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# Technical Compatibility Between Building Regulations

*Robust Details Roadshows 2010*

**Huddersfield, Coventry, London**


**Professor Sean Smith**
Director – Institute for Sustainable Construction
Professor of Construction Innovation
RC UK Academic Fellow


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2009

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# ISC – Directors and Heads of Centres

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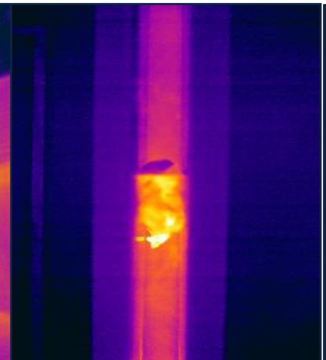
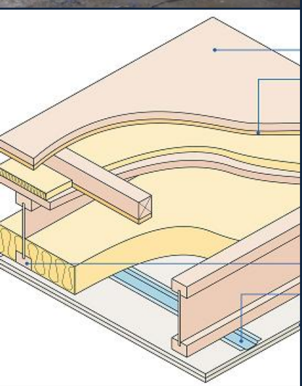


# SPIRIT-CIAC PROJECT

## Technical compatibility for future Low Carbon Housing (LCH)




*Professor Sean Smith*

**Institute for Sustainable Construction**

The Queen's Anniversary Prizes
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# Construction - Future Factors

Adaption and resilience for Climate Change

Sullivan Report (Low Carbon Buildings) – new technical standards 2010-2016

Existing domestic and non domestic buildings energy reduction targets

2018 and 2019 (Zero Carbon targets) from EU

Code for Sustainable Homes (England)

Future increase in brownfield sites & complexity

Sourcing materials & Waste management

Growth in all renewables, infrastructure, offshore and incentives (TIFs, RHIs)

Energy Demand, Supply & Behaviour of energy users

Innovation and energy measures cost offsetting – BRE Scotland Innovation Park

Housing shortage and types of housing occupant factors (including SHQS - 2012)

Labour skills shortage and growth in offsite construction

Regeneration and technical guidance

Sustainable Communities

Commonwealth Games 2014 (Glasgow)

ALL Need Applied Research and Knowledge Transfer

## SPIRIT-CIAC ISSUES

**Largest New Housing Sector** - 80% of Scottish New Homes (timber frame), 20% England (timber frame)

**Low Carbon Economy** - Sullivan Report (Low Carbon Built Environment) Part L - Key changes 2010, 2013 and 2016

**Technical Compatibility -** an important factor for future LCH, new products and systems coming to market

**Innovation Support** - R&D, Pathway to Market, Supply Chain Partnerships

**Assessment** - Prototypes, Full scale, Integration, Field testing

**Technical Standards** – Support for Government and LA's, Housebuilders, Architects, Developers, Product Manufacturers

**Supply** – Future skills shortages driver to Offsite Construction

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**THERMAL ENVELOPE**

**Sound Insulation**

**Structure**

Energy is the driver…………

**BUT** must have technical compatibility with other regulations

….Cavity thermal bypass?

*Party wall cavity convected heat loss*

# Cavity convected heat loss

bpc
building performance centre

More……..

# Cavity convected heat loss

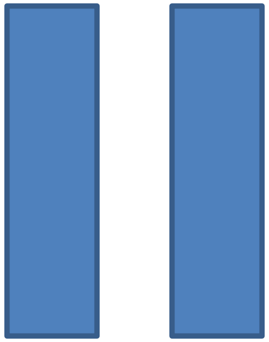
bpc
building performance centre

More…..

# Cavity convected heat loss

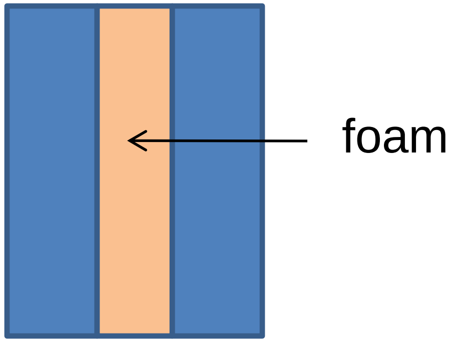
## Fully filling cavities – why are we cautious?

Empty cavity forces sound transmission only through air or wall ties. Some transmission occurs through strip foundation.



*BRE paper Journal of Sound & Vibration 1974 34 (1)*

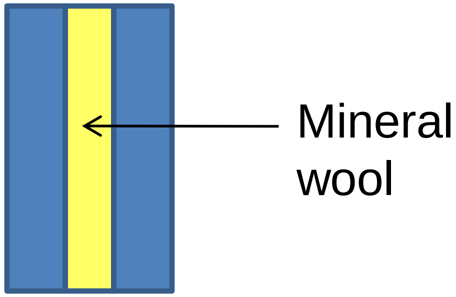
Fully filled cavities (with foam) showed reductions of 6 to 7 dB in acoustic performance – affecting BOTH separating walls AND floors (in apartments)

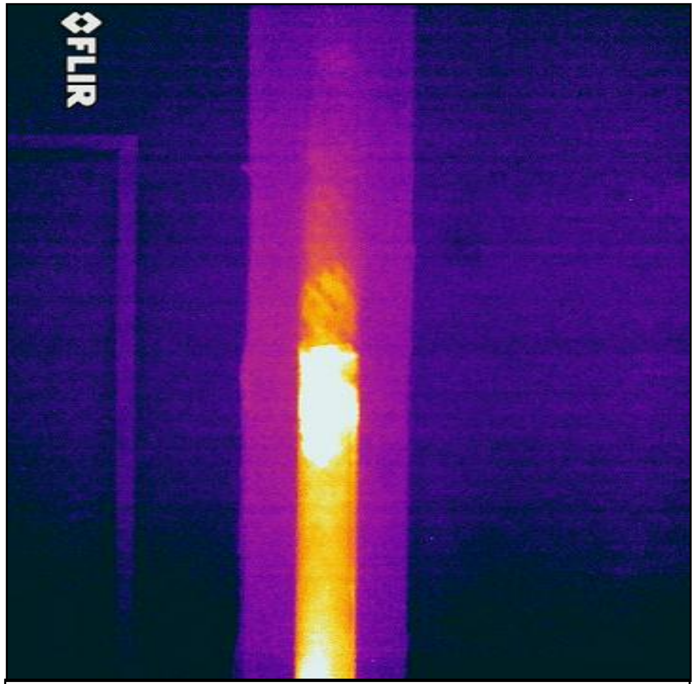


# Fully filling cavities – mineral wool?

| | | | England & Wales | | |
|---|---|---|---|---|---|
| **Plot and construction details** | | | **no fill** | **Fullfill** | **Diff,** |
| **Storey** | **Wall** | **Plot** | DnT,w+Ctr | DnT,w+Ctr | dB |
| First Floor | Cavity Wall | Plot 65 bedroom to Plot 66 bedroom | 53 | 52 | -1dB |
| Ground floor | radon barrier "bridged" | Plot 65 living room | 46 | 46 | 0 |

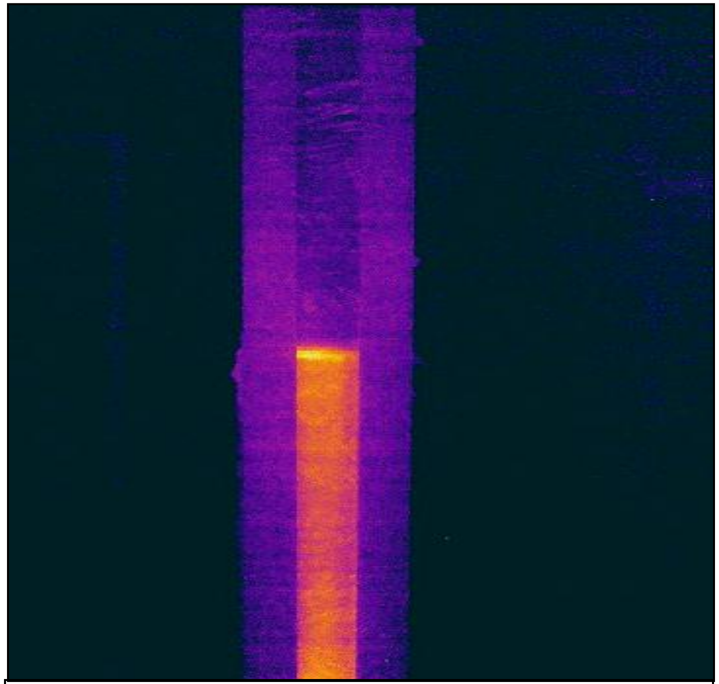
Not the same effect with mineral fibres
Potentially +/- 1 dB but may influence very high performing walls by -2 to -3 dB





Cavity fire sock (horizontal)

Example of heat loss past a horizontal cavity fire stop



Icopal WALLCAP

Example of new membrane preventing cavity convected heat loss

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## Potential time plan for LCH Government Delivery / Building Regulations

| | | | | |
|---|---|---|---|---|
| | 2010 | APRIL | Publication of New Part L | |
| A-Finish | | OCTOBER | Enactment of New Part L | |
| B-Start | 2011 | Jan to Dec | R&D for next Part L changes | 0.5 years |
| | 2012 | Jan to Mar | Prep of Consul document | 1.5 years |
| | | Apr to July | Consultation | |
| | | Sept to Dec | Review of consultation responses | |
| | 2013 | January | Final amendments to New Part L | 2.5 years |
| | | APRIL | Publication of New Part L | |
| B-Finish | | OCTOBER | Enactment of New Part L | |
| C-Start | 2014 | Jan to Dec | R&D for next Part L changes | 3.5 years |
| | 2015 | Jan to Mar | Prep of Consul document | 4.5 years |
| | | Apr to July | Consultation | |
| | | Sept to Dec | Review of consultation responses | |
| | 2016 | January | Final amendments to New Part L | 5.5 years |
| | | APRIL | Publication of New Part L | |
| C-Finish | | OCTOBER | Enactment of New Part L | 6.3 years |

# NNR – Non-renewable Natural Resources

Global population expansion

Global industrial & development expansion

Pressure on raw materials resources and supply

Leads to ……. ***A critical appraisal of NNR***

………………. ***"Watch list" of future scarce resources***

………………. ***Review of future industries & impacts***

# Demand and Supply factors on prices

According to the European Parliament
between 2002 and 2008:

*the price of non-fuel commodities increased by 159%,*

*metal and mineral prices increased by 285%*

*and agricultural raw material prices increased by 133%.*

# New EU Strategy – sourcing raw materials

European Commission proposes new strategy to address EU critical needs for raw materials

**450 export restrictions on more than 400 different raw materials**

**China** has 95% of all rare earth concentrates
**Brazil** 90% of all niobium
**South Africa** has 79% of all rhodium

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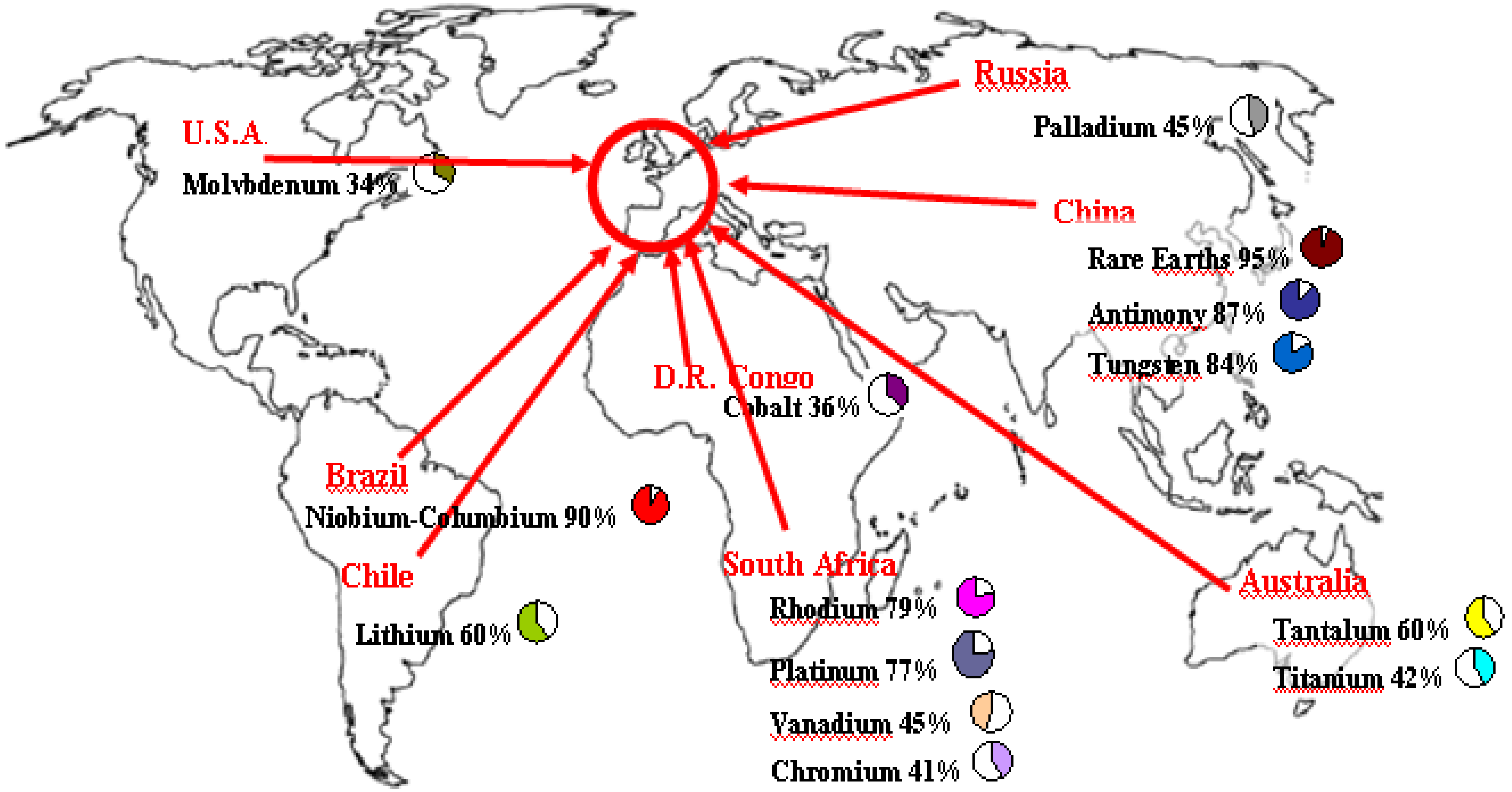
# Major global producers of high-tech metals




Source: EU Raw Materials Initiative 2008

# Future Energy Supply Solutions & Raw Materials

| Problem | Solutions | Raw materials (application) |
|---|---|---|
| Future Energy supply | Fuel cells | Platinum, palladium |
| | | REE* |
| | | Cobalt |
| | Hybrid cars | Samarium (permanent magnets) |
| | | REE: Neodymium (high performance magnets) |
| | | Silver (advanced electromotor generators) |
| | | Platinum, palladium (catalysts) |
| | Alternative energies | Silicon, gallium (solar cells) |
| | | Silver (solar cells, energy collection/transmission) |
| | | Gold, silver (high performance mirrors) |
| | Energy storage | Lithium, zinc, tantalum, cobalt (rechargeable batteries) |

Source: EU Raw Materials Initiative 2008

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# At Risk Materials – "Watch List"

The need for Europe to focus particularly on the critical role of high tech metals is confirmed by the French geological survey BRGM. The work of the French geological survey focuses on the higher degree of criticality of high tech metals based on three criticality criteria: possibility (or not) of substitution, essential role, and potential supply risks. In their analysis[7,8,9,10] they identify short to medium risks to their supply of a number of materials: **antimony, chromite, cobalt, germanium, gallium, indium, lithium, magnesium, molybdenum, platinum, palladium, rhodium, rare earths, rhenium, titanium, and tungsten.**

CIGS = Cu-Indium-Gallium-Selenium = "thin-film" photovoltaic technology

Source: EU Raw Materials Initiative 2008

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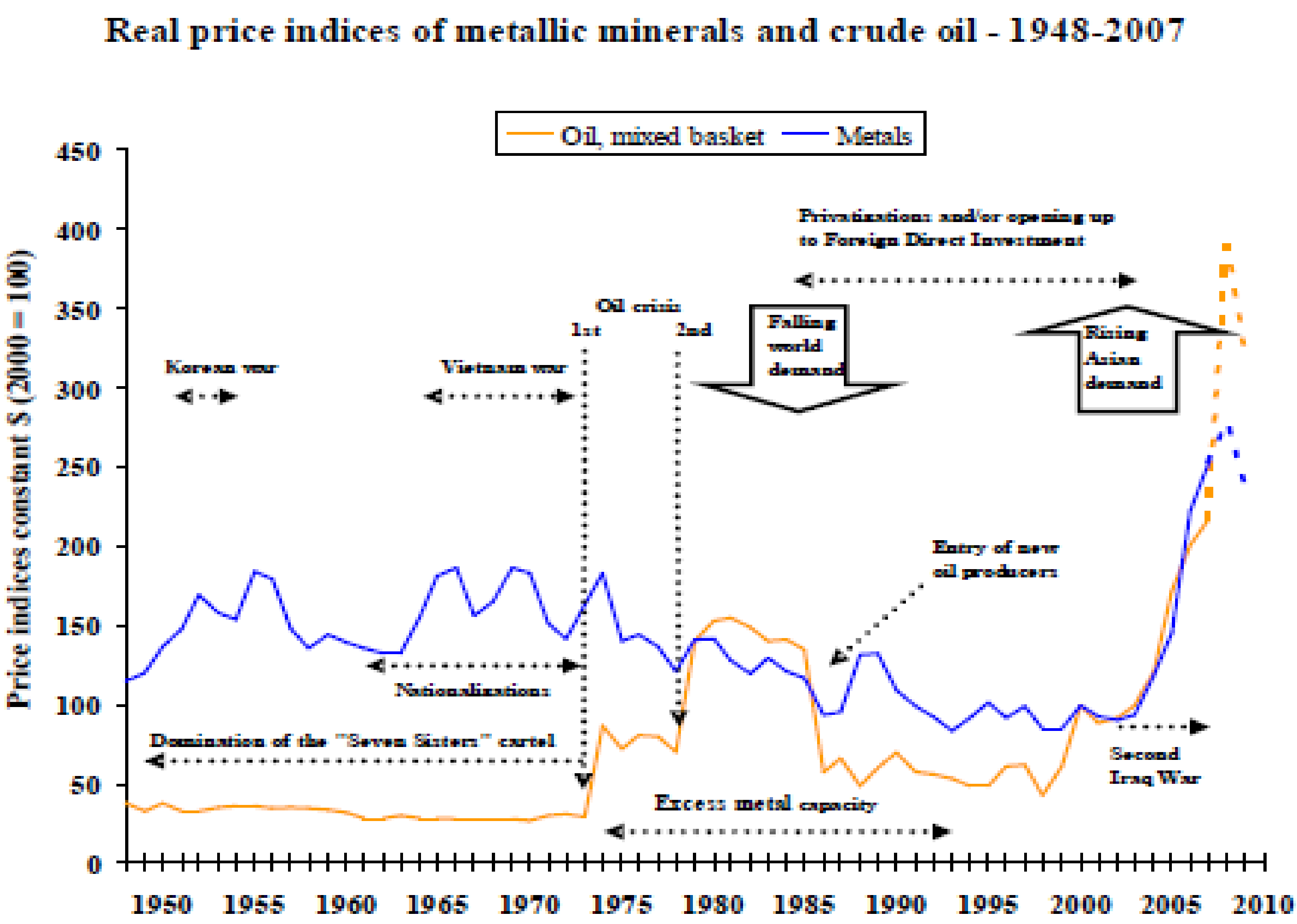
# Comparing oil and metal price fluctuations




Sources: EU Raw Materials Initiative 2008
Radetzki M., A Handbook of primary commodities in the global economy. 2008

**Future Low Carbon Housing**

33% of $CO_2$ emissions linked to housing
New build less than 1% annually
But by 2050 (80% reduction target) – 20 to 25% from New Build

Can new build innovations assist existing housing stock (CiC Start)

Three factor Energy Issues
1) Energy Power Source
2) Building Fabric
3) Occupant behaviour

Energy – key factor BUT not only factor

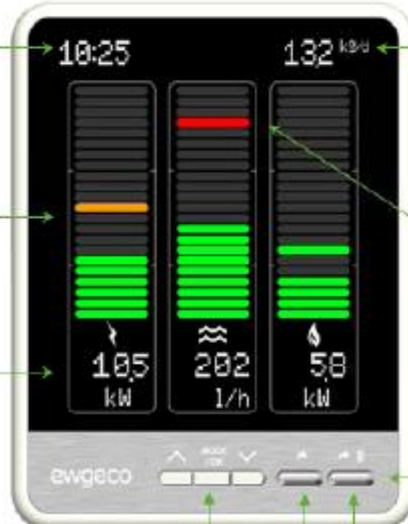
Also need to - Reduce materials, reduce waste, innovate in how we build – becoming more Hi-Tech & Clean-Tech ewgeco

# Key Ewgeco functionality

Time
Temperature

Bars light up from green to amber to red

Consumption rate display




$CO_2$ display

Peak consumption rate for the day remains lit

Pause function (individual appliance monitoring)

Function buttons:

- Brightness control
- Access memory
- Set alarm level
- Adjust tariff
- Recalibrate

$CO_2$ display:

- Kg/d
- Ewgeco units

Consumption rate display:

- Current consumption
- Total since midnight
- Cost per hour
- Cost today (since midnight)

# House Builders - Value proposition

ewgeco

**Why Ewgeco**

Max 3 points for Code for Sustainable Homes

Improve saleability of your home

- We appeal to the male buyer
- Adds green and eco to the home

Make existing meters smart

Solution now - delay in Smart Meters rollout (2014 to 2020)

Only 2 and 3 Utility Real Time Display on the market

## Future Low Carbon Housing

Cost of higher energy efficient and lower carbon buildings?

*Very Important……..*

Can we "*offset*" these primary energy and low carbon costs by how we build in future?

Can we innovate in other areas of the construction process which delivers….. "*Reduced carbon footprint, saves materials and delivers new approaches to housebuilding*"?

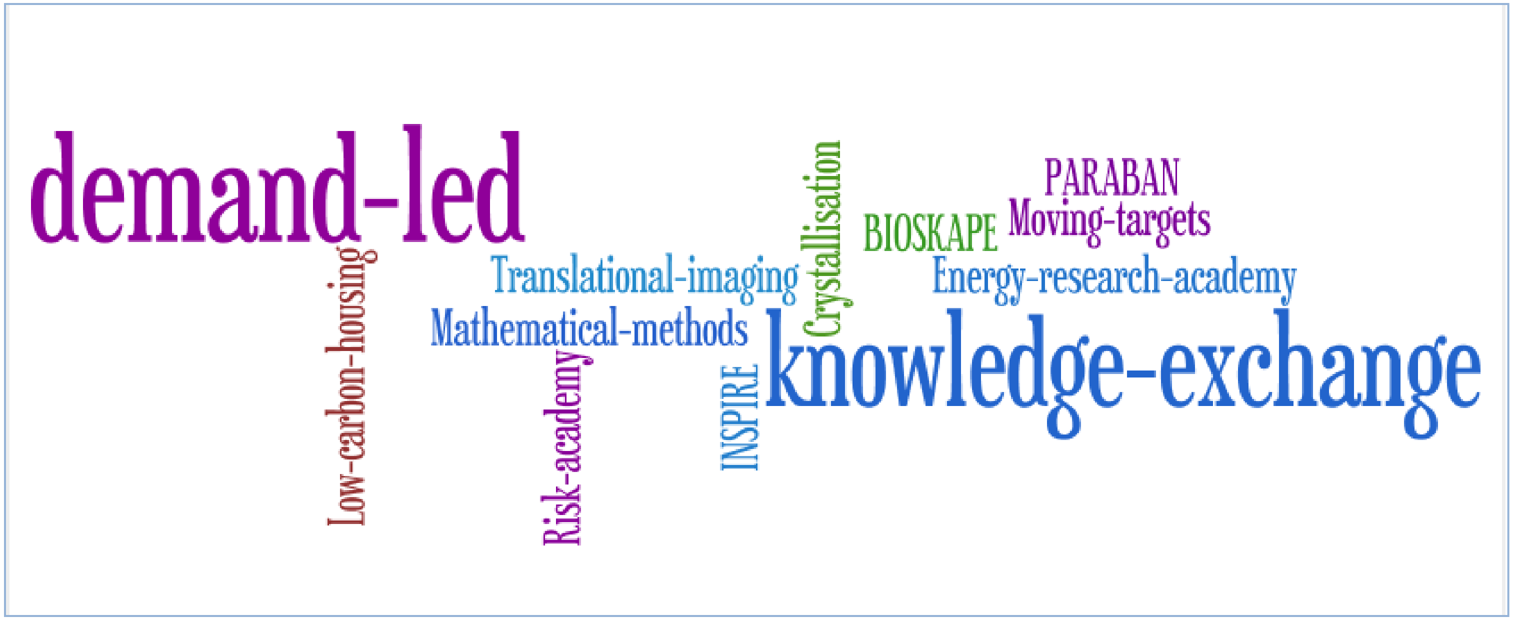
Are these innovations "*technically compatible*"?

## Future Low Carbon Housing

### Range of Innovations

System Build, Cassette, Closed Panel, Pod, Modular
New product innovations (1 product not 2)
External fabric
Separating construction elements
Key junctions and structural issues
Adaptable future homes
Micro-renewables, conductivity enhancement and fuel cells
RTD’s energy display devices
Roof systems
New connectors, fixings, straps
New insulation systems
Linings mechanisms, isolators and closures / sealings
Passive systems
Less raw materials
Assembly or build innovations
Workmanship tolerance..?

# SPIRIT Projects 2010 - 2013



# Academic and Industry Partners

| | | |
|---|---|---|
| Technical experts | Dr Elena Prokofieva / Nicola Robertson<br>Dr Robert Hairstans<br>John Currie / Dr Celine Garnier<br>tbc | Section 5: Noise / Sound Insulation<br>Section 1: Structures<br>Section 6: Energy<br>CBM |
| Product Innovation and Animation | John Wood | Advisor |
| BPAC Technical Manager | Mark Milne | Hangar 17 test co-ordinator |
| C4Ci | Dr Luke Whale | Specialist Advisor |
| Scotland Low Carbon Innovation Park | | STAGE B - CIAC |

| | | |
|---|---|---|
| PhD Supervision | Dr Elena Prokofieva and Prof Sue Roaf (HWU) | Knowledge Exchange |
| Specialist Advisors | Dr Luke Whale, C4Ci | |
| Project Outreach | Prof Sean Smith, Dr Prokofieva and Dr Branka Dimtrijevic (GCU) | Knowledge Exchange |

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# UK Leading Test Facilities

**BPAC "Hangar 17"**

Developed in Partnership (ISC with BPAC)

*(Building Performance Assessment Centre)*

Leading test facility for new housing construction products

Specialist racking test equipment

Large beam testing rig

Small beam testing rigs and puncture/impact assessment rigs

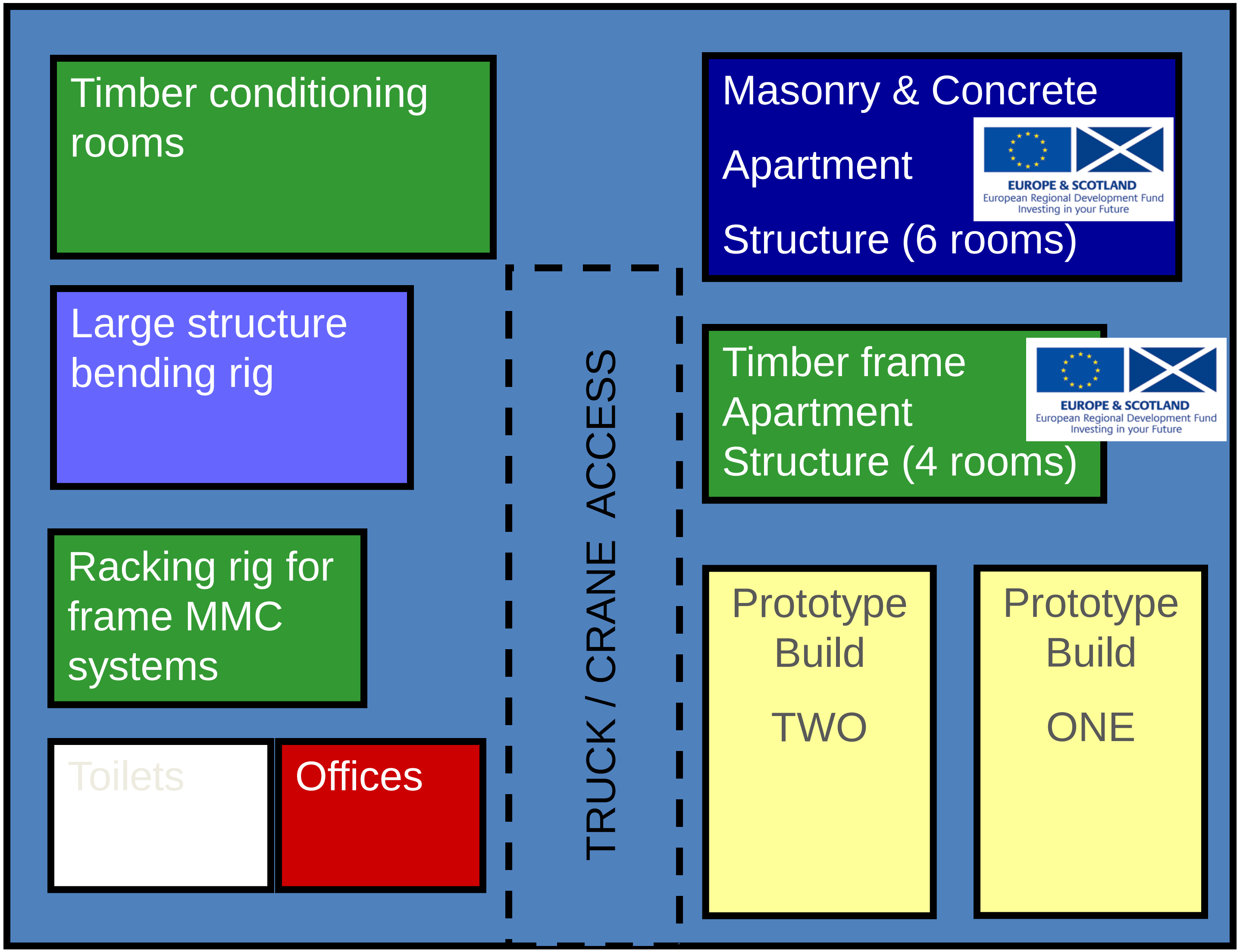
10 test apartment rooms

2 large prototype test bays

Timber conditioning chambers

Staff research office

# BPAC "HANGAR 17" - layout




BPAC

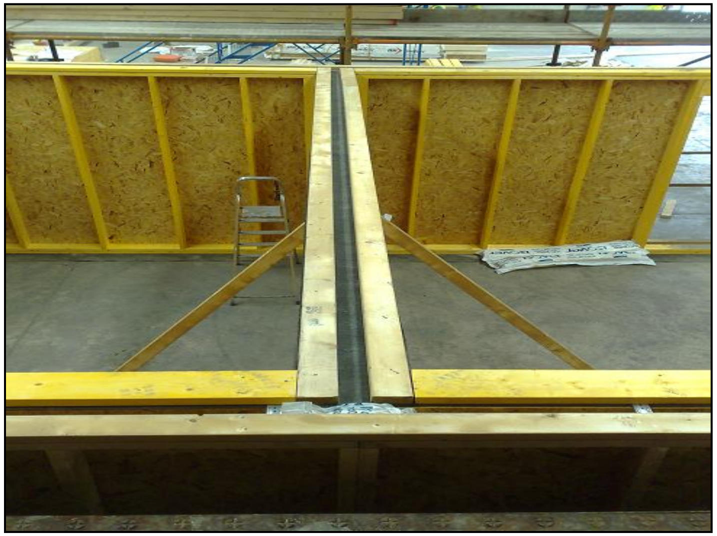
bpc building performance centre

c4ci Consultants Construction Innovation

Construction Innovation Test Facility

**BPAC: HANGAR 17**

(BPAC) Building Performance Assessment Centre

# Timber Frame Apartment Test Buildings (BPAC)

# BRE Scotland Innovation Park


bre

Innovation Park masterplan

# A+B …PROJECT SUMMARY

**STAGE A**

Universities
R&D, KE
Innovation Support
Advice & Direction
Prototypes
Initial testing and evaluation
BPAC Hangar 17
Technical Advisors
Small field trials

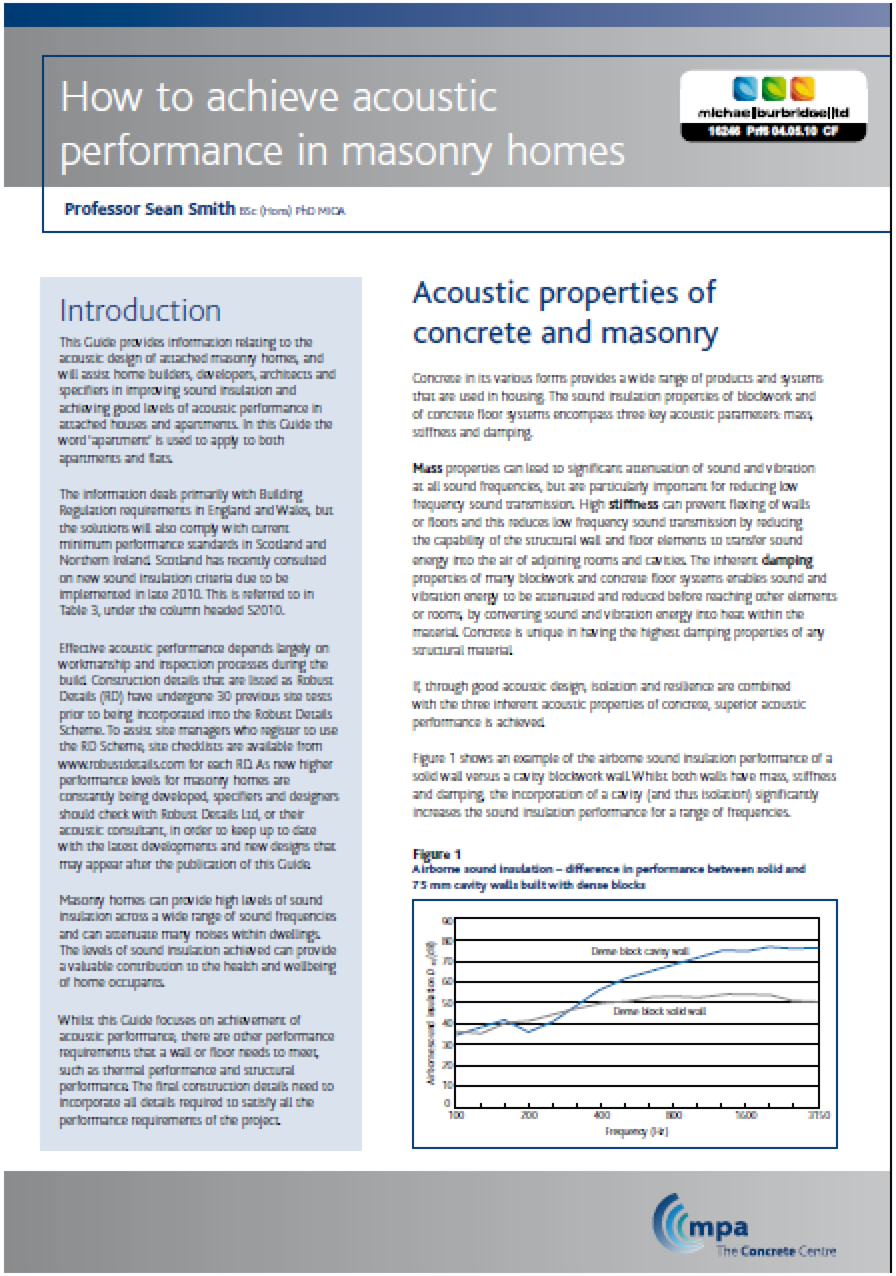
**STAGE B**

Full scale prototypes
Scotland Low Carbon Innovation Park
Technical Support
Site Management
Supply chain co-ordination support
Key stakeholder involvement
Public awareness

SFC SPIRIT LCH Housing

ERDF / Scottish Enterprise – SME Company growth for LCH

# New Publication – due soon
*The Concrete Centre*



# How to achieve acoustic performance in masonry homes

michaelburbridgeltd 16246 Prf6 04.05.10 CF

**Professor Sean Smith** BSc (Hons) PhD MIOA

## Introduction

This Guide provides information relating to the acoustic design of attached masonry homes, and will assist home builders, developers, architects and specifiers in improving sound insulation and achieving good levels of acoustic performance in attached houses and apartments. In this Guide the word 'apartment' is used to apply to both apartments and flats.

The information deals primarily with Building Regulation requirements in England and Wales, but the solutions will also comply with current minimum performance standards in Scotland and Northern Ireland. Scotland has recently consulted on new sound insulation criteria due to be implemented in late 2010. This is referred to in Table 3, under the column headed S2010.

Effective acoustic performance depends largely on workmanship and inspection processes during the build. Construction details that are listed as Robust Details (RD) have undergone 30 previous site tests prior to being incorporated into the Robust Details Scheme. To assist site managers who register to use the RD Scheme, site checklists are available from www.robustdetails.com for each RD. As new higher performance levels for masonry homes are constantly being developed, specifiers and designers should check with Robust Details Ltd, or their acoustic consultant, in order to keep up to date with the latest developments and new designs that may appear after the publication of this Guide.

Masonry homes can provide high levels of sound insulation across a wide range of sound frequencies and can attenuate many noises within dwellings. The levels of sound insulation achieved can provide a valuable contribution to the health and wellbeing of home occupants.

Whilst this Guide focuses on achievement of acoustic performance, there are other performance requirements that a wall or floor needs to meet, such as thermal performance and structural performance. The final construction details need to incorporate all details required to satisfy all the performance requirements of the project.

## Acoustic properties of concrete and masonry

Concrete in its various forms provides a wide range of products and systems that are used in housing. The sound insulation properties of blockwork and of concrete floor systems encompass three key acoustic parameters: mass, stiffness and damping.

**Mass** properties can lead to significant attenuation of sound and vibration at all sound frequencies, but are particularly important for reducing low frequency sound transmission. High **stiffness** can prevent flexing of walls or floors and this reduces low frequency sound transmission by reducing the capability of the structural wall and floor elements to transfer sound energy into the air of adjoining rooms and cavities. The inherent **damping** properties of many blockwork and concrete floor systems enables sound and vibration energy to be attenuated and reduced before reaching other elements or rooms, by converting sound and vibration energy into heat within the material. Concrete is unique in having the highest damping properties of any structural material.

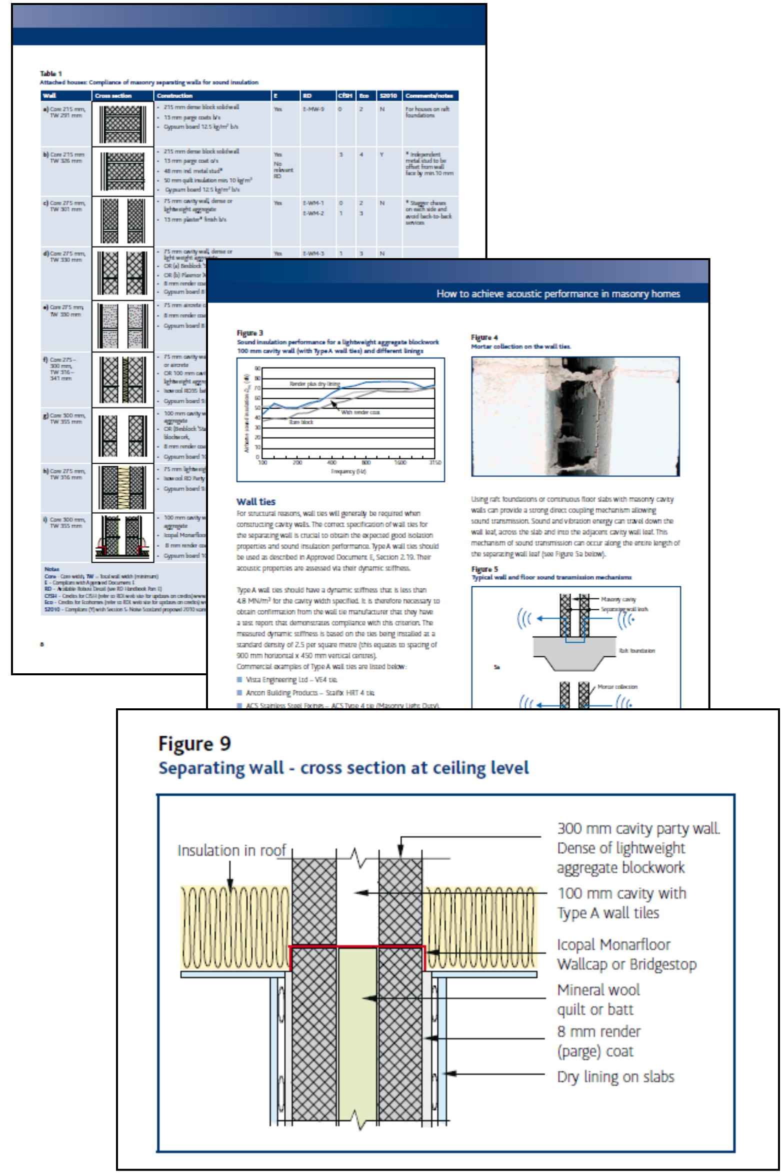
If, through good acoustic design, isolation and resilience are combined with the three inherent acoustic properties of concrete, superior acoustic performance is achieved.

Figure 1 shows an example of the airborne sound insulation performance of a solid wall versus a cavity blockwork wall. Whilst both walls have mass, stiffness and damping, the incorporation of a cavity (and thus isolation) significantly increases the sound insulation performance for a range of frequencies.

**Figure 1**
**Airborne sound insulation – difference in performance between solid and 75 mm cavity walls built with dense blocks**



mpa The Concrete Centre



# WHY THINK ABOUT THE FUTURE ?


“ We can either stumble into the future and hope it turns out alright or we can try and shape it. To shape it, the first step is to work out what it might look like” - *Stephen Ladyman MP, January 2006*

“ It is not the strongest of the species who survive, nor the most intelligent; rather it is those most responsive to change” - *Charles Darwin*

Edinburgh Napier University

# Institute for Sustainable Construction (ISC)

THE QUEEN'S
ANNIVERSARY PRIZES
FOR HIGHER AND FURTHER EDUCATION
2009

Awarded to Edinburgh Napier University
for ISC Research & Knowledge Transfer involving
*"Innovative Housing Construction - for environmental benefit and quality of life"*