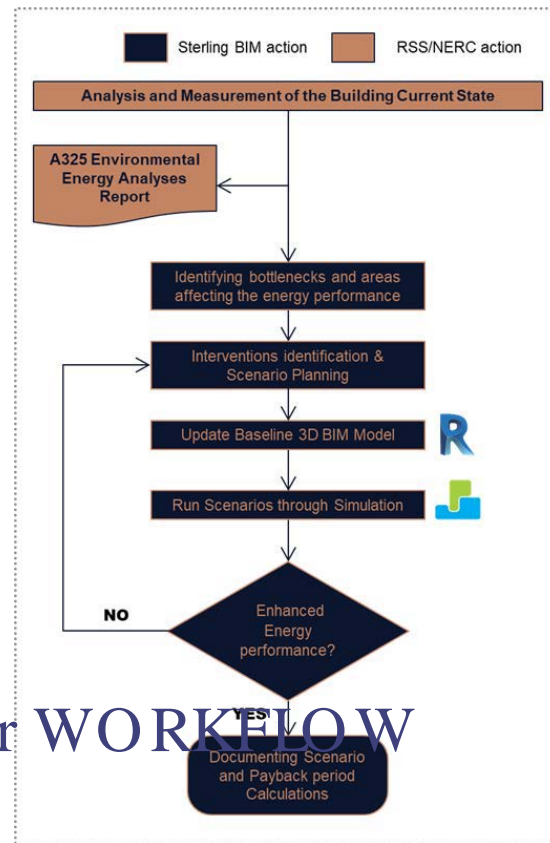




Al Karak Municipality guest house' case study by Jordan



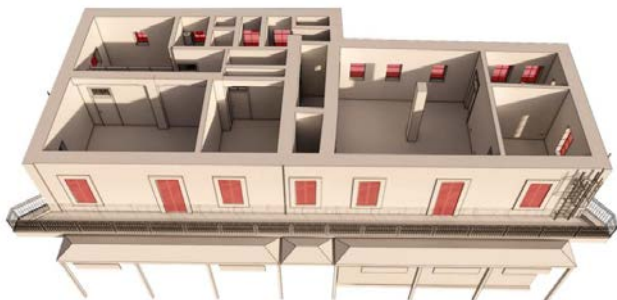
Re vit to Design Builder WORKFLOW



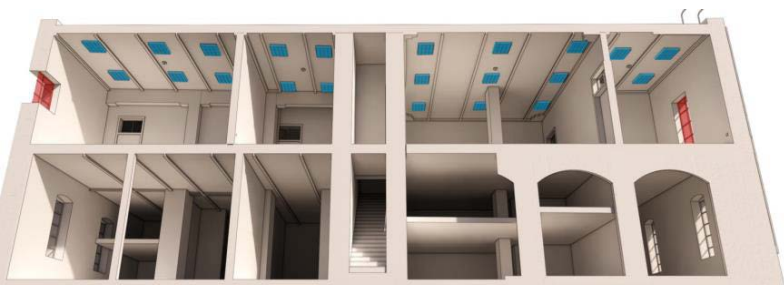


Energy modelling and simulation results of the scen ■ JO4P02 [Roof Retrofitting]

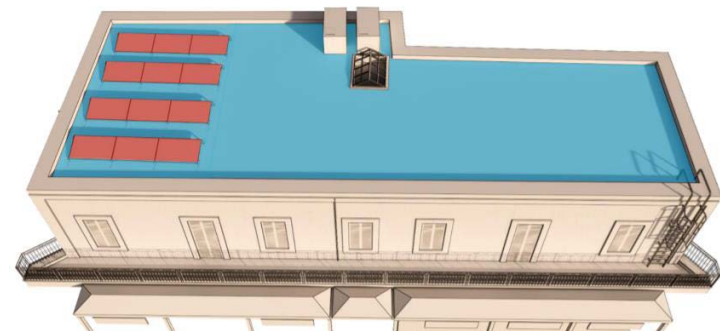
Al Karak Municipality guest house' case study by Jordan



■ JO4P04 [Windows Replacement]



■ JO4A02 [Lightings' Replacement]



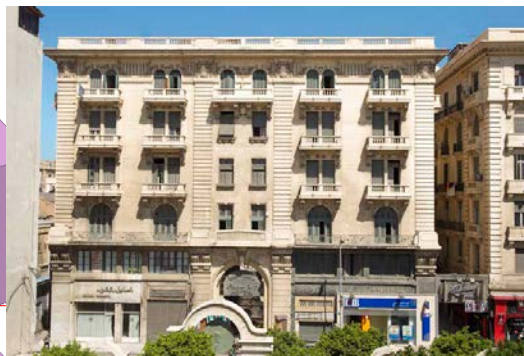
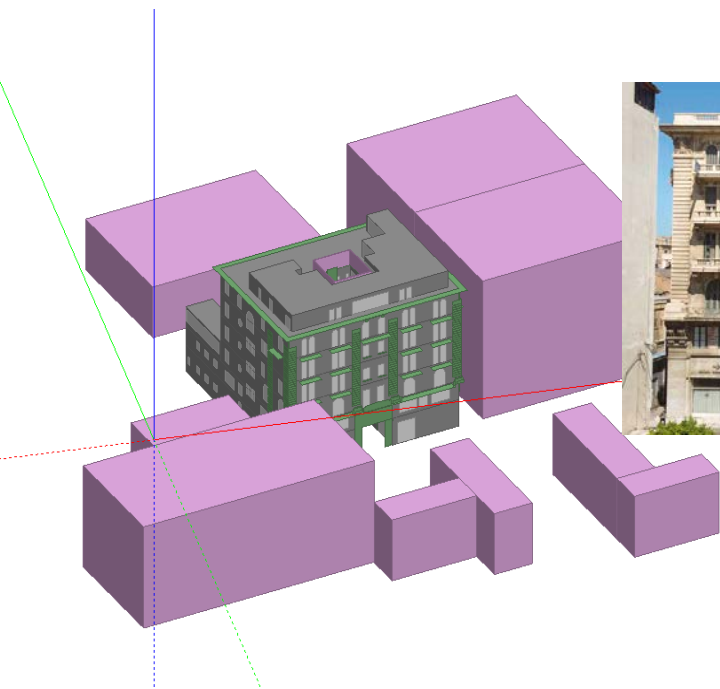
■ JO4R01 [Installation of Rooftop Photovoltaic (PV) Panels]

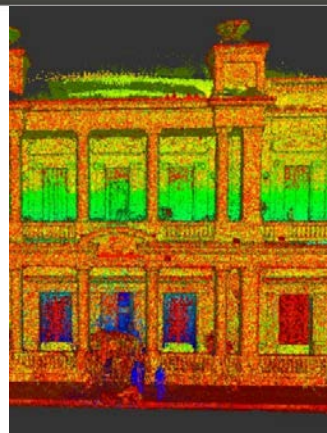


Electrical Water Heater Replacement



Egyptian case study: Cordahi Building





Horreya Center for Creativity: from 3D Point Cloud to HBIM model



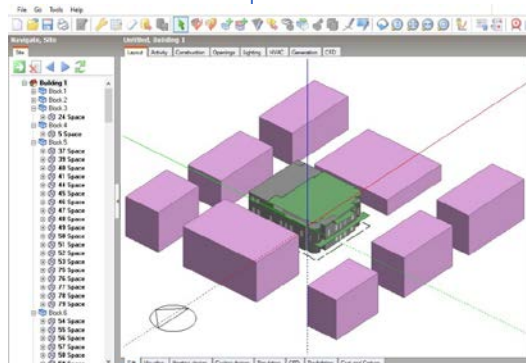
Some recommendations on interventions and scenarios

Whole building
Energy
Performance in
Design Builder

Phase 1:

Dry Scenarios:

1. Internal blinds.
2. Change the Artificial Lighting (Lamps)
3. Internal Insulation (Paints)
4. Natural Ventilation
5. Lighting Sensors

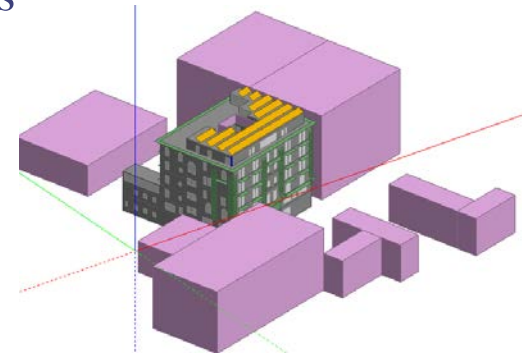


Phase 2:

Architectural Intervention

Scenarios:

1. External Shading
2. Roof Insulation
3. Change the Glazing
4. Wall Renovation (Such as: Cavity walls)
5. Phase Change Materials



Phase 3:

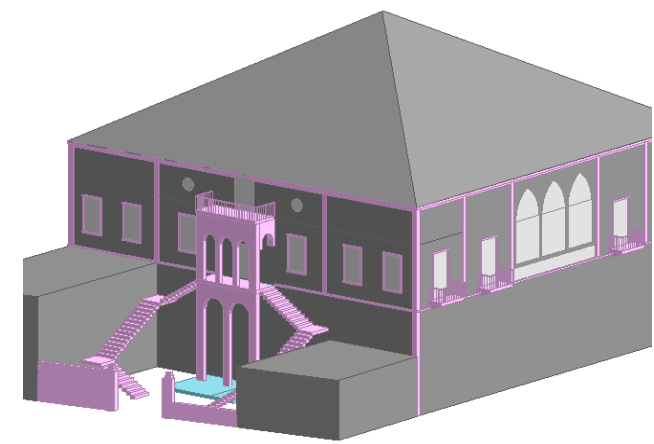
Electromechanical

Scenarios:

1. Change HVAC Systems
2. Change Water Boilers
3. PV
4. Grey Water



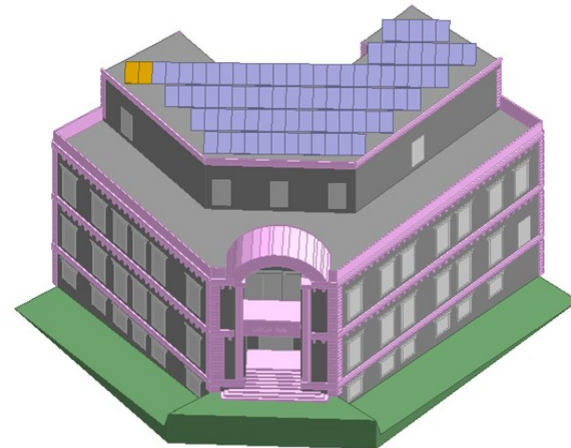
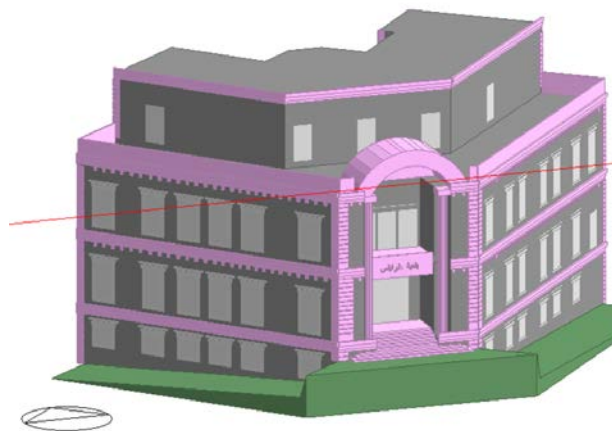
First Lebanon case studies of Tripoli: the Rachid Karami Cultural Center.





Second Lebanon case study: Municipality of Tripoli

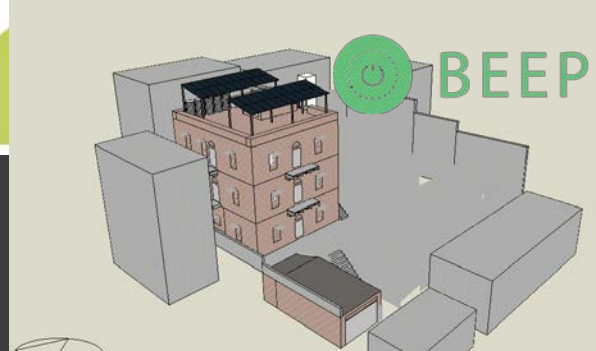
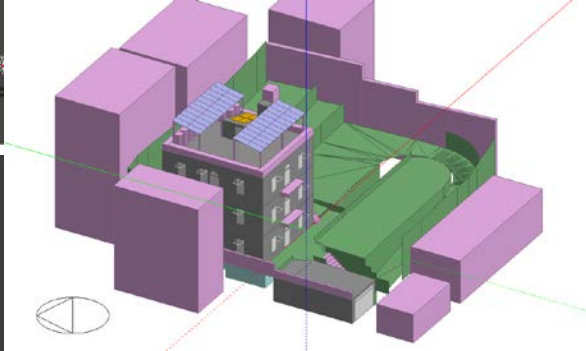
- The scenarios were then amended to maximize the energy savings with the highest ROI. Additional simulations were performed where additional measures were included for both case studies.



Energy modelling and simulation

results of the scenarios (post-operam)

- Palestinian case study Morcos Nassar Palace



Window shading

General | Slot data | Cost and Carbon

Slot Properties

Blind to glass distance (m)	0.3160
Slot overhang	Horizontal
Slot width (m)	0.0500
Slot separation (m)	0.01675
Slot thickness (m)	0.03100
Slot conductivity (W/m-K)	0.986
Slot angle (°)	45.8
Minimum slot angle (°)	0
Maximum slot angle (°)	180

Slot Color Properties

Slot solar transmittance	0.086
Slot solar reflectance, front side	0.086
Slot solar reflectance, back side	0.086

Slot Air Properties

Slot air U-factor	0.086
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Slot Data

Enter details on the slots

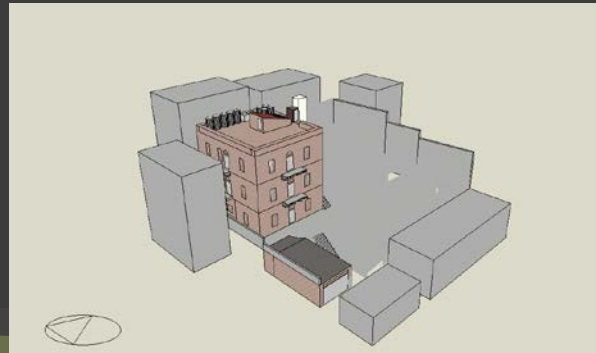
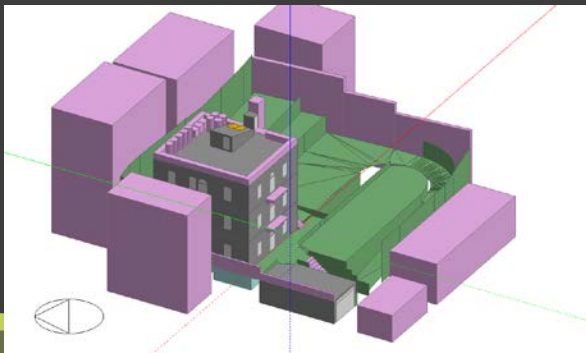
Local shading

General | Location | Spacing | Overhangs | Cost and Carbon

Overhangs

Vertical offset from window top (m)	0.000
Projection (m)	1.000
Horizontal window overhang (m)	0.000

Enter details on the overhangs if filled



Project news

30 August 2021

BEEP project: application of "Building Information Modelling" to increase energy efficiency in historical buildings

The innovative methodology will be tested on 9 heritage public buildings located in Italy, Spain, Cyprus,...

Environment Projects

Project news

06 August 2021

Jordan: BEEP team informs local stakeholders about innovative methodologies in the renovation of historic buildings

Attendees were briefed on the progress made in the renovation of the "Municipal Guest House" in Al-Karak municipality.

Environment Projects

Project news

19 July 2021

BEEP project explains the benefits of using Building Performance Simulation (BPS) on historic buildings

Introduction to the advantages of applying Building Performance Simulation (BPS) methodologies and tools on built heritage

Environment Projects

Project news

29 July 2021

BEEP: how to carry out an energy audit of a historical building to be financed with private funds

BEEP project shares a guideline for an energy audit of a historical building to promote its energy and environmental improvement, to be fina...

Environment Projects

Programme expected results indicators (see below for a quick overview of calculation methods an

	4.3.2 C	4.3.2 D	4.3.2 E	Number of scenarios
	<i>Estimated annual decrease of greenhouse gases (Tons of CO² equivalent/year)</i>	<i>Total kWh generated using renewable energy</i>	<i>Total kWh saved (expressed in budget reductions) using renewable energy</i>	
BEN ISPC-CNR	178.85	107793	107793	3
PP1 MASI				
PP2 IVE				
PP3 CYI	89.35	42806	41681.6	2
PP4 RSS-NERC		6280	6435	3
PP5 CCHP	25.17	30000	38366	2
PP6 LCEC (Municipality)	189.85	51544	51544	2
PP6 LCEC (Karami)	23.8	68626	46807.9	2
PP7 EJUST (Cordahi)	62.12	179136.7	179136.7	3
PP7 EJUST (Horreya)	77.28	222850	222850	3
Result	646.42	709035.7	694614.2	20
<i>Expected result</i>	<i>500</i>	<i>400000</i>	<i>400000</i>	<i>18</i>

CONCLUSIONS

The BEEP project main result is the establish a common framework among the partners to set up and harmonize the project workflow depending on local specificities.

Furthermore, we have not only reached but even exceeded the performance indicators that the program requested (CO2 avoided, kWh of RES produced and self-consumed)

We are now supporting the public administration (building's owners and managers) in the renovation project in the EPC implementation, phase, helping them to write and sign the correct and more suitable contract and efficient Escso.



Med-EcoSuRe



BEEP

Grazie per l'ascolto

Convegno

UNIVERSOstenibilitA'

la transizione digital-green dei
luoghi del sapere

Napoli, Mostra d'Oltremare
Venerdì, 25 marzo 2022

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SOLARTYS



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