Temperature profiles of private rental housing occupied by third level students in Ireland

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ABSTRACT: The Irish Government published a National Student Accommodation Strategy to tackle issues surrounding the availability of accommodation for students in higher education. 23,634 students could not be accommodated with a bed space supplied by a Higher Education Institution in 2017. Therefore, many students live in private rental accommodation during the academic year. This paper examines the indoor temperature profiles of private rental housing occupied by third level students in Ireland. From the results, the temperature levels across the majority of the 16 cases were found to have temperatures below the recommended 18°C. At least 90% of the recorded temperature data during February for all but three of the cases was less than 18°C, highlighting the poor indoor temperature levels that the students were living in. While the sample size of this study is small and more research needs to be carried out on this topic in the future, the data suggests more accommodation needs to be provided for people in higher education that allows them to achieve indoor temperature levels within recommended guidelines.

KEY WORDS: Indoor temperature, Private rental housing.

1 IRISH STUDENT ACCOMODATION

Over 230,000 people enrolled in higher education courses in Ireland during the 2017/2018 academic year [1] and this number is expected to rise until 2024 [2]. The Higher Education Authority (HEA) reported that only 55% of the demand for bed spaces could be met by Higher Education Institution (HEI) bed spaces in 2014 [3]. The Irish Government published a National Student Accommodation Strategy to tackle issues surrounding the availability of accommodation for students in higher education [2]. 23,634 students could not be accommodated with a bed space supplied by a HEI in 2017 due to demand [2]. Despite plans to increase the supply of bed spaces for students from 33,441 in 2017 to 54,654 in 2024, the demand for accommodation is predicted to increase also. The excess demand for student bed spaces is expected to only reduce by 2,648 to 20,986 in 2024 compared to 2017 due to the increase in demand for bed spaces [2].

There is limited information on the type of accommodation students live in that do not avail of bed spaces provided by Higher Education Institutions. A survey carried out by the Union of Students in Ireland revealed that, excluding students in college or private student accommodation, 48% of students were living in privately rented accommodation [4]. At least 21% of students surveyed reported to have either inadequate heating, issues with mould or issues with dampness in their accommodation. Although the sample of students surveyed (3,597) in the Union of Students survey is small relative to the total number of students in Ireland, it is still expected that a significant portion of students are living in private rental accommodation.

2 IRISH RENTAL SECTOR

1.7 million housing units are occupied in Ireland [5]. At the end of 2017, 19% of households were living in private rental accommodation [6]. Building Energy Ratings (BERs) are used to rate the energy performance levels of residential housing units in Ireland. The housing units are rated on a scale of A1-G with G having the largest primary energy usage [7]. The energy performance levels of a BER rating are based on the estimated energy demand for a house during the heating season. The heating season in Ireland is from October to May.

Over 55% of private rented dwellings have a BER of D or lower suggesting that people living in them are at a greater risk of fuel poverty [8]. The academic year for the majority of third level students is from September to May. Thus with (i) many students living in private rental accommodation, (ii) a high percentage of private rental accommodation being of a poor energy efficiency standard, (iii) the academic year for students falling within the Irish heating season and (iv) many students reporting issues with inadequate heating, mould and dampness, this paper examines the indoor temperature profiles of private rental housing occupied by third level students in Ireland. The temperature profiles of 16 case study buildings were examined to assess whether students were living within recommended indoor temperature guidelines and reasons for differences in temperature levels across the sample of housing units.

3 METHODOLOGY

Lascar EL-USB-2+ data loggers collected temperature and relative humidity in this study. The data loggers have an accuracy of ±0.45°C. The data loggers were installed in four locations within each house. One was placed in the kitchen, the living area, a front bedroom and a back bedroom. The sensors were placed approximately 1.5 metres above the floor level. The data loggers were not installed close to a heat source. Temperature data collection began on the 1st December 2019. The data loggers recorded data every 10 minutes with the data recorded for 3 consecutive months. Four sensors in total were removed from the analysis as they were moved from the original location of where they were installed.

Data for the three months which are generally the three coldest months of the year in Galway [9] were available for analysis. During the monitoring period, the average external temperature was 6.1°C, 6.1°C and 5.8°C during December, January and February, respectively [9].

The indoor temperature data were complemented by data collected from the building occupants. Semi-structured surveys were carried out with one occupant per household to gather information on the physical characteristics of the dwellings, the socio-demographic profile of the occupants, their attitudes towards energy use and conservation, quality of life and the environment, which items they viewed to be necessities or luxuries, their energy-related practices, and their thermal satisfaction within their homes. The semi-structured surveys have been used in a previous research study examining how the energy cultures of householders shape the household energy demand [10].

4 CASE STUDY BUILDINGS

The housing units monitored in this study are privately owned rental properties in Galway city, Ireland. All the dwellings monitored were rented by students attending the National University of Ireland, Galway. Details of the 16 households are included in Table 1.

There are a number of differences in the households as shown in Table 1 with five different typologies included in the study, and with three different external wall types constructed across a wide range of years. The number of bedrooms and people occupying the housing units ranges from two to six. The building occupants were aged between 18-35 years of age with 41 female and 37 male occupants, respectively. There is some commonality in the fuel used to heat the housing units with all but three relying on oil as their main source of fuel.

Table 1. Details of the 16 households involved in the study.

Case	TYP	YR	Wall	Insulation	Fuel	BR	OCC
A	MT	1993	CW	50mm	Oil	6	6
B	SD	1980	CW	25mm	Oil	4	4
C	MT	1950	HB	Unknown	Oil	5	5
D	ET	1950	HB	Unknown	Oil	4	5
E	MT	1950	HB	Unknown	Oil	5	5
F	DBU	2006	CW	50mm	Oil	5	5
G	BU	1970	CW	Unknown	Oil	4	4
H	SD	1970	HB	Unknown	Oil	3	2
I	ET	1970	CW	15mm	Oil	5	6
J	SD	2000	CW	50mm	Oil	4	5
K	SD	2000	CW	50mm	Oil	5	5
L	APT	1990	HB	25mm	Elec	3	3
M	APT	1940	SM	Unknown	Oil	4	4
N	APT	1940	SM	Unknown	Oil	4	5
O	APT	2000	CW	50mm	Elec	2	2
P	APT	1995	CW	50mm	Elec	2	2

Abbreviations

APT-Apartment
BR-Number of bedrooms
BU-Bungalow
CW- Cavity masonry block
DBU-Dormer Bungalow
Elec-Electricity
ET-End terrace
HB-Hollow block wall
Insulation-Thickness of insulation in external wall
MT-Mid terrace
OCC-Number of occupants
SD-Semi-detached
SM-Solid mass concrete
TY-Housing typology
Wall-External wall type
YR-Construction year

5 RESULTS AND DISCUSSION

Figure 1 shows the average 24hr temperature profile for each of the cases in the study during the month of February. There is a large variability in the profiles. This is understandable given many of the students had different class schedules across the housing units and the large variability in the building characteristics as shown in Table 1.

The households exhibited different periods of when the house was gaining heat. All temperature profiles of the households were increasing from 6pm onwards with temperatures peaking anywhere from 7pm to 2am.

Case A had the highest peak temperature of all the cases with a peak temperature of 21.3°C. Case A also experienced the highest temperature drop overnight but had the highest average temperature of all the cases. Case A having the highest average temperature can be partially explained by the way the students living in Case A paid for their utility costs. The utility costs were included in the rent paid by the students to their landlord at a fixed rate, meaning that they could use as much energy as they wanted to heat their home (while at the same time not overconsuming energy). For all the other cases, the students were responsible for paying their own utility bills in addition to their rent resulting in them being more conservative with the spending on fuel.

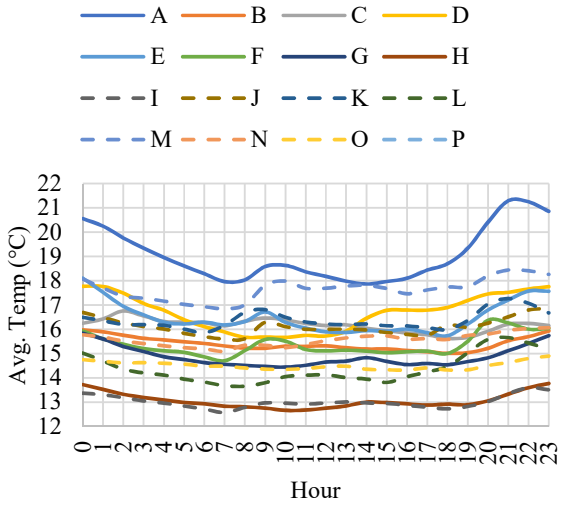

Figure 1. Average 24hr temperature profile for the 16 households during February.

Figure 2 gives the average temperature of the cases during December, January and February. The average indoor temperature of the 16 cases was 16.0°C in December, 15.6°C in January and 15.8°C in February. The first semester of the academic year ended on the 20th December with the second semester beginning on the 13th January. As many of students spent some if not all of that time in another house in between the semesters, the data recorded during these periods was removed.

Case I had the lowest average temperature across the three months. Case I was built in 1970 and one of the eight cases constructed before the first draft building regulations were introduced in the mid 1970's [11]. While the energy efficiency of a house plays a role in the indoor temperature levels, the people occupying the homes also play a role. Case F is the newest housing unit in the study. It was built in 2006. Despite being one of the more energy efficient homes, Case F had the 6th lowest average temperature across the three months.

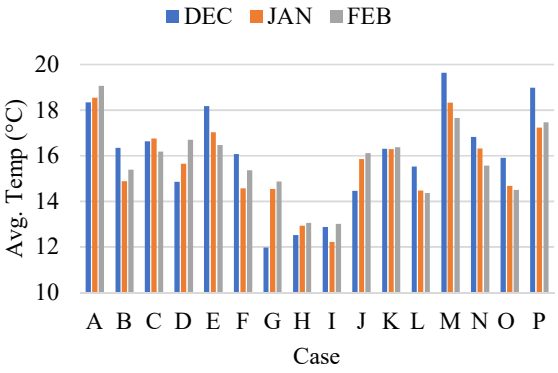

Figure 2. Average temperature for each case during December, January and February.

The World Health Organization (WHO) and public health research in the UK recommend living in indoor temperatures of at least 18°C [12], [13]. Table 2 gives the percentage of data which was recorded during February for a range of temperatures for each of the cases. As the different households have different occupancy patterns for a number of reasons such as differing class schedules and people working part-time jobs, the results are given for two different time periods of the day. At least 90% of the recorded data for ten of the cases was less than 18°C from 8am-8pm. Even from 8pm-8am when the all the houses were generally occupied, eleven of the cases had temperature levels of less than 18°C for at least 90% of the recorded data highlighting the poor indoor temperature levels many of the students were living in. While the review of minimum indoor temperature for English homes in winter recommends houses can be heated slightly less than 18°C for healthy people during the day and overnight, they stop short at recommending to what temperature level below 18°C is acceptable [12].

The quantitative temperature data collected by the data loggers supported the qualitative data collected from the semi-structured surveys carried out with the students. From the semi-structured surveys, it was found that 75% of the cases were either "much too cold" or "too cool" in the morning when asked to rate the internal temperature level on a seven point scale. 56% were either "much too cold" or "too cool" in the evening with more students reporting to be "comfortably cool" and "comfortably warm" in the evening compared to the morning.

The students were asked if they had experienced any problem with draughts, cold, condensation, mould or dampness with the results given in (Figure 3). On a regular (daily) basis, 25% of the cases felt draughts, 50% said the houses were cold, 75% acknowledged condensation, 50% found mould and 38% noticed damp All cases acknowledged mould present in the premises at some stage of their tenure.

Table 2. Percentage of temperature data recorded for given temperature ranges during February

	8am-8pm			8pm-8am		
Case	<18°C	18-21°C	>21°C	<18°C	18-21°C	>21°C
A	13.0	68.8	18.2	41.4	48.9	9.6
B	96.3	3.7	0.0	96.6	3.4	0.0
C	84.0	15.7	0.3	87.2	12.5	0.3
D	67.8	32.2	0.0	79.3	20.3	0.4
E	73.5	26.3	0.2	92.6	7.4	0.0
F	99.0	1.0	0.0	98.5	1.5	0.0
G	94.3	5.7	0.0	97.6	2.4	0.0
H	100.0	0.0	0.0	100.0	0.0	0.0
I	100.0	0.0	0.0	100.0	0.0	0.0
J	92.0	8.0	0.0	98.5	1.5	0.0
K	97.7	2.3	0.0	97.2	2.8	0.0
L	97.2	2.8	0.0	99.6	0.4	0.0
M	48.6	48.8	2.7	39.9	58.7	1.4
N	100.0	0.0	0.0	100.0	0.0	0.0
O	100.0	0.0	0.0	100.0	0.0	0.0
P	42.7	57.2	0.1	69.6	30.4	0.0

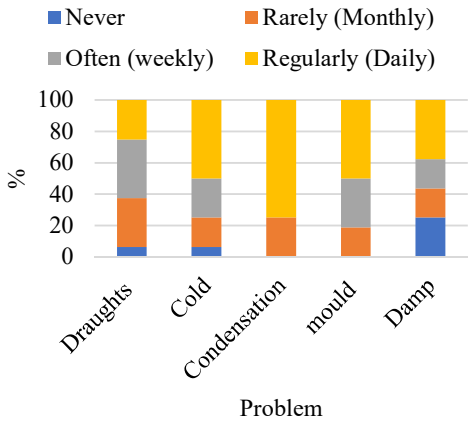

Figure 3. Problems experienced by students in their rented accommodation.

6 CONCLUSSION

This paper examines the indoor temperature profiles of private rental housing occupied by third level students in Ireland. The temperature profiles of 16 case study buildings were examined to assess whether students were living within recommended indoor temperature profiles and reasons for differences in temperature levels across the sample of housing units.

From the results, the temperature levels across the majority of cases were found to be below the recommended 18°C on a regular basis. At least 90% of the recorded data during February for all but six of the cases was less than 18°C, highlighting the poor indoor temperature levels the students were living in. Furthermore, 50% of the cases reported a daily problem of mould growth.

Based on the data collected, it was difficult to determine if the unsatisfactory living conditions within the buildings were mainly due to the technical characteristics of the building or if it was due to the student's behaviour in how they heated the home. However, both factors are expected to have played some role in the unsatisfactory living conditions. It was found that for the one household of students whose utility bill costs were included in their rent bill, they were living in the house with the highest indoor temperature level.

While the sample size of this study is small and more research needs to be carried out on this topic in the future, the data suggests that many third level students renting in the private rental sector struggle to achieve indoor temperature levels within recommended indoor temperature guidelines. With the government expecting an excess demand of 20,986 for HEI beds in 2024 [2], more accommodation needs to be provided for people in higher education that allows them to achieve indoor temperature levels within recommended guidelines.

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