DIT architectural students propose low energy social housing upgrades

(below) a digital model of the Dublin City Council "gull wing" social housing blocks

Students of Dublin Institute of Technology's new Digital Analysis & Energy Retrofit postgraduate certificate have launched proposals for a major energy overhaul of Dublin City Council's social housing blocks, designed to bring their BER up to an A3.

The students were divided up into four teams to work on the project. Three teams were presented with blocks, each with a different orientation, while the fourth had to come up with a realistic proposal for how to retrofit an apartment block with a piecemeal approach as units became vacant.

The goal was to develop a plan to radically overhaul the existing block to resolve all existing shortcomings in terms of space, access, escape, condensation, comfort and energy efficiency, with "due regard to the architectural integrity of the existing building".

"What we wanted to achieve was a comprehensive suite of solutions that could be applied by Dublin City Council to any block in any location to achieve the [A3] BER," said course director Simon McGuinness.

The proposals were required to comply with all parts of the building regulations.

For most teams, the first step was to bring the existing balconies inside the thermal envelope of their building — to make the shape of the building simpler so there'd be less surface area through which heat could escape, to eliminate heat loss via thermal bridging through balconies, and to increase living space. Most teams opted to design new stairwells outside the building envelope.

All four teams opted to externally insulate the buildings, to reduce thermal bridging and the risk of mould and condensation. Naturally the ground floor and roof were also insulated in each of the proposals.

One team opted to install a green roof to support biodiversity in the inner city environment, and to add rainwater harvesting too.

Every team installed a solar thermal array on the roof to help meet hot water demand, while two also put in solar photovoltaic arrays to produce electricity.

Each team also re-designed the layout of the dwellings to make the most of passive solar gains.

The principle source of heat varied: one team chose an air source heat pump for each apartment, one chose centralised gas boilers, another chose individual gas boilers, and one chose a biomass combined heat and power plant.

All opted for demand controlled ventilation systems, which automatically turn on an extract fan to remove indoor air as humidity rises inside, and most teams put in triple glazing too. Two teams specified that an airtightness target of 1.5 air changes per hour be achieved.

The team charged with coming up with a proposal to retrofit units as they vacated chose instead to vacate and renovate one vertical "bay" at a time in a rolling operation, which would allow the project have a definite deadline and lead to a less piecemeal approach.

As well as coming up with team proposals, students were also required to write a short individual essay on one aspect of the project.

In her essay, Susan Cogan encouraged all architects to get to grips with the technical aspects of energy retrofit. "If we, as architects, don't grasp the nettle of this new reality and master the science required...we will quickly find ourselves limited in what we are 'allowed to do'", she wrote.

Karen Hammond's essay looked at why condensation and mould were so rife in Dublin City Council flats, and blamed a lack of proper ventilation and insulation. "The internal surface temperature of the existing single leaf walls, & balcony overhangs, drop to as low as 11.5C in the floors, & 13.6C in the walls," she wrote. "The surface humidity level reaches levels close to 0.7 Rsi for approx 4 months of the year, [...] high enough to encourage mould spore germination."

Padarig McHugh's essay emphasised the use of solar PV arrays for complying with Part L of the Building Regulations, and particularly its energy performance coefficient (EPC). "Together with general fabric upgrades to all walls, roof etc., several variations of boiler types and solar panels sizes were modelled in Deap but EPC compliance seemed elusive. It was then that photovoltaic (PV) panels were considered," he wrote. "Using an array of 5m^2 of monocrystalline PV (per apartment) panels rated 265Wp, EPC compliance was easily achieved, as well as reducing primary energy significantly."

Course director Simon McGuinness said that one of the project's most significant findings was of the huge thermal bridge caused by balconies in typical Dublin City Council flats. He recommended that different default values for linear thermal bridging in apartment buildings be introduced to Deap, with a grading of the default value for different concrete projections such as balconies, cantilevers and canopies.
"The retrofit qualification provides a vital missing skill set," McGuinness said of the course. "We have shown that the typical "add insulation" approach would actually have endangered the health of residents by inducing additional mould growth at thermal bridges. It would have cost more to achieve compliance and delivered significantly poorer energy savings than the integrated Gullwing solution proposes."

The postgraduate certificate in Digital Analysis and Energy retrofit launched last year with the admission of 20 unemployed architects and architectural technologists, and aims to develop skills in digital analysis, energy retrofit and building information modelling.