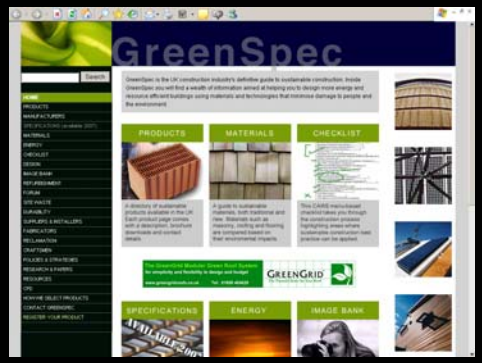


COMMENDED
The UK eWell-Being Awards 2004
www.sustainit.org

National Green Specification

www.greenspec.co.uk

Air movement in & about buildings 3 of 9 + Q&As

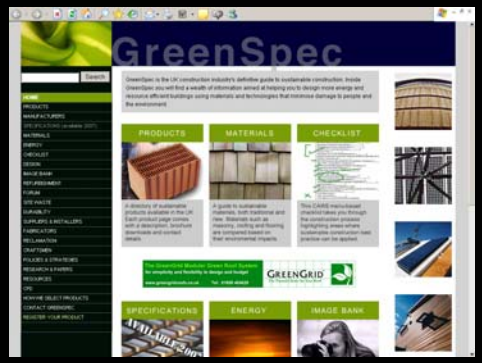
 CPD in 10 parts

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: 3 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



National Green Specification

www.greenspec.co.uk

Natural Ventilation

using wind & air movement

External Wind loading

- Prevailing wind direction and magnitude
- Wind driven rain index (rain carried in wind)
- External pressures on elevations:
  - +ve & -ve
- For every action there is an equal and opposite reaction
- Internal suction correspond to external pressures and visa versa

Internal Wind Pressure Buffeting

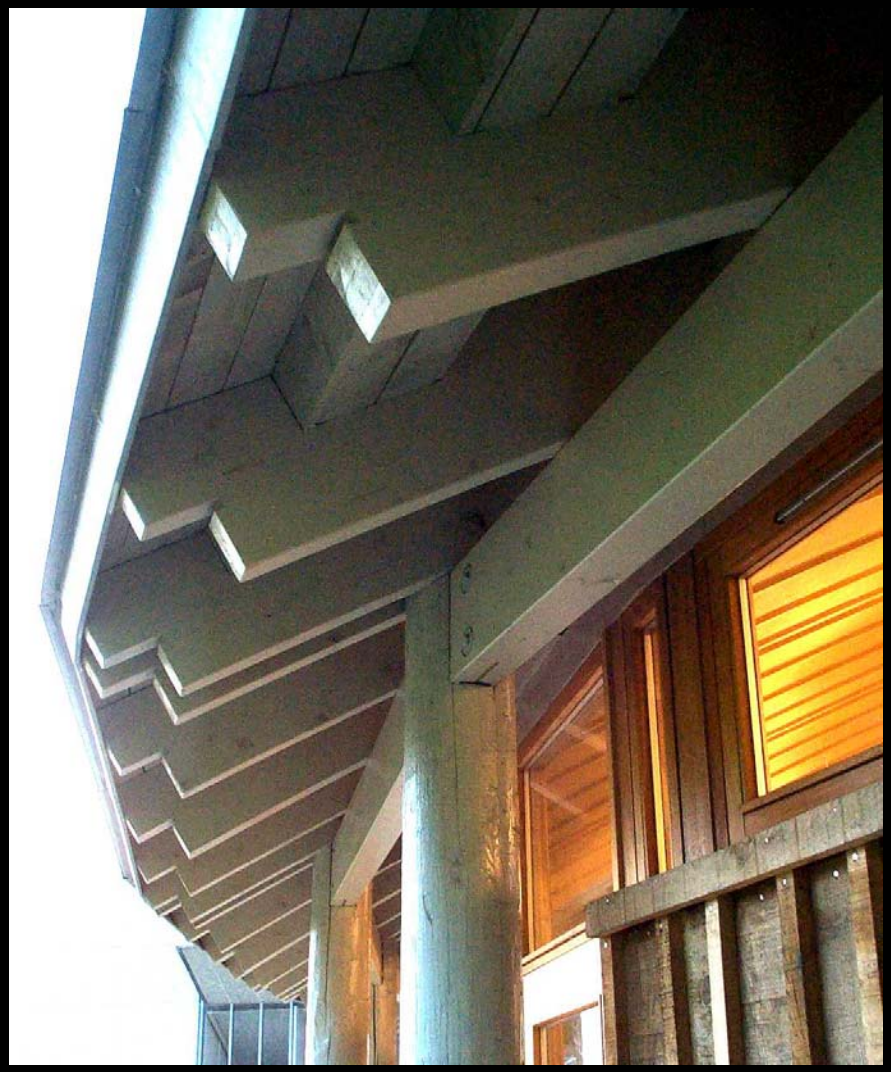
- Internal pressures on walls and partitions
- Doors shutting in breeze, bang into frame, force held by walls
- Stability posts in tall slender walls
- Wind posts in internal and external walls
- Air leaky joints around posts
- Waste of cut blockwork either side

Deliberate Ventilation to rooms

- UK By-Laws (in the past)
- To Control humidity
  - Airbricks & hit/miss grilles (close/open)
  - Into Larders (food stores)
  - Into habitable (living and bed) rooms
  - Into Kitchens, WCs, lobbies and Bathrooms
- To supply combustion air to fires
  - Airbricks

Ventilated cavities

- Traditionally construction ventilated to avoid condensation
- Flat Roof void
- Attic space
- Ground floor voids under timber floor
- Cavity walls: Weep holes and Air Bricks
- Control humidity and moisture content of materials around the cavity



Layered Construction: Simplifies details and avoids interfaces: Ventilation zone above insulation. Don’t puncture Damp proof membrane, Gas proof membrane, Vapour barrier, Breather membrane & Air tightness layer. Add services zones to avoid complications

Aberystwyth Arts Centre: Architect: Smith Roberts: Peter N Roberts

Moisture in materials

- The air is full of spores and pollen from fungi and plants
- They land on surfaces or materials
- If the Relative Humidity (RH) of the air is high the moisture content of those materials may rise
- Timber above 20 % moisture content is at risk of the spores growing on the surfaces
- Once growing the spores turn to fruiting bodies feeding off the timber
- Timber in buildings is not vigorously living, nature does not like waste so it tries to reduce the dead timber and return it to nutrients for nature

Moisture and Health

- Those same spores create mould on surfaces of absorbent materials that are kept moist
- Mould releases more spores which can affect the respiratory system in humans
- Unventilated bathrooms, showers and bedrooms are prone
- Ventilation is important and it can solve many ills

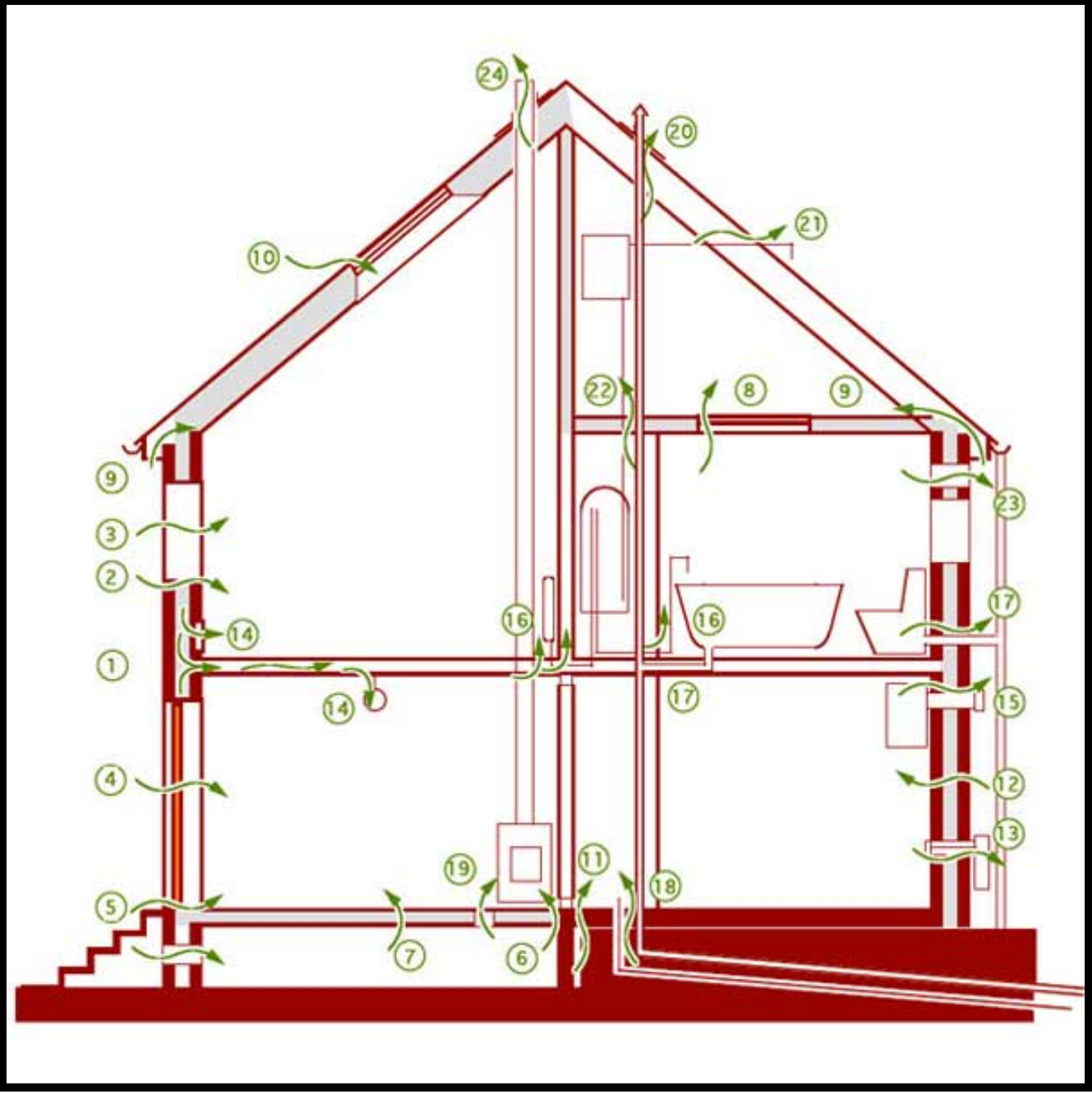
Ventilation today

- In addition to ventilating moisture today we have other issues
- We use so many synthetic materials, adhesives, finishes and cleaning agents in buildings today
- They off-gas chemicals into the air which can affect air quality and health
- Sick Building Syndrome is one result.

Leaky construction

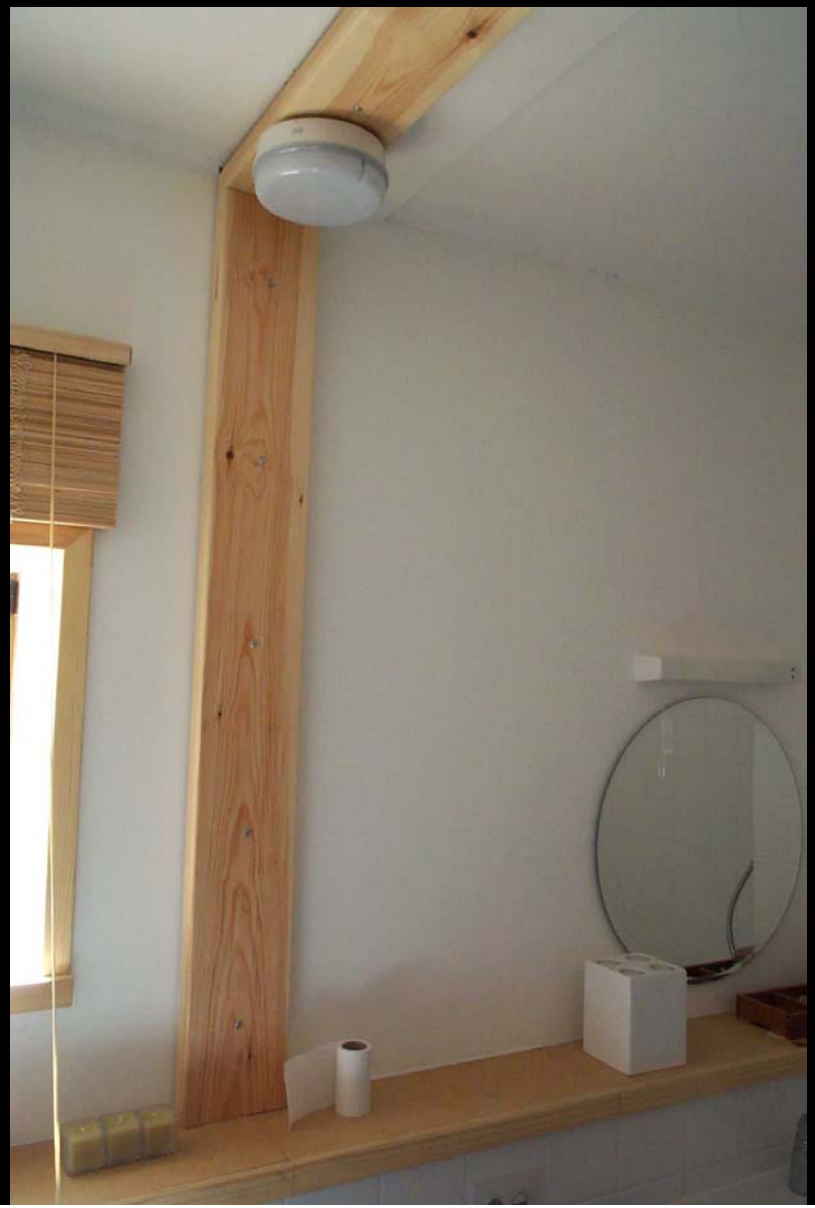
- Cavity wall construction (open perpends)
- Plasterboard dry-linings to walls and ceilings with cavities behind
- Plasterboard and metal or timber stud partitions
- Decorative linings to walls
- Cladding to external walls
- Tiled and slated roofs (but sarking boards in Scotland, sarking felt in England)

Leaky Buildings



Surface mounted service ducts:

Use hollow skirting, dado & services cover
But form a pathway for air leakage.



Traditional method may be more airtight but:

Avoid chasing masonry

Avoid noise

Avoid masonry dust

Avoid exclusion zones

Avoid waste materials

Avoid conduits

Avoid Rendering-in

Avoid Plastering over

Brownfield site ventilation

- Methane from biodegrading organic waste in backfill
- Petro-chemicals from prior use
- Hydro-carbons from prior use
- Ventilated cavity below buildings allow removal before entry into building
- Gas Proof Membrane in floors
- Often combination Damp Proof Membrane
- Cigarette smokers must take care with stubs
- Methane is combustible


Brownfield gas ventilation boards

Radon Ventilation

- Radio-active granite e.g. in west country
- Releases radioactivity into air
- Ventilated cavity below buildings allow removal before entry into building
- Radon Barrier: Gas Proof Membrane in floors
- Often combination Damp Proof Membrane

Combustion Air: Fire Places

- Victorians designed leaky buildings to provide combustion air to open fires
- The heat of the fire draws air up chimney and draws fresh cold air in through doors, windows and airbricks
- Chimneys include a throat, a narrowing of the flue above the fire which causes the warm air to pass through the narrowing at higher speed than the flue above
- Know as the Venturi effect it is an effective measure to prevent back draft pushing smoke back into the room

Combustion Air: Boilers

- Air demand is known from boiler manufacturer data
- Air bricks or louvres or gap under doors
- Additional air bricks to ventilate the room, inefficient boilers loose heat to the room
- Some flues radiate heat to the room
- Walls between Plant room and other room are effectively external walls, insulate accordingly

Build-tight ventilate-right

- Do not build leaky buildings to prevent humidity build up and condensation
- This will only squander heat energy uncontrollably as well
- Do build airtight buildings and then purposefully ventilate them in a controlled way
- Choose passive or active ventilation over mechanical and air-conditioning

Design of Barriers

- We design Damp proof membranes (DPM), Damp proof courses (DPC) & their junctions
- We specify vapour barriers (VB) but fail to detail them and fail to police them on site
- We fail to design airtightness layers (ATL) and its many contributing materials, layers and junctions
- We need to red line the VB/ATL on drawings
- We expect our inadequacies to be corrected by the builder
- Actually don’t think about it

Workmanship: often poor

- Buttered, tip and tailed joints in masonry
- Inaccurate cutting of insulation materials
- Inaccurate fitting of insulation materials
- Gaps in insulation, around edges and abutments
- Unsealed laps in barrier sheets
- Incomplete seals in laps
- Missing barrier sheets
- Wind damaged barrier sheets
- Punctured barrier sheets
- Service penetrations not resealed

Locational Assembly: oversized compress, offer up & release

- If rafter spacing and insulation size correspond
- No waste
- Do they?

Airtight construction

- Wet trades often are
- External Render
- Internal Plaster or plaster skim on board
- Parge Coat (British Gypsum Ltd. have one)
- Insitu Concrete
- Vapour Barriers in timber construction (can be)
- Airtightness layers (new to industry)

Open Materials

- Open cell glass and rock mineral fibre insulation
- No fines concrete blockwork (open interstices)
- Rainscreen Cladding (open joints)
- Gabion walls & Dry stone walling (linked interstices)
- Straw bale walls (high-setting on harvester)
- Permeable pavement (oxygen for microbes)
- Butted floor boards and loose T&G boards
- Micro-porous paints and stains
- Breather Membranes
- Breathing sheathing boards

Open materials/construction


Gabions
using new
bricks 3
colours and
random
Retail development
Gateshead

Adobe, Welwyn Garden City Proctor & Matthews Gabion Walls

www.greenspec.co.uk

Gabions Trapions & Matresses

D41 Crib walls/Gabions/Reinforced earth
Construction & Materials

Another GreenSpec CPD seminar to consider

Rainscreen

- Rainscreen cladding works on the principle that the outer layer of cladding catches most of the wind and rain
- The open joints permit some air and rain to pass through
- a second line of defence a Damp Proof Membrane over the wall surface
- Stops the rain and wind wetting the wall


Rainscreen
cladding

Open Joint Weather boarding using Rainscreen principles breaks up the pressure of the wind on the glazing behind

Earth Centre Doncaster

Pressure Equalisation

- Rainscreen cladding benefits from the principle that air passing through the joints will fill the void behind, build up pressure and then bounce back out
- Following air and rain will meet the air bouncing back out through the joints
- Less air and rain will pass through the joints and reach the rear wall

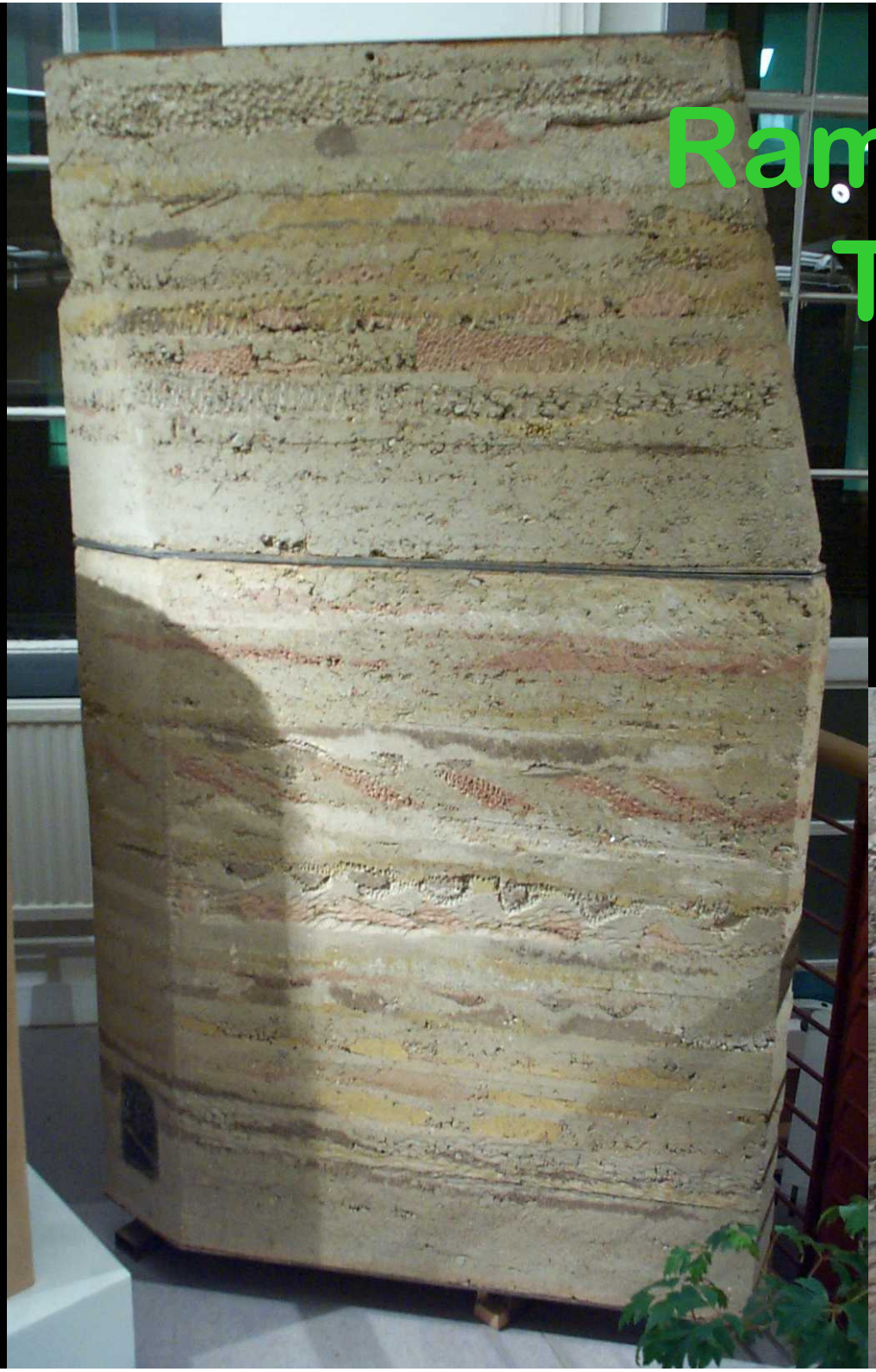
Pressure Equalisation

- Curtain walling can adopt the same principle where it has open drain holes to remove rain and condensation
- Pressure equalisation will occur when air entering one hole will push air out through other holes
- Some window manufacturers rely on air pressure entering the deep recess around the window to bounce air back to deflect further air entering the recess, avoiding the use of sealants

Pressure equalised doors invented for towers with high pressure winds at ground level

Closed Materials (potentially airtight)

- Structural Glass Assembly sealant jointed
- Metal sheet cladding
- Aircrete concrete blockwork (Closed cell matrix)
- Hemp-lime (but micro-porous fibres)
- Rammed earth walls
- Tongue & Groove Jointed boards
- Oil Paints (skin forming)
- Vapour barriers
  - Polyethylene e.g. polythene
  - Aluminium



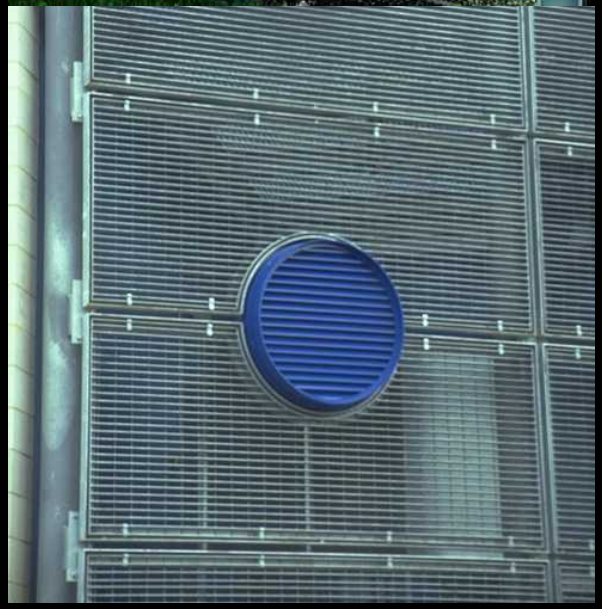
Rammed Earth walls: Thermal, acoustic & moisture mass Closed material

At Construction Resources

Rammed Earth walls: Chalk & Flint

Pines Caryx Conference Centre Dover

Closed glass balustrade
Offers view and wind shelter.



Open Mesh offers view but little protection from wind

Greenwich Millennium Village and Oxford Science Park Architect: Proctor Matthews

Test Yourself Part 3

- Name some advantages of layered construction related to ventilation
- What is Venturi Principle?
- What are we trying to remove that relates to Sick Building Syndrome?

How did you do? Part 3

- Clear ventilation zone, uncomplicated eaves detail
- A narrowing in a flue which speeds up the air flow to resist air being blown back down
- Off-gassing from synthetic materials finishes and cleaning fluids

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