Introduction

Radiators are designed to emit heat out into a room, ideally providing an even heat distribution throughout. However, according to industry experts, up to 80% of the heat emitted by a radiator is convected via a heat plume from the top of the radiator. This warm air rises and collects at the ceiling causing thermal stratification.

The Radfan addresses this problem by redirecting the warm air plume horizontally out into the inhabited space, generating a more uniform heat distribution. Data presented in this digest shows typical results of tests conducted over a 6 month time period in Newcastle Upon Tyne from October 2011 to March 2012 in a 2 bedroom semidetached house.

Equipment and set up

The experimental setup comprised of 29 Maxim DS18B20 One-Wire temperature sensors, accurate to +/- 0.5 °C, distributed throughout a room of width of 3.3 m, length 4.1 m and height 2.35 m. The room had a double glazed window (W: 1.2 m, H: 1.15 m) and a single panel single convector radiator directly beneath that (W: 1 m, H: 0.3 m) to which the Radfan was affixed.

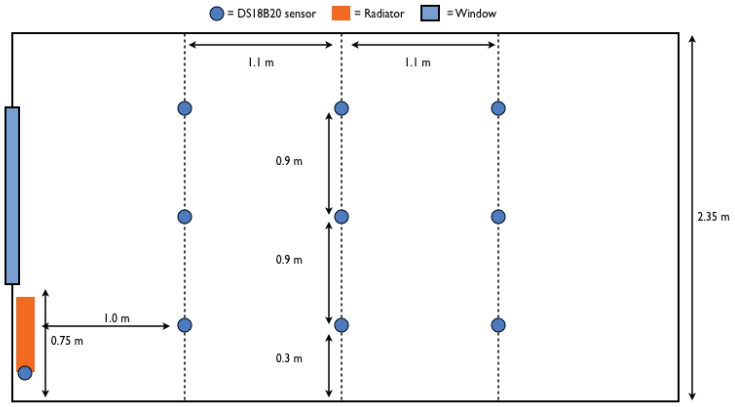

Figure 1: Cross sectional profile of the test room

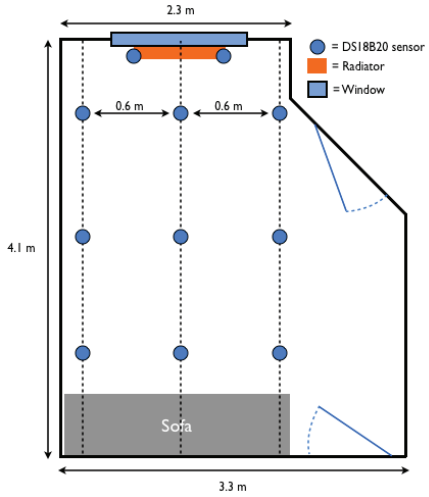

Figure 2: Plan view of test room

The boiler was a condensing boiler set to its maximum setting as per the manufacture's instructions. The house thermostat is located in the room adjacent to the test room and was set to 22 °C, the thermostatic valve on the radiator is set to position 4 (out of 5).

Results

The data in figure 4 shows the response of the three temperature sensors furthest from the radiator (marked V, W, X in figure 1). For the first hour the room was heated without the Radfan on the radiator. The Radfan is then placed on the radiator and turned on. It is clear that there is significant stratification in the room prior to the Radfan being placed on the radiator, once the Radfan is installed this stratification is reduced as the warm air on the ceiling is redistributed. At 60 minutes the stratification at this point in the room is 3.2 °C, after the Radfan is installed, this decreases to 2 °C with the temperatures at 2.1 m and 1.2 m exhibiting a difference of 0.3 °C, shown by data in figure 3.

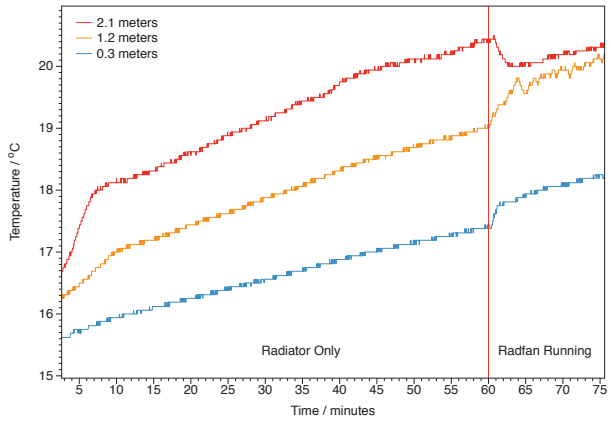

Figure 3: Data from sensors VWX showing the destratification effect of the Radfan. The external temperature at the start of the test was 4 °C and at the end was 3 °C

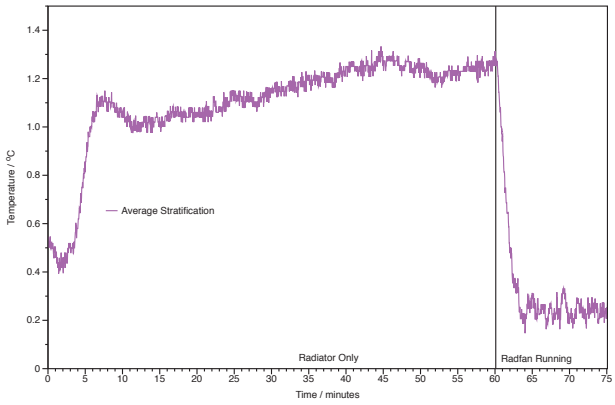

Figure 4: Average air stratification between heights 2.1 m and 1.2 m as a function of time

Data presented so far is for the temperatures at points V, W and X in the room, furthest from the radiator. A more general representation is shown by the data in figure 4. The data in figure 4 is the difference between the average temperature at 2.1 m and 1.2 m on line X1 in figure 2. The data shows a clear overall destratification of the room.

Localised radiator testing

To determine how the Radfan causes this change in the room a localised test around the Radfan was conducted. The image in figure 5 shows the set up for this where a string of 3 sensors was placed 30 cm above the radiator and another string placed 30 cm in front of it. Figure 6 shows the results of the localised temperature test. The Radfan was enabled at 20 minutes and sensor E (above the radiator) and sensor T (in front of the radiator) recorded a change from 37 °C to 31 °C and 22 °C to 30 °C respectively. This indicates a redirection of the warm air plume. Sensors F, D, U and S showed little variation.

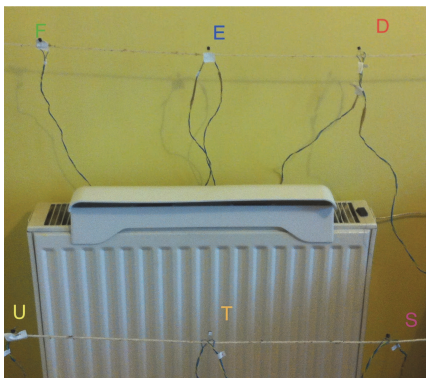

Figure 5: Results from localised temperature test around a radiator and radiator with Radfan (Pictured Radfan is an earlier prototype with the same dimensions as that described in the introduction).

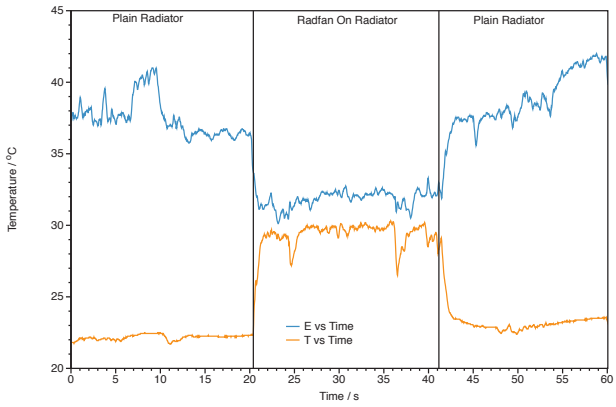

Figure 6: Results from localised temperature test around a radiator and radiator with Radfan

Conclusion

The collected data shows that Radfan may be able to improve the thermal distribution within a room. It has done this by redirecting the flow of the warm air out into the the room allowing it to circulated more effectively in the inhabited space. There is still a gradient from the ceiling to the floor however this is much reduced from just a standalone radiator.