Simulation of movable translucent aerogel shutters

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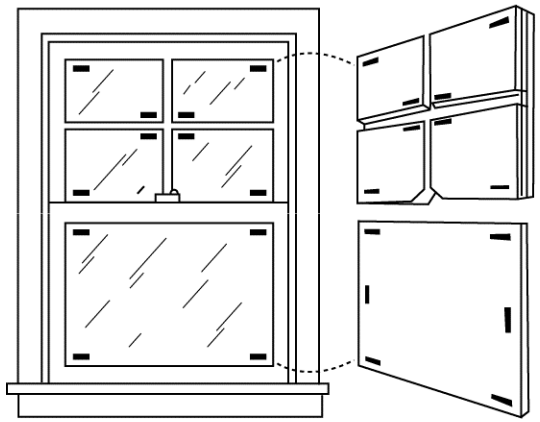
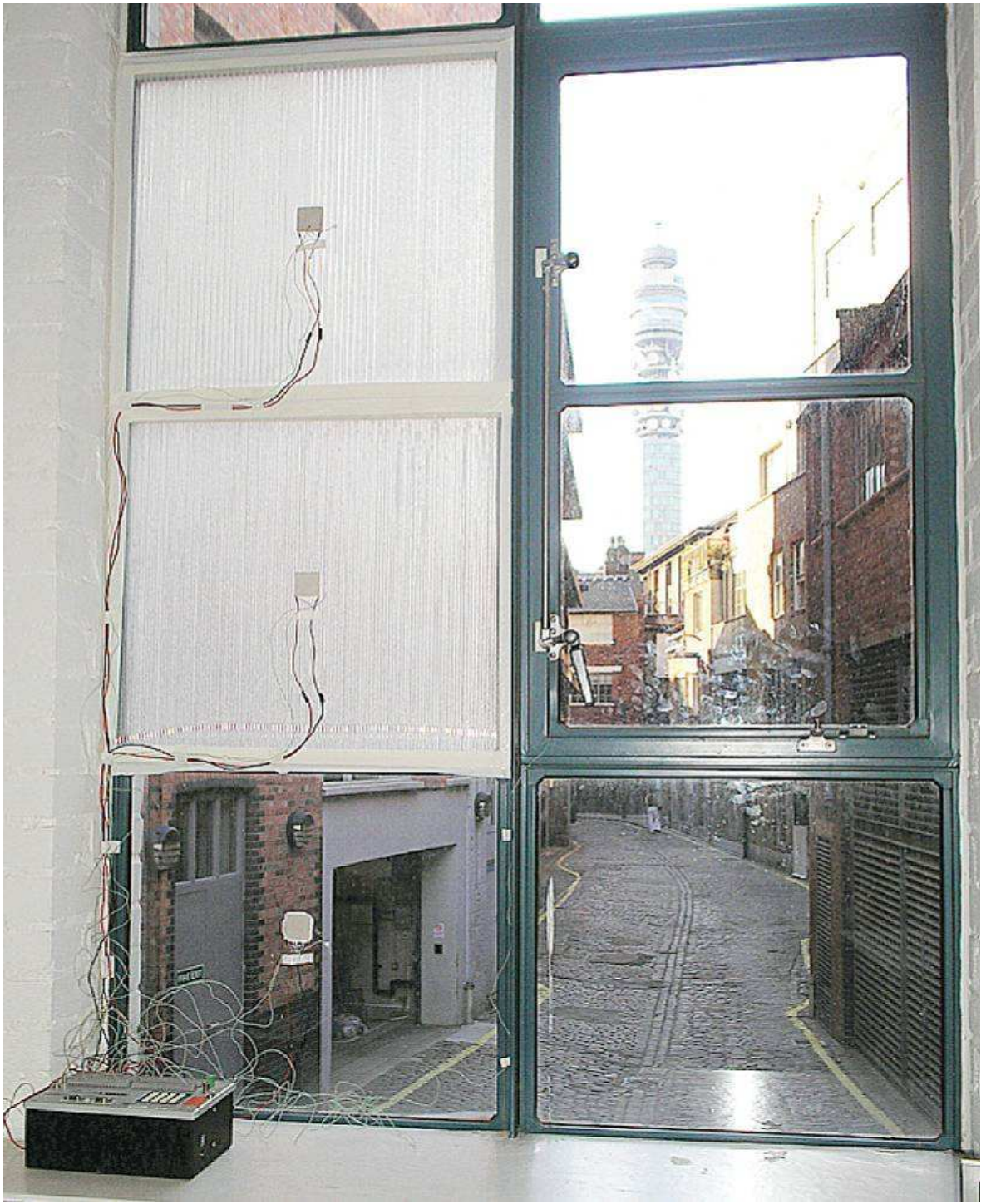
Moveable aerogel shutter

Magnetic removable shutters





Dowson, M., 2012.
Novel retrofit technologies incorporating silica aerogel for lower energy buildings.
Doctoral thesis, Brunel University.

Combinations

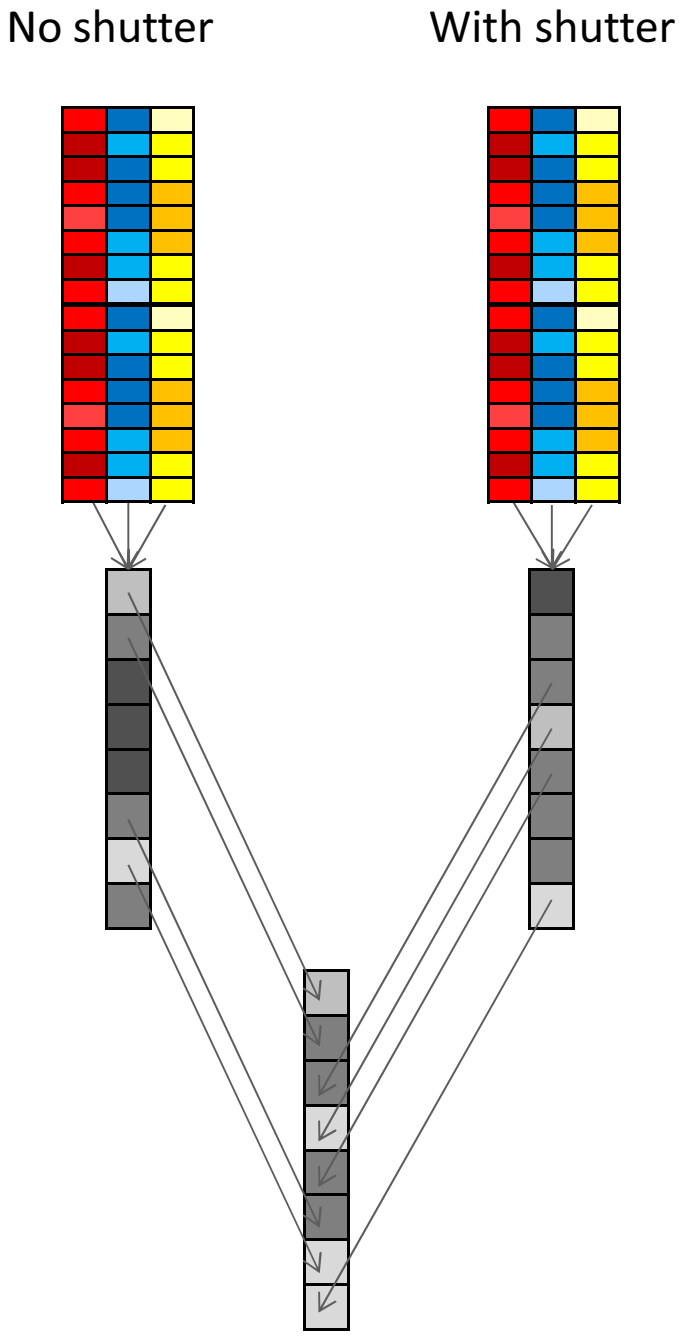
	U-value	G-value	Daylight	*Cost*
Single glazing	5.7	0.85	75%	-
Old double glazing	2.8	0.77	68%	-
New double glazing	1.8	0.54	64%	*££*
New triple glazing	0.8	0.36	55%	*£££*
Single glazing + aerogel shutter	1.17	0.51	51%	*£*
Old double glazing + aerogel shutter	0.95	0.45	45%	*£*

Simplified calculation approach

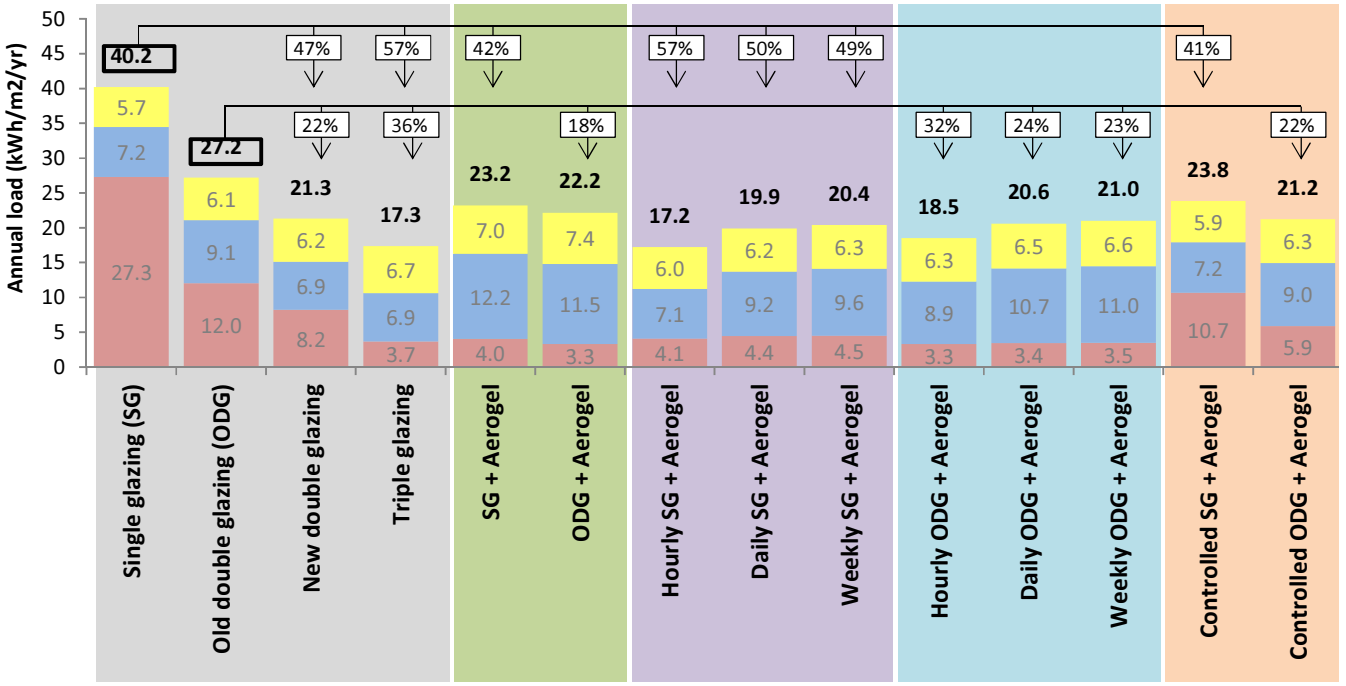
1. Run a dynamic thermal model for a whole year for each insulation level, manually or parametric model.

2. Sum the total energy use for each option at a specified frequency (hourly, daily, weekly).

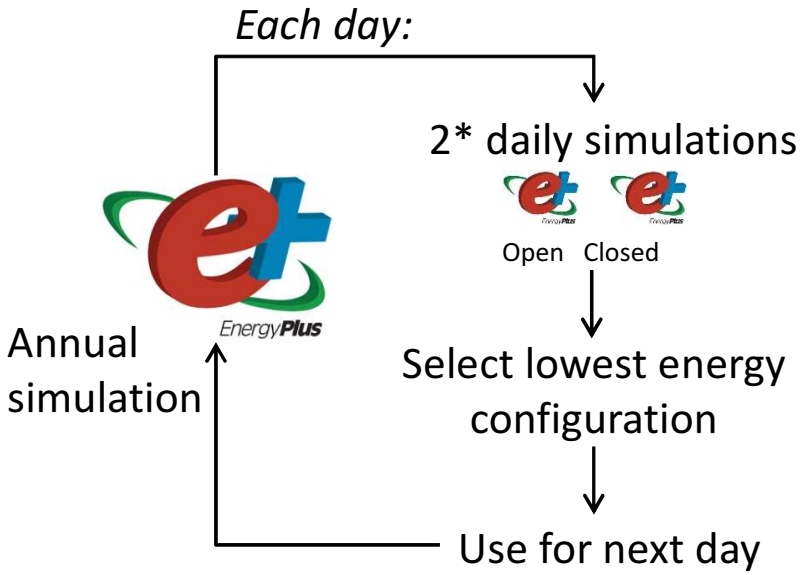
3. Select the option giving the minimum energy use for each period.

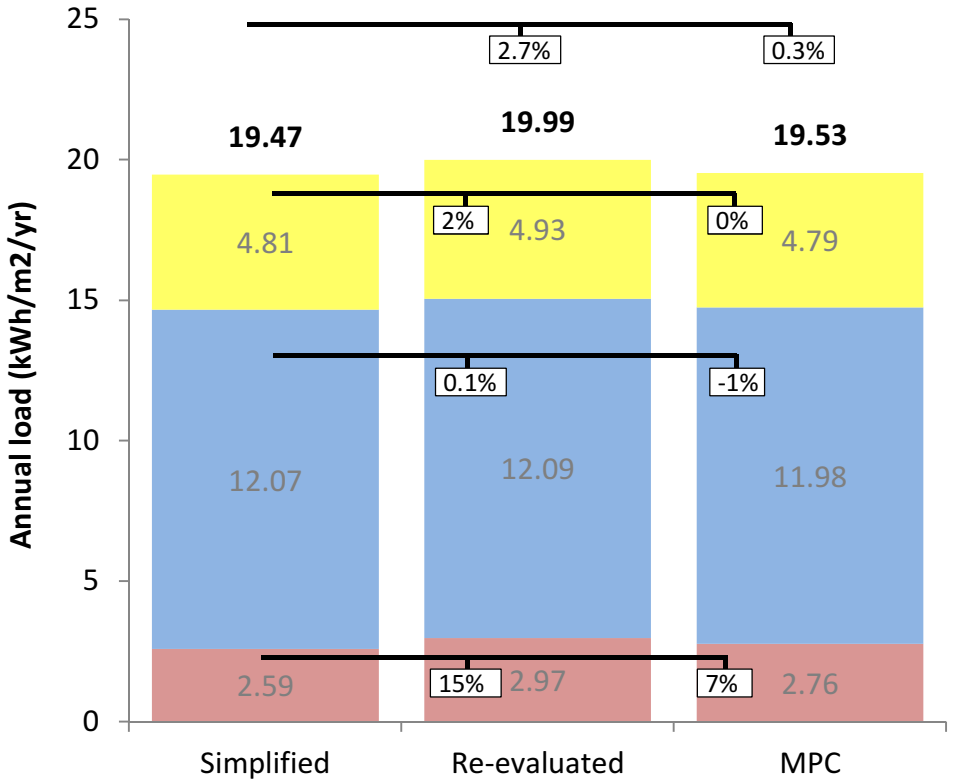


Results


Annual load (kWh/m2/yr)
50
45
40
35
30
25
20
15
10
5
0
40.2
5.7
7.2
27.3
27.2
6.1
9.1
12.0
47%
22%
21.3
6.2
6.9
8.2
57%
36%
17.3
6.7
6.9
3.7
42%
18%
23.2
7.0
12.2
4.0
22.2
7.4
11.5
3.3
57%
17.2
6.0
7.1
4.1
50%
19.9
6.2
9.2
4.4
49%
20.4
6.3
9.6
4.5
32%
18.5
6.3
8.9
3.3
24%
20.6
6.5
10.7
3.4
23%
21.0
6.6
11.0
3.5
41%
23.8
5.9
7.2
10.7
22%
21.2
6.3
9.0
5.9
Single glazing (SG)
Old double glazing (ODG)
New double glazing
Triple glazing
SG + Aerogel
ODG + Aerogel
Hourly SG + Aerogel
Daily SG + Aerogel
Weekly SG + Aerogel
Hourly ODG + Aerogel
Daily ODG + Aerogel
Weekly ODG + Aerogel
Controlled SG + Aerogel
Controlled ODG + Aerogel

Model predictive control





Conclusions

Good choice for single-glazed buildings

Can outperform triple-glazing if controlled hourly

Less effective on the south façade (cooling dominated)

Fixed aerogel shutters are effective on north façades (heating dominated)

Best possible combination:

- triple-glazing south
- hourly-controlled aerogel shutters on all other façades

Simplified calculation approach performed well

(within 3% when dynamic effects re-evaluated)

Model-predictive control gave very similar results