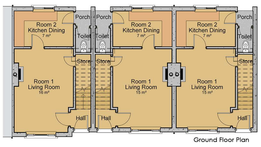
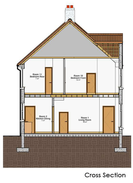
Crumlin House — nZEB Retrofit Design

Existing Terrace

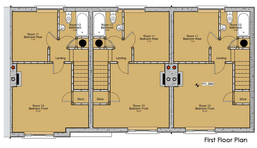
Existing development in Lismore Road
6 no terraced houses
South Elevation



Ground Floor Plan



Cross Section



First Floor Plan

Design Drawings

Mid Terrace House Type

Ground Floor Plan

First Floor Plan

3D View from Southeast

3D View from Northeast

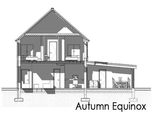
3D Longitudinal Section - Mid Terrace

Daylight Analysis

Site Location Plan

Spring Equinox

Summer Solstice



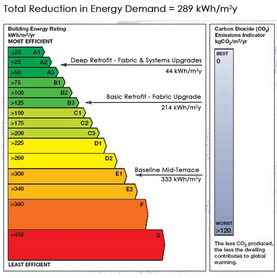
Autumn Equinox

Winter Solstice

Energy Demand Reduction to nZEB (45 kWh/m²y)

BER Rating from E1 to A2

Total Reduction in Energy Demand = 289 kWh/m²y



Retrofit Strategy:
the refurbishment woorks will be phased into two stages:

First the thermal envelope of the existing dwelling will be upgraded to reduce the Space Heating energy demand. Insulation to the external wall, roof, ceiling and ground floor will be added. Windows and doors will be replaced with better U-Value units. All works will be carried out to guarantee that junctions with be improved and sealed to achieve the overall target Air Tightness level of 1 Ach.

After the basic retrofit the rear extension will be built using prefabricated walls and roof. The MVHR system will be installed, the water cylinder replaced and heating controls will be upgraded. Lastly the PV panels will be fitted on the roof.

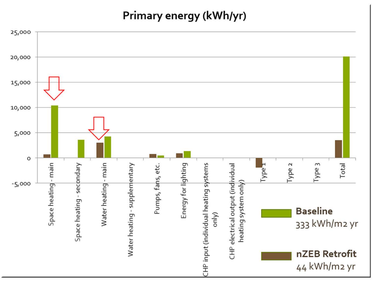
	BER (kWh/m²y)	Total Floor Area (m²)	EPC	CPC
End Terrace	47	81	0.261	0.228
Mid Terrace	43	81	0.255	0.223
Gable	44	82	0.262	0.230

Building Fabric Upgrades

Element	Measure	Existing U-value (W/m²K)	Upgraded U-value (W/m²K)	Energy Saved (kWh/m²y)	Baseline: 333 (kWh/m²y)
Geometry Change	Adding back door to reduce heat losses through walls and first floors			28	305
External Wall	Adding External Wall insulation 130mm Phenolic Foam Board + 10mm Polymer Render	2.47	0.15	98	207
Horizontal Ceiling	Adding 200 mm Earthwool insulation (λ =0.032 W/m²K) over joists - Adding 62.5mm insulated plasterboard (λ =0.020) below existing plasterboard	0.45	0.09	12	195
Sloped Roof	Adding 62.5 mm insulated plasterboard (λ =0.020) below ceiling - Adding 75 mm Earthwool insulation between rafters and eaves	3.91	0.19	24	171
Ground Floor	Replacing Concrete Floor with Solid Concrete Floor with 120mm Thermaset Rigid Insulation & Perimeter Insulation	0.64	0.14	19	152
Windows & Doors	Replacing with Munster Joinery -EcoClad windows and Passiv doors	3.1 (window) 3 (door)	0.71 0.58	28	124
Linear Thermal Bridges	Calculated factor y=0.010 at junctions			5	119
Extension	Building 20 m² extension at the rear with kitchen, utility and toilet			5	114
			Total Energy Saved		**219**

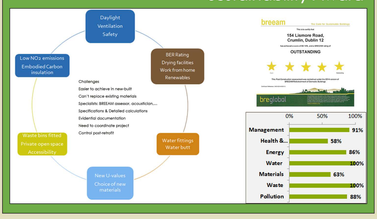
System & Renewables Upgrades

Element	Measure	Upgraded U-value (W/m²K)	Energy Saved (kWh/m²y)	Baseline: 333 (kWh/m²y)
Ventilation	Closing open vent and blocking off a chimney		5	109
	Change Air-tightness from 4.65 Ach to 1 Ach		1	108
	Installing Mechanical Ventilation with Heat Recovery System		6	102
		Total Ventilation	12	
Lighting	Replacing all light bulbs to low-energy		10	92
Water Heating	Replacing immersion to a factory insulated cylinder & insulating primary pipework		14	78
Space Heating	Upgrading controls (Room Thermostat, Immersion Thermostat)		3	75
	Removing Open fire in crate		6	69
		Total Space Heating	9	
Renewable Energies	Installing 4 x Trina 250W PV panels on roof		25	44
		Total Energy Saved		**70**



Baseline and nZEB retrofit DEAP results for Mid Terrace

Sustainability Award



Renewable Energies

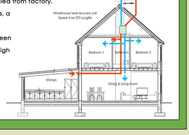
Photovoltaic Panels
Reduction in Energy Demand = 25 kWh/m2y

Once the fabric envelope and systems have been upgraded, an additional reduction in energy demand of 25 kWh/m2y is required to achieve the nZEB target. For this purpose, a set of 4 Trina PDG5: 60-cell Dual Glass Modules (with a power of 250 kW each) are installed on the roof of each dwelling.
An alternative renewable energy is solar thermal panels instead but it doesn't return the neccessary savings.
These PV panels are certified to withstand the most challenging environmental conditions, with a more reliable frameless design. The finish coat makes them resistant to sand, acid, and alkali.
The modules are produced in a sustainable manufacturing process, with a low carbon footprint, electricity and water usage.

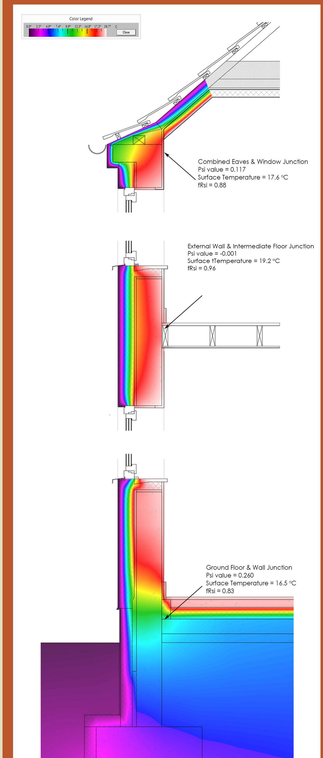
Ventilation Strategy

MVHR System & Air Tightness
Reduction in Energy Demands = 12 kWh/m2y

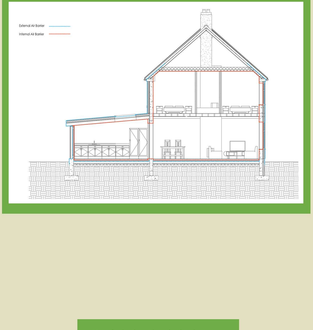
During the upgrade of the existing fabric all junctions will be sealed and improved externally and internally to achieve an overall new airtightness of 1 Ach. The new construction is made of prefabricated walls and roof, which junctions and perforations for services will arrive appropriately sealed from factory.
To work in conjunction with the new air tightness levels, a wholehouse heat recovery unit will be installed.
The MVHR unit is a Xpelair Xcell 270 DC which has been chosen for its ultra-low running costs, long-life and high efficiency (90%). There will be two extraction points (kitchen and bathroom) and supply diffusers for the living room, bedrooms connected to the unit by 125 mm insulated semi-rigid ducts.



Linear Thermal Bridging - Cross section at front wall



Airtightness - Continuity of Wind & Vapour Barriers

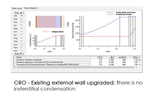


Prefabricated Timber Frame Wall & Roof Panel for Extension

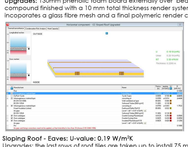
Upgraded Fabric: U-Values

Condensation Risk Analysis

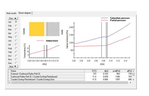
External Wall - External Insulation: U-value: 0.15 W/m²K
Upgrades: 130mm phenolic foam board externally over bedding compound finished with a 10 mm total thickness render system that incorporates a glass fibre mesh and a final polymeric render coat.



CRO - Existing external wall upgraded: there is no insterstitial condensation

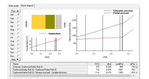


Sloping Roof - Eaves: U-value: 0.19 W/m²K
Upgrades: the last rows of roof tiles are taken up to install 75 mm Earth Wool insulation between rafters and filling in gaps down to the eaves. An wind barrier is added on top of battens. A 62.5 mm insulated plasterboard is attached to the existing ceiling, finished with a 3 mm wet plaster to work as VCL.



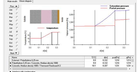
CRO - Sloped Roof:
there is no insterstitial condensation

Horizontal Ceiling: U-value: 0.10 W/m²K
Upgrades: 200 mm of Earthwool insulation is added on top of joists leaving the existing 100 mm of mineral wool.. A 62.5 mm insulated plasterboard is fixed to the existing plasterboard, finished with wet plaster to work as a VCL.



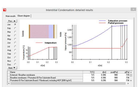
CRO - Horizontal Ceiling:
there is no insterstitial condensation

Concrete Ground Floor - Insulation below screed: U-value: 0.10 W/m²K
Upgrades: the existing solid floor downstairs is demolished and replaced with a new concrete floor which is the same as per te extension. This new floor is insulated with 120 mm rigid Thermaset panels over the concrete slab and around the perimeter. A Vapour Control Layer is added on top of the insulation and a DPC to the underside of insulation.

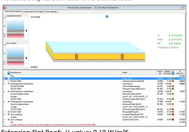


CRO - Ground Floor:
insterstitial condensation occurs between the DPC and the concrete slab, which doesn't affect the insulation. The joints between floorboard insulating panels will be sealed to avoid water vapour condensation falling through gaps.

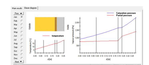
New Wall Extension: the prefabricated wall panels are built using the Promatect II system. They are 60 min Fire Resistant and load bearing. The timber frame structure is filled with 200 mm of phenolic wall board. Promatect Fire Protected lining has been fixed to the external face.



CRO - New Wall Extension:
there is no insterstitial condensation



Extension Flat Roof: U-value: 0.12 W/m²K
New-Built: the flat roof is also a prefabricated panel that will arrive ready to be fixed. The roofligh is factory installed. The timber frame panel is filled with earth wool 175 mm insulation and lined to the underside with an insulated plasterboard. To avoid condensation, battens are installed over the rafters to provide a 25 mm well ventilated cavity. The panel is finished externally with Tyvek Supro air barrier.



CRO - New Wall Extension:
there is no insterstitial condensation

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