

Lecture 04 - External Walls, Openings & Windows

Advanced Technology

Module Code: 5CTA1140

Semester A: Weeks 10 - 24

Credits: 15

Module Co-ordinator: Kenny Fitzmaurice

Module Leader: Ilona Hay

Lecturer: Brian Murphy

22nd October 2018

University of
Huddersfield



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4 Quotes for today:

Build Tight > Ventilate Right

Fabric First (Eco bling last)

No Insulation without Ventilation (PAS 2035)

Build Light > Insulate Right > Solar Tight

Semester A Programme

Week 10	01.10.2018	Lecture 01.	Introduction to Materials	Design Task 01
Week 11	08.10.2018	Lecture 02.	Sustainability Principles	-
Week 12	15.10.2018	Lecture 03.	Building Envelope Principles	-
Week 13	22.10.2018	Lecture 04.	External Walls, Openings & Windows	-
Week 14	29.10.2018	-	Submission	-
Week 15	05.11.2018	-	Independent Study Week	-
Week 16	12.11.2018	Lecture 05.	Floors, Ceilings & Roofs	Design Task 02
Week 17	19.11.2018	Lecture 06	Guest Lecture: Structural Engineer	-
Week 18	26.11.2018	Lecture 07.	Lighting, Heating, Ventilation, Services	-
Week 19	03.12.2018	Lecture 08.	Stairs, Lifts & Ramps	-
Week 20	10.12.2018	-	Formative Review	Present your Semester A Work
Week 21	17.12.2018	-	Winter Break	-
Week 22	24.12.2018	-	Winter Break	-
Week 23	31.12.2018	-	Winter Break	-
Week 24	07.01.2019	-	Submission	Semester A Work

Semester B Programme

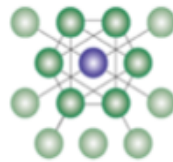
Week 26	21.01.2019	Lecture 09.	Regulatory Framework	Design Task 03
Week 27	28.01.2019	Lecture 10.	Site Analysis	-
Week 28	04.02.2019	Lecture 11.	Building Costs	-
Week 28	05.02.2018		Technology Champion	
Week 29	11.02.2019	Lecture 12.	Future Systems: Sustainability	Design Task 04
Week 30	18.02.2019	Lecture 13.	Guest Lecture: Structural Engineer	-
Week 31	25.02.2019	Lecture 14.	Design to Perform & Detailing	-
Week 32	04.03.2019	-	Class Trip (TBC)	-
Week 33	11.03.2019	-	Independent Study Week	-
Week 34	18.03.2019	Lecture 15	Future Systems: Technologies	-
Week 35	25.03.2019	Lecture 16.	Module Review	-
Week 36	01.04.2019	-	Formative Review	Present your Semester B Work
Week 37	08.04.2019	-	No Lecture	-
Week 38	15.04.2019	-	Spring Break	-
Week 39	22.04.2019	-	Spring Break	-
Week 40	29.04.2019	-	No Lecture	-
Week 41	06.05.2019	-	Portfolio Submission	Semester A & B Work

>40 years into 1 Hour won't go

- So I am providing links to other information if you want to know more
- Question Everything
- Don't assume that I know everything
- Don't assume I have cherry picked the best bits
- Don't assume what your being told is the whole story
- Some will hide what they don't want you to know
- Do your best with what you know
- When you know better
- Do better

UofH Part 1 Year 2 Schedule

GBE






Green Building Encyclopaedia

<https://greenbuildingencyclopaedia.uk/?P=17699>

Task	Topic	Lecture/CPD	Books	GBE Website pages
0	The Whole Year	Principles of Element Design (Lecture)	Architects Pocket Book	G#17699 (this page)
		Fixings Fastenings	Environmental Design Pocket Book (Book)	Interest 220 Connectivity (folders)
		Adopt a material (Lecture)	Principles of Element Design (Book)	
		Future Systems (Lecture)	Designed to perform (Book)	
1	Site Survey	Site / Existing Building Survey Test Analysis (CPD/Lecture)	Survey Site Analysis (Navigation)	
2	Sustainable Strategy	HERACEY® (Jargon Buster CPD)	TBH Designer's Handbook	HERACEY® (Jargon Buster)
		Matrix (Navigation)	Building Regulations AD L-+ Conservation of fuel and power	Healthy (Jargon Buster)
			PHPP Passivhaus & EnerPHit	Environmental (Jargon Buster)
			AECB Carbon Lite & Retrofit	Resourceful (Jargon Buster)
			CIBSE TM60 2018 Good Practice in the Design of Homes (Book)	Appropriate (Jargon Buster)
				Competent (Jargon Buster)
				Effective (Jargon Buster)
				Yardstick (Jargon Buster)
3	External walls and openings	Timber External walls External wall Opening Window Door (Lecture)	Principles of Element Design (Lecture)	Calculators (Navigation)
		Masonry External walls External wall Opening Window Door (Lecture)	IBO Passive Houses New Build	Elemental Building U-value calculator
		Glass External walls External wall Opening Window Door (Lecture)	Designed to perform (Book)	Elemental Assemblies Spreadsheet
		Other External walls	Building Regulations	Windows (Checklist)



		External wall Opening Window Door (Lecture)	AD L-+ Conservation of fuel and power	
		Windows External wall Opening Window Door (Lecture)		Rooflights (Checklist)
		Doors External wall Opening Window Door (Lecture)		
		Rooflights		
		Solar Shading (CPD)		
4	Roof & Floor	Pitched Roof	Principles of Element Design (Lecture)	Calculators (Navigation)
		Flat Roof	IBO Passive Houses New Build	Elemental U value calculator
		Ground Floor	Designed to perform (Book)	Elemental Assemblies Spreadsheet
		Upper Floor	Building Regulations AD L-+ Conservation of fuel and power	
5	Access Stairs	Stairs Ramps Lifts Escalators (Lecture)	Building Regulations AD K	Checklist (Navigation)
	Stairs Ramps Balustrades Walkways	Stairs Ramps Lifts Escalators (Lecture)	Building Regulations AD K	
	Lifts Escalators	Stairs Ramps Lifts Escalators (Lecture)		
6	Internal Linings Elevations and Reflected ceiling Plans	(22) Internal partitions	Principles of Element Design (Lecture)	
		(23) Upper Floors	IBO Passive Houses New Build	
		Interior Linings	Designed to perform (Book)	
		(40) Finishes (CPD/Lectures)		
7	Axo, Build ups, thicknesses	Principles of Element Design (Lecture)	Principles of Element Design (Lecture)	Calculators (Navigation)
			IBO Passive Houses New Build	Elemental Building U-value calculator
			Designed to perform (Book)	
8	Drawings + Model			Calculators (Navigation)
				Whole Building U value calculator
9	3D Design	Intro to BIM	BIM A Spec Writers Perspective (Shop)	GBE BIM (Jargon Buster)
10	Wall Roof Junctions	Principles of Element Design (Lecture)	IBO Passive Houses New Build	Calculators (Navigation)
			Designed to perform (Book)	Psi value calculator
11	Wall Floor Foundation Junctions	(16.4) Foundation (Lecture)	Principles of Element Design (Lecture)	Calculators (Navigation)
		(16.4) Groundworks RC Raft Foundation (Lecture) G#2114	IBO Passive Houses New Build	Psi value calculator
			Designed to perform (Book)	
12	Model			

GBE   
www.GreenBuildingEncyclopedia.uk
Cycle Assessment Procedure for Eco-impacts of Materials

Glass External Walls



(21.4) Curtain Walls

Another GBE CPD lecture file to download
<http://www.greenbuildingencyclopedia.uk>

GBE   
https://GreenBuildingEncyclopedia.uk




(21) Timber External Walls

CI/SfB (21.1) Load-bearing
(21.3) Non Load-bearing

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www.GreenBuildingEncyclopedia.uk
Cycle Assessment Procedure for Eco-impacts of Materials




(21) Masonry External Walls

CI/SfB: (21.1) Load-bearing
(21.3) Non Load-bearing

GBE   
www.GreenBuildingEncyclopedia.uk
Cycle Assessment Procedure for Eco-impacts of Materials




(21) Timber Frame

Construction Critique

GBE   
https://GreenBuildingEncyclopedia.uk

(21) Other External Walls

CI/SfB (21.1) Load-bearing
(21.3) Non Load-bearing

GBE   
http://GreenBuildingEncyclopedia.uk




BDA Illustrated Introduction to Brickwork Design

© Brick Development Association 1975
TL Knight AADipl RIBA
A shining example of how to communicate with Architects ¹

GBE   
http://GreenBuildingEncyclopedia.uk

(22) Internal Partitions

G14 Light steel frame • G20 Light timber framed • K10 Plasterboard
• K30 Panel Partitions • K32 Cubicle Partitions

GBE   
www.GreenBuildingEncyclopedia.uk
Cycle Assessment Procedure for Eco-impacts of Materials

GBE GBS H21 Timber Cladding

Issues: Designers, Stewardship, Market
Solutions: Expert system, Design Guide, Certification scheme, Definitive Specification

GBE   
www.GreenBuildingEncyclopedia.uk
Cycle Assessment Procedure for Eco-impacts of Materials

GBE GBS H21 Timber Cladding

Issues: Designers, Stewardship, Market
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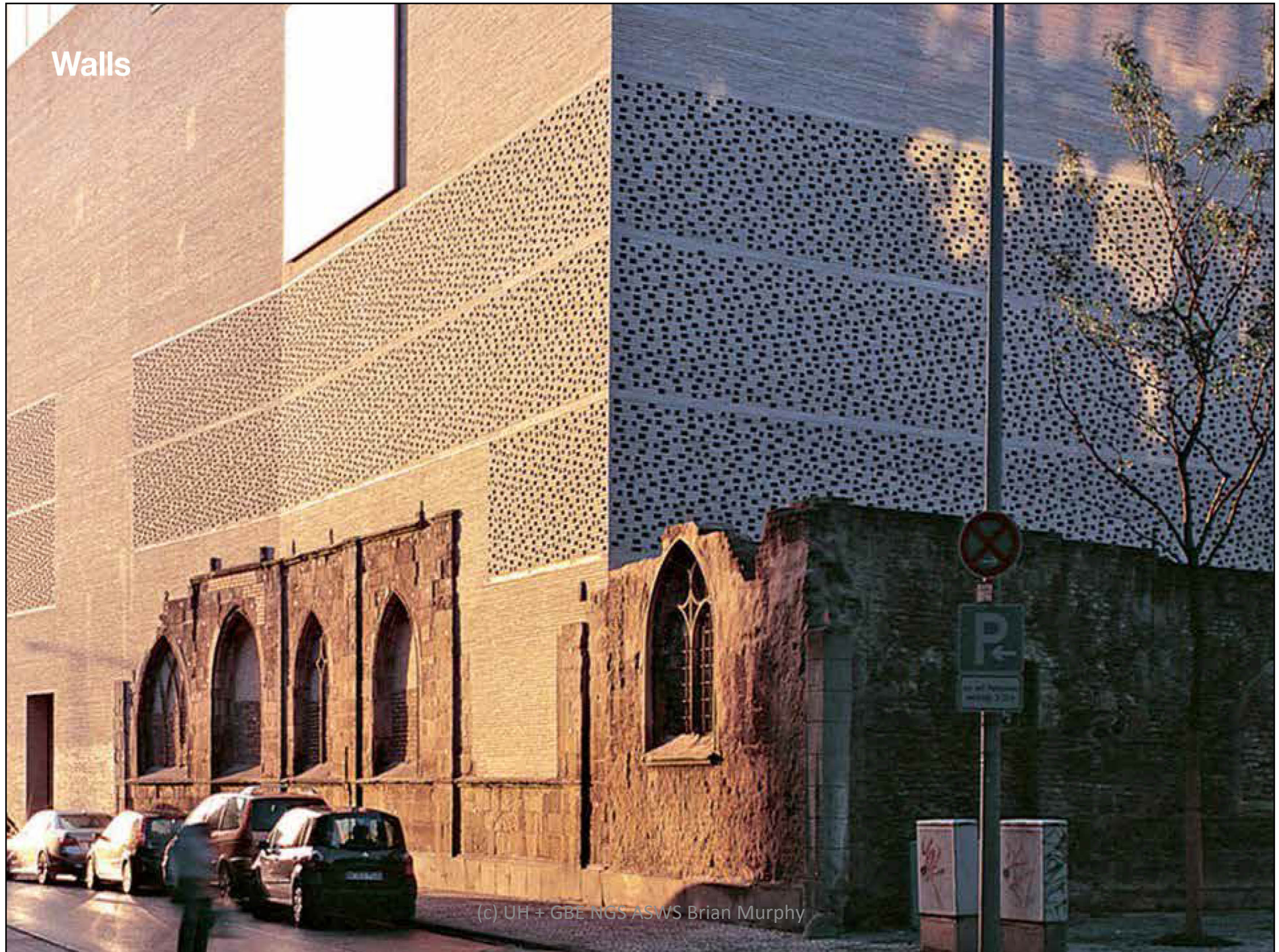
Today's Lecture

- External Wall
 - Openings
 - Windows
 - Doors
 - Internal Walls/Partitions
 - Function + Performance
 - Principles of Element Design
-
- Fabric First: make the building fabric do all the work
 - Or you end up with services making up the difference
 - We need buildings that do not need loads of services
 - consuming loads of energy for the rest of the building's life
 - But we do need low level deliberate purposeful ventilation or we die from poor indoor air quality:
 - CO₂ Carbon Dioxide and VOC Volatile Organic Compounds, Formaldehyde

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Walls



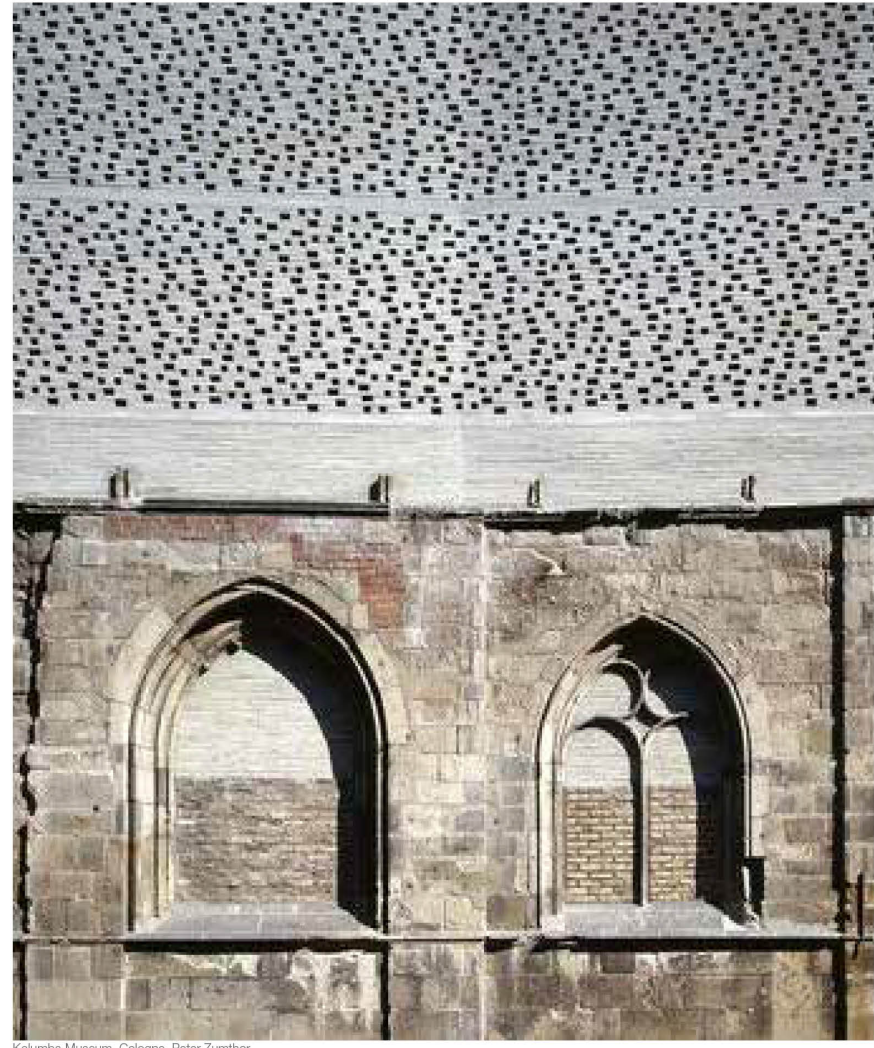
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First Principles

Function of an external wall:

- *Environmental control between the external and internal climates of a building*
- *Support the combined dead, imposed and wind loads of the roof and floor construction, as well as its own combined loads and transfer them safely to a foundation (depending upon the precise nature of the overall structural system)*
- *Considerations of appearance must be a critical part of the design since to a very large extent an external wall determines the architectural character and quality of a building*

This only scratches the surface



Kolumba Museum, Cologne, Peter Zumthor

Key Building Regulations

Legal minimum > But 'the Performance Gap' suggests we don't meet this minimum very often

The Building Regulations 2010

Fire safety

APPROVED DOCUMENT

B

VOLUME 1 – DWELLINGHOUSES

- B1** Means of warning and escape
- B2** Internal fire spread (linings)
- B3** Internal fire spread (structure)

The Building Regulations 2010

Site preparation and resistance to contaminants and moisture

APPROVED DOCUMENT

C

- C1** Site preparation and resistance to contaminants
- C2** Resistance to moisture

The Building Regulations 2010
The Building (Approved Inspections etc) Regulations 2010

Resistance to the passage of sound

APPROVED DOCUMENT

E

- E1** Protection against sound from other parts of the building and adjoining buildings
- E2** Protection against sound within a dwelling-house etc

The Building Regulations 2010

Conservation of fuel and power

APPROVED DOCUMENT

L1A

L1A Conservation of fuel and power

THIRD EDITION

PRINCIPLES OF element design



Peter Rich &
Yvonne Dean

ARCHITECTURE/DESIGN

PRINCIPLES OF element design

THIRD EDITION

Peter Rich & Yvonne Dean



- Unique in its approach to detail design
- Invaluable for both students and practising architects, builders and surveyors
- Completely updated in a convenient reference sheet format

The construction of buildings is learnt through experience and the inheritance of a tradition in forming buildings over several thousand years. Successful construction learns from this experience which becomes embodied in principles of application. Though materials and techniques change, various elements have to perform the same function. **Principles of Element Design** identifies all the relevant elements and then breaks these elements down into all their basic constituents, making it possible for students to fully understand the given theory and principles behind each part. As all building projects are subject to guidance through the Building Regulations and British Standards, this book gives an immediate reference back to relevant information to help practitioners and contractors identify key documents needed.

Peter Rich AA (Hons) Architect. Started his career with 14 years' experience as a qualified architectural technician. He then joined the AA School of Architecture, working with Bill Allen and John Bickerdike after his graduation, later becoming a partner of Bickerdike Allen Rich and Partners. He also taught building construction at the Bartlett School of Architecture, University College London, and architectural design at the Polytechnic of North London. He now acts as a Consultant.

Yvonne Dean BA (Hons) BA (Hons) BA, is an architect, energy consultant and materials technologist. She also has 15 years' experience as a lecturer, travels widely and is a guest lecturer at many universities. She pioneered an access course for Women into Architecture and Building, which has been used as a template by others, and has been instrumental in helping to change the teaching of technology for architects and designers.



Architectural Press

An imprint of Butterworth-Heinemann
<http://www.bh.com>

ISBN 0-7506-3113-9



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Wall Actions

- Gravity: downward pull
- Wind: Motive, Destructive, Penetrative
- Rain: Moisture deposition, penetration
- Snow: Moisture deposition, loading
- Moisture vapour: permeation, surface and interstitial condensation, insulation impaired, material degradation
- Sun: Temp variation, thermal movement, solar heat gains, Chemical decomposition
- Dirt and Dust: infiltration, deposition, surface pollution
- Chemicals: corrosion, disintegration, decomposition
- Sound: Noise nuisance, from within and from without
- Attack: Manual, Ballistics, Bomb Blast
- Thermal: heat loss, radiant coolth, condensation, stack effect

Wall Reactions

- Gravity: Support & restraint
- Wind: rigidity, resilience, sealing, air tightness layers and detailing
- Rain: deflection, impervious skin, absorption and drainage, sealing
- Moisture vapour: resistance, hygro-scopicity, permeability, 'breathing', moisture mass
- Snow: deflection, impervious skin, absorption and drainage, sealing
- Sun: movement joints, insulation, shielding, invulnerable materials, decrement delay
- Dirt and Dust: repulsion, exclusion, shielding, cleaning, covering
- Chemicals: invulnerable materials, exclusion,
- Sound: Insulation, absorption, acoustic mass, separation, isolation,
- Attack: toughness, lamination, edge restraint, edge protection
- Insulating: thermal insulation, k and U value, thermal mass, thermal bridge avoidance/minimisation,
- Glass: G value,

Principles of Element Design

- Appearance
 - **Interior and exterior materials and finishes**
- Structural strength and stability
 - **Load-bearing**
 - **Wind resistance**
- Weather barrier
 - **Rain, snow, wind, sun,**
 - **dirt dust pollution**
- Durability
 - **Moisture resistance, frost, mould**
 - **Moisture Mass & Hygroscopicity**
 - **Ozone and sunlight degradation**
- Thermal Performance
 - **Heat Resistance: loss and gain**
 - **Condensation Avoidance**
 - **Airtightness**
 - **Avoidance of Cold Bridges**
 - **Thermal Mass**
- Movement
 - **Structural , thermal, moisture, Frost**
 - **Chemical**

Principles of Element Design

- Acoustic Performance
 - Resistance, absorption
- Fire Performance
 - Surface spread of flame
 - Fire Resistance
- Security
- Inspection and maintenance
 - Inside & out
- Pest infestation
 - Termites,
 - Termite Barriers
- Rising damp
 - Barriers
 - Capillary Attraction, Moisture Transport
 - Hygroscopic or Hydrophobic
 - Frost action
- Health
 - Moisture Mass
 - Low allergy materials

Weather Envelope



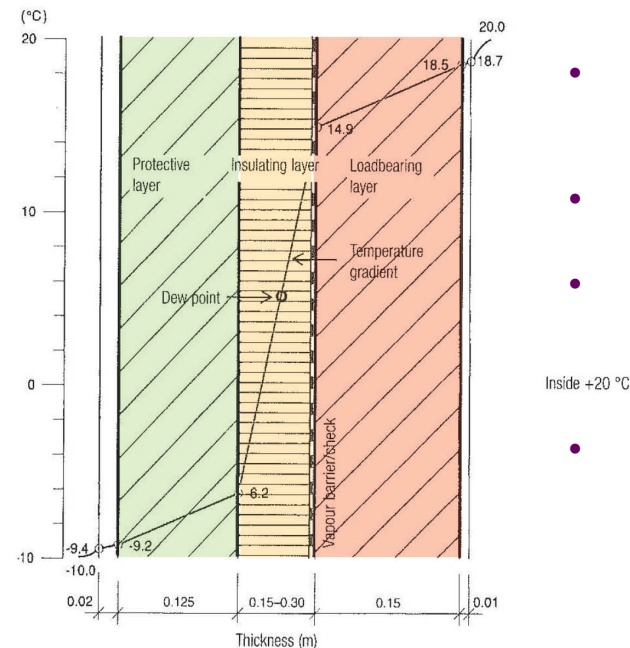
**Absorbent – Repellent – Open Joint Panelled
Masonry – Curtain Wall – Rainscreen**

Throwback

The Building Envelope

The problem of heat flow and vapour diffusion

- A building has more than one orientation,
- Subject to different moisture uptake, wind driven rain penetration and solar radiation.
- All of this is variable of over time:
 - Diurnal (night day)
 - Annual (through seasons)
- Static analysis is inadequate
- Dynamic Hygro/Hydro/thermal moisture movement analysis is essential.
- BS 5250 is inadequate
- WUFI or Delphin essential



Constructing Architecture Materials Processes Structures, Birkhauser

- This is not UK construction practice or thicknesses.
- Vapour barrier in cavity masonry does not happen in UK
- 150 to 300 mm insulation not precise (for a calculation).
- Beware of incomplete diagrams:
- It shows the 'heat flow' gradient from inside to outside
- It does not show the 'vapour diffusion' line
- It does not show the crossing point so the 'Due Point' is entirely speculative
- There is no 'evidence' here, beware Birkhauser

Lightweight Construction

No solar tight insulation > overheats > open vents



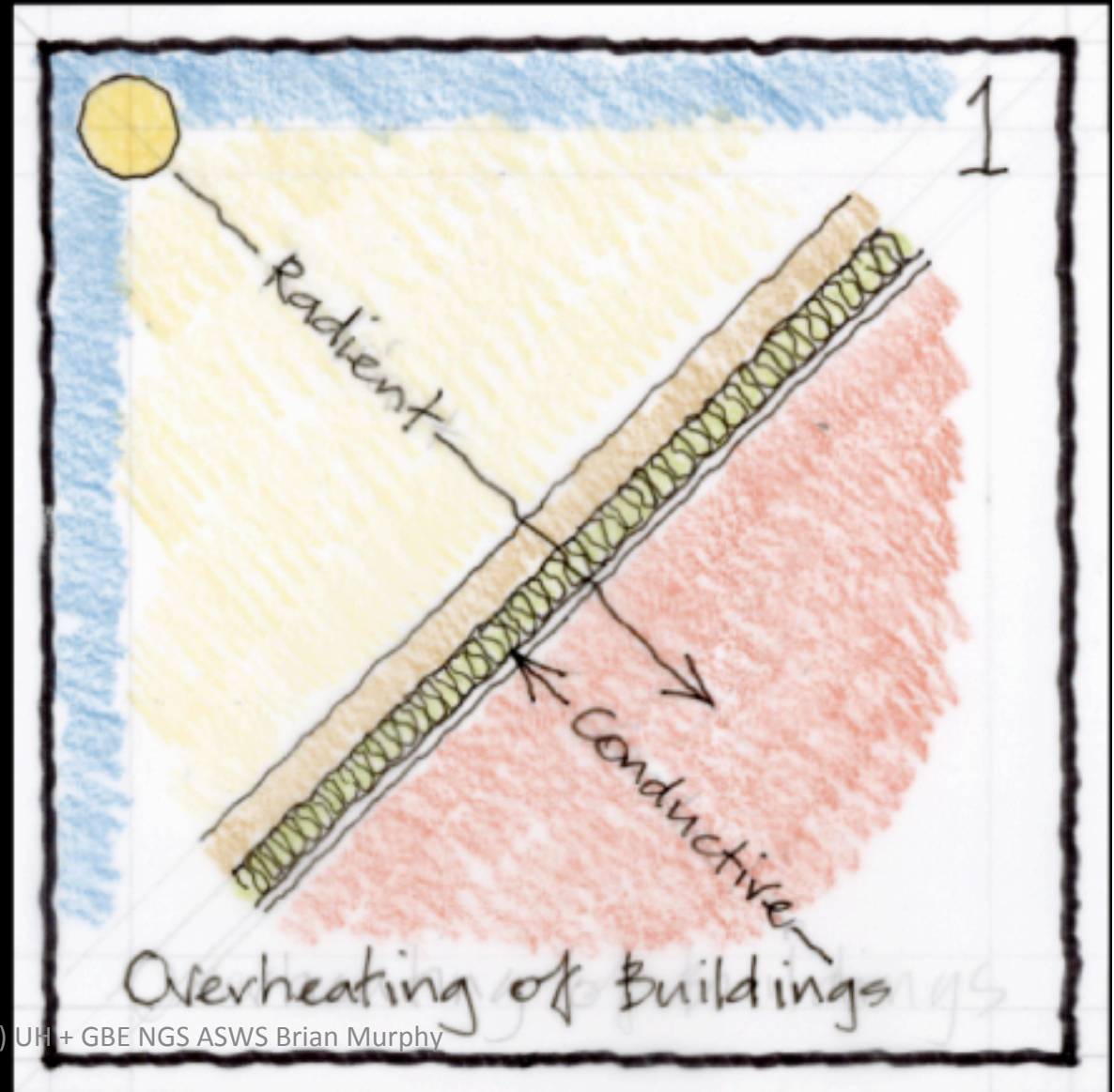
Steel Frame, Tin Roof, Timber Cladding

Build Light > Insulate Right > Solar Tight

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Overheating

**Radiant
verses
Conductive
heat flows
Insulation
needs to
resist both or
overheating
occurs**



Solid Construction

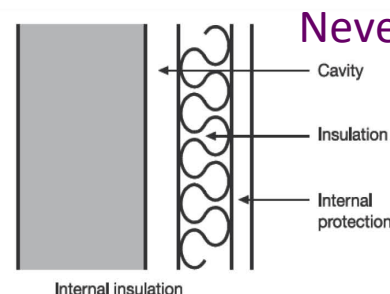
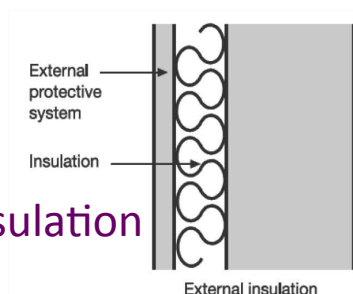
- Solid in this context means heavy not opaque
 - Density
 - k value
 - Specific heat capacity
- Opaque can also be beneficial
 - Less solar gains through glazing in summer
- If masonry walls and concrete roof:
 - Can be solar tight
- Long Decrement Delay 10 hours
 - cool retreat in summer
- Albedo effect can be beneficial:
 - White for the planet
 - Earth Albedo = 0.39
- Building Solar exploitation
 - White at equator,
 - Black at poles



Integrated Structure, Solid Masonry Walls and Roof

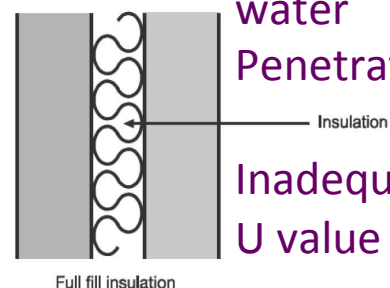
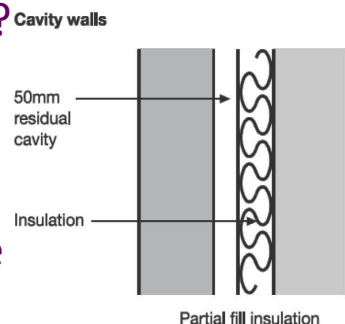
Solid Wall, Cavity Wall, Timber frame

- EWI
External Solid
Wall Insulation
Never use plastic insulation
or cement render



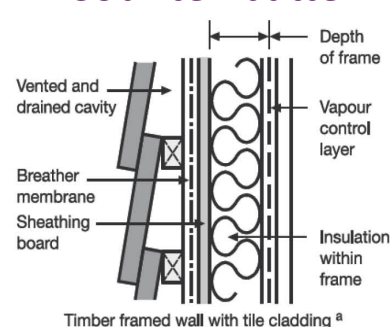
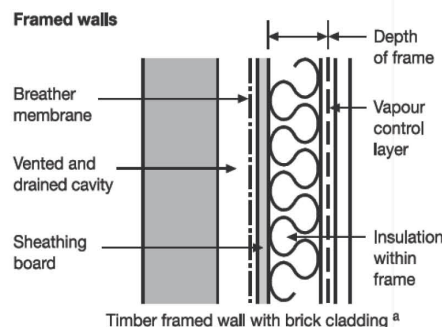
Never use cavity here
• IWI Internal
Solid Wall
Insulation

- Partial Fill
Masonry Cavity
Wall insulation
Inadequate U value



• Full Fill
Masonry
cavity Wall
Insulation
water
Penetration?
Inadequate
U value or 300 mm cavity

- Insulated timber
frame inner leaf
Masonry outer
leaf



Counter-batten needed for ventilation

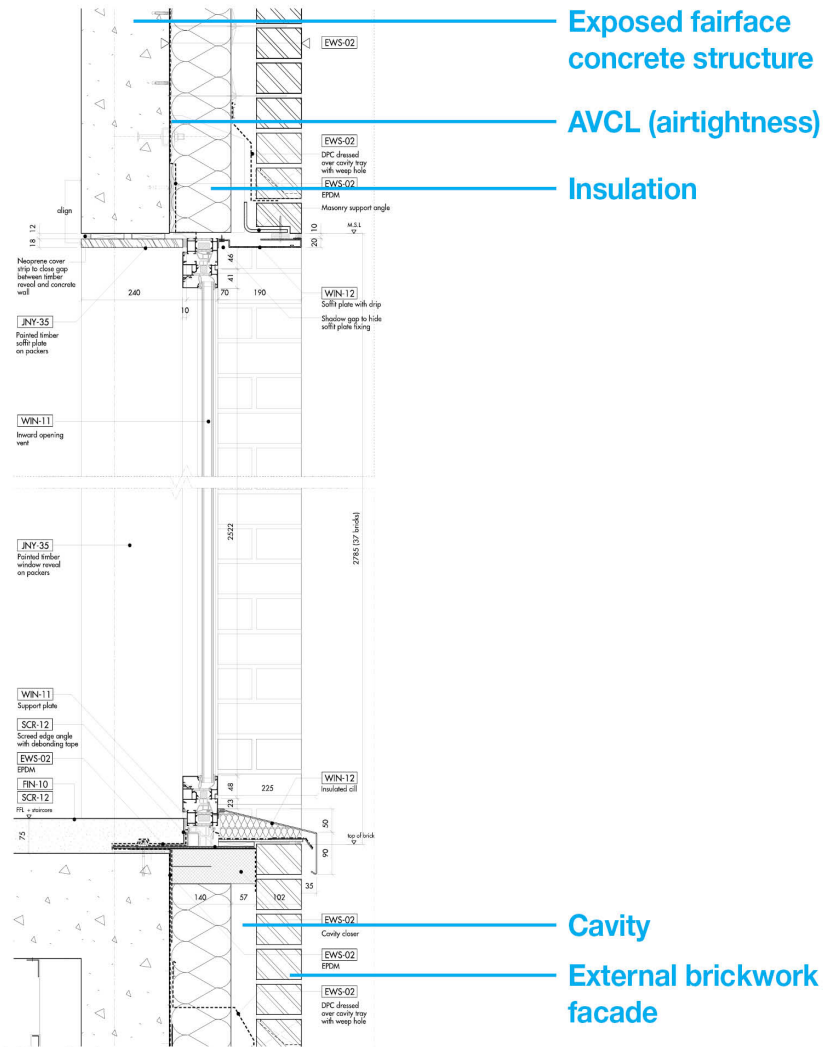
- Insulated
timber frame
single lap
concrete or
clay tile
cladding

Inadequate frame depth = poor U value need >300 mm

Extract from Building Regulations Approved Document C (Dampness and Health)

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Brick/Blockwork External Wall



Insulation to window relationship good

But gap could be insulated/sealed

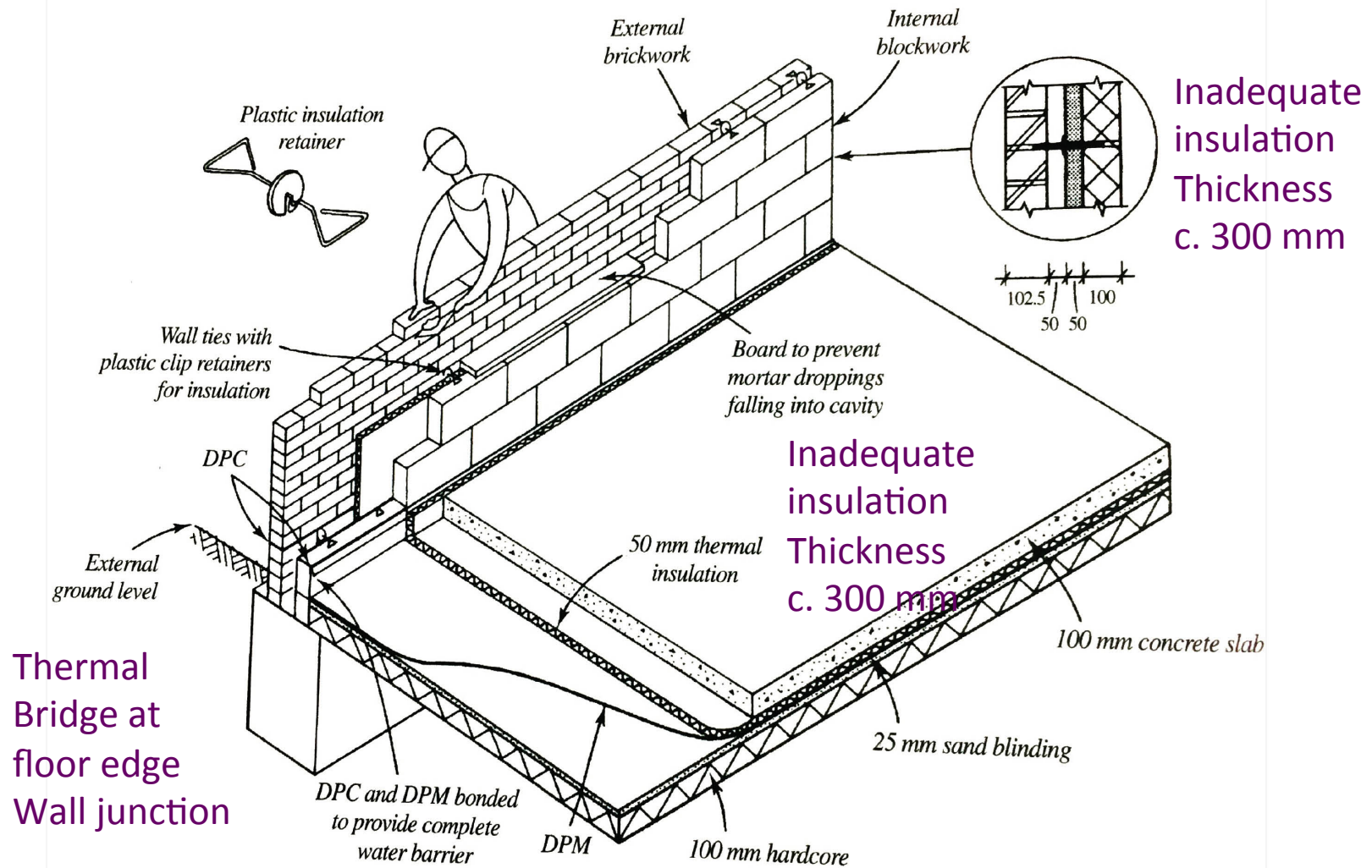
Double glazed windows inadequate for future

Triple glazed windows enable internal surface temperature closer to external wall internal temperature

Minimise perception of down drafts and poor thermal comfort

Cavity closer creates thermal bridge through insulation

Brick/Blockwork External Wall



Construction of Brickwork/Blockwork Cavity Wall

Brick/Blockwork External Wall

Brick outer leaf, assumes block inner leaf, thick wall/thick insulation, complicated details

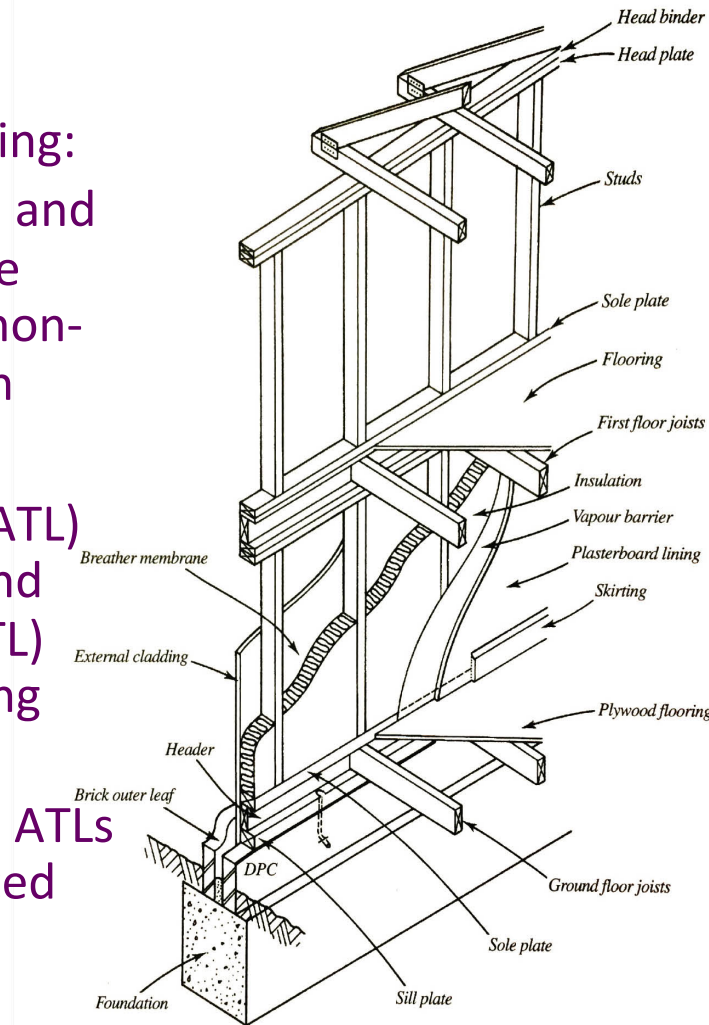


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Timber External Wall

Platform Timber Frame

- Conventional Thinking:
- Vapour Barrier (VB) and Breather membrane (BM) needed with non-breathing insulation
- Current thinking:
- Airtightness layer (ATL) or Intelligent ATL and Wind tightness (WTL) needed for Breathing insulation
- Platform frame and ATLs are more complicated but understood



- Plastic, glass and stone wool is okay winter insulation (conduction) but not good summer insulation (radiation)
- Current U values need c.300 mm of thermal insulation
- Depending upon insulation materials
- Breathing insulation may need to be thicker
- Studs 140 or 190 mm inadequate for the job

Typical Timber Wall Construction

Timber External Wall

Timber framed external wall

Glulam Lintel is
uninsulated =
Thermal bridge

Stud size: 140 or
190 mm
inadequate for U
value

Window
placement not
ideal only just
aligns with
insulation

But framing
makes wide
thermal bridges

Concrete plinth =
thermal bridge

Glue-laminated
softwood structural
frame

Plasterboard lining on
vapour barrier

Insulation

Sheathing Board

Breather Membrane

Timber Cladding

Glulam Lintel is
uninsulated = Thermal
bridge.

Potential rot between
timber rainscreen battens
if less than 8 mm gap:
Gap between faces
minimum 8 mm at
bottom and wider at top.

Double section below
windows = thermal bridge

Glass wool/stone wool
good for winter, bad for
summer overheating:
Cellulose or dense wood
fibre necessary

Welsh Visitor Centre, Allie and Morrison

Timber External Wall

Rain screen weather battens

Grey stains due to timbers too close or
ferrous screws and acidic species timber



Welsh Visitor Centre, Allie and Morrison

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Cladding

Corten self rusting steel;



Metal Cladding

Concrete or render finish?



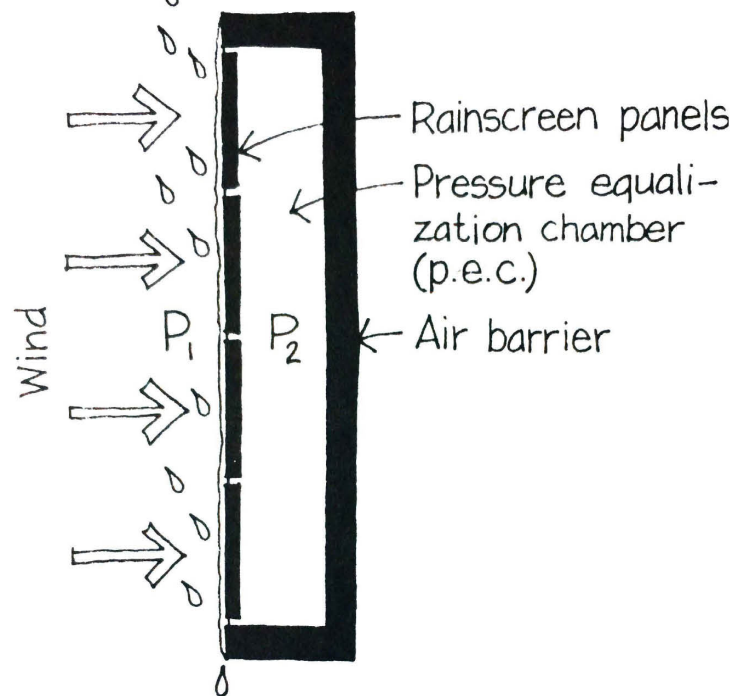
Masonry Cladding Panels

Rainscreen Cladding

Some rain will pass through joints

Air barrier is also a water barrier

Thermal insulation not shown



Principle of the Rainscreen

Wind pressure $P_1 = P_2$, pressure in p.e.c.

Therefore wind cannot force water through joints in rainscreen.

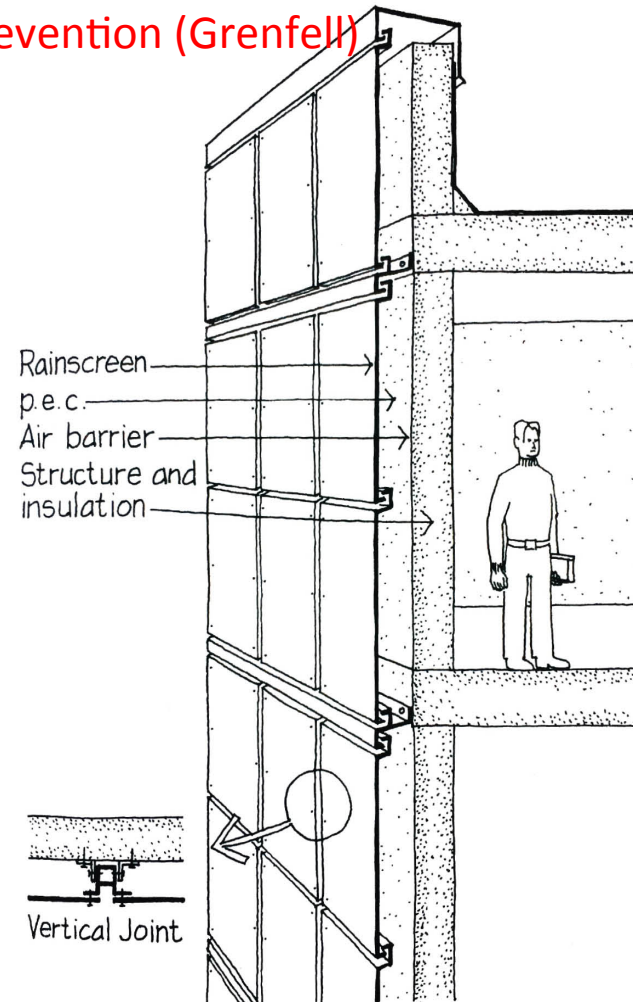
Rainscreen Diagram 01

Thermal insulation not shown only annotated

Thermal Bridges Prevail

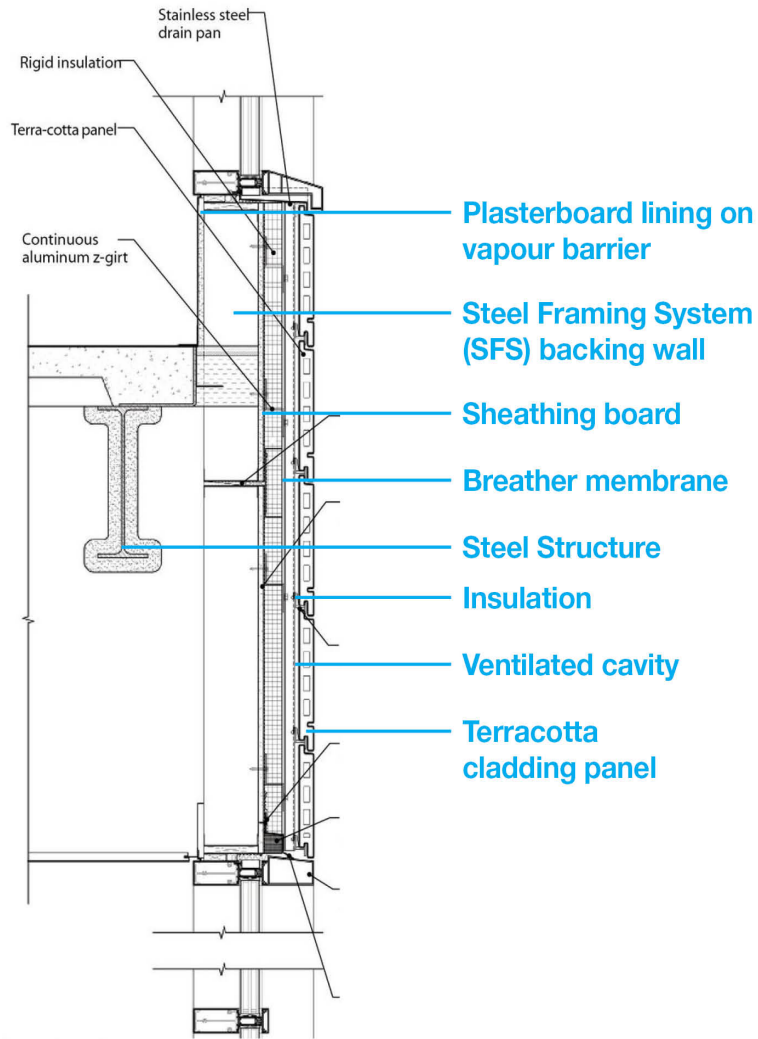
Cavity barriers at floor levels

Fire prevention (Grenfell)



Rainscreen Diagram 02

Rainscreen Cladding



Example Section

Interlocking
overlap
terracotta tiles
not rainscreen
on corners.

Rainscreen
above and
below windows

Inadequate
thermal
insulation

Thermal bridges
at windows

Hollow backing
wall: place for
escaping heat



Terra-cotta Cladding Tiles

Rainscreen Cladding

Slates do not have gaps but overlaps so are a form of tiling not Pressure Equalised rainscreen



Elbow Cement Slate Cladding, Youth Centre, Hampshire, Alex Chamberlain Gaunt

(c) UH + GBE NGS ASWS Brian Murphy

- Wall Openings
- Windows
- Doors
- Ventilation Louvres (not covered by this)
- Solar shading of opening (not covered by this)

Openings



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First Principles

Functions and key considerations of openings:

- *Allows access and egress*
- *Security*
- *Allows light in*
- *Allows views out*
- *Doors and windows can be a weak point in the external envelope (weather exclusion, sound control, thermal comfort, fire protection and security)*
- *Size, shape, proportion, materials and location profoundly influence the overall and detail appearance as well as the aesthetics of a building*

This only scratches the surface



Entrance Door, Haldenstein Studio, Peter Zumthor

Key Building Regulations

Legal minimum > But 'the Performance Gap' suggests we don't meet this minimum very often

The Building Regulations 2010

Access to and use of
buildings

APPROVED DOCUMENT

M

The Building Regulations 2010
The Building (Approved Inspections etc) Regulations 2010

Resistance to the passage of sound

APPROVED DOCUMENT

E

- E1 Protection against sound from other parts of the building and adjoining buildings
- E2 Protection against sound within a dwelling-house etc

The Building Regulations 2010

Fire safety

APPROVED DOCUMENT

B

VOLUME 1 – DWELLINGHOUSES

- B1 Means of warning and escape
- B2 Internal fire spread (linings)
- B3 Internal fire spread (structure)

The Building Regulations 2010

Conservation of
fuel and power

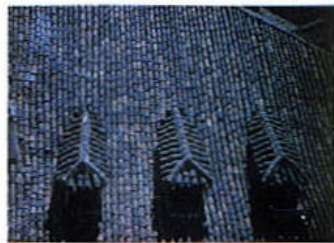
APPROVED DOCUMENT

L1A

L1A Conservation of fuel and power

THIRD EDITION

PRINCIPLES OF element design



Peter Rich &
Yvonne Dean

ARCHITECTURE/DESIGN

PRINCIPLES OF element design

THIRD EDITION

Peter Rich & Yvonne Dean



- Unique in its approach to detail design
- Invaluable for both students and practising architects, builders and surveyors
- Completely updated in a convenient reference sheet format

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Architectural Press

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ISBN 0-7506-3113-9



9 780750 631136

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Windows Actions

- Gravity: downward pull
- Wind: Motive, Destructive, Penetrative
- Rain: Moisture deposition, penetration
- Snow: Moisture deposition, loading
- Sun: Temp variation, thermal movement, solar heat gains, Chemical decomposition
- Dirt and Dust: infiltration, deposition, surface pollution
- Chemicals: corrosion, disintegration, decomposition
- Sound: Noise nuisance, from within and from without
- Attack: Manual, Ballistics, Bomb Blast
- Heat:

Windows Reactions

- Gravity: Support & restraint
- Wind: rigidity, resilience, sealing
- Rain: deflection, impervious skin, absorption and drainage, sealing
- Snow: deflection, impervious skin, absorption and drainage, sealing
- Sun: movement joints, insulation, shielding, invulnerable materials,
- Dirt and Dust: repulsion, exclusion, sheilding, cleaning
- Chemicals: invulnerable materials, exclusion,
- Sound: Insulation
- Attack: toughness, lamination, edge restraint, edge protection
- Heat: insulating glazing, low E glass, Solar control glass

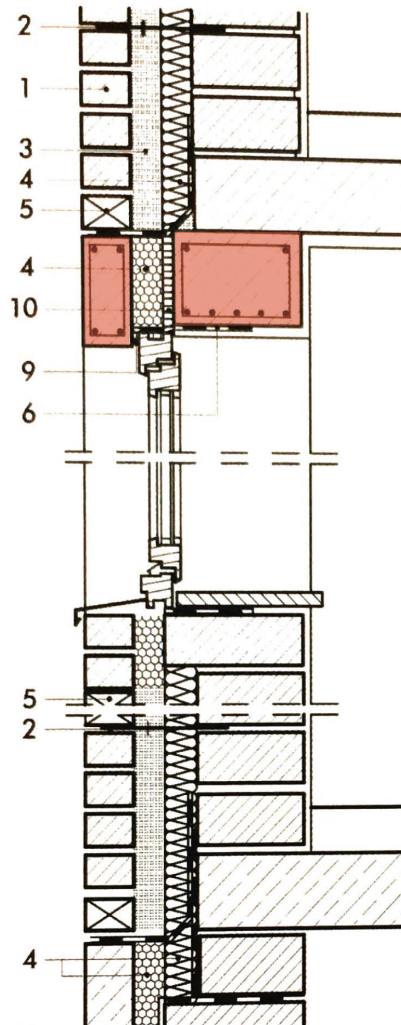
Windows Outside

- Daylight, Sunlight, Glare, Solar Heat gains,
- Sound Insulation
- Fresh air, ventilation and smell exclusion
- Smoke control: Smoke outlet & air inlet
- Wind driven rain and snow
- Privacy from overlooking
- Cleaning
- Security
- Insect exclusion

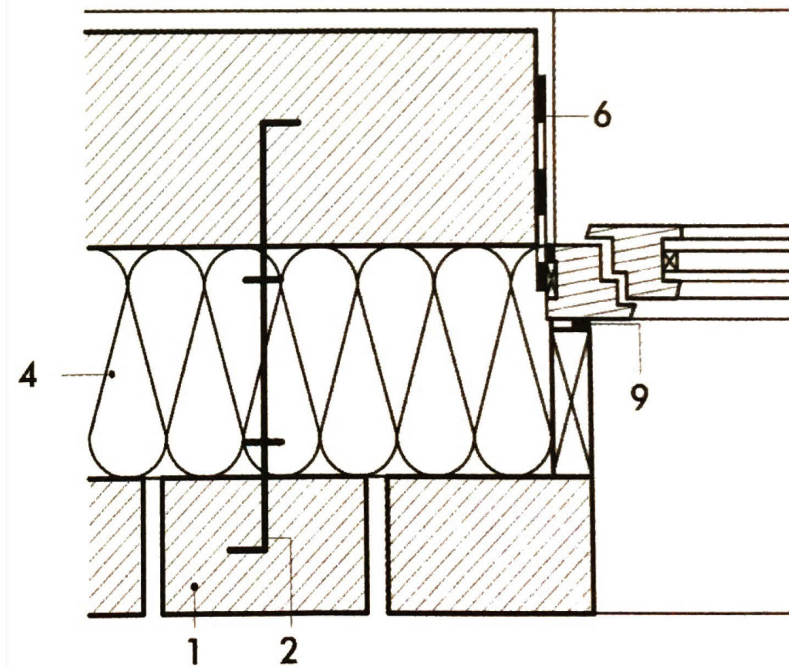
Windows Inside

- Statutory Ventilation areas, **trickle ventilation**
- Thermal insulation, heat losses: U values G F W
- Solar heat gains: G value of glass
- Emissivity: Low E glass coatings
- Comfort conditions:
 - 17 degrees internally, close to wall temperature
- Views out and eye level
- Safety, Containment, Impact,
 - Ironmongery, Balustrade
- Fire: Non-combustible, Low smoke generation
- Statutory Window Area: Habitable areas

Forming the Opening - Structure



2 sections not of the same construction
Spot the differences
Do not borrow details, draw your own
2 leafs supported independently
Or risk thermal bridge

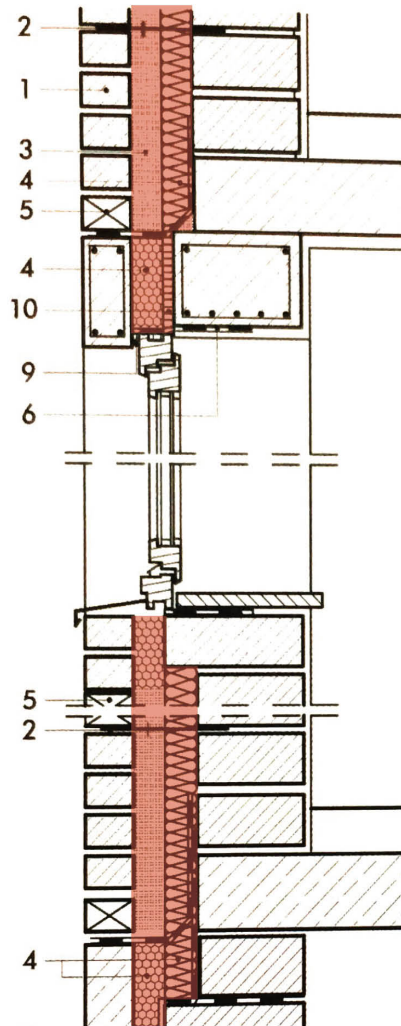


Brick/Blockwork External Wall

Complicated brickwork requires 3/2 sets of lintels and 3/2 cavity trays & complicated details

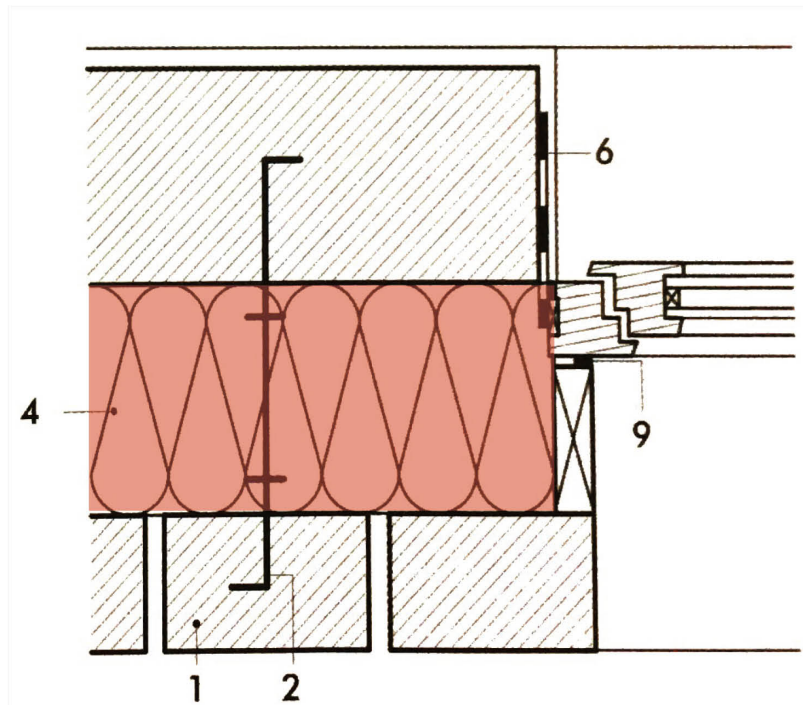


Forming the Opening - Insulation



Example Vertical Section

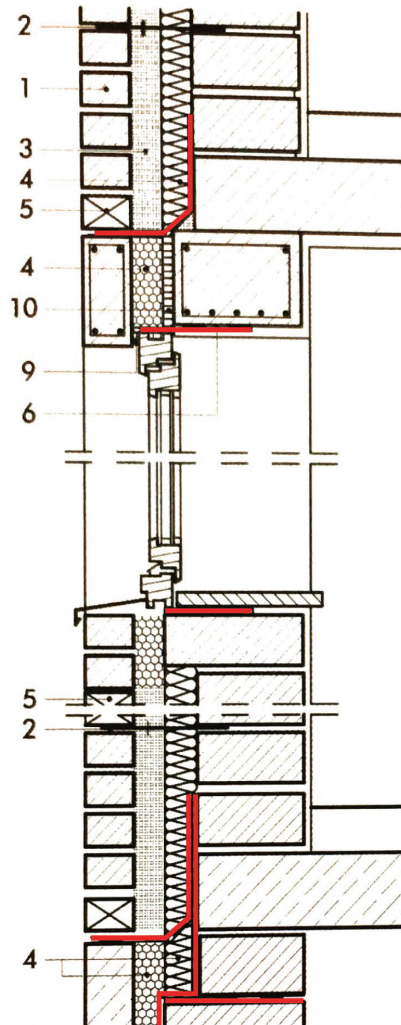
2 sections not of the same construction
Spot the differences
Window aligned with cavity insulation
Insufficient insulation thickness



Example Horizontal Section

Forming the Opening - DPC/EPDM

DPC(Damp Proof Course)/EPDM (Ethylene Propylene Diene Monomer)



Example Vertical Section

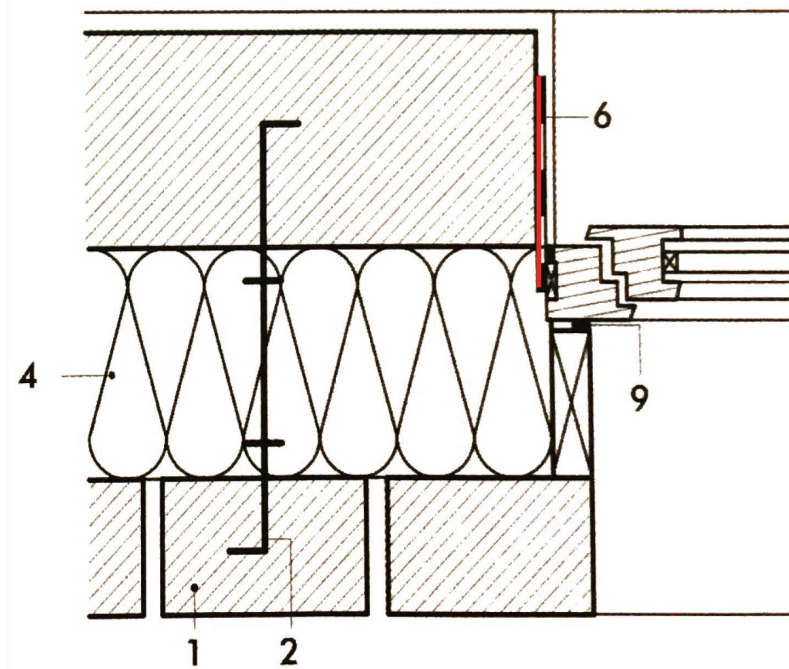
2 sections not of the same construction

Spot the differences

Damp Proof Course DPC

Cavity Tray Damp Proof Course

Other materials in the market than EPDM



Example Horizontal Section

Openings

Openings: Not/obvious lintel



The Shadow House, Lillington and Goldhill

Look
no
Hands
No
obvious
lintel

Flush
detailing
will
lead
to
shorter
life



Fitzroy Road, Dunrobin Morris Architects

THIRD EDITION

PRINCIPLES OF element design



Peter Rich &
Yvonne Dean

ARCHITECTURE/DESIGN

PRINCIPLES OF element design

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External Door Actions

- Gravity: Downward pull, rotation
- Wind: Motive, Destructive, Penetrative, whistling
- Rain: Moisture deposition, penetration
- Snow: Moisture deposition, loading
- Dirt and Dust: infiltration, deposition, surface pollution
- Chemicals: corrosion, disintegration, decomposition
- Sound: Noise nuisance, from within and from without
- Attack: Manual, Ballistics, Bomb Blast
- Heat: Solar Heat Gains, Heat passage

External Door Reactions

- Gravity: Ironmongery Support & restraint
- Wind: rigidity, resilience, sealing
- Rain: deflection, impervious skin, absorption and drainage, sealing
- Snow: deflection, impervious skin, absorption and drainage, sealing
- Sun: movement joints, insulation, shielding, invulnerable materials,
- Dirt and Dust: repulsion, exclusion, sheilding, cleaning
- Chemicals: invulnerable materials, exclusion,
- Sound: Insulation
- Attack: toughness, lamination, edge restraint, edge protection
- Heat: insulating glazing, low E glass, Solar control glass

Door Outside

- Daylight, Sunlight, Glare, Solar Heat gains,
- Sound Insulation
- Fresh air, ventilation and smell exclusion
- Smoke control: Smoke outlet & air inlet
- Wind driven rain and snow
- Privacy from overlooking
- Cleaning
- Security
- Insect exclusion

Door Inside

- Statutory Ventilation areas: trickle ventilation
 - When is a door a windows?
- Thermal insulation, heat losses:
 - U values Glass Frame Door
- Solar heat gains: G value of glass
- Emissivity: Low E glass coatings
- Comfort conditions:
 - 17 degrees internally, close to wall temperature
- Views out and eye level
- Safety, Containment, Impact,
 - Ironmongery,
- Fire: Non-combustible, Low smoke generation

Openings



Shelter for Roman Archaeological Remains, Peter Zumthor

Left:
Placement creates cutting waste
and opening in a joint zone

Right:
Simple uncomplicated



VC Morris Gift Shop, Frank Lloyd Wright

Partitions

/Loadbearing Internal walls, Solid Wall Solutions



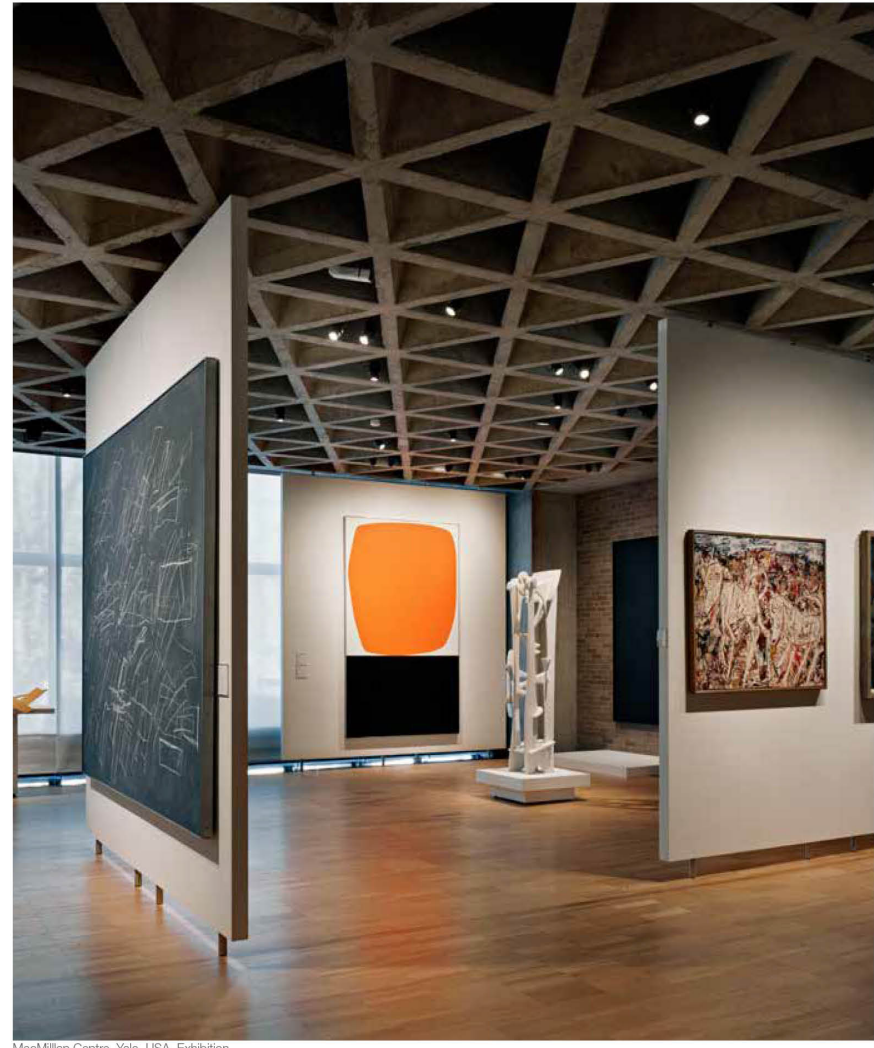
(c) UH + GBE NGS ASWS Brian Murphy

First Principles

Function of an internal wall:

- *Physical space separation*
- Isolation of certain activities
- Fire protection
- Thermal insulation
- Sound control
- Support internal fittings and fixtures
- Pleasing appearance colour and texture
- Structural (depending on structural strategy)

This only scratches the surface



MacMillan Centre, Yale, USA. Exhibition



(22) Internal Partitions

**G14 Light steel frame • G20 Light Timber framed •
K10 Plasterboard
• K30 Panel Partitions • K32 Cubicle Partitions**

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Partition Actions

- **Gravity:**
 - downward pull, self weight,
 - Furniture and Lining loads
- **Dynamic forces:**
 - Human impacts, wheeled furniture impacts
- **Internal Wind Pressure Buffeting:**
 - Pressure, Rattling, Motive, Destructive, Penetrative
- **Moisture vapour:**
 - permeation, condensation, moisture mass, moisture moderation, insulation impaired, hygroscopicity, material degradation
- **Sun:**
 - Temp variation, thermal movement, heat gains, Chemical decomposition
- **Dirt and Dust:** infiltration, deposition, surface pollution
- **Chemicals:** corrosion, disintegration, decomposition
- **Sound:** Noise nuisance, from within
- **Attack:** Manual, Ballistics, Bomb Blast
- **Thermal:** Solar heat gains/loss, thermal mass, phase change, stack effect,
- **Electromagnetic radiation:** sickness for susceptible occupants

Partition Reactions

- **Gravity: Support & restraint**
- **Wind pressure buffeting:**
 - rigidity, resilience, sealing, air tightness layers and detailing
- **Moisture vapour:**
 - resistance, hygroscopicity, permability, breathing, moisture mass
- **Sun:**
 - movement joints, insulation, shielding, invulnerable materials
- **Dirt and Dust: repulsion, exclusion, sheilding, cleaning**
- **Chemicals: invulnerable materials, exclusion,**
- **Sound:**
 - Insulation, absorption, acoustic mass, separation, isolation,
- **Attack:**
 - toughness, lamination, edge restraint, edge protection
- **Insulating: thermal insulation, thermal mass,**
- **Electromagnetic radiation: Absorbs, shields**

Partition properties

- **Wall Categories**
 - Partition, Party/Separating walls, Compartment walls
- **Systems**
 - Brick/block units, Monolithic, frame and sheet, sandwich panels
- **Appearance**
- **Structural strength and stability**
 - Loadbearing, non-loadbearing
 - Wind pressure buffeting post, stability stiffening posts, head and abutment restraint, joint reinforcement
- **Fire Protection**
 - Fire resistance, spread of flame
 - Stability, integrity, insulation
- **Durability and maintenance**
- **Thermal performance**
 - Insulation, thermal mass, cold bridge avoidance, air tightness
- **Acoustic performance:**
 - Noise barrier, sound absorption, flanking sound,

Partition Properties

- **Movement**
 - Thermal, structural, moisture
- **Security**
 - Prevent Entry, Resist Attack, Restrain occupants
- **Party walls**
 - Structural fire precautions, structural stability, Condensation and Insulation, sound control
- **Compartment Walls**
- **Fixed Partitions**
- **Relocate able Partitions**
- **Cubicles**
- **Mobile Partitions**

Key Building Regulations

Legal minimum > But 'the Performance Gap' suggests we don't meet this minimum very often

The Building Regulations 2010

Fire safety

APPROVED DOCUMENT

B

VOLUME 1 – DWELLINGHOUSES

- B1 Means of warning and escape
- B2 Internal fire spread (linings)
- B3 Internal fire spread (structure)

Part L

Internal partitions not normally regulated
Insulate to restrict overheating to sunny side

The Building Regulations 2010
The Building (Approved Inspections etc) Regulations 2010

Resistance to the passage of sound

E

APPROVED DOCUMENT

- E1 Protection against sound from other parts of the building and adjoining buildings
- E2 Protection against sound within a dwelling-house etc

The Building Regulations 2010

Conservation of
fuel and power

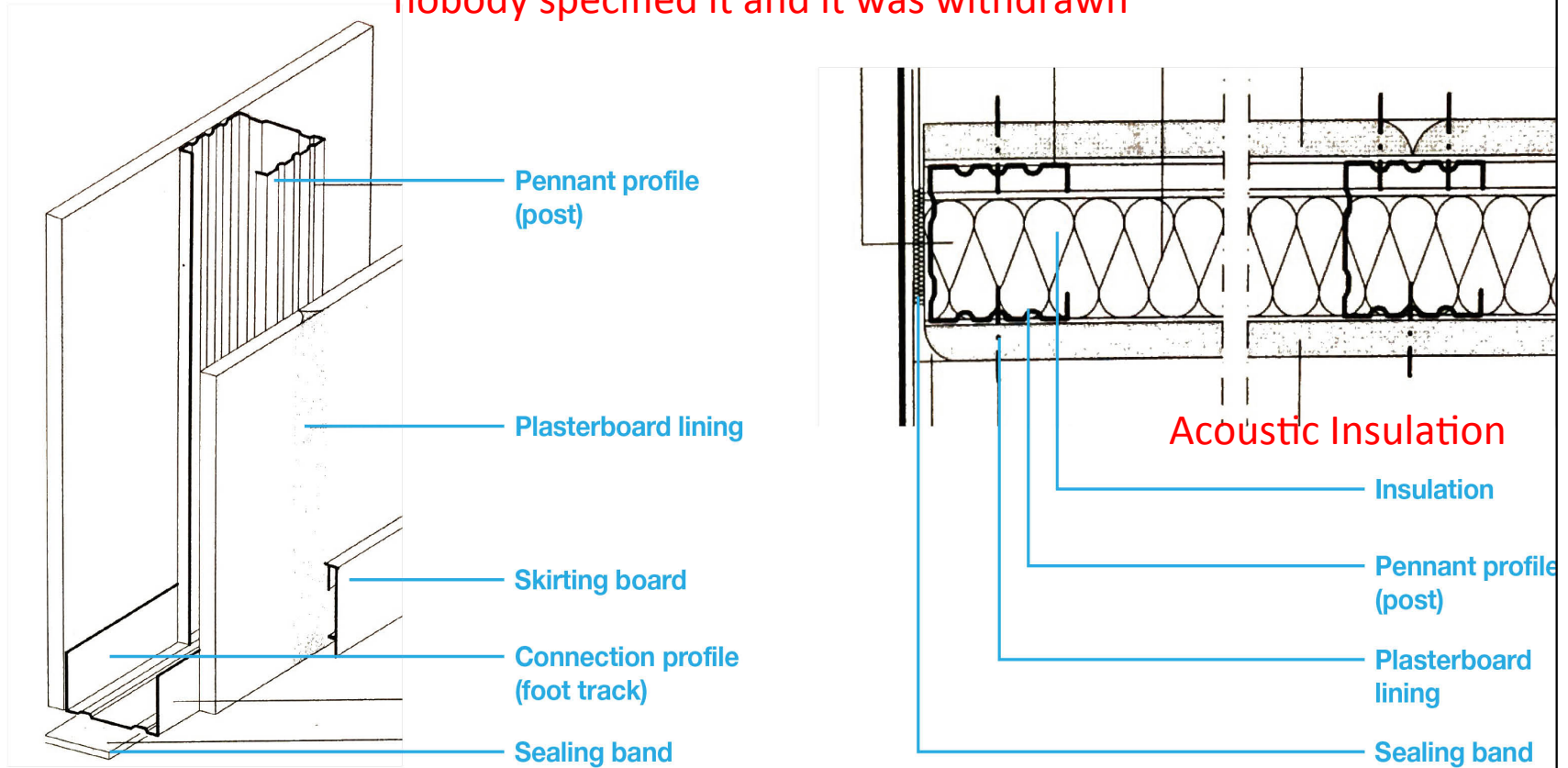
APPROVED DOCUMENT

L1A

L1A Conservation of fuel and power

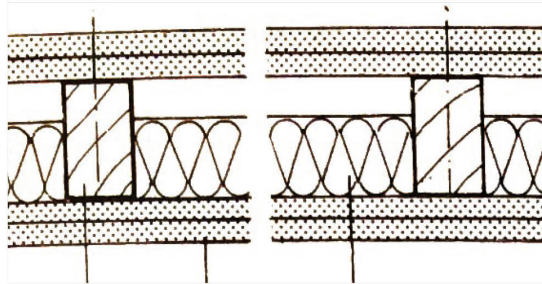
Typical ('demountable') Internal Partition Components

Demolish able: British Gypsum made Demountable,
nobody specified it and it was withdrawn

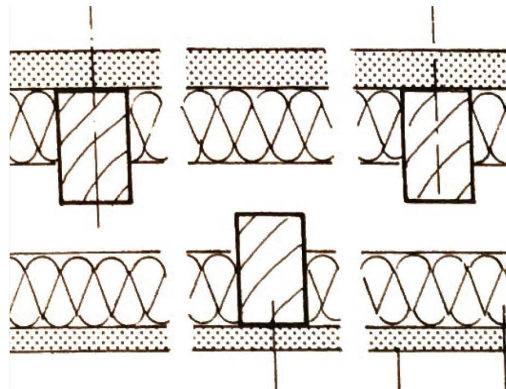


Example Horizontal Wall Sections /Partitions

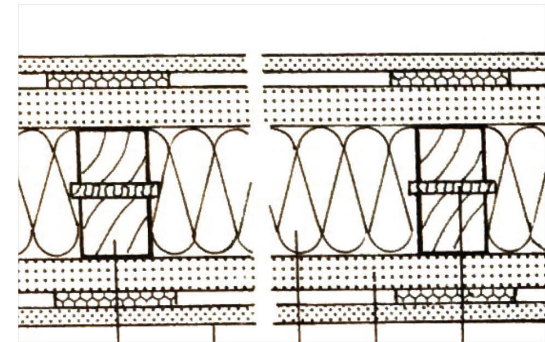
Single stud
Partial acoustic insulated
Double layers lining



Timber Stud Partitions
Double staggered stud
Two layers acoustic insulation
Thicker linings



Acoustically broken stud
Thicker full insulated
Acoustically isolated linings



Partitions



Maison a Vassu, Antonio et Daniela Camerin Architects



Evland House, David Chipperfield

Design Task 01: Reminder

Based on your Studio Design Project 01, 'adopt' a material to study in more detail.

Learning Outcomes:

- Integrate technology into your Studio project through an exploration of design ideas and materials
- Understand impact of chosen material on design proposal
- Place sustainability and green issues at the centre of your design process
- Develop modelling and prototyping skills

Ed Blake & Will Guthrie, Unbuilt Proposal

(c) UH + GBE NGS ASWS Brian Murphy



Design Task 01: Adopt a Material

Use following headings;

1. How It Is Made

(raw materials, preparation, process, end product, etc.)

2. Inherent Properties

(strengths, weaknesses, construction considerations, etc)

3. Sustainability

(sourcing, production process, pollution caused, carbon footprint, recycling, etc)

4. Relevant Precedent Studies

(minimum 5 no. built precedents exploring construction principles, typologies, details, etc)

5. Comparative Qualities

(compare to a material from a different category; Timber, Fired, Formed, Textile)

6. Design Process

(record design process and thought of your Studio Design Project 01; sketches, drawings, photos of prototypes, tectonics, fabrication, etc.)

Format:

Report, A4 landscape, bound

Submission:

29.10.2018 before 12 o'clock noon to Student Office

(c) UH + GBE NGS ASWS Brian Murphy



Same 4 Quotes for today:

Build Tight > Ventilate Right

Fabric First (Eco bling last)

No Insulation without Ventilation (PAS 2035)

Build Light > Insulate Right > Solar Tight

Insert another quote & image