Aer Lingus Head Office Building
Final Energy Analysis

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INTRODUCTION

This study presents an investigation into determining the optimal retrofit solution for the Dublin Airport Authority, Aer Lingus Head Office building which was built in the 1960's.

The existing building has been modelled in DesignBuilder Building Energy Simulation Tool to calculate energy loads, heating and cooling peak demand, occupant comfort levels, daylighting etc.

The existing elements modelled for the purposes of this study is a typical mid floor 3 bay office area as a representation of the entire building.

Data was input into the modelling tool to reflect the current building status following investigative surveys on site, which indicated that the building is naturally ventilated, has a separate mechanical extract system, very poor airtightness and fabric U values, thermal bridging problems, and high electrical and lighting loads.

AIMS

The aim of the modelling studies has been to understand and simulate the existing building fabric and systems, and its energy performance and then exploring and modelling a range of Passive Architectural solutions to reduce energy loads.

The building has been simulated with an extensive range of options and interventions, some, though not all implemented to arrive at a final solution.

External rainscreen cladding to external wall to achieve a wall U value of 0.18W/m²K. New Passivhaus certified quadruple glazed windows U value of 0.85 W/m²K with internal solar responsive window blinds and solar responsive brise soleils. Lighting template improved to 5W/m² with lighting controls. Air-tightness improved and a natural ventilation strategy with mechanical ventilation turned on to a winter schedule to provide fresh air in winter and MVHR.

RESULTS

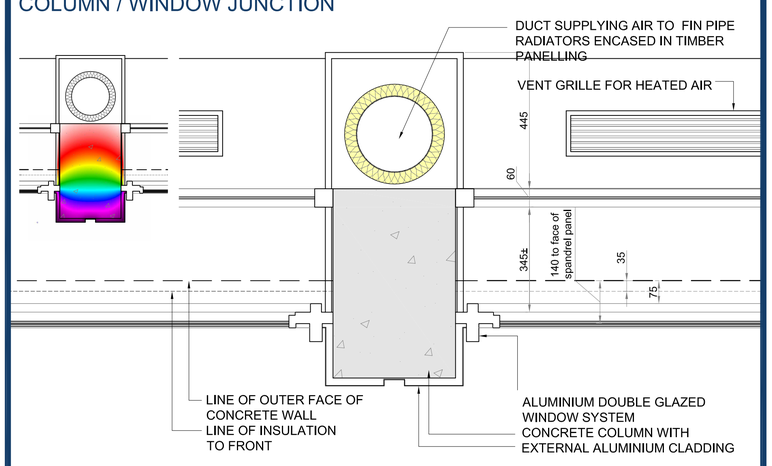
The proposed retrofit uses Passive Architectural solutions to achieve these results, indicating that the DAA could retrofit this building to near NZEB energy levels, with good comfort levels without the need for additional mechanical cooling.

The potential to fit large PV arrays on the flat roof with excess electricity generated during unoccupied periods feeding back into a site wide grid, or to link to a CHP plant on the Dublin Airport site in the future would further reduce the building energy loads towards nZEB.

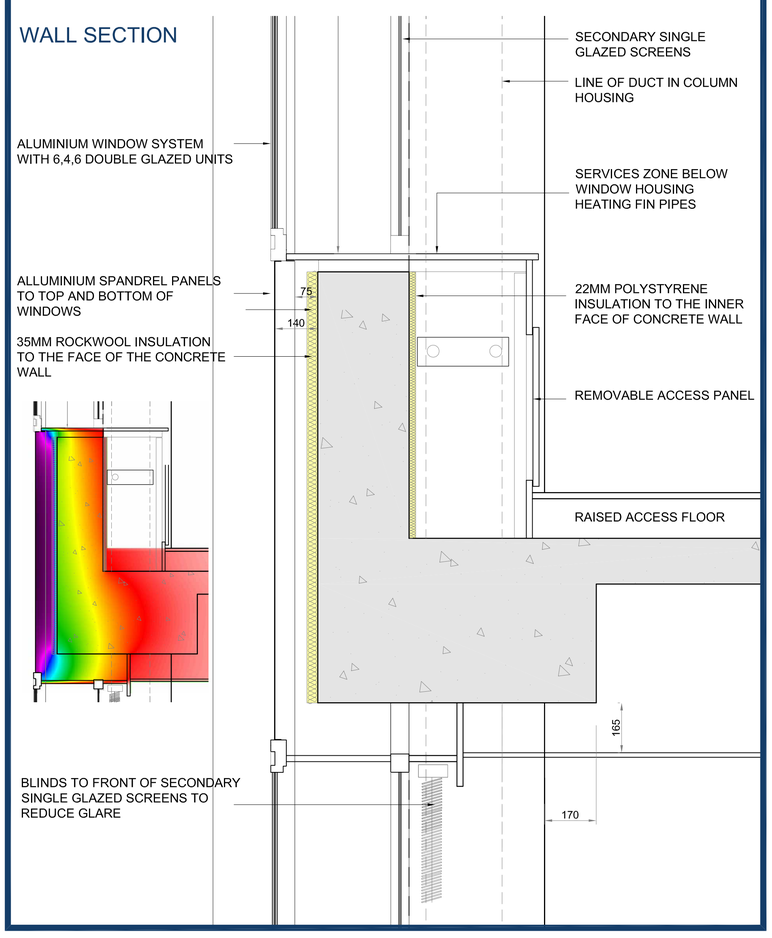
DesignBuilder has proved to be an effective tool in predicting how a building might behave as each retrofit solution is applied, clearly indicating if a zone has an issue with overheat from equipment, lighting or excessive solar gain, daylight availability and ventilation, and quickly gives an indication of the energy use impact that a particular choice of HVAC or lighting system can have.

EXISTING CONSTRUCTION DETAILS 1 : 10

COLUMN / WINDOW JUNCTION

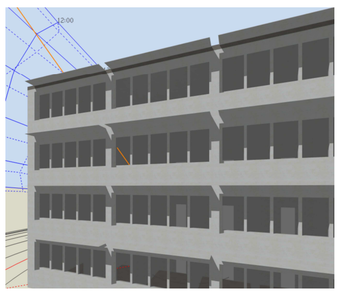


WALL SECTION

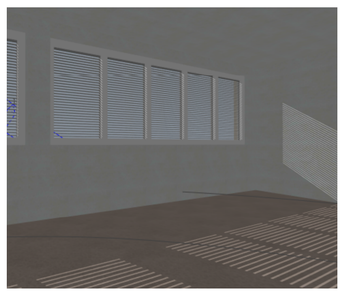


RETROFIT PROPOSAL

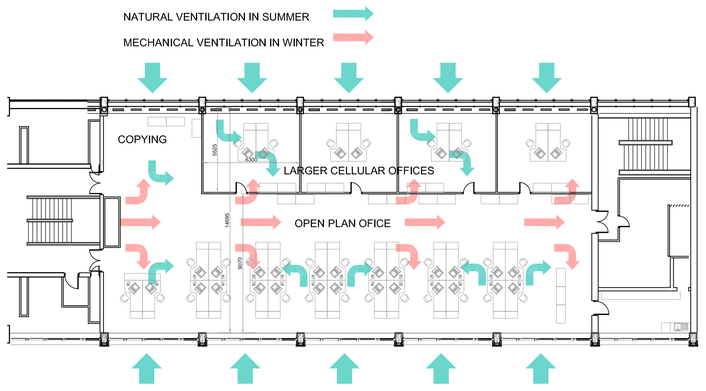
PROPOSED ELEVATION TREATMENT



DesignBuilder Elevation



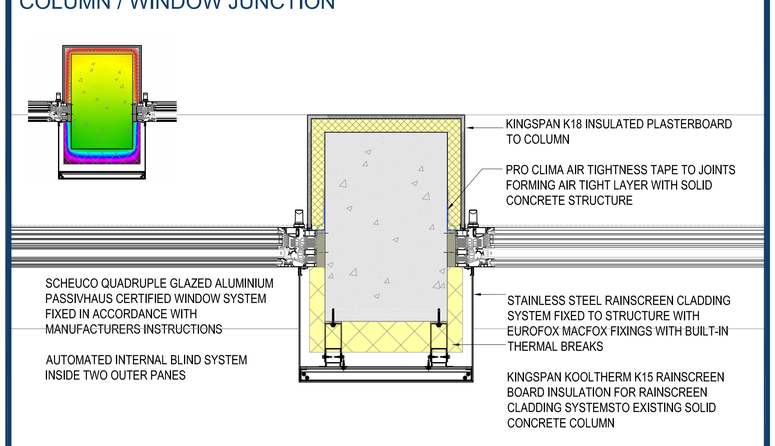
DesignBuilder Internal View



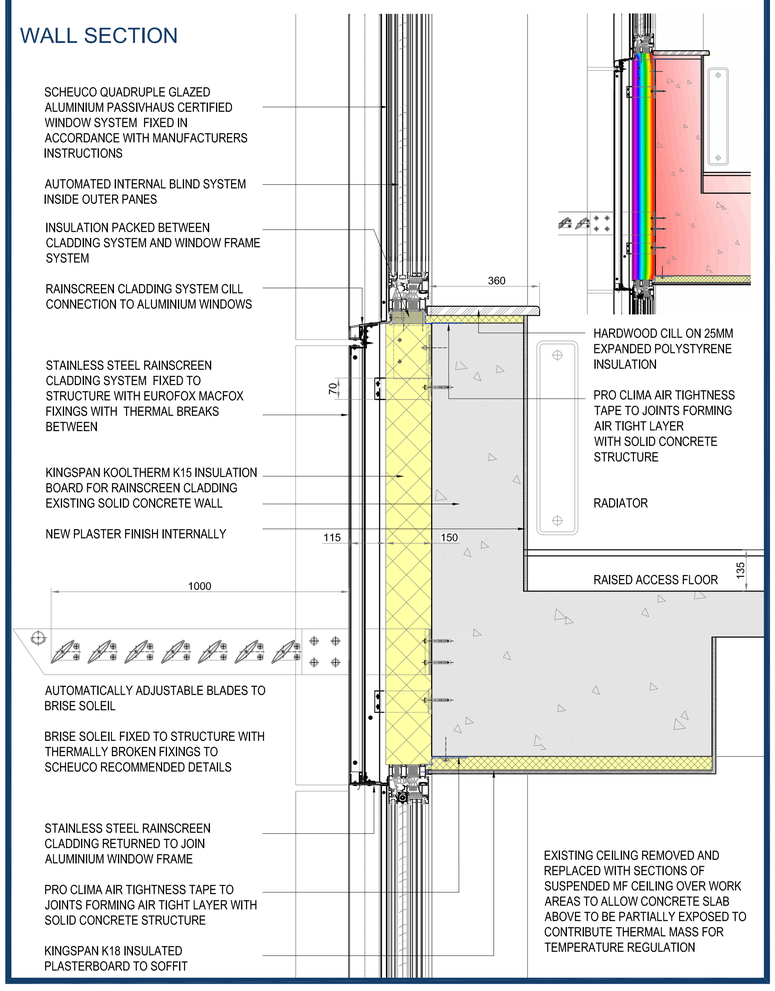
PROPOSED INTERNAL LAYOUT

PROPOSED CONSTRUCTION DETAILS 1 : 10

COLUMN / WINDOW JUNCTION

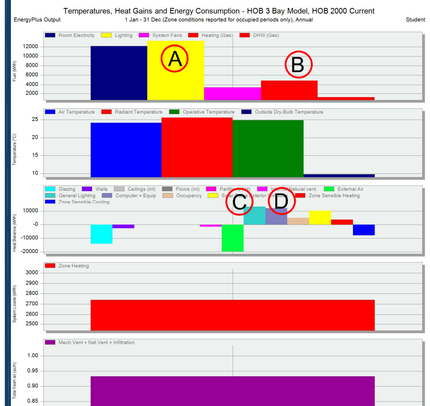


WALL SECTION



BASE MODEL RESULTS

	Total Engery kWh/m2	Total Energy % reduction	CO2 kg/m²	CO2 % Reduction	Electrical kWh/m²	Gas kWh/m²	Space Heating kWh/m²	pumps and fans kWh/m²	Lighting kWh/m²	Room Elec kWh/m²	DHW kWh/m²
Existing Base with compact HVAC + calc nat vent	123.2		74.2		102.2	21.6	17.2	13.9	47.0	43.0	4.3
	Total Engery W/m2	Total Energy % reduction	CO2 kg/m²	CO2 % Reduction	Electrical W/m²	Gas W/m²	Space Heating W/m²	pumps and fans W/m²	Lighting W/m²	Room Elec W/m²	DHW W/m²
	39.34	0.00	23.69	0.00	32.64	6.89	5.49	4.44	15.00	13.73	1.37

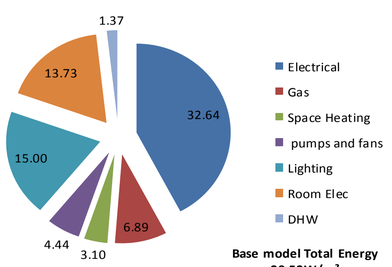


A. The existing building is predominantly electricity dependant as can be seen by the high lighting load at 102.2kWh/m²

B. The total gas load for heating and DHW is 21.6kWh/m² with heating at 17.2kWh/m²at B.

C. Most heat gains come from lighting and

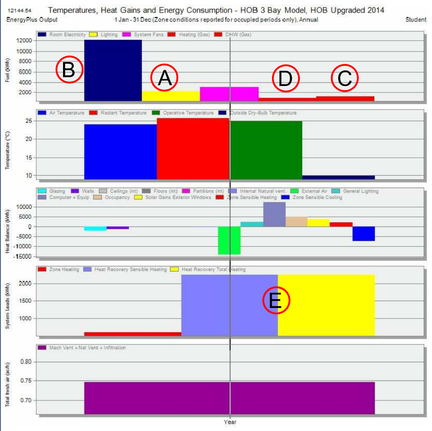
D. equipment loads



Base model Total Energy 39.53W/m²

OPTIMAL MODEL RESULTS

Model	Improvement	Total Engery kWh/m2	Total Energy % reduction	CO2 kg/m²	CO2 % Reduction	Electrical kWh/m²	Gas kWh/m²	Space Heating kWh/m²	pumps and fans kWh/m²	Lighting kWh/m²	Room Elec kWh/m²	DHW kWh/m²
Upgrade Base no.9 =	fabric + windows with internal blinds+ brise soleil + airtightness + lighting improvements + thermal mass exposed + MVHR	70.9	43.00	44.4	39.00	62.4	8.5	2.5	11.3	7.9	43.0	4.3
		Total Engery W/m2	Total Energy % reduction	CO2 kg/m²	CO2 % Reduction	Electrical W/m²	Gas W/m²	Space Heating W/m²	pumps and fans W/m²	Lighting W/m²	Room Elec W/m²	DHW W/m²
		22.62		14.16		19.91	2.71	0.80	3.61	2.52	13.73	1.37



A. The lighting load has been reduced significantly by the reduction in lighting to 5W/m² thus reducing the total electrical load to 61.8kWh/m².

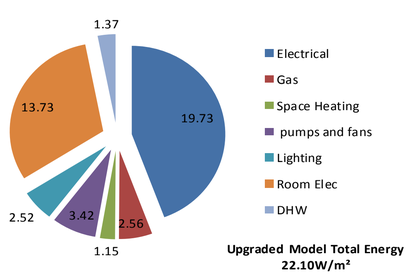
B. Room equipment now becomes predominant user of electricity

C. The total gas load for heating and DHW is 21.6kWh/m² with

D. Heating at 17.2kWh/m².

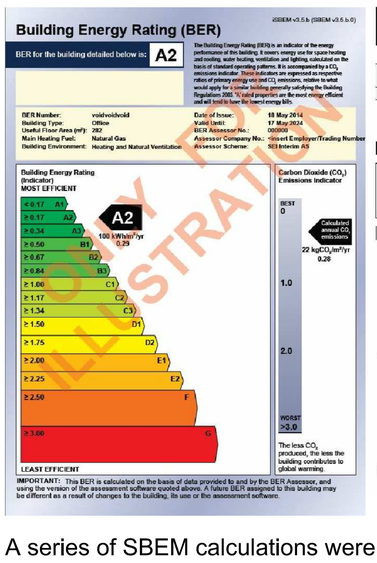
E. Heating load is cut significantly by the use of MVHR

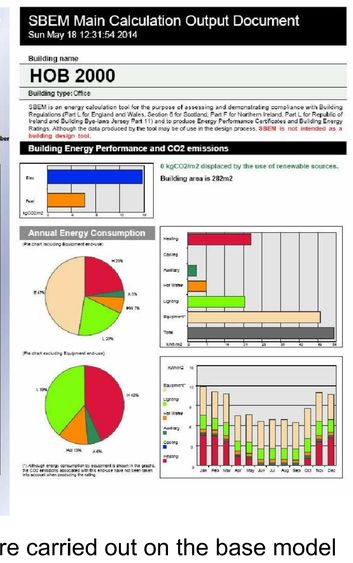
There is a predicted 43% reduction in total energy and less the 1% of occupied hours overheat with no additional cooling.



Upgraded Model Total Energy 22.10W/m²

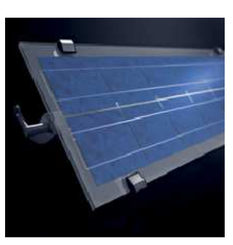
SBEM





A series of SBEM calculations were carried out on the base model which gave a building BER rating of C2 - C1.
The Upgraded building SBEM calculation has yielded an A2 BER.

RENEWABLE ENERGY



Possibility of large PV array on roof and on brise Soileil blades. Link to on site CHP plant in the future.