Floor Insulation and energy use, does more equal less?

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Introduction

- Ever increasing requirements for insulation to domestic extensions
- Where is the sense if the existing building remains largely un-insulated?

Undergraduate Dissertation [1]

- It was decided to test where the economic and environmental limit is when adding insulation in new extensions
- TAS from EDSL was used to compile the primary data

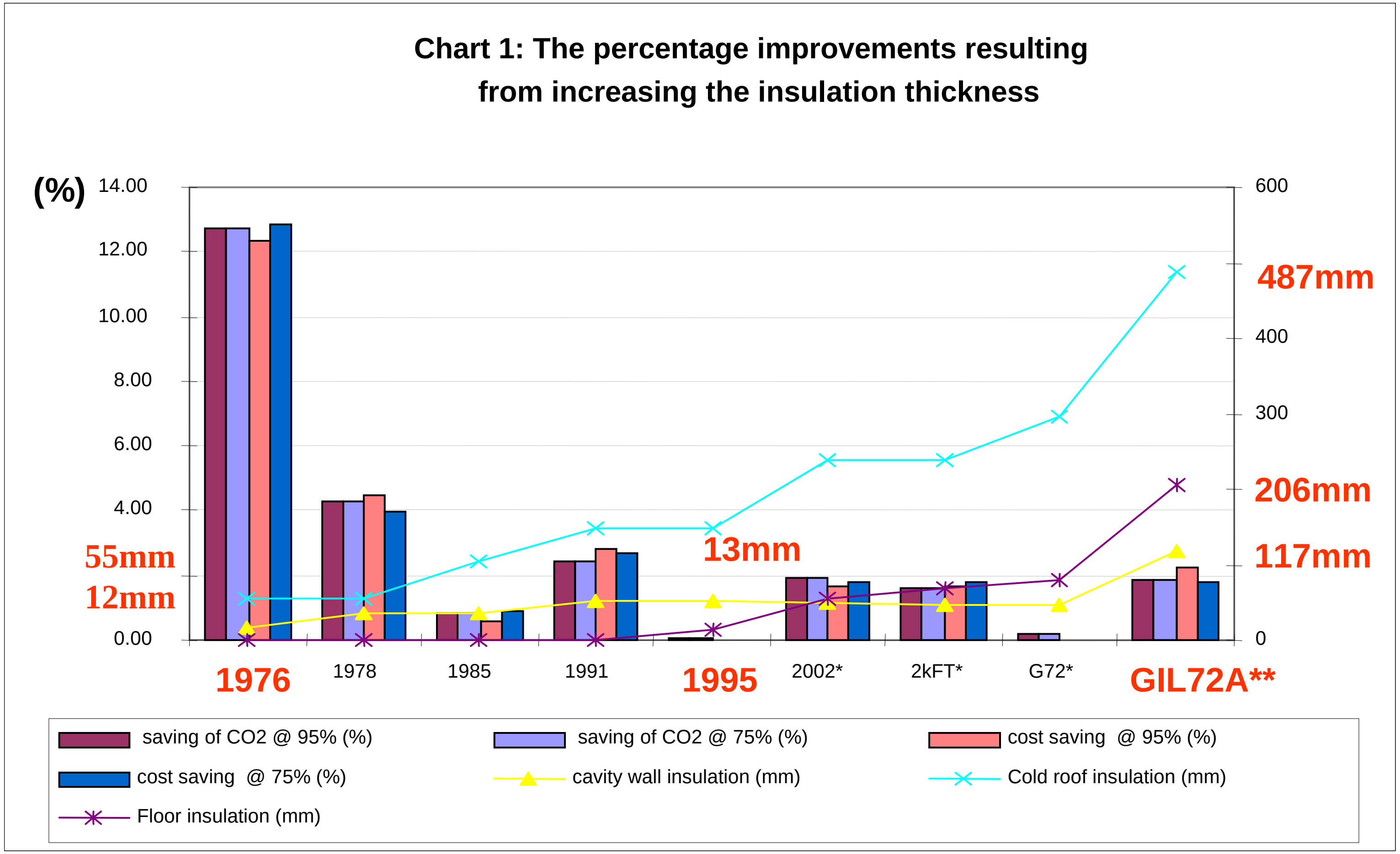
Research methodology

- Energy use relating to space heating was modelled
- Incremental changes were made to thickness of insulation.
- All other elements remained constant
- Results were measured in percentage savings relative to successive building regulation amendments

The Building in question

- Live project
- Designed and Completed in 2003

Results



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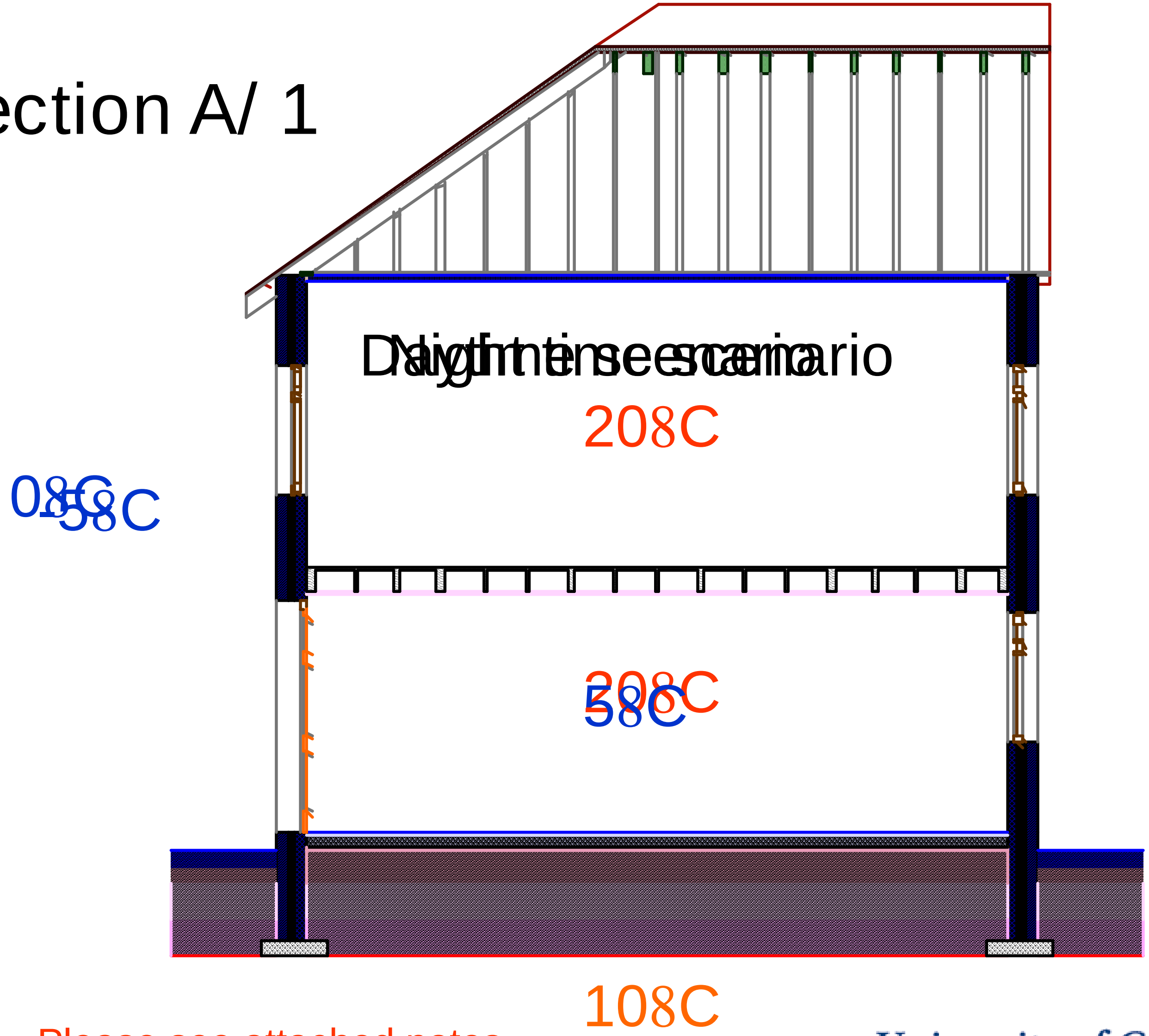
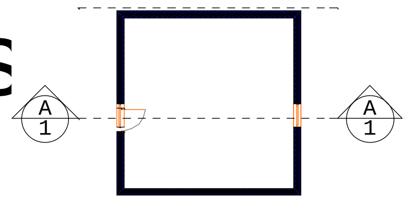
So can the results be eas

Section A/ 1





Existing uninsulated dwelling

Please see attached notes

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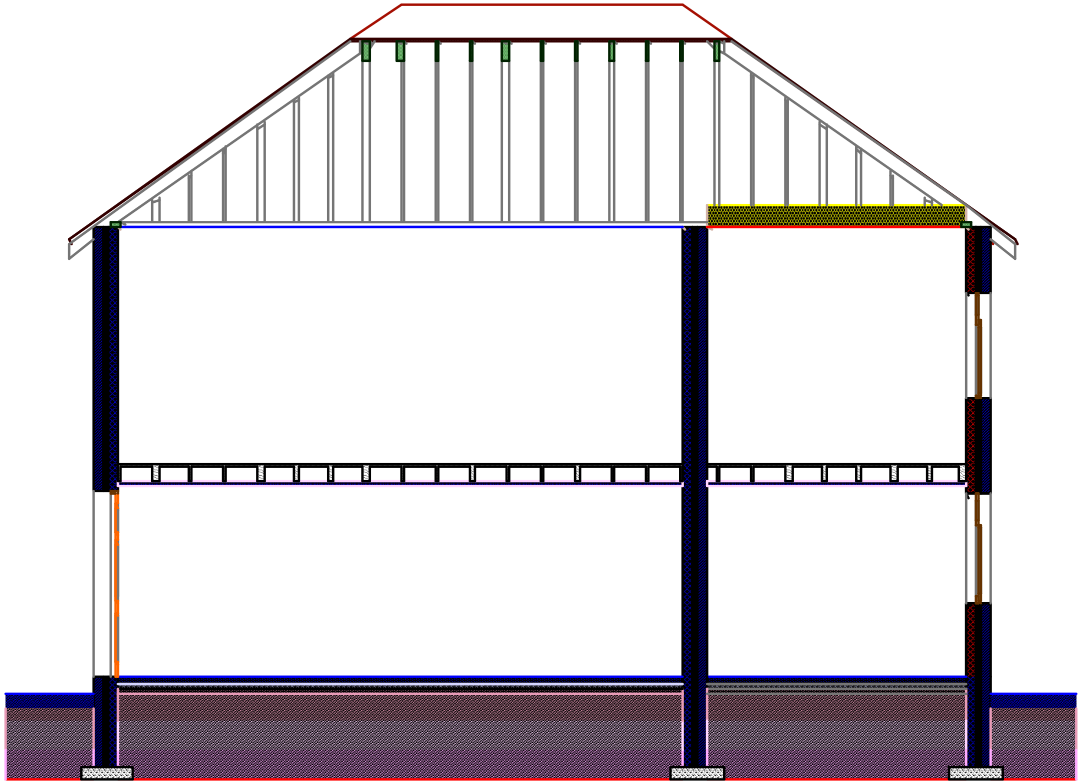
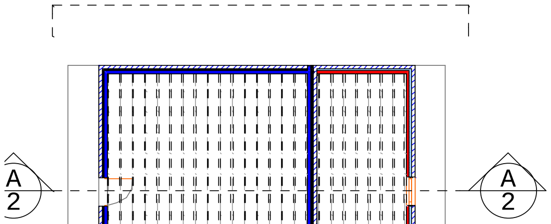
Section A/2





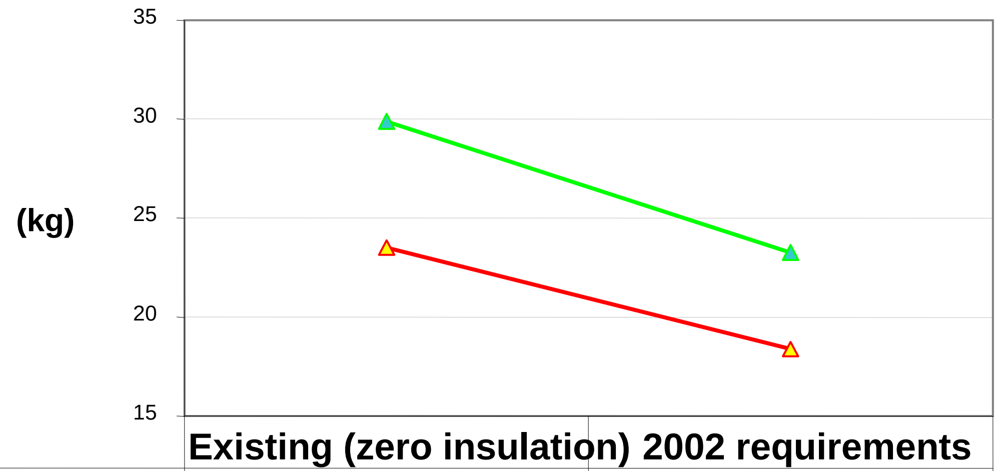
The addition of an insulated extension

Alternative strategy

- Simulations were also carried out at different gas boiler efficiencies
- To establish whether increasing boiler efficiency is a reasonable alternative
- The comparison is drawn between insulating the extension versus improving boiler efficiency by 20%

Boiler efficiency

Chart 2: Alternative methods of reducing CO_2 emissions



	Existing (zero insulation)	2002 requirements
95%efficiency	**23.544Kg**	18.325
75%efficiency	29.823	**23.212Kg**

332g

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Dissertation findings

- The inclusion of any insulation to solid floors in this scenario is economically and environmentally unjustifiable
- High efficiency boilers are an attractive method for reducing Carbon Dioxide emissions

Limitations

- The Dissertation findings only apply where an insulated extension is added to an un-insulated existing building.
- This may not be representative of the existing stock
- The simulation period is only 24 hours
- Fixed ‘moment in time’

Overcoming limitations

- It is recognised findings are considered by many to be counter-intuitive.
- The next step therefore was to model incremental changes to a complete dwelling

Beware of the blanket approach [2]

- Whole dwelling is modelled
- Substantial criticisms
- 24 hr simulation period
- Lack of reference to empirical studies

Stimulating simulations [3]

- Incorporated reference to measured studies
- Simulation period extended to a complete heating season
- Different soil conditions were modelled

Building for a Future model details

Model details	Model	soil type (1000mm)	carpet (mm)	screed (mm)	insulation (mm)*	concrete (mm)	dpm (mm)	Sand (mm)	agg (mm)	U-value (W/m^2C)**
Control based on BFF [1]	control	**b**	There is no insulation to any of the control model element							N/A
Inclusion of insulation to Part L1 standards for roof and walls [9]	1a	a	5	50	0	100	3	10	75	0.71
	1b	b	5	50	0	100	3	10	75	0.62
	1c	c	5	50	0	100	3	10	75	0.43
Additional Inclusion of insulation to Part L1 standards for floor [9]	2a	a	5	50	65	100	3	10	75	0.25
	2b	b	5	50	65	100	3	10	75	0.24
	2c	c	5	50	65	100	3	10	75	0.20
Additional Inclusion of insulation to EST Best Practice for floor [13]	3a	a	5	50	90	100	3	10	75	0.20
	3b	b	5	50	90	100	3	10	75	0.19
	3c	c	5	50	90	100	3	10	75	0.17
Additional Inclusion of insulation to EST Advanced Standard for floor [13]	4a	a	5	50	216	100	3	10	75	0.10
	4b	b	5	50	216	100	3	10	75	0.10
	4c	c	5	50	216	100	3	10	75	0.09

* insulation simulated has a density of $30kg/m^3$ a specific heat capacity of 1400 J/kg C and a conductivity of 0.025 W/m C

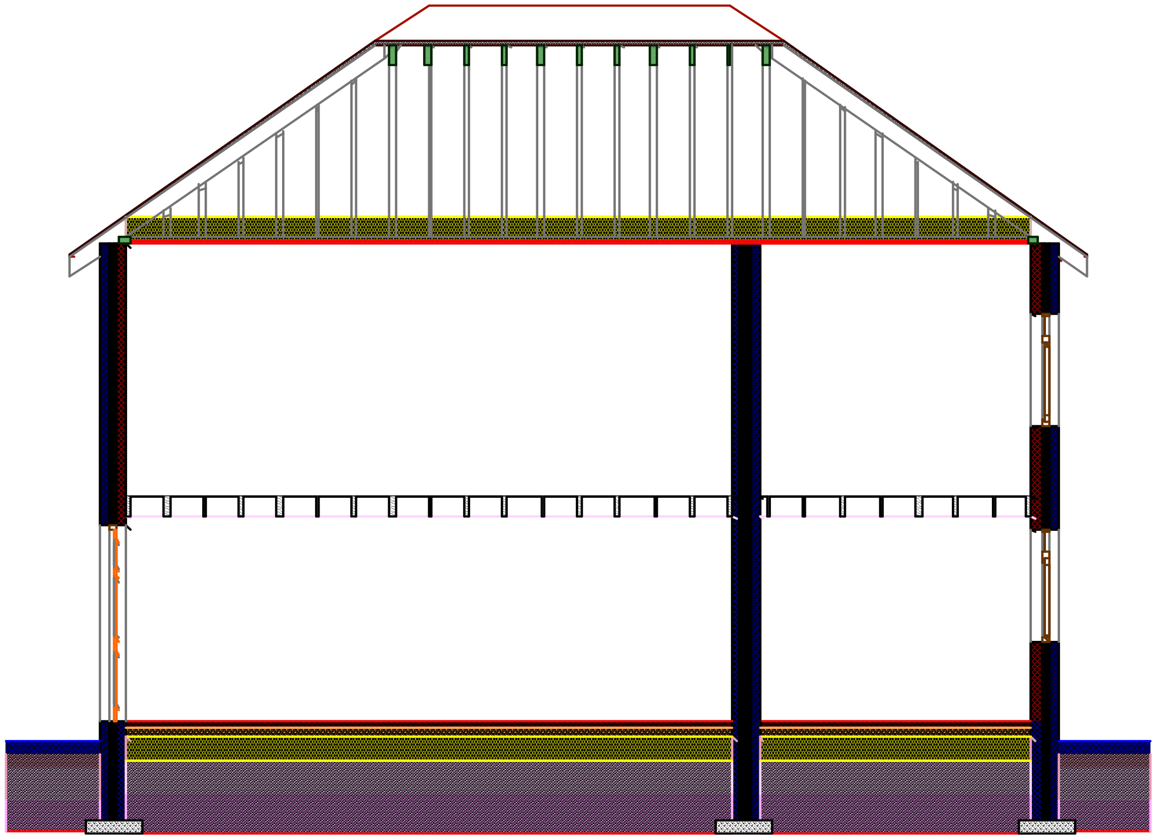
** U-values given are indicative only and depend upon the size and shape of the floor [ref]

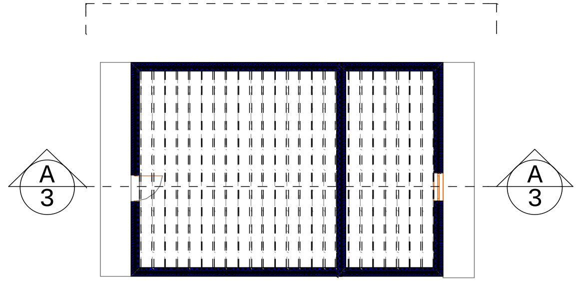
Soil type a: wet clay simulated has a density of $1762kg/m^3$ a specific heat capacity of 2512 J/kg C and a conductivity of 0.97W/m C

Soil type b: dry clay simulated has a density of $1800kg/m^3$ a specific heat capacity of 873 J/kg C and a conductivity of 0.81W/m C

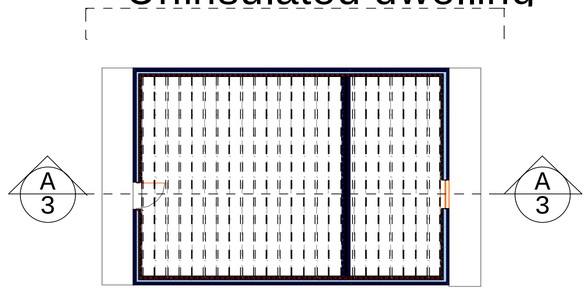
Soil type c: coarse gravelly earth simulated has a density of $2050kg/m^3$ a specific heat capacity of 1824 J/kg C and a conductivity of 0.52W/m C

Section A/3

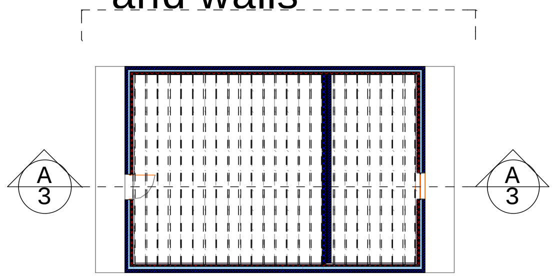




Uninsulated dwelling



The addition of insulation to ceilings and walls



The addition of 206mm insulation to the floor

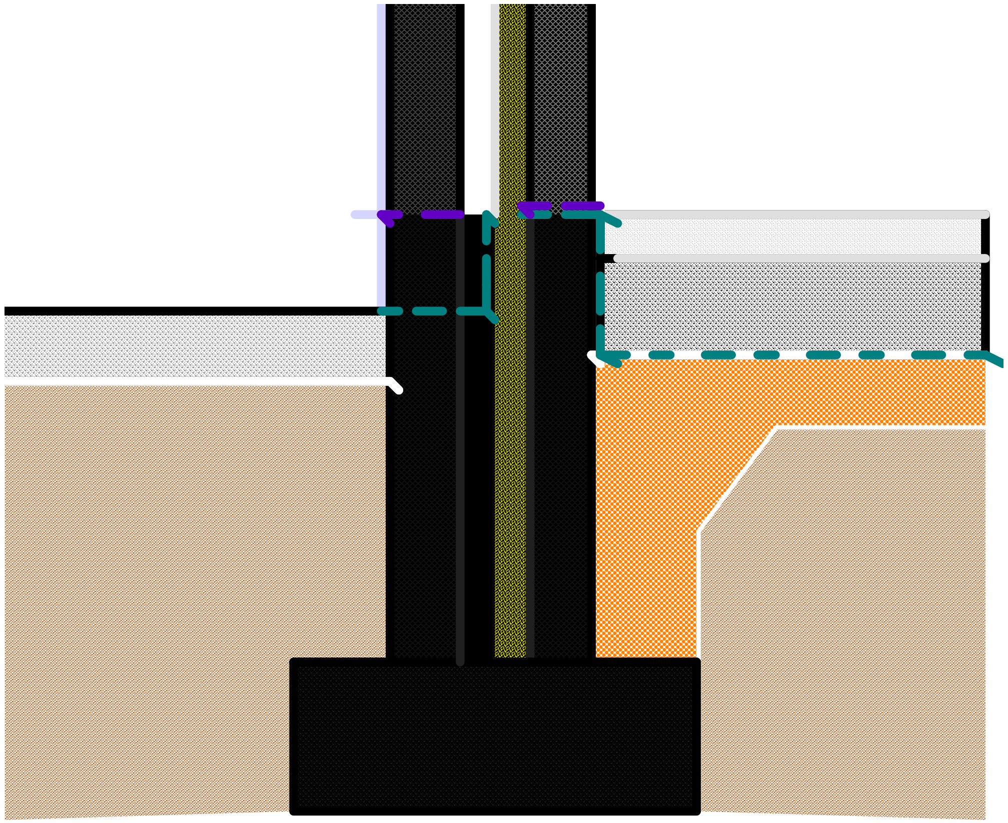
Building for a Future(2006) model results

Annual data			Inclusion of insulation to ADL1 standards for roof and walls [9]			Additional Inclusion of insulation to ADL1 standards for floor [9]			Additional Inclusion of insulation to EST Best Practice for floor [13]			Additional Inclusion of insulation to EST Advanced Standard for floor [13]		
		Control	1a	1b	1c	2a	2b	2c	3a	3b	3c	4a	4b	4c
Fuel use	(kWh)	18047	6706	6617	6409	6221	6207	6174	6156	6147	6117	6027	6024	6010
Fuel cost	(£)	£397	£148	£146	£141	£137	£137	£136	£135	£135	£135	£133	£133	£132
CO_2 emissions	(Kg)	3501	1301	1284	1243	1207	1204	1198	1194	1193	1187	1169	1169	1166

Annual savings			Inclusion of insulation to ADL1 standards for roof and walls [9]			Additional Inclusion of insulation to ADL1 standards for floor [9]			Additional Inclusion of insulation to EST Best Practice for floor [13]			Additional Inclusion of insulation to EST Advanced Standard for floor [13]		
		Control	1a	1b	1c	2a	2b	2c	3a	3b	3c	4a	4b	4c
U-value	(W/m2/C)	n/a	0.71	0.62	0.43	0.25	0.24	0.20	0.20	0.19	0.17	0,10	0.10	0.09
Floor insulation	(mm)	n/a	0	0	0	65	65	65	90	90	90	216	216	216
Fuel saving	(kWh)	n/a	11341	11431	11638	485	410	235	65	60	57	129	123	107
Fuel saving	(£)	n/a	£250	£251	£256	£10.67	£9.02	£5.17	£1.43	£1.31	£1.26	£2.84	£2.71	£2.35
CO_2 saving	(Kg)	n/a	2200	2218	2258	94	80	46	13	12	11	25	24	21

Courtesy of Green Building Press 2006

Alternative to blanket insulation



Please see attached notes

References

[1] George, M D 2004. Do small builders need more L? Unpublished Dissertation, University of Glamorgan, Pontypridd, UK.

[2[George, M.D.J; Geens, A J & Littlewood, J R. 2005. Beware the blanket approach *Building For A Future*, Winter, pp. 62-65

[3] George, M.D.J; Geens, A J & Graham, M. 2006. Stimulating simulations. Building for a Future, Volume 15, No 4, Spring 2006 pp.28-32

[4] CIBSE 1998. *Guide Book A,* Chartered Institute for Building Services Engineers, London