Energy Efficiency for Historic Buildings

October 2009

Existing Building Survival Strategies

Mike Robinson

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Previous experience

- 26 years with Arup
- Many historic, listed and heritage buildings
- Work in NW, Yorkshire and overseas
- Prime mover in AIRR network
- Existing buildings survival strategies

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Question?

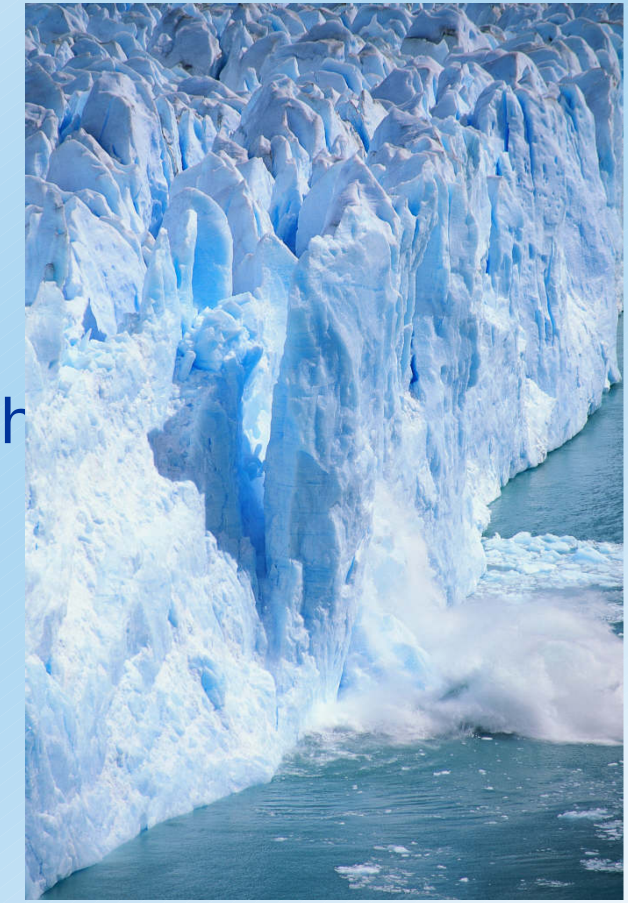
- Why we need to consider climate change
- What we can learn from our experiences
- Existing buildings survival strategies
- Interventions

Why we need to consider change

Climate change issues

Why we should act

- Climate Change
  -floods –Singapore
  - ice melt –polar thinning
  - dust storms –Sydney
  - rising seas –Bangladesh
  - floods - Philippines



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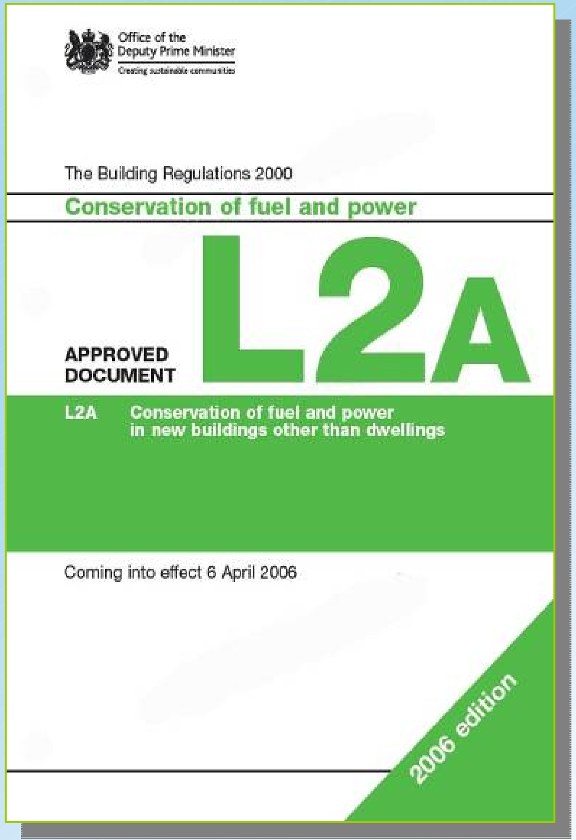
Why we should act

- Because we have to?



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What can we do

- Reduce consumption of fuel
- Conserve energy
- Make appropriate changes

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Carbon Production

- Main players are for example, planes, ships, power, personal transport, cows, etc.
- Historic Buildings play small part in global warming?
- But, no reason not to act

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The people factor

- The good old days

  -one warm room
  -appropriate clothing
  -a bit tougher !!

- 20th century softening

  -Central heating
  -Air conditioning
  -Increased mobility
  -Demand for goods and value

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Learning from our experiences

Projects and key issues

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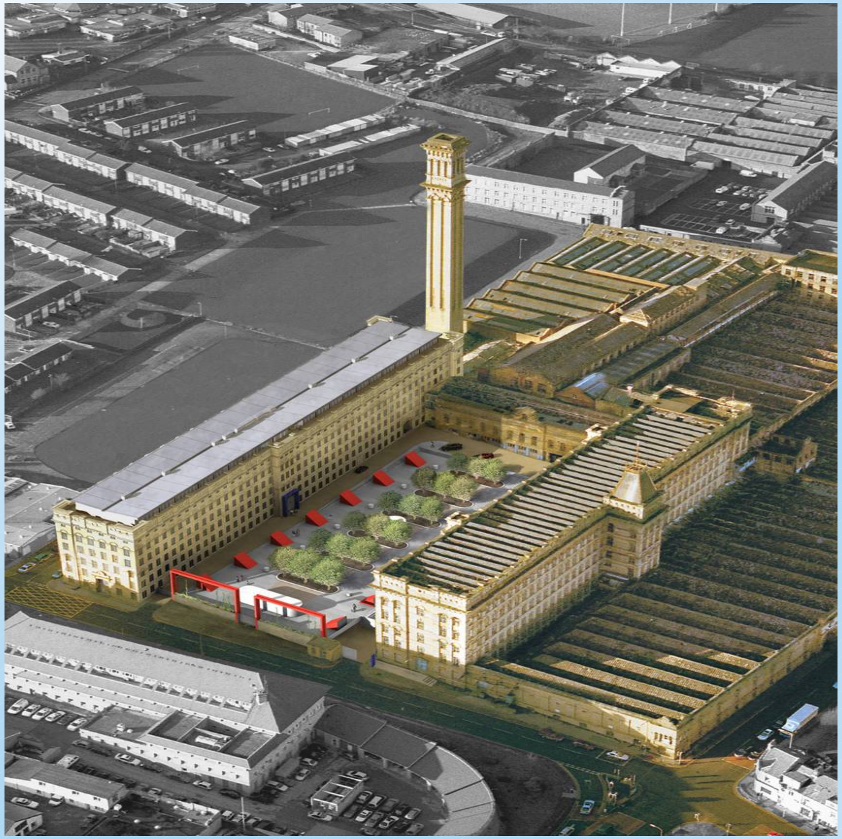
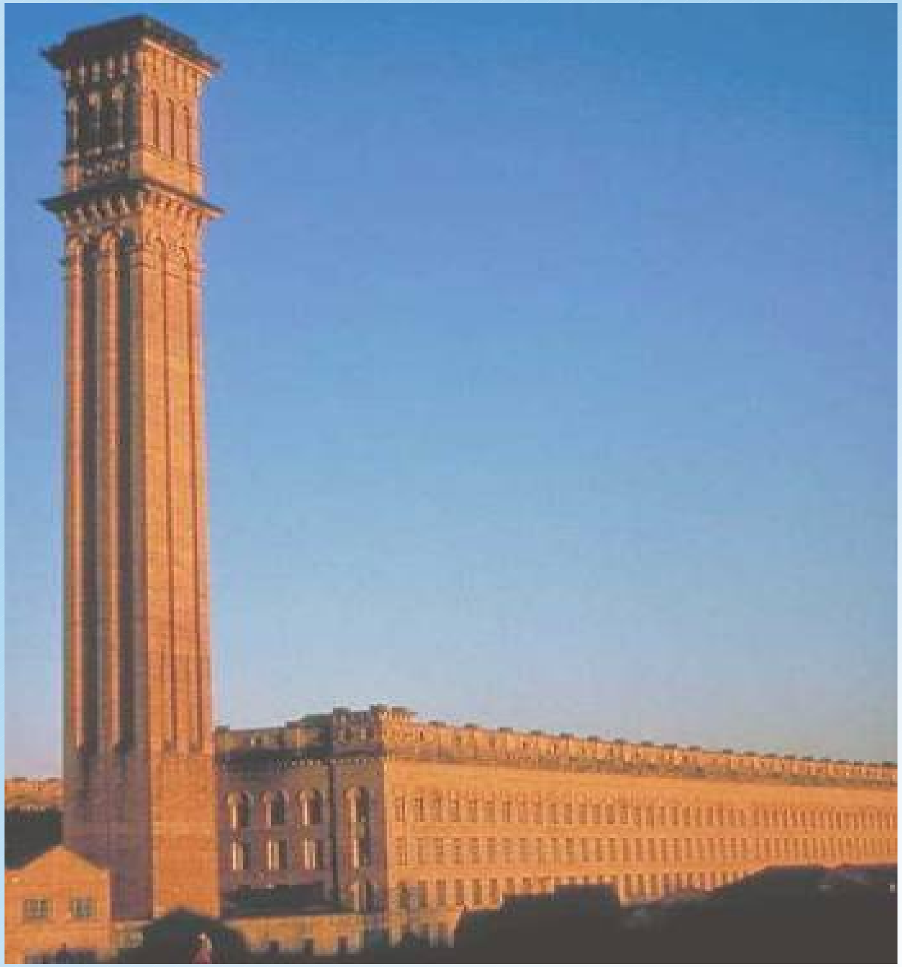
Projects and key issues

- Manningham Mills





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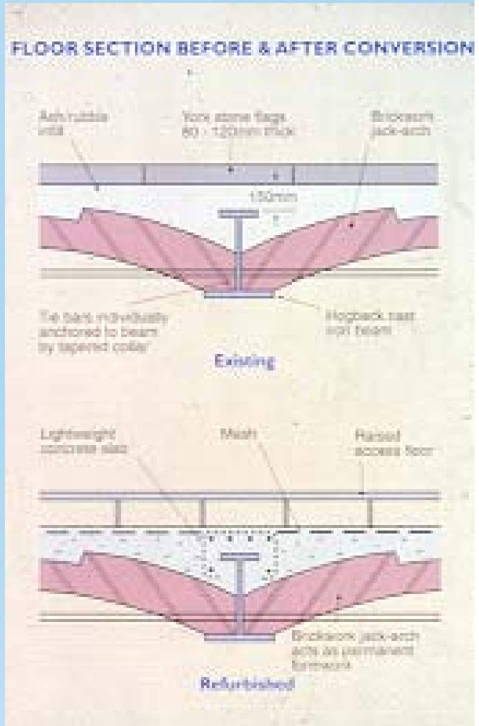
Projects and key issues

- Huddersfield West Mill

Projects and key issues

- Huddersfield West Mill



Projects and key issues

- Great Northern

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Projects and key issues

- CIS Building

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Projects and key issues

- Manchester Art Gallery

Projects and key issues

- North Manchester 6th Form College

Projects and key issues

- North Manchester 6th Form College-Phase 2

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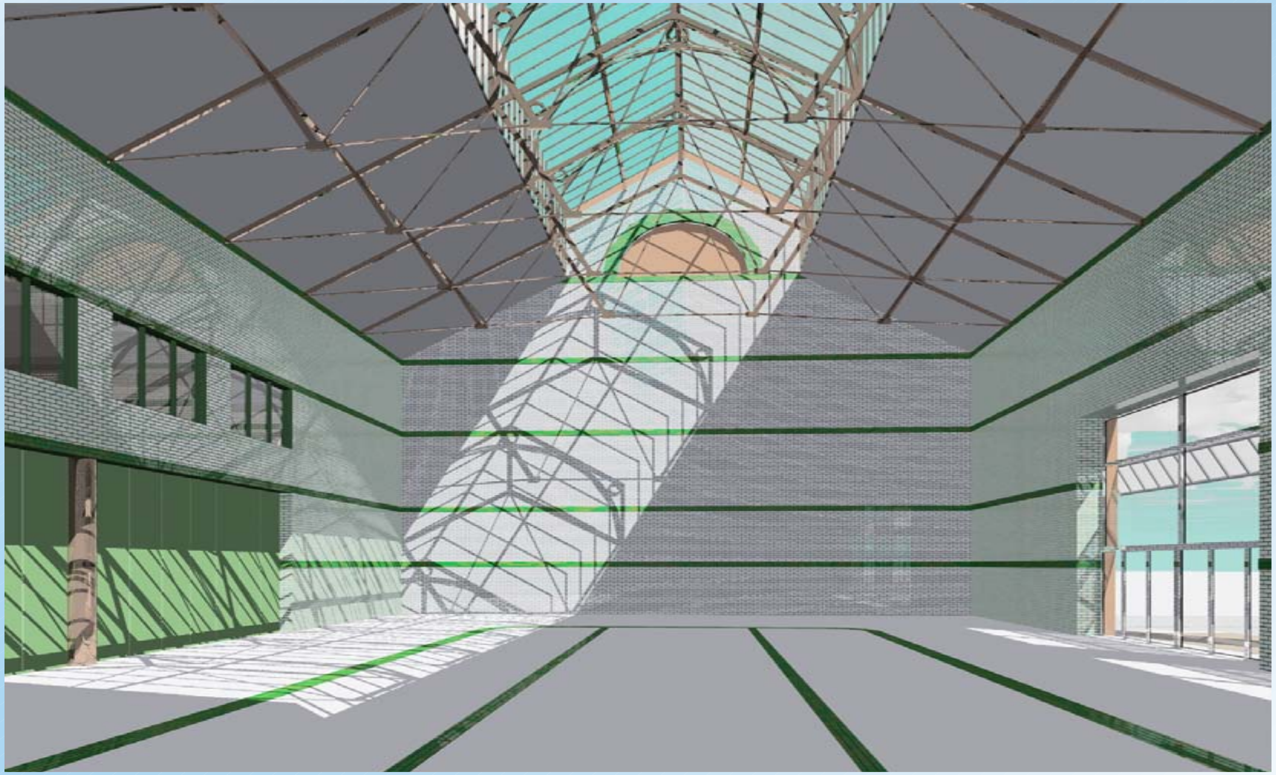
Projects and key issues

North Manchester 6th Form College-Phase 2

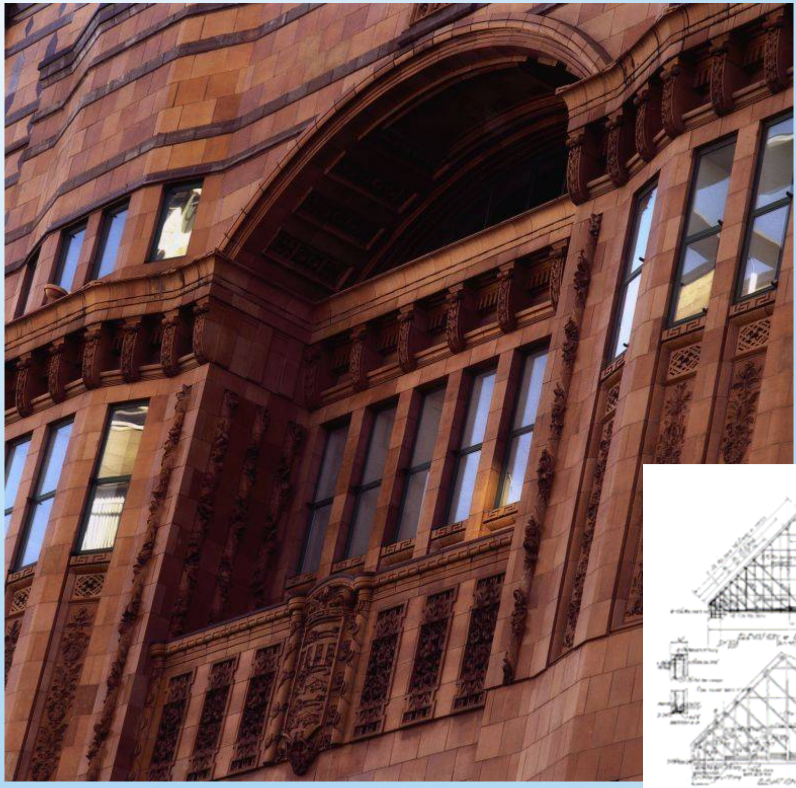


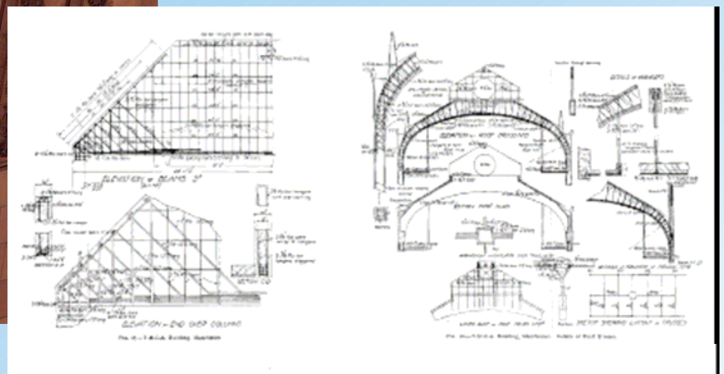
Projects and key issues

- Devonshire Royal Campus

Projects and key issues

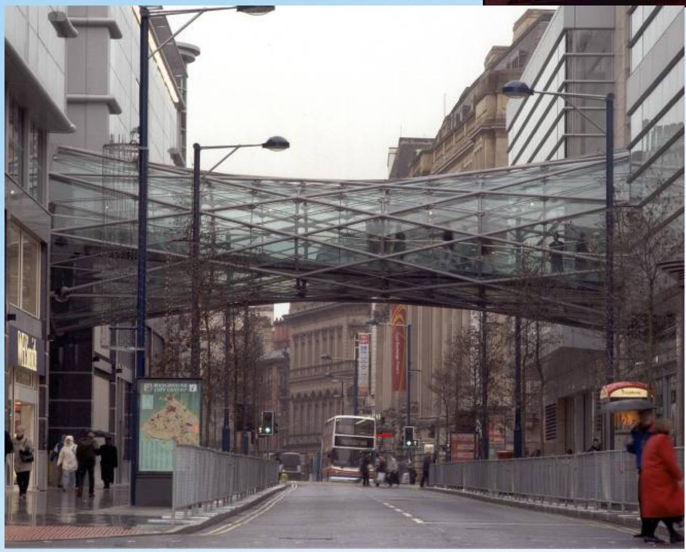
- St Georges - YMCA





Projects and key issues

- Manchester Arndale Centre



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Projects and key issues

- Wycoller Visitor Centre

Projects and key issues

- Town Hall Santa

Existing Buildings Survival Strategies

EBSS

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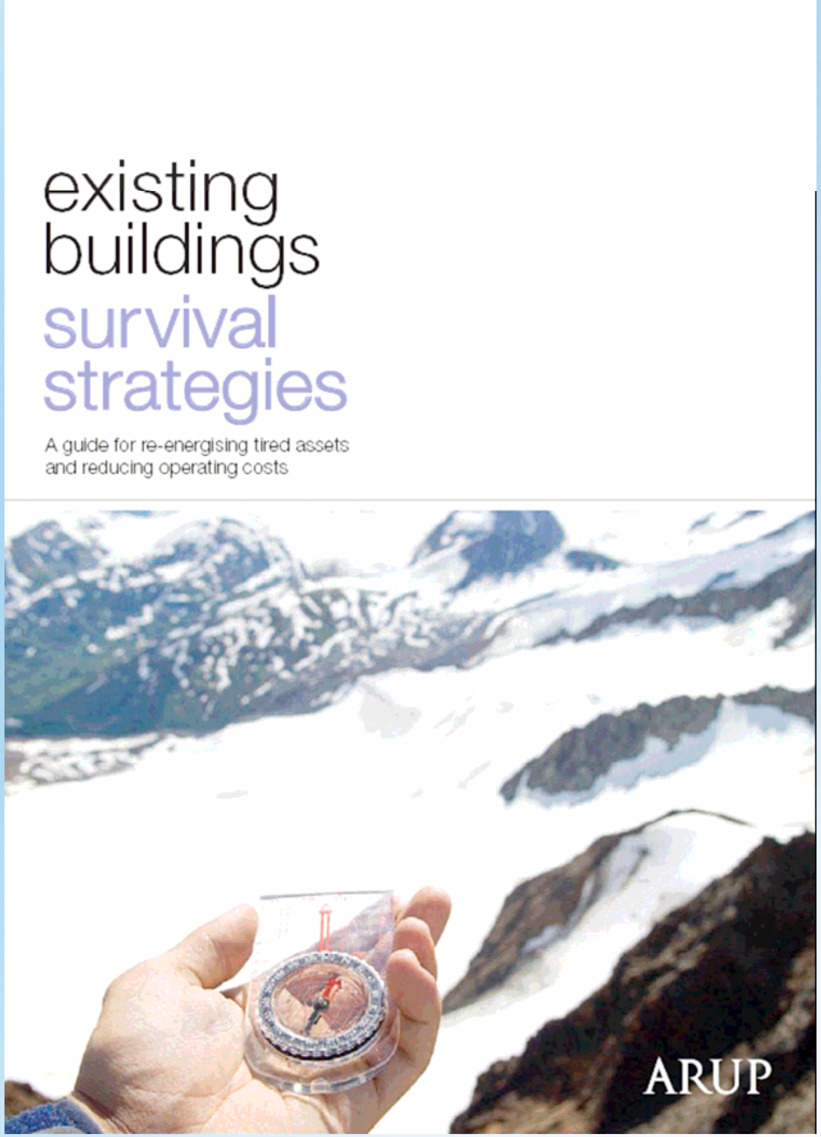
EBSS

- Existing Buildings Survival Strategies (EBSS)
  - Arup Initiative
  - Australia first
  - Based on commercial and contemporary buildings.
  - Based on common sense



EBSS

- 5 stages
- 3 levels of intervention
- Measure of effect, energy, costs, feelgood

EBSS

- **The 5 Stages**

(i) Review the building performance and decide if interventions are required.

(ii) Measure the building performance , energy rating, costs of running, people factors etc.

(iii) Set targets for where you want to be.

(iv) Select the Interventions, Arup document has around 200.

(v) Do it ! Then review and compare to predictions

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EBSS

- **3 levels of intervention**

(i) low level, low cost – little disruption

(ii) medium level ,higher cost – some localised disruption

(iii) high level, high cost – almost certainly requires cleared building

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EBSS

- Applicability to historic buildings
- Create schedule of interventions
- More appropriate acknowledgement of reusing buildings BREEAM scores

Interventions

Interventions

Measure changes

- Energy
- BREEAM
- CEQUAL or others
- (Pound symbol)#
- Image and profile
- Increased usage

Interventions

PILKINGTON
NSG Group Flat Glass Business

- Glass and glazing

NSG
PILKINGTON
Nippon Sheet Glass Spacia
Energy effic

About SPACIA®
Who invented SPACIA?
Summary

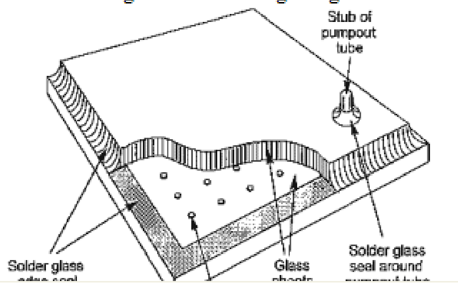
SPACIA®
Technical information
The principle
Benefits
Condensation free
Sound reduction
Thin and light window
Products specification
Warranty,Precaution

SPACIA-21
About SPACIA-21
Performance

The principle

Conventional IG unit consists of two parallel panes placed 6-
spacing gap between them is filled with a dry gas. The edge
made with an organic sealant. The gas enclosed in this space
reduces heat transfer through the glass for its low thermal co
However, in vacuum glazing SPACIA extremely high therm
expectable by minimized heat flow due to the conductance a
mm vacuum spacing gap between two panes, and by the rest
radiationenergy using Low-E glass.
Furthermore, for long term safety of glass, SPACIA is desig
resist the force of atmospheric pressure applied to ita panes.

Figure1:
Schematic diagram of vacuum glazing.



Figu
struc
pillar
mm
diam
pane
vacu
mm
One
glass
spac
is sealed with solder glass,
which has matched expansion

NSG
PILKINGTON
Nippon Sheet Glass Spacia
Energy efficiency at your fingertips

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Summary

Nippon Sheet Glass Co. has developed the world's first commercialized vacuum glazing product known as SPACIA. The glazing consists of two 3-mm thick glass with 0.2 mm vacuum spacing gap, giving a total thickness of 6 mm. Due to the vacuum space, SPACIA's heat transfer is extremely reduced to the level of a quarter of 3mm thick single pane's and a half of 12mm thick double glazing's.
Its thin structure enables to replace a single pane with SPACIA without changing an existing framing sash in old houses.
SPACIA can reduce the air conditioning energy load by 31% as compared a single pane, when used in wooden houses.
SPACIA is being produced and supplied by Nippon Sheet Glass Spacia Co.,LTD.

Figure: SPACIA structure

Highlights

1. World's first commercailzed vacuum glazing
2. Extremely high performance for thermal insulation
3. Thin structure
4. High performance for sound reduction
5. 31% less air-conditioning load when installed in wooden houses.

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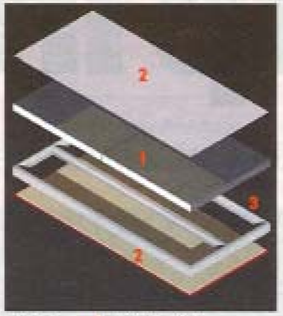
Interventions

- Insulation

NG VACUUM INSULATION PANELS

were achieved to reduce thermal bridging while accommodating flexible fixing options. The resulting prototype is a versatile system that can be used for new facades as well as for over-cladding. Each panel is designed to be up to 2m wide by 600mm long and comprises one vacuum insulated panel unit (55, 60 or 70mm thick depending on performance required) with a 10mm-thick sheet of polyurethane foam on each side for padding. This is faced in 0.7mm thick pre-coated steel to provide the protection and external finish. An extruded PVC perimeter frame provides edge stiffness and enclosure and points for fixing supporting brackets are glued to the steel skins.

The thermal performance calculations have produced an average U-value for the whole facade. A U-value of 0.137



Panel concept 1 Insulation 2 Foam-and-steel facings 3 PVC frame

SOLUTIONS: INSULATION

Vacuum promises a thinner future

As buildings' required insulation levels rise, vacuum insulation's relative thinness could prove invaluable, writes **Amanda Birch**

Imagine an insulation material that is just 20mm thick yet six times more efficient than the best conventional insulation. Sound implausible?

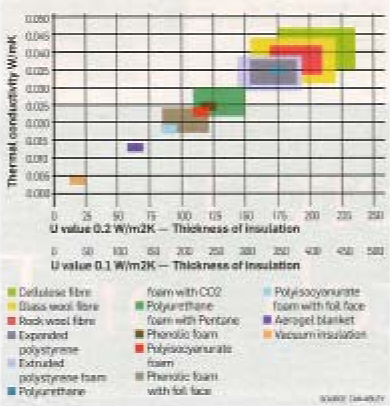
Vacuum insulation is the material, although its application in the building sector is still rare owing to limited scientific knowledge on

"A serious improvement in insulation is required if we are to move to lower U-values" Ian Abley

its behaviour when used in construction. But its use is gradually spreading.

The core material of vacuum insulation is micro-porous fumed silica. To manufacture the material and create a panel, the powder is poured into a plastic membrane and formed into a board shape. As the panel is pushed through a vacuum chamber, a sheet of barrier film (metallised plastic) is placed on either side of the panel and the film is heat sealed around the edges. This holds the vacuum within the structure of the material. Scientists often compare the manufacturing process to vacuum-packed coffee, where the air is drawn out of a bag to keep the

INSULATION U VALUES BY PRODUCT



lating properties, vacuum insulated panels were originally developed for white goods such as refrigerators or to keep medicines cold during transportation. Increasing pressure to make refrigerators more energy efficient meant more insulation was

insulation suddenly seemed very appealing.

A similar situation is being experienced today in the construction industry. As architects and services engineers attempt to reduce CO2 emissions and heat transmission through the building

not only thicker facades, but an increased complexity of building joints and details; a reduction in the internal space of the building; and, paradoxically, an increased environmental impact because of the additional material use.

Architect Ian Abley is a champion of vacuum insulated panels and believes they are the future. "Architects need to understand that a serious improvement in insulation is required if we are to move to lower U-values," he says. "They need to take responsibility for designing high thermal performance from thinner, prefabricated vacuum panels or carry on increasing the thickness of cut-to-fit insulation until construction ceases to be rational or subtle in appearance."

But like many developing technologies, there are a number of fundamental problems with the product. First is its lack of robustness. "It has the same problems as vacuum-packed coffee, stab it with a fork and you kill it," says Abley.

It's a vulnerable material and needs to be protected from puncture agrees Ray Ogden, professor of architectural technologies at Oxford Brookes University. "When it's punctured, it's not as catastrophic as it sounds, but it will start to compromise the insulation. We need to find ways of

Installing the vacuum insulated panels in the Munich building.

Panels manufactured by Va-Q-tec.

nates any possibility of it being cut on site like conventional insula-

buildings where a stable temperature is needed, but they have also

Interventions

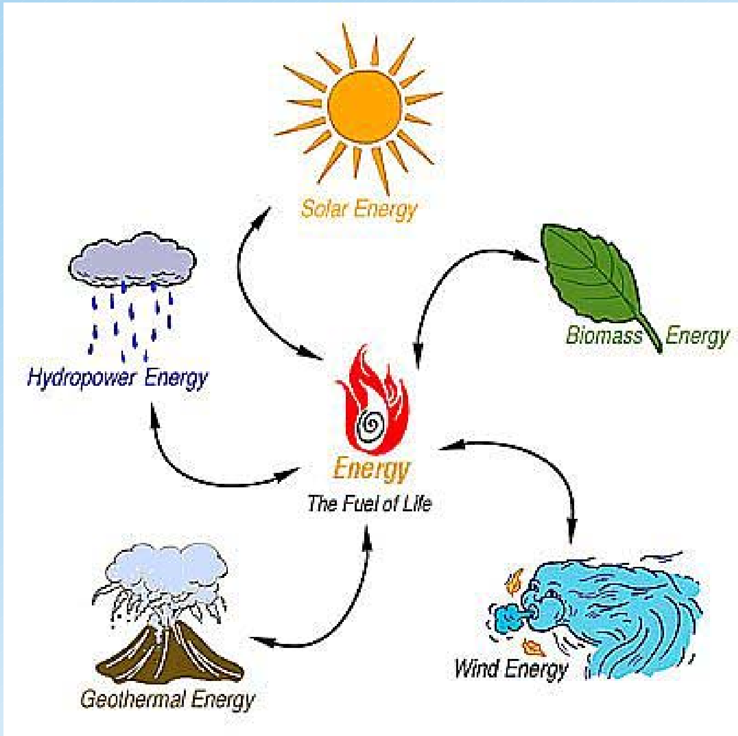
- **Energy supply**

  -Renewables

  -Local supply (biomass)

  -Community linking

  -



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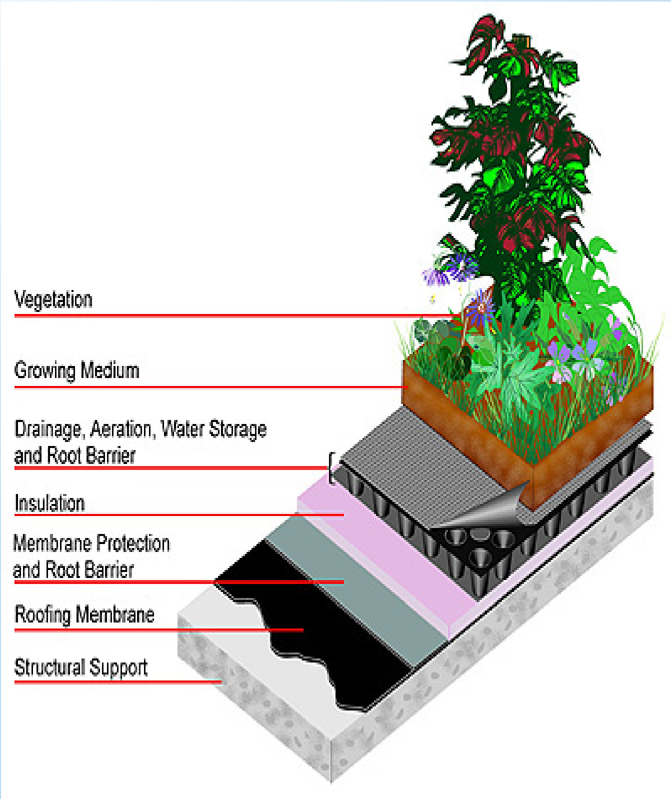
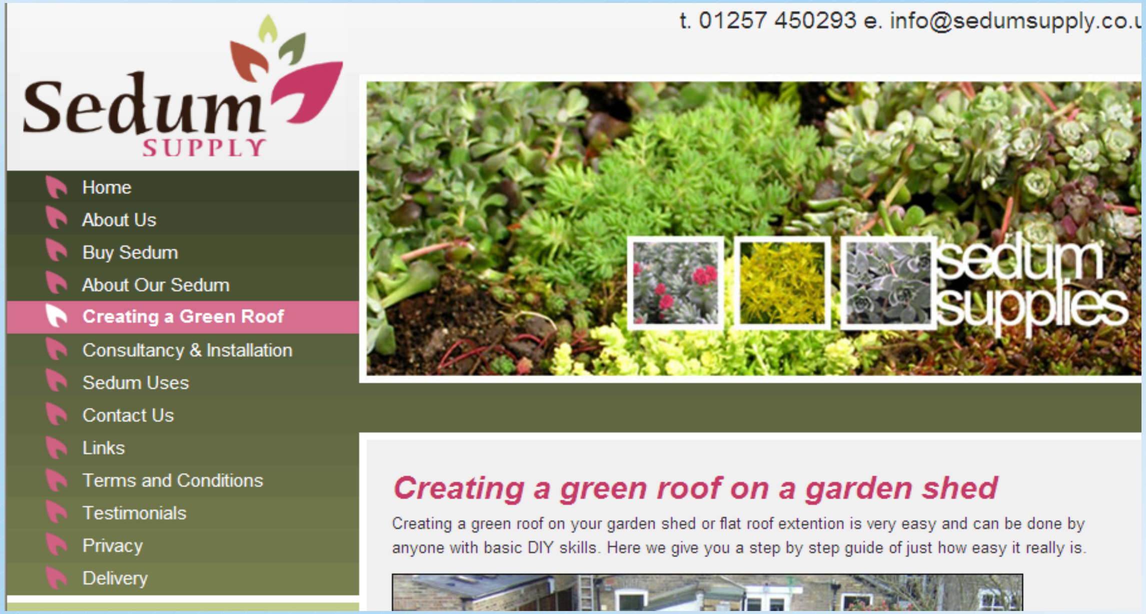
Interventions

- **Green Roofs**





Interventions

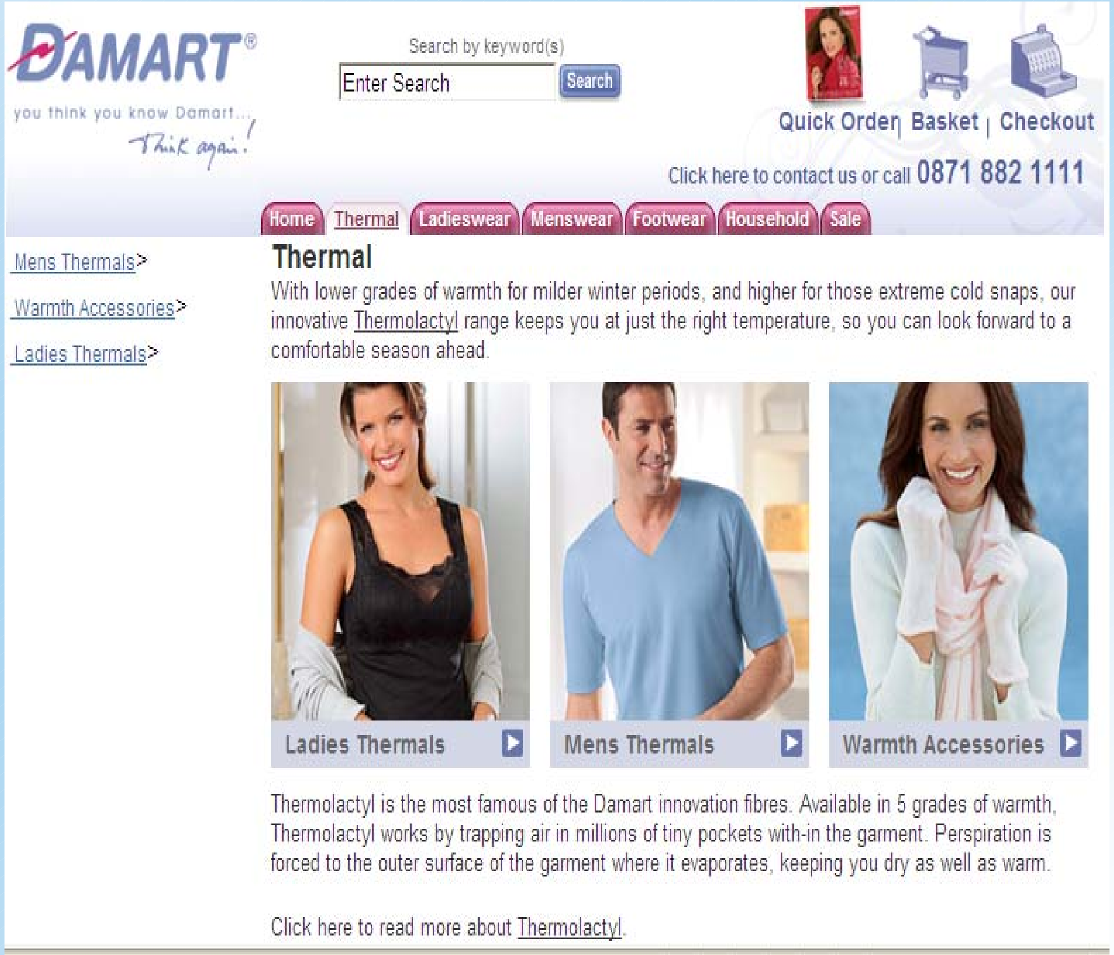
- Lighting

Lighting Comparison Chart

Lighting type	Efficacy (lumens/watt)	Lifetime (hours)	Color rendition index (CRI)	Color temperature (K)	Indoors/outdoors
Incandescent					
Standard "A" bulb	10–17	750–2500	98–100 (excellent)	2700–2800 (warm)	Indoors/outdoors
Tungsten halogen	12–22	2000–4000	98–100 (excellent)	2900–3200 (warm to neutral)	Indoors/outdoors
Reflector	12–19	2000–3000	98–100 (excellent)	2800 (warm)	Indoors/outdoors
Fluorescent					
Straight tube	30–110	7000–24,000	50–90 (fair to good)	2700–6500 (warm to cold)	Indoors/outdoors
Compact fluorescent lamp (CFL)	50–70	10,000	65–88 (good)	2700–6500 (warm to cold)	Indoors/outdoors
Circline	40–50	12,000			Indoors
High-intensity discharge					
Mercury vapor	25–60	16,000–24,000	50 (poor to fair)	3200–7000 (warm to cold)	Outdoors
Metal halide	70–115	5000–20,000	70 (fair)	3700 (cold)	Indoors/outdoors
High-pressure sodium	50–140	16,000–24,000	25 (poor)	2100 (warm)	Outdoors

Interventions

- People
- Change in attitude and attire



Interventions

Appropriate conditions

- Galleries – easy example
  - conditions to suit exhibits – not BS
- Lighting control

Interventions
Historic Buildings

- Appropriate to type, grade 1, 2*,2 etc-
- Creative new uses
- Heritage approach

-sympathetic
-non destructive
-reversible

- We are or are we guarding the past for the future or …..
- Are we creating low use large museum pieces
- LIDAR and 3D technology, a whole topic with great potential

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Summary

- The obvious need
- We should act to control energy
- Consider our own attitude and expectations
- There are a range of appropriate interventions, develop further
- Good Housekeeping
- Develop or promote more appropriate measures, planning and BREEAM etc…
- Enjoy the challenge

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