http://www.zero2020energy.com/#!home/mainPage

Senior Staff Breakfast Forum
Nov 2nd 2012

Zero2020 Test Bed

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Zero2020 “Test-bed” @ CIT

- What is the Zero2020 Project?
- Origins
- Development
- The “Testbed” Principle
- Conclusions

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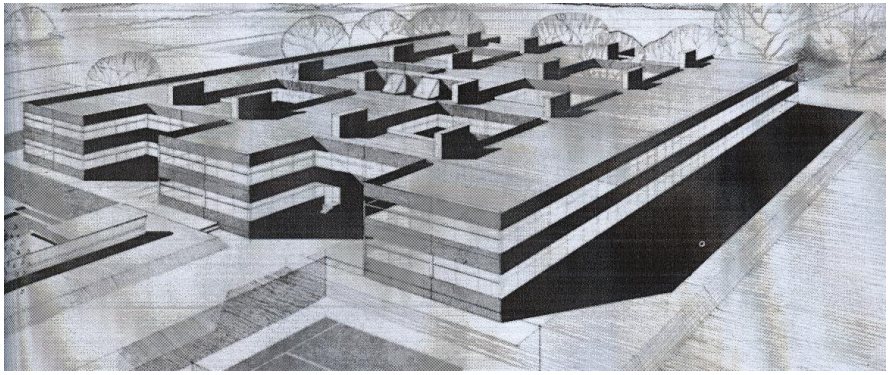
What is the Zero2020 Project?

The **'Zero2020' Project** is a project involving extensive refurbishment and upgrade of an existing 1974 office and teaching space on the Bishopstown Campus of Cork Institute of Technology.



Its mission is to provide a live, controlled testbed environment to explore energy and resource performance through the use of pioneering technological solutions with emphasis on demonstrating zero energy public sector building in use operation.

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Zero2020 “Test-bed” Origins

- Two Centres involved in significant external ‘Engagement’

CENTRE FOR ADVANCED MANUFACTURING AND MANAGEMENT SYSTEMS

- CAMMS CPD, Consultancy > 500 Students
- Short Courses, Special Purpose Awards
- Technical themes related to School expertise
- Client List: SR Technics, HSE, Yves Roche etc.

- Applied Research Centre
- Detailed Motion Analysis
- Biomedical Device Development

MEDIC
MEDICAL ENGINEERING DESIGN INNOVATION CENTRE

- Centres needed to present an outward looking ‘commercial’ face
- Involvement of Building Services Engineering

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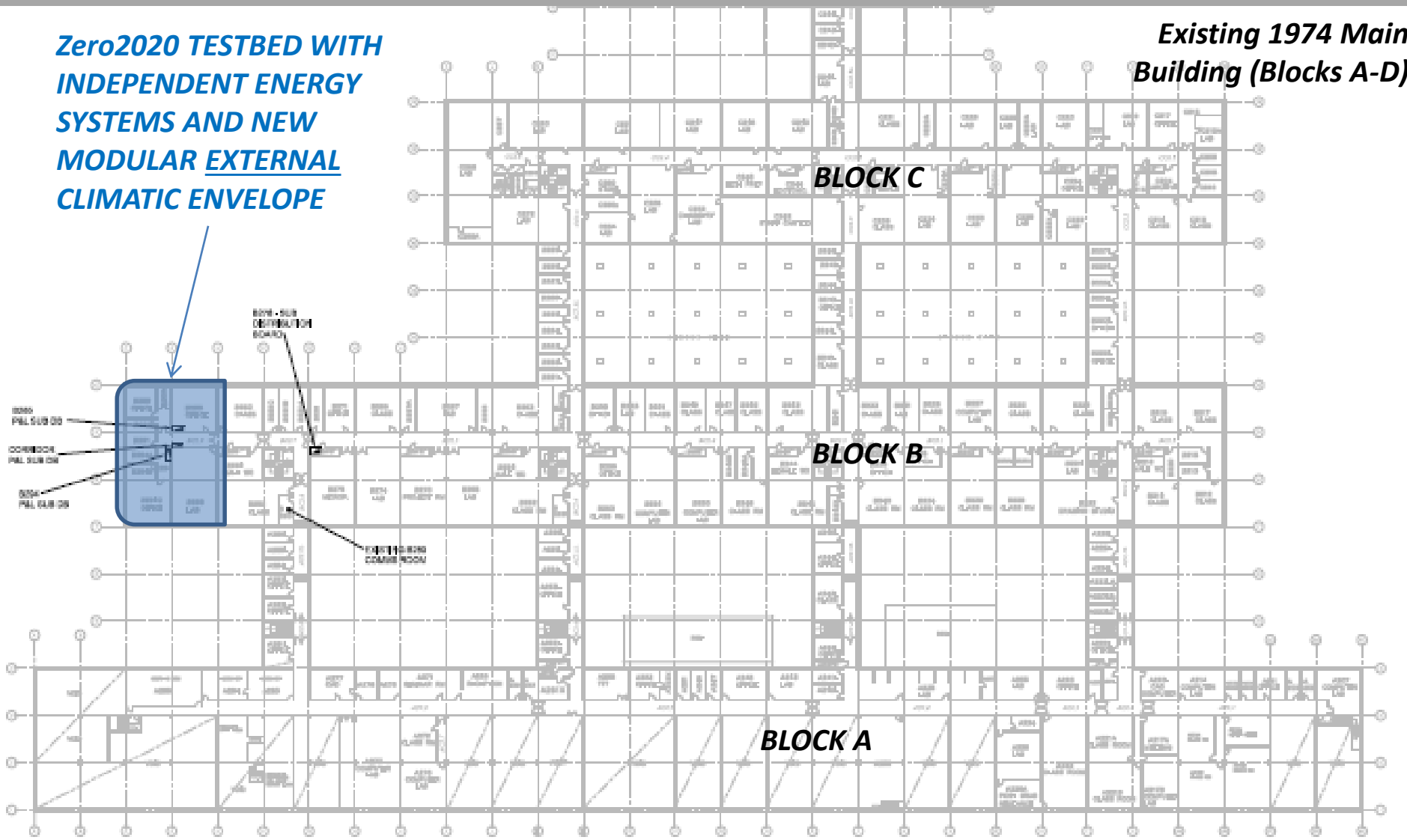
Where on campus is the **Zero2020** Project?



Basis for Undertaking Zero2020 “test-bed” Project

- *80% of the existing building stock will still be in use in 2050.*
- *In order to deliver on long term EU goals of 80% reductions in carbon emissions by 2050, this 80% of the building stock must form a large part of the focus for reductions in total demand for energy.*
- *The Public Sector Building stock must lead by example through the implementation of optimised strategies for reduction in energy consumption through focused refurbishment solutions*
- *In the medium term EU 2020 plan calls for all public sector buildings to be low or nearly zero energy by 2018.*

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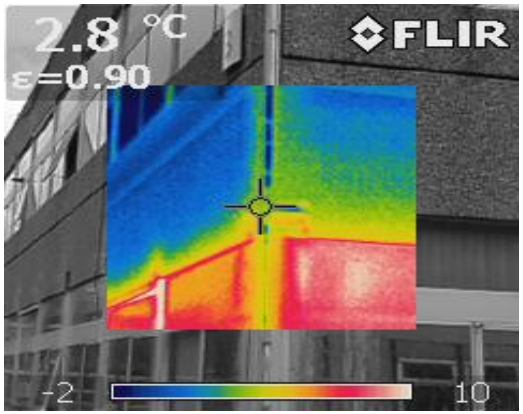
CIT - 1974 Pre Retrofit Space

What do we do in practice?
We finish we leave……



Existing

No Temperature Control

High Air Permeability
14.77 $m^3/h/m^2$

Un-insulated fabric
2.4 W/m2K

Summer Overheating

Poor Ventilation Control

Recessed T5 manual

No Energy Monitoring

Space Heat Demand
95 kWh/m2a

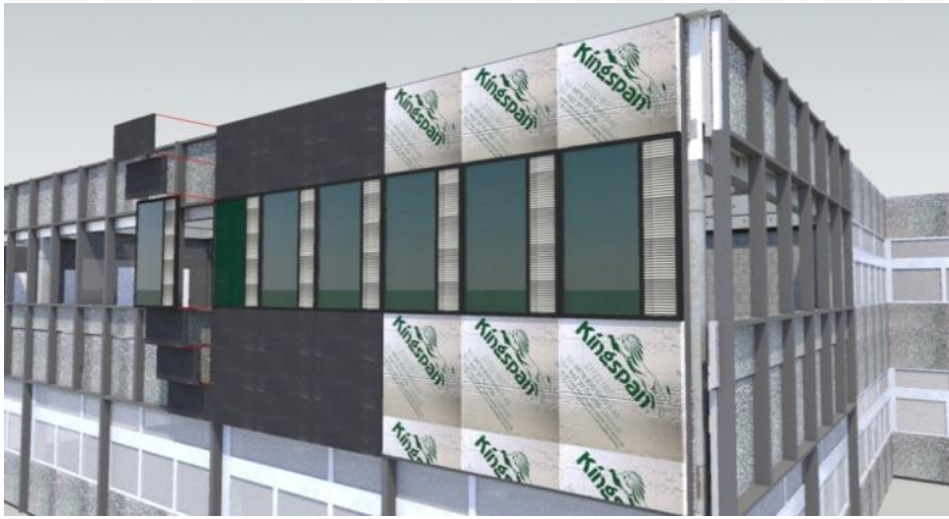
Design Solution

Existing Energy Performance

- Av. U-Value = 2.4 W/m2K
- Air infiltration 14.77 m3/hr/m2
- Glazing ratio 1:3
- Mould Growth
- No thermal Control
- Erratic temperature fluctuations

Design Energy Performance

- Av. U-Value = 0.36w/m2K
- Air infiltration 1.76 m3/hr/m2 @ 50Pa
- Glazing ratio 1:4
- Ug= 0.6w/m2K
- G Factors- 0.61 & 0.34(excluding blinds)
- Co2 average 500-1000ppm



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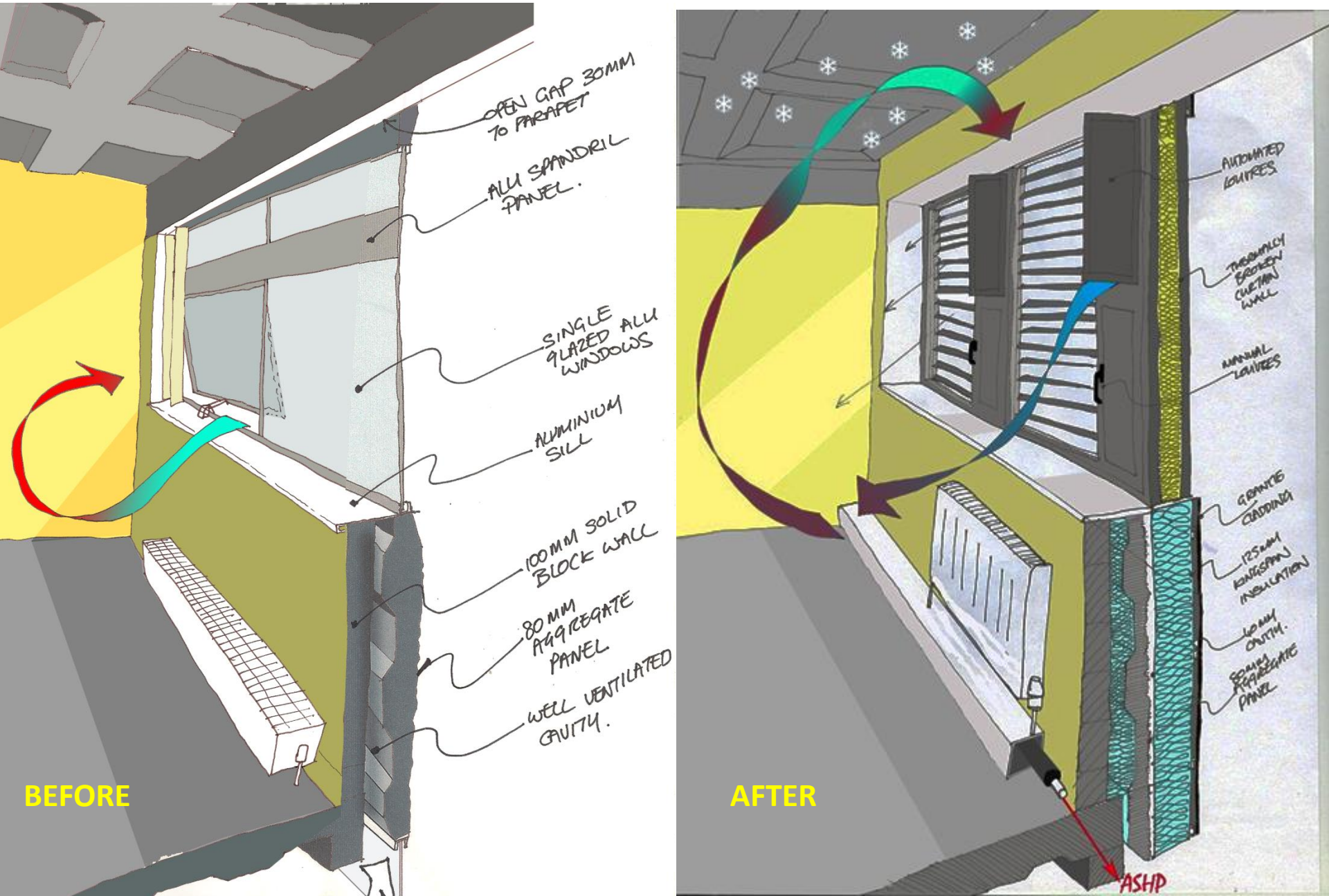
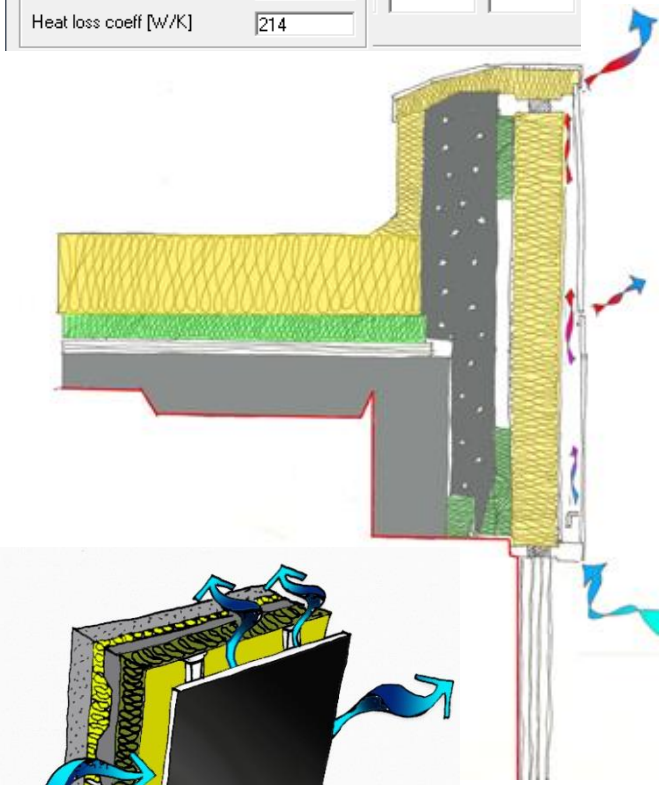

OPEN GAP 30MM TO PARAPET
ALU SPANDRIL PANEL.
SINGLE GLAZED ALU WINDOWS
ALUMINIUM SILL
100MM SOLID BLOCK WALL
80 MM AGGREGATE PANEL
WELL VENTILATED CAVITY.
BEFORE
AUTOMATED LOUVRES
THERMALLY BROKEN CURTAIN WALL
MANUAL LOUVRES
GRANITE CLADDING
125MM KINGSPAN INSULATION
40MM CAVITY.
90MM AGGREGATE PANEL
ASHP
AFTER

Elements

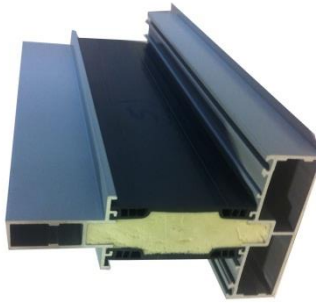
Name	Area [m2]	U-value [W/m2 K]
Roof	233.0	0.09
Main External Wall Upper	65.7	0.17
Main External Wall	88.6	0.10
Windows	162.0	1.03
Main External Wall Ground floor	54.0	0.10

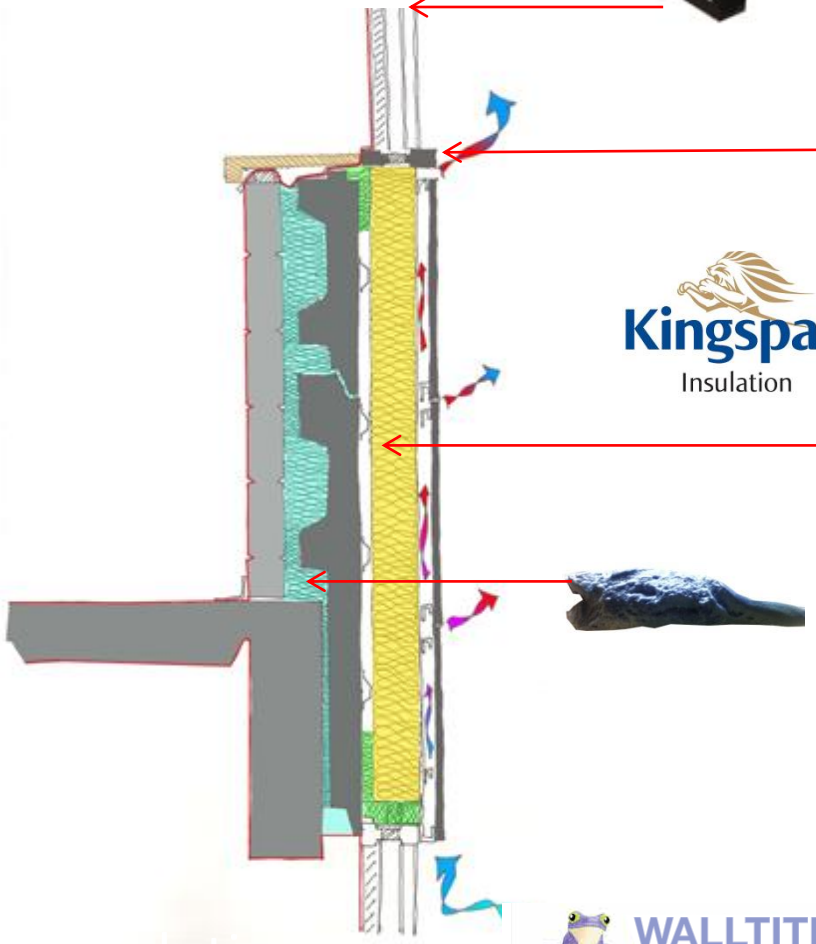
Results for whole building

Average U-value [W/m2 K]	0.36
Envelope area [m2]	603.3
Heat loss coeff [W/K]	214



AMS Architectural & Metal Systems





Kingspan Insulation

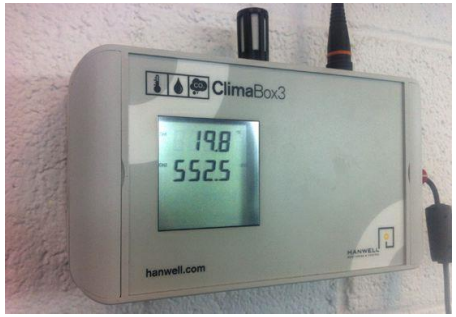
WALLTITE Eco

FEATURES

- High Performance Envelope (Heat Transfer, Light, Noise, Glare, Heat Gain)
- Passive cooling and ventilation strategies
- Active Energy Management (BMS)
- Dedicated wireless data logging system
- 2m+ datapoints collected per annum
- Full energy use metering and monitoring
- Self Contained heating system/strategy
- Low Energy Lighting Solutions
- High comfort, environmentally stable working environment





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Education & Research Potential

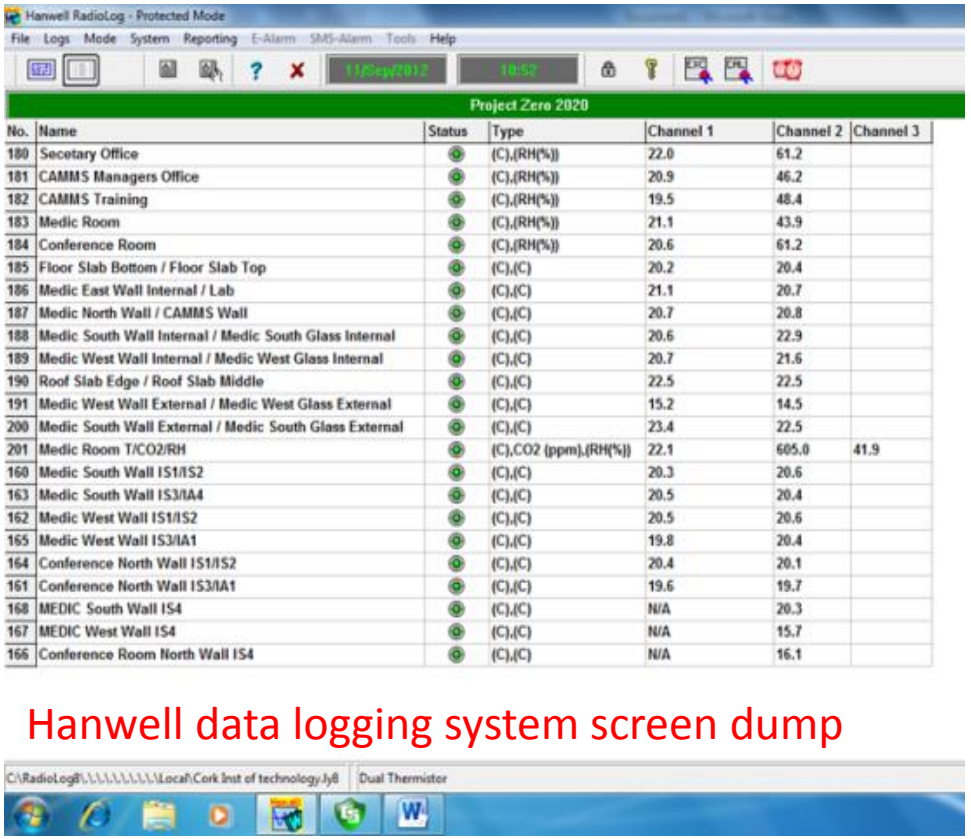
DATA COLLECTION AREAS

1. **Environmental Parameters**
2. **Metering of Energy Data**
3. **Zero2020 Weather Station**

(1.5m+ data-points logged annually)

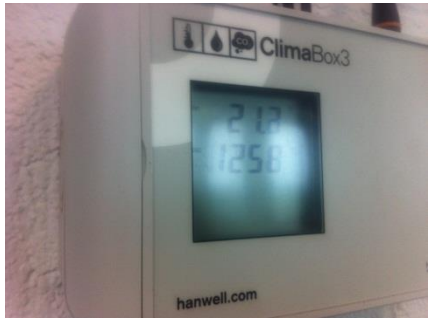
ZERO2020 AS A RETROFIT TESTBED

1. **‘live lab’ approach**
2. **Fully adaptable flexibility with users**
3. **‘plug and play’ capability with systems**
4. **Industry collaboration ‘in use’ testing**



No.	Name	Status	Type	Channel 1	Channel 2	Channel 3
180	Secetary Office		(C),(RH(%))	22.0	61.2	
181	CAMMS Managers Office		(C),(RH(%))	20.9	46.2	
182	CAMMS Training		(C),(RH(%))	19.5	48.4	
183	Medic Room		(C),(RH(%))	21.1	43.9	
184	Conference Room		(C),(RH(%))	20.6	61.2	
185	Floor Slab Bottom / Floor Slab Top		(C),(C)	20.2	20.4	
186	Medic East Wall Internal / Lab		(C),(C)	21.1	20.7	
187	Medic North Wall / CAMMS Wall		(C),(C)	20.7	20.8	
188	Medic South Wall Internal / Medic South Glass Internal		(C),(C)	20.6	22.9	
189	Medic West Wall Internal / Medic West Glass Internal		(C),(C)	20.7	21.6	
190	Roof Slab Edge / Roof Slab Middle		(C),(C)	22.5	22.5	
191	Medic West Wall External / Medic West Glass External		(C),(C)	15.2	14.5	
200	Medic South Wall External / Medic South Glass External		(C),(C)	23.4	22.5	
201	Medic Room T/CO2/RH		(C),CO2 (ppm),(RH(%))	22.1	605.0	41.9
160	Medic South Wall IS1/IS2		(C),(C)	20.3	20.6	
163	Medic South Wall IS3/IA4		(C),(C)	20.5	20.4	
162	Medic West Wall IS1/IS2		(C),(C)	20.5	20.6	
165	Medic West Wall IS3/IA1		(C),(C)	19.8	20.4	
164	Conference North Wall IS1/IS2		(C),(C)	20.4	20.1	
161	Conference North Wall IS3/IA1		(C),(C)	19.6	19.7	
168	MEDIC South Wall IS4		(C),(C)	N/A	20.3	
167	MEDIC West Wall IS4		(C),(C)	N/A	15.7	
166	Conference Room North Wall IS4		(C),(C)	N/A	16.1	

Hanwell data logging system screen dump



Wireless data loggers

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Building Energy Rating Assessment Results

Building	Heating ($kWh/m^2/yr$)	Lighting ($kWh/m^2/yr$)	Auxiliary ($kWh/m^2/yr$)	Hot Water ($kWh/m^2/yr$)	Total ($kWh/m^2/yr$)
1974	386.83	46.43	3.24	16.4	452.57
zero2020	14.25	45.47	1.91	2.51	64.14

Zero2020 Asset Rating – A3

1974 Asset Rating – D2

BER No. 726892364

- *A3 is based on phase 1 of zero2020 project*
- *A1 very difficult to achieve without electrical renewable energy / high efficiency lighting*
- *Phase 2 covers renewable energy supply systems to meet net zero site energy*

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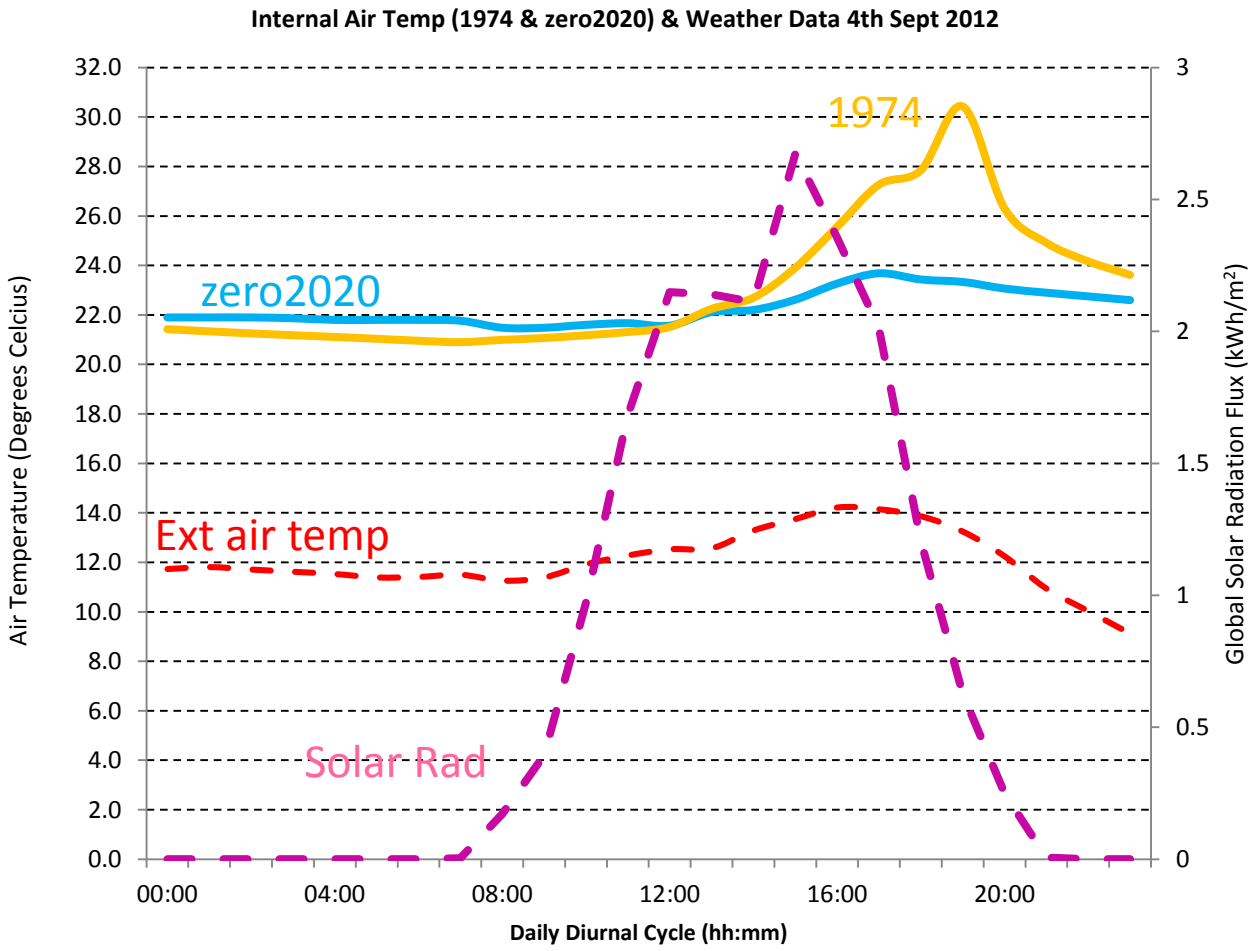
Initial Environmental Data Findings – Sample 24hr cycle (4th Sept '12)



Consider 4th Sept 2012:

- **Similar minimum internal T_{air} values both spaces**
- **6.9°C difference in maximum diurnal values**
- **Peak conditions occur outside occupied hours for both spaces**
- **Peak solar radiation at 15:00 (solar azimuth & altitude)**
- **Zero2020 diurnal temp deviation about mean = 1.4°C**
- **1974 diurnal temp deviation about mean = 7.3°C**

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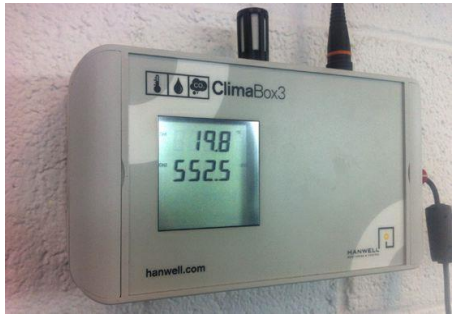
Next Steps – zero 2020 timeline

Phase 2 –Integration of Renewables

- Occupancy comfort, energy usage and key performance indicators being monitored and logged.
- Commence data logging and monitoring of existing building comparative space to provide control data
- Assess Renewable technologies & Supplement
- Achieve net zero energy usage





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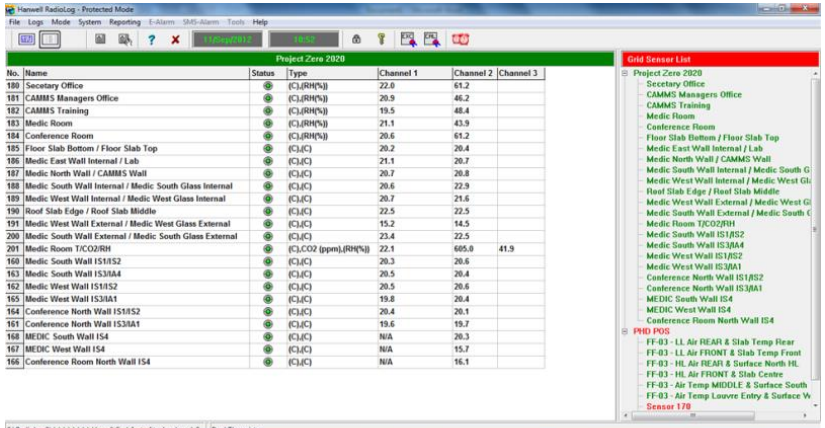
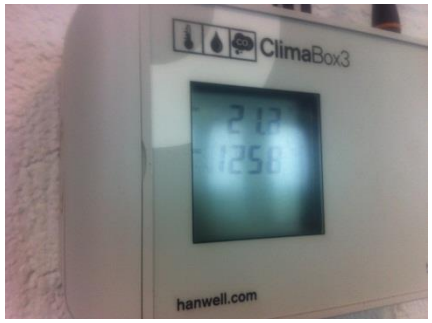
Education: Research Potential

1. **Environmental Parameters**
2. **Metering of Energy Data**
3. **Zero2020 Weather Station**

- Full plug and play capabilities with metering of systems and add-in flexibility
- Validation of dynamic simulation models (PO'S PhD)
- Application of PCM in retrofit applications (PO'S PhD)
- Low Energy Retrofit of IoT buildings (MO'R PhD)
- User Behaviour in Retrofit energy efficiency (MO'R PhD)
- Post Occupancy & User Behaviour (CO'D MSc)
- Macro Weather in Low Energy Simulation (JP MSc)
- Wireless instrumentation location optimisation based on communications protocol (Nimbus centre)
- Development of reduced-order physics models for dyn thermal conditions predictions (IRCSET)
- Development of embedded PCM technologies in heat recovery/mechanical ventilation based systems
- Qualitative Research; POE, Behavioural Analysis, Air Quality, Thermal Comfort, Health





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Zero2020 Conclusions

- 250m^2 of original 1974 building upgraded to State of the Art
- CAMMS and MEDIC suitably accommodated with top class facilities
- Low energy (close to passive) standard achieved
- Live Test Bed with Plug and Play Capability Developed
- Space now a ‘living-lab’ for teaching and learning
- Continued data monitoring and comparison with 1974 building
- Solution partially integrated into Block ‘D’ refurbishment
- Commencement of Phase 2, generation of renewable energy
- Pathway to net Zero Energy mapped

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ZERO2020

'Everyone will want one'

Anon, 2012

Open Morning
Some Friday ?????
10:30am 12:30pm

http://youtu.be/Rvcfo03Gp9w

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