PROPEC Ouro Preto

Steel Buildings and Sustainable Construction

Roger Plank

University of Sheffield, UK

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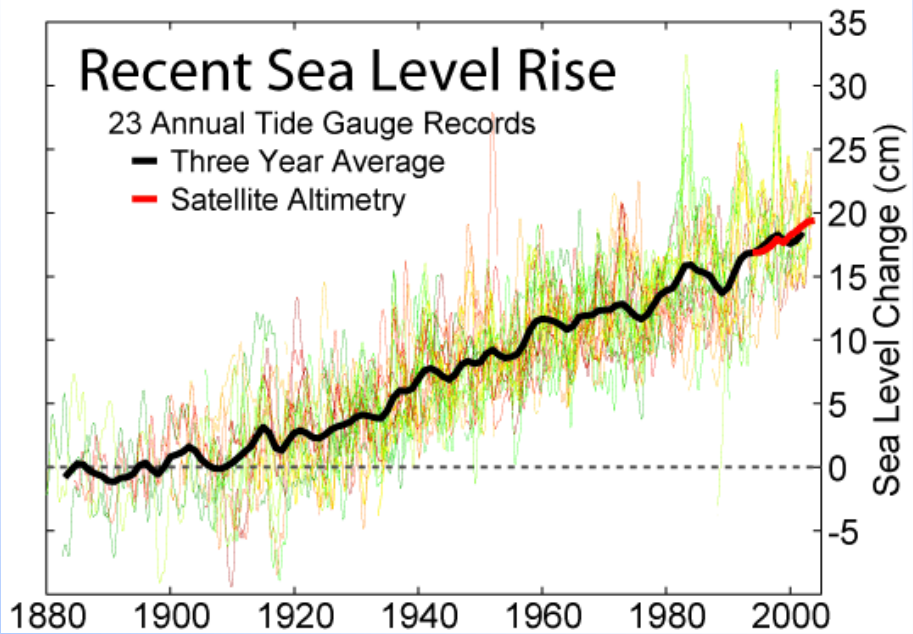
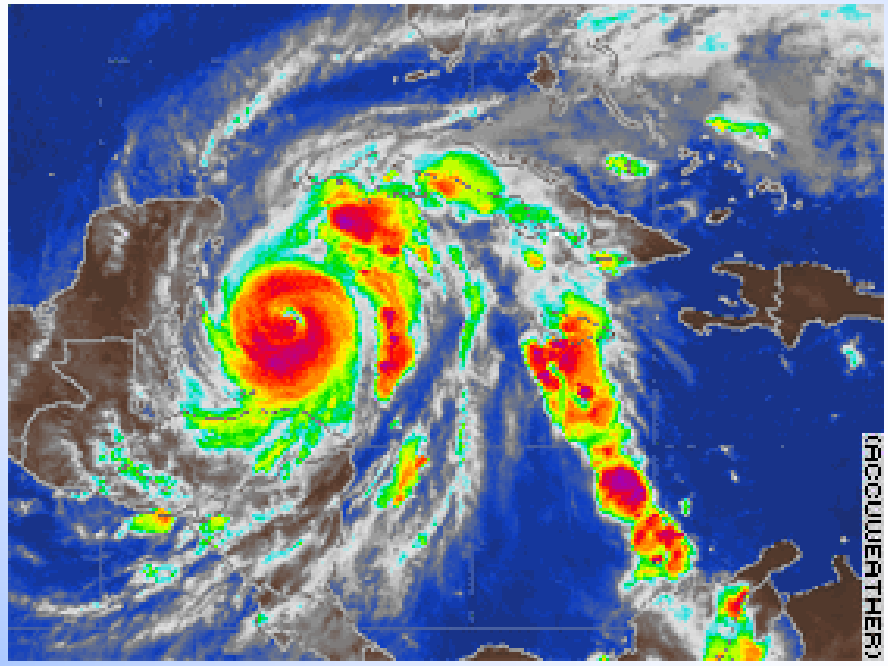
The need to reduce energy use and CO_2



The need to reduce energy use and CO_2

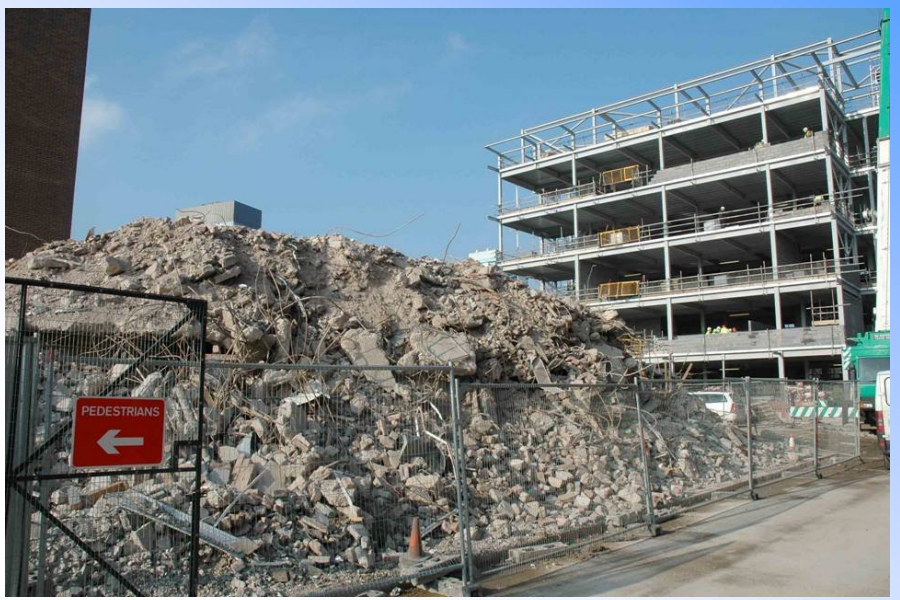


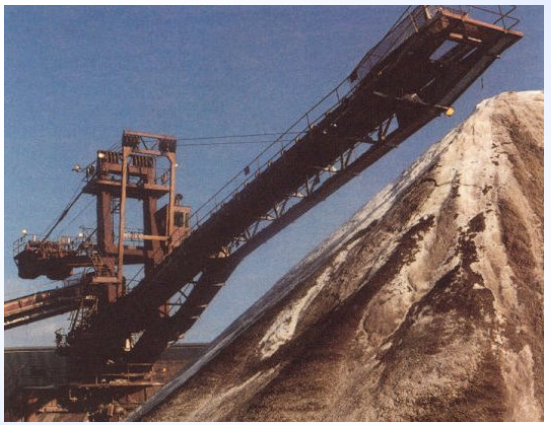
The main environmental issues

- Climate change
  - 89% of energy derived from fossil fuels
- Resource depletion
- Construction & Demolition waste

Data for UK construction sector

- 420Mt of a raw materials
- 94Mt of waste
  - (~ 12% due to over specification)
- 50% of all energy used
- 2% of CO_2 from cement production





Positive aspects of buildings

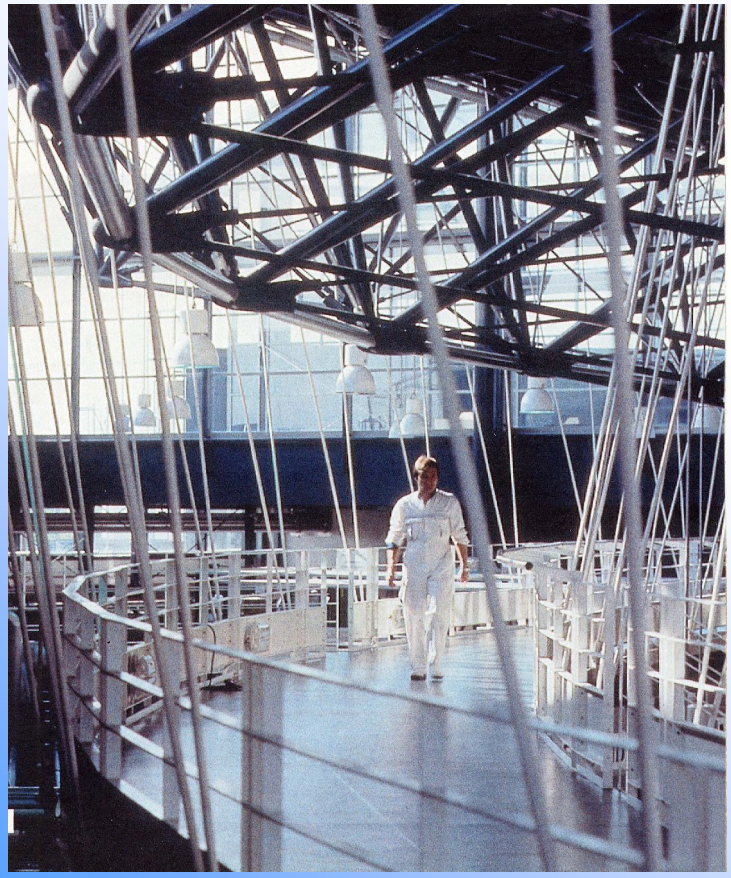
We spend 90% of our lives in buildings

…at work

…at leisure

…at home

Construction can improve productivity & efficiency



Construct for regeneration

- Limited land, decaying cities
- Redevelopment of waste (brownfield) sites
- Reduce travel

Poor foundation conditions

- Lightweight long span construction
  - Reduces loads
  - Minimise columns

The sustainability challenge

Improve living standards ***for all***

- Without environmental or ecological harm
- Affordably

The principal issues for sustainable construction

- Build what is needed
- Maximise useful life of buildings and structures – flexibility, durability
- Build efficiently & consider end of life
- Design for operational efficiency

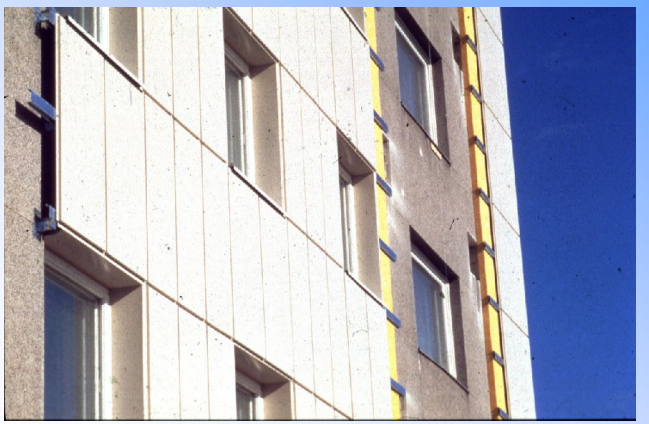
What to build?

- Respond to real need
  - Approx 4m new homes needed in the UK

Reuse existing buildings?

Reclad

Over-clad



Over-roof

…Refurbish

…Extend

Convert

…Restructure

Steel's versatility

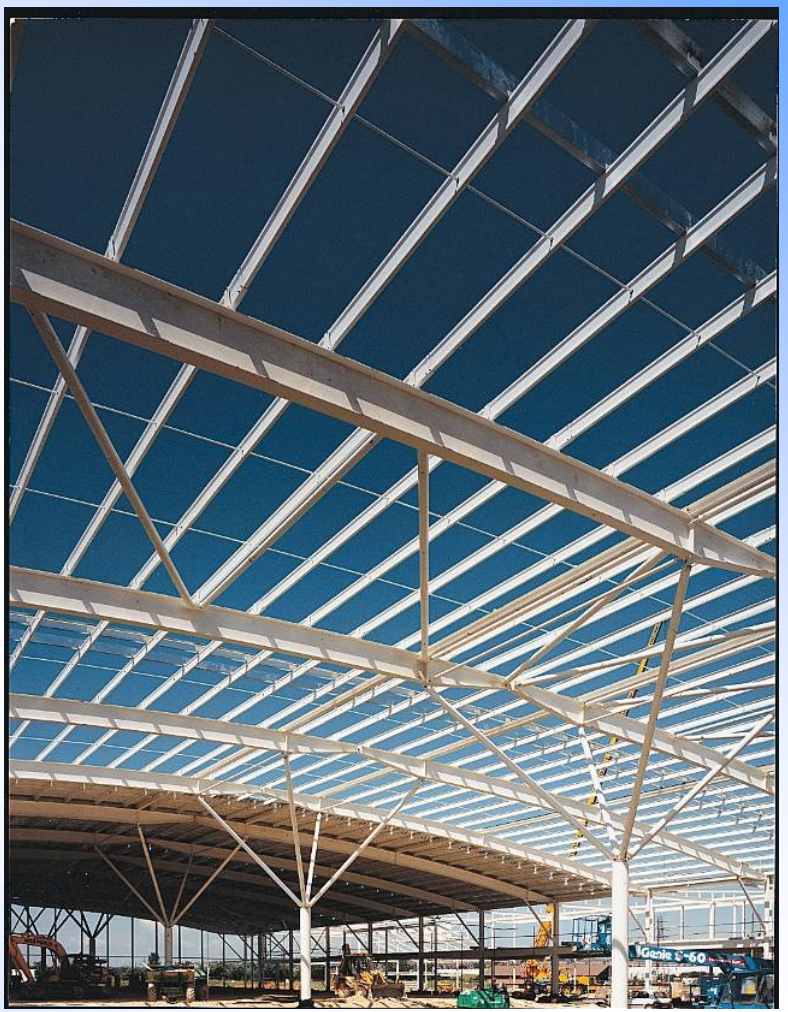
- Igus factory, Cologne
  - Extended horizontally seven times
  - Internal flexibility
- Car park, Hamburg
  - Dismantled
  - Moved
  - Reassembled

How to build

- Flexibility
  - to allow change of use
- Durability
  - to maximise life
- Demountability
  - to facilitate re-use

Flexibility

- Long spans
- Flexible, open, column-free space



Flexibility

Flat soffits provide easy installation (and refit) of services

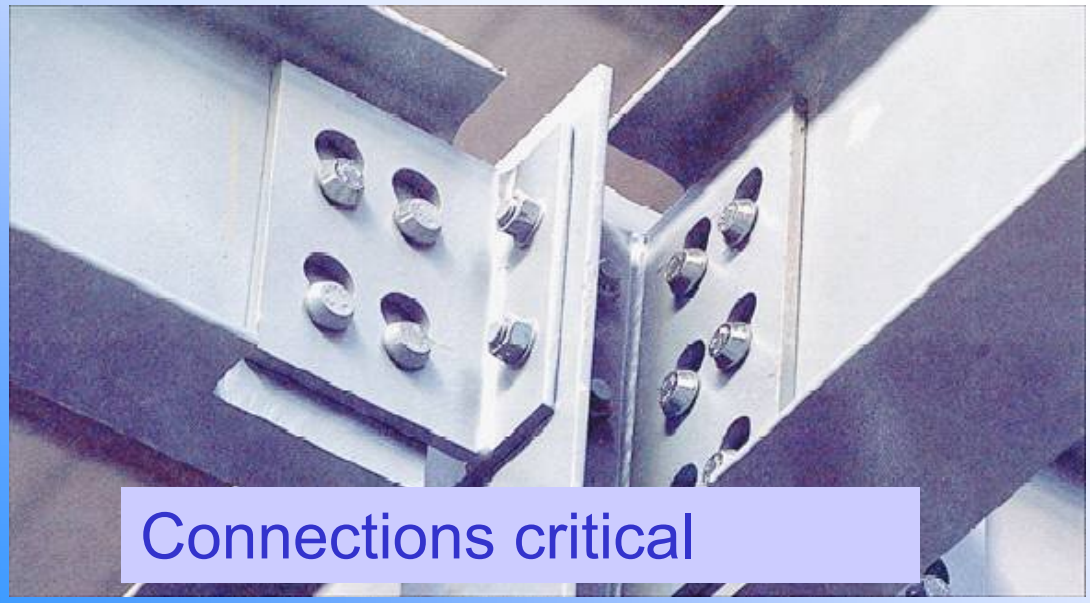
Durability

- Durability is important to minimise the need for replacement

Re-using steel

- Reuse preserves the value added during manufacture
- Technically feasible but other barriers
- Limited reuse market

Elements must be recoverable



Connections critical

Concerns about:

- Supply
- Quality

How to build?

- Minimise impacts of both construction and occupation
  - Materials
  - Waste
  - Energy
  - The construction process

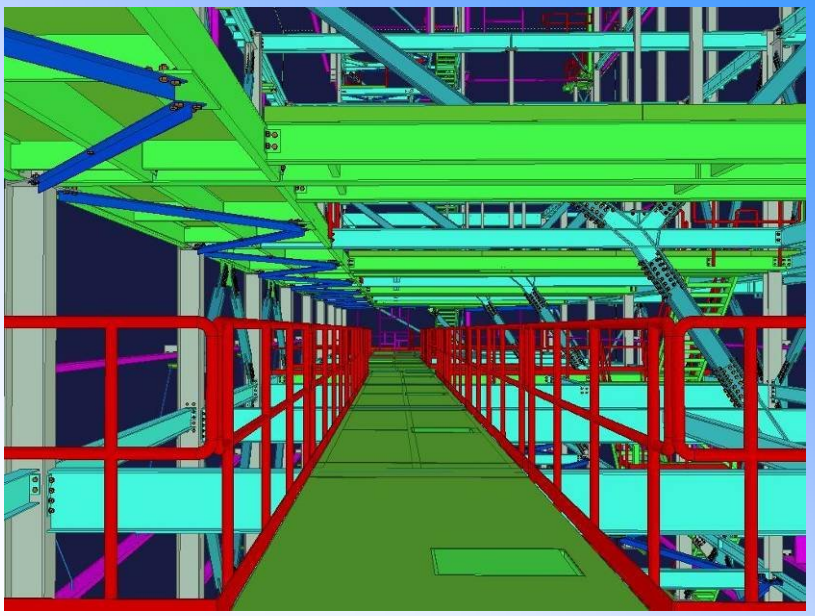
Materials

- Reduce
- Maximise use of recycled materials
- Source from sustainable supplies
- Minimise waste
- Minimise energy and pollution in production

Embodied energy seen as less important than operational energy

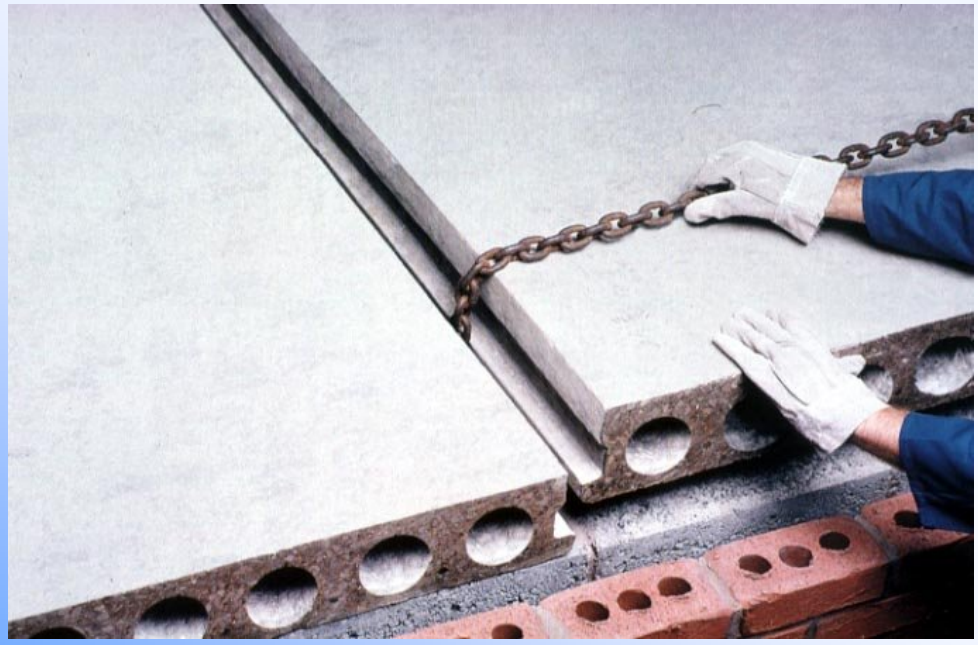
Lean construction

- Efficient supply chain
- Low waste
- Product standardisation
- Computerised design and manufacture



Reduce

Efficient design - not only structure..



..but also finishes, cladding etc

Use of recycled materials

- Minimises depletion of raw materials
- Reduces energy for production
- UK proposals for minimum % of recycled/ recyclable materials

Use of recycled materials

- Steel almost fully recycled
  - No degradation of quality
- Concrete recycled as aggregate for:
  - Sub-base or fill
  - New concrete production

Energy consumption

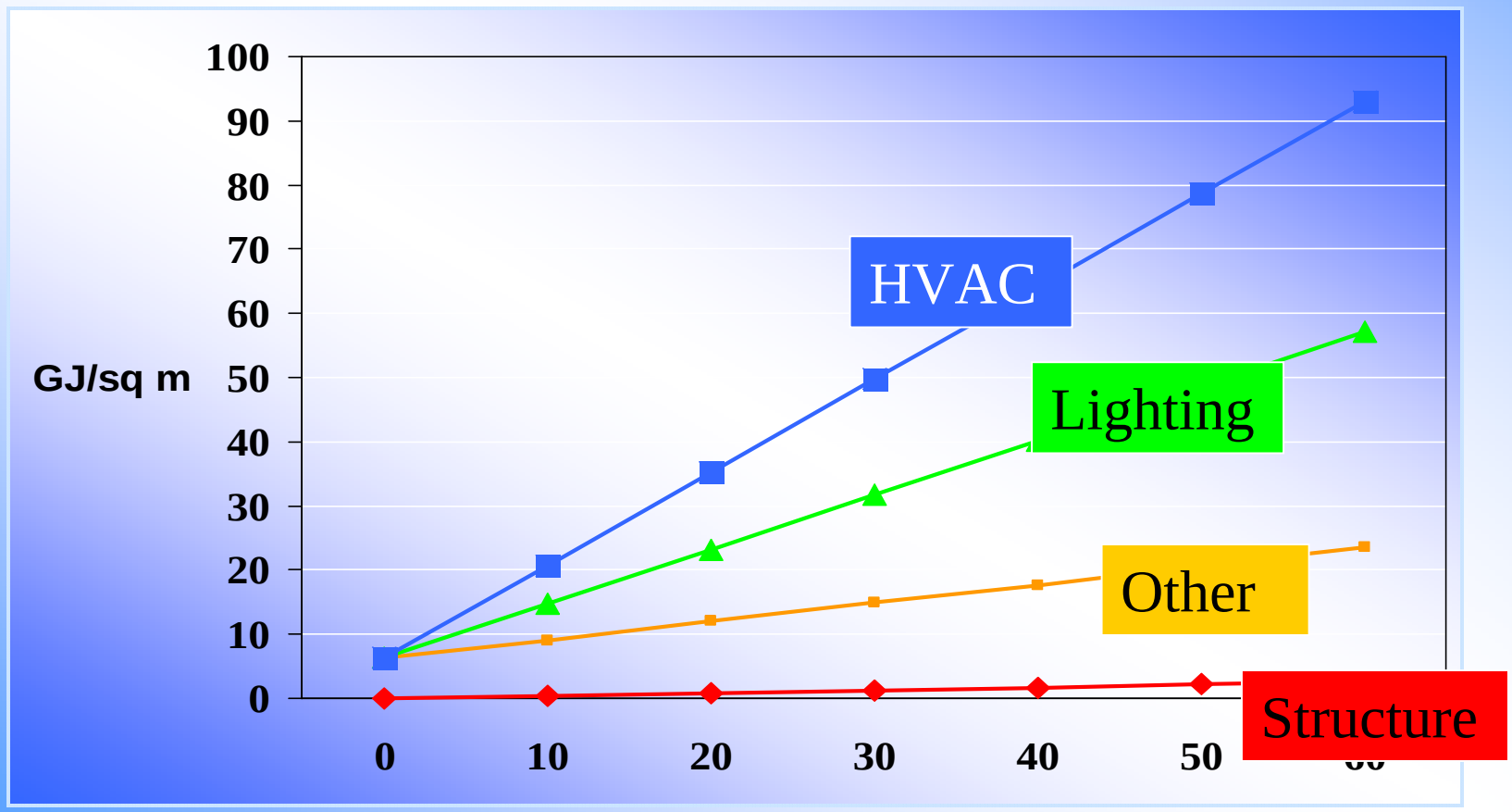
Energy reduction – *40% since 1970*

The need for energy efficient buildings

- Energy from fossil fuels → CO_2
- Finite reserves
- Renewable energy → environmental changes
- Increased energy costs
- Buildings in use account for high proportion of total energy use

Operational and embodied energy

- Operational energy ~ 5-8 x embodied energy
- Heat, light, ventilation & cooling



Embodied energy

- More important for buildings which are:
  - unserviced
  - energy efficient
  - of short design life

Minimise operational energy

- Reduce cooling loads
- Reduce heat losses
  - through envelope
- Reduce artificial lighting
- Self generation of energy
  - wind turbines
  - photovoltaics

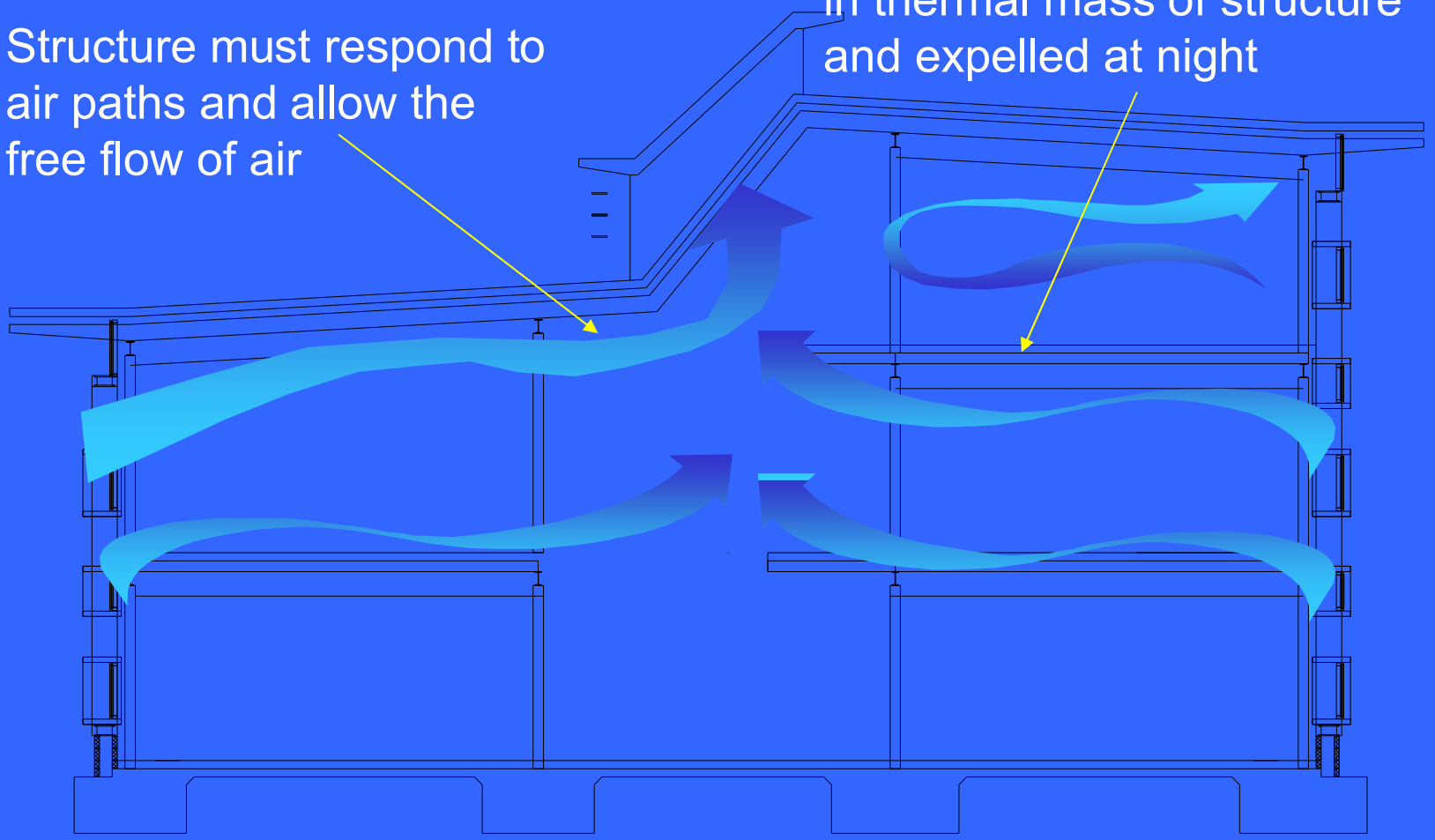
Cooling

- Commercial offices
  - cooling
  - air conditioning is energy intensive

Principles of Natural Cooling

Structure must respond to air paths and allow the free flow of air

Heat during the day is stored in thermal mass of structure and expelled at night



Principles of natural cooling

- Referred to alternatively as:

  Fabric energy storage (FES)

  Thermal capacity

  Thermal mass

- Passive systems
  - Rely on natural heat exchange
- Active systems
  - 'Forced' ventilation encourages heat exchange
  - Water circulation to chill elements

Natural cooling – key issues

- Expose soffit
- Allow free ventilation
- Mass less critical
- Appearance important

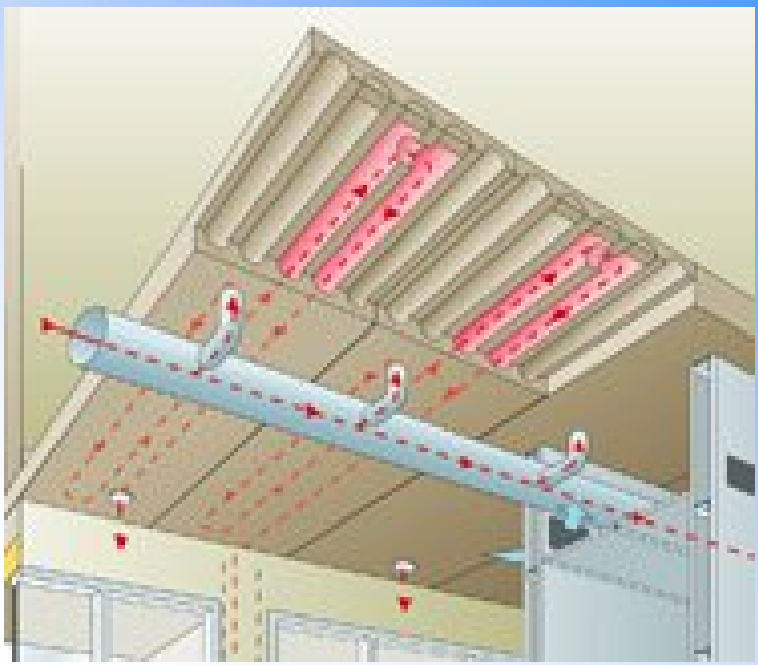
Active systems

- Forced ventilation through:
  - Raised floor voids
  - Air cores (eg Termodek)
- Water circulation
  - Chilled slabs (plastic pipes cast in slab)
  - Chilled beams

Termodeck

Significantly reduced energy & CO_2 compared with

- Average figures
- Government targets
- Best practice



Effectiveness of natural cooling

- Passive systems
  - typical night cooling performance (UK) 10 to 20 W/m^2.
- Active systems
  - cooling of 20 to 30 W/m^2
- Can reduce peak temperatures by 3-5°C

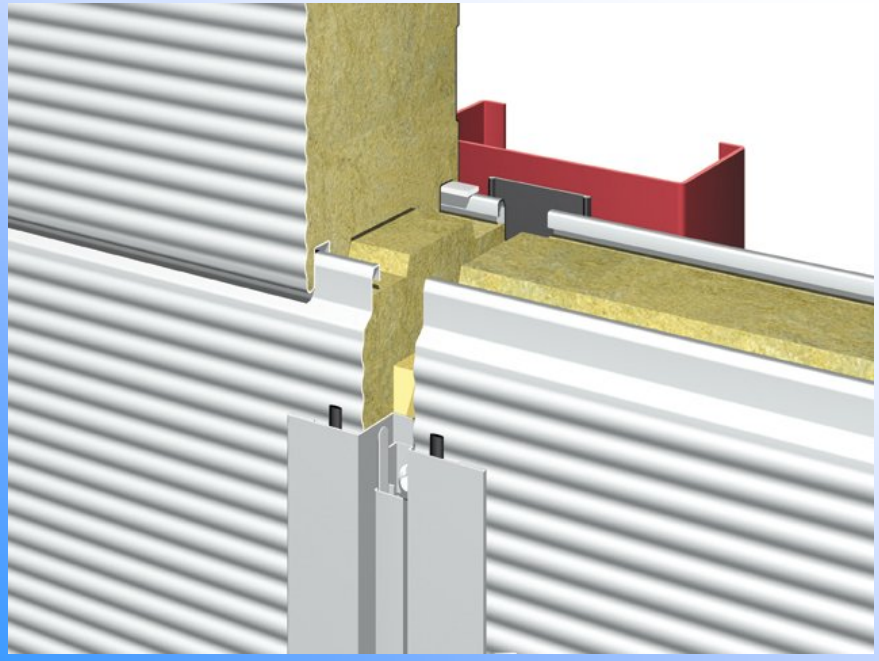
Importance of envelope

- Insulation
- ‘Air tight’ construction
- Higher specification saves
  - Net capital costs
  - Operational costs

Insulation

Cavity insulation

Highly insulating cladding



Artificial lighting

- High energy use
- Maximise natural lighting

Natural lighting

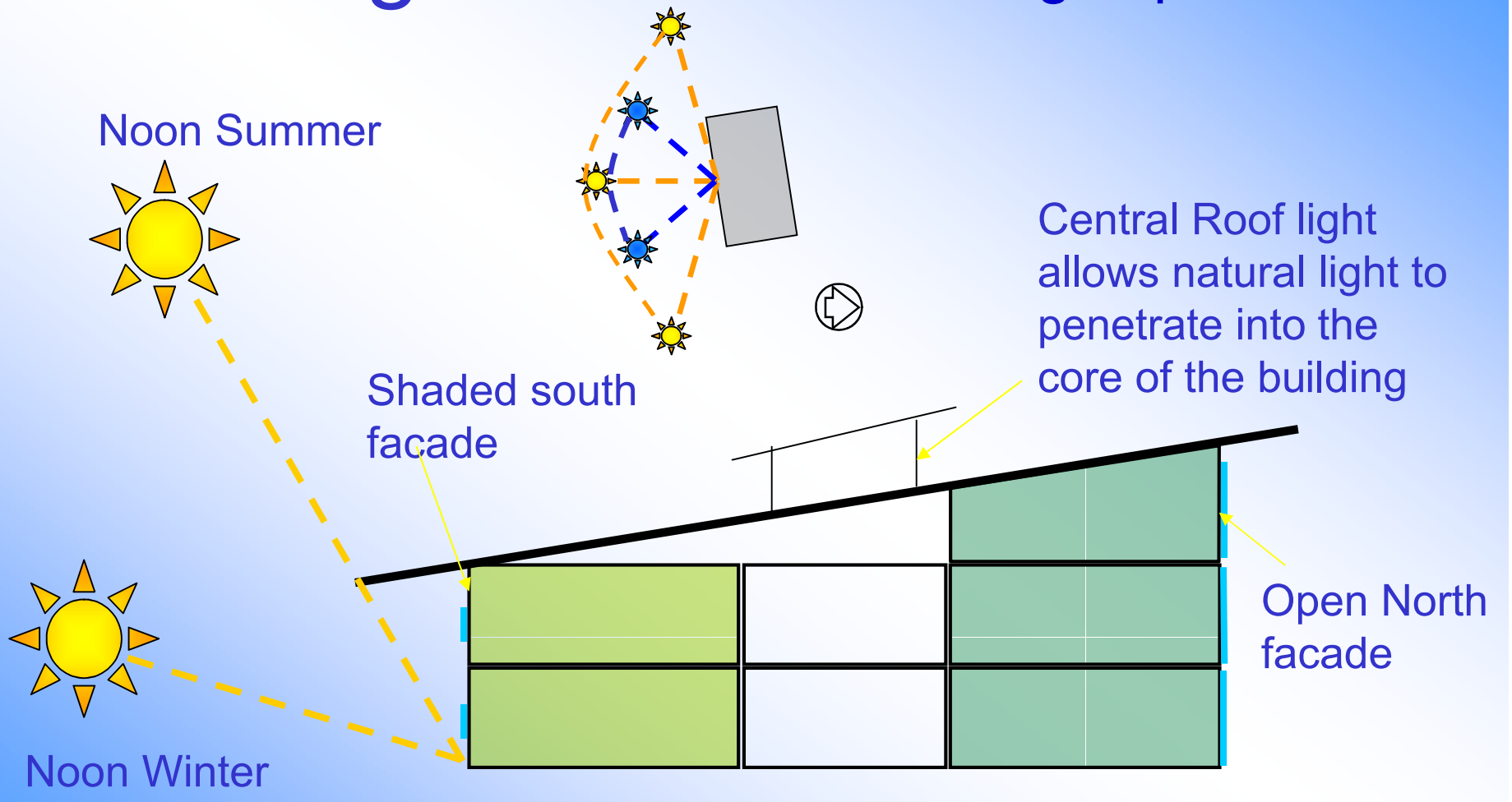
- Reduces energy use
- Improves internal environment
- Increases productivity

Avoid

- Direct sun
- Glare
- Solar gain

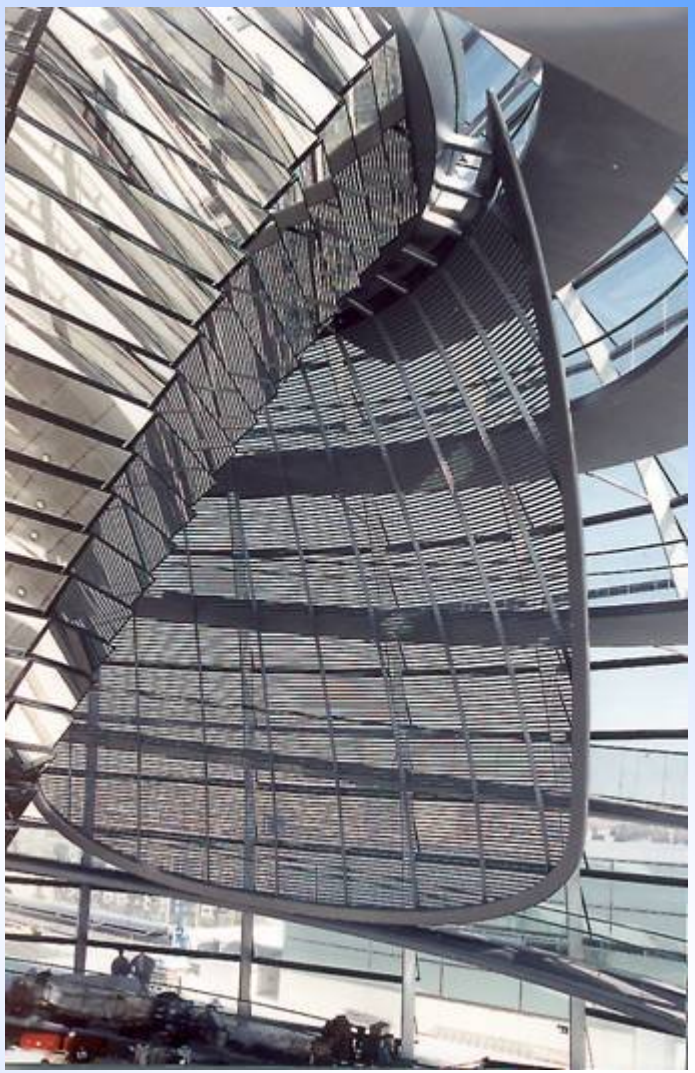
Natural light

Orientation and siting of building important



Shading

Control solar gain by shading devices



Interior shading provides some benefit

External shading devices

Exterior shading – fixed or moveable - better

Energy generation

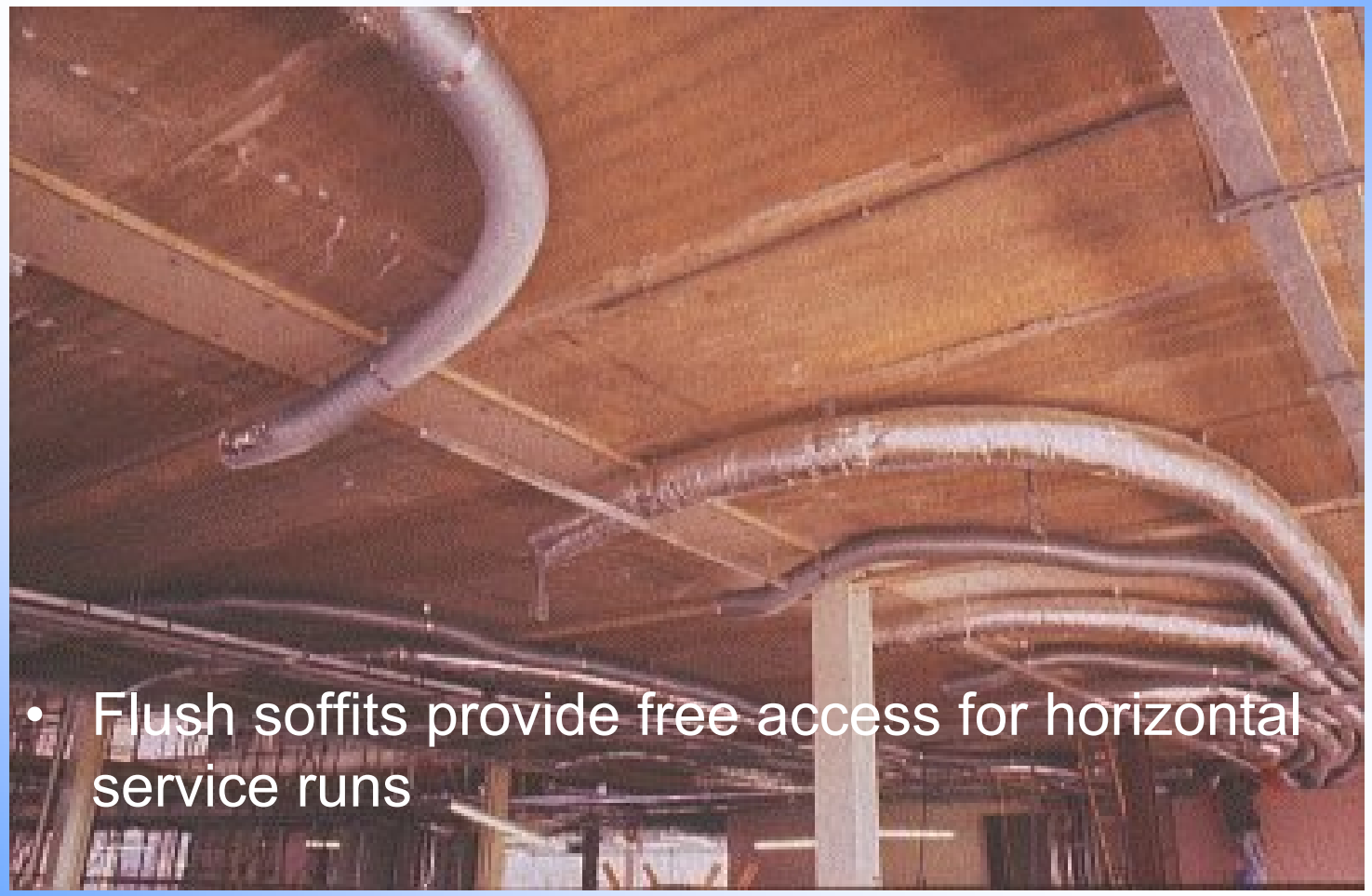
- Increasing interest in local energy generation
  - Photovoltaic cells
  - Solar panels
  - Wind turbines

Impact of construction

- Prefabrication
- Minimise site activity

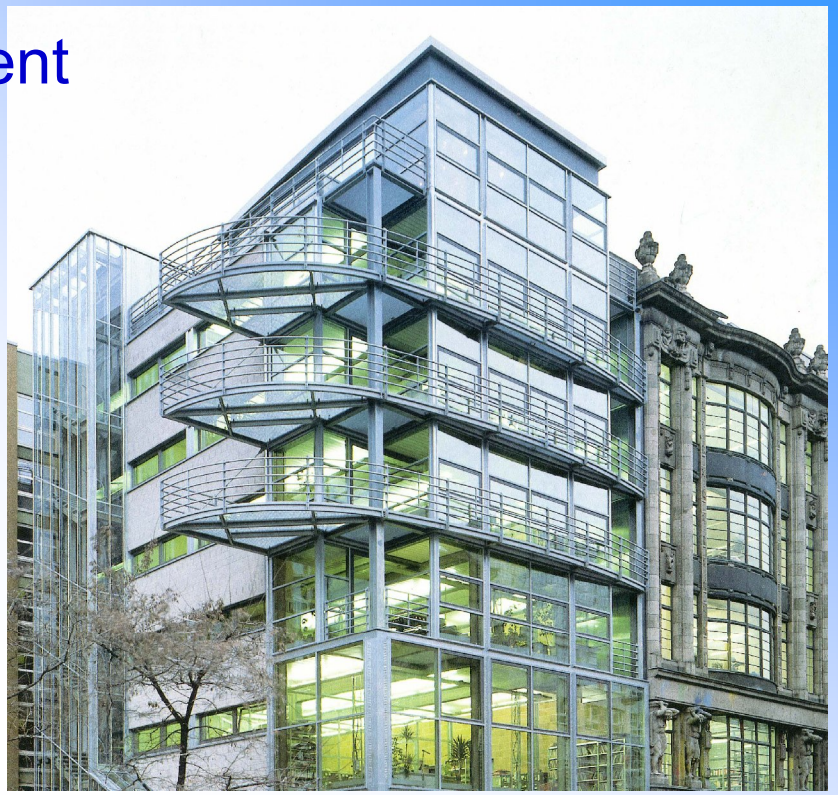
Modular Construction

Consider future refit



- Flush soffits provide free access for horizontal service runs

Sustainable construction consistent with quality & good practice



Summary

- Construction important
- Very broad – holistic approach
- Depends on many small contributions
- Construction team must work together
- Requires conscious consideration
- Regional variations

Sustainable construction - summary

- Re-use existing built assets
- Design for minimum waste & long life
- Source materials carefully
- Lean construction
- Minimise energy
  - Operational
  - Embodied
- Do not pollute
- Monitor, set and report targets

The contribution of steel

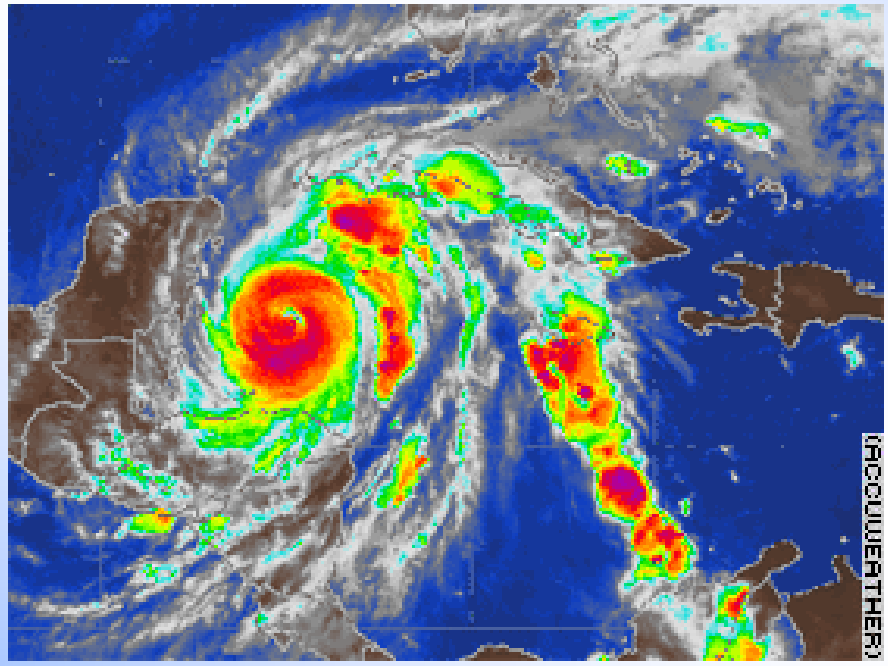
- Structurally efficient
- Versatile
- Adaptable/flexible
- Low waste
- Highly demountable
- Reusable
- 100% recyclable

Why should we do it?

- Realise unseen opportunities
  - Energy saving
  - Employee efficiency
- Commercial advantage
- Modest commitment
- Minimal risk

- For the benefit of your (and their) grandchildren

The choice is ours – this…



…or this

Thank you