The Impact of Floor Insulation Across 100 Homes

Q-Bot has developed the first affordable and fully accredited solution for the retrofit of insulation to suspended timber floors. The results of this case study across 100 homes show that the measure reduces heat loss by 80% through the floor and cold draughts by 1/3 for the whole house. Compared with other options to upgrade energy efficiency Q-Bot is the most cost-effective solution available, after loft insulation. The average cost was £2,400 per install, with an improvement of 6 EPC points per home, resulting in a cost of £400 per EPC point gained. All of the customers were satisfied with the install and 9 out of 10 would recommend Q-Bot to their neighbours.

“I am much warmer, and I’m saving £20 per month on bills. I love Q-Bot, it has made a massive difference. There are now no draughts.”

– Customer, NW London

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 698607.
The Impact of Floor Insulation

As part of a drive to improve energy efficiency and reduce fuel poverty, several Housing Associations have worked with Q-Bot to install underfloor insulation across the UK. This case study shows the impact on comfort and energy savings of the service.

100 properties were selected to include a wide range of housing types, different ages and sizes. The energy savings achieved by the upgrades were modelled in SAP using elemental U-values for the individual floors and the airtightness test results of each property. This enabled the energy improvements to be calculated against a range of scenarios with alternative retrofit measures. In addition, a pre and post installation questionnaire provided qualitative feedback from customers.

Impact

The installation of floor insulation significantly improved thermal comfort with fewer cold draughts and much more even temperatures within the house. The results show, on average, a 31% improvement in airtightness and a 79% reduction in the heat loss through the floor.

Q-Bot’s solution for the insulation of suspended floors was shown to be the most cost-effective retrofit measure available, after loft insulation. The average cost was £2,400 per install, with an improvement of 6 EPC points per home, resulting in a cost of £400 per EPC point gained. In addition, due to the innovative installation process, there was minimal disruption for the Housing Association’s customers.

Customer Feedback

100% of the occupants said they were ‘Satisfied’, or ‘Very Satisfied’ with the installation and 86% scored Q-Bot 7 or higher on a survey of how likely would you recommend Q-Bot (where 1 stood for ‘not at all’ and 10 for ‘highly recommend’).

Q-Bot’s non-disruptive nature has received praise from residents:

"Wow, what a fantastic team you have. I had excellent communication from the start. Great work carried out by a clearly competent team and my house was left better than it was when they came."

Customer, Argyll & Bute

2/3 of respondents have noticed a significant reduction in energy bills of between £150 and £240 per year:

"I am much warmer, and I'm saving £20 per month on bills. I love Q-Bot, it has made a massive difference. There are now no draughts."

Customer, NW London.
Summary

Key Outcomes from the pilots

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Floor heat loss (U-value)</th>
<th>Draughts (Air Permeability)*</th>
<th>Space Heating Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before (average)</td>
<td>0.90 W/m²K</td>
<td>16.8 m³/m².h @50Pa</td>
<td>13,300 kWh/yr</td>
</tr>
<tr>
<td>After (average)</td>
<td>0.19 W/m²K</td>
<td>11.5 m³/m².h @50Pa</td>
<td>11,100 kWh/yr</td>
</tr>
<tr>
<td>Reduction (average)</td>
<td>79%</td>
<td>31%</td>
<td>17%</td>
</tr>
<tr>
<td>EPC Points Improvement</td>
<td></td>
<td></td>
<td>6.0</td>
</tr>
<tr>
<td>Total Carbon Emissions Savings (all 100 homes, over 42 years)</td>
<td></td>
<td>3,060,000 kgCO₂e</td>
<td></td>
</tr>
</tbody>
</table>

*An average was used when specific results were not available.

48 homes now comply with the Part L1A requirement for new build dwellings of <= 10 m³/ m².hr @50Pa (there are no regulations covering airtightness in existing properties).

The U-value of the floor in 99 homes now complies with the Part L1B requirement for upgrading retained thermal elements in existing dwellings of <= 0.25 W/m².K

86% of residents would recommend the service
The most cost-effective solution available
31% reduction in draughts
79% reduction in heat loss

Fig 2. One of Q-Bot robots in action.
Fig 3. A resident enjoying a warmer home.
Results

Reduction in Air-Permeability

The air-permeability of the properties was tested according to the ATTMA Technical Standard to comply with BS EN 13829:2001. Of the 100 properties with air-permeability results, 45 did not have a pre-installation pressure test (mainly due to being ‘too leaky’ to pressurise). For these cases, a “pre-install” air permeability was estimated using the average improvement of the other properties for each Housing Association. All the post-installation results were measured directly for each of the 100 properties, with the average of post-installation test results of 11.5 m³/m².hr. The before and after test results demonstrated an average 30% improvement in airtightness.

![Air Permeability Graph]

48 homes now meet the building regulations air permeability threshold for new builds.

Improved U-Values

The U-values for both pre- and post-installation conditions, were calculated using actual measurements of the floors, vents, perimeter walls and physical site conditions within 100 homes (in accordance with ISO 13370:2007). The pre-installation U-values for the floors were, on average, 0.90 W/m²K. The post-installation U-values were, on average, 0.19 W/m²K, which constitutes a 79% improvement, and meets the Part L1B requirements for elemental U-values of floors in existing buildings.

![U-Value Graph]

99 homes now meet the requirement of Part L Building Regulations for upgrades to existing buildings.
Energy Savings and Cost Effectiveness

The comparison of annual energy savings of Q-Bot’s floor insulation with a range of standard retrofit measures was calculated using SAP. Q-Bot’s solution was shown to provide the most cost-effective measure after loft insulation, at an average cost of £400 per EPC point. It also produced an average annual energy saving of £151, with properties saving up to £665 per year. The average EPC improvement across the range of properties was 6 points.

The average sales price for the installs was £2,400 per property based on a minimum volume per year.

Average Annual Energy Savings (£ saved per year)

Average Cost (£/EPC Point)

Comparison with Different Measures

When compared with other potential retrofit measures, Q-Bot is approximately half the cost of EWI and IWI. It has a lower calculated cost per EPC point and both of these measures would involve significantly more disruption to those living in the property, as well as enabling works, redecoration and removal/replacement of furniture (the cost of which is not included in the comparison above). Neither IWI or EWI would remove cold draughts originating from the floor.
Example
Semi-Detached House

A three bedroom two storey house in West Scotland was insulated as part of the pilot. The house was a semi-detached house built between 1980 and 2000 and had $40\text{m}^2$ of suspended timber floor. The property was not connected to the national gas grid and had loft and external wall insulation as well as double glazed windows. 150mm of insulation was installed between the joists and 25mm below the joists. This resulted in an annual energy saving of £652 per year and will pay back within 5 years. Q-Bot improved the energy performance rating of the house by two bands, from G to E, and a carbon emissions reduction of 108,000 kgCO$_2$e over the 42 year lifespan of the insulation.

Property Details

Suspended floor area: ........................................... 40m$^2$
Area sprayed: ...................................................... 38.7m$^2$
External wall area: .............................................. 37m$^2$
Window area: ...................................................... 13m$^2$

The price of the install was £3,100.

<table>
<thead>
<tr>
<th>KPI</th>
<th>Before</th>
<th>After</th>
</tr>
</thead>
<tbody>
<tr>
<td>EPC Score</td>
<td>G 20</td>
<td>E 41</td>
</tr>
<tr>
<td>Annual Heat Cost</td>
<td>£1,980</td>
<td>£1,330</td>
</tr>
<tr>
<td>Annual CO$_2$e</td>
<td>7,360 kgCO$_2$e/yr</td>
<td>4,790 kgCO$_2$e/yr</td>
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<tr>
<td>Air Permeability</td>
<td>55 m$^3$/m$^2$/h@50Pa</td>
<td>38 m$^3$/m$^2$/h@50Pa</td>
</tr>
<tr>
<td>Floor U-Value</td>
<td>1.16 W/m$^2$.K</td>
<td>0.18 W/m$^2$.K</td>
</tr>
</tbody>
</table>

Fig 4. Semi-detached house in West Scotland.

Fig 5. Before the installation.

Fig 6. After the installation, showing the insulation now applied.

Pays back the initial investment in 5 years.

Cost per SAP Point

- Q-Bot
- Traditional Underfloor
- Draught Proofing
- Double Glazing
- Top Up Loft Insulation

£4,539

www.q-bot.co
Example
Terraced Ground Floor Flat

A one bedroom, ground floor flat, in Northwest London was insulated as part of the pilot. The flat was built between 1950 and 1980 with solid wall construction and had $40m^2$ of suspended timber floor. 150mm of insulation was installed between the joists and 25mm below the joists. This resulted in an EPC points improvement of 2.8, and a carbon emissions reduction of $14,200kgCO_2e$ over the 42 year lifespan of the insulation.

Property Details

Suspended floor area: ........................................... 40m$^2$
Area Insulated: .................................................. 36m$^2$
External wall area: ............................................. 65m$^2$
Window area: .................................................... 10m$^2$

The price of the install was £2,160.

<table>
<thead>
<tr>
<th>KPI</th>
<th>Before</th>
<th>After</th>
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</thead>
<tbody>
<tr>
<td>EPC Rating</td>
<td>D 54.6</td>
<td>D 57.4</td>
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<tr>
<td>Annual Heating Cost</td>
<td>£950</td>
<td>£870</td>
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<tr>
<td>Annual CO2e</td>
<td>4,100 kgCO2e/yr</td>
<td>3,700 kgCO2e/yr</td>
</tr>
<tr>
<td>Air Permeability</td>
<td>14.3 m$^3$/m$^2$.h@50Pa</td>
<td>9.1 m$^3$/m$^2$.h@50Pa</td>
</tr>
<tr>
<td>Floor U-Value</td>
<td>0.82 W/m$^2$.K</td>
<td>0.17 W/m$^2$.K</td>
</tr>
</tbody>
</table>

Fig 7. Terraced ground floor flat in North London.

Fig 8. Before the installation.

Fig 9. After the installation, showing the insulation now applied.
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