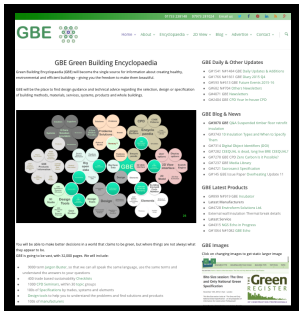

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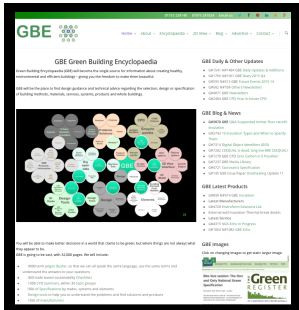
(27.1) Flat Roofs

CI/SfB (27.1) Flat Roofs

LSBU RIBA Part 1 Degree Architecture Tech & Env2 Lecture

- Domestic, Small & Medium size buildings
- Construction methods, materials, services and systems
- Flat Roofs



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Performance Requirements

Principles of Element Design

THIRD EDITION

PRINCIPLES OF element design

Peter Rich &
Yvonne Dean

Architectural Press

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 Dipl (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 B.A. (Hons) B.A.(Oxon) RIBA, 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
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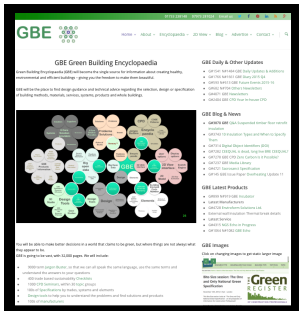

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Principles

Flat Roof Actions

- Gravity: downward pull
- Wind: Motive, Destructive, Penetrative, Scour, concentration of ballast and blow off roof
- Rain: Moisture deposition, penetration
- Snow: Moisture deposition, loading
- Sun: Temp variation, thermal movement, solar radiation heat gains, Chemical decomposition
- Dirt and Dust: infiltration, deposition, surface pollution
- Chemicals: corrosion, disintegration, decomposition
- Sound: Noise nuisance, from within and from without flanking from adjacent

Flat Roof Reactions

- Gravity: Support & restraint
- Wind: rigidity, resilience, sealing, wind and air tightness, bonding/fastening/ballast, high upstands
- Rain: deflection, impervious skin, absorption and drainage, sealing
- Snow: retention, deflection, impervious skin, absorption and drainage, sealing
- Sun: reflection, albedo, thermal mass, decrement delay, movement joints, radiation, convection and conduction insulation, shielding, invulnerable materials
- Dirt and Dust: repulsion, exclusion, shielding, collection, cleaning, demineralisation
- Chemicals: invulnerable materials, exclusion, bio-remediation
- Sound: Insulation

Principles of Flat Roof Design

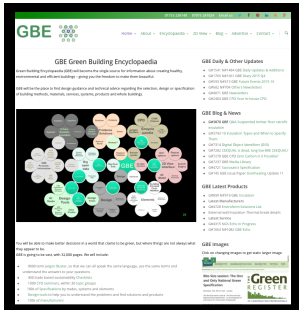
- Roof form and types of weatherproof coverings
- Structural strength and stability
  - +ve and –ve pressure
- Weather shield
- Rain and other precipitation
- Snow: Weight, Insulation, reflection, Slippage, melt water run off
- Wind
  - Wind driven rain, wind driven snow, wind scour of ballast, wind driven melt water,
- Sun
  - UV radiation
  - Solar radiant Heat resistance
  - Internal conduction insulation
  - Overheating
- Dirt and dust
- Thermal performance
  - Thermal movement
  - Heat Gain and resistance
  - Heat loss and retention
  - Condensation risk
- Drainage:
  - Rain, snow melt water
  - Pitch and materials
  - Retention and Mitigation, SUDS
- Durability
- Sound Insulation
- Maintenance
  - External and internal, loading, safety
- Security
  - Entry through tiles and battens USA
- Fire,
  - External Fire Penetration
  - Internal Fire Spread
- Roof Access: Maintenance, cleaning, inspection, Safety
- Ventilation
- Rooflights
  - Privacy from overlooking
- Insect exclusion or selective inclusion
- Bat and Bird exclusion or inclusion

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 Thermal Bridges
  - Thermal Mass
  - Decrement Delay
- Movement
  - Structural , thermal, moisture, Frost
  - Creep
  - Chemical

Principles of Element Design

- Acoustic Performance
  - Resistance, absorption
- Fire Performance
  - ___
  - Fire Resistance
  - Proximity to boundary
- Security
- Inspection and maintenance
  - Inside & out
- Biodiversity
  - inhabitation
- Health
  - Moisture Mass
  - Low allergy materials



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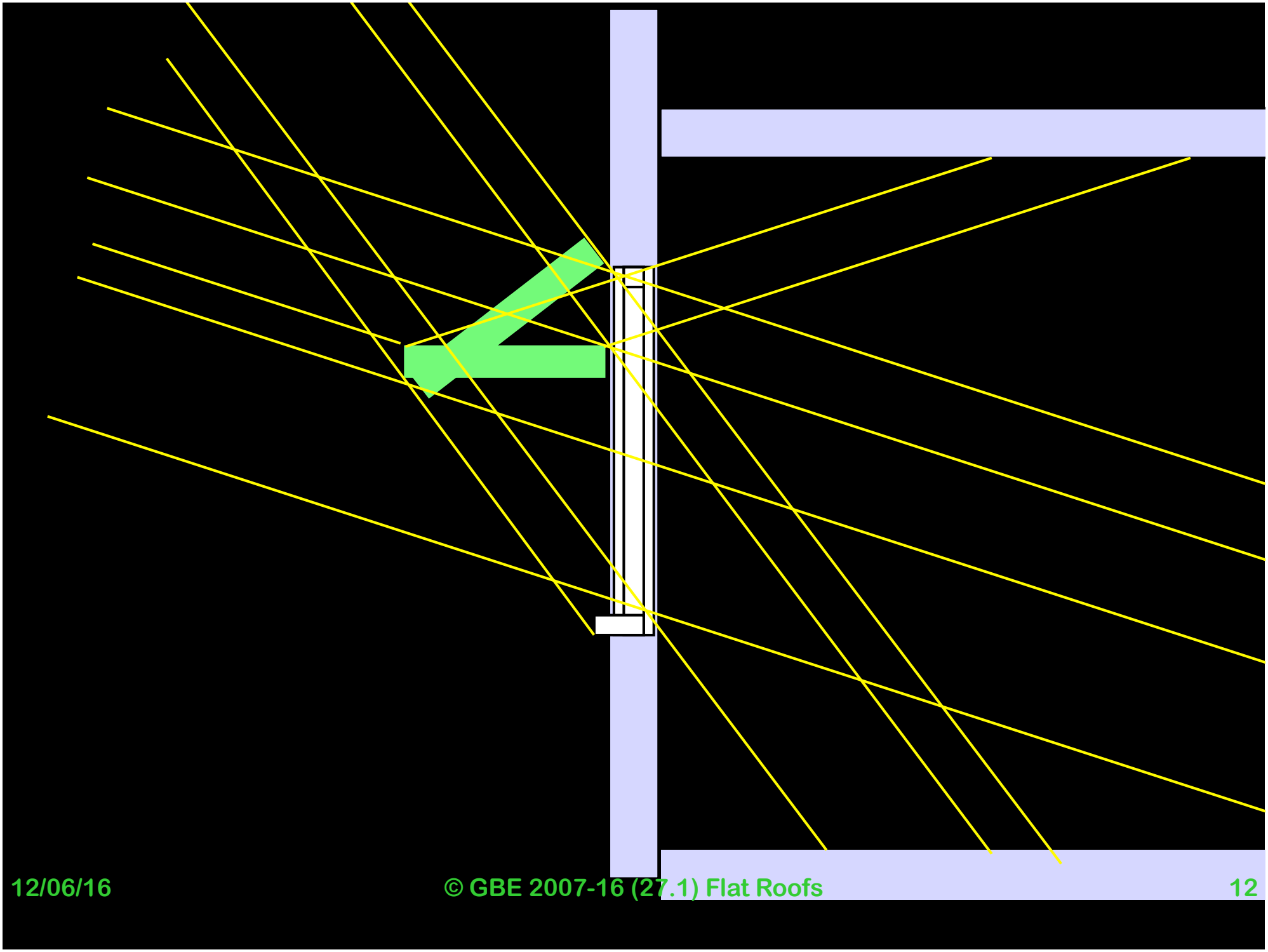
Solar Shading

And light shelves



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GreenSpec
www.greenspec.co.uk
CAP'EM
Cycle Assessment Procedure for Eco-Materials

LCGB: Low Carbon Green Buildings

Brian Murphy (GreenSpec)

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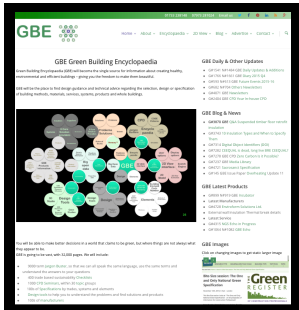

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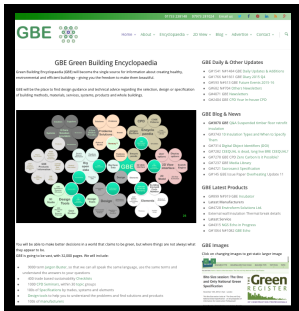
Systems & Applications



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Flat Concrete roofs

CI/SfB (27.1) Flat Roof

Violet materials: Concrete blocks

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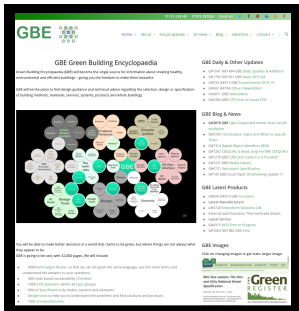
Suspended Roof: Economic & common:

- Suspended insitu concrete is labour intensive and not common
- Precast concrete plank and structural screed topping Cement:Sand
- Precast concrete beam and concrete block with topping
- Hybrid mixtures of the above
- Holes drilled (cored), cut or trimmed



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Insitu Concrete Roofs

CI/SfB (27) External Roof

1960's tower insitu concrete Roof/gutter refurbishment

- Eco Energy Refurbishment

Suspended insitu concrete

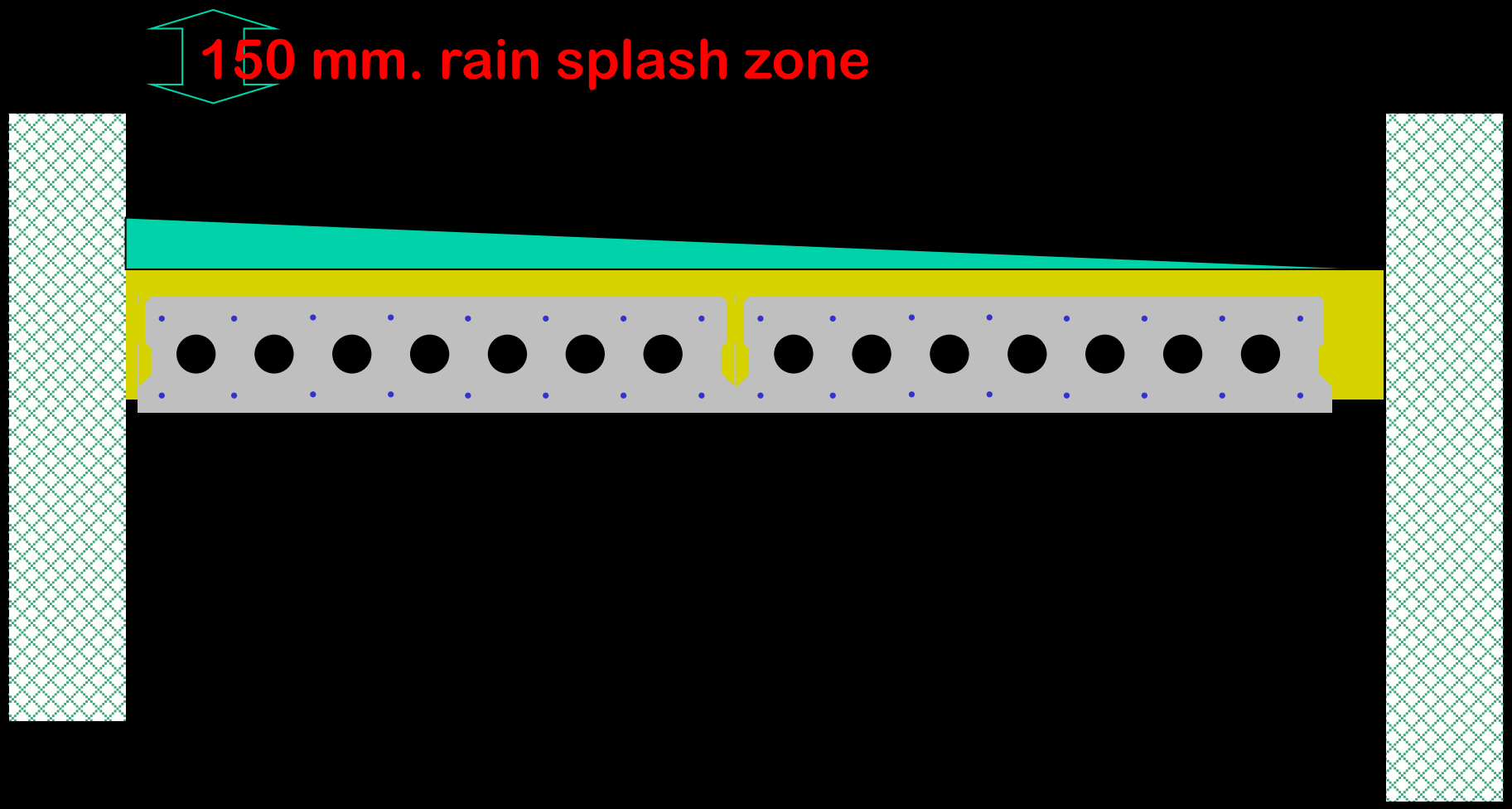
- labour intensive
- wastes formwork
- is not so common
- Holes formed, late holes drilled (cored)

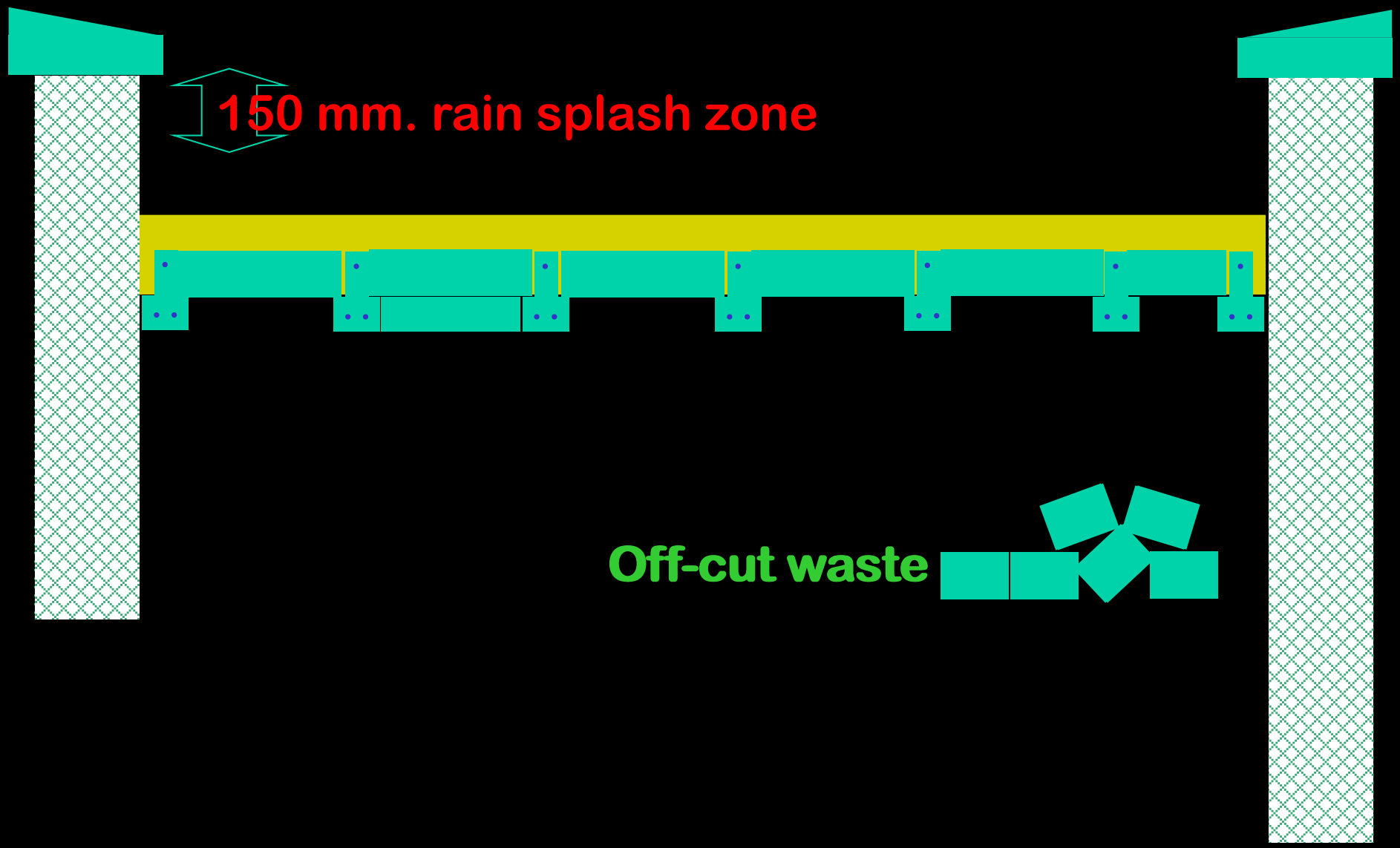
Metal Trough & Insitu EcoConcrete

- Requires steel frame superstructure
- Steel Permanent formwork deck provides access
- Insitu eco-concrete
- Bond and together to make thin floors
- Potential reduction in storey heights

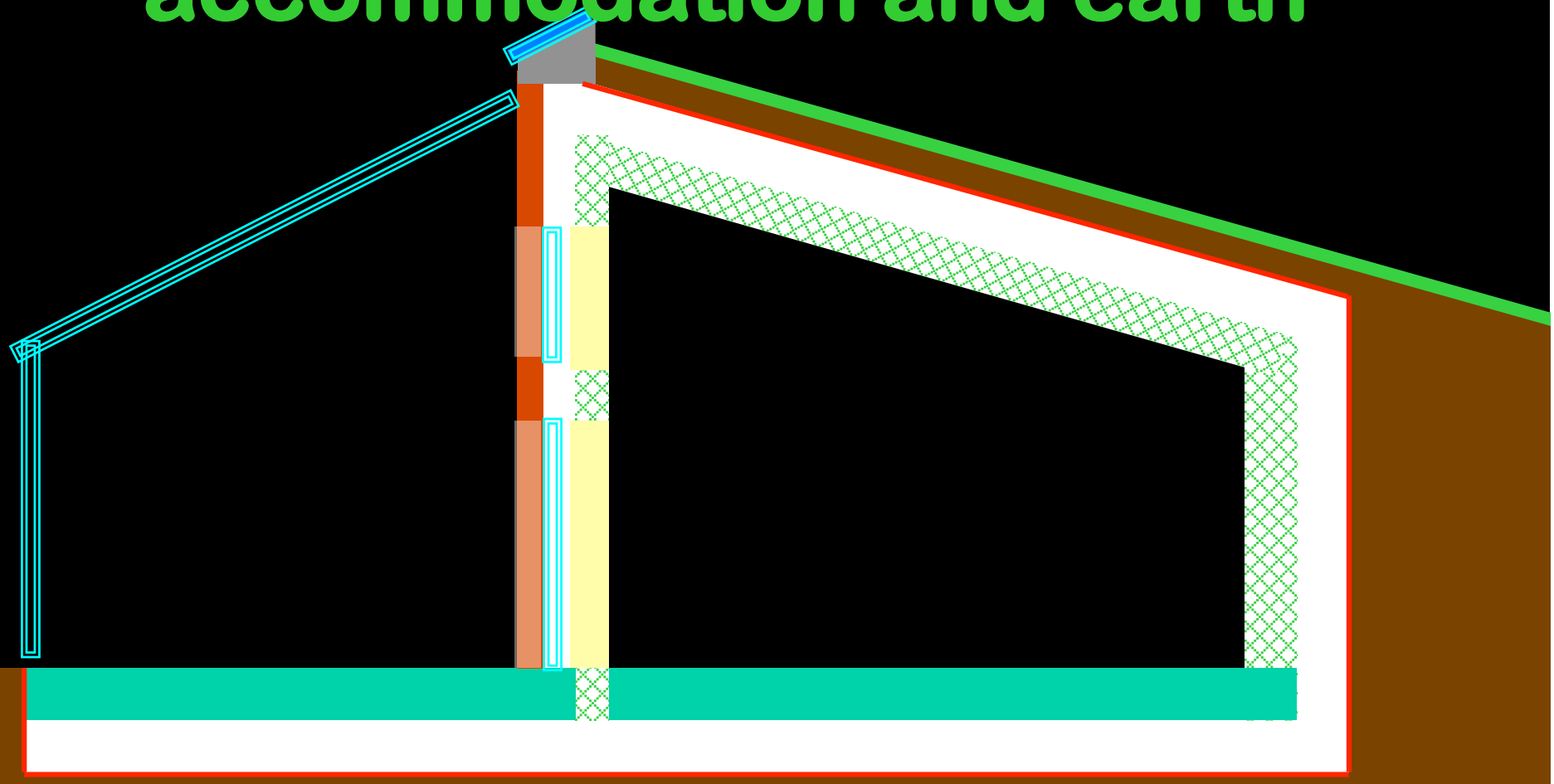
Precast concrete Plank roofs Beam & Block roof

CI/SfB (27.1) Flat Roof





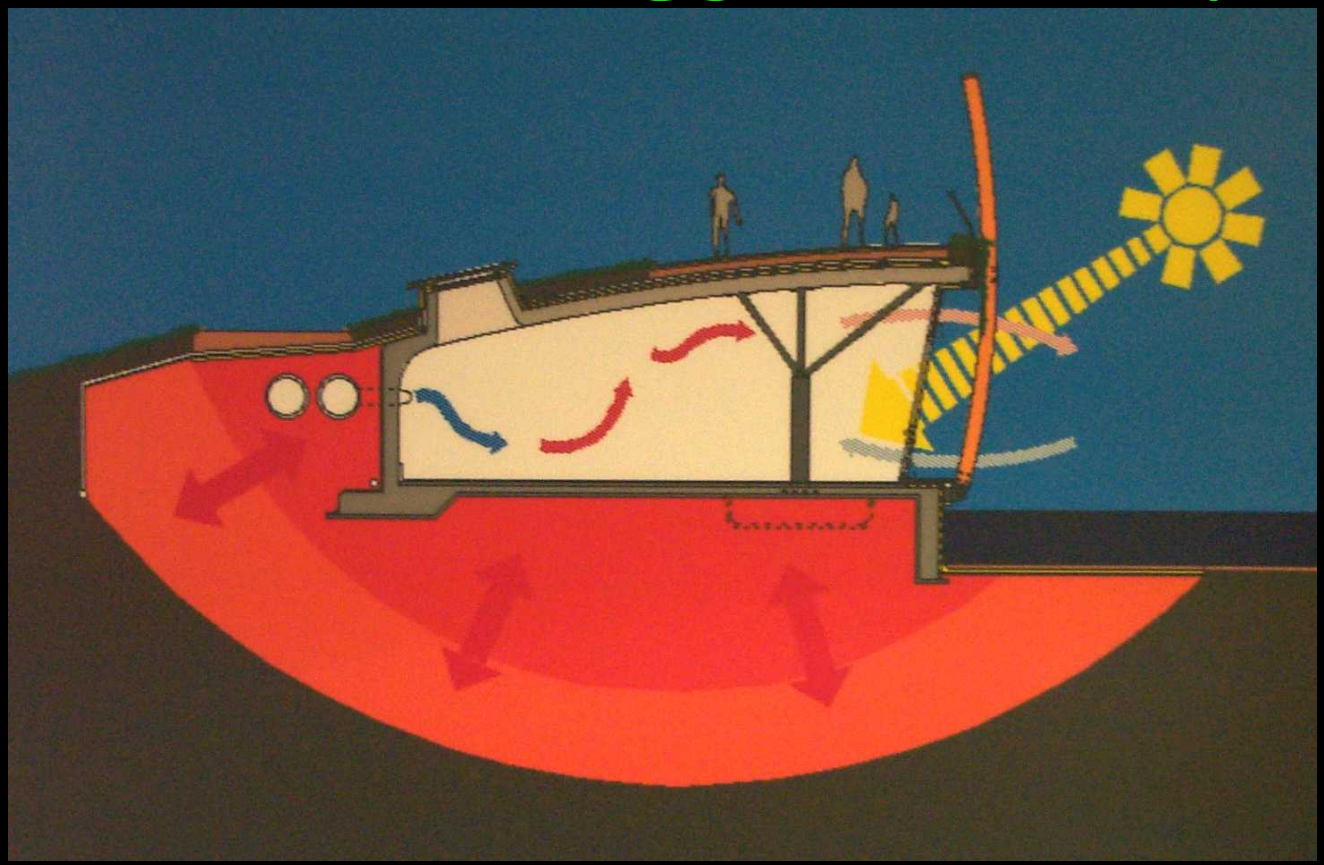
Solid concrete blockwork retaining wall Insulated outside between accommodation and earth



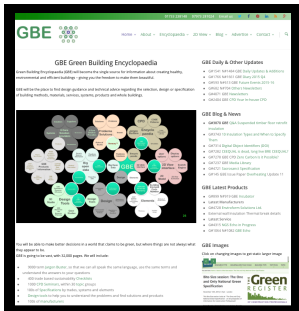
Zero Energy Development

Mile End Road Park

Zero Energy Development



Zero Energy Development Use of thermal mass of earth to store heat for 6 months



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Flat timber roofs

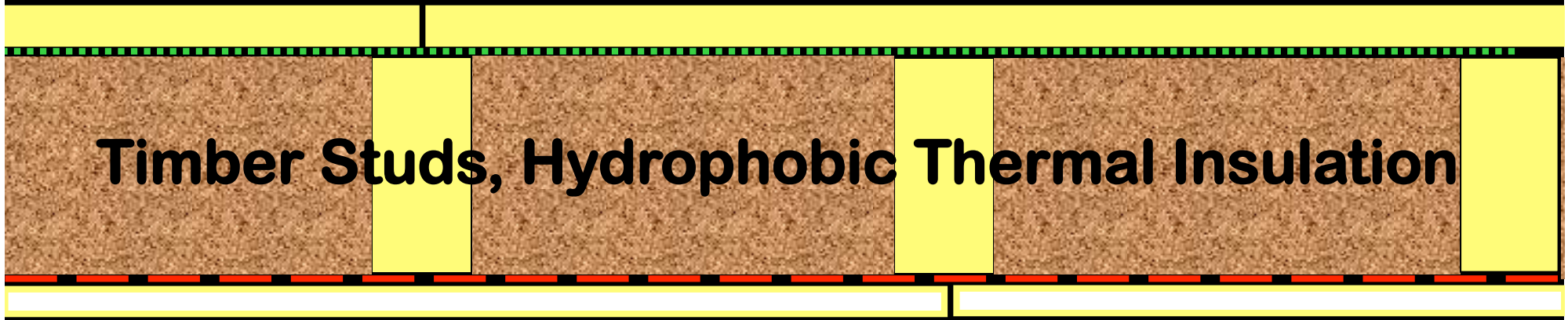
CI/SfB (27.1) Flat Timber Roof

Flat Roof Timber Joists

Section

Outside

Breather Membrane, outer lining (plywood)



Vapour Barrier, inner lining (plasterboard)

Inside

Timber sections: limited depth before uneconomic or unobtainable

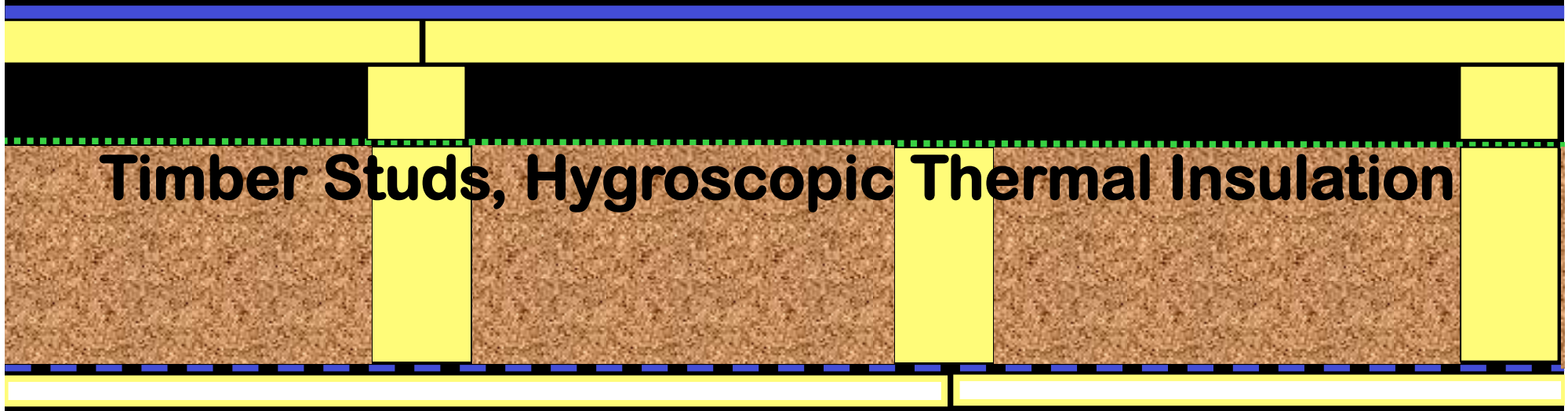
Timber framed roof

Breathing Roof

Flat roof section

Outside

Breather Membrane, Breathing Sheathing Board



Vapour permeable Air tightness layer, inner lining

Inside

Timber sections: limited depth before uneconomic or unobtainable

Concrete Frame

Breathing Construction

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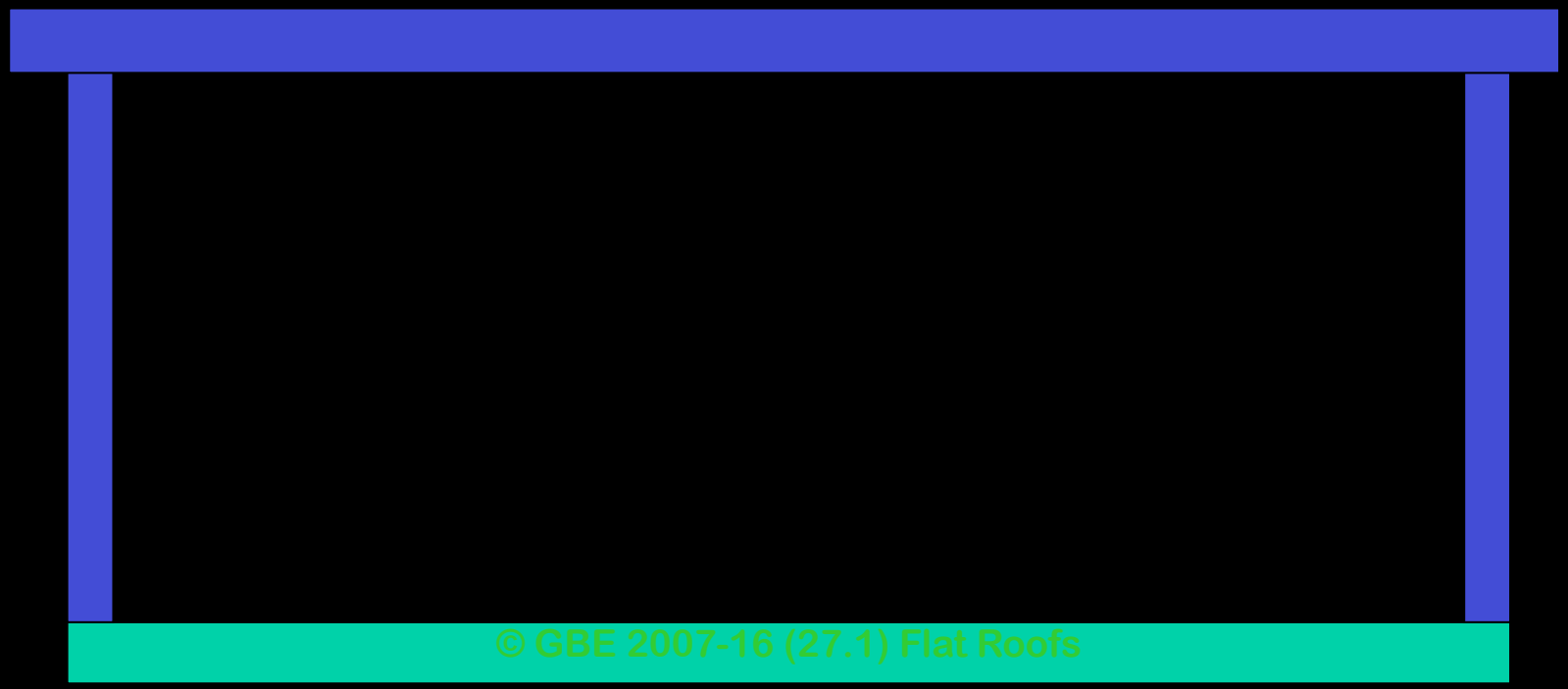
Metal Roof Joists

Metal C Studs, Thermal Insulation, Breather Membrane, inner lining, Vapour Barrier, outer lining

Metal frame walls



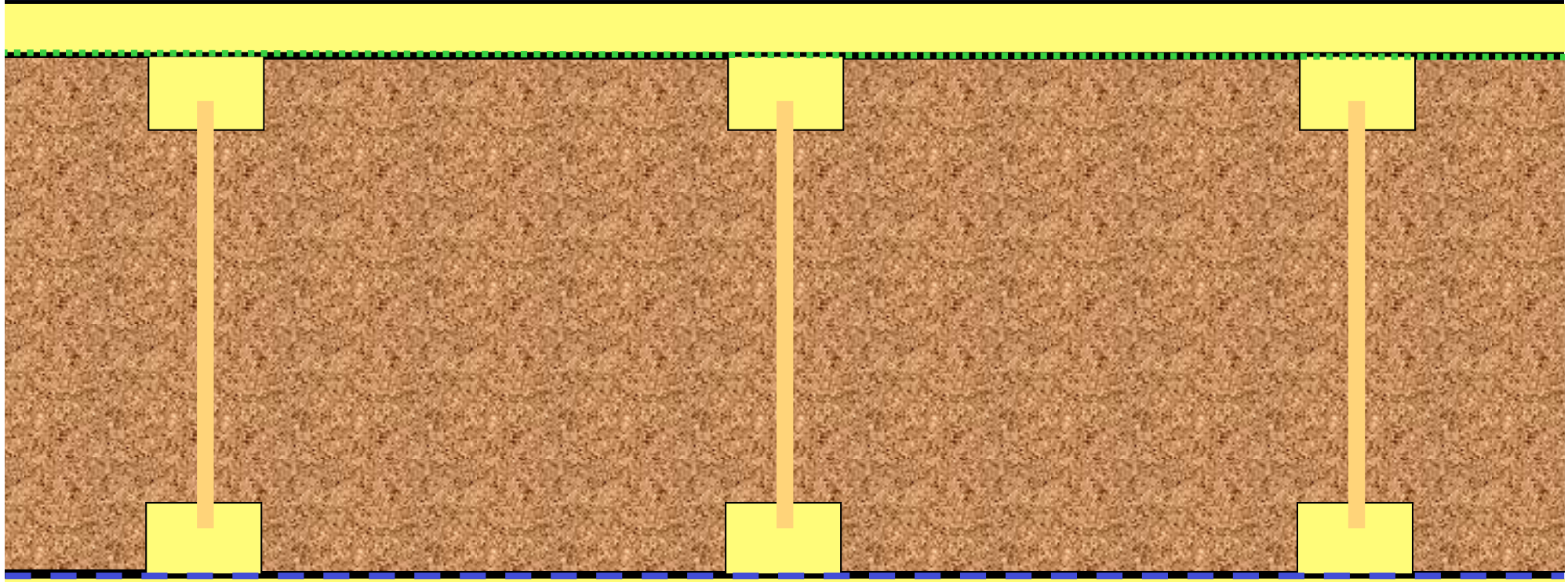
Factory Prefabrication:

- Conditions ensure no deterioration
- No mud or cement splashes
- No rain to spoil
- Use of all the materials supplied
- Reusing until all is gone
- Virtually no waste

Strength v U Value in roof construction

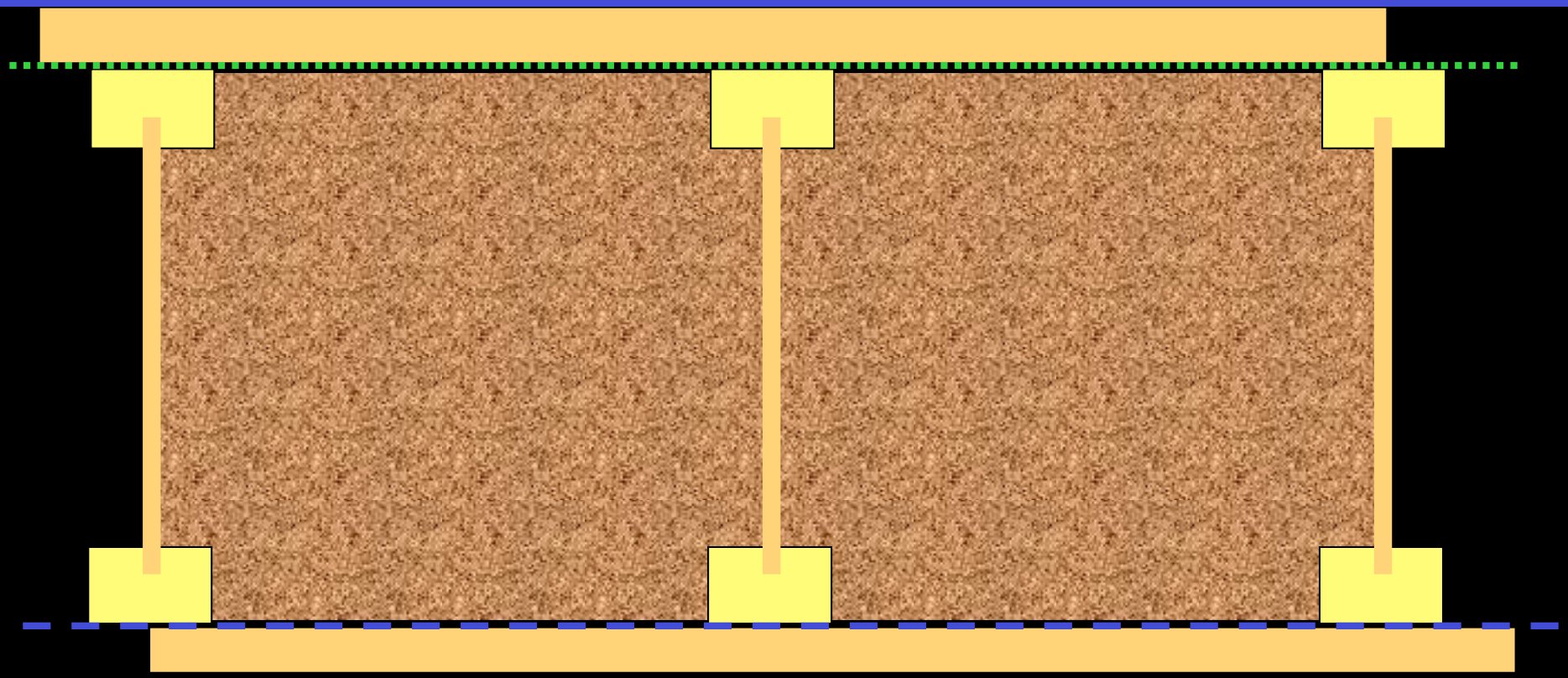
Avoid over design of structure around openings
Avoid lack of design: adding additional studs for luck
Avoid creating wide cold bridges through insulation
Avoid Waste: chopping thermal insulation rolls

Compound Roof 'I beams' to accommodate more thermal insulation



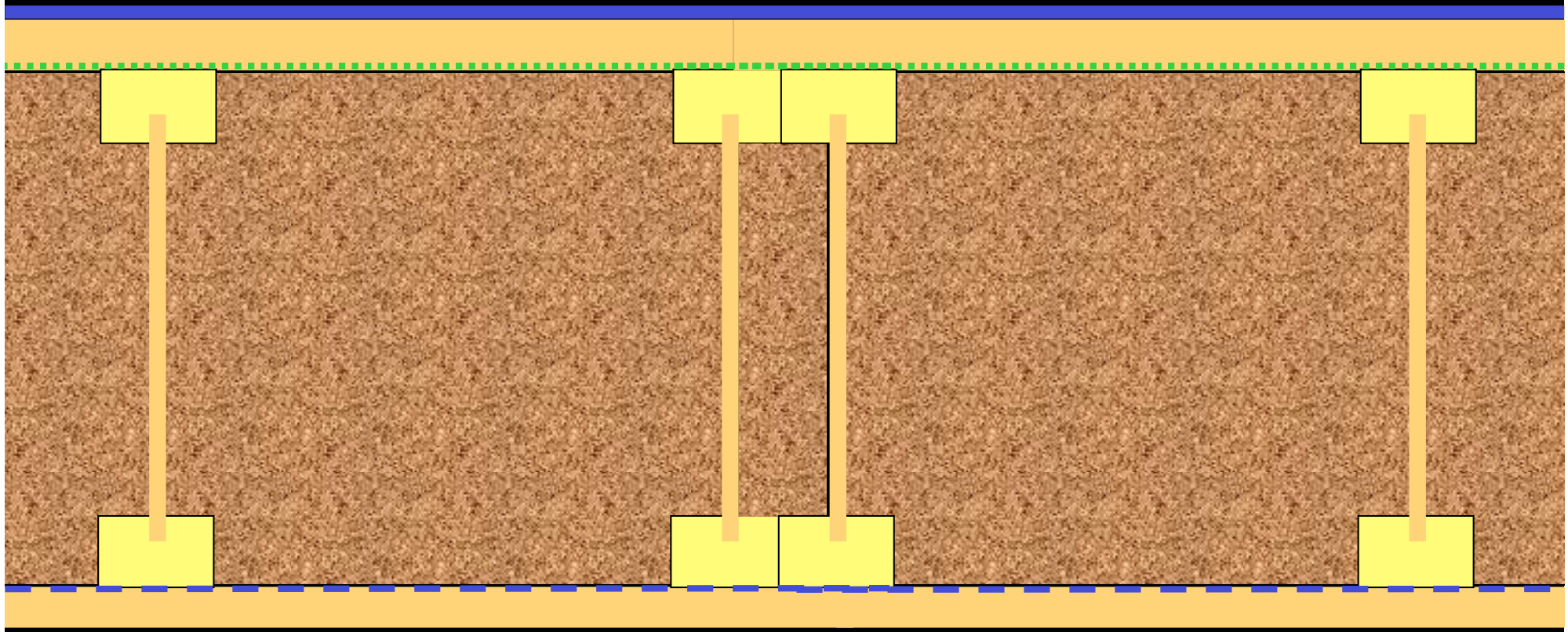
Compound section reduces amount of materials used, weight, cold-bridging

Compound Studs 'I Studs', inner and outer boards and thermal insulation



Prefabricated external wall panel

Compound studs 'I studs', inner and outer boards and thermal insulation



Prefabricated external wall panels

Insulated structural Panels

GreenSpec
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Airtightness & Building Elements

12 of 25 Air Movement in Buildings

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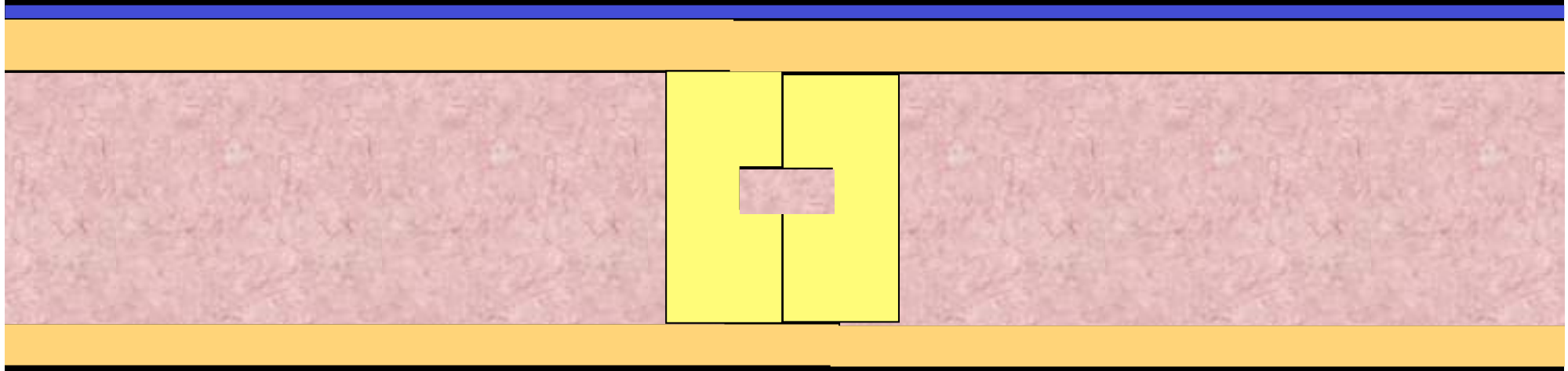
SIP Structural Insulated Panel

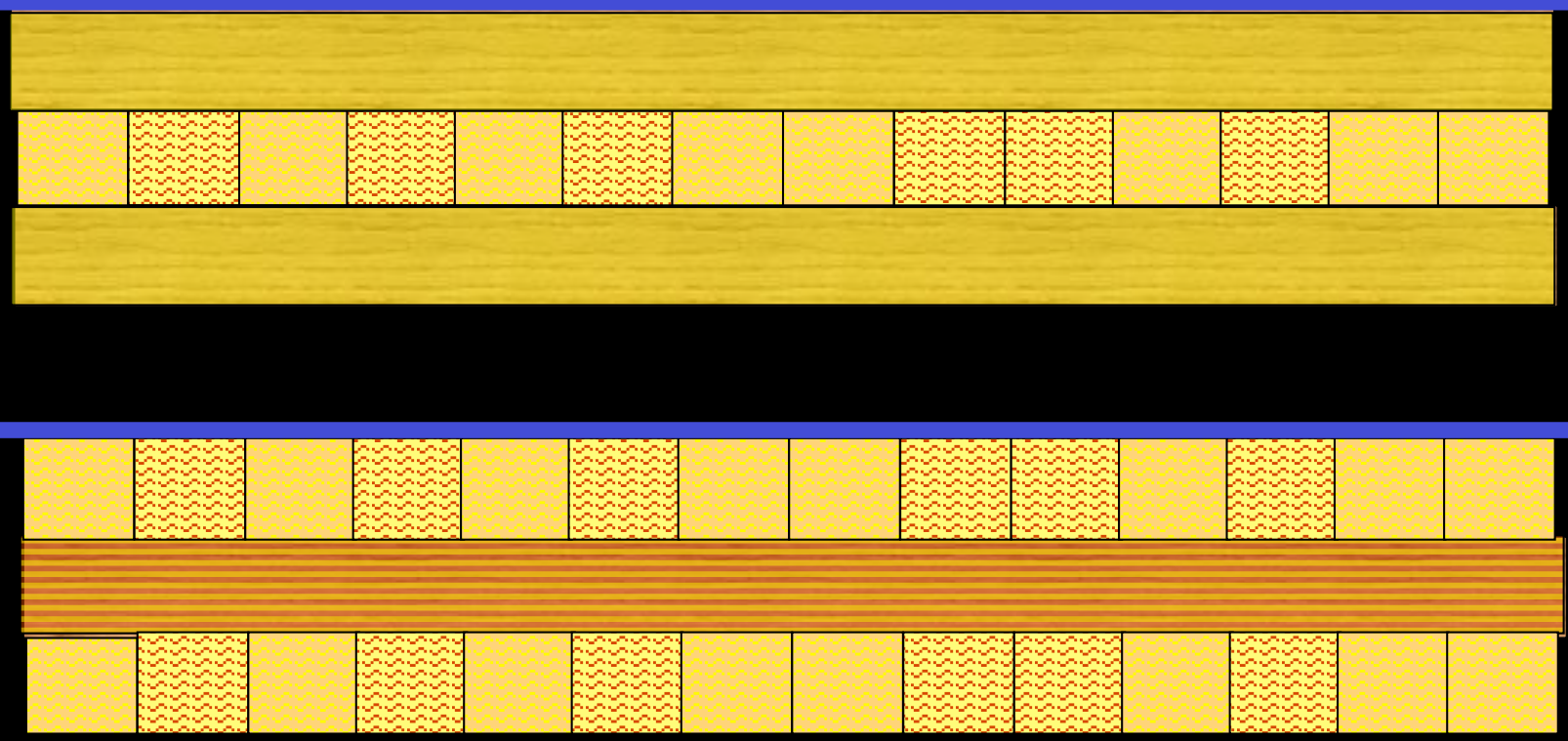
Prefabricated external wall panel

SIP Structural Insulated Panel

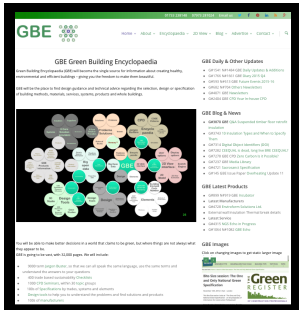


Prefabricated external wall panel

Load-bearing Structural Timber Panel



Prefabricated flat roof panel
softwood lamina or plywood core option



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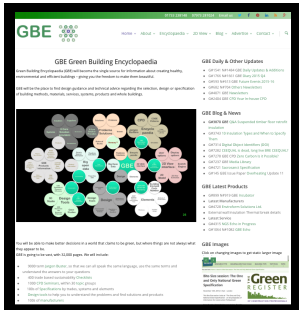
Roof & Wall Junctions

CI/SfB: (21) External Walls

(27) Roofs



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Roof Joists in external walls

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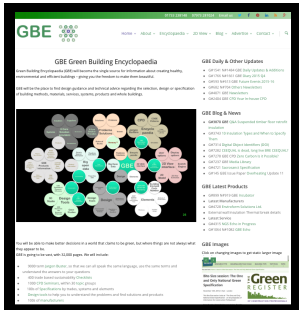
Joist penetrations into wall need to be airtight



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Living Roofs

Q37 Green Roofs

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The Natural Choice for Your Roof

THE GREENGRID ® ROOFING SYSTEM

Simplicity and flexibility in design are the hallmarks of GreenGrid ®. The System was designed by engineering, roofing and horticultural experts to produce an efficient, integrated green roof product. GreenGrid ® offers a modular design that arrives at your site pre-planted and ready for installation.

The GreenGrid ® modules contain recycled plastics, the components can be handled by conventional means to be quickly installed in accordance with the design. The GreenGrid ® modules can be placed on top of the roof membrane or on any other surface with adequate structural capacity.

GreenGrid ® green roof system modules are lightweight compared to many other green roof systems. The three GreenGrid ® options support different plant types, allowing your roof garden to be easily arranged or re-arranged to suit changing client needs and desires. Most importantly, roof maintenance and repair is simple - GreenGrid ® modules can just be moved whilst the roof repair/maintenance is carried out and then put back in place without damaging the plants.

GreenGrid ® has made it possible for some of the best green roofs to take shape. The GreenGrid ® system's straight-forward design, pre-planted modules and movable modular features give it distinct advantages over any other green roofing system.

GreenGrid Benefits

- Versatility for creativity
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- Light & easy to install
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- One contractor can install entire roof
- Roof surfaces easily accessible for maintenance

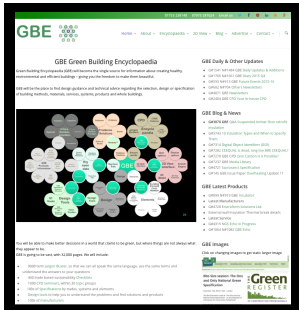
Prominent projects

Apple Computer Store
IKEA Store
Center for Urban Ecology
Home Depot Store

mailing list

email address:

Submit



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ENVIRONMENTAL ROOFING SYSTEM

GREENGRID
The Natural Choice for Your Roof
MODULAR GREEN ROOF SYSTEM

"Using a pvc membrane in a green roof system is like putting lipstick on a gorilla"

Many clients choose a green roof installation in the belief that they are choosing a completely environmental system.

Did you know that some green roof systems contain a pvc waterproofing membrane?

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cts of Materials

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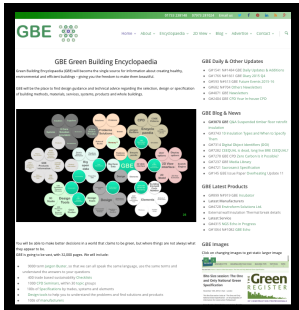

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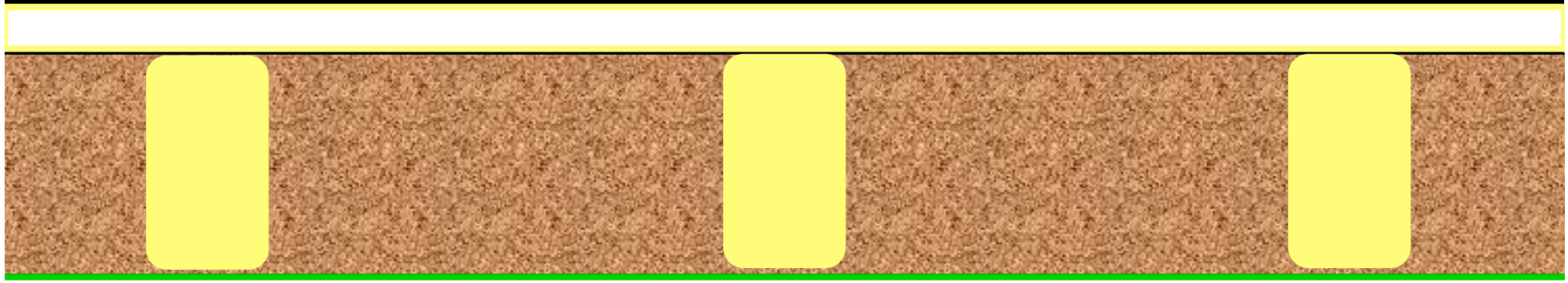
Resource Efficiency

Layered Construction

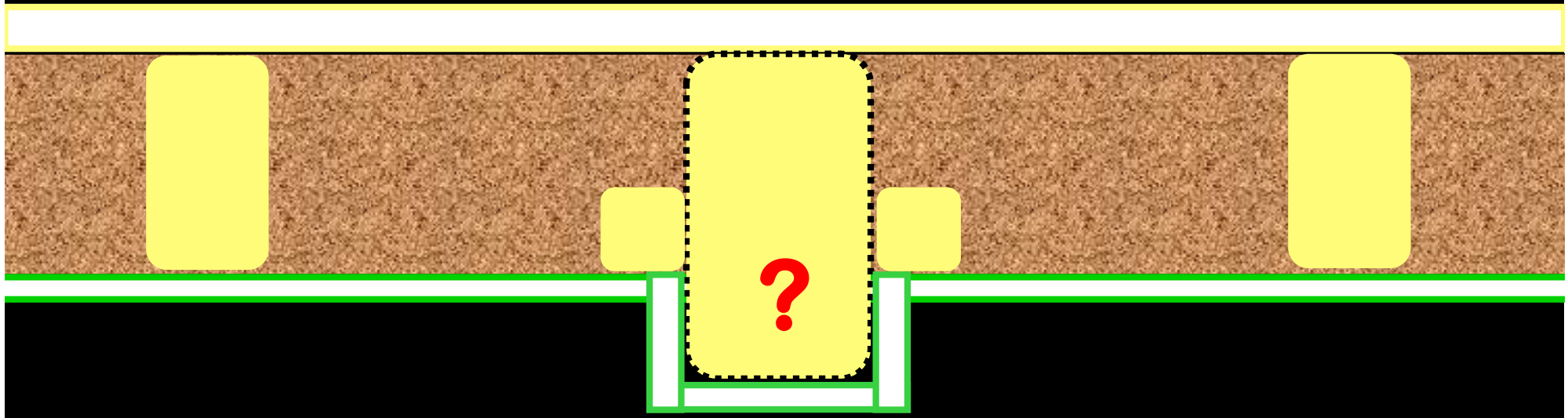
- Simplifies details and avoids interfaces:
- Ventilation zone above/outside insulation
- Don't puncture Damp proof membrane, Gas proof membrane, Vapour barrier, Breather membrane & Air tightness layer
- Add services zones to avoid complications

Roof Joists



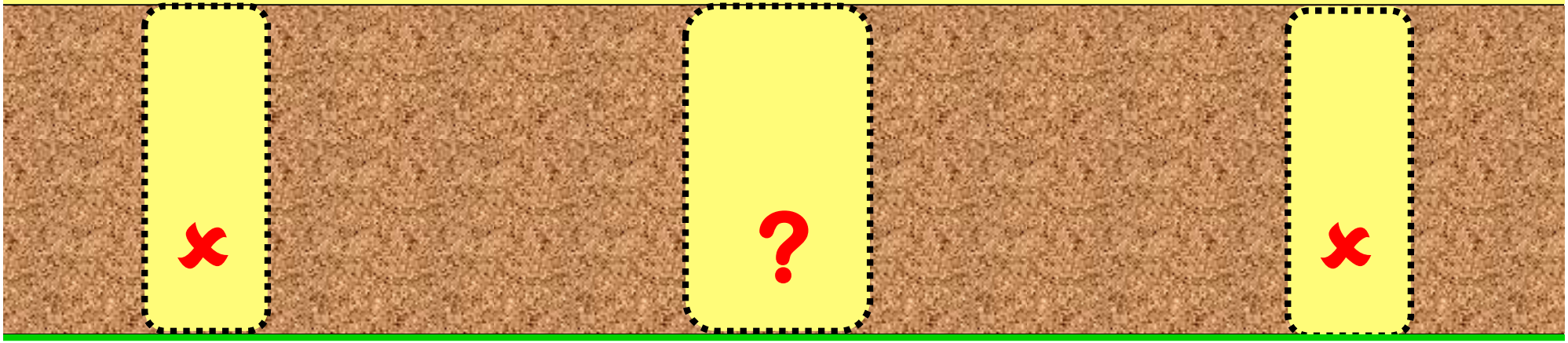
Multiple section simplifies design

Roof Joists/Beams & RE Supports



Different section complicates detail
Creates off-cuts and waste
Changes appearance below

Roof Joists/Beams & RE Supports

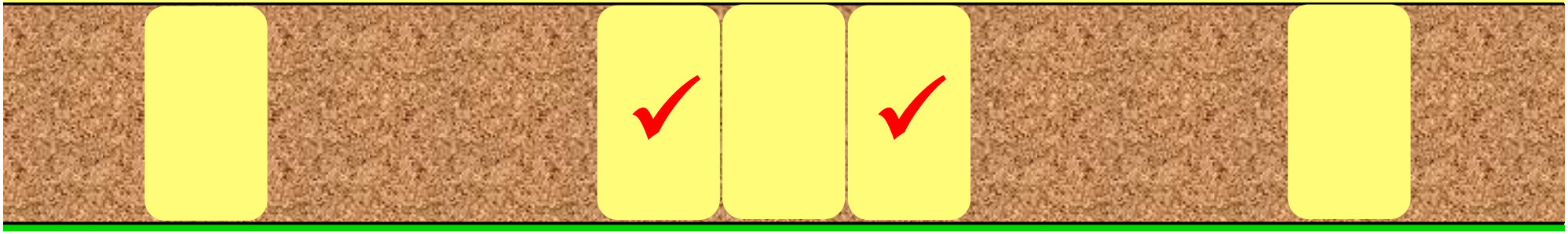


Standardising size leads to over-design of many for the sake of one

No harm done by extra insulation

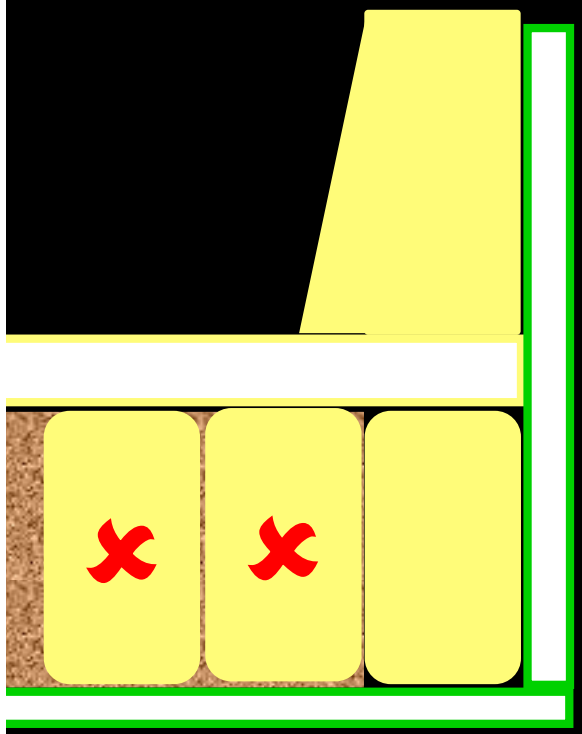
Future proofing: RE support, later RE add-on

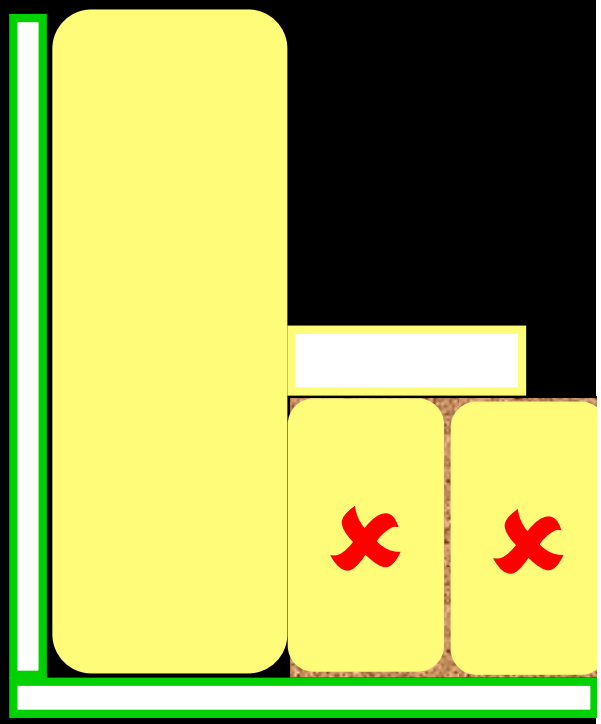
Roof Joists/Beams & RE Supports



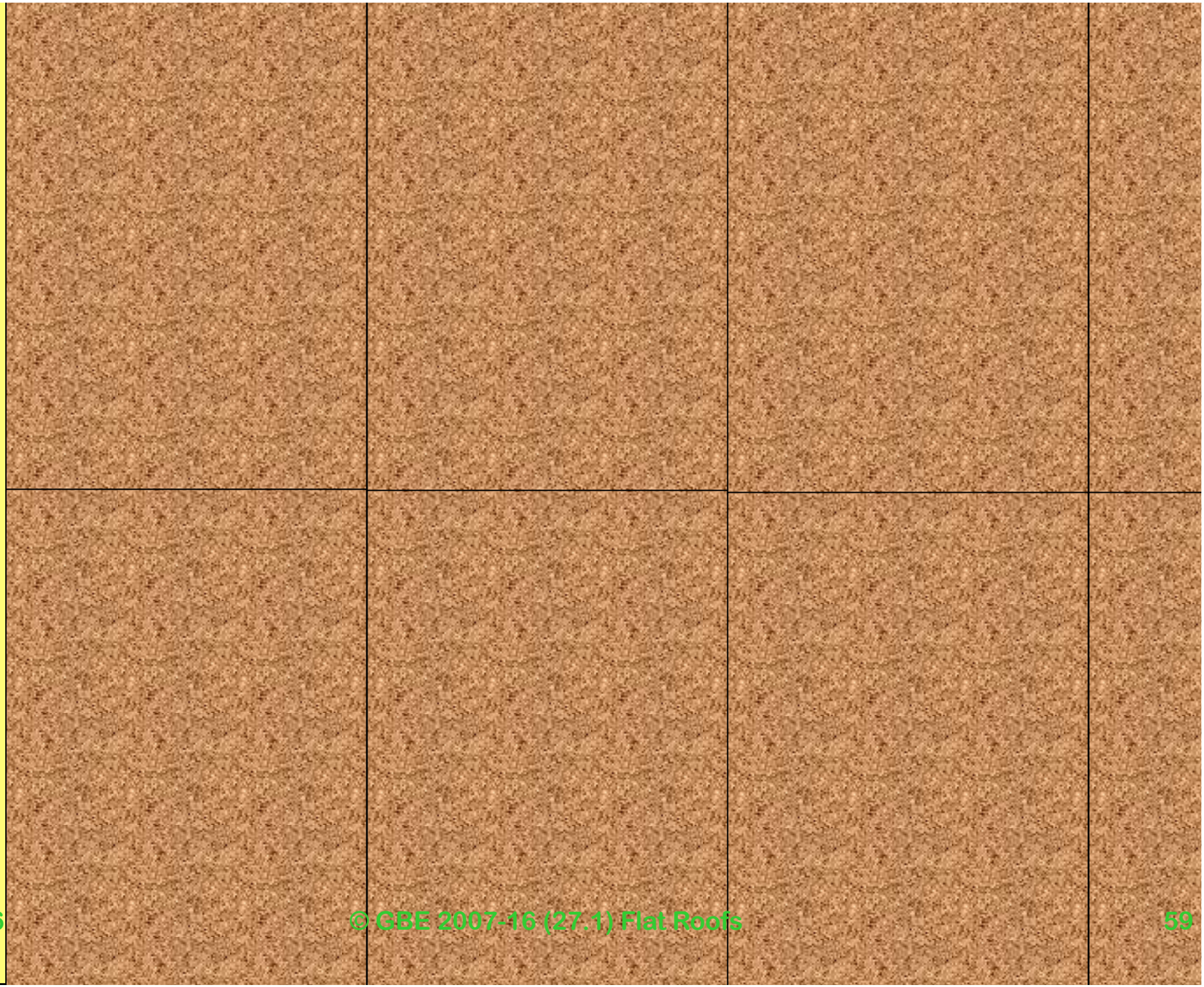
Multiple section simplifies design

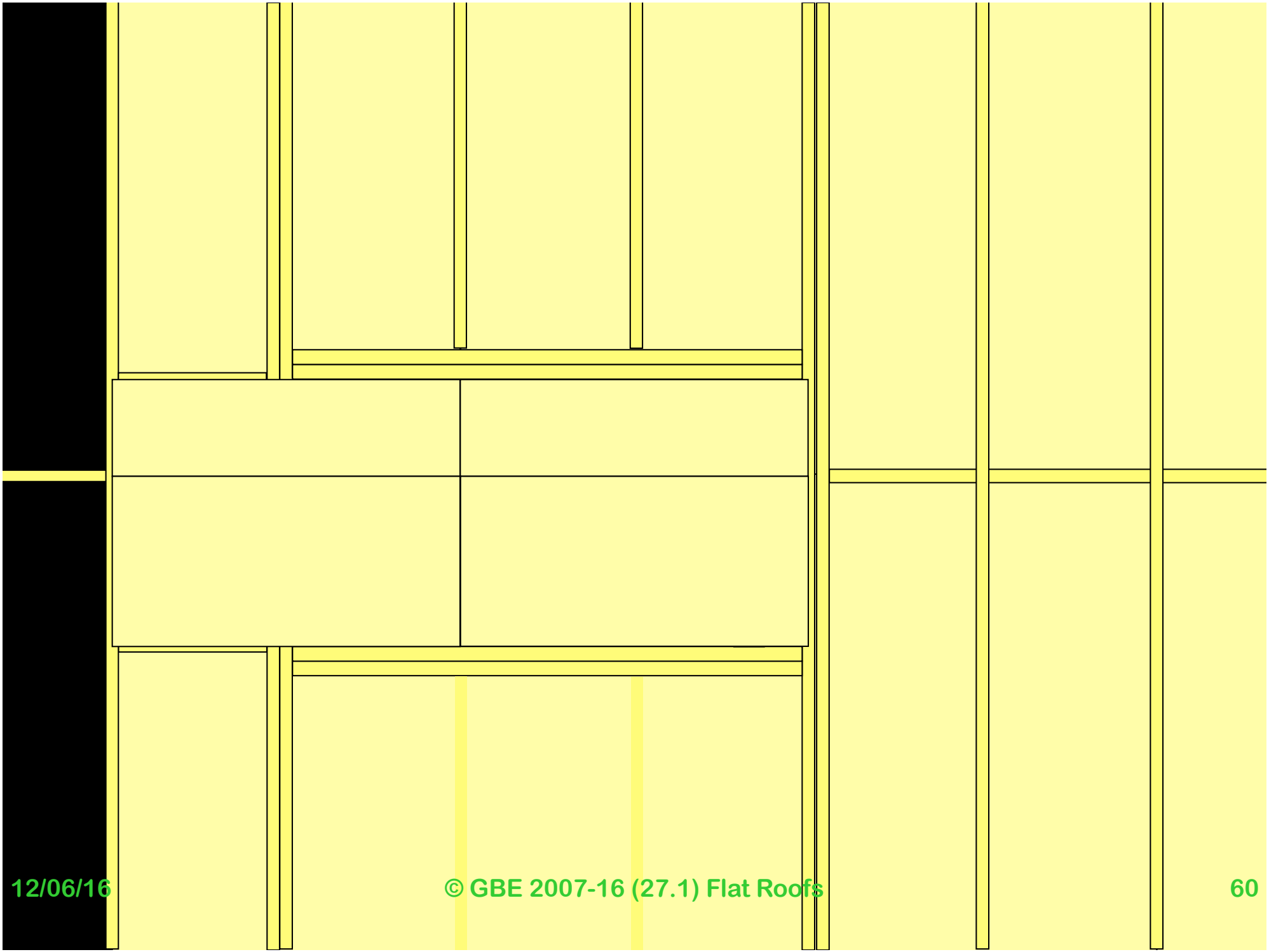
Trimming of openings flat or pitched roof section

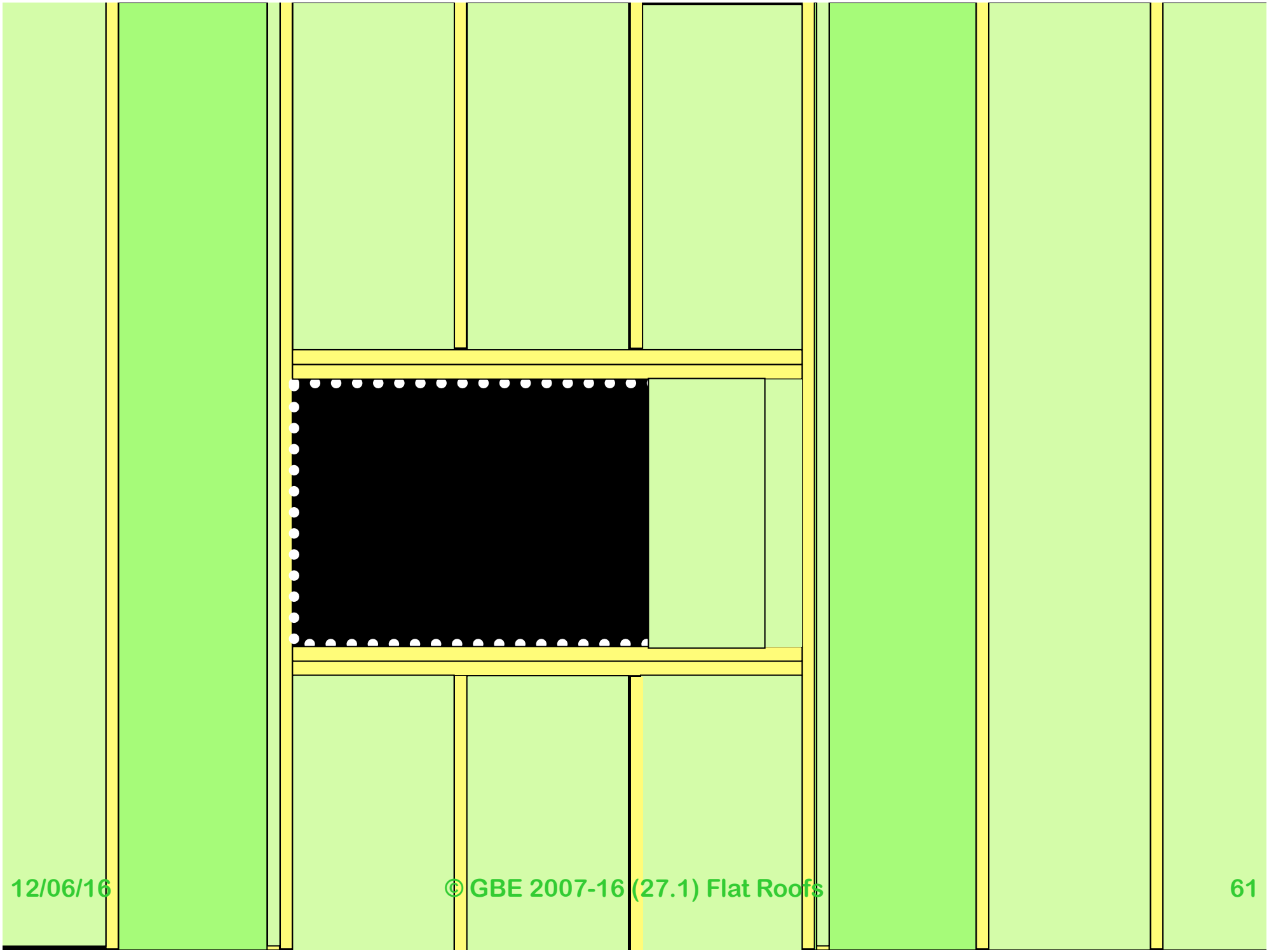


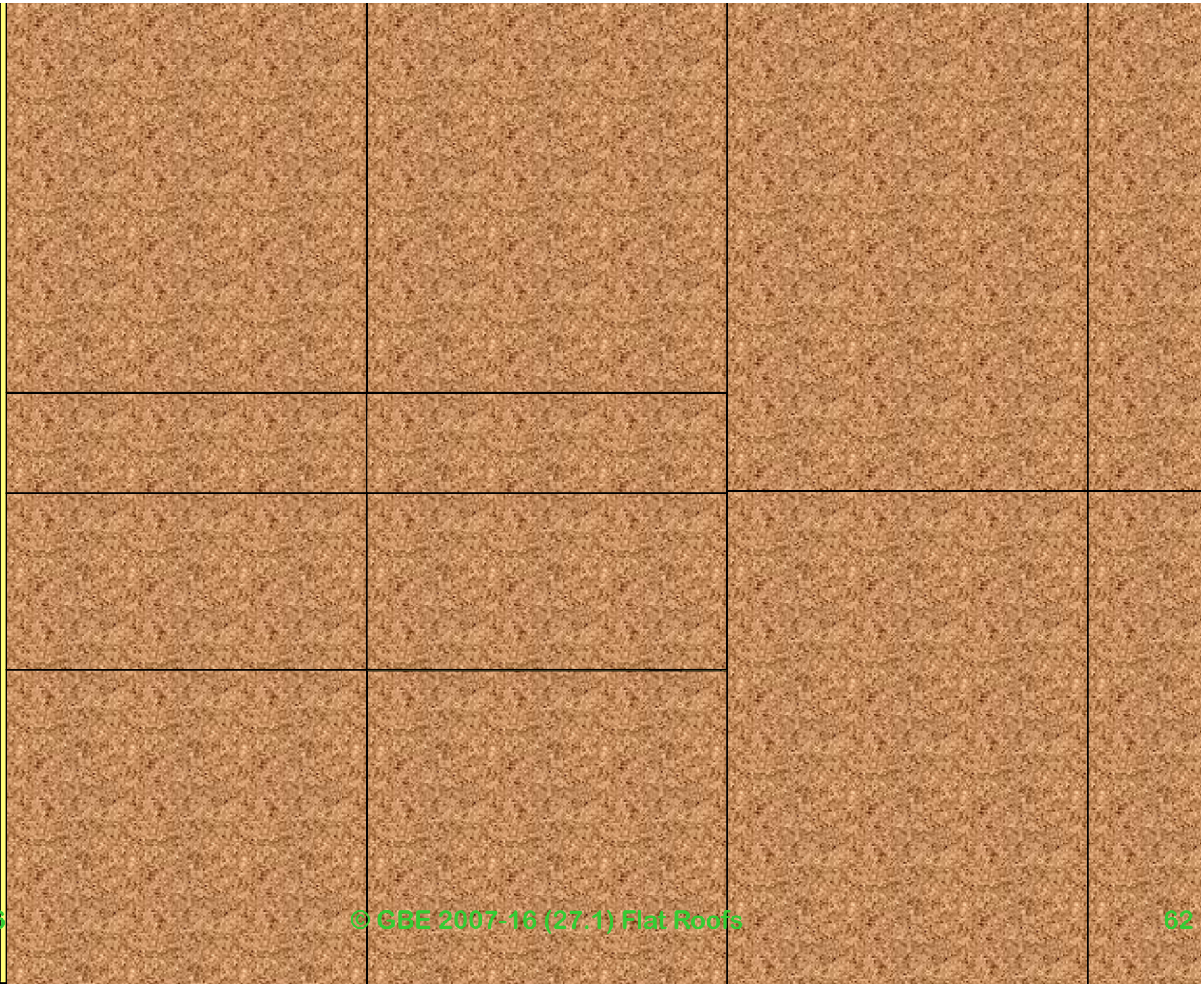


Lazy Structural Design: less calculation, more structure
Avoid over design of structural supports or around openings
Avoid creating wide cold bridges through insulation
chopping standard width insulation rolls: more waste







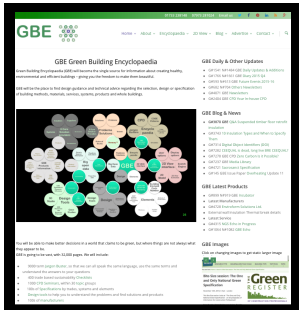


Design to Reduce Waste

Another GBS CPD/Lecture file to download and www.greenbuildingencyclopaedia.uk

Reused wood better than new

BedZED Beddington Sutton Architect: Dr Bill Dunster,
Reclaim: BioRegional ReCLAIMED



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CAP'EM

Cycle Assessment Procedure for Eco-impacts of Materials

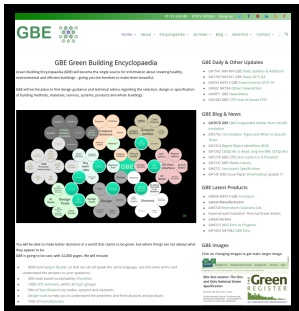
Investing in Opportunities

This project has received European Regional Development Funding through INTERREG IV B.

INTERREG IVB

Reduce Demand

- Don't over design structure
- Except if long design life demands it
- Don't oversize
- Don't cut section from solid if compound is possible



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Cycle Assessment Procedure for Eco-impacts of Materials

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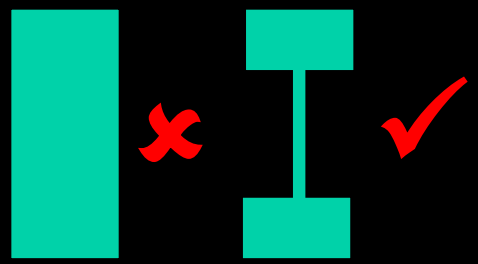
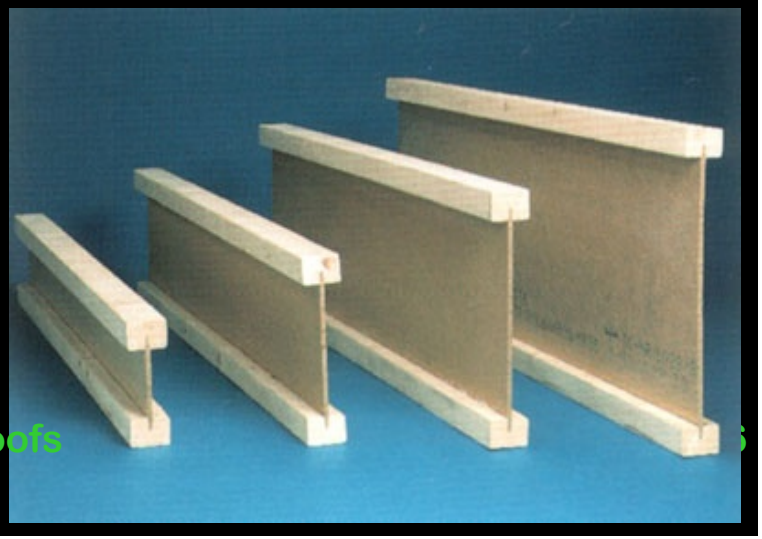
INTERREG IVB

Reduce Demand

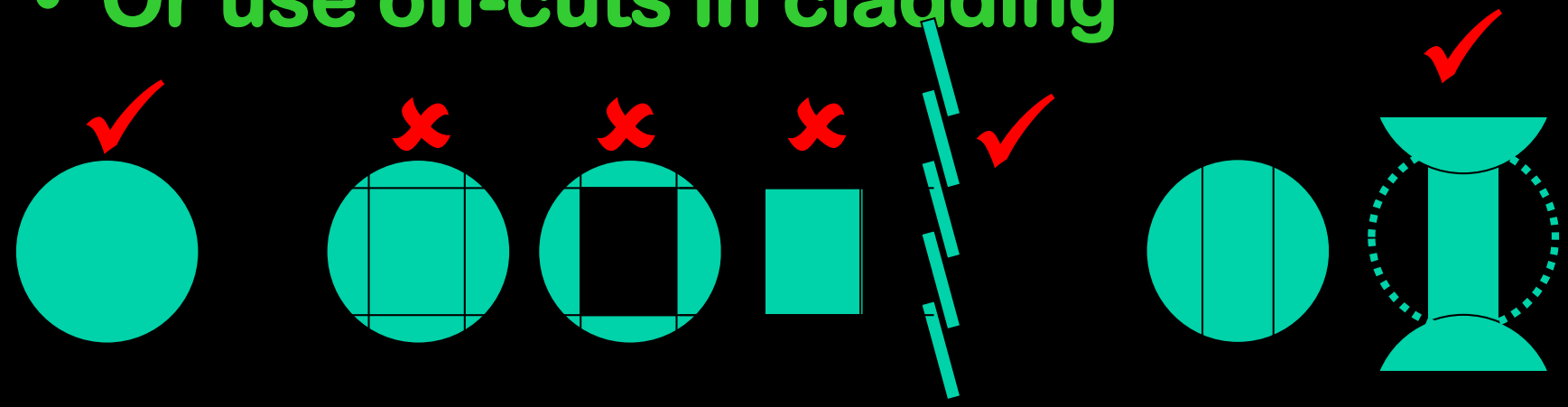
- Don't cut section from solid if compound is possible
- Reduce solid sections to compound to reduce weight and materials used

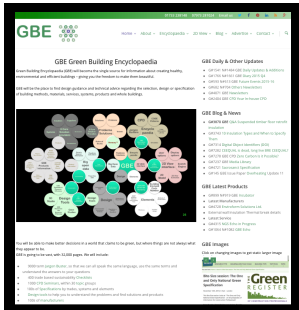




Reduce Demand

- Consider use of materials as found:
- Round pole structures
- Or compound sections without waste
- Or use off-cuts in cladding





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- Brian Murphy BSc Dip Arch (Hons+Dist)
  - Architect by Training
  - Specification Writer by Choice
  - Environmentalist by Actions
- Greening up my act since 1999
- Founded National Green Specification 2001
- Launched www.greenspec.co.uk 2003
- Created: GBE at www.greenbuildingencyclopaedia.uk 2015
- E BrianSpecMan@aol.com
- Twitter: http://twitter.com/brianspecman
- Facebook: http://www.facebook.com/brianspecman
- LinkedIN:
- Google+:
- Created 06/11/2007