D3.9_Overall Refurbishment Plan

DRAFT

CS01

Home for Elderly, Dun Laoghaire

INTELLIGENT ENERGY – EUROPE II

Energy efficiency and renewable energy in buildings

IEE/12/070

EuroPHit

[Improving the energy performance of step-by-step refurbishment and integration of renewable energies]

Contract N°: SI2.645928

Co-funded by the Intelligent Energy Europe Programme of the European Union

Technical References

Project Acronym	EuroPHit
Project Title	Improving the energy performance of step-by-step refurbishment and integration of renewable energies
Project Coordinator	Jan Steiger Passive House Institute, Dr. Wolfgang Feist Rheinstrasse 44/46 D 64283 Darmstadt jan.steiger@passiv.de
Project Duration	1 April 2013 – 31March 2016 (36 Months)

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Contributing beneficiary(ies)	CB4, MosArt
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Abstract

This overall refurbishment plan provides an overview of the retrofit steps of a step-by-step refurbishment to EnerPHit standard to be undertaken for the project Home for Elderly.

First, the existing building will shortly be described, including building component and component conditions. In addition, the existing energy efficiency performance of the building will be described.

In a second step, the overall refurbishment plan will describe the retrofit steps to be undertaken until the refurbishment will finally be completed. The EnerPHit standard will be achieved by: a) externally insulate the existing walls; b) replace existing double glazed windows to passive house windows; c) carefully airtight the building at each junction and fully plaster the external walls, d) heat recovery ventilation unit for each apartment, community areas and circulation areas; e) install a micro CHP (combined heat and power) with gas condenser boiler connected to radiators installed throughout the building.

Figure 1: Northwest view [MosArt, 2013]

1 General Project description

1.1 Motivation

Dun Laoghaire Rathdown County Council (DLR Co. Co) key members of staff became quite inspired by the Passive House concept and this project was the first one that this high quality building standard could be put in practice.

1.2 Existing Building

The existing building is a two-storey block of 34 apartments for the elderly built during the early 1970's. There are modest common facilities, including a kitchen and dining room. The floors, walls (external and internal) and roof comprise poured concrete construction with little or no insulation incorporated. The existing windows and glazed doors are double glazed with poorly insulated frames. Ventilation is mostly natural, using opening window sections but also some room-based fans.

1.3 Refurbishment steps

1.3.1 Retrofit steps within EuroPHit

The steps comprise of: 1) externally insulate all existing walls and replace existing double glazed windows to passive standard windows; 2) a new floor level will be built on top of the existing two story building as well as minor extensions to accommodate vertical circulation. The new floor and vertical circulation to be designed detailed and built to passive house standard. 3) Install a micro CHP (combined heat and power) with gas condenser boiler connected to radiators installed throughout the building.

1.3.2 Further retrofit steps

In the future and with improved technologies, the Client might consider installing PV and Solar panels on the roof.

1.4 EnerPHit standard

The final retrofit step to EnerPHit standard will be the installation of the micro Baxi Senertec CHP with gas condenser boiler connected to radiators installed throughout the building. This will be the back up heating for space and water as well as generating electricity.

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1.5 Drawings

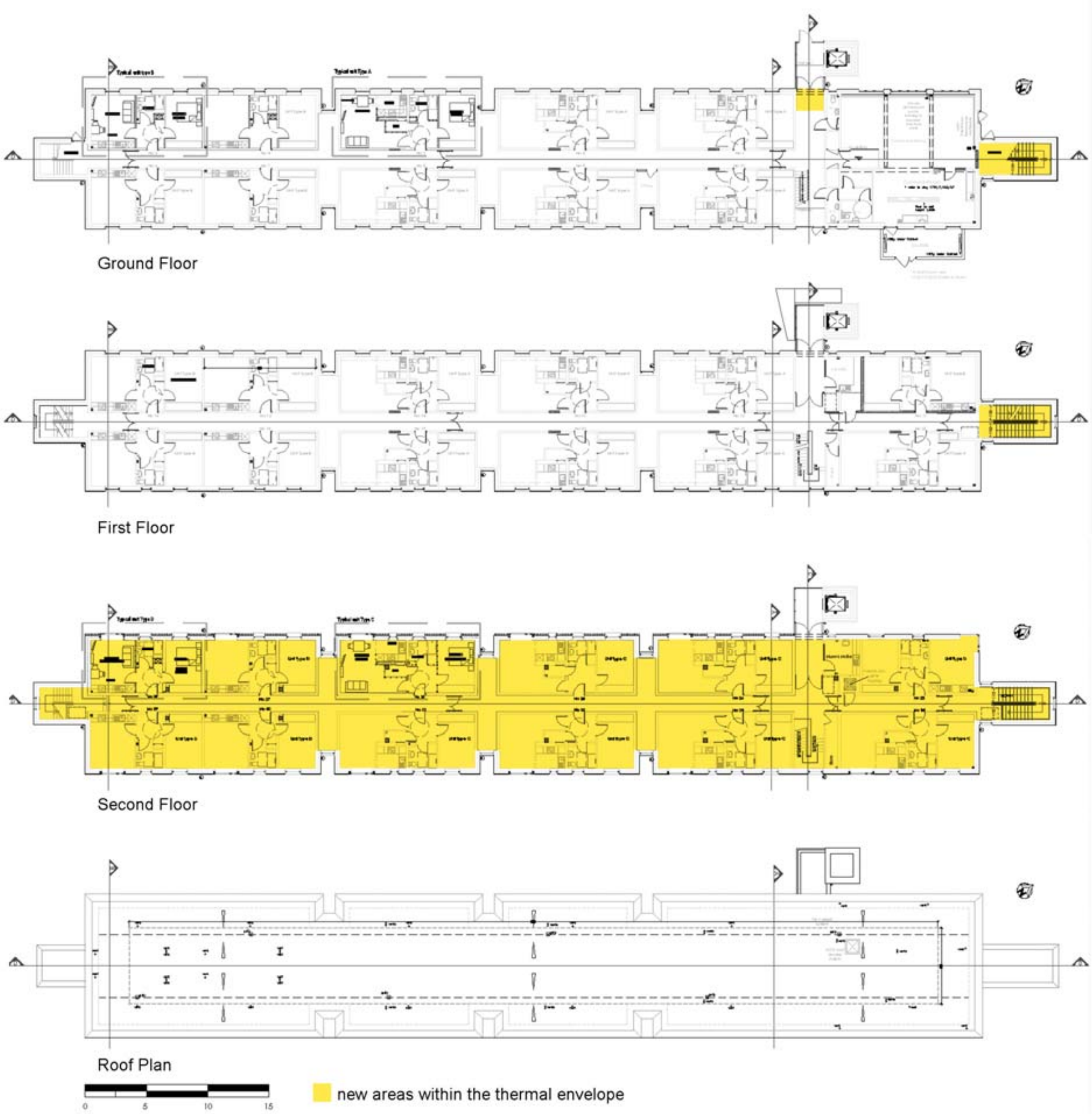

Figure 2: Existing and proposed floor plans [DLR Co. Co., 2014]

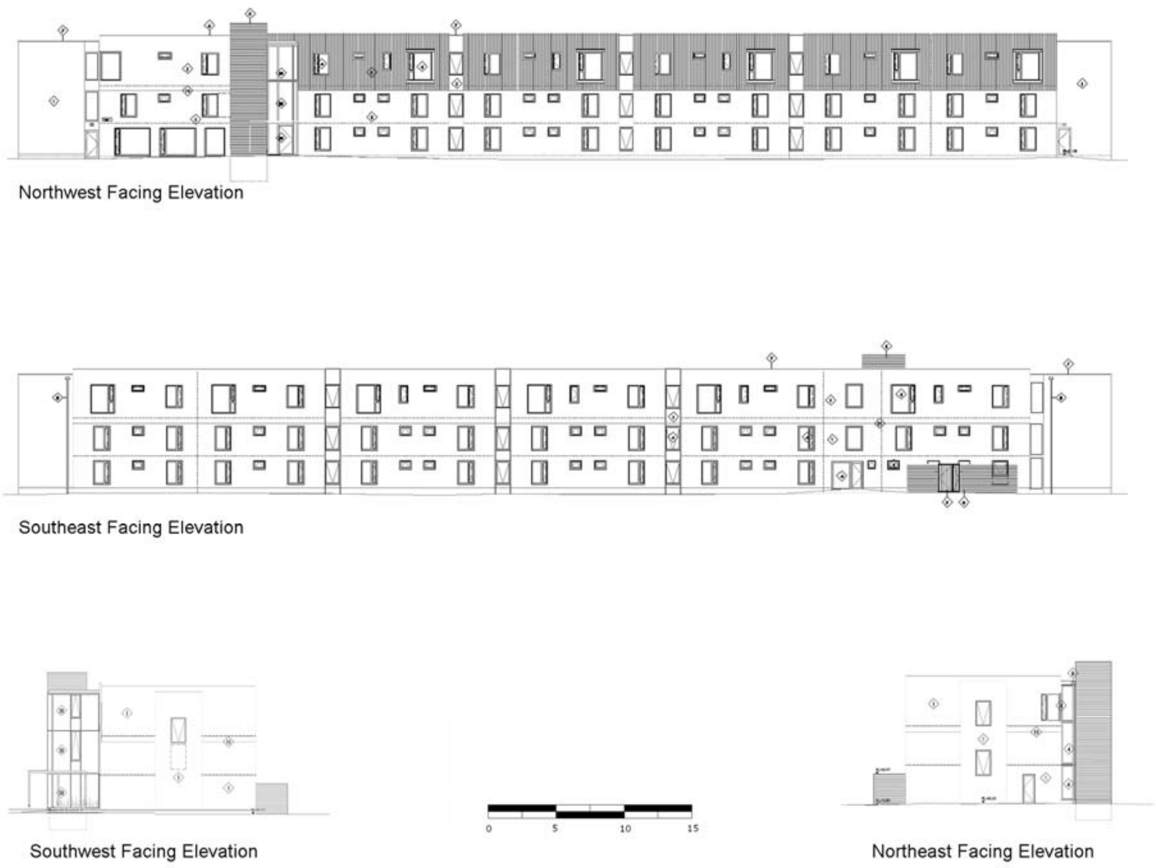

Figure 3: Elevations of proposed development [DLR Co. Co., 2014]

2 Existing Building

2.1 General description

This two storey building has a rectangular shape in plan, overall quite compact. It is part of a couple of Home for Elderly blocks. Both blocks were deemed to be refurbished. One is on site at the moment and it is to achieve current building regulations. The block that it is being analysed here aims to go further and achieve the EnerPHit standard. The type of its construction allowed it to have an overall low airtight result (4.9 air changes @ 50 Pa) for a building built in the 1970s. The main challenge was to agree what type of ventilation solution would be more appropriate (due to its low floor to ceiling height), efficient and economical as well as it future maintenance issues such as changing of filters. All critical junctions of the building are being proposed by the Client and Engineer appointed and we assess each one to guarantee that the refurbishment work will be done to EnerPHit standards.

2.1.1 Building data

Construction Time	:	1970
Last retrofit	:	
Building use	:	Home for elderly
General condition	:	Good
Occupancy	:	34 apartments - 34 elderly people
Treated floor Area	:	1,613 sqm
Other	:	

2.1.2 Client

Name / Company	:	Sarah Clifford / Dun Laoghaire Rathdown (DLR) County Council
Address	:	County Hall, Marine Road, Dun Laoghaire, County Dublin, Ireland
Email	:	sclifford@DLRCOCO.IE
Other	:	

2.2 Envelope of the existing Building

2.2.1 Floor slab

Description	:	poured concrete construction
U-Value [W/(m²K)]	:	3,85
Installation date	:	1970
Condition	:	Good
Next replacement	:	The existing floor slab will not be retrofitted.
Other	:	

2.2.2 External walls

Description	:	poured concrete construction
U-Value [W/(m²K)]	:	3,75
Installation date	:	1970
Condition	:	Good
Next replacement	:	2014
Other	:	

2.2.3 Windows

Description	:	double glazed, PVC frame
U-Value [W/(m²K)]	:	1,71

Installation date	:	1970
Condition	:	Good
Next replacement	:	2015
Other	:	

2.2.4 Roof / Top floor ceiling

Description	:	poured concrete construction
U-Value [W/(m²K)]	:	4,36
Installation date	:	1970
Condition	:	Good
Next replacement	:	2015
Other	:	

2.3 Technical equipment of the existing building

2.3.1 Heating

Description	:	Oil Boiler
Performance ratio of heat generation [%]	:	
Installation date	:	
Condition	:	Medium
Next replacement	:	2015
Other	:	

2.3.2 Domestic hot water

Description	:	Oil Boiler and Electric emersion
Performance ratio of heat generation [%]	:	na
Installation date	:	1970
Condition	:	Medium
Next replacement	:	2015
Other	:	

2.3.3 Ventilation

Description	:	Natural ventilation
HR Efficiency[%]	:	na
El.Efficiency [Wh/m³]		na

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Installation date	:	1970
Condition	:	
Next replacement	:	2015
Other	:	

2.4 Energy efficiency of the existing building

The energy efficiency properties of the existing building were calculated with the use of the PHPP 9 (Passive House Planning Package) and the results prove that the energy performance of the building is very poor due mainly to the lack of insulation in the thermal envelope..

2.4.1 Modelled efficiency parameters

PHPP: specific heating demand [kWh/(m²K)]	:	354.08
PHPP: specific cooling demand | Overheating frequency [kWh/(m²K) | %]	:	na
PHPP: specific primary energy demand [kWh/(m²K)]	:	688

2.4.2 Available consumption parameters

Annual Gas/Oil consumption | bills [kWh/a | €]	:	In 2012 the average Oil bill **per month** was **€1,350**
Annual Electricity consumption | bills [kWh/a | €]	:	na
Other	:	

For an overview of the energy efficiency of the existing building, see the verification spreadsheet of the PHPP 9 beta version [PHI 2013] on the next page.

EnerPHit verification

Building:	Block One Rochestown House
Street:	Sallynogin Road Upper
Postcode/City:	Dún Laoghaire
Country:	Ireland
Building type:	Home for Elderly
Climate:	[IE] - Dublin
Altitude of building site (in [m] above sea level):	–
Home owner/client:	DLR CC
Street:	Dún Laoghaire
Postcode/City:	Dún Laoghaire

Architecture:	DLR CC	Mechanical System:	
Street:	Dún Laoghaire	Street:	
Postcode/City:	Dún Laoghaire	Postcode/City:	
Energy consulting:		Certification:	
Street:		Street:	
Postcode/City:		Postcode/City:	

Year of Construction:	1960	Interior temperature winter [C°]	20.0	Interior temp. summer [C°]	25.0
Number of dwelling units:	34	Internal heat gains winter [W/m²]	4.1	IHG summer [W/m²]	4.1
Number of Occupants:	46.1			Spec. capacity [Wh/K per m² TFA]	204
Exterior vol. V_e:	6339.6 m³			Mechanical cooling:	

Specific building demands with reference to the treated floor area

				Requirements	Fulfilled?*
	Treated floor area	1613.3	m²		
Space heating	Annual heating demand	**354.08**	kWh/(m²a)	25 kWh/(m²a)	no
	Heating load	**110**	W/m²	-	-
Space cooling	Overall specific space cooling demand		kWh/(m²a)	-	-
	Cooling load		W/m²	-	-
	Frequency of overheating (> 25 °C)	0.0	%	-	-
Primary Energy	Heating, cooling, dehumidifying, DHW,	**688**	kWh/(m²a)	527 kWh/(m²a)	no
	DHW, space heating and auxiliary electricity	604	kWh/(m²a)	-	-
	Specific primary energy reduction through solar electricity		kWh/(m²a)	-	-
Airtightness	Pressurization test result n_{50}	**5.0**	1/h	1 1/h	no

EnerPHit (Modernisierung): Bauteilkennwerte

Gebäudehülle	Außendämmung zu Außenluft	**4.05**	W/(m²K)	-	-
mittlere U-Werte	Außendämmung zu Erdreich	**3.85**	W/(m²K)	-	-
	Innendämmung zu Außenluft		W/(m²K)	-	-
	Innendämmung zu Erdreich		W/(m²K)	-	-
	Wärmebrücken ΔU	0.00	W/(m²K)	-	-
	Fenster	**1.71**	W/(m²K)	-	-
	Außentüren		W/(m²K)	-	-
Lüftungsanlage	eff. Wärmebereitstellungsgrad		%	-	-

* empty field: data missing; '-': no requirement

Figure 4: Specific energy efficiency values of the existing building modelled with PHPP 9 Beta

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2.5 Pictures / Drawings

These pictures or drawings illustrate the existing building.

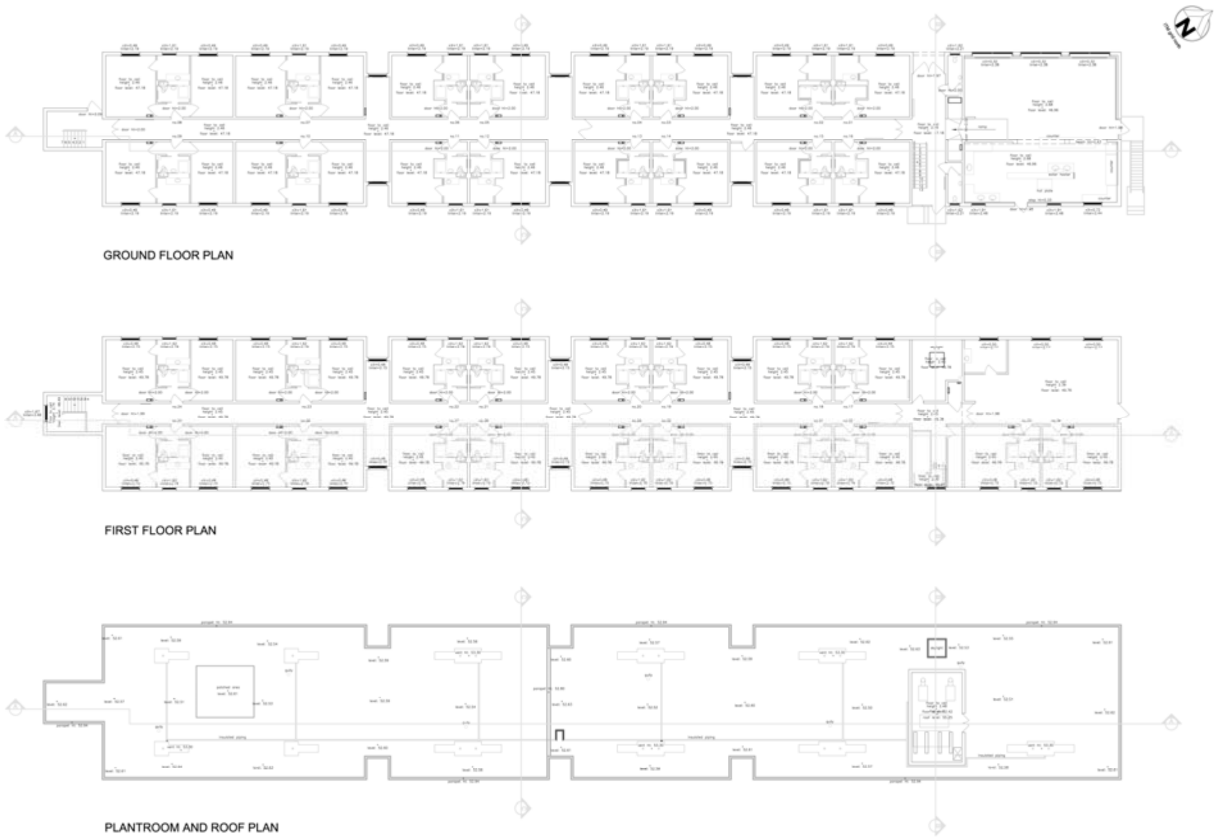

Figure 5: Floor plans of the existing building

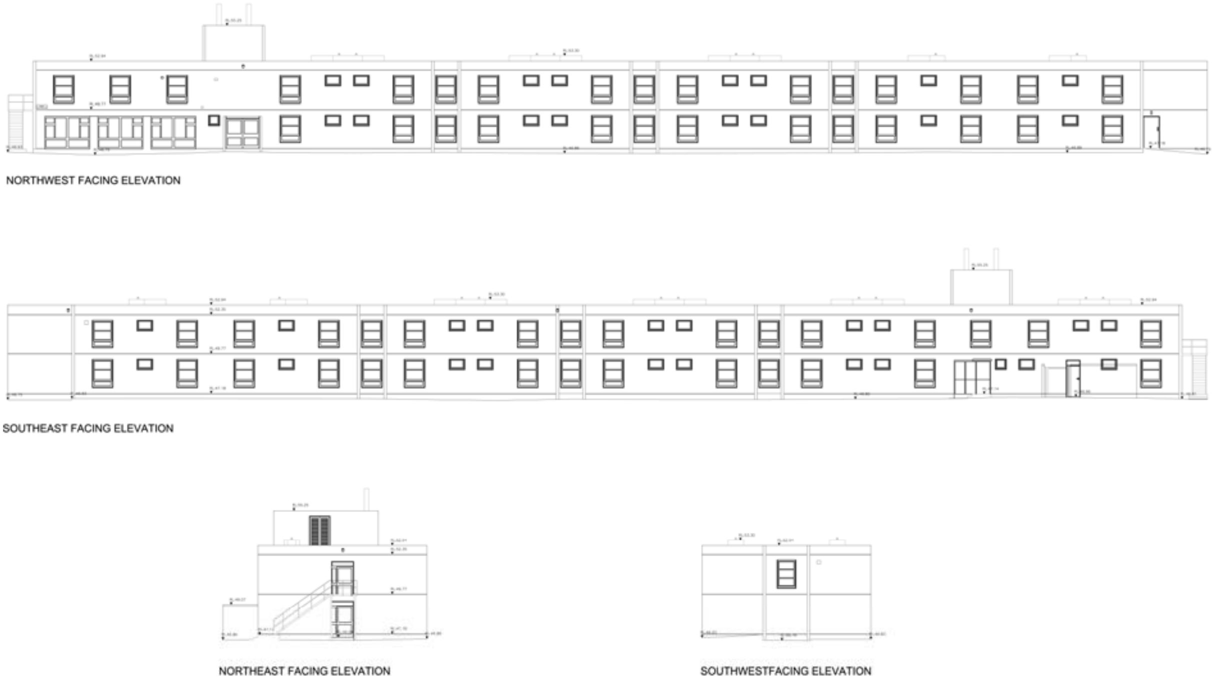

Figure 6: Elevations of the existing building

Figure 7: View of the North facade [MosArt, 2013]

Figure 8: View of the Southeast facade [MosArt, 2013]

Figure 9 & 10: View of the recessed areas and Communal space on the first floor [MosArt, 2013]

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3 Retrofit steps

3.1 Overall refurbishment Plan

3.1.1 Retrofit steps:

This Client is willing to complete the EnerPHit standard refurbishment of this building in one phase – the first refurbishment step that includes the additional floor, entrance area and vertical circulation area to Passive House standards and the refurbishment of existing walls, windows and door. We propose that a Solar hot water system will be installed on the roof by 2020, as the second phase of the refurbishment of this building.

Step No.	Year	Measures	Specific Heating Demand	Specific Primary Energy Demand	Additional Specific PV Gains
1	1960	Existing Building	354	688	
2	2015	EnerPHit standard refurbishment	24	109	
3	2020	Solar Panels	24	95	0

Figure 11: Overview refurbishment steps

3.1.2 Efficiency Improvements

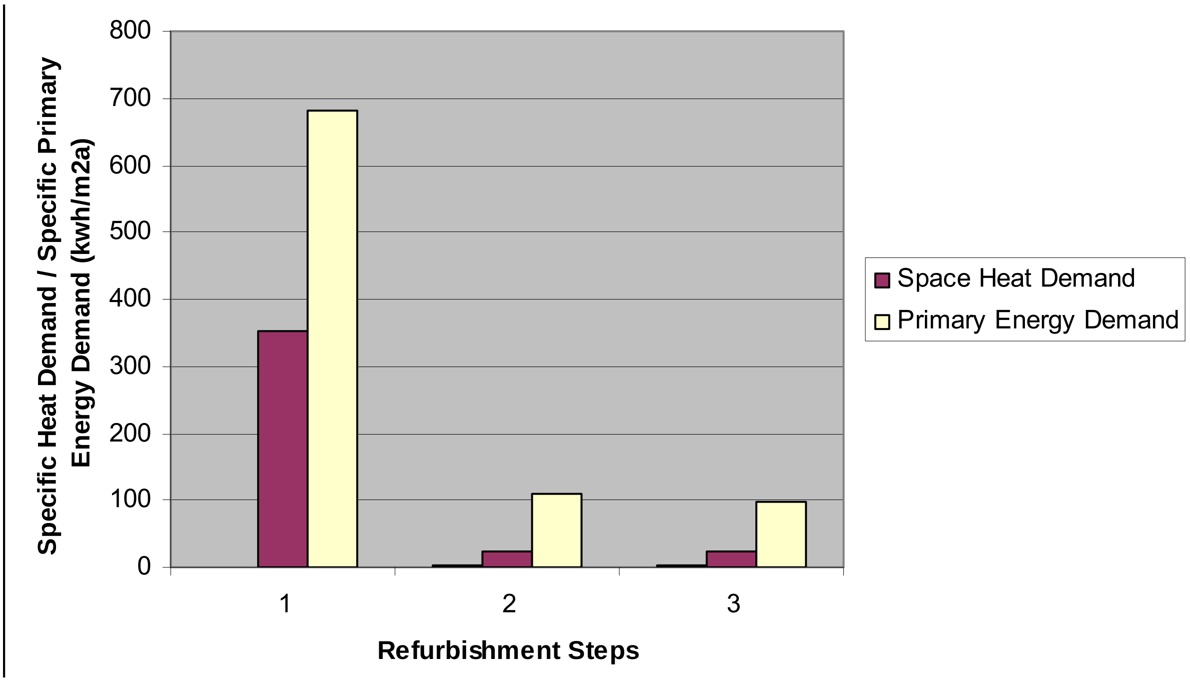

Figure 12: Overview energy efficiency improvement according to the overall refurbishment plan

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3.2 Retrofit steps within EuroPHit

3.2.1 Retrofit step 1:

Addition of a new floor improving Area to Volume ratio; external insulation applied to all existing and new external walls; replacement of all windows and doors to Passive House standard; improvement of the air tightness to 1 air changes @50 Pa and 39 MHRVs installation throughout; micro CHP with gas condenser boiler installation.

Start date	:	Winter 2014
Completion date	:	Summer 2015
Budget	:	
PHPP: specific heating demand [kWh/(m²K)]	:	24
PHPP: specific cooling demand | Overheating frequency [kWh/(m²K) | %]	:	
PHPP: specific primary energy demand [kWh/(m²K)]	:	109

3.2.1.1 New Envelope component (existing walls)

Description	:	200 mm EPS insulation on external walls
U-Value [W/(m²K)]	:	0.15
Installation date	:	2015
Condition	:	
Next replacement	:	
Other	:	

3.2.1.2 New Envelope component (new walls)

Description	:	200 mm EPS insulation on aerated block external walls
U-Value [W/(m²K)]	:	0.13
Installation date	:	2015
Condition	:	
Next replacement	:	
Other	:	

3.2.1.3 New Envelope component (new flat roof)

Description	:	Insulated metal deck with 150 mm phenolic

		insulation
U-Value [W/(m²K)]	:	0.13
Installation date	:	2015
Condition	:	
Next replacement	:	
Other	:	

3.2.1.4 New Envelope component (new floor to the entrance area and to the new fire escape stairs)

Description	:	120 mm PIR insulation under new concrete slab
U-Value [W/(m²K)]	:	0.18
Installation date	:	2015
Condition	:	
Next replacement	:	
Other	:	

3.2.1.5 New Envelope component (new windows and doors throughout)

Description	:	Aluminium clad timber frame triple glazed windows
U-Value [W/(m²K)]	:	1
Installation date	:	2015
Condition	:	
Next replacement	:	
Other	:	

3.2.1.6 New Envelope component (airtight layer in a continuous line along the thermal envelope)

Description	:	The airtight layer will be the plaster on the internal face of the existing concrete walls and the new aerated block walls
Air changes @ 50 Pa	:	1
Installation date	:	2015
Condition	:	
Next replacement	:	
Other	:	

3.2.1.7 New heating component

Description	:	Micro CHP with gas condenser boiler
Performance ratio of heat generation [%]	:	

Installation date	:	Summer 2015
Condition	:	
Next replacement	:	
Other	:	

3.2.2 New ventilation component

Description	:	ConfoAir 160 HRV - Zehnder to be installed in each of the 34 apartments and 5 more units to be installed in the circulation and communal areas.
HR Efficiency[%]	:	89
El.Efficiency [Wh/m³]	:	0.36
Installation date	:	Summer 2015
Condition	:	
Next replacement	:	
Other	:	

3.2.3 Retrofit step 2:

136 square meters of vacuum tube collector installed on the flat roof. Also installed a 2000 litre stratified solar storage with domestic hot water (DHW) heat exchanger.

Start date	:	2020
Completion date	:	2020
Budget	:	
PHPP: specific heating demand [kWh/(m²K)]	:	24
PHPP: specific cooling demand | Overheating frequency [kWh/(m²K) | %]	:	
PHPP: specific primary energy demand [kWh/(m²K)]	:	95

EnerPHit verification

Building:	Block One Rochestown House
Street:	Sallynogin Road Upper
Postcode/City:	Dún Laoghaire
Country:	Ireland
Building type:	Home for Elderly
Climate:	[IE] - Dublin
Altitude of building site (in [m] above sea level):	–
ome owner/client:	DLR CC
Street:	Dún Laoghaire
Postcode/City:	Dún Laoghaire

Architecture:	DLR CC	Mechanical System:	
Street:	Dún Laoghaire	Street:	
Postcode/City:	Dún Laoghaire	Postcode/City:	
Energy consulting:		Certification:	
Street:		Street:	
Postcode/City:		Postcode/City:	

Year of Construction:	2015	Interior temperature winter [C°]:	20.0	Interior temp. summer [C°]:	25.0
Number of dwelling units:	34	Internal heat gains winter [W/m²]:	4.1	IHG summer [W/m²]:	4.1
Number of Occupants:	53.0			Spec. capacity [Wh/K per m² TFA]:	204
Exterior vol. V_e:	6339.6 m³			Mechanical cooling:	

Specific building demands with reference to the treated floor area

				Requirements	Fulfilled?*
	Treated floor area	1856.1	m²		
Space heating	Annual heating demand	23.72	kWh/(m²a)	25 kWh/(m²a)	yes
	Heating load	13	W/m²	-	-
Space cooling	Overall specific space cooling demand		kWh/(m²a)	-	-
	Cooling load		W/m²	-	-
	Frequency of overheating (> 25 °C)	0.0	%	-	-
Primary Energy	Heating, cooling, dehumidifying, DHW,	109	kWh/(m²a)	130 kWh/(m²a)	yes
	DHW, space heating and auxiliary electricity	38	kWh/(m²a)	-	-
	Specific primary energy reduction through solar electricity		kWh/(m²a)	-	-
Airtightness	Pressurization test result n_{50}	1.0	1/h	1 1/h	yes

EnerPHit (Modernisierung): Bauteilkennwerte

Gebäudehülle	Außendämmung zu Außenluft	0.14	W/(m²K)	-	-
mittlere U-Werte	Außendämmung zu Erdreich	3.74	W/(m²K)	-	-
	Innendämmung zu Außenluft		W/(m²K)	-	-
	Innendämmung zu Erdreich		W/(m²K)	-	-
	Wärmebrücken ΔU	0.00	W/(m²K)	-	-
	Fenster	1.00	W/(m²K)	-	-
	Außentüren		W/(m²K)	-	-
Lüftungsanlage	eff. Wärmebereitstellungsgrad	78	%	-	-

* empty field: data missing; '-': no requirement

Figure 13: Specific energy efficiency values after measures within EuroPHit

3.3 Future retrofit Steps

3.3.1 Retrofit step 3:

PV Panels installation on the flat roof

Start date	:	2035
Completion date	:	2035
Budget	:	
PHPP: specific heating demand [kWh/(m²K)]	:	24
PHPP: specific cooling demand | Overheating frequency [kWh/(m²K) | %]	:	
PHPP: specific primary energy demand [kWh/(m²K)]	:	95

3.3.1.1 New building equipment component

Description	:	PV Panels
Efficiency	:	
Installation date	:	2035
Condition	:	
Next replacement	:	
Other	:	

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3.4 Pictures / Drawings

These pictures or drawings illustrate the retrofit process.

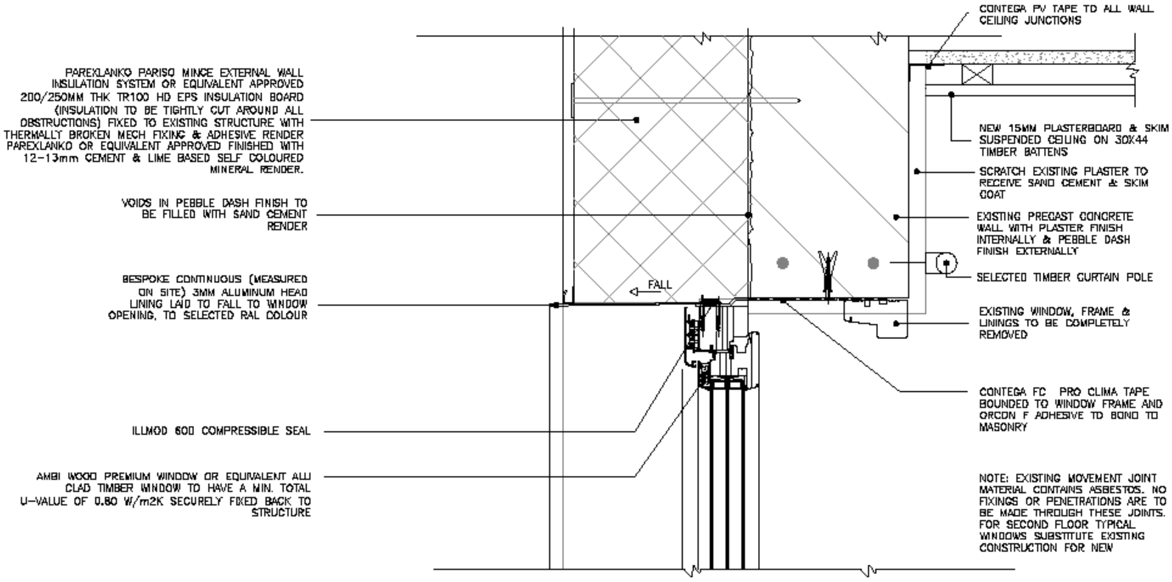

Figure 14: Window head detail on the existing building (not to scale) [DLR Co. Co., 2014]

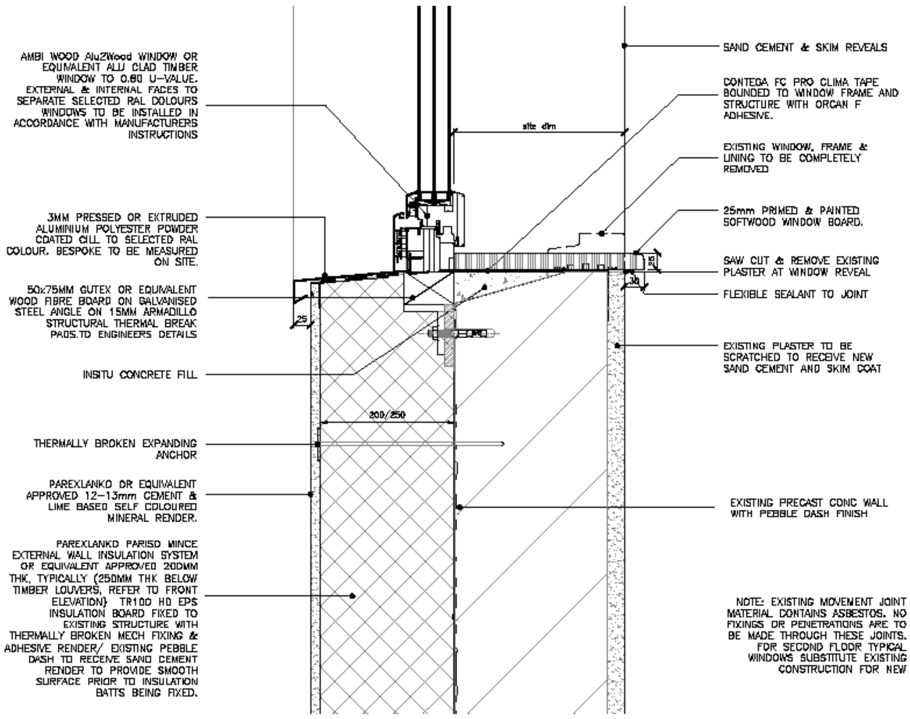

Figure 15: Window cill detail on the existing building (not to scale) [DLR Co. Co., 2014]

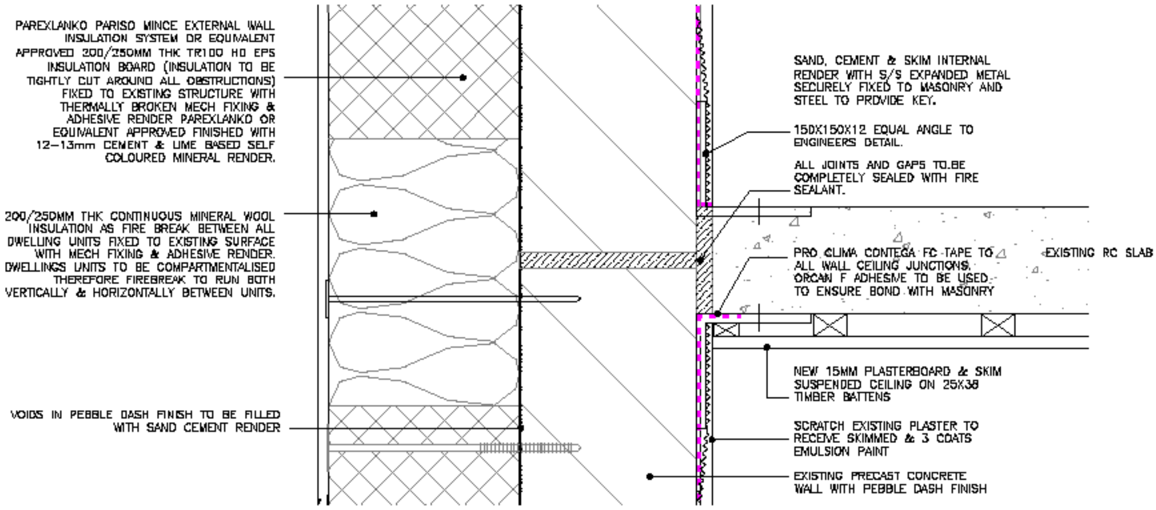

Figure 16: Wall floor slab junction (not to scale) [DLR Co. Co., 2014]

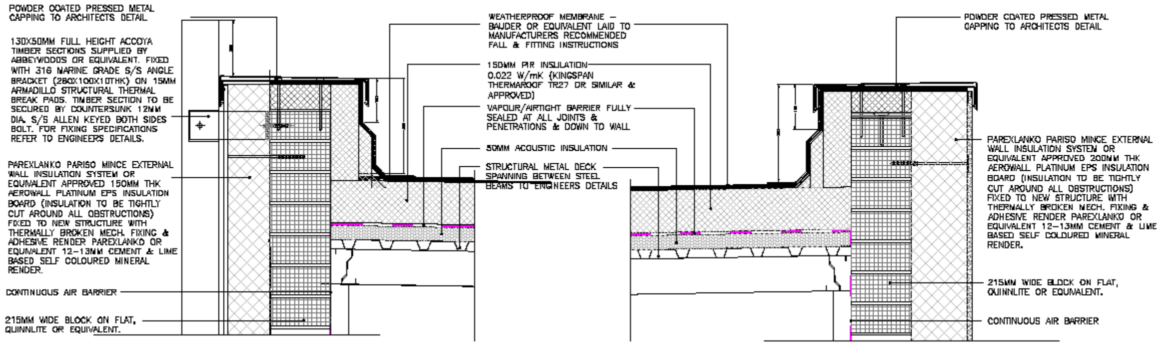

Figure 17: Parapet details (not to scale) [DLR Co. Co., 2014]

4 Completion of step-by-step refurbishment to EnerPHit standard including RES

4.1 General description

The proposed refurbishment plan is achieving the EnerPHit standard. The great improvement of this project's energy performance is due to all different steps outlined above but also due to careful analysis and development of thermal bridge free and airtight details throughout the building envelop.

4.2 Retrofit steps carried out

The following figure presents the chosen efficiency improvement steps expected to be carried out after completion of the overall refurbishment plan:

EnerPHit planning: CALCULATION OF VARIANTS

		Active				
	select active variants >>	2-EnerPHit proposal	Existing	EnerPHit proposal	Solar Panels (2020)	Solar PV (2035)
Results	Units	2	1	2	3	4
Annual heating demand	kwh/(m²a)	23.7	354.1	23.7	23.7	23.7
Heating Load	W/m²	13.1	109.5	13.1	13.1	13.1
Overall specific space cooling demand	kwh/(m²a)					
Cooling load	W/m²					
Frequency of overheating	%	0.0	0.0	0.0	0.0	0.0
Total primary energy demand	kwh/(m²a)	109.0	687.5	109.0	95.3	95.3
Certifiable as EnerPHit building retrofit (acc. to heating demand)?	yes / no	yes	no	yes	yes	yes
<< User defined	Units	Link	Link	Link	Link	Link
Input variables	Units	Value	1	2	3	4

Figure 12: PHPP9 beta [PHI 2013] Variant sheet with the retrofit steps carried out

4.2.1 Building data

Construction Time	:	Summer 2015
Last retrofit	:	
Building use	:	Home for elderly
General condition	:	Good
Occupancy	:	34 apartments occupied
Treated floor Area	:	1856 sqm
Other	:	

4.2.2 Client

Name / Company	:	Sarah Clifford / Dun Laoghaire Rathdown (DLR) County Council
Address	:	County Hall, Marine Road, Dun Laoghaire, County Dublin, Ireland
Email	:	sclifford@DLRCOCO.IE
Other	:	

4.3 Envelope of the refurbished Building

4.3.1 Floor slab

Description	:	Existing floor slab	New floor slab
U-Value [W/(m²K)]	:	3.85	0.18
Installation date	:		Spring 2015
Condition	:	Good	
Next replacement	:		
Other	:		

4.3.2 External walls

Description	:	Existing walls	New walls
U-Value [W/(m²K)]	:	0.15	0.13
Installation date	:	Spring 2015	
Condition	:		
Next replacement	:		
Other	:		

4.3.3 Windows

Description	:	Triple glazed windows (not yet decided the manufacture)
U-Value [W/(m²K)]	:	1
Installation date	:	Spring 2015
Condition	:	
Next replacement	:	
Other	:	

4.3.4 Roof / Top floor ceiling

Description	:	Lightweight metal deck roof with phenolic insulation on top
U-Value [W/(m²K)]	:	0.13

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Installation date	:	Spring 2015
Condition	:	
Next replacement	:	
Other	:	

4.4 Technical equipment of the refurbished building

4.4.1 Heating

Description	:	Baxi Senertec Micro CHP with gas condenser boiler connected to radiators throughout the building
Performance ratio of heat generation [%]	:	
Installation date	:	Summer 2015
Condition	:	
Next replacement	:	
Other	:	

4.4.2 Domestic hot water

Description	:	Baxi Senertec Micro CHP with gas condenser boiler connected to provide domestic hot water
Performance ratio of heat generation [%]	:	
Installation date	:	Summer 2015
Condition	:	
Next replacement	:	
Other	:	

4.4.3 Ventilation

Description	:	ConfoAir 160 HRV - Zehnder to be installed in each of the 34 apartments and 5 more units to be installed in the circulation and communal areas.
HR Efficiency[%]	:	89
El.Efficiency [Wh/m³]	:	0.36
Installation date	:	Summer 2015
Condition	:	
Next replacement	:	
Other	:	

4.5 Energy efficiency of the refurbished building

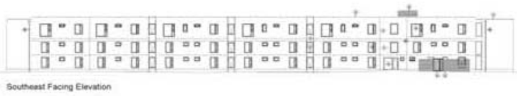
The refurbishment of this building is aiming to achieve the EnerPHit standard. The PHPP model carried out with the data submitted so far by the client is the following.

4.5.1 Modelled efficiency parameters

PHPP: specific heating demand [kWh/(m²K)]	:	24
PHPP: specific cooling demand | Overheating frequency [kWh/(m²K) | %]	:	
PHPP: specific primary energy demand [kWh/(m²K)]	:	109

For an overview of the energy efficiency of the completed step-by-step refurbishment, see the verification spreadsheet of the PHPP 9 beta version [PHI 2013] on the next page.

EnerPHit verification



Building:	Block One Rochestown House
Street:	Sallynogin Road Upper
Postcode/City:	Dún Laoghaire
Country:	Ireland
Building type:	Home for Elderly
Climate:	[IE] - Dublin
Altitude of building site (in [m] above sea level):	–
ome owner/client:	DLR CC
Street:	Dún Laoghaire
Postcode/City:	Dún Laoghaire

Architecture:	DLR CC	Mechanical System:	
Street:	Dún Laoghaire	Street:	
Postcode/City:	Dún Laoghaire	Postcode/City:	
Energy consulting:		Certification:	
Street:		Street:	
Postcode/City:		Postcode/City:	

Year of Construction:	2020	Interior temperature winter [C°]	20.0	Interior temp. summer [C°]	25.0
Number of dwelling units:	34	Internal heat gains winter [W/m²]	4.1	IHG summer [W/m²]	4.1
Number of Occupants:	53.0			Spec. capacity [Wh/K per m² TFA]	204
Exterior vol. V_e:	6339.6 m³			Mechanical cooling:	

Specific building demands with reference to the treated floor area

				Requirements	Fulfilled?*
	Treated floor area	1856.1	m²		
Space heating	Annual heating demand	23.72	kWh/(m²a)	25 kWh/(m²a)	yes
	Heating load	13	W/m²	-	-
Space cooling	Overall specific space cooling demand		kWh/(m²a)	-	-
	Cooling load		W/m²	-	-
	Frequency of overheating (> 25 °C)	0.0	%	-	-
Primary Energy	Heating, cooling, dehumidifying, DHW,	95	kWh/(m²a)	130 kWh/(m²a)	yes
	DHW, space heating and auxiliary electricity	24	kWh/(m²a)	-	-
	Specific primary energy reduction through solar electricity		kWh/(m²a)	-	-
Airtightness	Pressurization test result n_{50}	1.0	1/h	1 1/h	yes

EnerPHit (Modernisierung): Bauteilkennwerte

Gebäudehülle mittlere U-Werte	Außendämmung zu Außenluft	0.14	W/(m²K)	-	-
	Außendämmung zu Erdreich	3.74	W/(m²K)	-	-
	Innendämmung zu Außenluft		W/(m²K)	-	-
	Innendämmung zu Erdreich		W/(m²K)	-	-
	Wärmebrücken ΔU	0.00	W/(m²K)	-	-
	Fenster	1.00	W/(m²K)	-	-
	Außentüren		W/(m²K)	-	-
Lüftungsanlage	eff. Wärmebereitstellungsgrad	78	%	-	-

* empty field: data missing; '-': no requirement

Figure 13: Specific energy efficiency values of the completed project modelled with PHPP 9 Beta

4.6 Pictures / Drawings

These pictures or drawings illustrate the final status of the retrofit.

Figure 4: Pictures / drawings of the completed retrofit (not yet available)

5 RES Strategy / PV potential Evaluation

5.1 Inhabitant's comfort and location concept

Onyx Solar will study in the following pages, the integration of photovoltaic technology on the Home for Elderly project located in Dun Laoghaire (Ireland).

BIPV integration will be analyzed as a multifunctional added value where, in addition to the electrical generation, the system could provide passive bioclimatic properties as thermal inner comfort -since most of the UV and infrared radiation from the sun will be harvested by the silicon-based material (solar filter effect)-, natural sunscreen and the highly modern appearance.

The location is a key issue in order to consider the best solutions for this intervention. Into these parameters, there are critical factors that must be taken into account to move ahead. These critical factors include climate and microclimate features, geographical conditions (latitude, longitude, altitude above sea level, orientation) and building orientation.

Location	**Dun Laoghaire**
Country	**Ireland**
Region	**Europe**
Latitude	**53º30'N**
Longitude	**6º14'W**
Altitude	**26 m**
Time Zone	**UTC/GMT +1**

Table 1: Location parameters

	Global Irradiation	**Diffuse Irradiation**	**Average temperature**
	kWh/m^2	**kWh/m^2**	**°C**
January			
February			
March			
April			
May			
June			
July			
August			
September			
October			
November			
December			
Year			

Table 1: Microclimate conditions

Dun Laoghaire shows annual irradiation of --- kWh/m^2. The average annual temperature is --- °C. The elevation above sea level is -- m. These climatic and geographic parameters, and the specific location of the building –latitude, longitude, altitude above sea level, orientation- were critical facts when selecting the technology to be implemented.

It is mandatory to point out that it has not been considered the effects of shadows or components of diffuse radiation and albedo in this approach. Therefore, a detailed analysis of production taking into account these critical factors should be done in subsequent stages of the analysis.

5.2 Evaluation of potential BIPV systems

This is an alternative solution for external walls that is composed by an insulation material in the inner part, an air gap and PV modules in the outer layer. This system could be implemented to reduce thermal exchanges and to avoid thermal bridges, producing at the same time clean electricity. Thanks to the ventilated air chamber and to the application of insulating material, this system increases the acoustic absorption and reduces the amount of heat that buildings absorb in hot weather conditions. In the air gap, the density difference between a hot and cold air creates a natural flow removing the air through a chimney effect that helps to eliminate heat and moisture increasing inner comfort.

The ventilated façade would be located in the south-east and south-west oriented elevation, covering the opaque walls. The scheme of the PV integration is shown below:

Figure 5South-east façade view

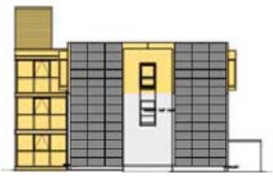


Figure 6: South-west façade view

The description of the components composing the PV ventilated system is included below:

5.3 Production estimation

A preliminary estimation of PV energy generation can be determined for the proposed solutions by means of implementing simulation tools, where key site location factors as climatic parameters (latitude, longitude, altitude above sea level, orientation) and BIPV system characteristics (tilted angle, azimuth etc.) are considered to establish the final solution energy performance.

The graphic draws a comparison between Peak Power and Energy yield for the different options of PV integration.

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Considering the data of energy mixing in ------ (country name) according to the International Energy Agency, where a ratio of ---- Kg CO2 / KWh is found, it can be extracted the following emissions of CO_2 per year that would be prevented for each option proposed:[1]

PV type	opaque a-si	opaque a-si	Opaque m-c
Location	South-east facade	South-west facade	Roof
Installed PV area [m²]	252,19	66,4	344,06
Installed peak power [kWp]	15,63	4,11	50,88
Annual RES gains [kWh]	9890	2600	37859
CO2 emissions prevented	pending	pending	pending

Table 1: Energy production summary

[1] CO_2 emissions from fossil fuels consumed for electricity generation, in both electricity-only and combined heat and power plants, divided by output of electricity generated from all fossil and non-fossil sources. Both main activity producers and auto producers have been included in the calculation.

Source: CO2 EMISSIONS FROM FUEL COMBUSTION Highlights (2013 Edition), INTERNATIONAL ENERGY AGENCY

6 Refurbishment to the current National Standards

6.1 General Description

The Irish building regulations are very much concerned with the Primary Energy consumption of a refurbished or new building. The targets for the thermal envelope improvements are still very low, and in regard to the airtight level, there is no ambition at all. Unfortunately the Heat demand is not at all a priority for the current regulations; the big priority is the investment on the Renewables and new heating (more efficient) systems.

6.2 Efficiency results comparison table

	Existing building	National regulations	EnerPHit standard	Differences [%]
Space heat demand [kWh/(m^2/a)]	354	62	24	10%
Primary energy demand [kWh/(m^2/a)]	688	131	109	3%
Heat Load [W/m^2]	110	24	13	10%

Figure 20: Comparison of efficiency results

6.3 Building envelope comparison table

	Existing building	National regulations	EnerPHit standard	Differences [%]
Airtightness Pressure test n50 [1/h]	5.0	5.0	1.0	20%
Building envelope				
Floor Slab [W/(m²K)]	3.85	0.18	0.18	-
Walls to ground [W/(m²K)]	-	-	-	
Walls [W/(m²K)]	3.75	0.16	0.13	1%
Roof / Attic ceilings [W/(m²K)]	4.36	0.16	0.13	1%
Windows [W/(m²K)]	2.0	1.6	1.0	30%
Doors [W/(m²K)]	3.0	1.6	1.0	20%
Thermal bridging ΔU[W/(m²K)]	0.15	0.08	0.01	47%

Figure 21: Comparison of building envelope components

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6.4 Building equipment comparison table

	Existing building	National regulations	EnerPHit standard	Differences [%]
Ventilation	**Natural**	**Natural**	**Zehnder comfoair**	
HR Efficiency [%]			84	
Electric efficiency [Wh/m³]			0,36	
Ducting				
Heating	**Boiler**		**CHP**	
Energy source	Oil		Gas	
Performance ratio of heat generation [%]	tbc	tbc	tbc	
Thermal output kW	tbc	tbc	tbc	
Insulation of pipes	tbc	tbc	tbc	
Domestic hot water	**Oil**		**CHP**	
Energy source	Oil		Gas	
Performance ratio of heat generation [%]	tbc	tbc	tbc	
Thermal output kW	tbc	tbc	tbc	
Insulation of pipes	tbc	tbc	tbc	
Cooling	**Gas**		**Heat pump**	
Energy source	na	na	na	
Performance ratio of cooling generation [%]	na	na	na	
Thermal output kW	na	na	na	
Insulation of pipes	na	na	na	

Figure 22: Comparison of building equipment

6.5 RES implementation comparison table

	Existing building	National regulations	EnerPHit standard	Differences [%]
Renewables	None	Either 10 kWh/m^2/yrof Domestic hot water heating or 4 kWh/m^2/yr of electrical energy – Baxi CHP meets target	Either 10 kWh/m^2/yrof Domestic hot water heating or 4 kWh/m^2/yr of electrical energy – Baxi CHP meets target	

Figure 23: Comparison of Renewables installed

6.6 Conclusions

The Irish Building Regulations clearly prioritise the primary energy demand of a refurbished building over its thermal envelope/airtightness improvements. The overall results for a refurbished building under the Irish regulations are clearly way over the EnerPHit standard. This is a case for a significant improve on the Irish regulation that are due to be revised in 2015.

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