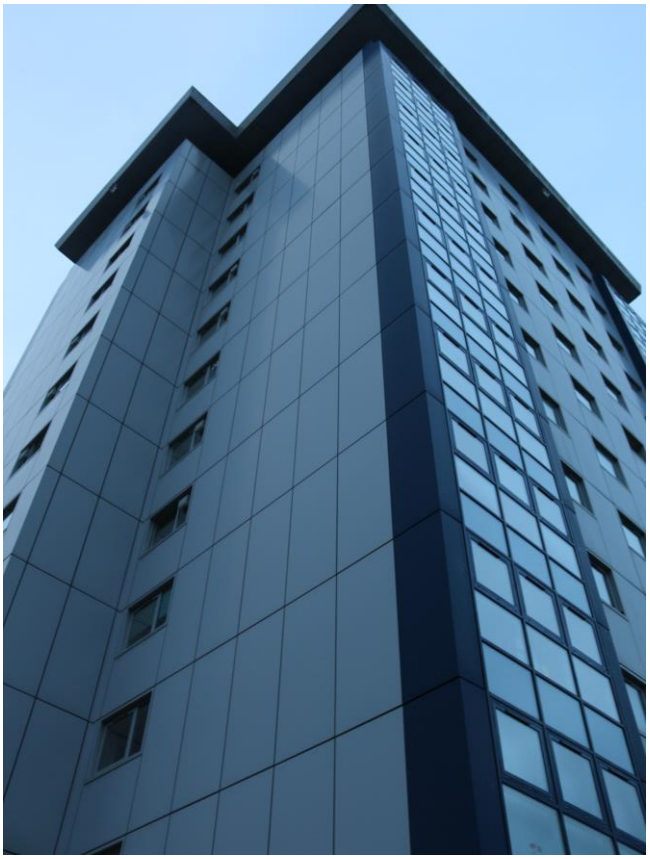
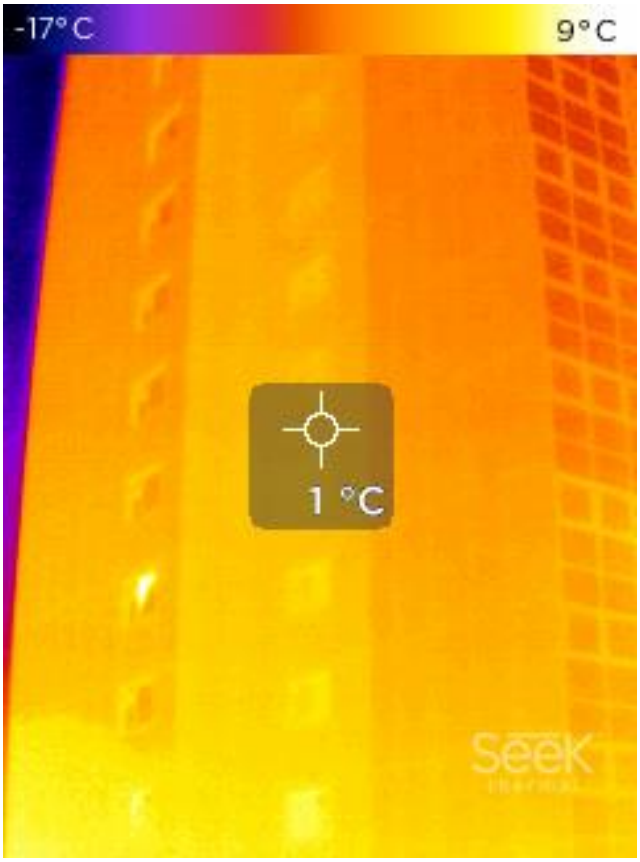
University of Strathclyde Engineering

DEPARTMENT OF MECHANICAL & AEROSPACE ENGINEERING

West Whitlawburn Housing Co-operative Thermal Imaging Report





Msc Renewable energy group – Nikki Homfray, Gavin Lavery, Aga Bachleda-Baca, Calum Love

07/04/2018

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Introduction

This brief thermal imaging study was carried out as part of our project on the housing stock and community district heating (DH) system at the West Whitlawburn housing estate. The data was collected during a site visit, where access to three different high-rise flats was granted. Thermal imaging, Temperature and humidity of these flats and various other relevant areas was collected. This report focuses on the high-rise flats on the estate which have recently undergone extensive upgrades, and aims to identify any weaknesses in the upgrades and if there is scope for further potential upgrades. The current upgrades include an aluminium rainscreen, curtain walling, balcony enclosures, replacement windows, steel extension roof, roof cladding and improved piping insulation. A basic model of an individual flat is shown in Figure 1. The layout of the flats in the tower blocks are all almost identical. The ambient temperature and humidity of each room can be found in the Appendix.

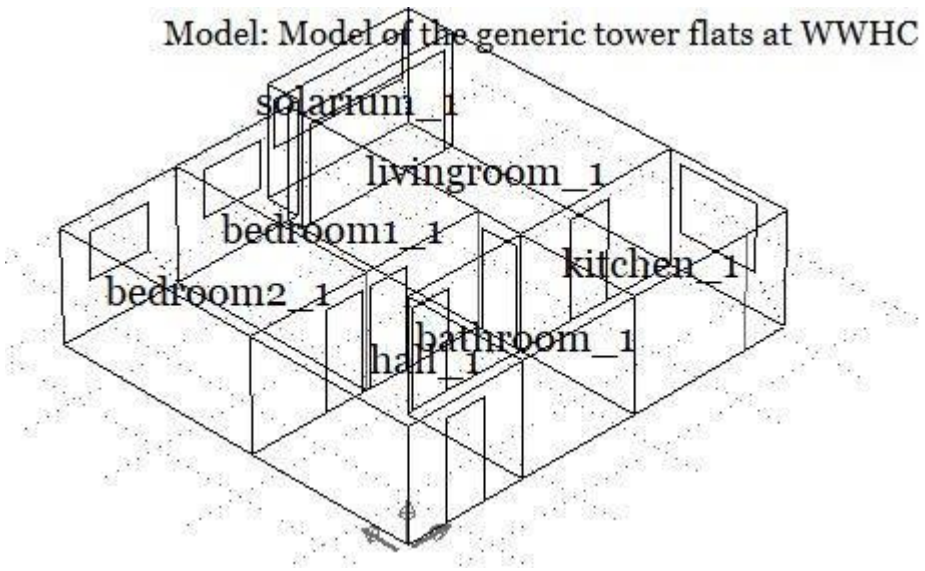

Figure 1: ESP-r flat model

Bute Tower 8th Floor Flat 46

The first flat considered is flat 46 on the 8th floor of the Bute Tower. The first images shown in Figure 2 and Figure 3 illustrate the heat loss in the corner. Figures 4 and 5 show the window frame in bedroom 2. From the images it is evident there are cold spots in the corner and around the edge of the window frame. This is expected, and is almost unavoidable, the cold areas are also limited to a small area so it is nothing to be overly concerned about. In Figure 8 the external wall in the living room is shown, the surface temperature is 17ºC. This is a good result as it shows there is minimal heat loss through what is a potential large area for heat loss. Figures 6 and 7 show the windows in the solarium. Figures 10 and 11 show the kitchen window, again there are only noticeable cold areas around the edge of the window frame. Finally Figure 9 shows the DH piping in the landing area. From the image we can see the piping and surrounding insulation is slightly warmer than the surroundings. So, there is some heat escaping here. There is insulation on these pipes but there could be scope to improve it.

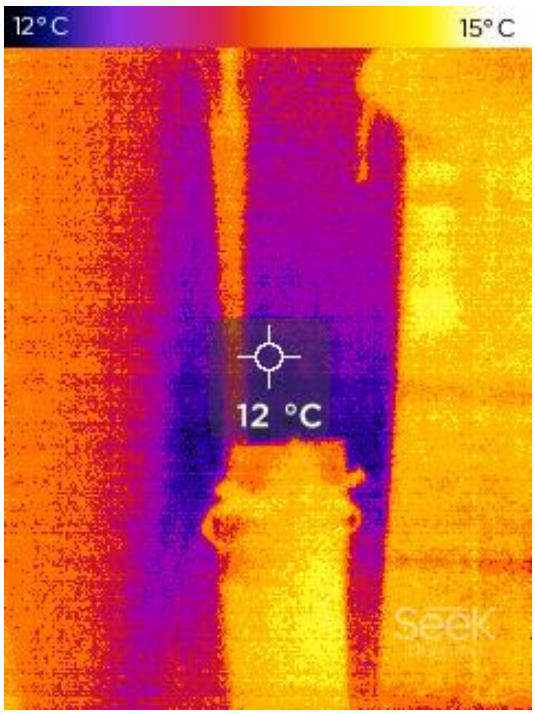

Figure 2: Floor corner in bedroom 2

Figure 3: Floor corner bedroom 2

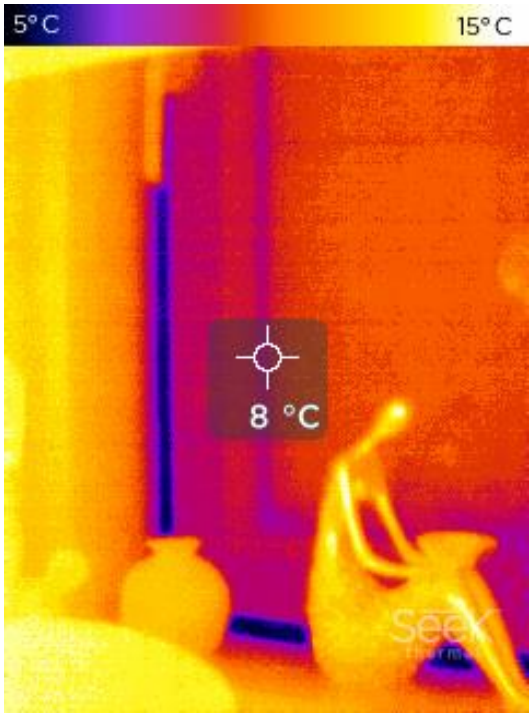

Figure 4: Window frame close up in bedroom 2

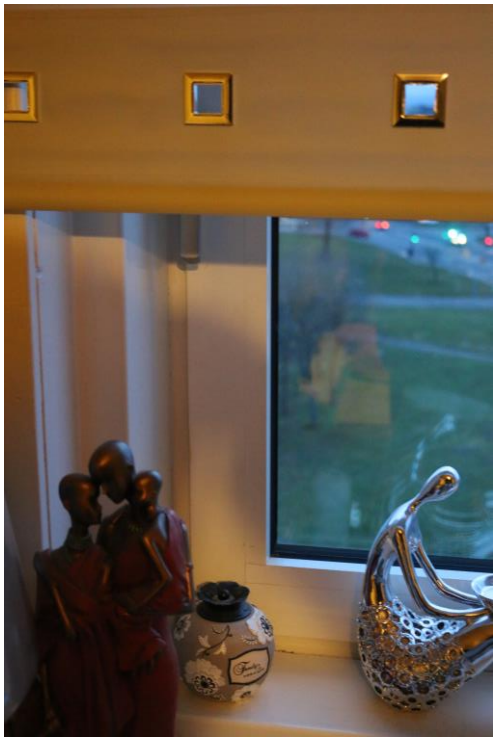

Figure 5: Window frame close up in bedroom 2

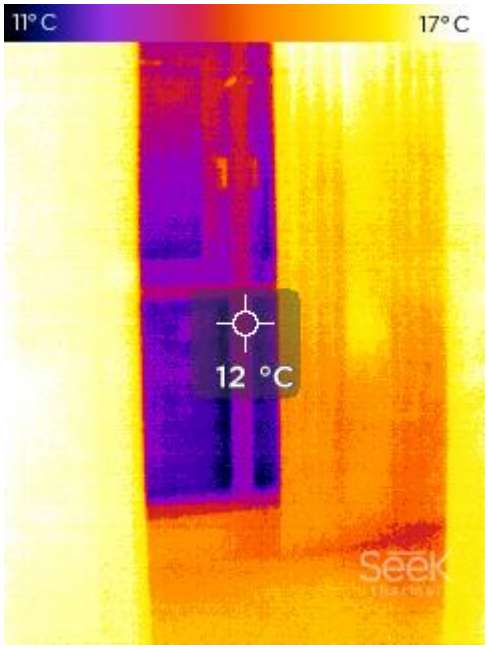

Figure 6: Solarium with open doors

Figure 7: Solarium

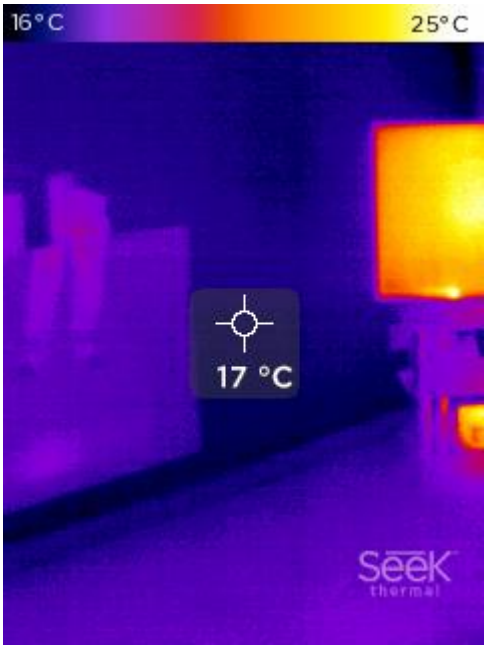

Figure 8: Living room external wall

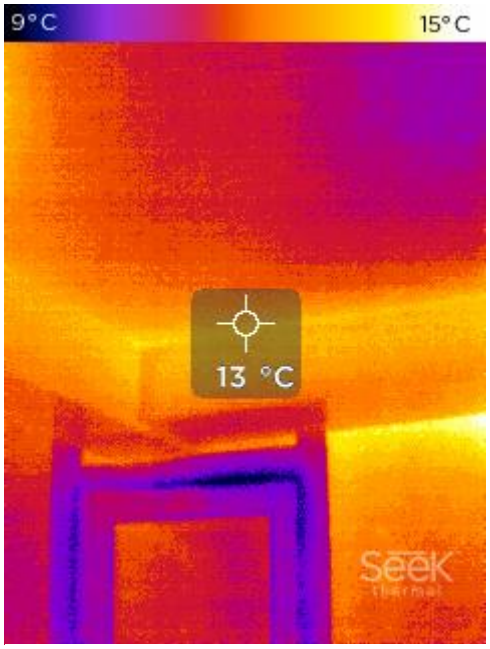

Figure 9: DH piping network in landing area

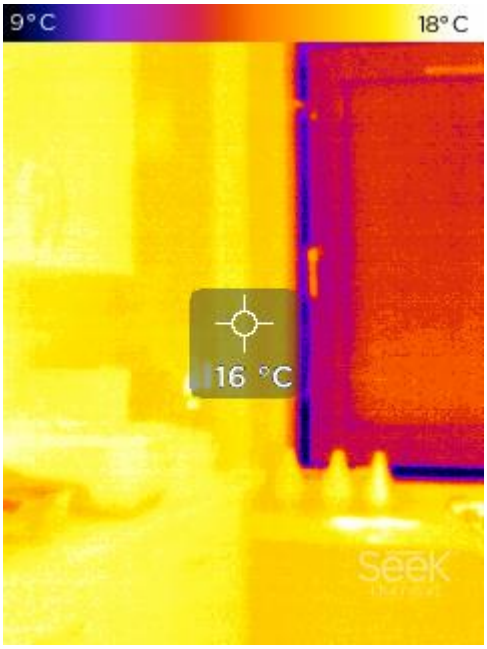

Figure 10: Kitchen window

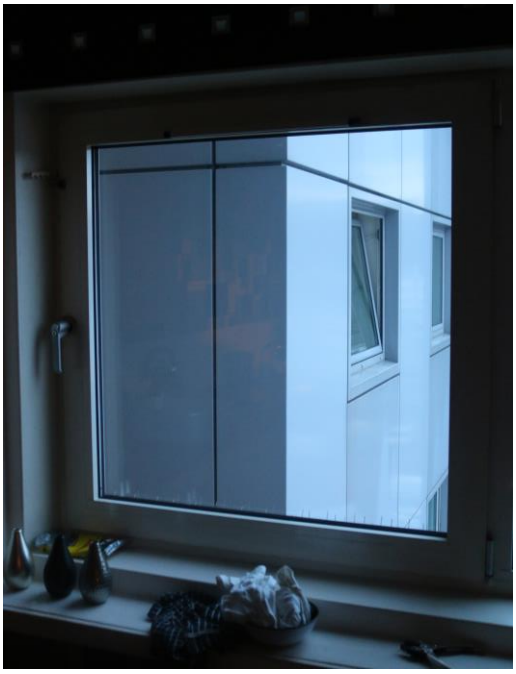

Figure 11: Kitchen window

Arran Tower 4th Floor Flat 19

The next set of images are of flat 19 on the 4th floor of the Arran tower. Figure 12 shows the external wall in the living room, and once more the temperature observed is encouraging, suggesting the external cladding is working as required. Figure 13 shows the ceiling and window in the solarium, where only small cold spots are seen in the corners. Figures 14 and 15 both show cold spots in the kitchen and bedroom room 1 respectively. Although these cold areas are slightly more significant than other examples, it is not overly concerning. They are likely due to small errors in installation where panels didn't quite align perfectly or something similar. Small problems like this are often unavoidable when retrofitting. Figures 16 and 17 show a similar scenario but for bedroom 2. Figures 18 and 19 show the DH piping and same as for the previous flat there is a visible heat loss.

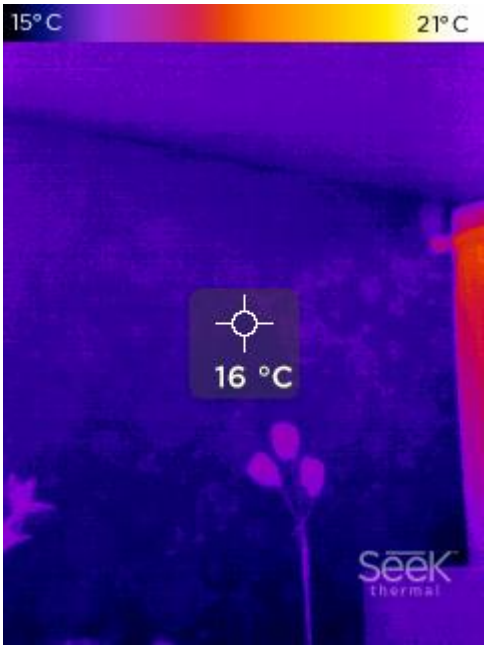

Figure 12: External wall in living room

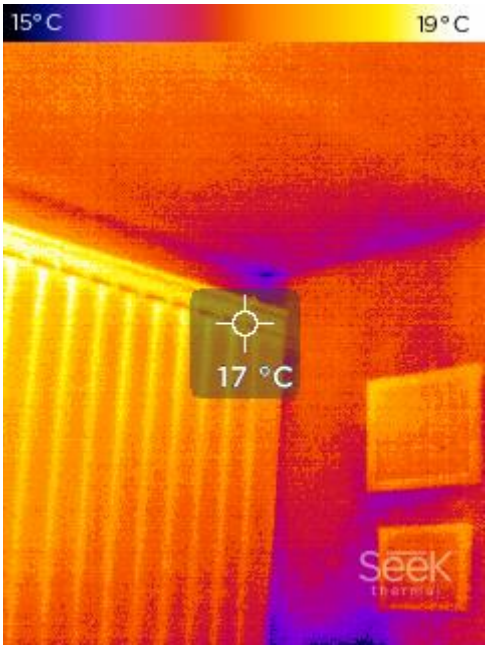

Figure 13: Solarium ceiling/wall

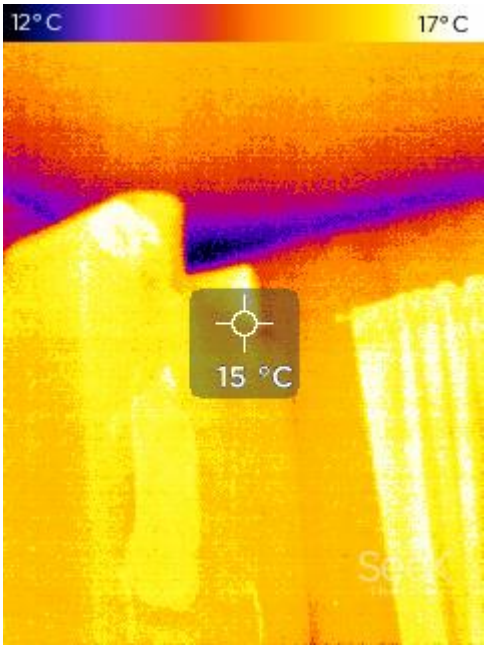

Figure 14: Kitchen external wall/ceiling

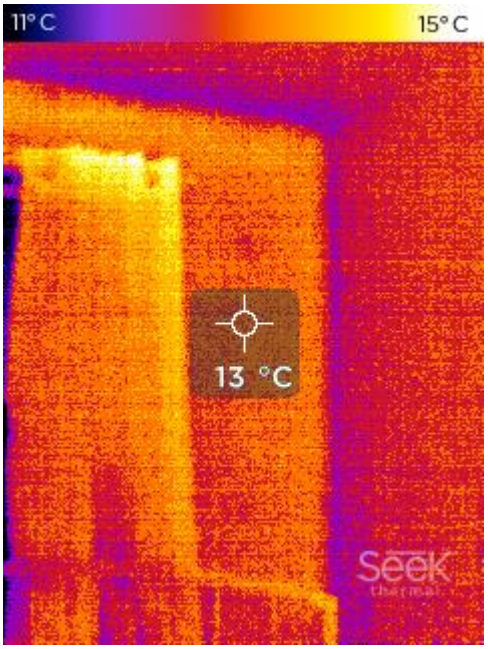

Figure 15: Bedroom 1 external wall/ceiling

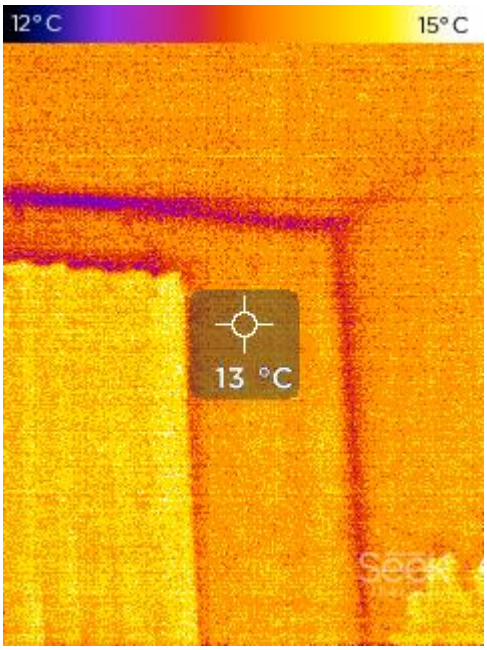

Figure 16: Bedroom 2 external wall/ceiling

Figure 17: Bedroom 2 external wall/ceiling

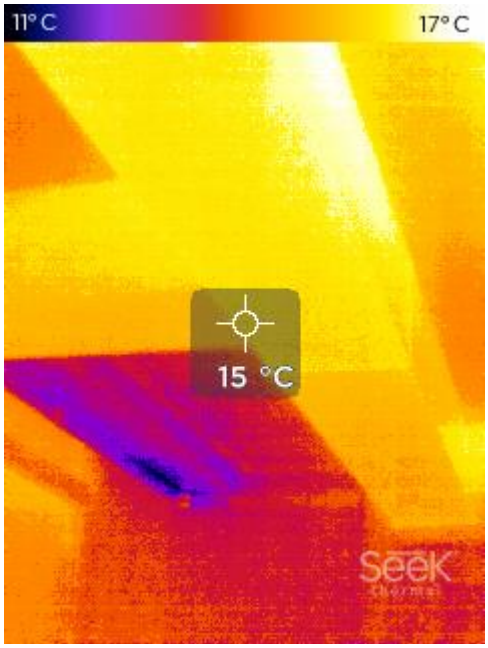

Figure 18: DH piping network in landing area

Figure 19: Flat door and DH piping

Kintore Tower 1st Floor Flat 6

The final flat studied was flat 6 on the first floor in the Kintore tower. This Flat is slightly different, they chose not to have the solarium area installed and keep a larger living room. This flat is of particular interest as it is on the first floor which is perceived to be colder, due to it being located directly above the outdoor bin area. There is no insulation between the ground and first floor, only a layer of concrete. Figure 20 shows there are cold area in the living room around where the balcony would have been previously. The next three images (Figures 21, 22, 23) shows the floor in the living room and kitchen. The tenants have complained of draughts and cold spots, and from these images their observations can be justified. There are noticeable colder areas, especially around the corners. Figures 24 and 25 also show noteworthy cold area around the floor in bedroom 1. Finally Figures 26 and 27 again show the heat loss from the DH piping in the landing area.

Figure 20: Living room window/ceiling

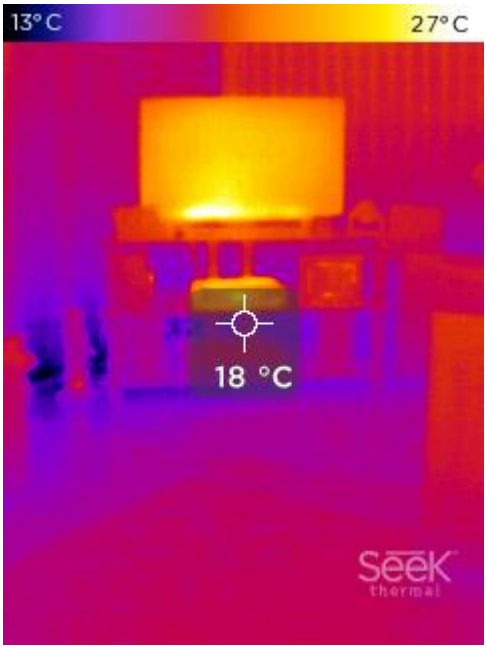

Figure 21: living room floor (1)

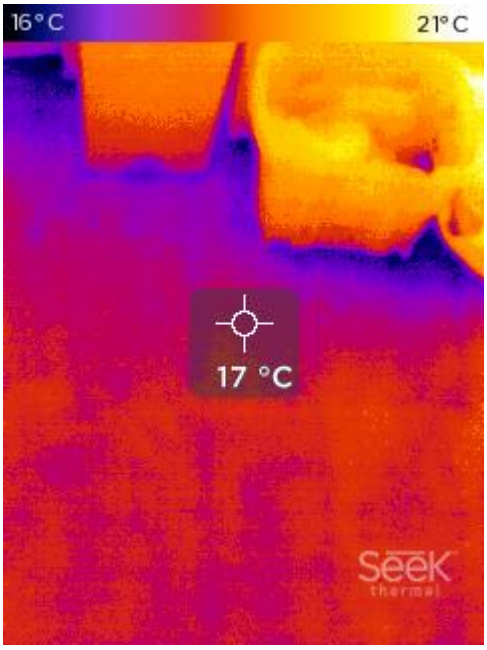

Figure 22: Living room floor (2)

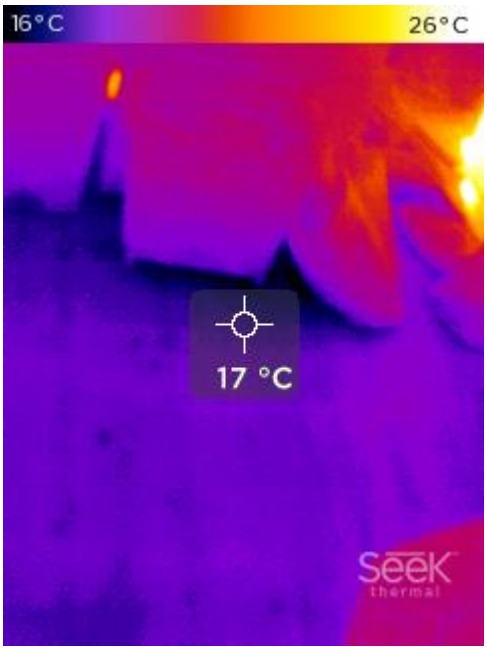

Figure 23: Kitchen floor

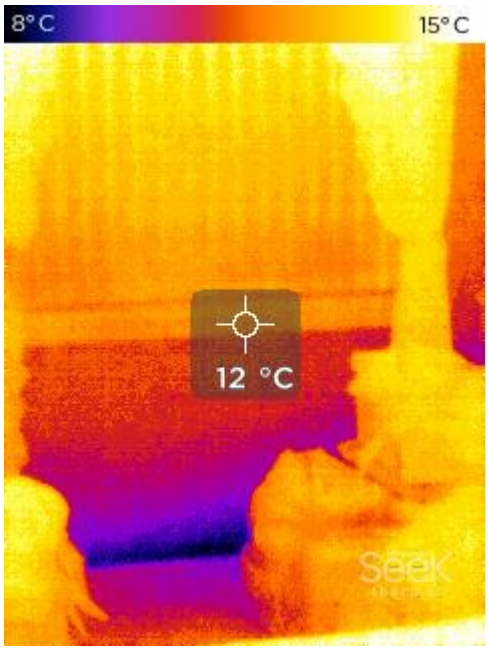

Figure 24: Bedroom 1 window/floor

Figure 25: Bedroom 1 window

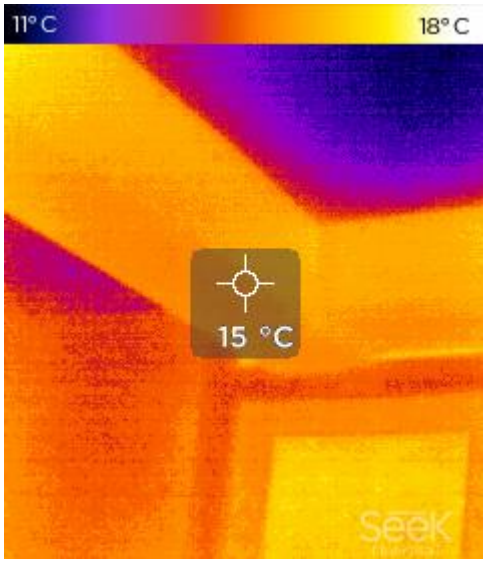

Figure 26: DH piping network in landing area

Figure 27: Flat door and DH piping

Tower External/ Other

Several images were also taken of the towers externally. From the images shown in Figures 28, 29, and 30 there is no obvious areas of heat loss which is evidence the external cladding is operating as intended. Figures 32 and 33 show a section of the DH piping in the bin area on the ground floor. From this the only obvious heat loss is through the manual flow controllers which must be left exposed to allow access, so the insulation is retaining most of the heat as it should. Figure 31 shows the ceiling of the bin area. Figures 34 and 35 show the storage area. These are valuable as the first-floor flats are located directly above. The surface temperatures show 0ºC and 3ºC, suggesting that cold floor areas in the first-floor flat are due to the lack of insulation in-between the two floors.

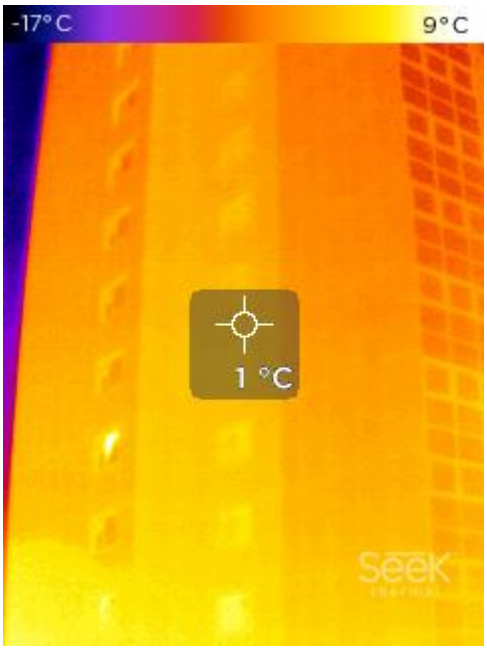

Figure 28: Arran tower external (1)

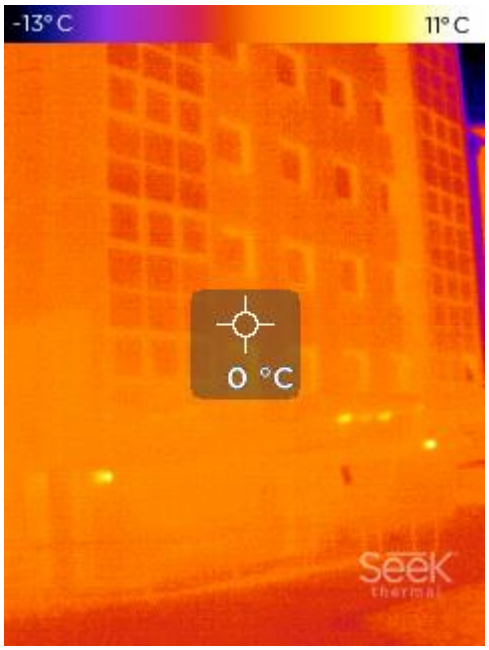

Figure 29: Arran tower external (2)

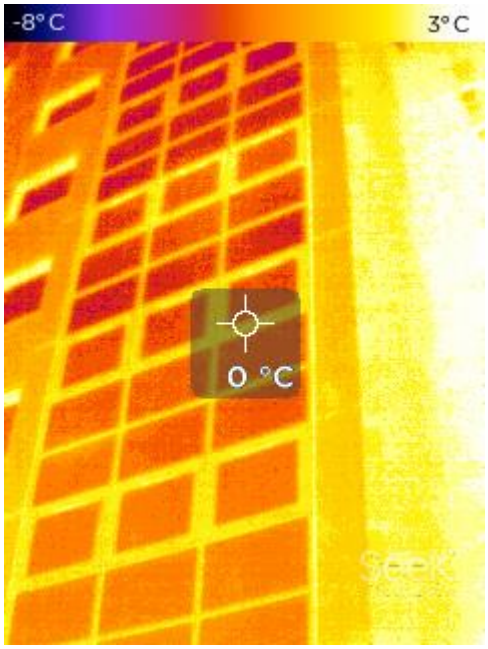

Figure 30: Arran tower external (3)

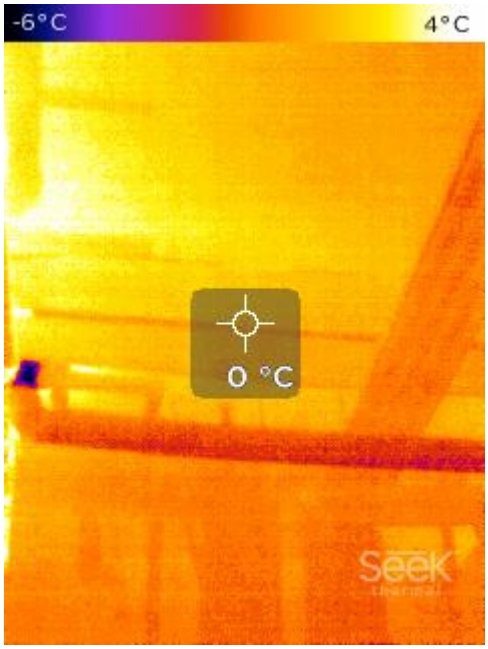

Figure 31: Kintore tower bin area ceiling

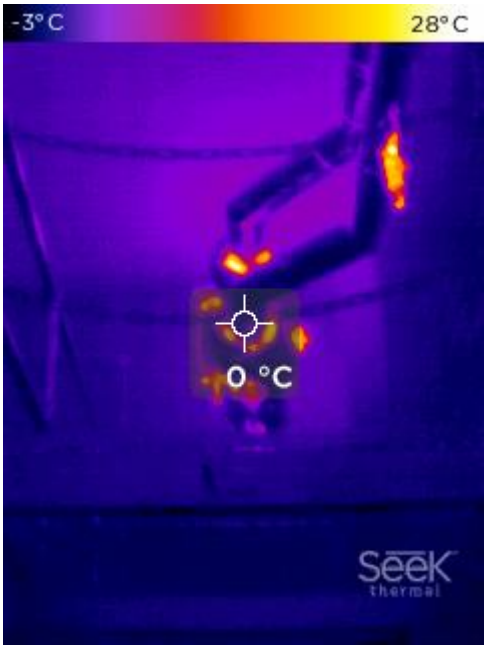

Figure 32: DH piping with insulation

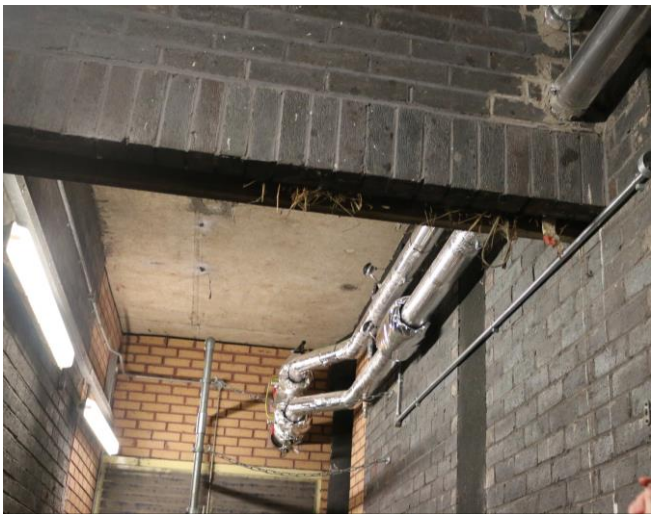

Figure 33: DH piping with insulation

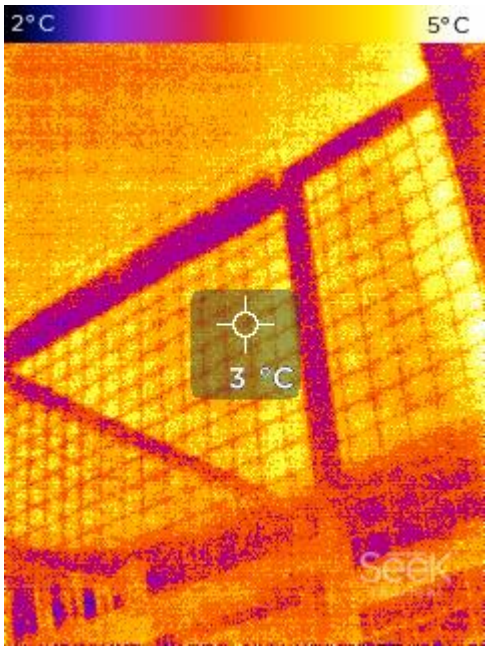

Figure 34: Kintore tower storage area ceiling

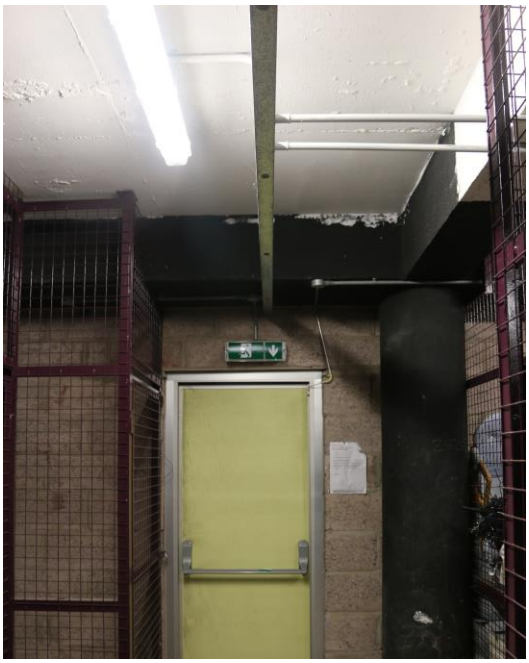
Figure 35: Kintore tower storage area

Conclusion

Overall, it is clear that the upgrades installed in the high-rise towers have had the desired result. There are minimal heat losses in the flats, and those that are noticeable in many cases are expected or generally unavoidable without greater investment and improved technology. One noticeable area which could be upgraded is the lack of insulation between the bin and storage areas on the ground floor and the first-floor flats. The site visit provided an important chance to collect data for our group's main project.

Appendix

Data Collection form

Building: ARRAN
FLAT No. 19 FLOOR: 4 LOBBY
TEMP: 15.9°C
LOCATION:
TIME IN/OUT: 6.37pm /6.48pm

Heating was set to 22°C

		Thermal Picture taken	Thermal Image reference	DSLR
Living Room T = 18.4°C Φ=48% Terrace T=18.6°C	Living Room External Wall	✓	133	
	Ceiling	✓	134	
	Floor	✓	135	
	Internal glazing living room	✓	136	
	Internal glazing close up living room	✓	137	769
	Living room thermal bridge	-	-	
	External glazing living room	✓	139	
	Close up glazing window	✓	142	770
Kitchen T=20°C Φ=50%	Kitchen window	✓	141	
	Close up of kitchen window frame	✓	144	772
Corridor T=20.8°C Φ=44%	HIU			
	Entrance			
	Outside	✓	159	
	Piping in lobby			
Bathroom T=20.8°C Φ=45%	Extractor shower	✓	145	773
		✓	161,162	
Bedroom 1 T=20.9°C Φ=43%	Room 1 window	✓	147	
	Room 1 close up window	✓	148	774
Bedroom 2 T=20.8°C Φ=43%	Room 2 window	✓	152	
	Room 2 close up window	✓	154	776

Building: BUTE
FLAT No. 46 FLOOR: 8 LOBBY TEMP: 19.6°C

LOCATION:

TIME IN/OUT: 6.11pm / 6.30pm

		Thermal Picture taken	Thermal Image reference	DSLR
Living Room T = 19.9°C	Living Room External Wall	✓	103	
	Ceiling	✓	101	
	Floor	✓	102	
	Internal glazing living room	✓	104	
	Internal glazing close up living room	✓	106	755
	Living room thermal bridge			
	External glazing living room	✓	107	
	Close up glazing window	✓	108	756
Kitchen T = 20°C	Kitchen window	✓	109	
	Close up of kitchen window frame	✓	110	758
Corridor T =20°C	HIU	✓	123	
	Entrance	✓	125	
	Outside	✓	127	766
	Piping in lobby	✓	128	767
Bathroom T =20°C	Extractor shower	✓	113	762
Bedroom 1 T =19.9°C	Room 1 window	✓	120	
	Room 1 close up window	✓	121	761
	corner	✓	122	760
Bedroom 2 T =19.9°C	Room 2 window	✓	114	
	Room 2 close up window	✓	115	763
	corner	✓	117	764

Building: KINTORE
FLAT No. 6 FLOOR: 1 LOBBY TEMP: 14.9°C

LOCATION:
TIME IN/OUT: 6.55pm /19.10pm

		Thermal Picture taken	Thermal Image reference	DSLR
Living Room T = 21.5°C Φ=53%	Living Room External Wall	✓	163	
	Ceiling	✓	164	
	Floor	✓	165	
	Internal glazing living room	✓	166	
	Internal glazing close up living room	✓	167	781
	Living room thermal bridge			
	External glazing living room			
	Close up glazing window			
Kitchen T = 19°C Φ=49%	Kitchen window	✓	174	
	Close up of kitchen window frame	✓	175	780
Corridor T = 21.2°C Φ=38.5%	HIU			
	Entrance			
	Outside			
	Lobby piping			
Bathroom T = 21.6°C Φ=38%	Extractor shower	✓	188	789
Bedroom 1 T = 21.3°C Φ=39%	Room 1 window	✓	184	
	Room 1 close up window			787
	corner	✓	185	786
Bedroom 2 T = 21.6°C Φ=38%	Room 2 window	✓	180	
	Room 2 close up window			785
	corner	✓	181	786

Location	Description	Ambient Temp	Thermal Image reference	DSLR
Building	Piping In the building		193	
	Lobby under the flat	16°C	198	
	Room with bins	12.4°C		