

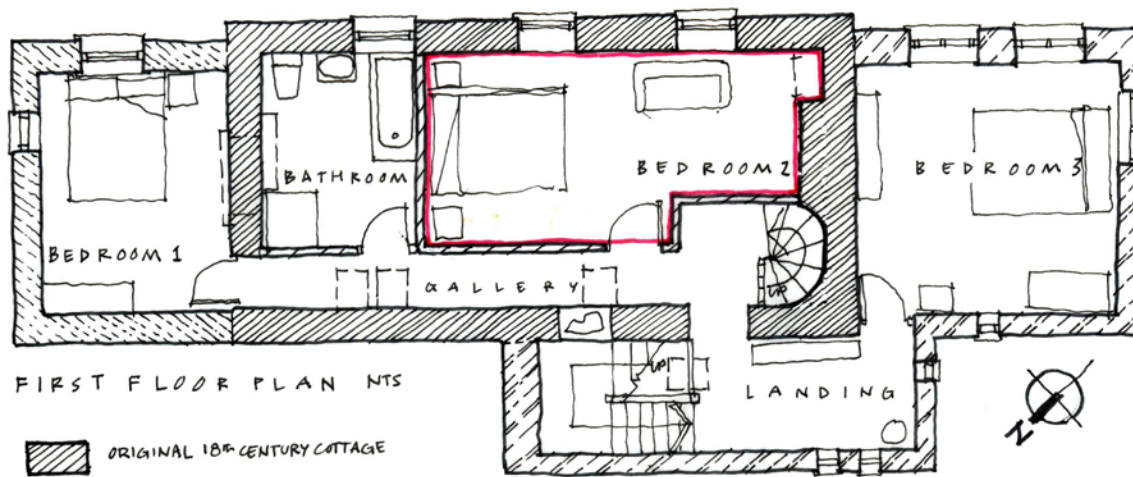


Permeable Insulation & Power

STRIDE TREGLOWN LIMITED

SPECIFIC / TATA STEEL / SWANSEA UNIVERSITY

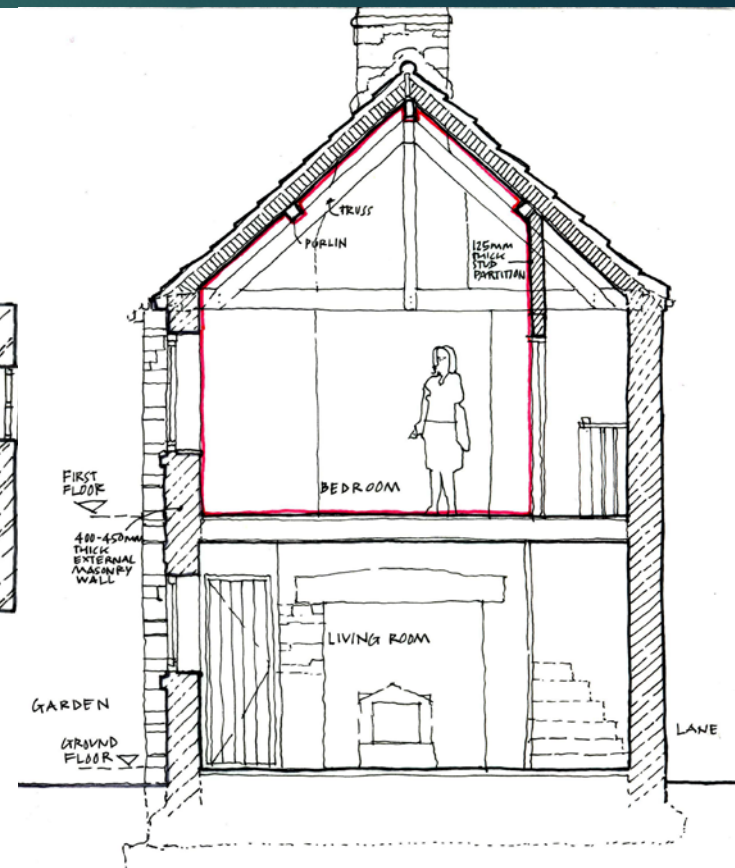
CARDIFF METROPOLITAN UNIVERSITY



FIRST FLOOR PLAN NTS

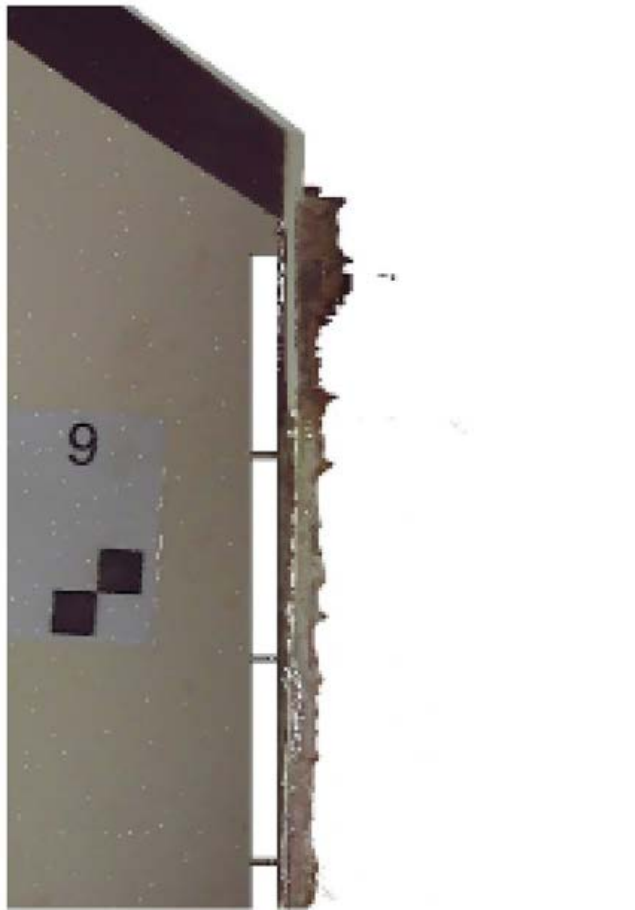
-  ORIGINAL 18th CENTURY COTTAGE
-  1980s EXTENSION
-  2002 EXTENSION
-  BEDROOM 2 ROOM CHOSEN FOR STUDY/EXPERIMENT

LANE END COTTAGE
MRS C FARRER

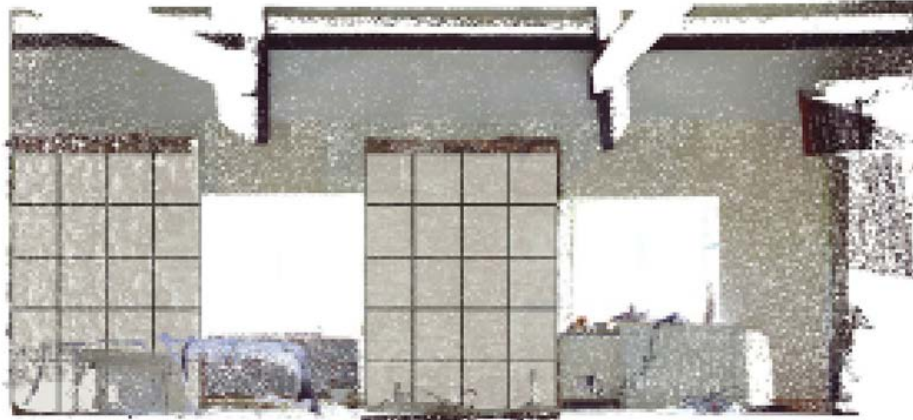


SECTION A-A

DESIGN PHASE



Close up section showing the profile of the existing wall and hemp units modelled in vertical plane. In reality the hemp blocks were laid to follow the wall profile



Scan Wall Elevation of Hemp Lime Unit Installation



Internal view generated in Revit from the laser scan. The hemp lime panels are placed in as 3d objects

DESIGN PHASE



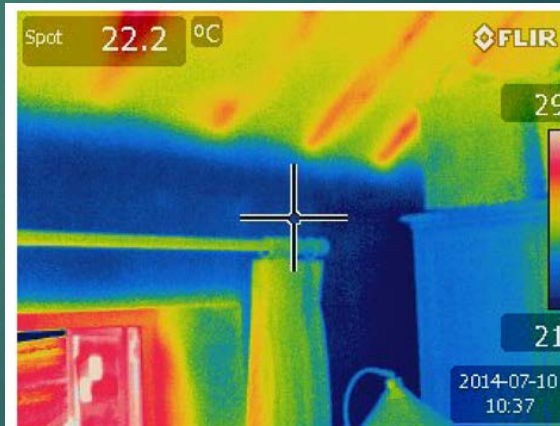
John setting up and calibrating the laser scanner



Example photographs of the room interior - wall/ roof intersection



Laser scan output images which measures the total interior space to within 2mm and creates linked continuous images



Corresponding images produced by a thermal camera for each location. Note the areas coloured dark blue show a greater surface temperature difference compared with the insulated yellow roof plane.

PREPARATION



Central section between windows with existing plaster removed. Gary Perkins is pointing to the upper right hand side where the stonework is poor quality and large voids are evident. Moisture content readings are taken.



HEMP LIME MOULD DESIGN



Modular plywood mould production with battens to form units



Panel interlock joint detail

THE 'MIX'



Material Costs

The material costs reflect small quantity purchases including VAT only and exclude delivery costs.

50 units 6 sq. m of units would typically cost-

- ▶ 1.5 bales of hemp (£18 per bale) - £27
- ▶ 3 bags of lime (£7.86 per bag) - £23.58
- ▶ 1.25 bags of brick dust (£12.00 per bag) -£15.00
- ▶ Total £65.58 or £10.58 per sq. m

MANUFACTURE



Finished panels of hydrated lime version finished with smooth lime plaster



Finished panels laid out in mould ready for face coating of lime plaster

MANUFACTURE

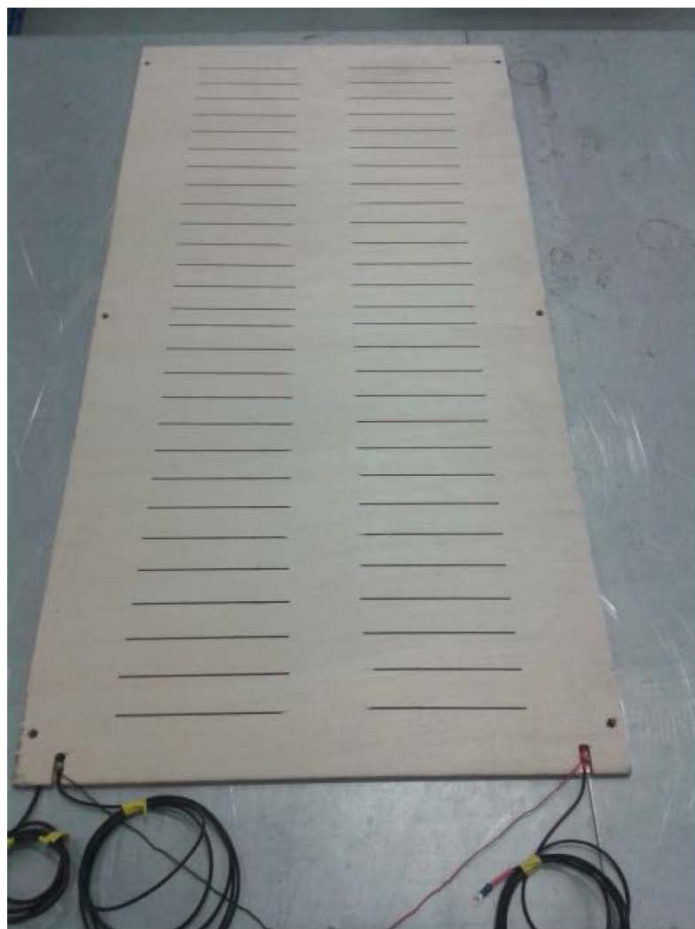


Figure 1: Assembled panel with slots for permeability and drilled holes to allow fixing to the wall.

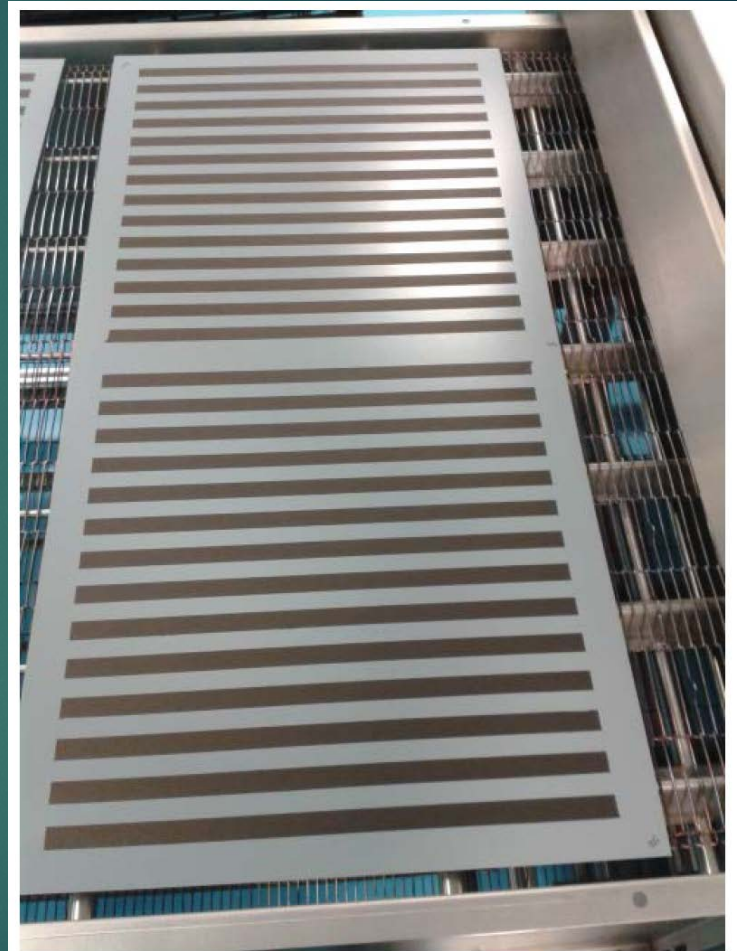
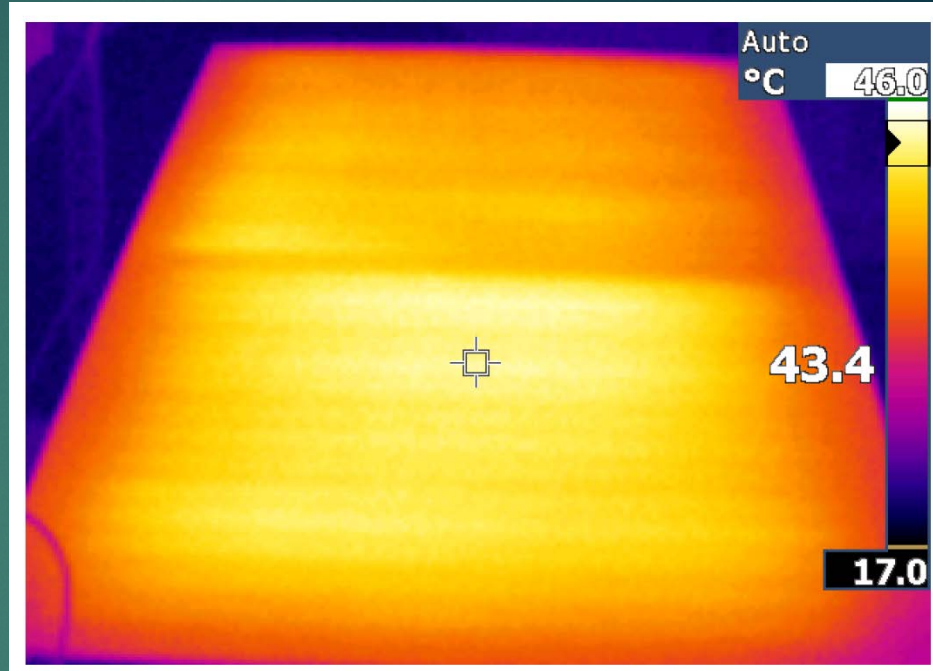


Figure 3: 1200 x 600mm coated steel panel with electrically resistive ink coating.

MANUFACTURE



Figure 2: 9mm plywood board for support and encapsulation of the heated panels.



INSTALLATION PHASE

FIGURE 6 showing gap at top of panel two



INSTALLATION PHASE



INSTALLATION PHASE



OPERATION



OPERATION



External sensor location



OPERATION

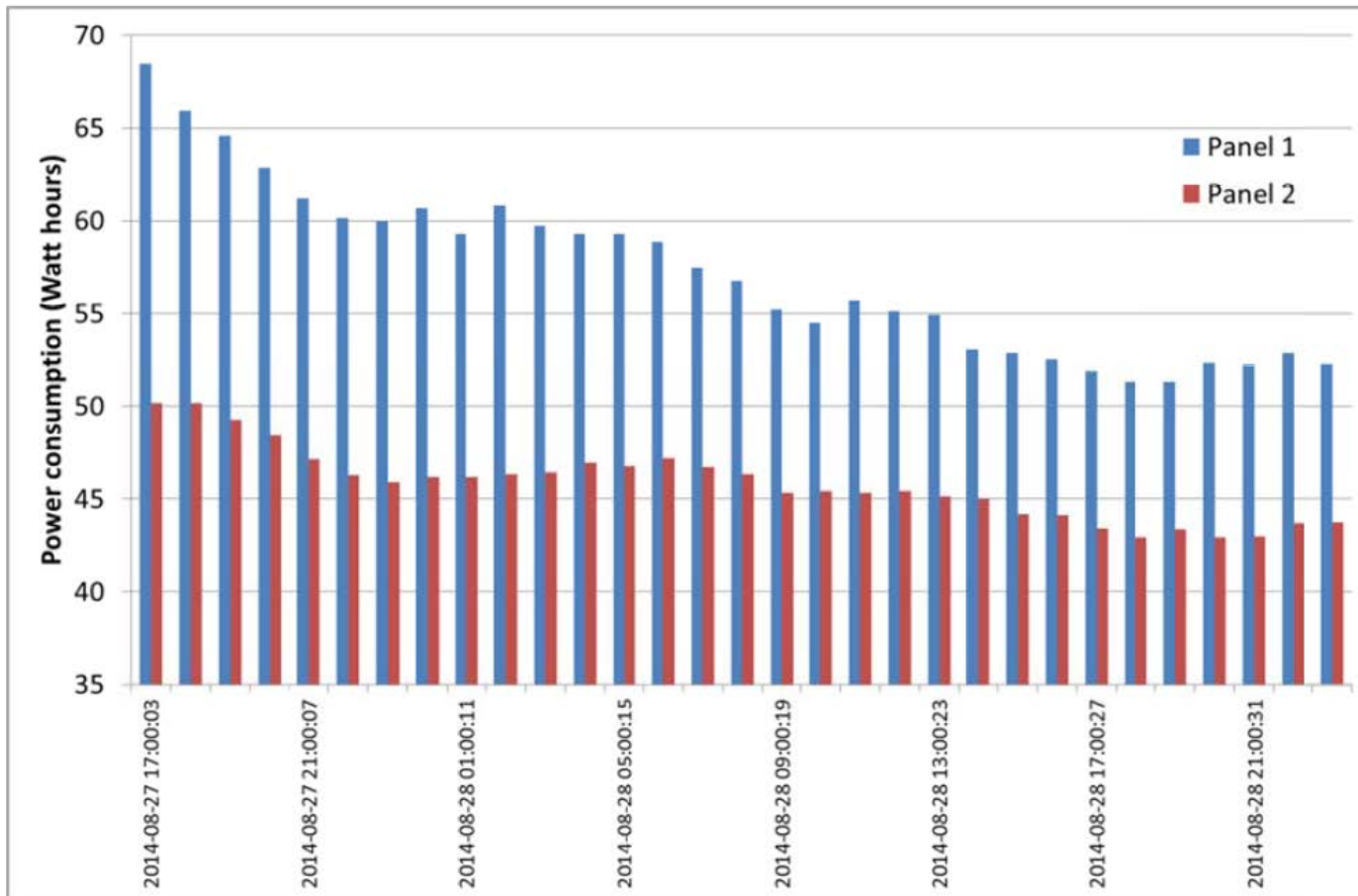
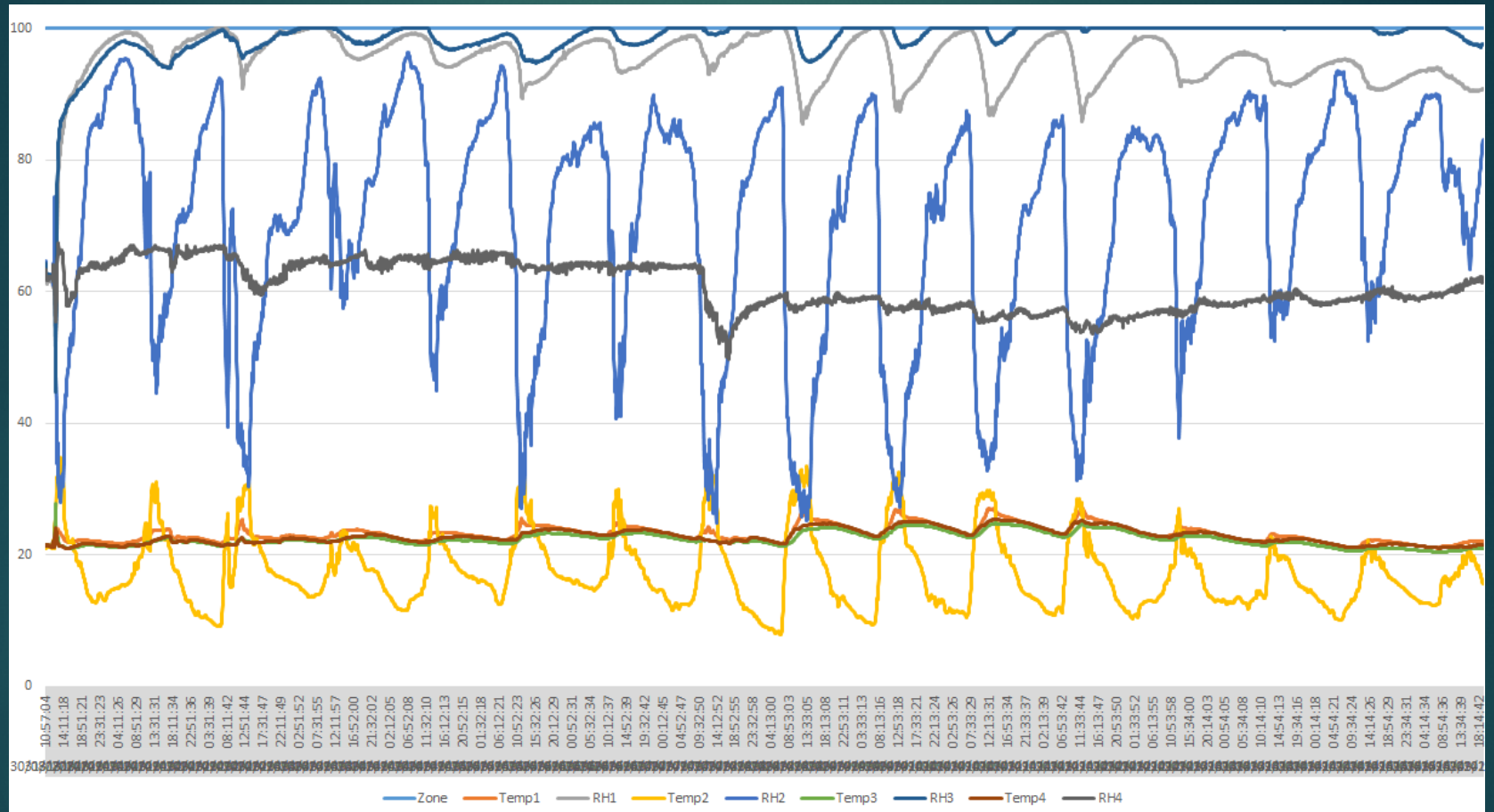


Figure 6: Bar graph illustrating power consumption of heated panels one and two, over a 28 hour period in August.

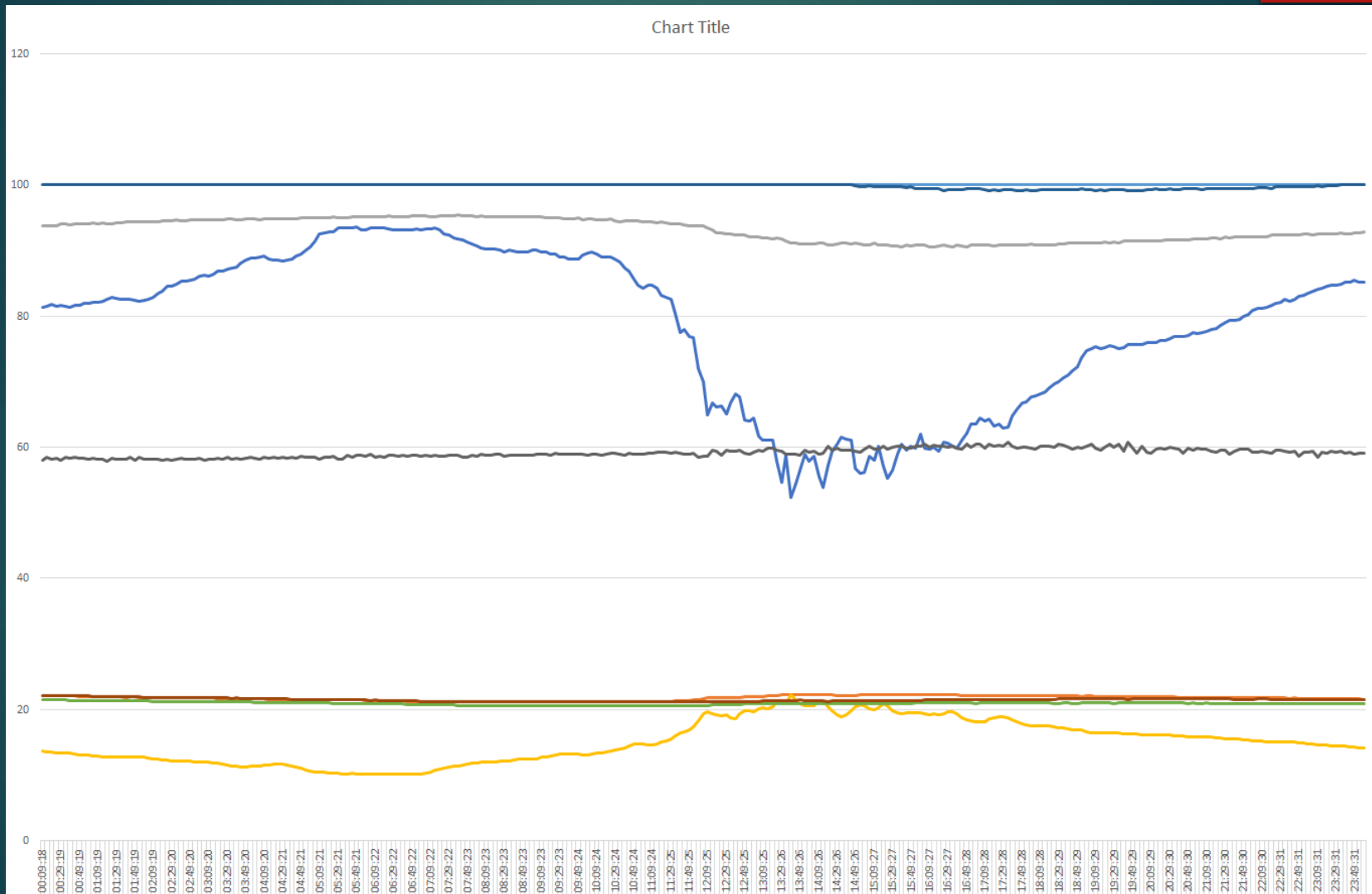
OPERATION



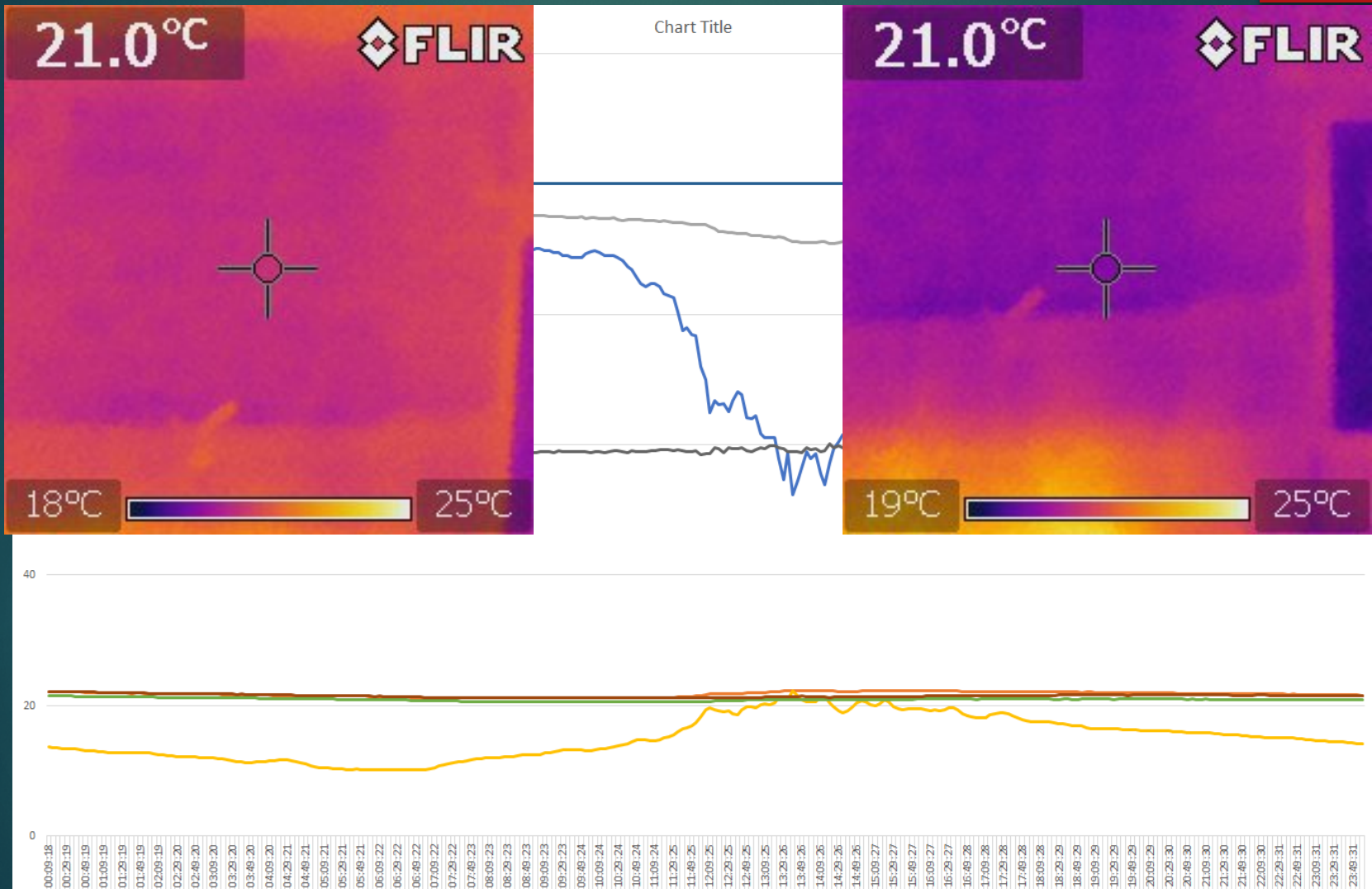
OPERATION

Date	Time	Zone	Temp1	RH1	Temp2	RH2	Temp3	RH3	Temp4	RH4
14/09/2014	00:09:18	100	22.12	93.8	13.62	81.3	21.43	100	22.12	58
14/09/2014	00:14:18	100	22.06	93.7	13.56	81.5	21.43	100	22.12	58.5
14/09/2014	00:19:18	100	22.06	93.8	13.5	81.8	21.43	100	22.12	58.1
14/09/2014	00:24:18	100	22.06	93.8	13.43	81.5	21.43	100	22.06	58.3
14/09/2014	00:29:19	100	22.06	94	13.43	81.6	21.43	100	22.12	58
14/09/2014	00:34:19	100	22.06	94	13.37	81.5	21.43	100	22.06	58.4
14/09/2014	00:39:19	100	22.06	93.9	13.31	81.4	21.37	100	22.06	58.3
14/09/2014	00:44:19	100	22.06	94	13.18	81.6	21.37	100	22.06	58.4
14/09/2014	00:49:19	100	22	94.1	13.12	81.7	21.37	100	22.06	58.3
14/09/2014	00:54:19	100	22	94.1	13.06	81.9	21.37	100	22.06	58.3
14/09/2014	00:59:19	100	22	94.1	13	82	21.37	100	22.06	58.2
14/09/2014	01:04:19	100	22	94.2	12.93	82.1	21.37	100	22	58.3
14/09/2014	01:09:19	100	22	94.1	12.87	82.1	21.37	100	22	58.2
14/09/2014	01:14:19	100	22	94.2	12.81	82.3	21.37	100	22	58.1
14/09/2014	01:19:19	100	21.93	94.1	12.75	82.6	21.37	100	22	57.9
14/09/2014	01:24:19	100	21.93	94.1	12.75	82.9	21.37	100	22	58.3
14/09/2014	01:29:19	100	21.93	94.2	12.75	82.7	21.31	100	22	58.2
14/09/2014	01:34:19	100	21.93	94.2	12.75	82.5	21.31	100	21.93	58.2
14/09/2014	01:39:19	100	21.87	94.3	12.81	82.5	21.31	100	21.93	58.2
14/09/2014	01:44:19	100	21.93	94.3	12.81	82.5	21.31	100	21.93	58.4
14/09/2014	01:49:19	100	21.93	94.3	12.75	82.4	21.31	100	21.93	58
14/09/2014	01:54:19	100	21.87	94.4	12.75	82.3	21.31	100	21.93	58.4
14/09/2014	01:59:19	100	21.87	94.3	12.75	82.4	21.31	100	21.87	58.2
14/09/2014	02:04:19	100	21.87	94.3	12.62	82.5	21.31	100	21.87	58.1
14/09/2014	02:09:19	100	21.87	94.3	12.5	82.8	21.25	100	21.87	58.2
14/09/2014	02:14:19	100	21.87	94.4	12.37	83.5	21.25	100	21.87	58.2
14/09/2014	02:19:19	100	21.87	94.5	12.25	83.8	21.25	100	21.87	58
14/09/2014	02:24:20	100	21.81	94.5	12.25	84.5	21.25	100	21.87	58.2
14/09/2014	02:29:20	100	21.81	94.5	12.18	84.6	21.25	100	21.81	58

OPERATION



OPERATION



PREDICTED U VALUE's

- ▶ The sample unit tested showed a density of 465.5 kg/m³ weighing 1.3kg size 200 x 325 x 45.5mm thick.
- ▶ The test was run over a 24-hour period
- ▶ overall measured thermal conductivity of **0.09874** W·m⁻¹·K⁻¹.
- ▶ The results are reported according to BS EN 12667:2001 where all the requirements set by the standard were met.



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TEST REPORT	
Determination of thermal conductivity by means of heat flow meter methods – products of high and medium thermal resistance	
ISSUED BY: The BioComposites Centre	ISSUED ON: 28/08/14
REPORT REFERENCE: GAO1/2014	Page 1 of 4

PREDICTED U VALUE's

- ▶ assuming a solid stone wall of 400mm with lime plaster interior finish provides a U value in the region of **1.55 w sq m deg C**.
- ▶ repairing the wall and adding **50mm** of hemp/ lime units the predicted U value improves to **0.8237 w sq m deg C**.



PERMEABILITY



minutes for karsten tube test

16:04	0
16:08	1
16:13	1.5
16:25	2.5
16:32	3
16:45	3.5
16:55	4
17:15	4.2
17:16	off scale
00:21	3 minutes from full at 0 to 4mm absorbed

‘When the fat lady sings’

- ▶ ‘the monitoring equipment is noisy but the room is rather toasty’
- ▶ The hygroscopic hemp lime units provide a material lining capable of managing moisture in the building where some modern materials cannot
- ▶ indoor air quality improvements for the occupants, energy saving and life cycle benefits

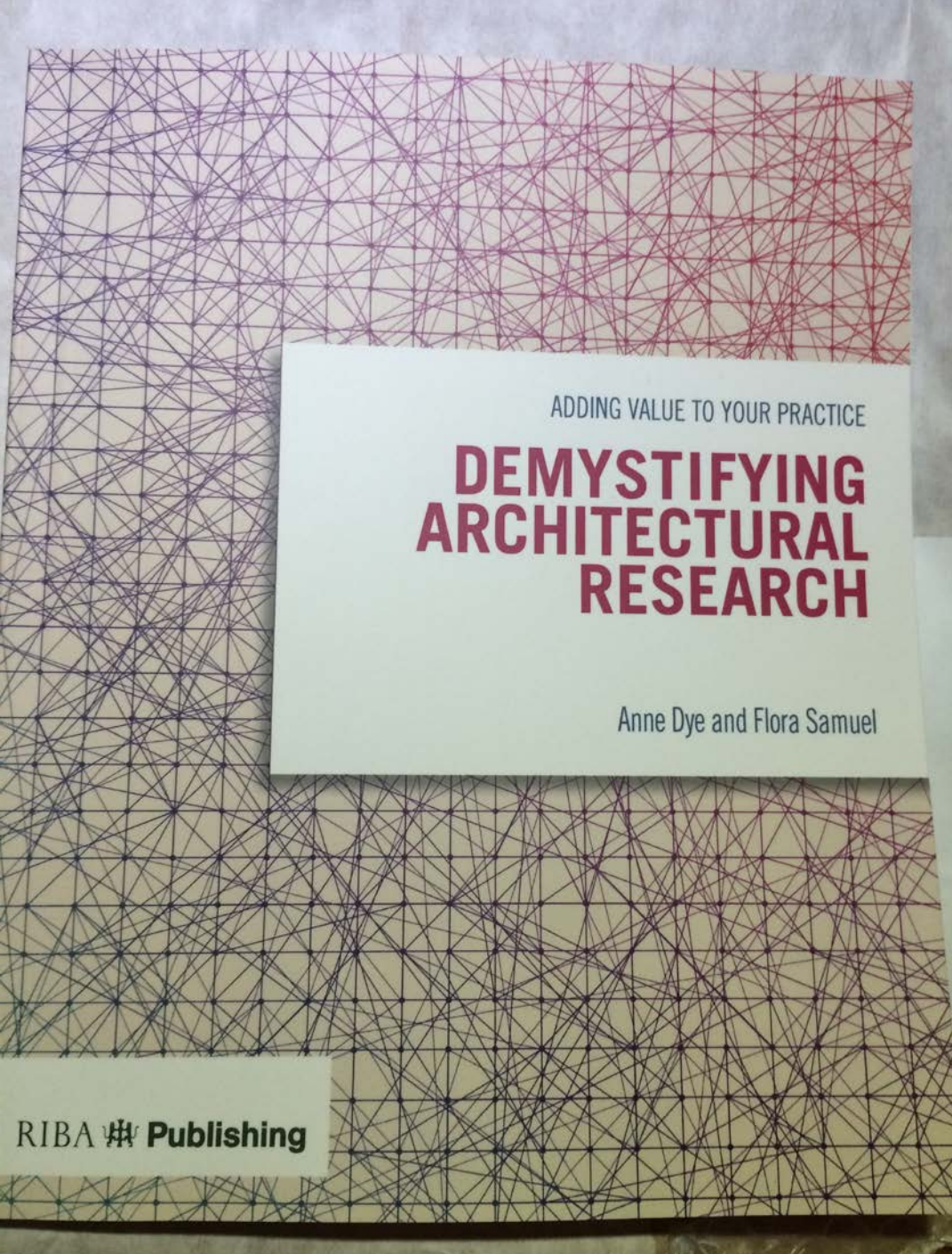
Next Steps

- ▶ Continue monitoring phase 1 installation through winter
- ▶ Scale up production & manufacture in factory conditions
- ▶ Further test and evaluation of factory produced hemp-lime panels
- ▶ Further test and evaluation of Specific heated panels
- ▶ Further research with Vivus Lime, Okatech, Wood Knowledge Wales, Bangor BioComposites
- ▶ Expand low cost sensor system towards responsive smart building (& enhanced analysis)







The book cover features a complex, dense pattern of thin, intersecting lines in shades of purple and red on a light beige background. A white rectangular label is centered on the cover, containing the title and authors' names. At the bottom left, there is a small white label with the publisher's name.

ADDING VALUE TO YOUR PRACTICE

DEMYSTIFYING ARCHITECTURAL RESEARCH

Anne Dye and Flora Samuel

RIBA  Publishing

Thank you