MODULE 2

HOUSING CONSTRUCTION METHODS AND PRINCIPLES. STRUCTURE AND FOUNDATION

NEES PROJECT

NATURAL ENERGY EFFICIENT SUSTAINABLE

VOCATIONAL TRAINING MODULES

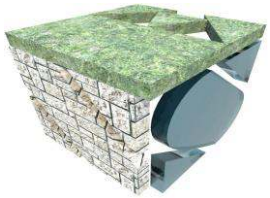
Training for Sustainable Building

Vocational Training Modules for the Natural Energy Efficiency and Sustainability (NEES) Project

University of ULSTER

Umeå University

UCC
University College Cork, Ireland
Coláiste na hOllscoile Corcaigh



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SOUTH KERRY DEVELOPMENT PARTNERSHIP LTD.

Northern Periphery Programme
2007–2013
Innovatively investing in Europe's Northern Periphery for a sustainable and prosperous future

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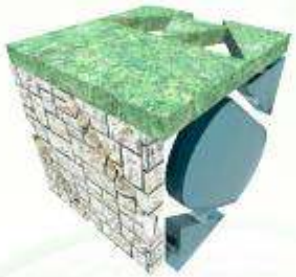

Where can I get more information on NEES?

If you wish to find out more about the NEES Project, please check our comprehensive Web Site, contact your NEES regional rerpesentative or the NEES Project Manager at the address below.

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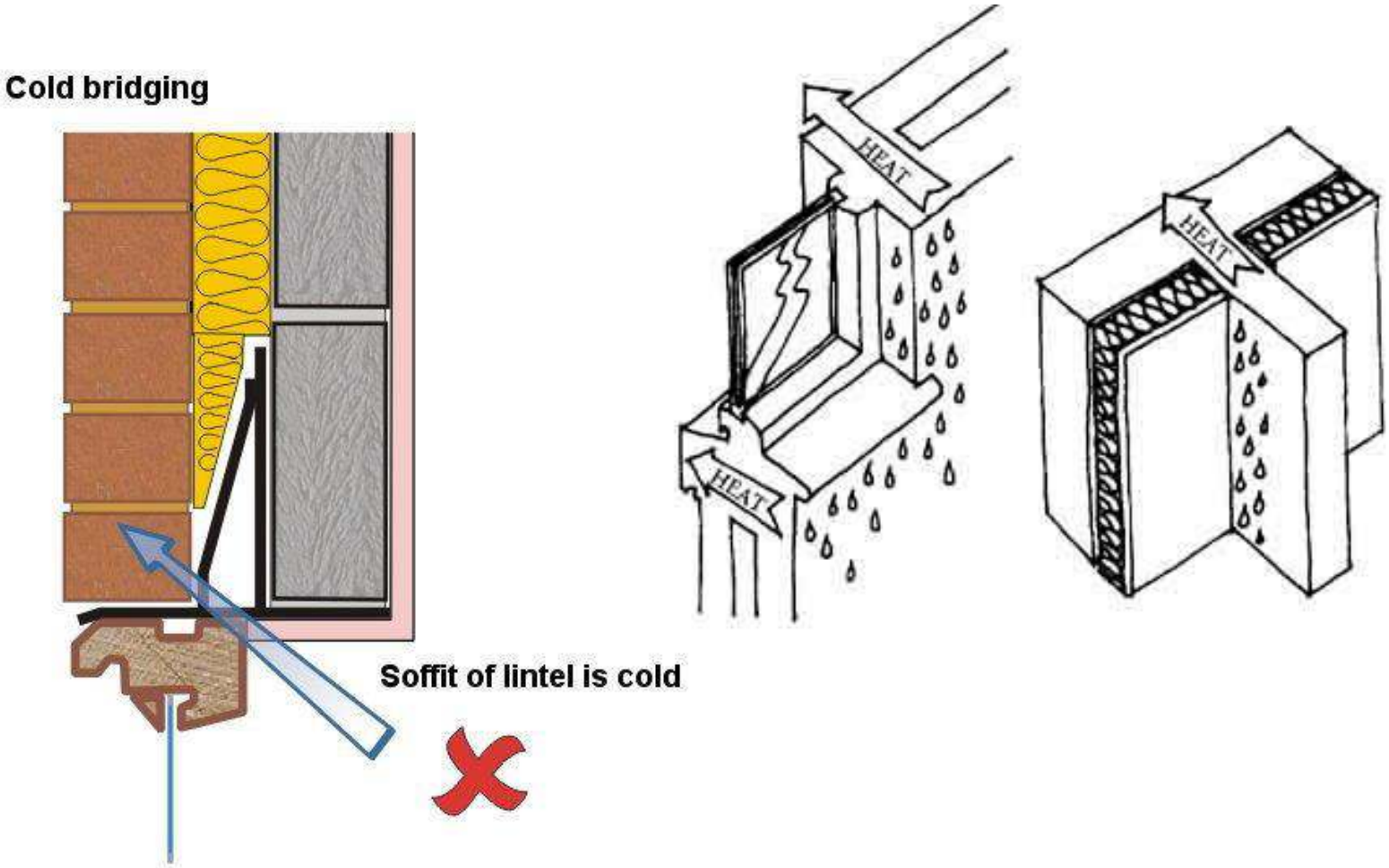
Natural - Energy Efficient - Sustainable

Module 2: Housing Construction Methods and principles

CONTENTS

2.1 Conventional Construction

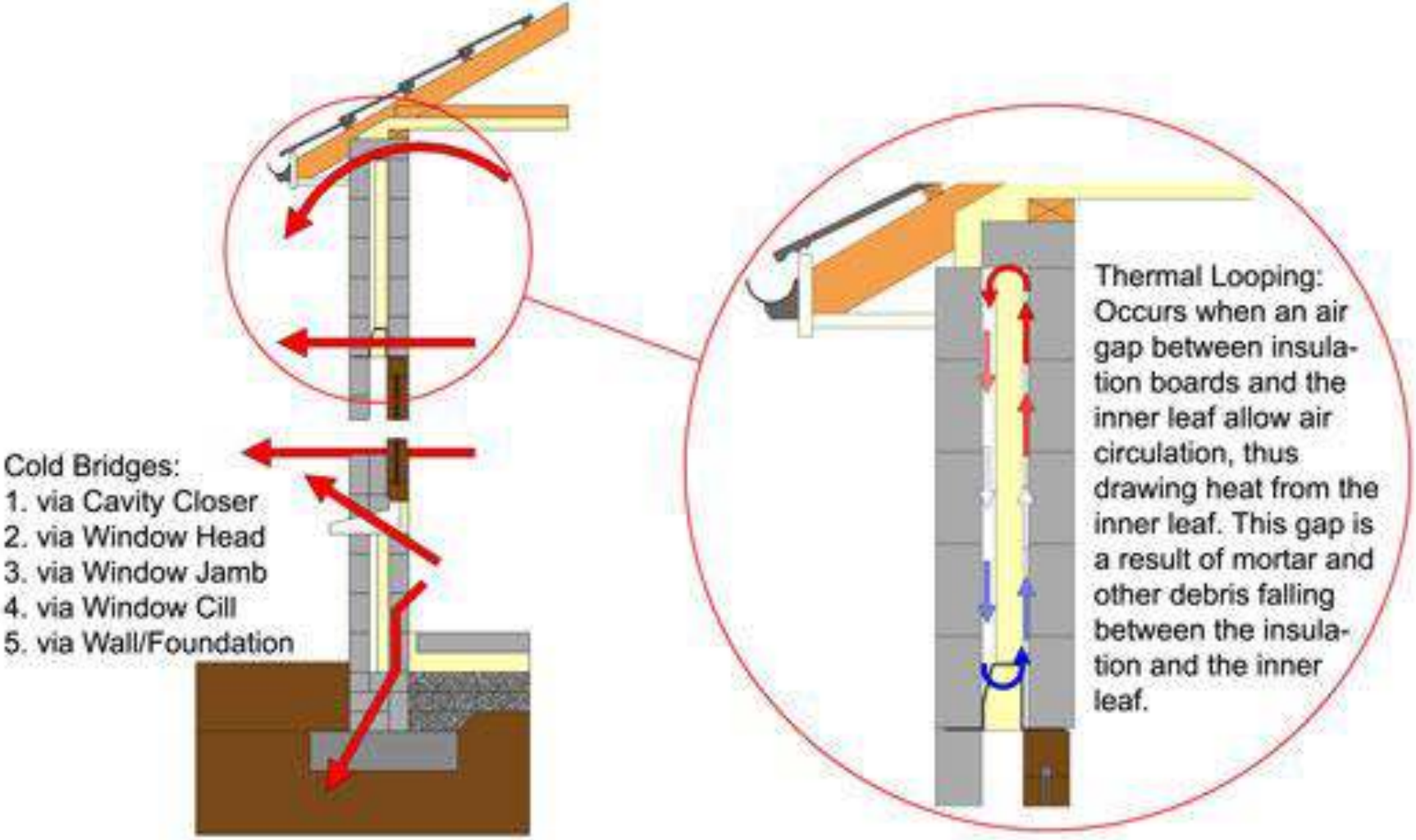
concrete block and steel construction leads to poor thermal performance, poor air tightness and cold bridging...



These are typical cold bridging problems in conventional construction

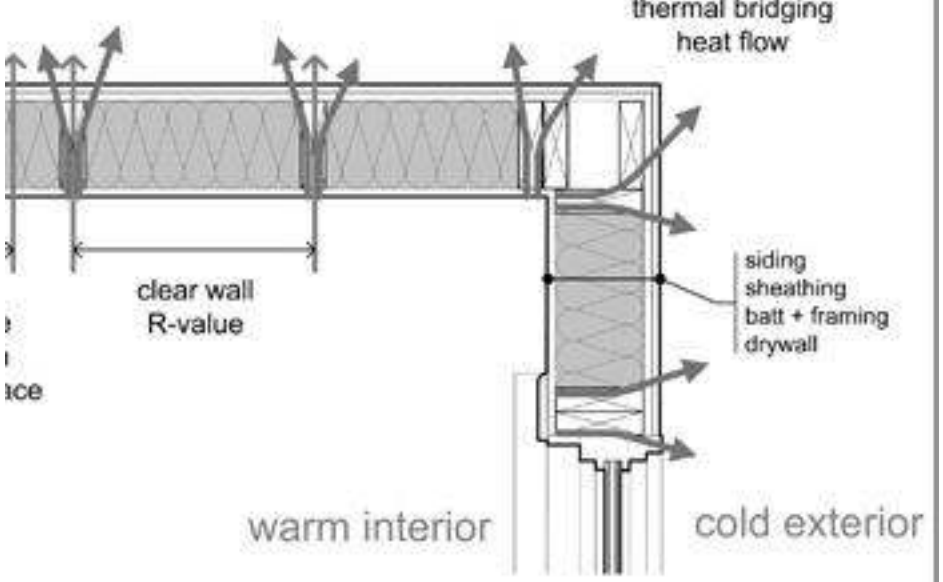
http://www.environ.ie/en/Publications/DevelopmentandHousing/BuildingStandards/FileDownLoad,18749,en.pdf

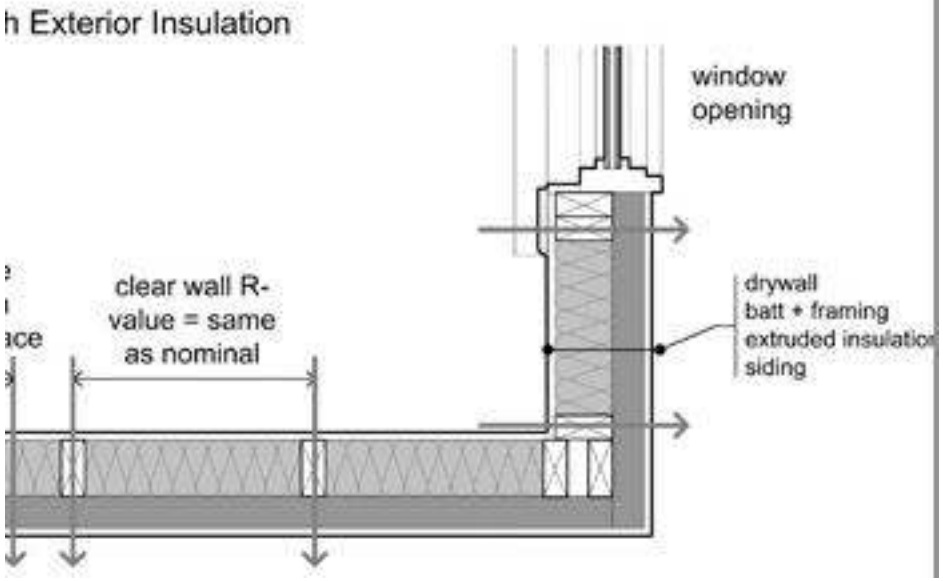
http://www.sesg.strath.ac.uk/Presentations/THERMW_Shop.pdf



Thermal Looping's affect on the U-value of an insulated cavity wall construction:

Gap = 0mm U-value = 0.34
Gap = 3mm U-value reduced to 0.54 = 159% decrease in performance
Gap = 10mm U-value reduced to 0.65 = 193% decrease in performance





Cold bridging can even be a problem in timber frame construction.

But its much simpler to avoid these problems

2.2 Thermal performance– Principles

To reduce energy wastage it is important that any energy used or generated in the house is not lost to the outside environment.

*Heat loss from a building can happen in two ways, through the **fabric** and by **ventilation**.*

To have a truly energy efficient building both of these must addressed

Thermal performance– Principles

Fabric losses occur through all parts of the building fabric. Walls, floors, ceiling, roof, windows and doors.

These losses can be conductive, convective and radiative.

In plane elements such as walls and floors the heat loss is measured in terms of a U Value

At junctions and where different materials meet it is measured in terms of a Ψ (psi) Value

THERMAL PERFORMANCE– PRINCIPLES

Details of the basic principles of building heat loss are provided in Module 6, relative contributions of fabric and ventilation losses and sample u value calculation.

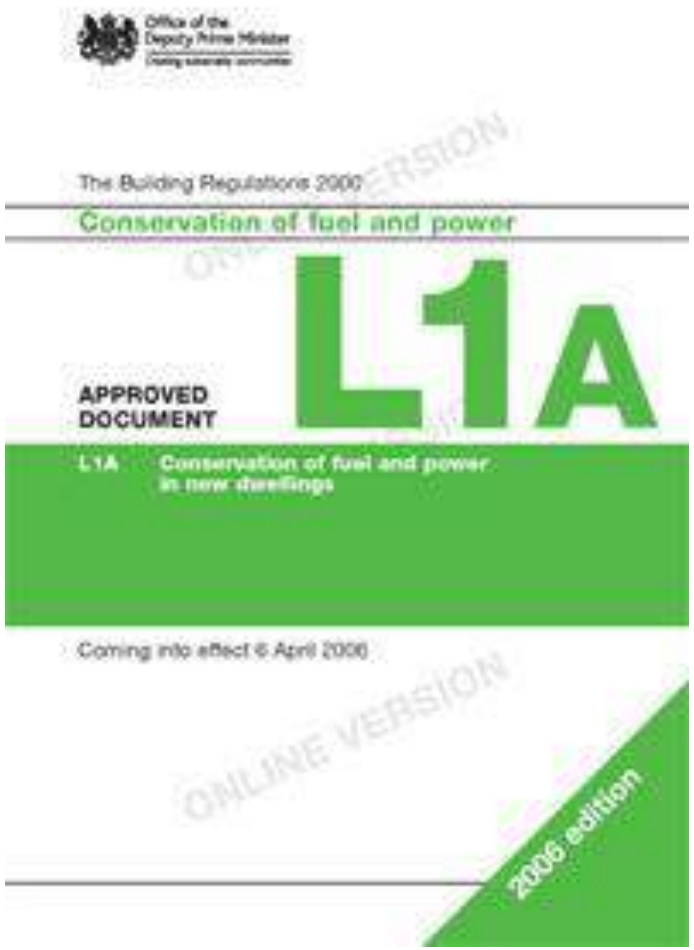
2.3 Air tightness

Most building regulations now require buildings to be tested for air tightness.
The simplest way to understand this is that draughts should be kept to a minimum

However if buildings are very air tight then some form of ventilation is required

A “blower” door is positioned in an outside door and the air is pressurised in the building. How quickly the pressure falls allows the air tightness to be calculated

Typical building regulation document



VENTILATION

Part F F1 (Irish Regulations)

Adequate means of ventilation shall be provided for people in buildings.

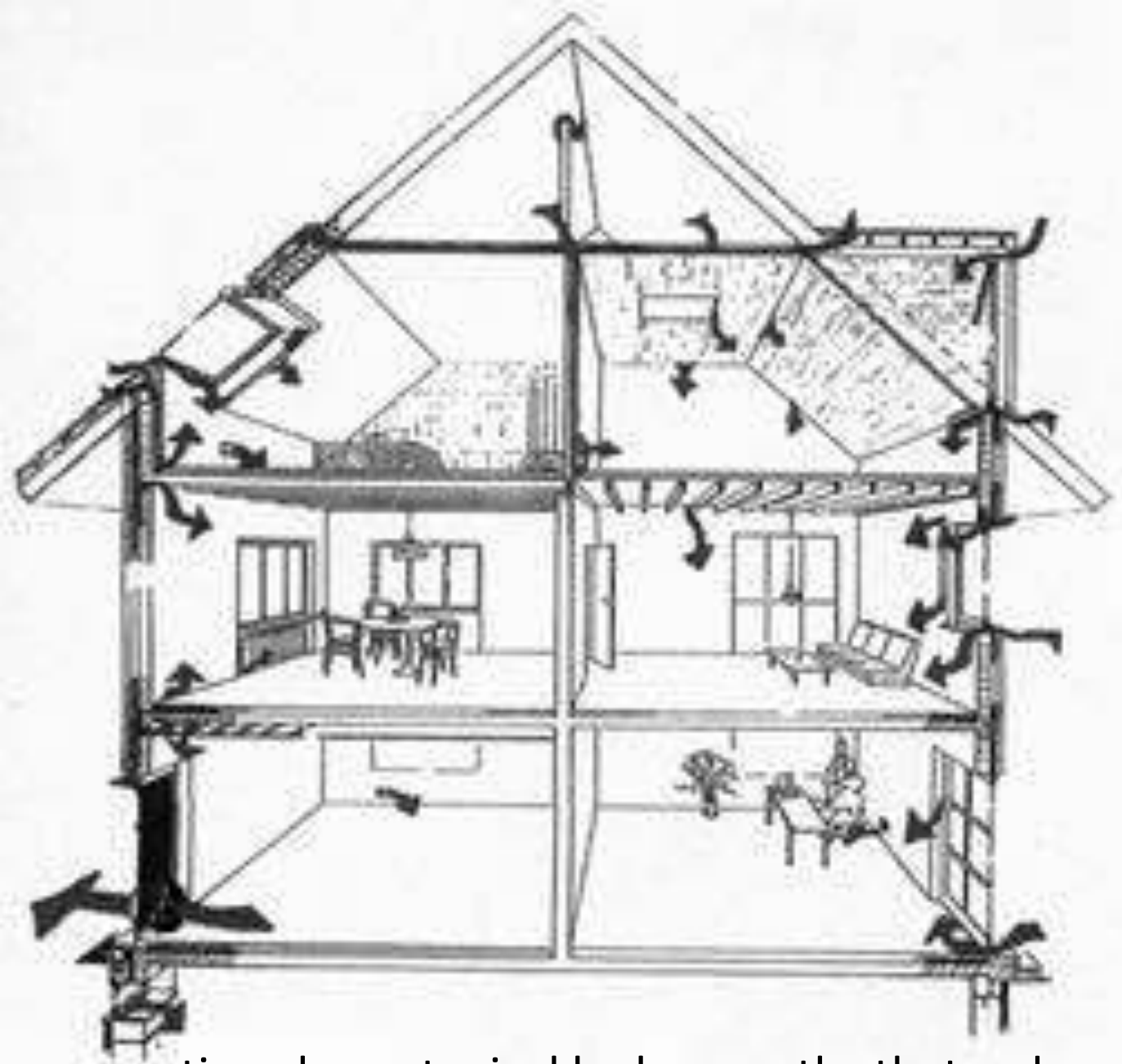
This shall be achieved by;

a) limiting the moisture content of the air within the building so that it does not contribute to condensation and mould growth, and

b) limiting the concentration of harmful pollutants in the air within the building.

Part F F2

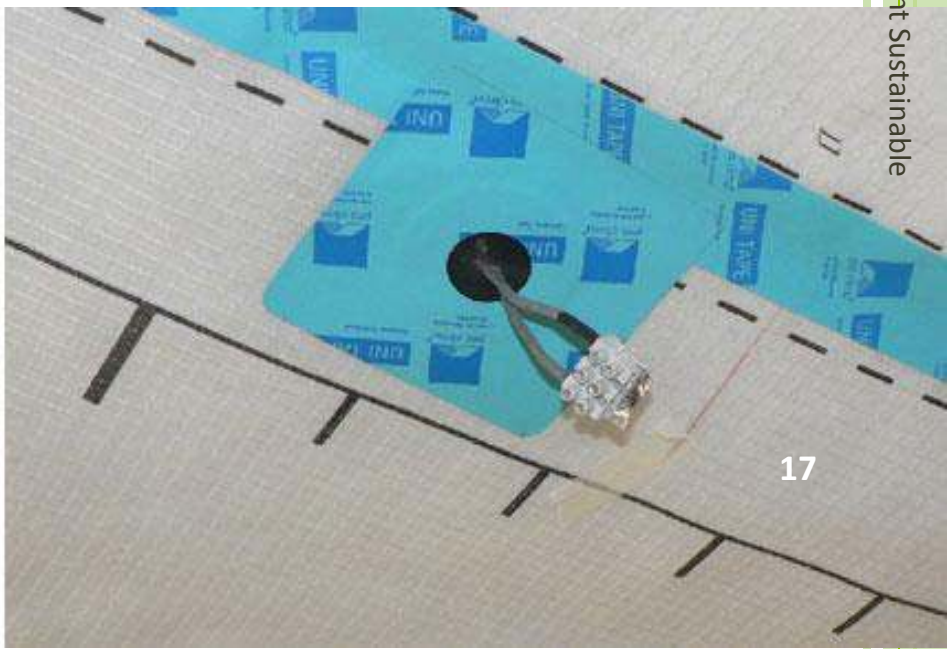
Adequate provision shall be made to prevent excessive condensation in a roof or in a roof void above an insulated ceiling.



The house section shows typical leakage paths that reduce air tightness

To achieve air tightness in standard construction many miles of sticky tape are required together with plastic membranes.

Also any perforations for wiring or plumbing services require special air tight fittings



Smoke pencils can be used to detect leakage paths

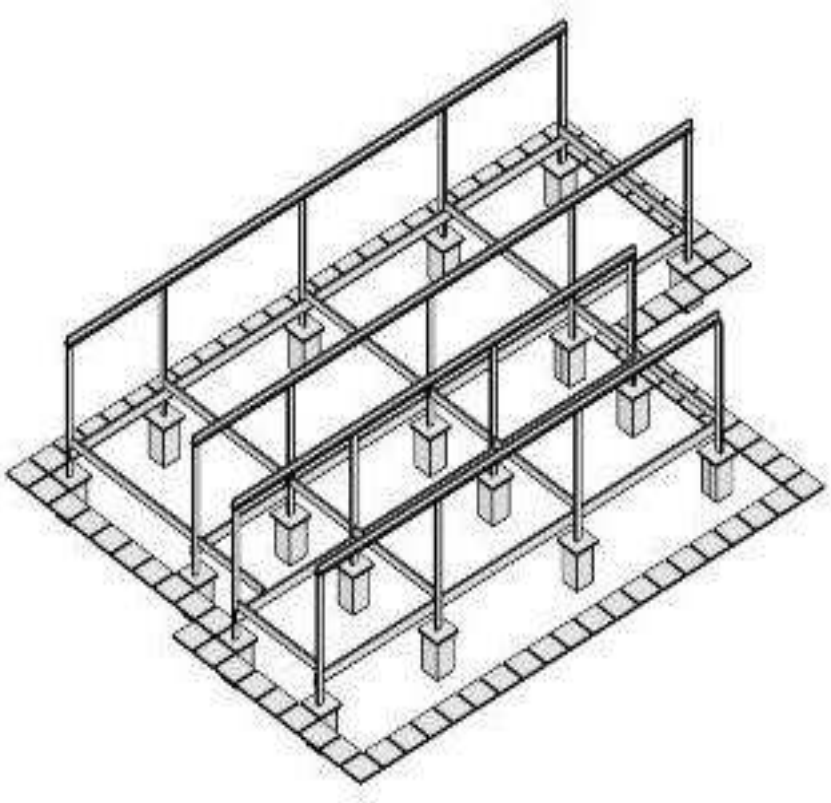
Some natural materials like hemp lime provide total air tightness
Without any membranes or sticky tapes
Here where it is being sprayed in, it blocks all air paths and potential draughts

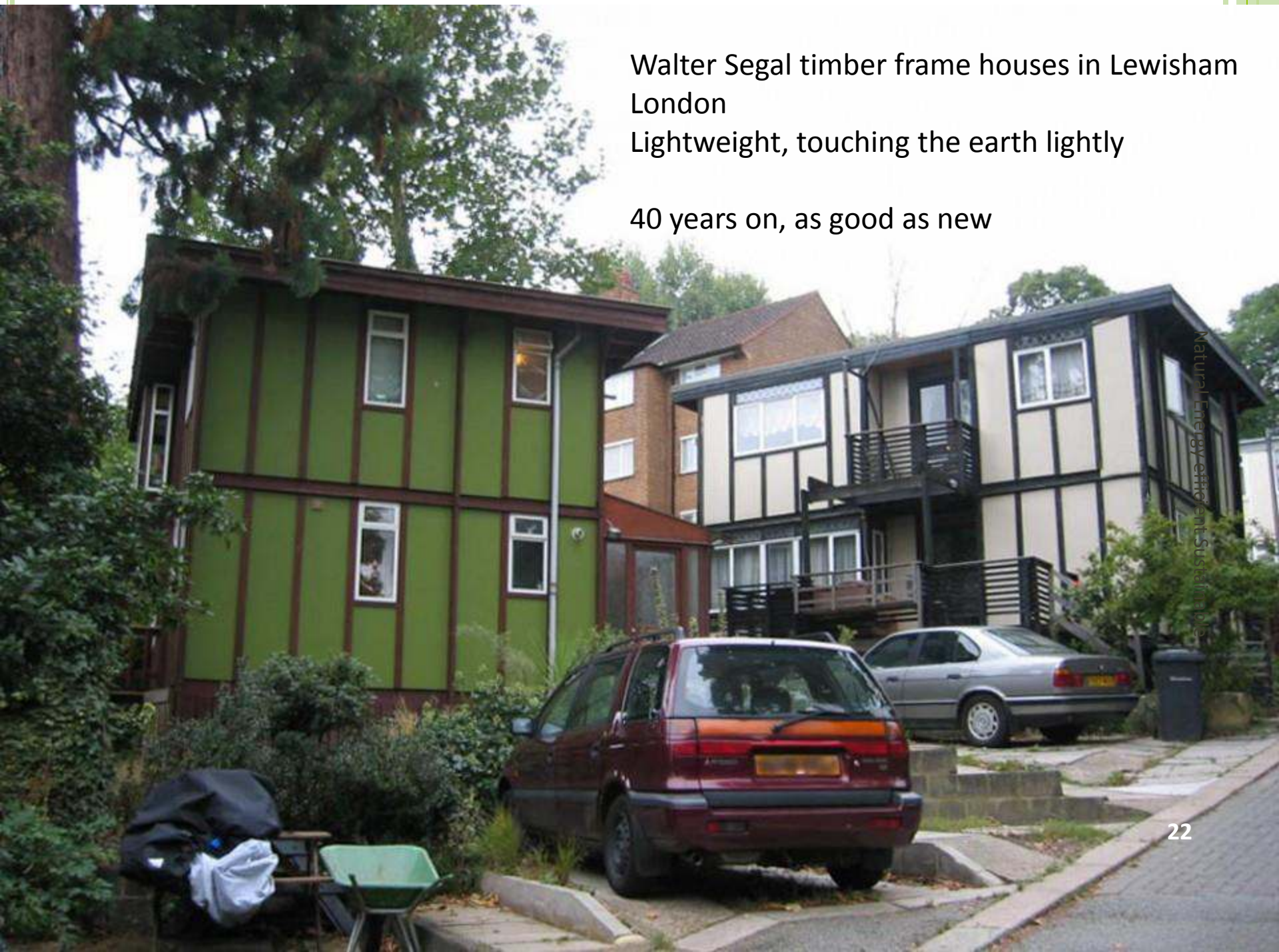
2.4 Foundations

The ecological principle of touching the earth lightly, based on an aboriginal saying made popular by Glen Murcutt, Australian Architect, is a good principle to follow

Foundations

The Walter Segal frame system involves minimal concrete footings using simple pads to support a post and beam timber frame system

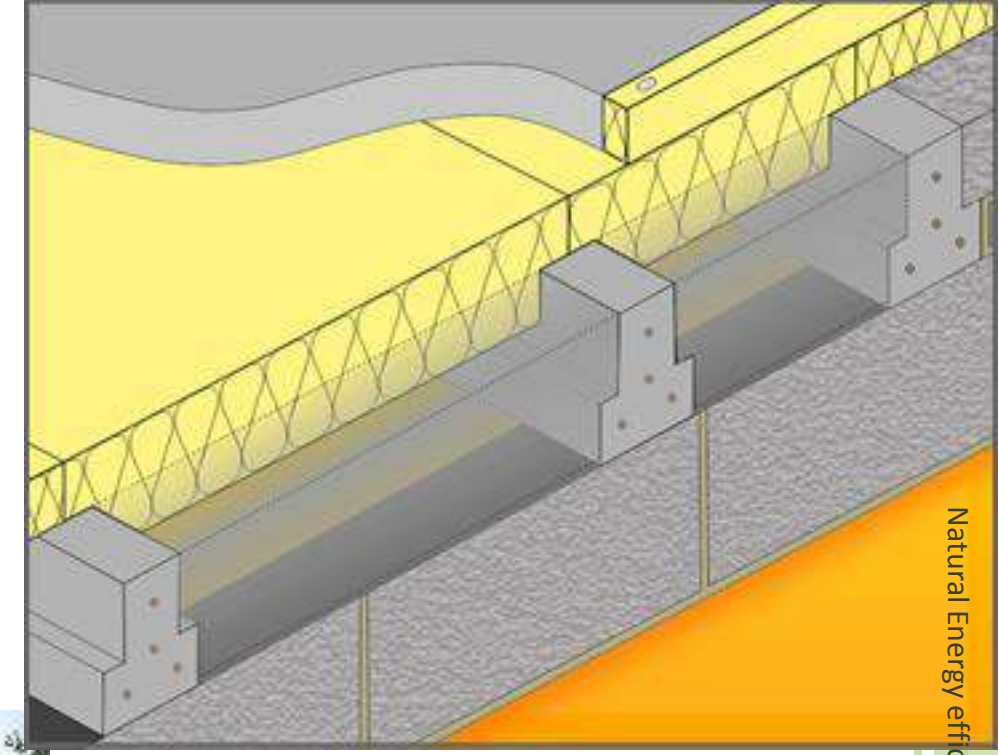




Walter Segal timber frame houses in Lewisham London
Lightweight, touching the earth lightly

40 years on, as good as new

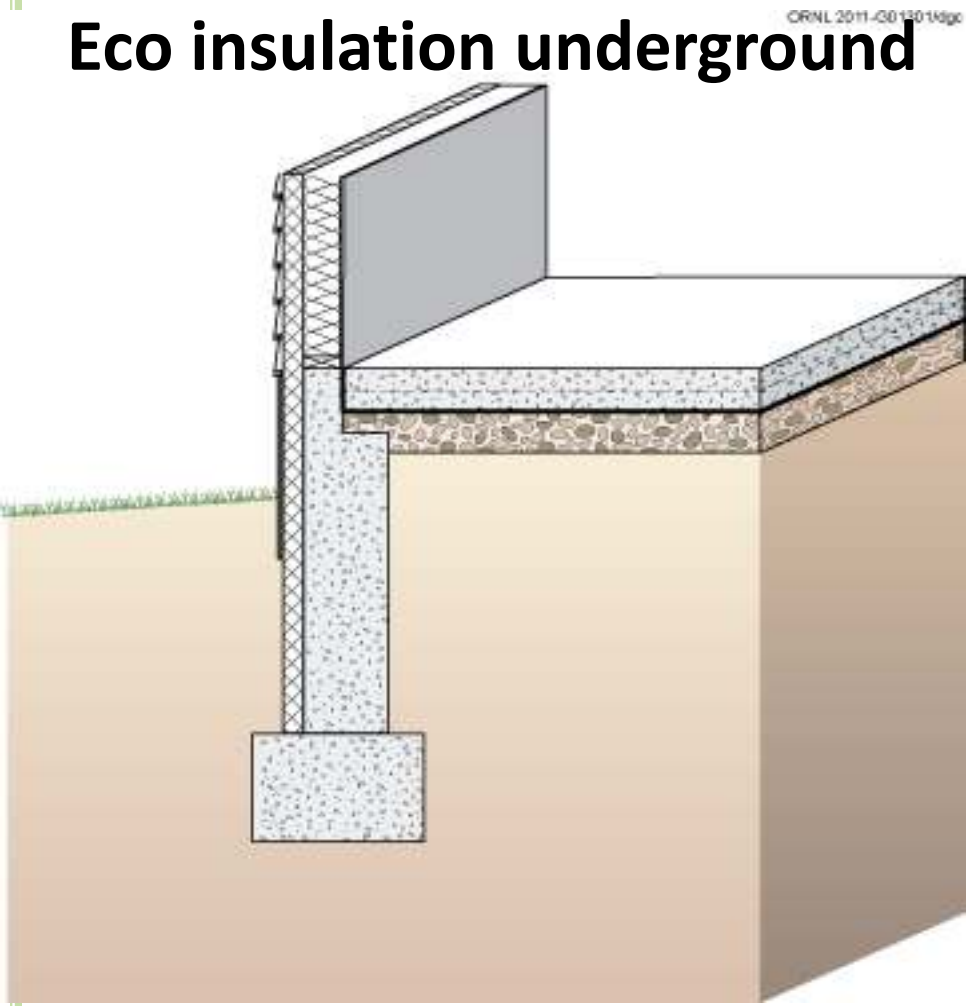
Insulated Foundations



Sometimes ground conditions require more concrete.

Insulation should always be used underground to minimise cold bridging

Eco insulation underground



Recycled glass insulating gravel

Foamed glass is the eco alternative to petrochemical based insulations underground
It is made from recycled car windscreens

Cellular recycled glass insulation

2.5 Timber Frame Construction

Timber frame house constructed by **Advanced Timber Craft**
A NEES Best practice Company

ADVANCED TIMBERCRAFT

Advanced Timbercraft

Habitable breathing Building solutions. Any-where in Europe

Country: UK, Northern Ireland
Contact name: Neil Orr
Address: 10, Brown's Road, Newtownabbey, BT36 4RN
Tel.: 028 9083 8951
Email: neil@advancedtimbercraft.com
Website: www.advancedtimbercraft.com

Natural Energy Efficiency and Sustainability (NEES)

Best Practice in Products and Services

1. Product Description

Advanced Timbercraft (ATC) are a small family business with a big mission to design, Manufacture and Erect high insulated, air tightened, breathable and ventilated timber frame buildings.

2. 'Natural' and/or 'recycled' content

They are focused upon using timber as their base material which is insulated using Cellulose and/or Hemp and/or Sheepwool with external liners made from wood wool or wood fibre.

3. Percentage of the product processed and / or manufactured in the NPP region

The complete building is designed and manufactured in the NPP region.

4. Recyclability / biodegradability

Virtually all materials used in ATC's process are recycled and Biodegradable.

5. Contribution to energy efficiency in buildings

ATC's buildings are seen as being some of the most energy efficient buildings in the NPP region.

6. Lifespan

If ATC's buildings are properly lived in and ventilated they will have centuries of use.

7. Costs – Product and maintenance

This product is flexible in terms of choice and therefore the cost varies upon decisions made by the potential end user. In the use of a Heat recovery Ventilation Unit it is necessary to change filters and clean around outlets and inlets of the system. Other than that no maintenance is required to the remainder of the product as it is covered with the remainder of the construction.

8. Examples of usage

This can be viewed via their web site and includes buildings in France, Holland and whole of UK.

Northern Periphery Programme 2007-2013

The above information was supplied by the producers/service provider and has been verified by the NEES Project.

Advanced Timber Craft

NEES Best Practice Company
Northern Ireland

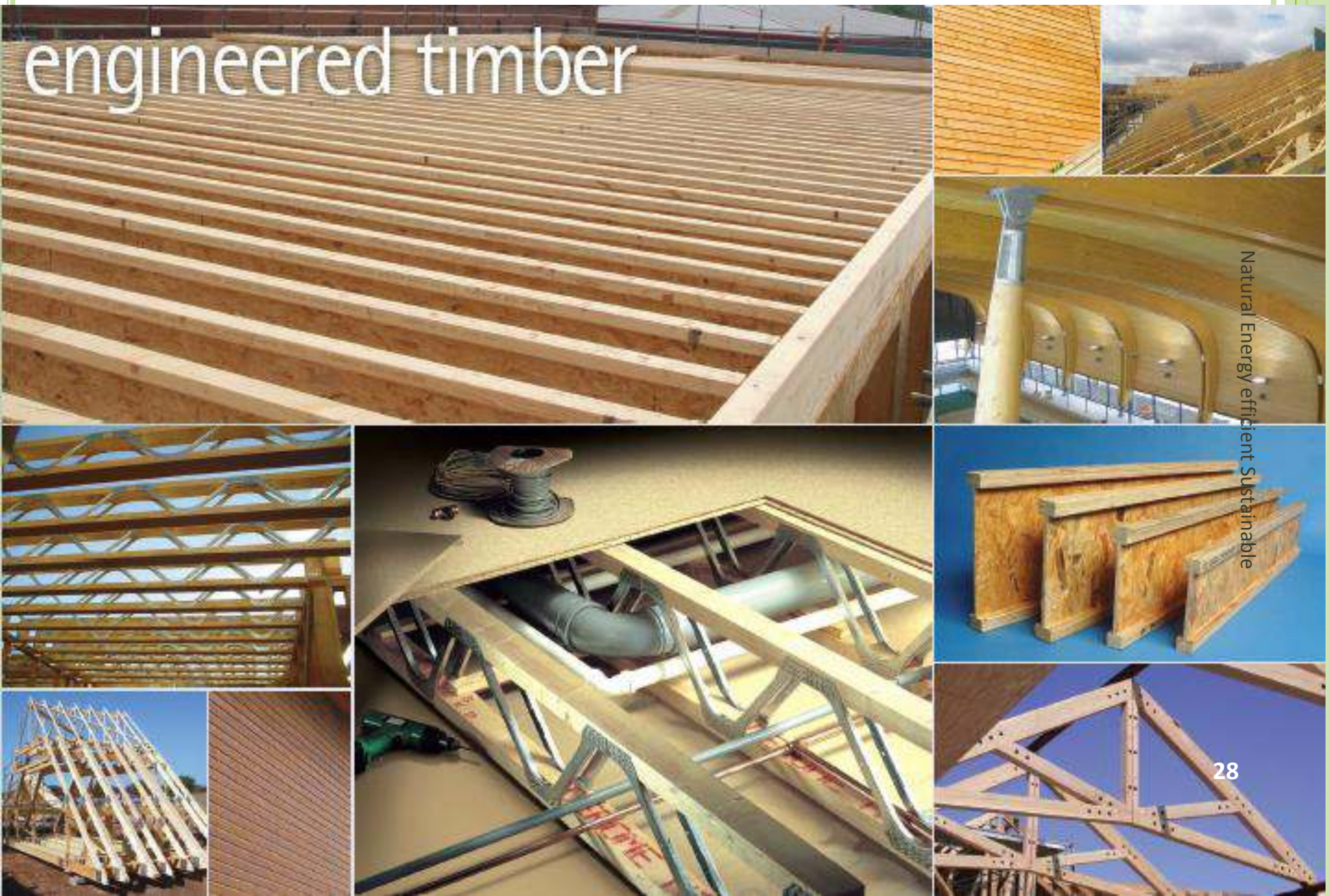
http://www.advancedtimbercraft.com/

MAKAR
NATURAL CONSTRUCTION

NEES best practice Scotland

http://makar.co.uk/?/site/practice/makar/

2.6 Engineered Timber Products

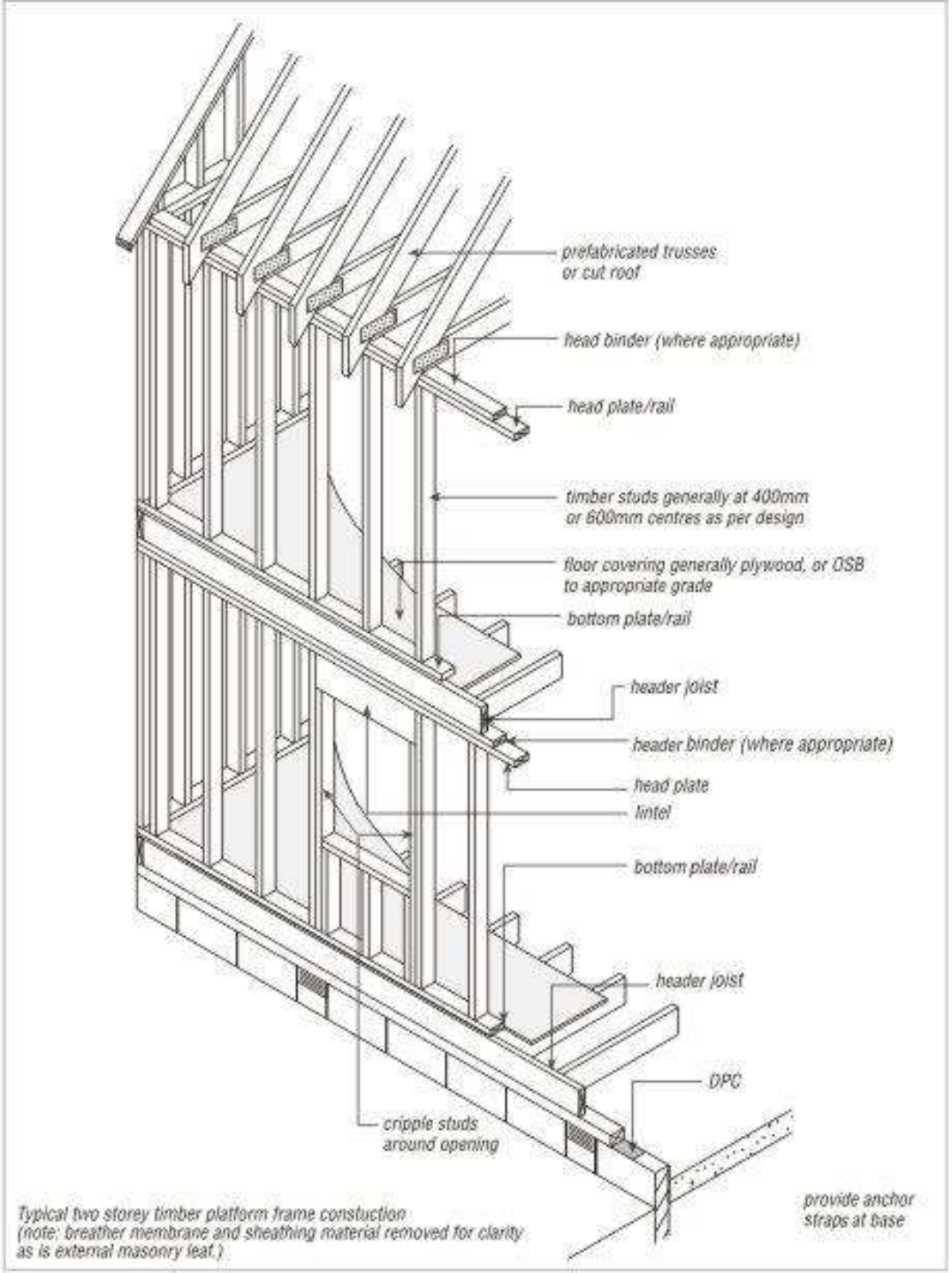


Engineered Timber Products

A wide range of engineered timber products are now available.

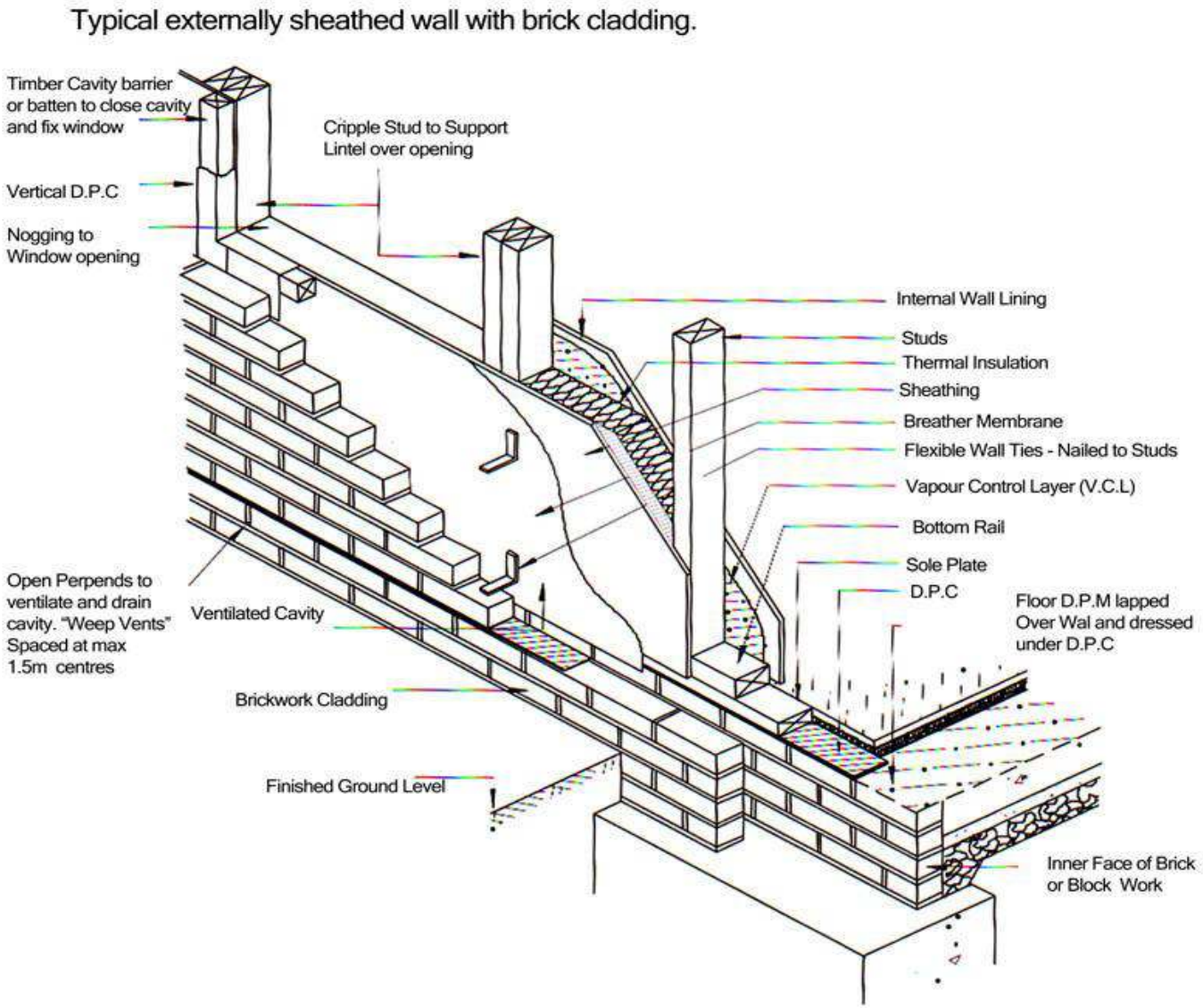
These minimise the amount of timber used

Engineered timber products make it possible to use less timber and yet get greater strength.
Often the timber used is of poorer quality than normal structural timber, thus safeguarding valuable trees



Typical Timber stud frame construction

Timber frame construction is sometimes clad with bricks or blocks
Different kinds of rain-screen cladding can be used including, bricks, rubble stone and timber boarding



Timber construction using hemp flax quilt insulation inside and woodfibre board cladding externally

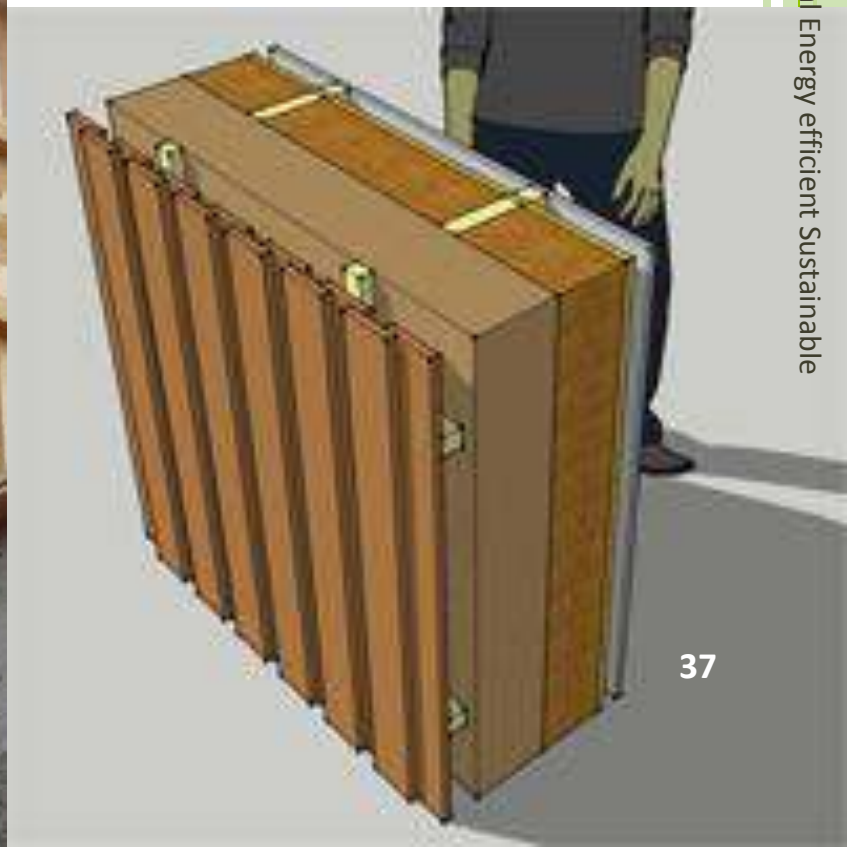
Timber frame with wood fibre natural insulation

Timber frame low energy house insulated with wood fibre insulation

Timber frame houses with wood fibre insulation
Designed by Rachel Bevan Architects

Wood fibre is ideal for roof sarking
And adds significantly to the insulation

Wood fibre board can obviate the need for a plastic membrane



Timber rain-screen cladding

Can be horizontal or vertical though vertical is better in heavy rainfall areas.

Timber can be treated, stained or left to grey down

Timber panel construction

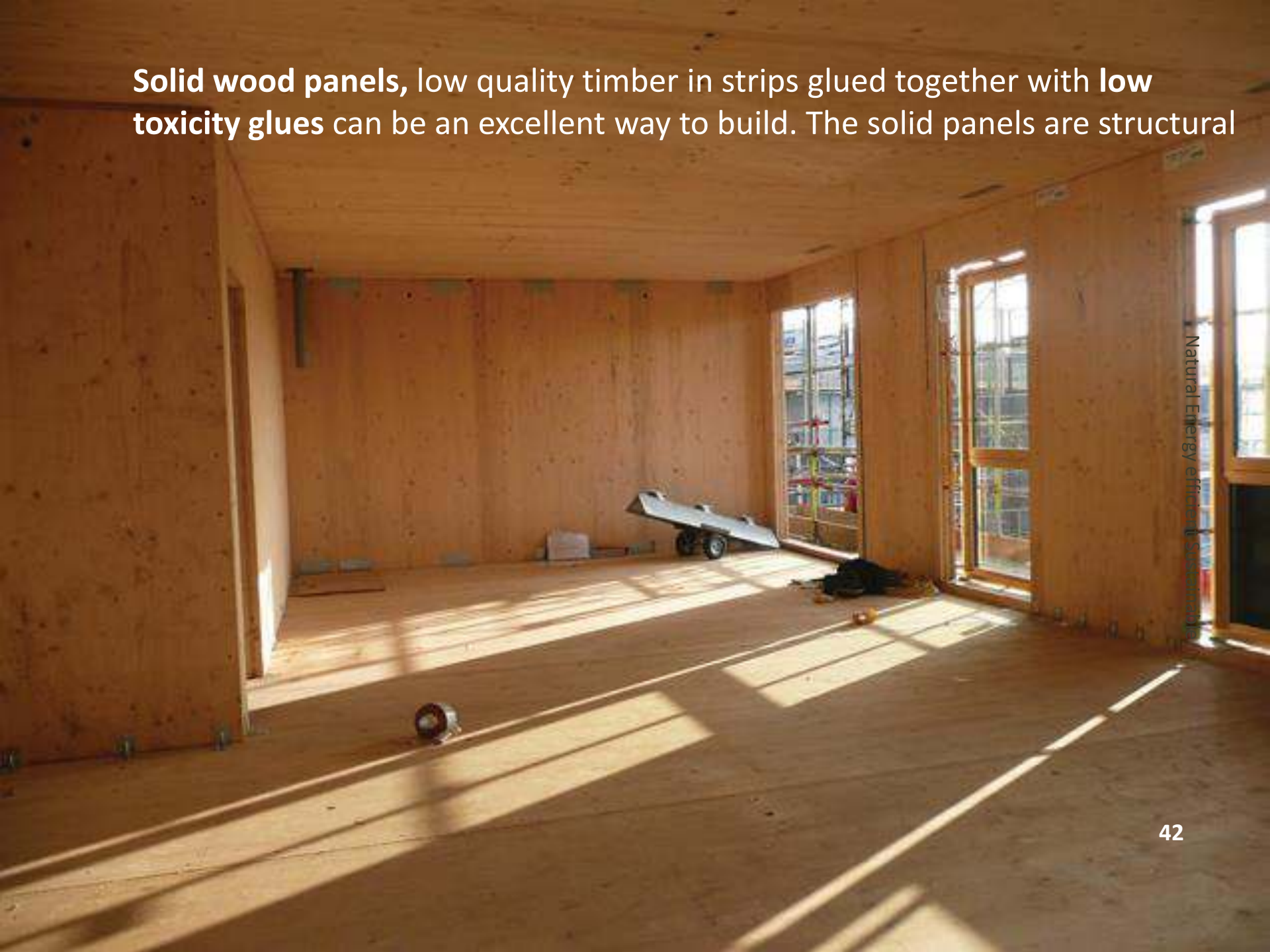
Standard prefabricated board sheathed panels with a wide range of options for insulation and cladding

Often petrochemical insulations are used in this form of construction

Why use a wonderful sustainable renewable form of construction such as timber frame and then fill it with synthetic petrochemical based materials?

Traditional oak frame construction can be popular for new buildings but is very expensive, however it can last for hundreds of years

Solid wood panels, low quality timber in strips glued together with **low toxicity glues** can be an excellent way to build. The solid panels are structural



2.7 Solid wood construction.

Can be used for multi storey buildings
8 storey apartment building in London

Solid wood walls and floors

Two storey house in Inverness Scotland

Inverness: CLT and fibre insulation

Type	2 two-bedroom semi-detached wide-frontage houses of 78 m2 each
Location	Inverness, Fife
Builder/developer	Morrison Construction, Albyn Housing Association
Material	Cross-laminated timber
Insulation	Natural wood fibre, Crown Framotherm glass wool
Grants	£40,000 (RHP)

Inverness **solid wood house** with hemp fibre insulation

Martinsons factory Sweden

NEES Best Practice fabricating sold wood panels

www.martinsons.se

See films of solid wood construction on NEES visit to Martinsons

http://www.youtube.com/watch?v=TPiXJjwBKt0

Report on innovative timber construction in Sweden

http://trastad2012.se/wp/wp-content/uploads/2013/01/Trästad_boken_web_rev-GB.pdf

Prefabricated timber housing Sweden

Prefabricated timber
Housing Sweden

Passiv haus is it ecological?

Passiv haus buildings are usually built with synthetic petrochemical based products But many eco experts are worried about this.

Below is a paper criticising passiv haus by leading expert Bjorn Berge

The engine is not responding

A critique of the automatic energy-saving home

by Bjorn Berge, Norway

[published in Arkitektur 1/2011]

The new Norwegian building code of 2010 - and expectations concerning the regulation fixing them to passive standard from 2015 - means that we are about to pass a milestone in the Norwegian building traditions. For the first time "requirement" for mechanical systems is being brought in as a prerequisite for living. That the direct energy and climate effects of these measures will often be questionable, and that it also relates to serious climatic problems, have both gradually become a part of the public debate. This article attempts to penetrate deeper into some of the social, political and cultural aspects of this that must now be called a fateful paradigm shift.

First Issue March 2012

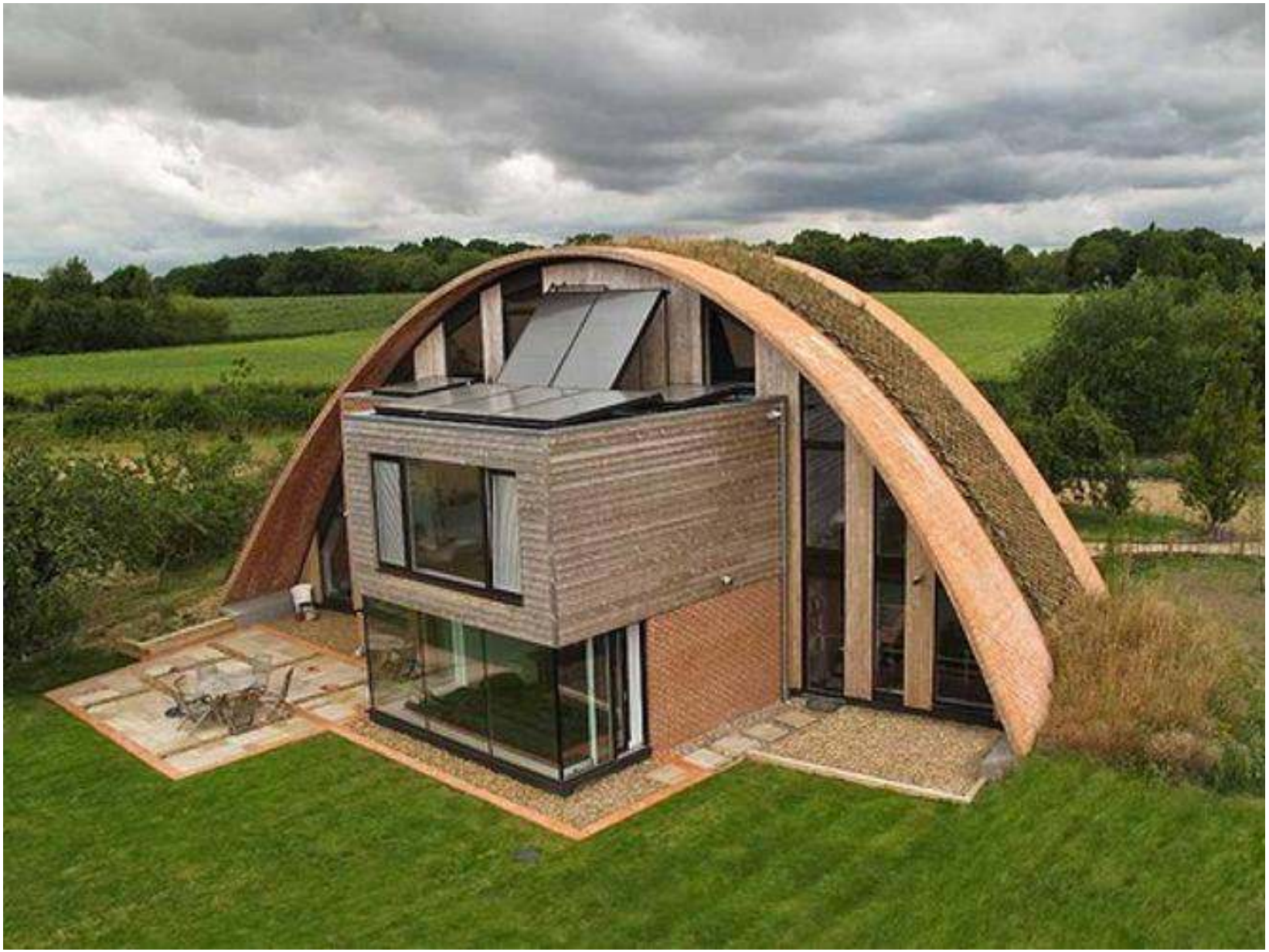
Passivhaus Buildings: Case Studies

Synthetic insulations are invariably used for passiv haus buildings

Kingspan
Low Energy–
Low Carbon Buildings

Passiv haus in England built with natural materials

Low energy standards **can be achieved** with **natural bio-based materials**



Hempcrete passiv haus built in County Longford Ireland

winkens architecture

practice profile

residential
bungalow
dormer
two storey
split level
extension

progress photos
projects in planning

featured project house
straw bale house

testimonials

commercial

information

practice news

home page

winkens architecture

project 'hemp lime' house progress photos

jb hemp house - Co. Longford

This two story dwelling is based on a traditional long house.
It will be constructed in timberframe with a hemp lime cast construction outer wall 450mm thick. It is a self build. The client is 100% hands on.
He has great attention to detail.
A heat recover ventilation system (HRV) and rainwater harvesting will also be installed.
A wetland system designed by Oian Herr reedbed and wetland system consultant Dundalk is also part fo the build.

Newest photos on top.

Low Energy hempcrete house in County Tipperary Ireland

2.8 Hemp lime Hempcrete

Or

Hemp Concrete Construction

Hemp lime can be used to create extremely airtight Passiv haus standard buildings, but the material is also breathable providing a natural solution to energy efficiency

Drumalla House, Carnlough, County Antrim: hempcrete and sheep's wool

Type	11 houses (10 two-storey semi-detached houses, 1 wheelchair bungalow), CSH Level 4
Location	Drumalla House, Carnlough, County Antrim
Builder/developer	MSM Construction Ltd. for Oaklee Housing Association
Material	Timber frame, hempcrete walls, PV panels, mechanical ventilation heat recovery systems
Insulation	Sheep's wool
Grants	£110,000 (RHP)

NEES associate partners

Oaklee Housing Association

Northern Ireland

Have built houses using hemp lime

prestigious industry awards

Uniquely, under the Renewable Construction Demonstrator Programme, the dwellings incorporate renewable materials such as sheepswool attic insulation and shredded newspaper cavity and floor insulation. The timber frame dwellings also have a Hempcrete outer skin in place of concrete. All of these elements reduce the carbon footprint of the dwellings, with this scheme being the largest in Ireland to use this construction method.

Group Chief Executive Ian Elliott said: "Drumalla Park is an exemplar housing project for building sustainable communities through development and regeneration. The pioneering energy efficient features of the properties have received extensive recognition, with the Belfast Telegraph listing it as one of the top 50 places to live in Northern Ireland, and the achievement of a UK Green Apple Award for Building and Construction and a CIH Award. These esteemed awards are testament to Oaklee's desire to be at the forefront in developing energy efficient housing schemes."

Brian Rankin and Chris Hopkins from Ploughcraft Solar at the Green Apple Awards.

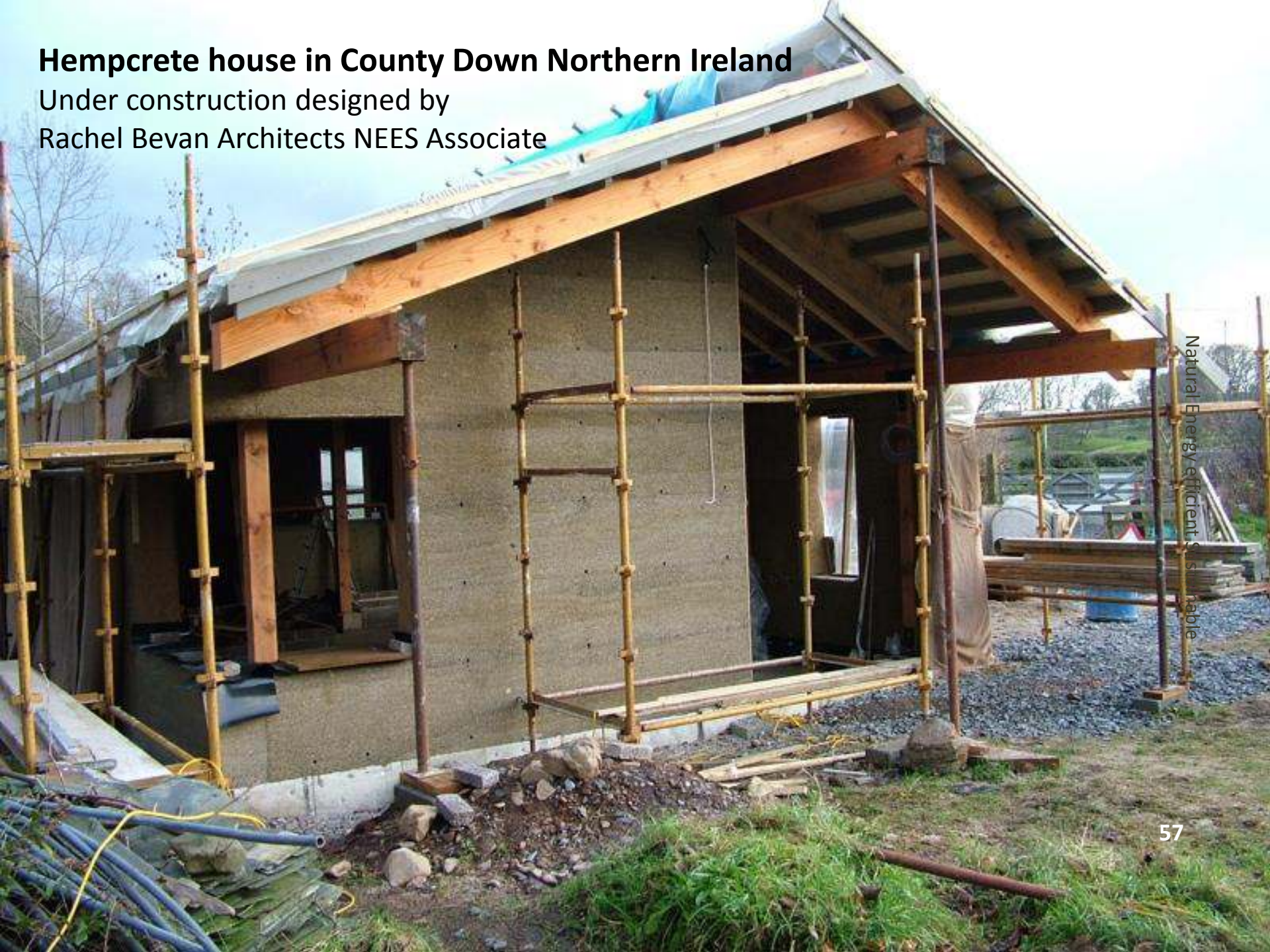
Action Renewables Green Goddess, Brian Rankin, Oaklee Homes Group and Hugh Savage, Ardminnan.

Natural Energy efficient Sustainable

Hempcrete house in County Down Northern Ireland

Under construction designed by

Rachel Bevan Architects NEES Associate



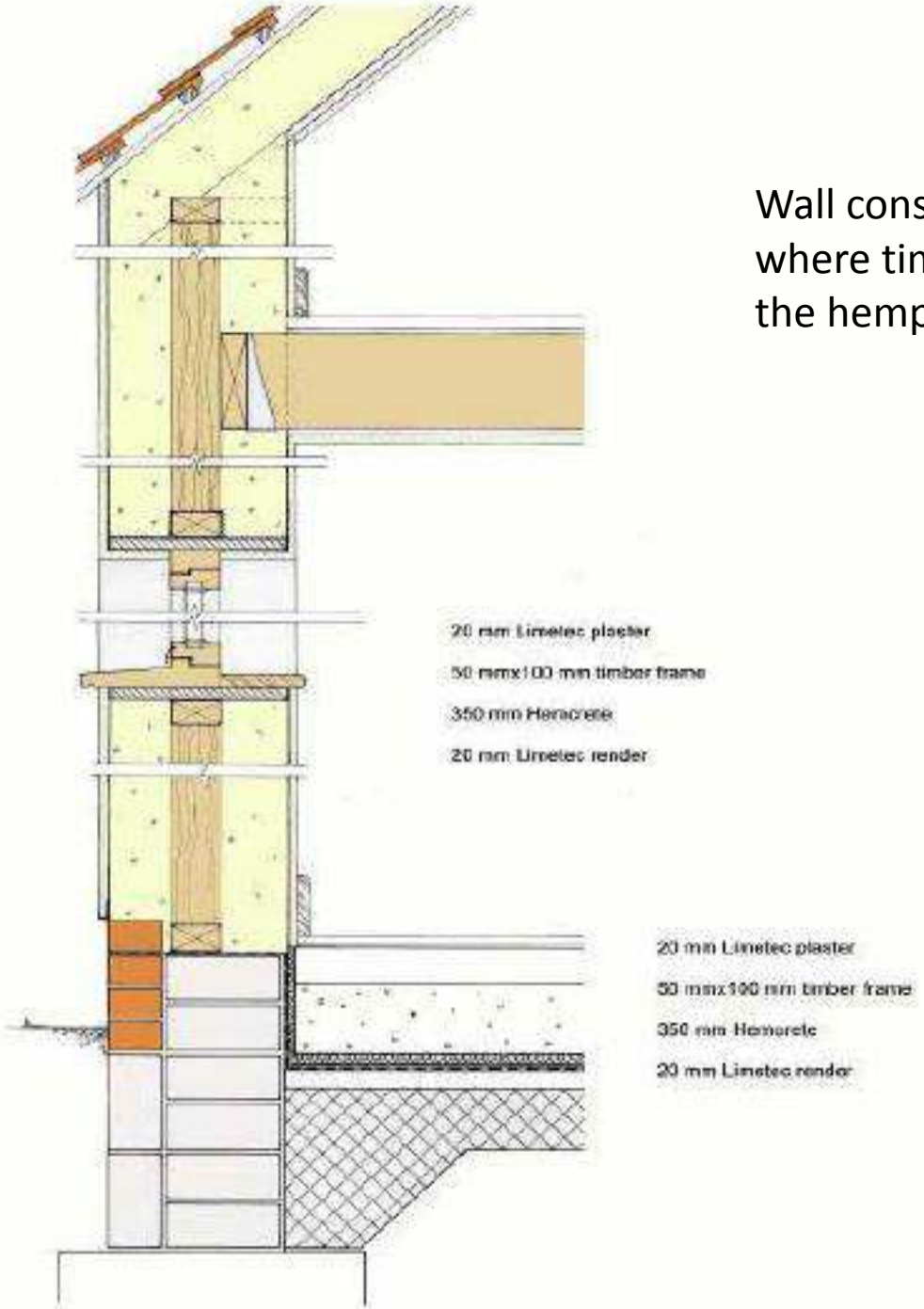
Hempcrete is a solid wall form of construction
Where hemp lime is cast around a timber frame using shuttering or formwork

Hemp and lime can also be sprayed

Prefabricated panels can be made with hemp and lime

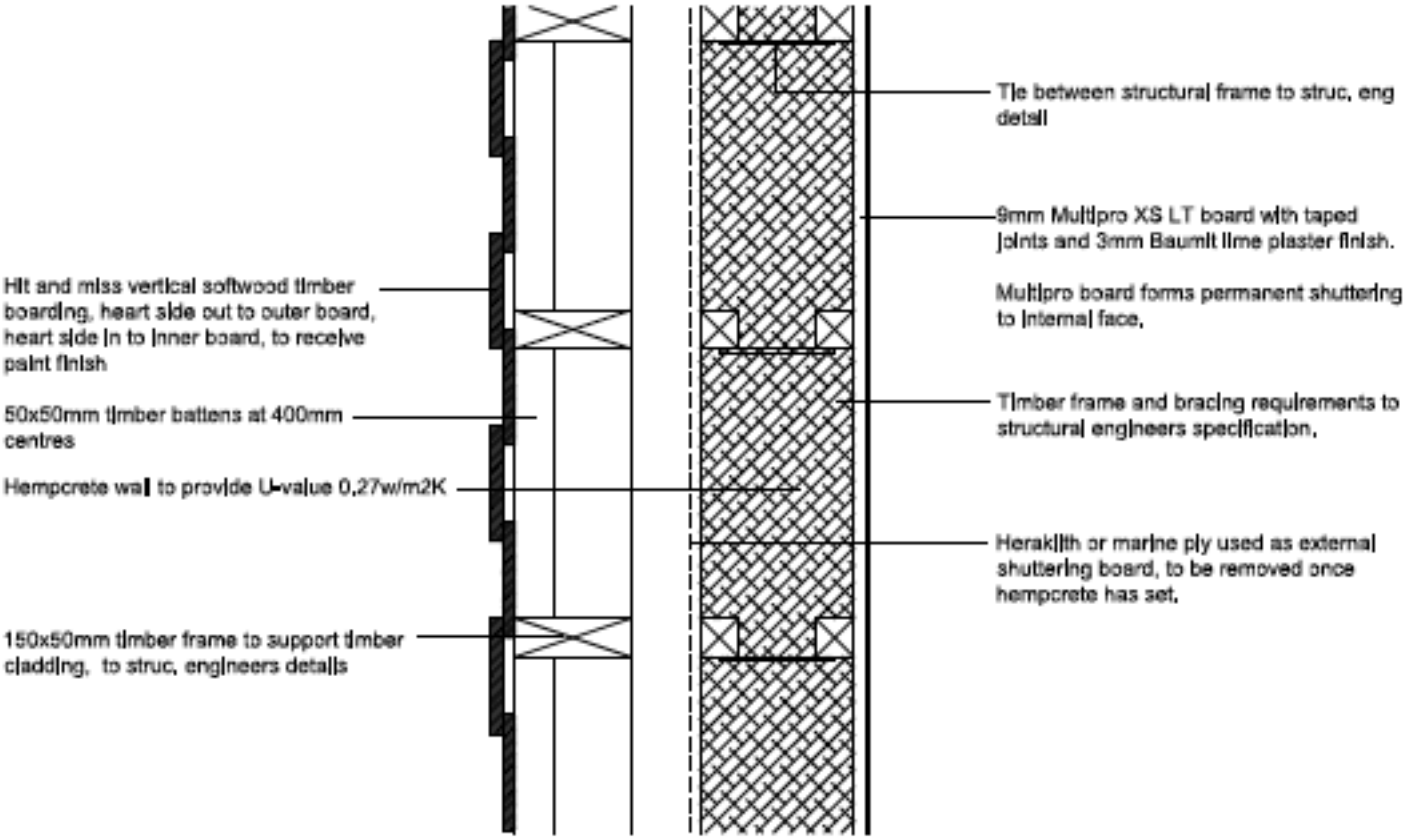
Social housing built with hempcrete

Hempcrete can be clad with timber rain-screen



Wall construction detail of hempcrete where timber frame is in the middle of the hempcrete

Hempcrete detail where there is a big gap between the insulating wall and an external rain-screen



Plan detail 1:10