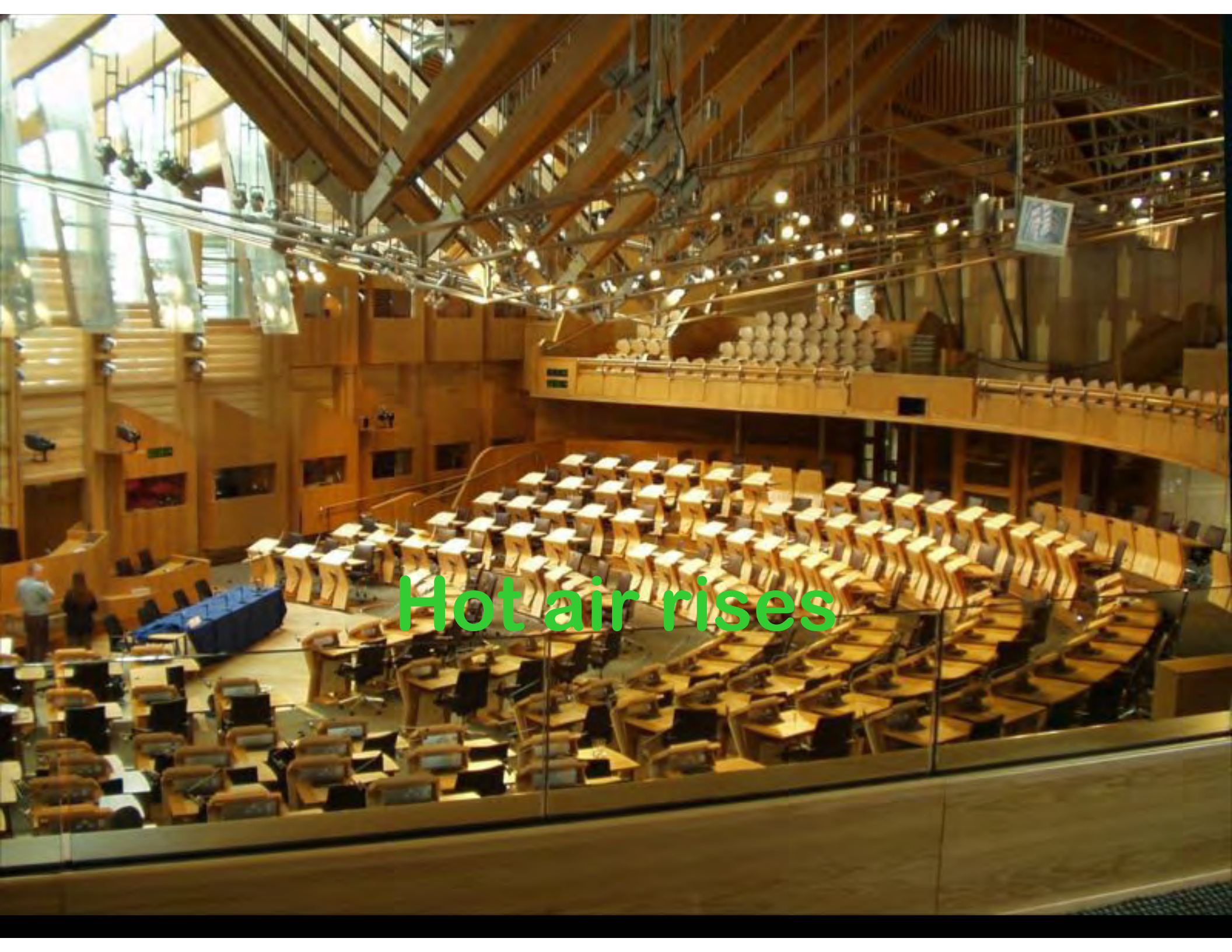


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Air movement in & about buildings 1 of 9 + Q&As

© NGS GreenSpec 2007 CPD in 10 parts



Hot air rises

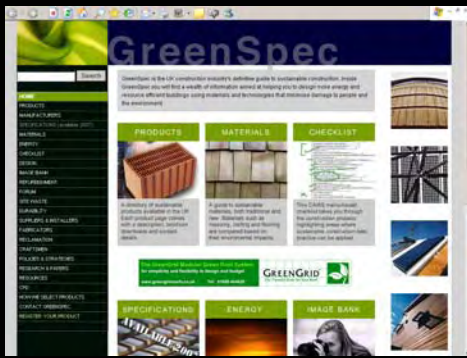
GreenSpec CPD Seminar Series

- **Educational Objective:**
 - Comprehensive introduction to subject: from wind to air-conditioning and a lot more in between
 - emphasis on environmentally sustainable solutions
 - design primer: addressing principles and solutions
 - technically rich: materials, construction, services & testing
 - Related GreenSpec CPD Seminars indicated
 - Questions and answers for each subtopic in file 10
- **Audience:**
 - Architecture Students Part 1 Year 2
 - CPD update for all levels of experience & knowledge
- **Delivery:**
 - 3 to 4 hours depending upon audience participation
 - Reading 1 hour
 - 26 subject breaks to enable subdivision

Air Movement in Buildings: 1 of 9

Sub-topics in 10 separate files

- Principles of Element Design
- Climate Change
- Wind
- Wind Tunnel Testing
- Wind Turbines
- Natural Ventilation
- Moisture Vapour & Condensation
- Thermal Insulation
- Breathing Construction
- Airtightness
- Wind & Airtightness Testing
- Building Elements
- Passive Ventilation
- Active Ventilation
- Stack Effect
- Atrium
- Solar Orientation & Solar Gain
- Conservatories
- Thermal mass
- Conduction, Convection, Radiation
- Solar Shading
- Thermal mass, Passive and active cooling
- Fluid dynamics
- Mechanical Ventilation
- Air-Conditioning
- Questions and Answers

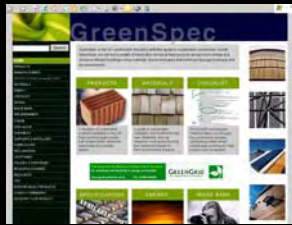


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Principles of Element Design

Performance Specification

Performance Drawings



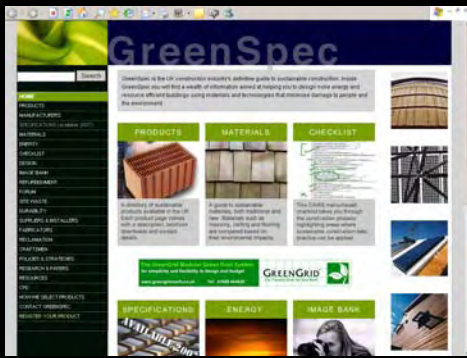
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Principles of Element Design

Performance Specification

Performance Drawings

Another GreenSpec CPD seminar to consider



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Being different

- If you want to avoid conventional construction
- you need to understand what the elements of the building will be subject to during their life
- And then design the new elements or their methods of construction to meet these needs:
- E.g. Wind, dead and live loads, weather, occupation moisture, heat flow, vapour, etc.

Rubber Facade

- If a student designs a Museum of Pornography or Sadism & Masochism (yes, one student did sadly)
- And wants a rubber external skin, pvc ceilings and walls
- There are no points of reference, so they have to start from scratch
- They need to understand the principle of element design

The criteria for success

- The aims may also be very different to conventional buildings
- The Student may want the museum to be hot and sweaty
- This is the opposite to conventional building
- a whole new set of rules apply
- these need to be explored, understood and worked with

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 AIA, Dip (Int) Archt, 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 Boverton School of Architecture, University College London, and architectural design at the Polytechnic of North London. He now works as a Consultant.

Yvonne Dean BA, Hons BA (Joint) 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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Peter Rich &
Norma Dean

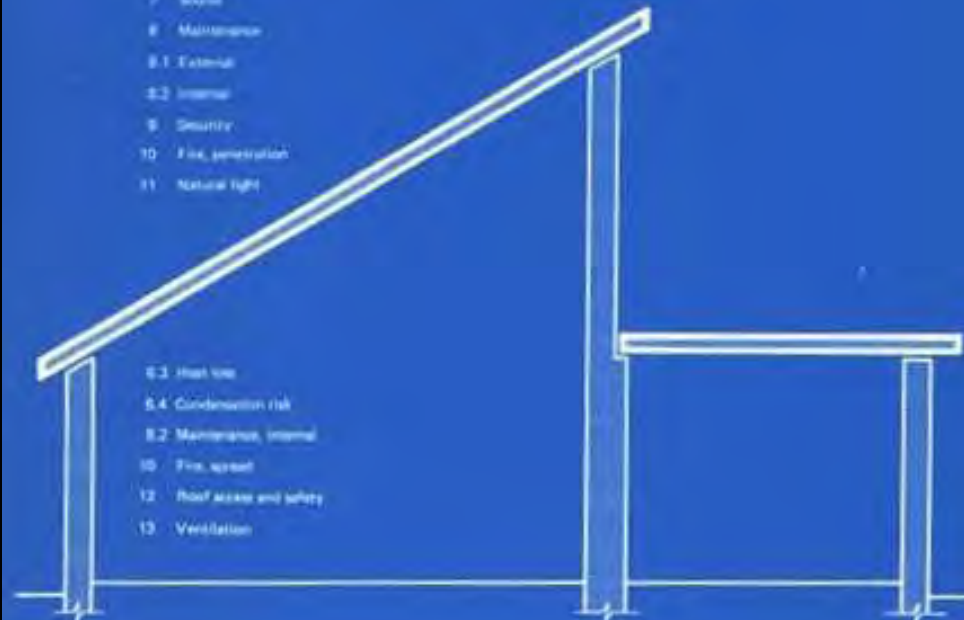


Roofs general factors

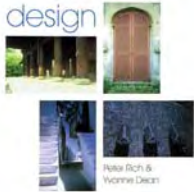
(see POED 9 and POED 10 for Flat roofs and POED 11 for Pitched roofs)

Key factors	Action	Counteraction
Gravity	Downward pull	Support
Wind	Motive force (suction), destructive, penetrative	Fixing, weathens, sealing
Rain	Moisture deposition	Deflection, impervious skin, absorption and drainage, sealing
Snow	Moisture deposition, loading	Deflection, impervious skin, absorption and drainage, sealing
Sun	Temperature variation, movement, heat gain, chemical decomposition	Movement joints, insulation, shading, insuperable materials, reflection
Dirt and dust	Infiltration, deposition, surface pollution	Repulsion, exclusion, shielding, cleaning
Chemicals	Corrosion, disintegration, decomposition	Insuperable materials, exclusion
Sound	Noise nuisance	Insulation

- 1 Roof form and type of weatherproof coating
- 2 Structural strength and stability
- 3 Weather effects
 - 3.1 Rain
 - 3.2 Snow
 - 3.3 Wind
 - 3.4 Sun
- 3.5 Dirt and dust
- 4 Drainage
- 5 Durability
- 6 Thermal performance
 - 6.1 Thermal movement
 - 6.2 Heat gain
 - 6.3 Heat loss
 - 6.4 Condensation risk
- 7 Sound
- 8 Maintenance
 - 8.1 External
 - 8.2 Internal
- 9 Security
- 10 Fire penetration
- 11 Access right



- 6.3 Heat loss
- 6.4 Condensation risk
- 8.2 Maintenance, internal
- 10 Fire, spread
- 12 Roof access and safety
- 13 Ventilation



Windows general factors

(see POED 17 for Specific factors)



A. "Hole in wall" type



B. "Slab filling" type



C. "Window wall" type

Key forces	Action	Counteraction
Gravity	Downward pull	Support
Wind	Moisture force, destructive, penetrative	Rigidity, resistance, sealing
Rain	Moisture deposition	Deflection, impervious skin, absorption and drainage, sealing
Snow	Moisture deposition, loading	Deflection, impervious skin, absorption and drainage, sealing
Soil	Temperature variation, movement, heat gain, chemical decomposition	Movement joints, insulation, shielding, invulnerable materials
Dirt and dust	Infiltration, deposition, surface pollution	Repulsion, exclusion, shielding, cleaning
Chemicals	Corrosion, disintegration, decomposition	Invulnerable materials, exclusion
Sound	Noise nuisance	Insulation

Outside

1. General purpose of window
2. Daylight
3. Sunlight
4. Glare
5. Solar heat gain
6. Sound insulation
7. Fresh air and ventilation
8. Wind-driven rain and snow
9. Privacy from overlooking
10. Cleaning
11. Security
12. Insects

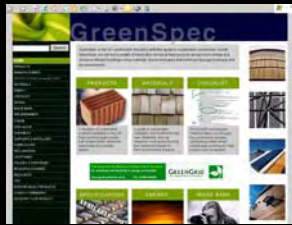


Inside

13. Views out and eye level
14. Thermal insulation and heat loss
15. Safety
16. Fire
17. Statutory window area
7. Statutory ventilation

Performance Design

- Establish the Performance requirements of the building
- Then design the elements to meet them
- E.g. What is the design life?
- This forces us to address durability
- And gives an opportunity to consider whole life costs and life cycle analysis



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Design Responsibility

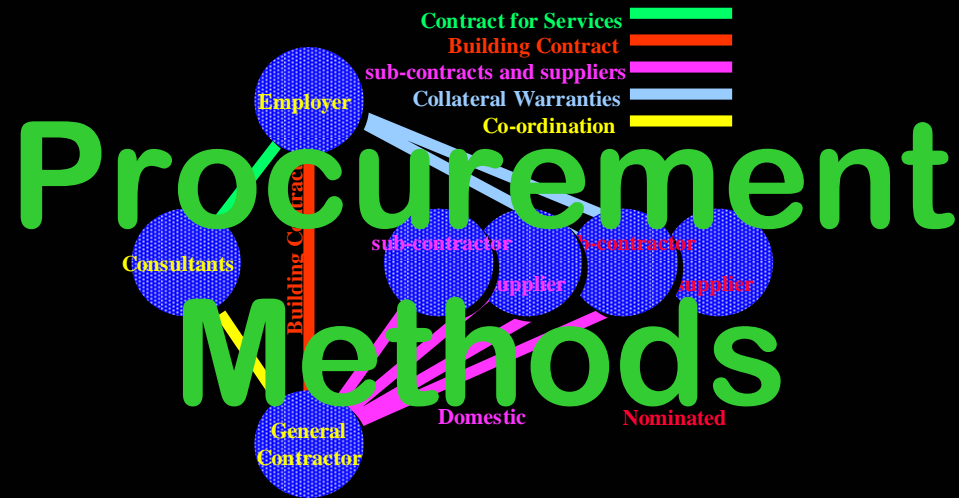
Another GreenSpec CPD seminar to consider

Performance Specification

- If the Project is Design & Build or the contract or package has Contractor's Design Portion
- The conventional designer passes the responsibility for the whole design or for completing the design
- to the 2nd party, the contractor's designer
- Its vitally important that all of the performance requirements are understood and communicated to the 2nd party
- And that the design solution is judged against them

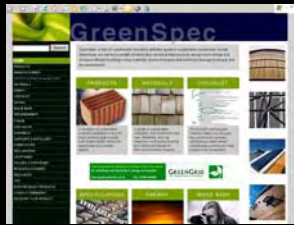


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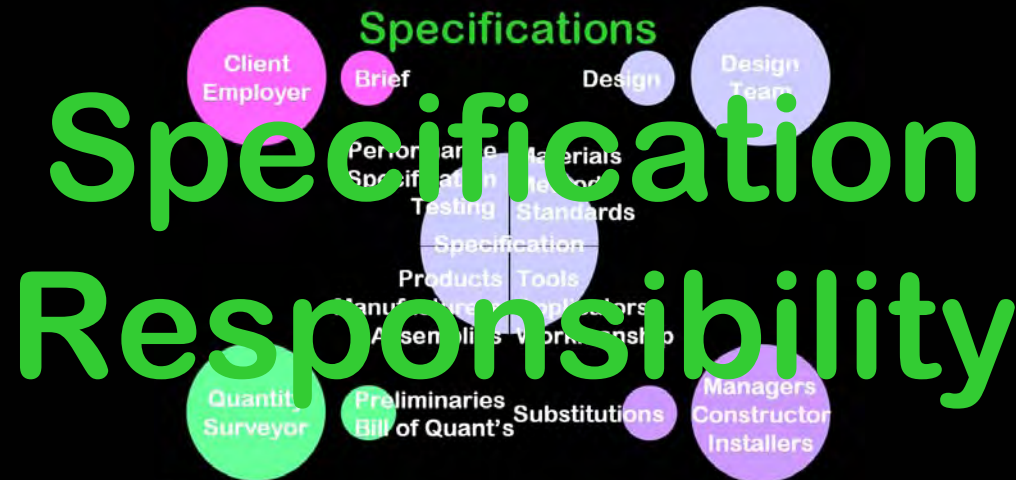


GC, D&B, MC, CM, DMC, BOOT

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Changes with
Procurement methods

Another GreenSpec CPD seminar to consider

Performance Drawings

- Just as the specifications describe principles
- drawings should not be prescriptive either
- Internal and external profiles and primary structural elements
- Movements to be accommodated, any limitations
- Abutments and surrounds
- But not materials and no construction

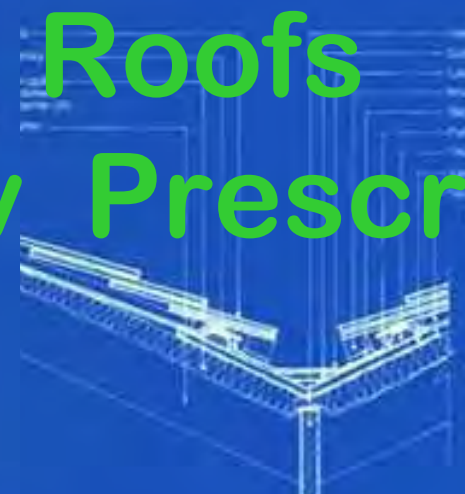
Pitched Roofs Performance v Prescriptive



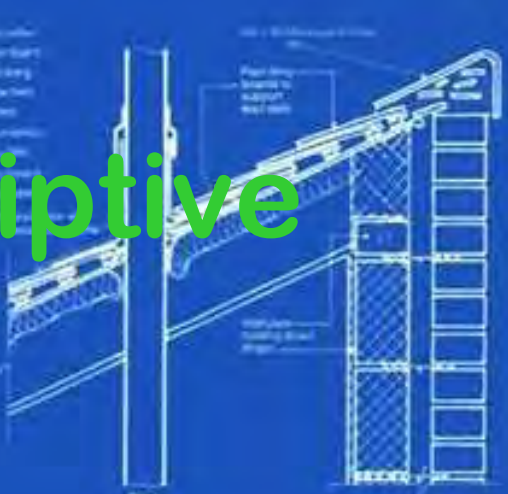
Eave



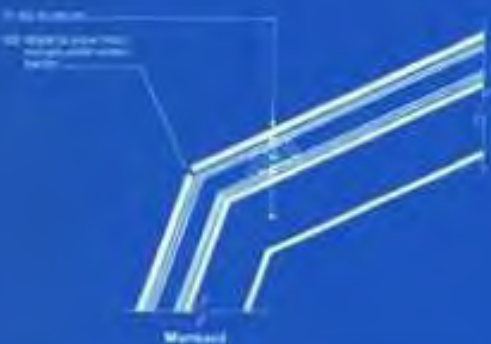
Ridge



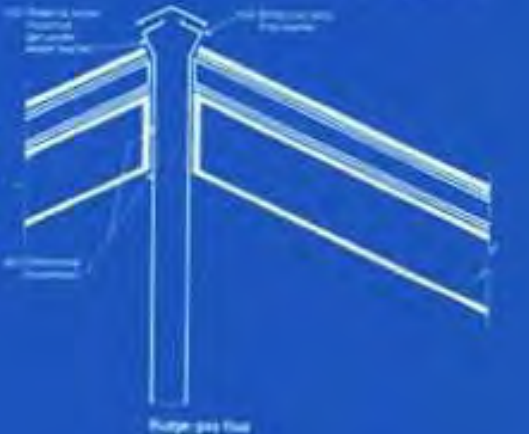
Valley



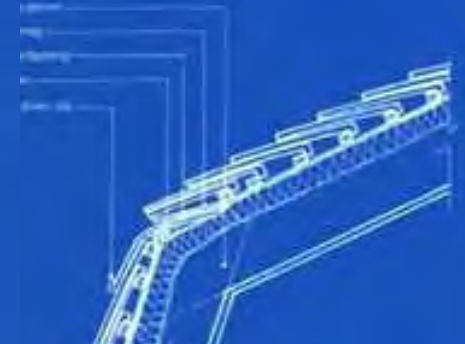
Parapet wall



Mansard



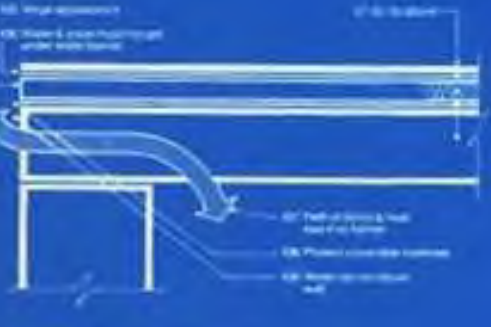
Ridge gas flue or air vent



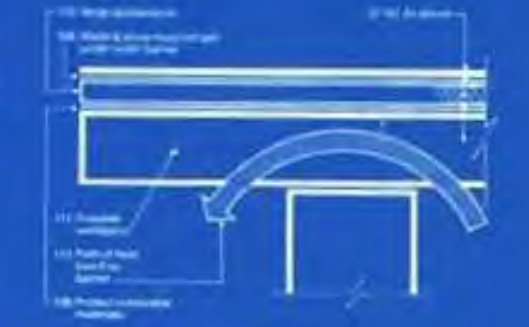
Mansard



Ridge gas flue or air vent



Standard verge (within eaves depth)



Overhanging verge (within eaves depth)



Standard verge (within eaves depth)



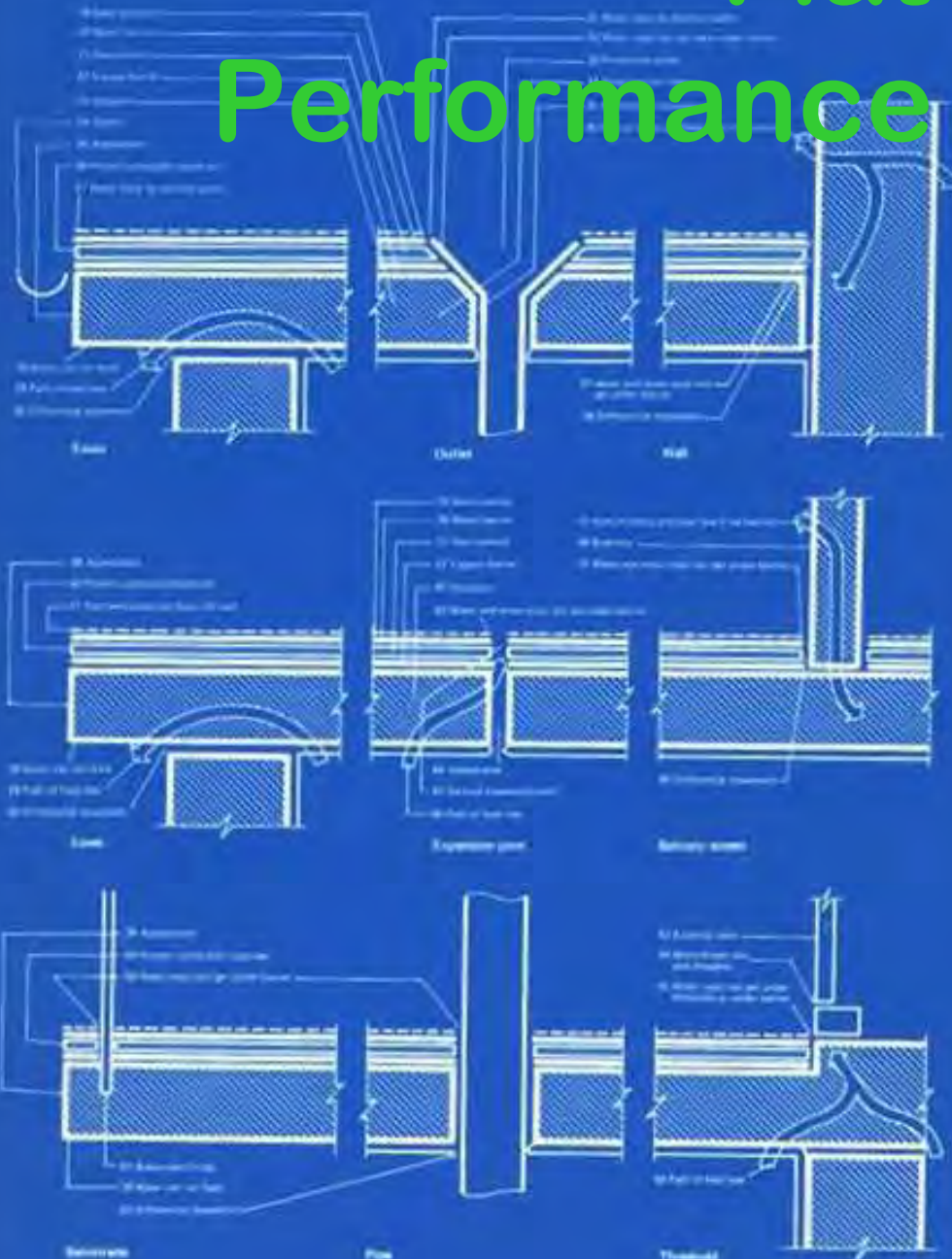
Overhanging verge (within eaves depth)



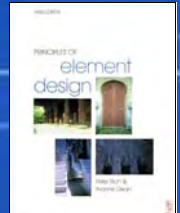
Flat roofs specific factors

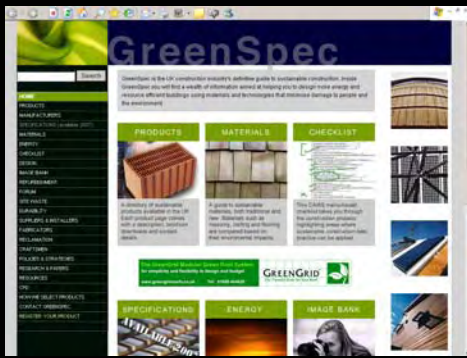
(see sheet 8 Roofs, General factors and 9 Flat roofs, Basic types)

Flat Roofs Performance v Prescriptive



Typical details





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Sustainability Checklist

On **GreenSpec** website

New Design Issues

- For most of the design professions and the construction industry as a whole
- Sustainability is completely new
- NGS GreenSpec has provided an easy starting point
- For each trade there is a list of prompts
- Avoid those, consider this, recycle these, etc.

GreenSpec Home Page

GreenSpec

 Search

- HOME
- PRODUCTS
- MANUFACTURERS
- SPECIFICATIONS (available 2007)
- MATERIALS
- ENERGY
- CHECKLIST
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- FORUMS
- SITE WASTE
- DURABILITY
- SUPPLIERS & INSTALLERS
- FABRICATORS
- RECLAMATION
- CRAFTSMEN
- POLICIES & STRATEGES
- RESEARCH & PAPERS
- RESOURCES
- CPD
- HOW WE SELECT PRODUCTS
- CONTACT GREENSPEC
- REGISTER YOUR PRODUCT

GreenSpec is the UK construction industry's definitive guide to sustainable construction. Inside GreenSpec you will find a wealth of information aimed at helping you to design more energy and resource efficient buildings using materials and technologies that minimise damage to people and the environment.

PRODUCTS



A directory of sustainable products available in the UK. Each product page comes with a description, brochure downloads and contact details.

MATERIALS

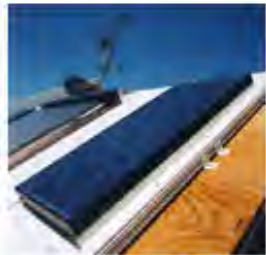
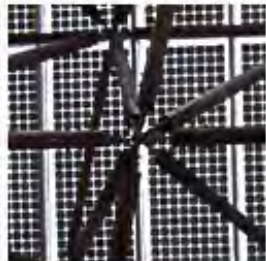


A guide to sustainable materials, both traditional and new. Materials such as masonry, roofing and flooring are compared based on their environmental impacts.

CHECKLIST



This CAWS menu-based checklist takes you through the construction process highlighting areas where sustainable construction best practice can be applied.



The GreenGrid Modular Green Roof System
for simplicity and flexibility in design and budget
www.greengridroofs.co.uk Tel: 01698 464620



SPECIFICATIONS

ENERGY

IMAGE BANK

- HOME
- PRODUCTS
- MANUFACTURERS
- SPECIFICATIONS (available 2007)
- MATERIALS
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- CHECKLIST CONTENTS:
- Specification Issues
 - A Preliminaries/General Conditions
 - B Complete Buildings/Structures/Units

U Ventilation/Air Conditioning Systems

Contents

U1 VENTILATION/FUME EXTRACT

- U10 General Ventilation Supply/Extract
- U11 Toilet Ventilation
- U12 Kitchen Ventilation
- U13 Car Parking Ventilation

U2 INDUSTRIAL EXTRACT

- U20 Dust Collection

U3 AIR CONDITIONING - ALL AIR

- U30 Low Velocity Air Conditioning
 - U31 Vav Air Conditioning
 - U32 Dual-Duct Air Conditioning
 - U33 Multi-Zone Air Conditioning
- #### U4 AIR CONDITIONING - AIR/WATER
- U40 Induction Air Conditioning
 - U41 Fan-Coil Air Conditioning
 - U42 Terminal Re-Heat Air Conditioning
 - U43 Terminal Heat Pump Air Conditioning

U5 AIR CONDITIONING - HYBRID

- U50 Hybrid System Air Conditioning

U6 AIR CONDITIONING - LOCAL

- U60 Free Standing Air Conditioning Units

U7 OTHER AIR SYSTEMS

- U70 Air Curtains



U10 General Ventilation Supply/Extract

! CONSIDER:

- Passive ventilation systems - but heat recovery is essential.
- Wind pressure driven air in and out with heat recovery is good as it avoids mechanical assistance.



CHECKLIST CONTENTS:

Specification Issues

A Preliminaries/General Conditions

B Complete Buildings/Structures/Units

C Existing Site/Buildings/Services

D Groundwork

E In Situ /Large Precast Concrete

F Masonry

G Structural/Carcassing Metal/Timber

H Cladding/Covering

J Waterproofing

K Linings/Sheathing/Dry Partitioning

L Windows/Doors/Stairs

M Surface Finishes

N Furniture/Equipment

P Building Fabric Sundries

Q Paving/Planting/Fencing/..

R Disposal Systems

S Piped Supply Systems

T Mechanical Heating/Cooling/..

U Ventilation/Air Conditioning Systems

V Electrical Supply/Power/Lighting

W Communications/Security/Control

X Transport Systems

Y Services Reference Specification

Z Building Fabric Reference

U10 General Ventilation Supply/Extract

❗ CONSIDER:

- Passive ventilation systems - but heat recovery is essential.
- Wind pressure driven air in and out with heat recovery is good as it avoids mechanical assistance.
- Passive or mechanical ventilation with heat recovery can extract heat from warm moist air to pre-warm fresh cool dryer incoming air.
- Overhead fans usually used for stirring warm air and driving it downwards may work in winter, but their use is doubtful in summer and will work against the stack effect used with passive ventilation in summer.

AIR AND WIND COOLING:

- The void below the building can be used to pre-cool the building overnight in summer through ventilation of the space or the floors themselves.

❌ AVOID:

- Passive systems without heat recovery.
- Mechanical extraction without heat recovery.



U11 Toilet Ventilation

❗ CONSIDER:

- Use wind driven air displacement systems with BedZED-type wind cowls.

❌ AVOID:

- Internal bathroom/toilets without windows/natural/passive ventilation.
- Mechanical ventilation except where smells/humidity will build up.



U12 Kitchen Ventilation

❗ CONSIDER:

- Use wind driven air displacement systems with BedZED-type wind cowls.

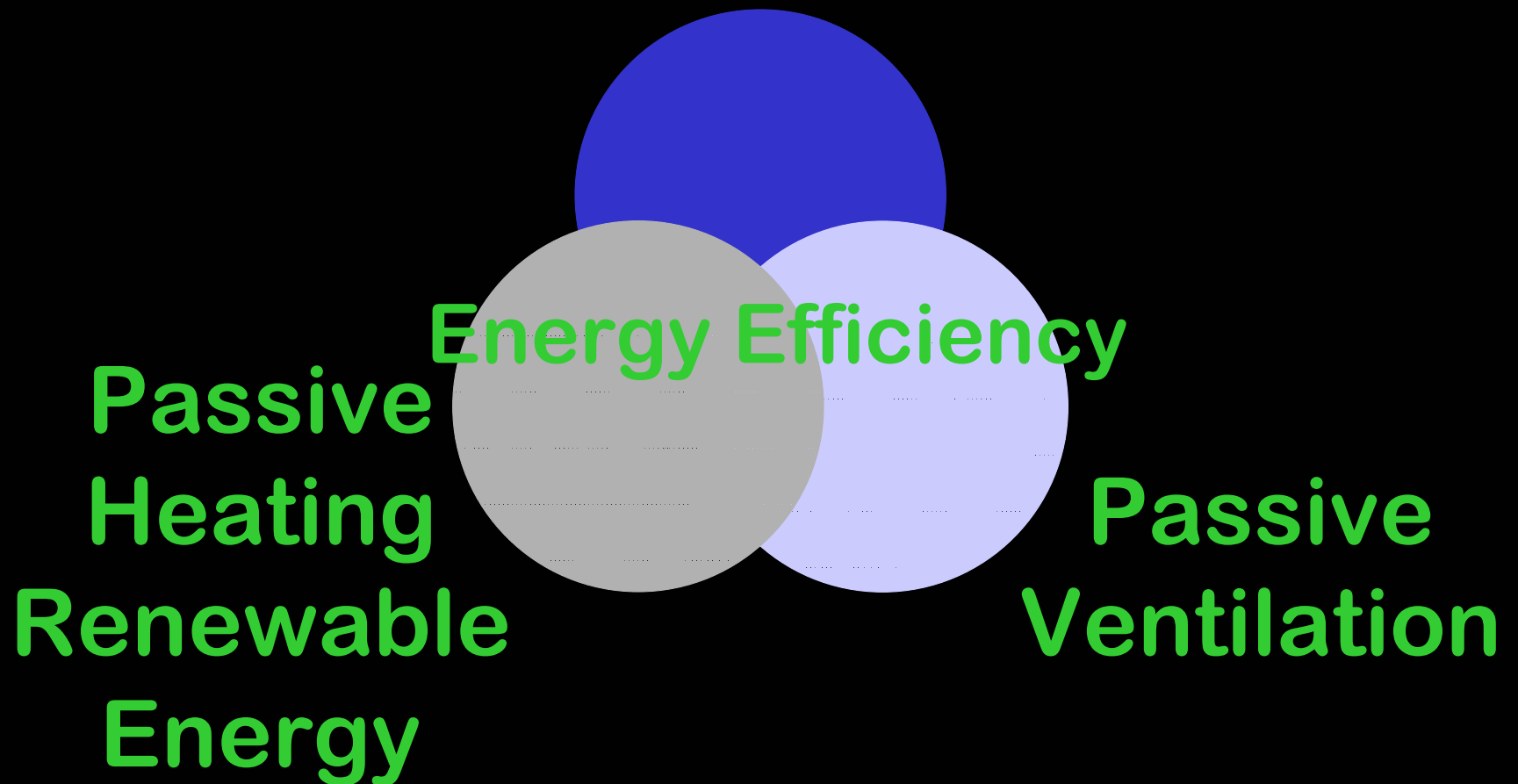
❌ AVOID:

- Internal kitchens without windows/natural/passive ventilation.
- Mechanical ventilation except where smells/humidity will build up.



Integrated design

Responsive Building Fabric



Fully Integrated Design

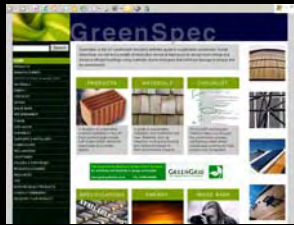
- Not only is it necessary to match up the building fabric with the method of heating and ventilation so they work well together
- Its is vitally important that the design disciplines work well individually on sustainability issues
- And that they work co-operatively towards a fully joined up design which works
- Moreover when the design works well it is vital to ensure that the designed building is constructed and not substituted or compromised by the constructor.



Integrated Design - half day seminar



- **Building Regulations Part L of the, The Sustainable and Secure Buildings Act and the Code for Sustainable Homes,**
- **Professionals are encouraged to work closely across disciplines to address sustainable construction issues.**
- **Areas such as heating, ventilation and renewable energy technologies require a cross disciplinary approach to improve the chances of success.**
- **Lucy Pedler of The Green Register key drivers for sustainable construction and the 'circle of blame'.**
- **Celia Beeson (Sustainable City Team, Bristol City Council)**
- **James Howard (Urban Splash)**
- **Architect Craig White (White Design)**
- **Engineers - Andy Jarvis (Ernest Griffiths Consulting) and Tim Mander (Integral Structural Design).**
- **Reclaimed materials resourcer Nicole Lazerus (BioRegional) encouraging contractors to break out of their usual procurement routes.**
- **Contractor Andrew Pears (Kotuku) site waste management and reusing/recycling C&D materials.**
- **Jim Allen, Ellis and Moore engineers, moderator**
- **Opportunity to contribute to the discussion in breakout sessions**
- **Delegate feedback: "More of these seminars please!" "Brilliant mix of speakers"**
- **"Avoiding the pitfalls by listening to first-hand experience was very useful" "Do it again!"**

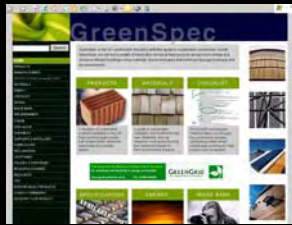


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Green Solutions Energy Efficient Design

Commercial Green
Appropriate systems

Another GreenSpec CPD seminar to consider



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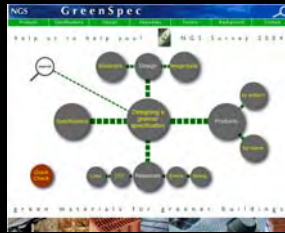
Energy Efficient Buildings Violet & Green Solutions

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© NGS 2000-7 Energy Efficient Green Buildings

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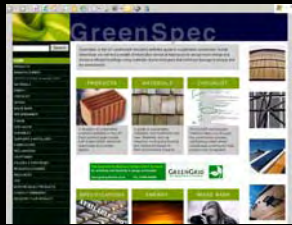
Specification Substitution

Case Lore, practices & pitfalls

Another GreenSpec CPD seminar to consider

Commercial Green

- Currently there are many technologies that are well understood but many are no longer suitable to tackle global warming
- We need to adopt new methods that are sufficiently well developed that their prices have reached commercial levels
- Some technologies are still immature and their prices reflect this
- Commercial Green is about finding the solutions that are for free:
 - e.g. natural ventilation and solar gains
- economic now:
 - e.g. Ground Source Heat Pumps & Solar Thermal hot water
- But not Photovoltaic: for some time yet unless an off-grid application.



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Commercial Green

© Andrew Pettifer
Gifford and Partners

Another GreenSpec CPD seminar to consider
And a paper on the website to read



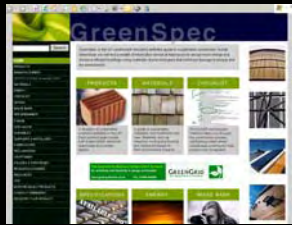
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Energy Refurbishment

Public and Private Housing
Industrial & Business Premises

Reduction in demand
Appropriate Improvements Appropriate
Commercial Installations

Another GreenSpec CPD seminar to consider

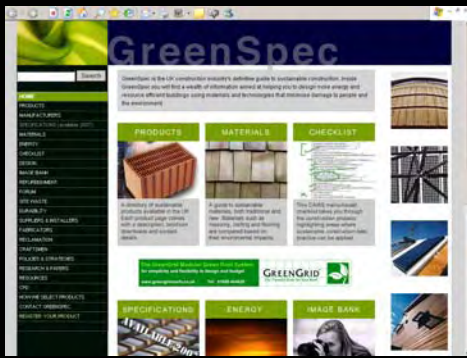


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Extreme Energy Refurbishment

Emphasis on Energy

Another GreenSpec CPD seminar to consider



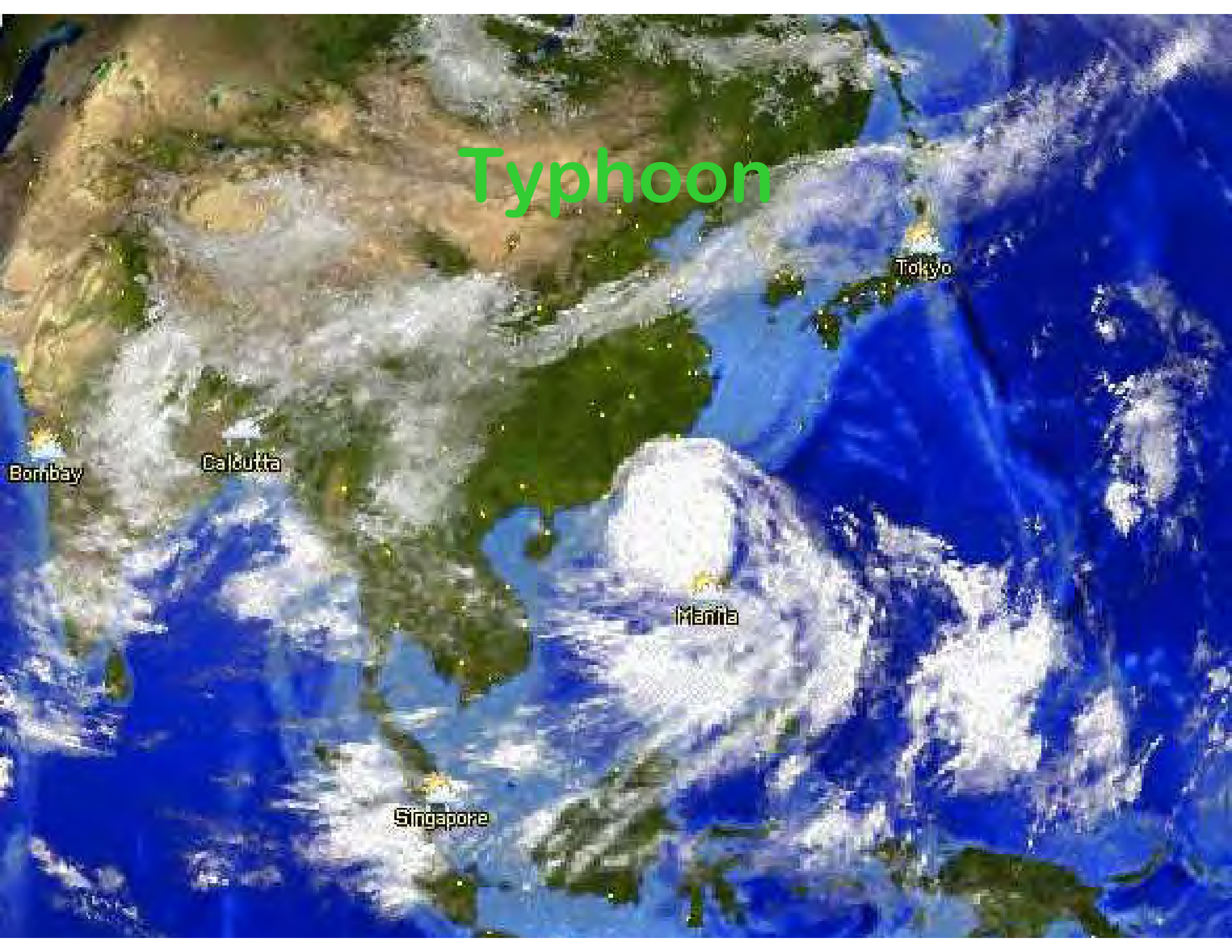
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Climate is Changing

Weather



Typhoon



Tokyo

Calcutta

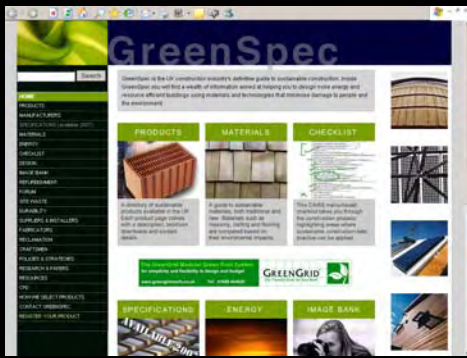
Bombay

Manila

Singapore

Hurricanes & Tornadoes on land
Hurricanes & Typhoons at sea
Can be very destructive

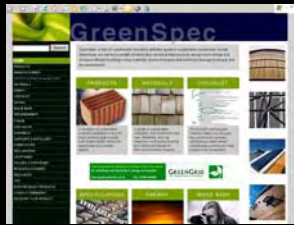




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Climate Change

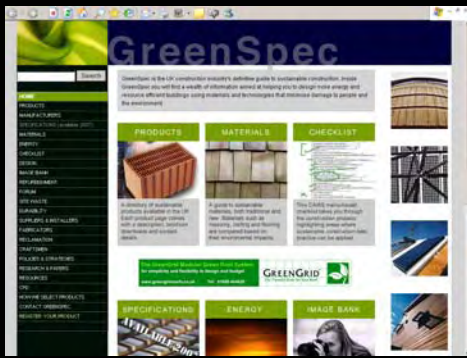
- As the climate changes it is anticipated that all nature's forces we are familiar with will become more extreme:
- Stronger winds, dryer summers, wetter winters, more intense rainfall, etc.
- We need to design accordingly but also to try to mitigate the changes



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From Global Imperative To Material Choices

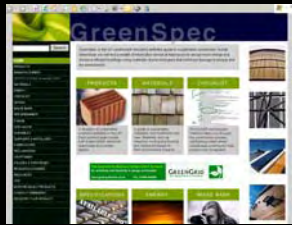
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Global Warming

- The consequences are already showing up on a regular basis, not just across the world, but increasingly in Europe and the UK.



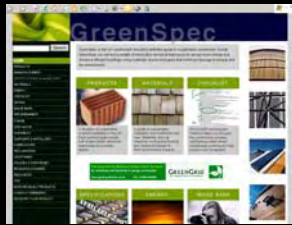
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Consequences of no action

Another GreenSpec CPD seminar to consider

Future Proofing

- Reliance on fossil fuels which release carbon dioxide and other green house gasses is futile
- Multi-fuelled boilers that can change over to biomass and bio-diesel fuels as they become available is okay
- Making provision for the addition of renewable heat and energy generation will make their addition feasible and economical
- Not being reliant on the need for heating and cooling at all is better still



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Climate Change Readiness

Future Proofing

Another GreenSpec CPD seminar to consider

Test Yourself Part 1

- When would Performance Drawings be appropriate?
- How will climate change affect the elements that affect buildings?
- What things can be done to future proof buildings against climate change?

How did you do? Part 1

- In Design and Build or when the specialist subcontractor has to complete the design
- We can expect to see more extreme wind and weather patterns in the future
- Use of multi-fuel boilers and avoidance of need for heating and cooling

Air Movement in Buildings: 1 of 9

Sub-topics in 10 separate files

- Principles of Element Design
- Climate Change
- Wind
- Wind Tunnel Testing
- Wind Turbines
- Natural Ventilation
- Moisture Vapour & Condensation
- Thermal Insulation
- Breathing Construction
- Airtightness
- Wind & Airtightness Testing
- Building Elements
- Passive Ventilation
- Active Ventilation
- Stack Effect
- Atrium
- Solar Orientation & Solar Gain
- Conservatories
- Thermal mass
- Conduction, Convection, Radiation
- Solar Shading
- Thermal mass, Passive and active cooling
- Fluid dynamics
- Mechanical Ventilation
- Air-Conditioning
- Questions and Answers