AER LINGUS HEAD OFFICE BUILDING ENERGY ANALYSIS & RETROFIT

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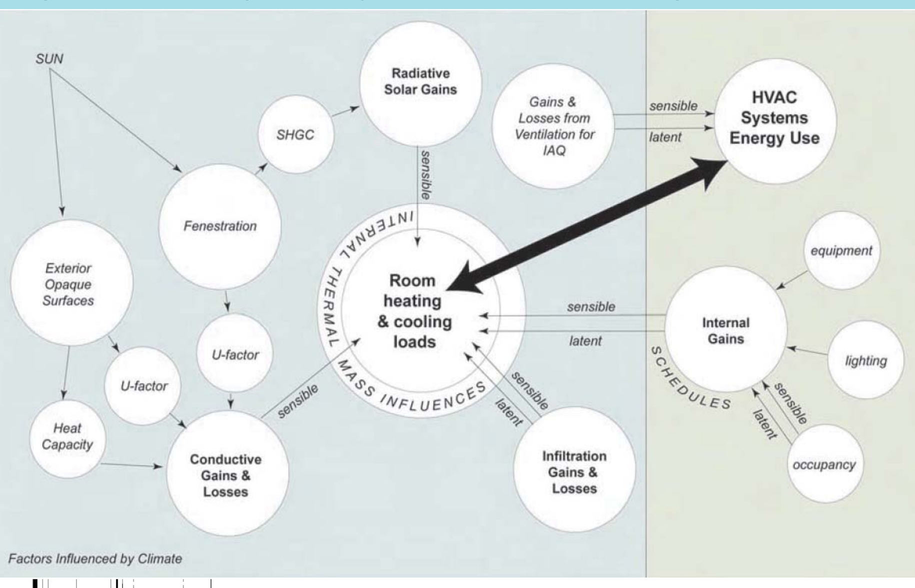
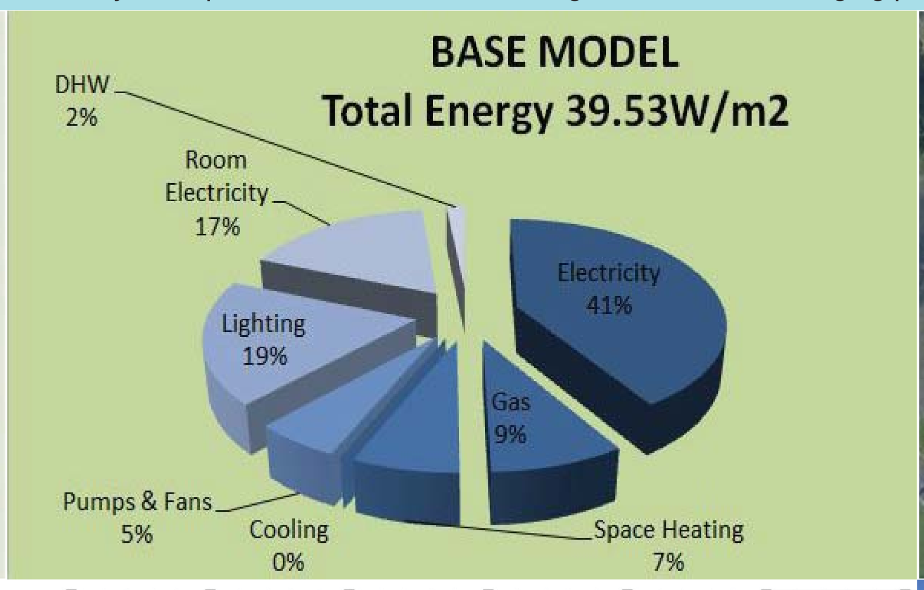
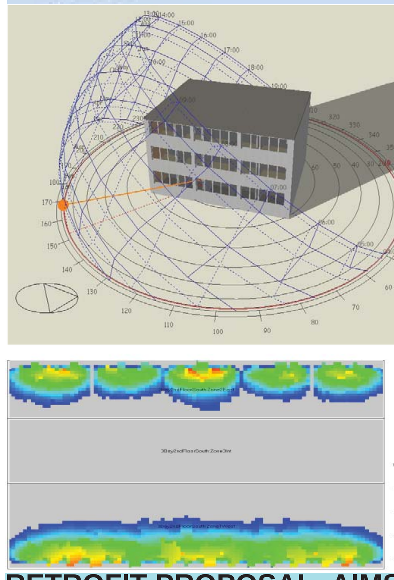
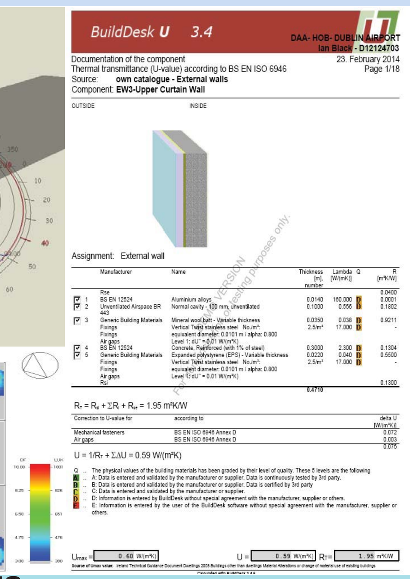
BRIEF- INTRODUCTION

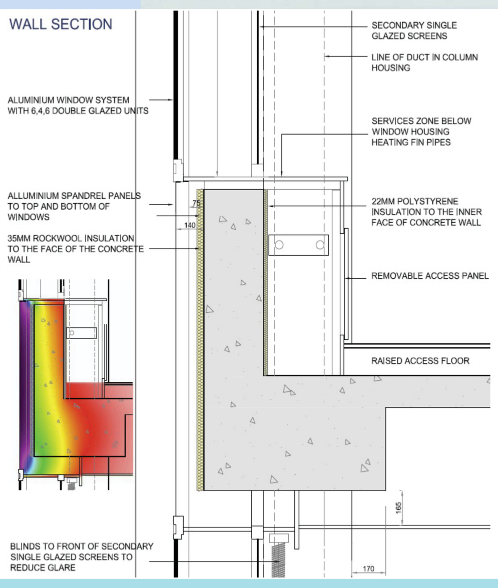
The recast European Performance Directive 2010/30 EU states that from January 1st 2021 every new building in Ireland will be required to be designed to near zero energy building standards (nZEB), essentially meaning ultra low energy demand for heating , cooling , ventilation , light & power. The residual energy demand being addressed using renewable energy sources. The subject of this study is to investigate the energy performance of an existing office building and in turn determine what range of low energy measures could be adopted to successfully retrofit and upgrade the building to meet nZEB requirements. The subject building is the multi storey former Aer Lingus Headquarters Building (now DAA) at Dublin Airport. The Building was built in the early 1960's and has been subject to minor upgrade measures more recently namely the elimination of an air conditioning system. It consists of five floors of office space both open plan and cellular over a podium at ground floor and basement containing office space ,canteen and services functions. This study was also an investigation in the use of various energy performance analysis tools including Design Builder Dynamic Simulation software. The study starts with a baseline energy analysis and proposes an optimal solution based on dynamic simulation modelling, undertaken on a three bay typical mid office floor model.Data was input into the modelling tool to reflect the current building status following investigative surveys on site, which indicated that the building is now currently naturally ventilated, but has a separate mechanical extract system, poor fabric U values and airtightness, thermal bridging problems, and high space heating ,electrical and lighting loads.

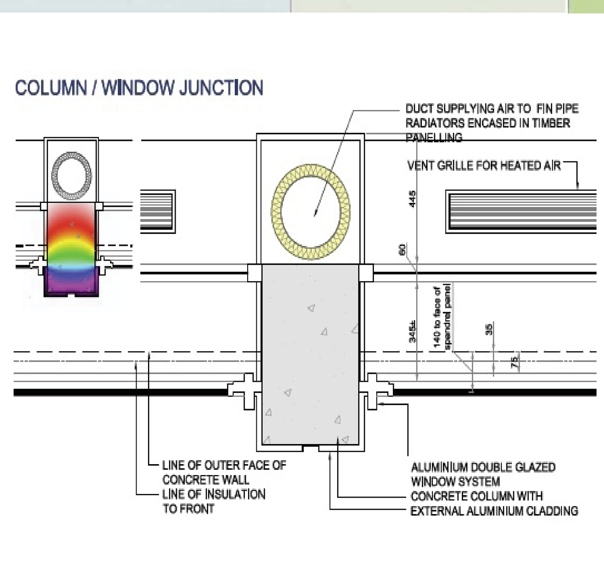


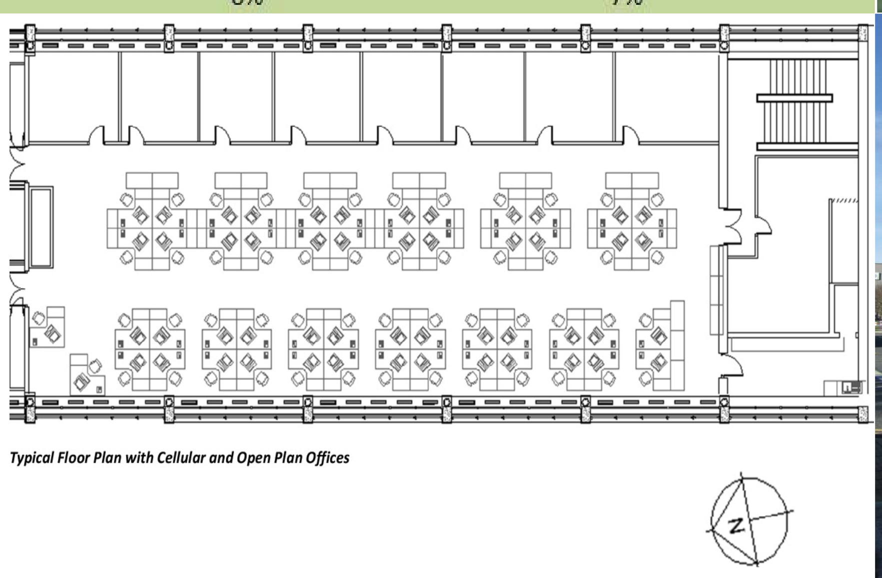








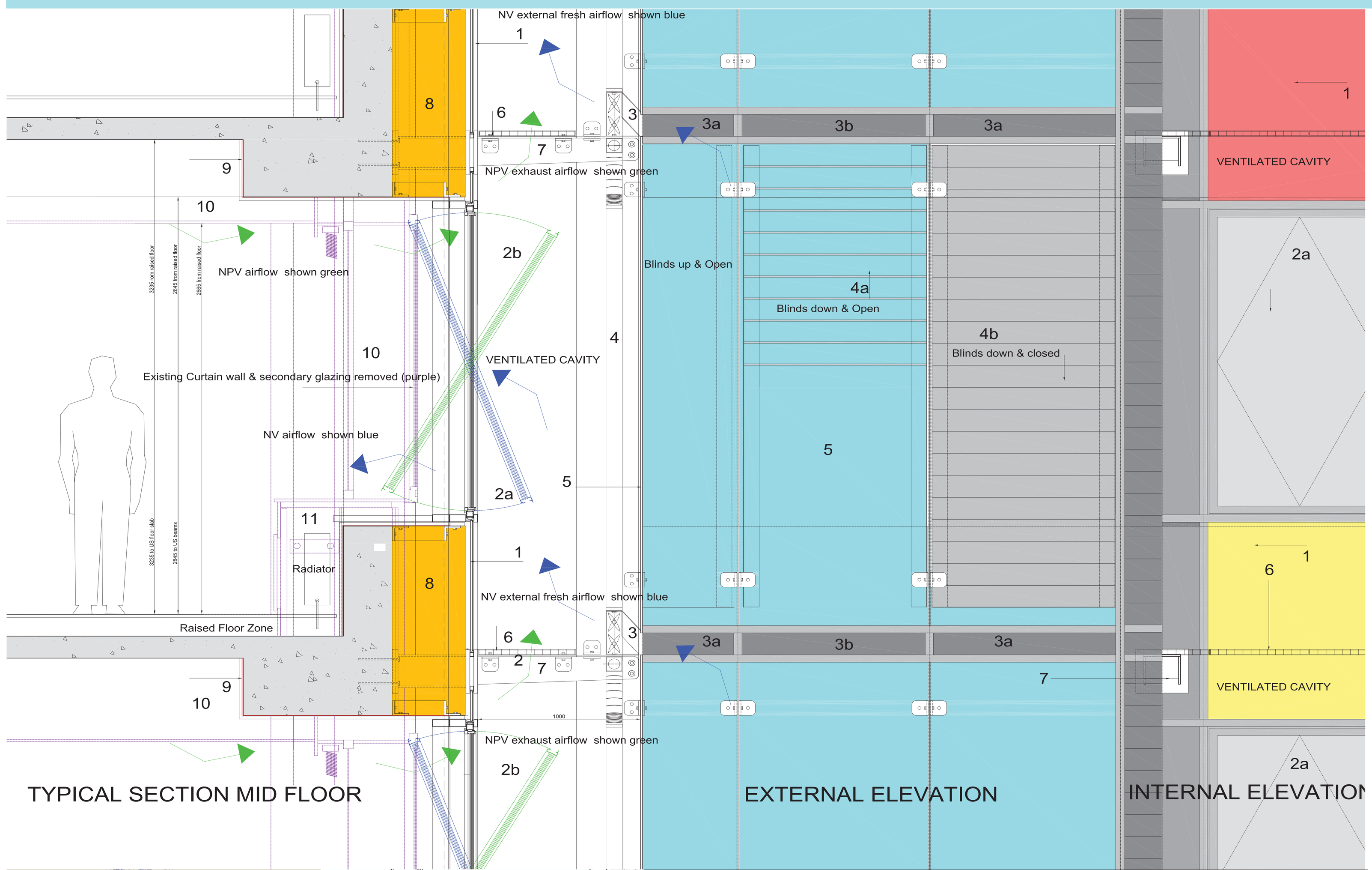




EXISTING BUILDING
24% HEAT LOSS from uncontrolled external infiltration
26% INTERNAL GAINS from lighting
NO summer Cooling strategy and limited winter fresh air intake

RETROFIT PROPOSAL- AIMS

The aim of the modelling studies has been to understand and simulate the existing building fabric & systems , and its energy performance.The focus of this project was to explore Passive architectural solutions to deliver optimal load reductions. This was achieved by engineering the building form and envelope to exploit passive heating , cooling , ventilation and lighting resources. The building was modelled using many iterations of upgrade measures and interventions to finally arrive at an optimal solution. Aircraft noise and fumes were major considerations in the design process due to the location of the building, as was orientation and glazing ratio in order to optimise passive solar gain.A twin skin design to both East & West facades was modelled as an optimal solution as it provided the facility to Naturally ventilate the office space all year round , without the need for mechanical cooling and without compromising acoustic and air quality standards. It provided occupant control and comfort and good levels of daylighting combined with controlled solar gain provided by automated brise soleil, which combined with lighting controls and LED fittings in turn reduced lighting energy usage. Fabric U values and airtightness were improved using certified Passivehaus curtain walling and insulation standards. Good acoustic standards were achieved with products and materials selected



LEGEND -SPECIFICATION

1- Wincona Wictec 50HI double glazed aluminium certified curtain wall system with Opaque safety glass spandrel panels to selected colours

2- Wincona Wicline75 EVO horizontal pivot opening windows fitted with actuators for automatic opening based on two schedules ;-
a) Workday Summer Nat Vent -(Inward opening -Blue)
b)- Night Purge Ventilation (Winter & Summer (Outward opening-Green)

3- Wincona Wicline75 EVO ventilation louvre system 250 fitted with actuators for automatic opening based on two schedules ;-
a) Workday Summer Nat Vent -(Inward opening -Blue)
b)- Night Purge Ventilation (Winter & Summer (Outward opening-Green)

4- Wincona horizontal brise soleil system fitted with actuators for automatic opening / closing based on two schedules ;-
a) Outside air temperature based on set point
b)- Solar Angle -based on orientation and time of day

5- Wincona toughened single glazed aluminium planar glazing curtain wall system with toughened glass fins & stainless steel fixings

6- Stainless steel elephant grating spanning between wind bracing to provide safe access for cleaning both external glazing systems and all associated components, in addition to permitting air flow in the ventilated cavity.

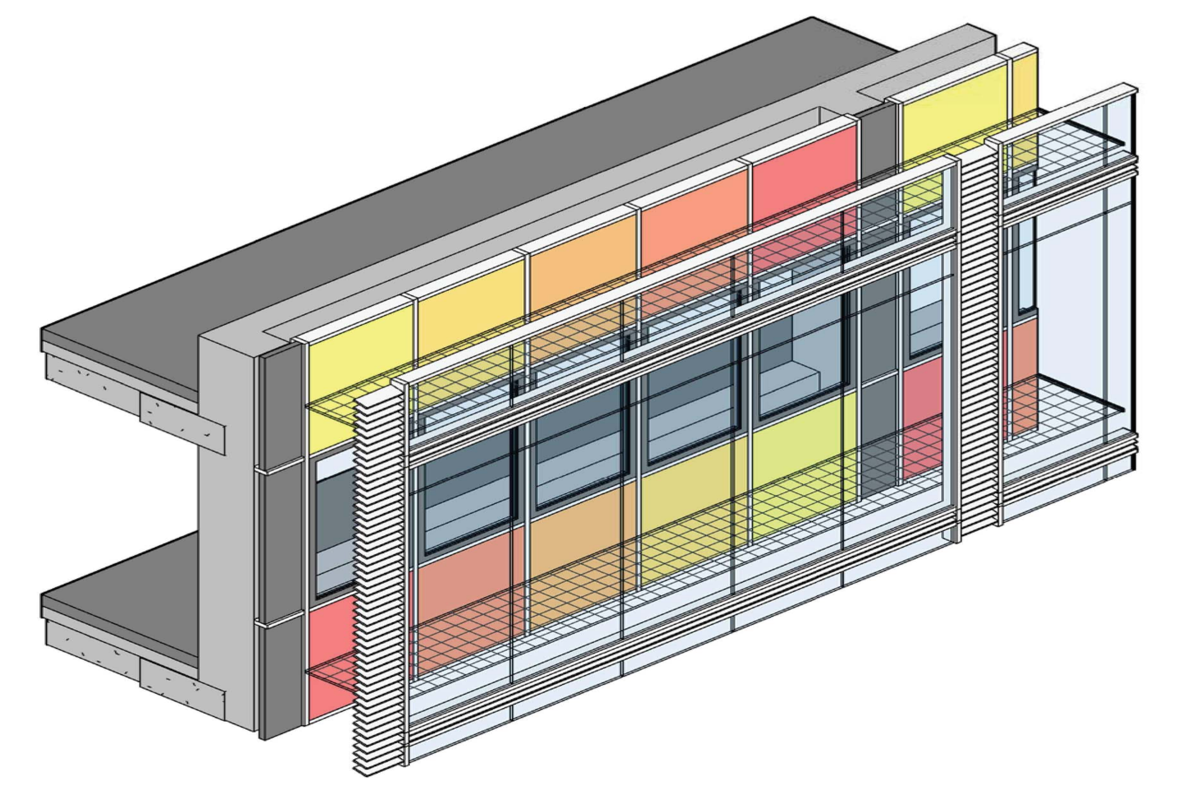
7- Stainless steel wind bracing for external glazing system fixed to existing concrete frame structure in accordance with manufacturers instructions

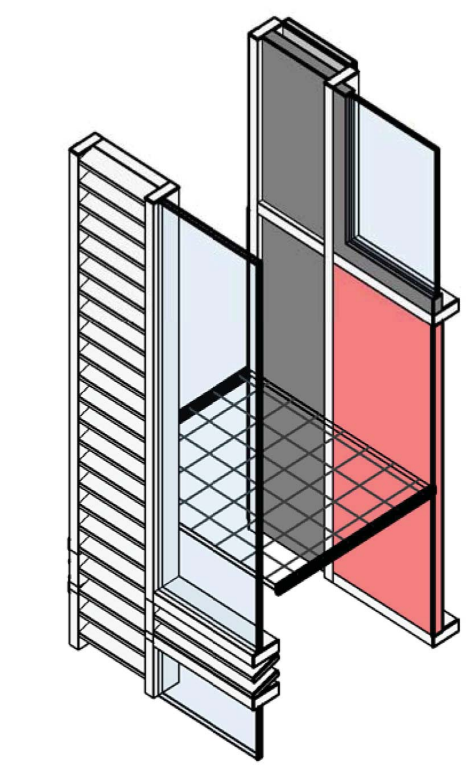
8- Selected rigid insulation fixed to existing concrete frame structure (Columns & spandrels)behind glass spandrel panels in accordance with manufacturers instructions

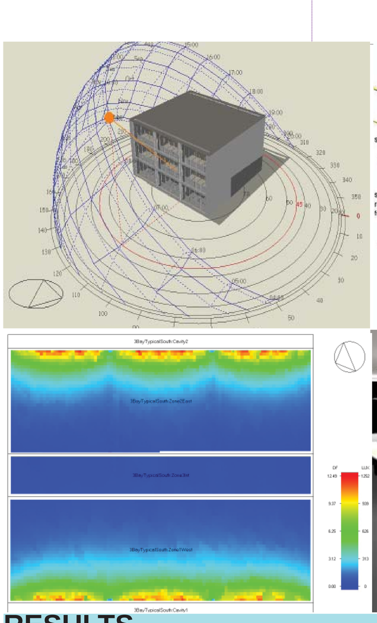
9- S/C plaster in conjunction with Pro Clima air tightness tape(red) fixed to all joints in existing concrete frame structure (Colums & spandrels)and new curtain wall system

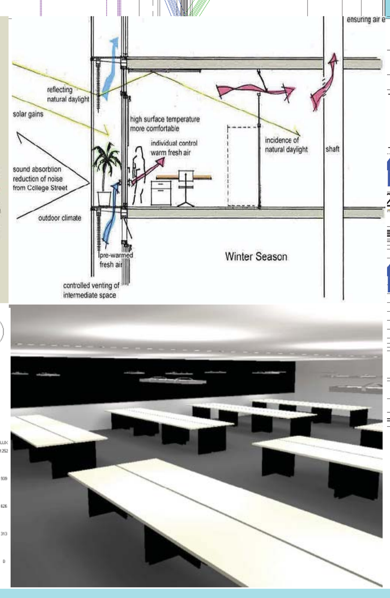
10- All existing wall linings and suspended ceiling removed (purple) to expose the existing masonry structure and activate the thermal mass for cooling

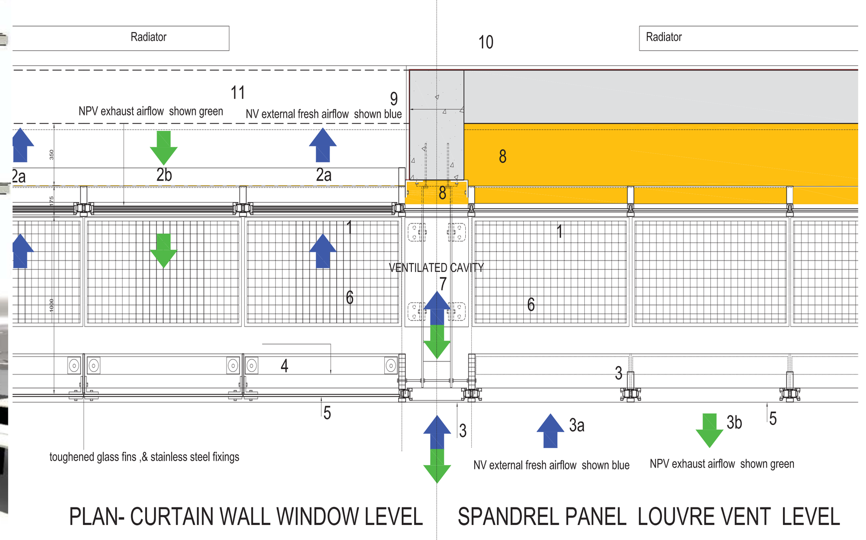
11- Hardwood windowboard on S/C plaster on EML in conjunction with Pro Clima air tightness tape(red) fixed to all joints between existing concrete frame structure (Colums & spandrels)and new curtain wall system in accordance with manufacturers instructions

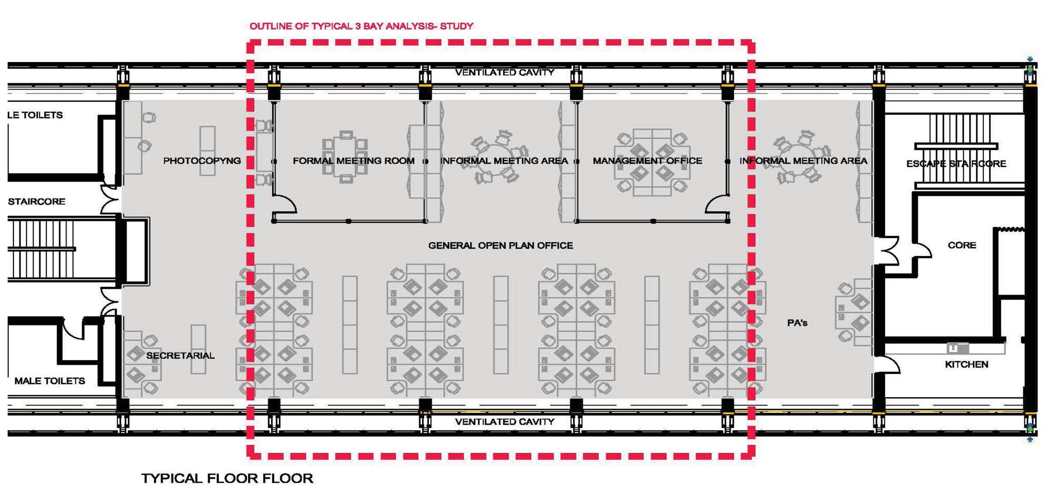


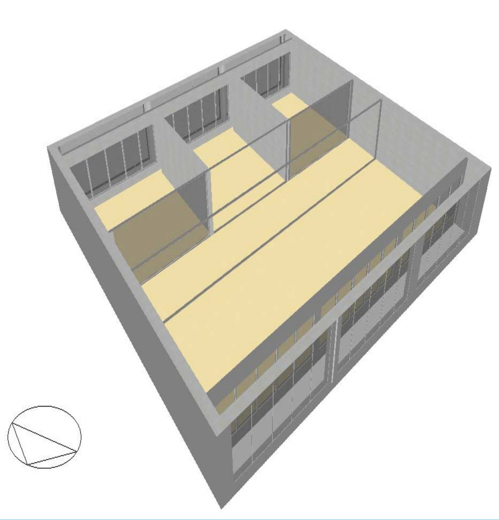












RESULTS

The total annual energy demand for the retrofitted office building has been reduced by over 70 %.Annual space heating demand reduced by nearly 90% and internal comfort conditions for the occupants maintained without the need for air conditioning. The potential to fit large PV arrays on the flat roof with excess electricity generated during unoccupied periods feeding back into the airport campus grid or link to an on site CHP plant as part of a future strategy would further reduce the building energy loads towards nZEB.

STRATEGY

LOAD REDUCTION

Improve FABRIC U Values & AIRTIGHTNESS

COMFORT

Natural VENTILATION used to control internal COMFORT levels to below 1% of cccupied hours above 28 Deg C without the requirement for MECHANICAL COOLING

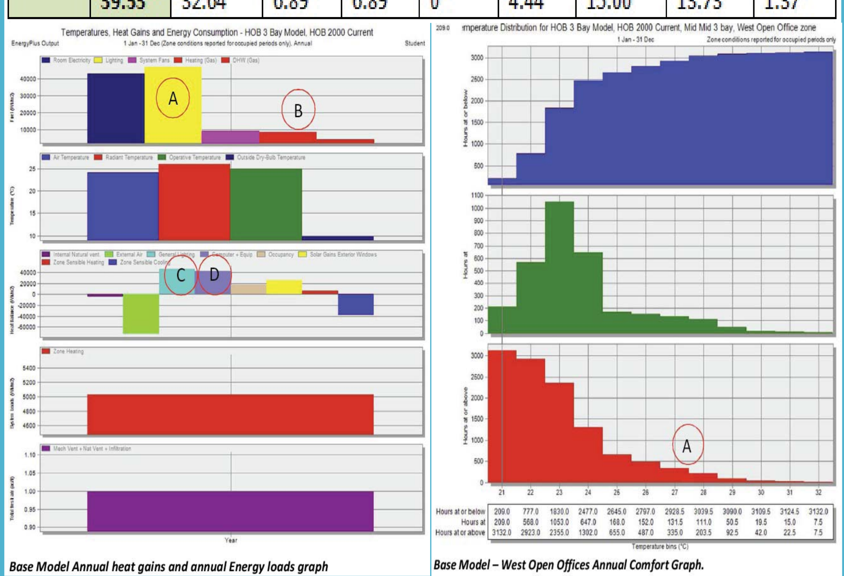
SAVINGS

63% reduction in ENERGY demand
55% Reduction in INTERNAL GAINS
60% reduction in HEAT LOSSES

minimal HEATING LOAD with 41% reduction
87% savings in LIGHTING energy using LED fittings and controls
COMPUTER & EQUIPMENT account for 55% of overall energy

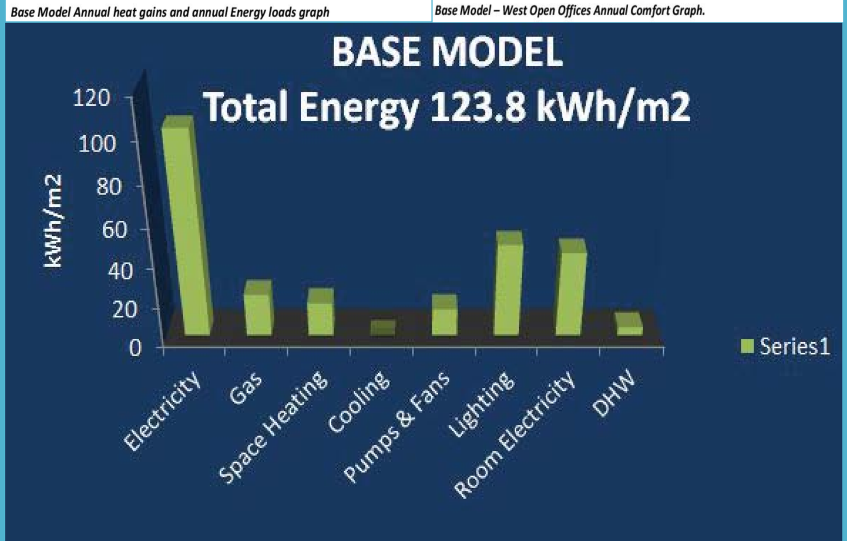
BASE MODEL RESULTS

BASE MODEL	Total Energy kWh/m2	Electrical kWh/m2	Gas kWh/m2	Space Heating kWh/m2	Cooling kWh/m2	P & Fans kWh/m2	Lighting kWh/m2	Room Elect kWh/m2	DHW kWh/m2
	123.8	102.2	21.6	17.2	0	13.9	47.0	43.0	4.3
	Total Energy W/m2	Electrical W/m2	Gas W/m2	Space Heating W/m2	Cooling W/m2	P & Fans W/m2	Lighting W/m2	Room Elect W/m2	DHW W/m2
	39.53	32.64	6.89	6.89	0	4.44	15.00	13.73	1.37



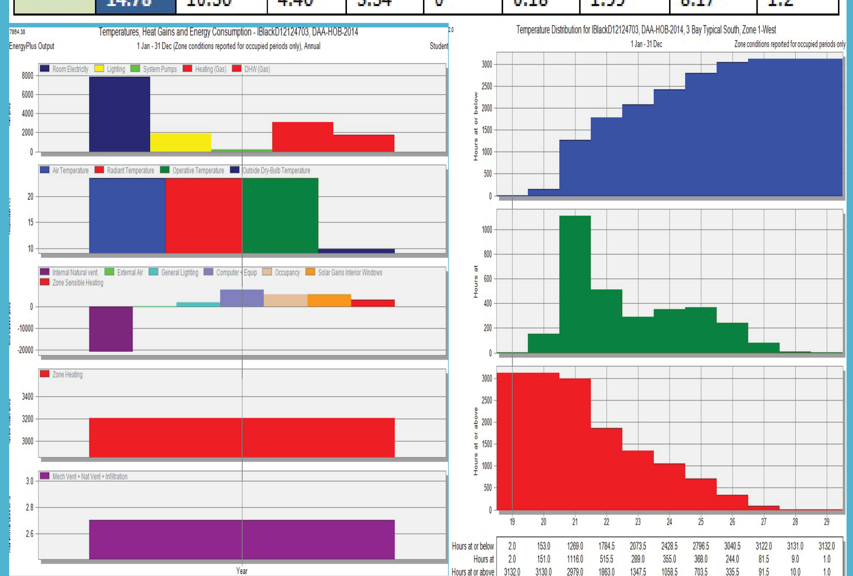
Base Model Annual heat gains and annual Energy loads graph

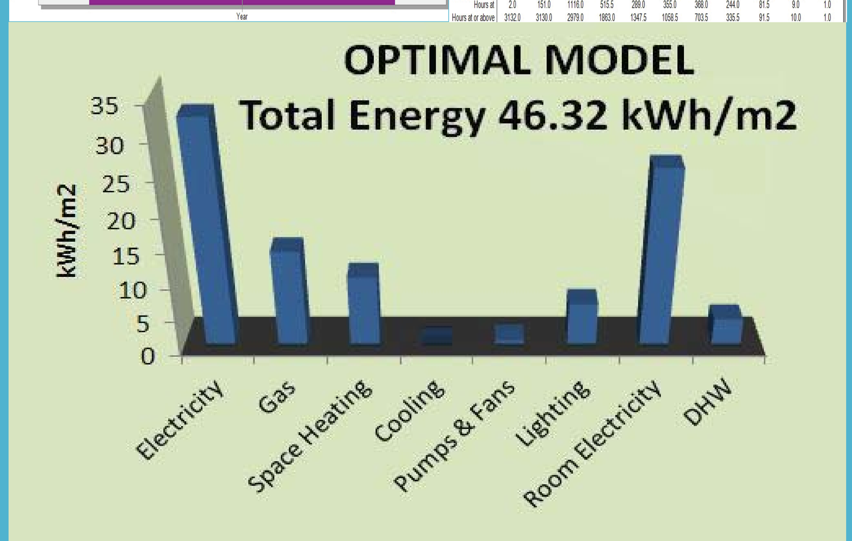
Base Model - West Open Offices Annual Comfort Graph



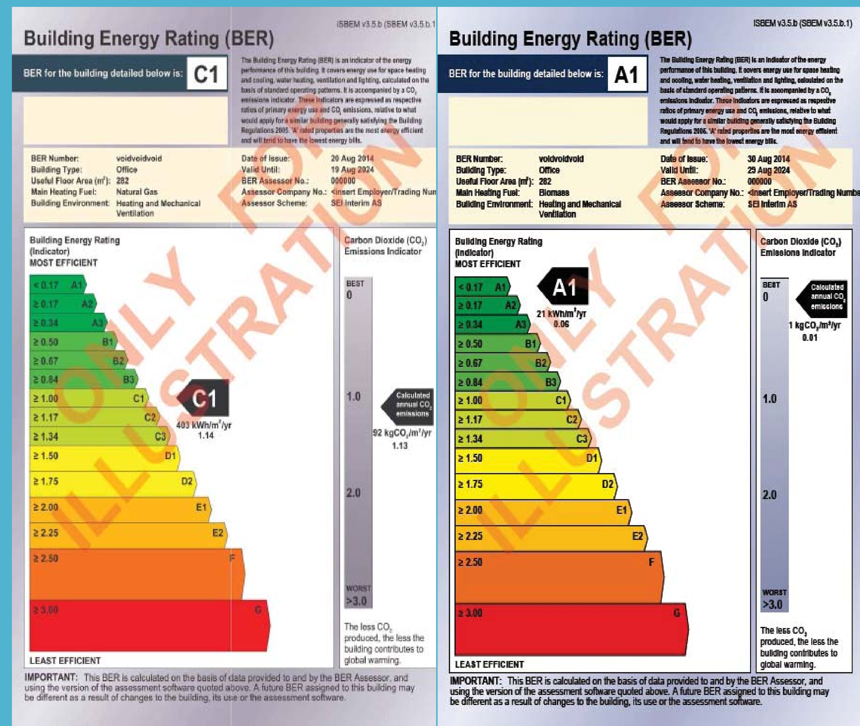
OPTIMAL MODEL RESULTS

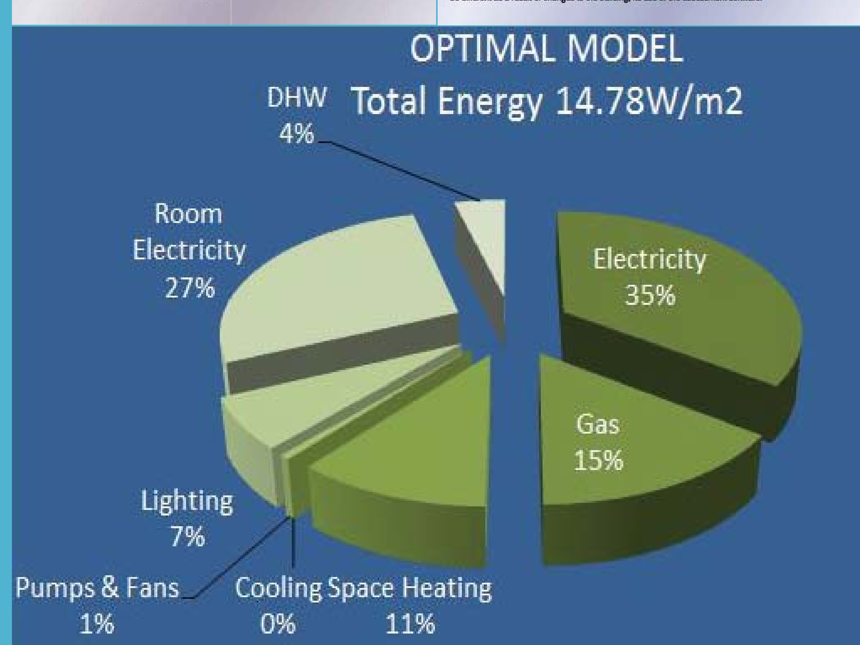
OPTIMAL MODEL	Total Energy kWh/m2	Electrical kWh/m2	Gas kWh/m2	Space Heating kWh/m2	Cooling kWh/m2	P & Fans kWh/m2	Lighting kWh/m2	Room Elect kWh/m2	DHW kWh/m2
	46.32	32.38	13.97	10.17	0	0.58	6.18	25.61	3.8
	Total Energy W/m2	Electrical W/m2	Gas W/m2	Space Heating W/m2	Cooling W/m2	P & Fans W/m2	Lighting W/m2	Room Elect W/m2	DHW W/m2
226	14.78	10.36	4.46	3.34	0	0.18	1.99	8.17	1.2





SBEM RESULTS





RENEWABLE ENERGY

RENEWABLES STRATEGY

Potential to install a large PV array on flat roofs and South facing gable . Possible future link to Biomass CHP plant on Airport Campus

iSBEM

Base model data was input through iSBEM and failed to meet Part L compliance and yielded a BER rating of C1. The upgraded model data using iSBEM calculations has yielded an A1 BER when using PV and Biomass CHP and also meets Part L compliance.