Constructing Excellence

Past, Present and Future

Innovation in the East of England

simon.smith@smithandwallwork.com

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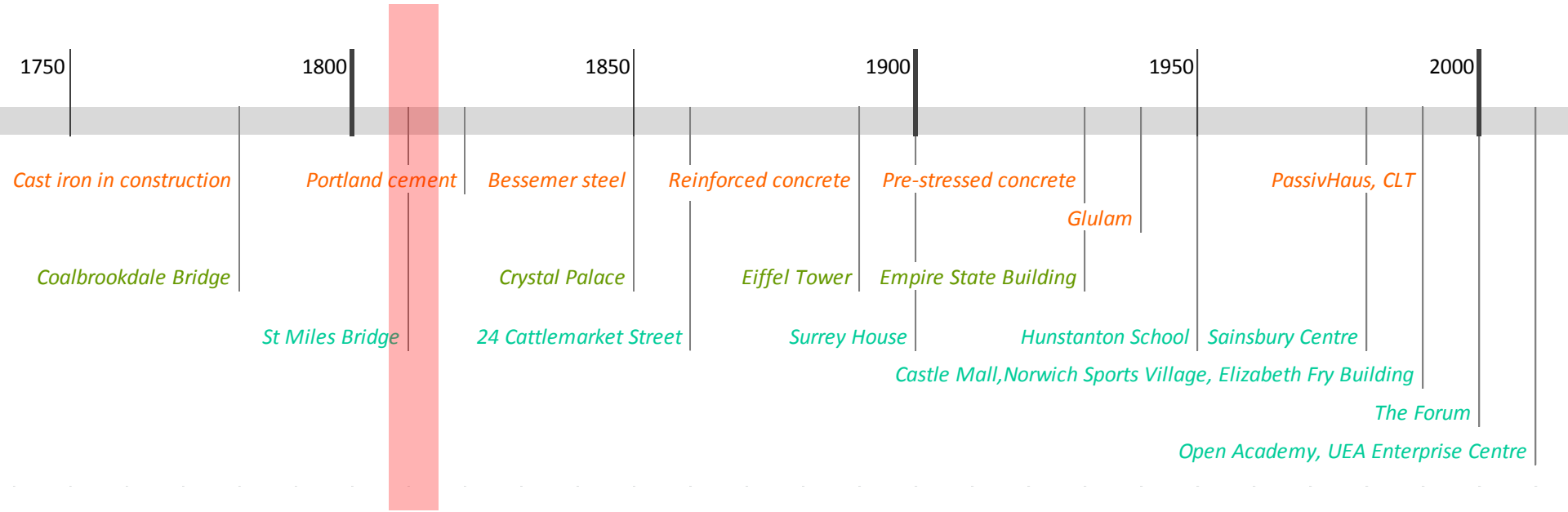
Construction Innovation Timeline



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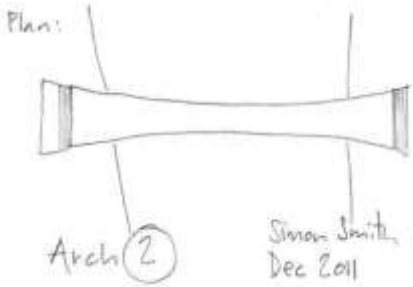
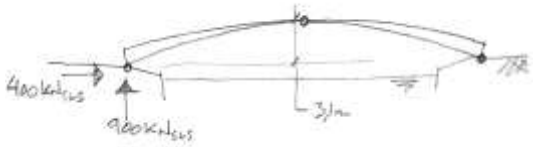
Date: May 2012

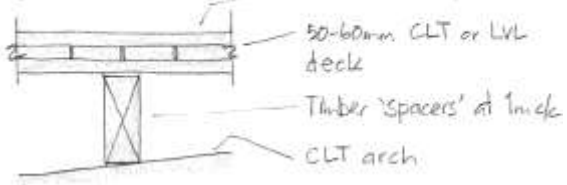

BREWERY
1804



Bridge designed as 3 pin arch with 3.1m rise. Radius curvature ≈ 70m.



Deck Section:



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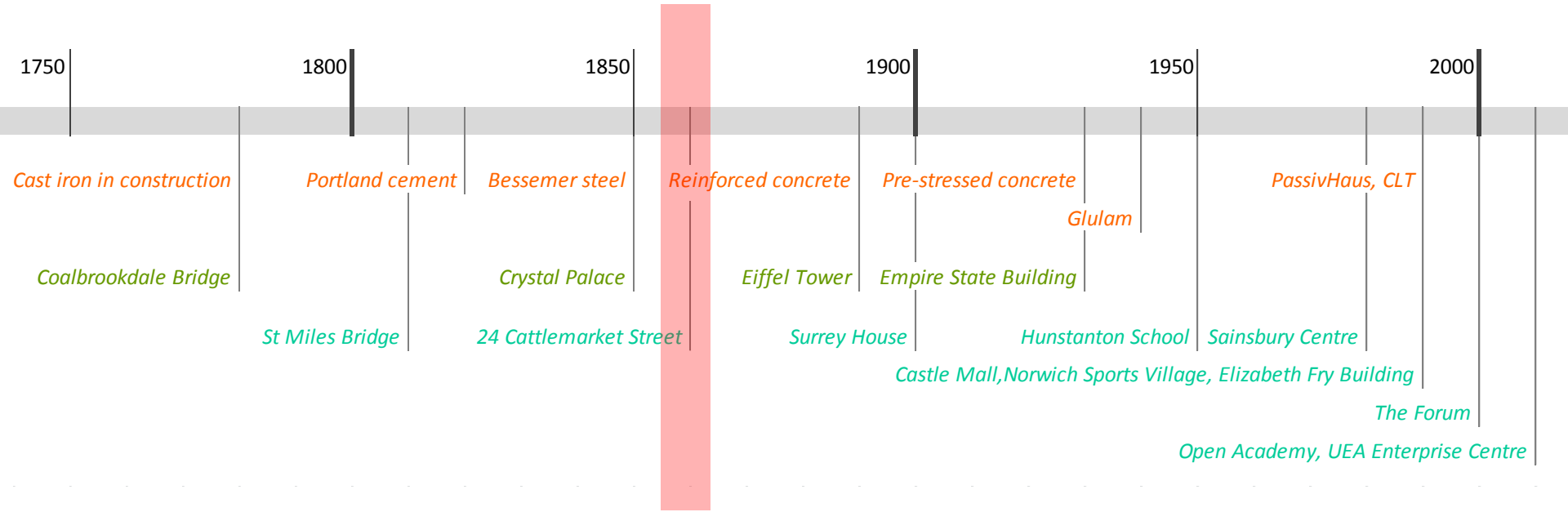
Construction Innovation Timeline



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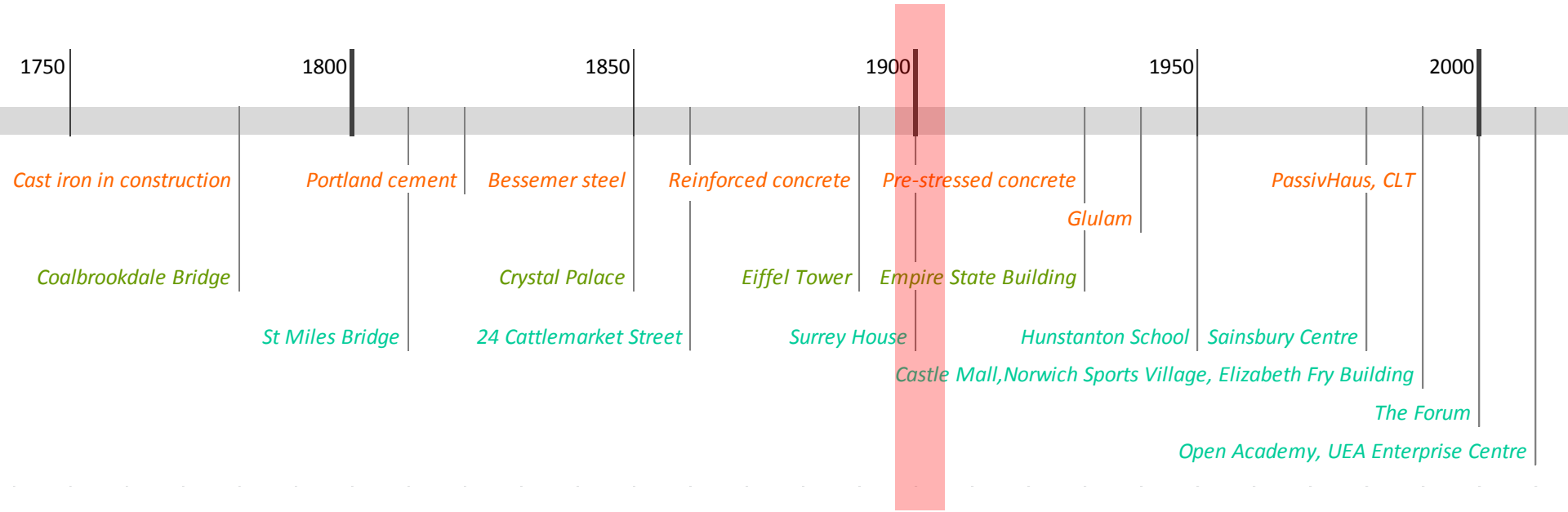
FAGUS — WER
CLASSICAL
CONTEMPORARY
24
VARINGS FURNITURE

Construction Innovation Timeline



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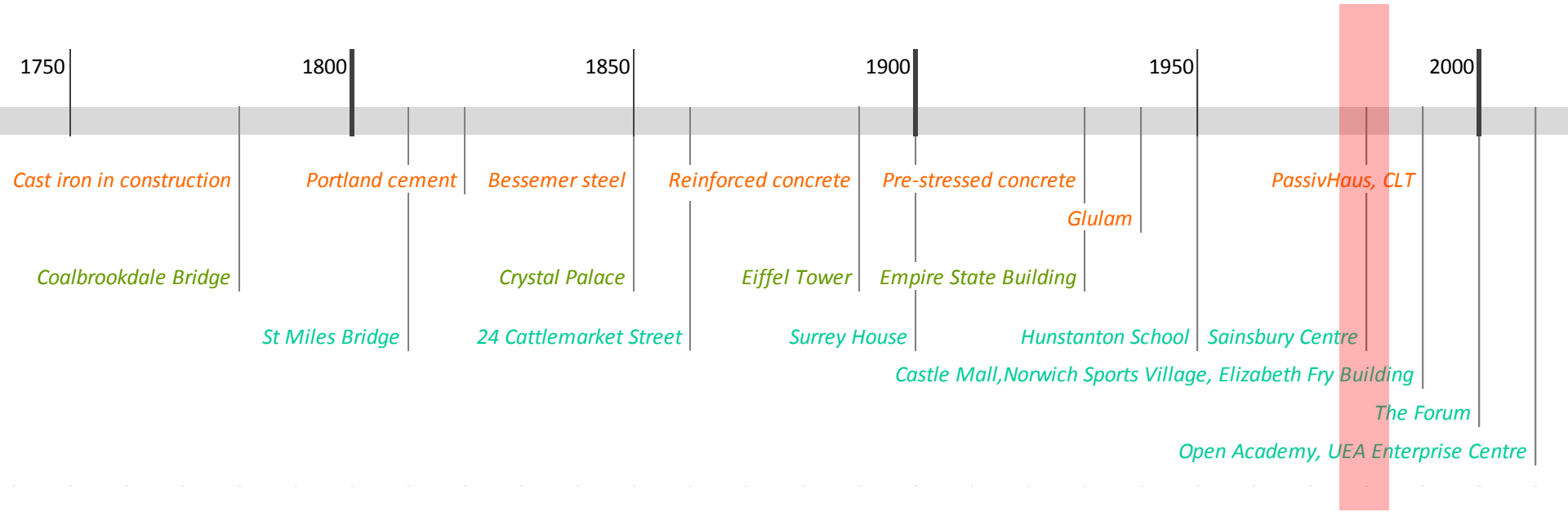
Construction Innovation Timeline



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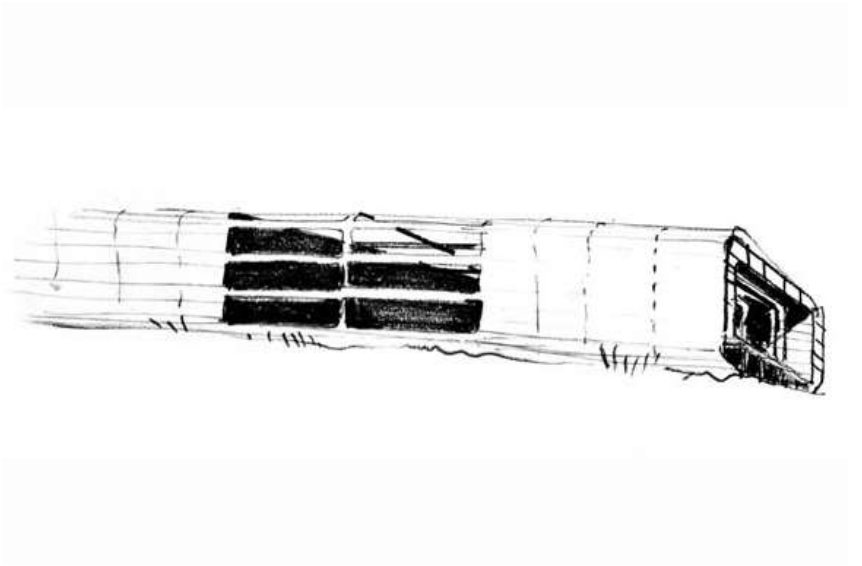

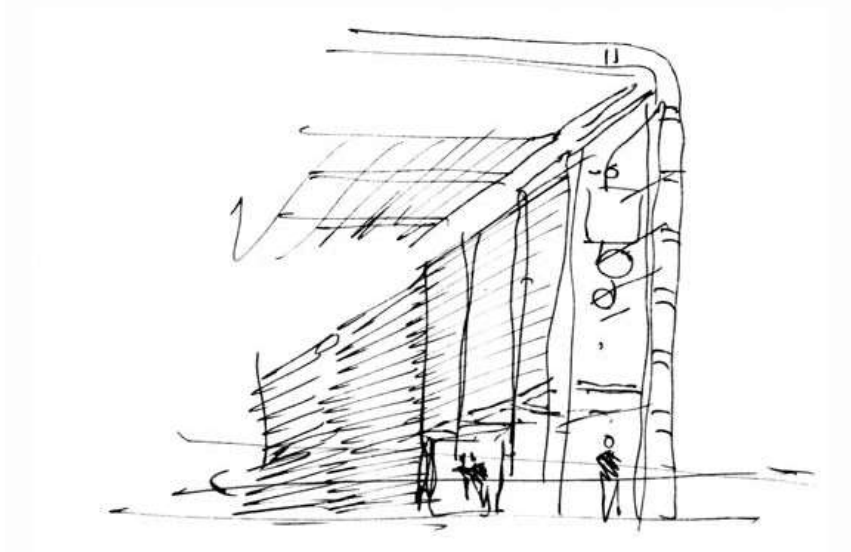

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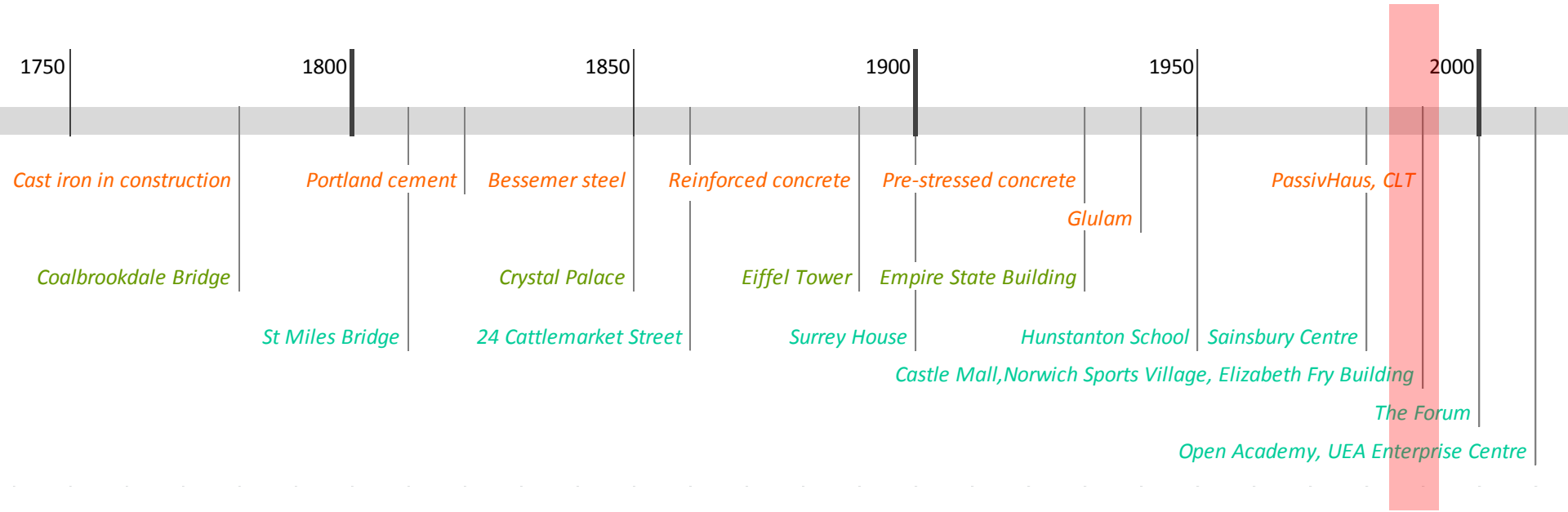
Construction Innovation Timeline



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ECN

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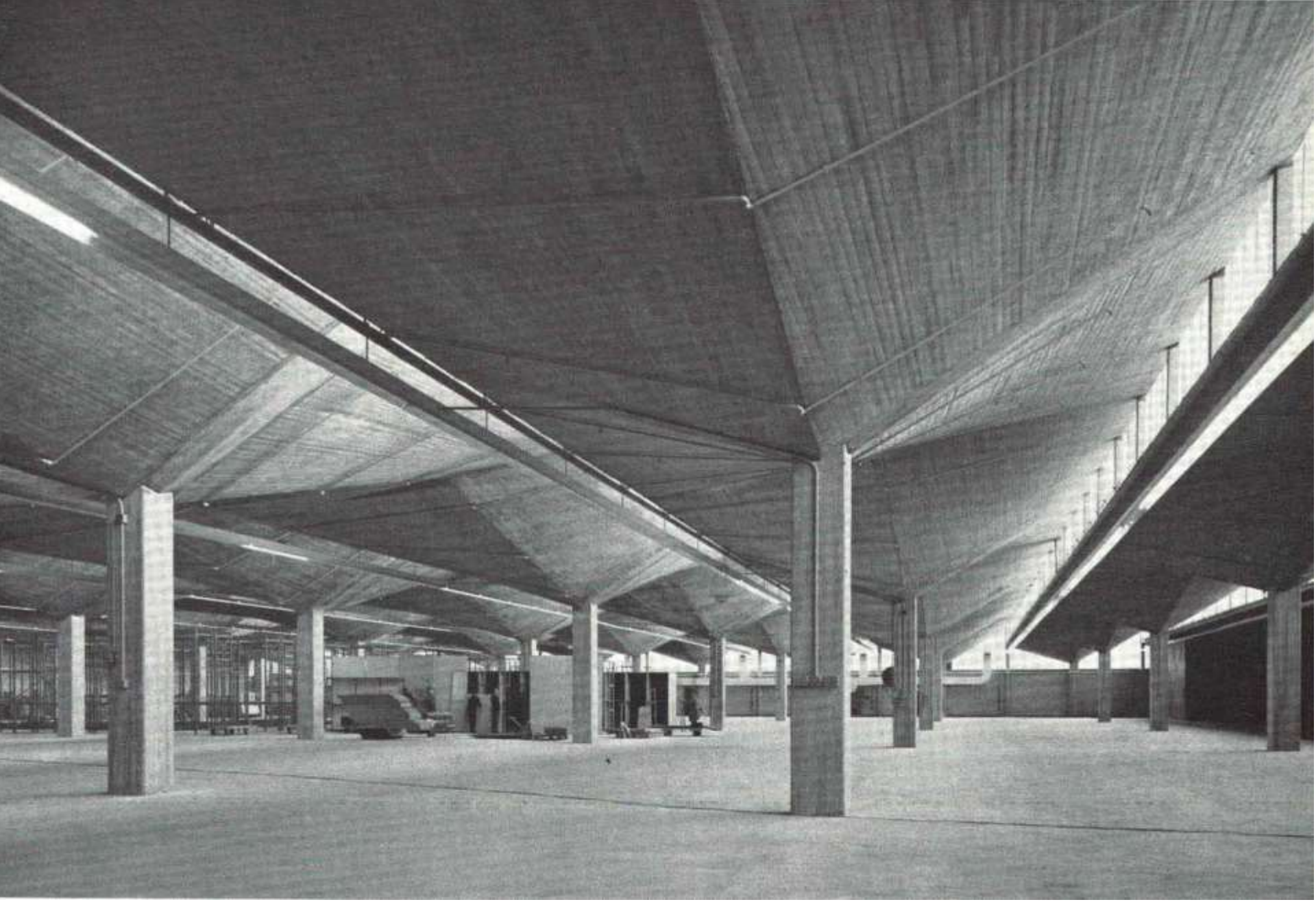
A1072
Cockerel
Gunnels Wood Rd
A1072



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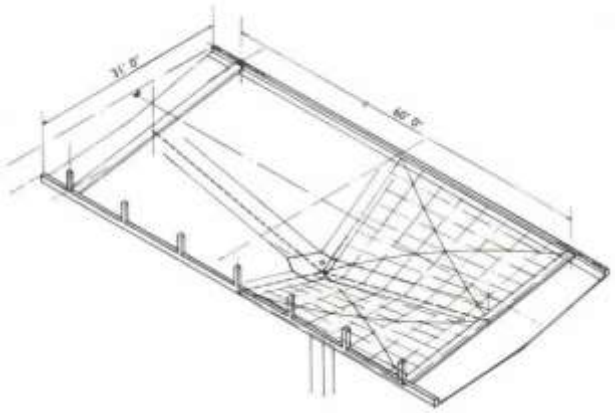

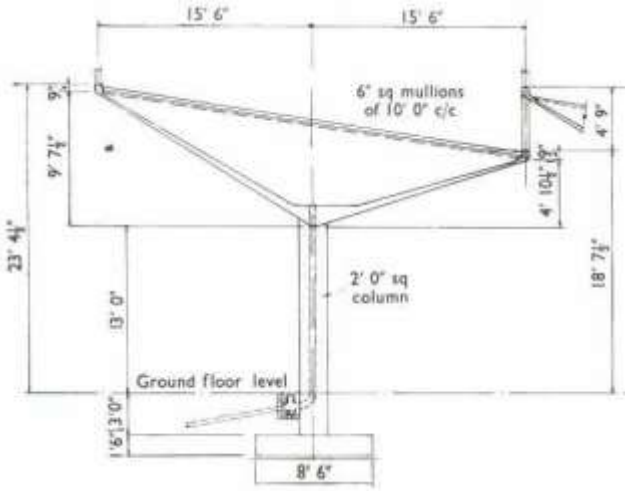

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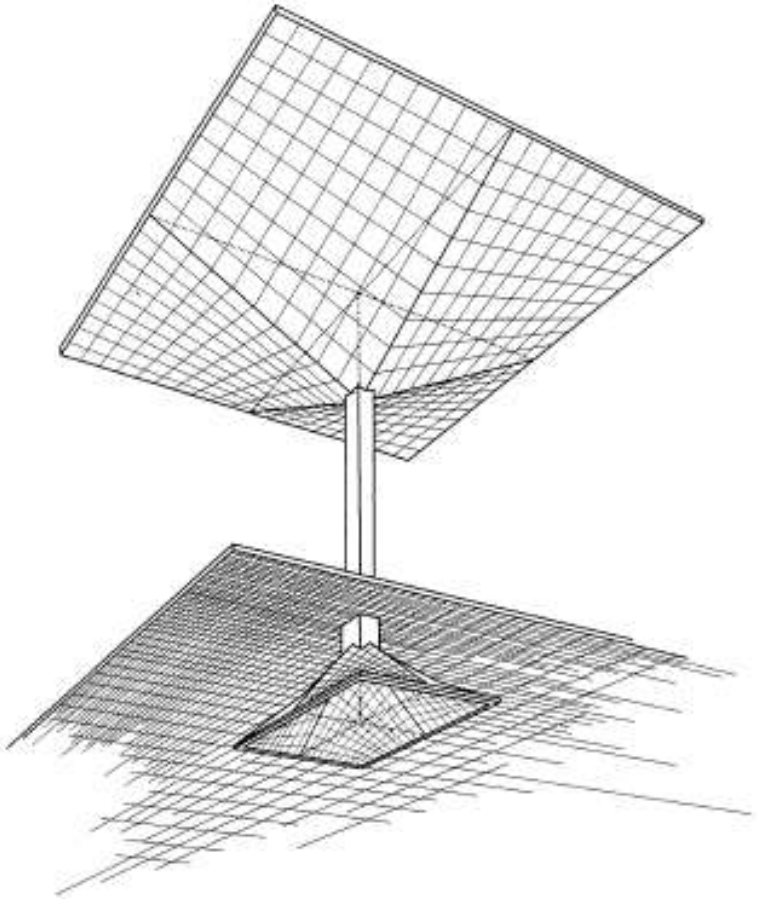
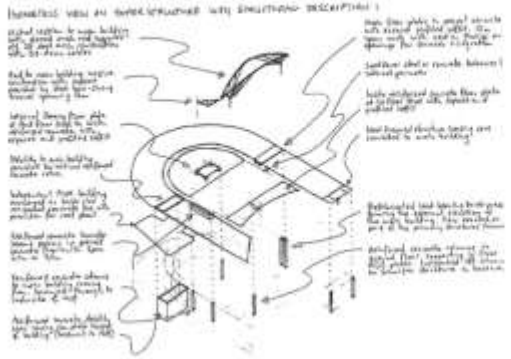
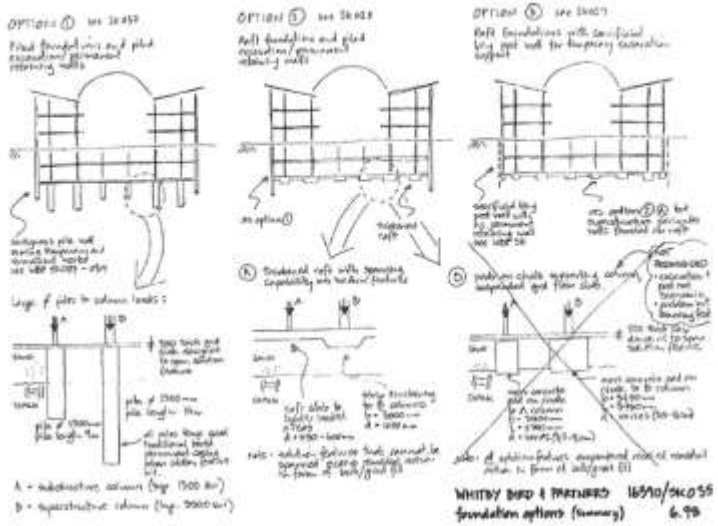
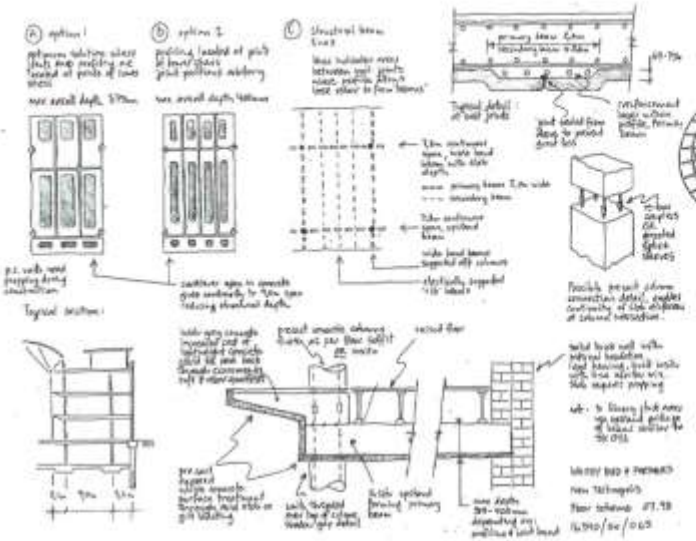
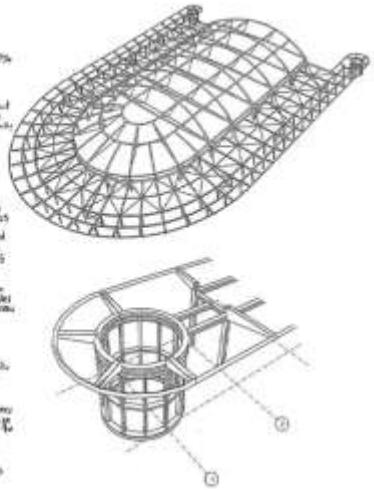










New Technopolis, Norwich

Client
Norfolk and Norwich Millennium Company

Architect
Sir Michael Hopkins

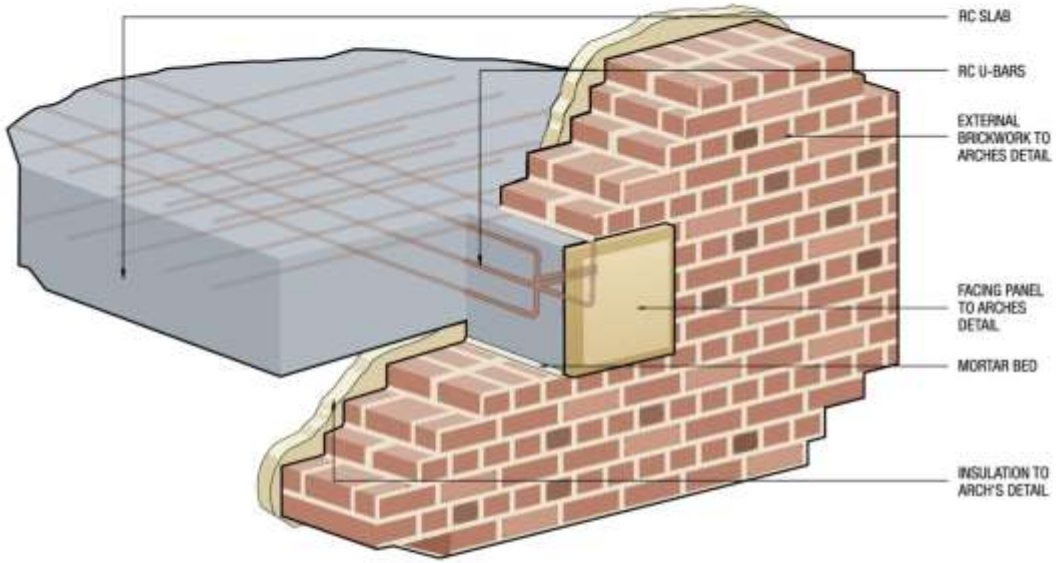
Contract Value
£24m

Status
On Site

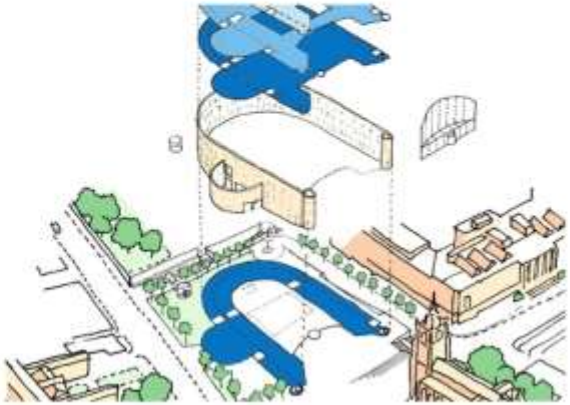
Role
Project Associate

THE FORUM

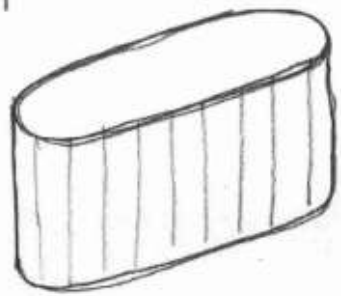
Market Square, Norwich



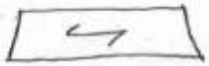
TYPICAL CORBEL DETAIL



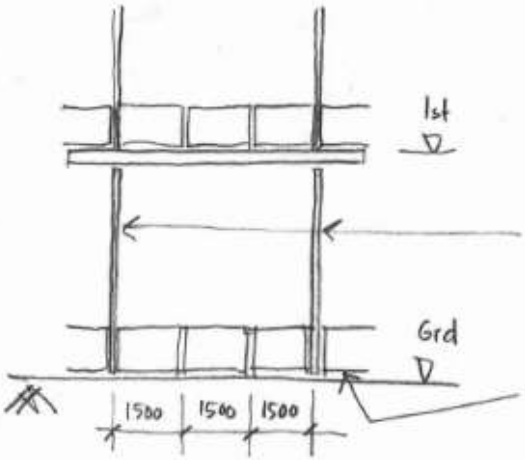
3 storey high walls
say 162mm thk.



floor panel cuts:
... tapered panels not req'd



facade engineering:
.. slab edge deflection control...

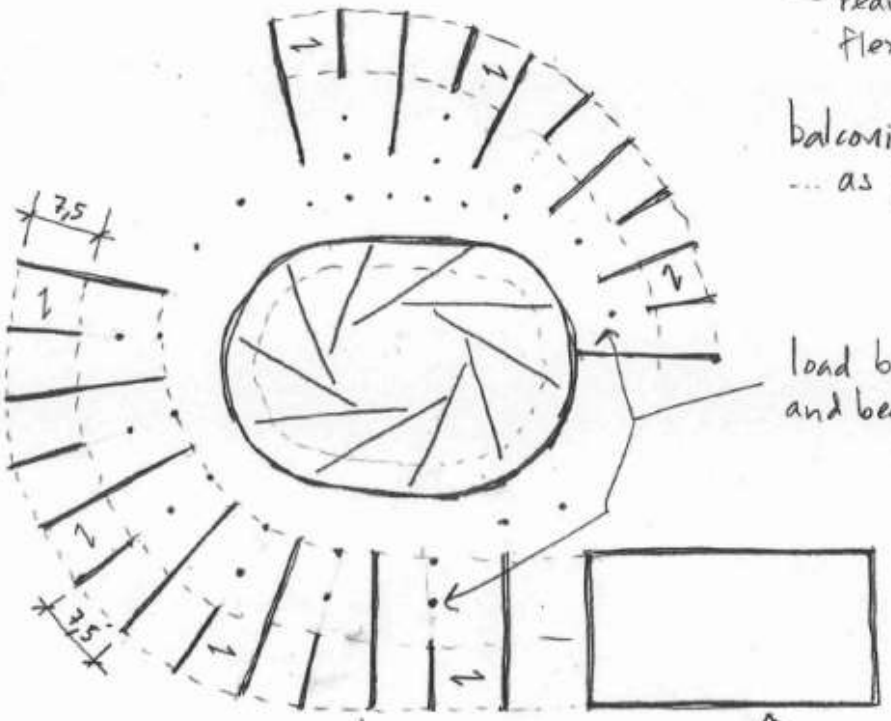


slender steel box 'mullions' to control slab edge deflection.

stability of parapet panels to be reviewed..... OR... just use similar to race track scheme

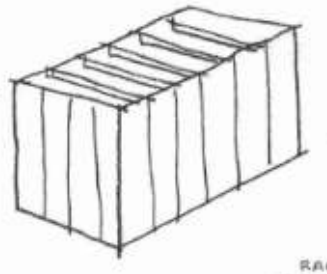
SPOKE STRUCTURE

1:500



load bearing glulam columns and beams

sports block as SJTS walls av 162mm thk glulams 880mm dp.



... don't require fire protection

Key points:
- non load bearing facade
- controlling slab edge deflections at perimeter...
- reduced space planning flexibility

balconies:
... as per race track scheme

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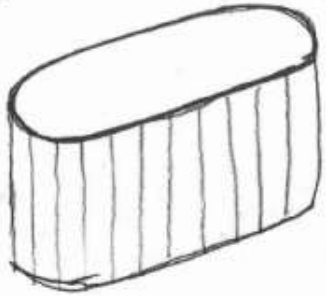
3 storey high walls say 162mm thk.



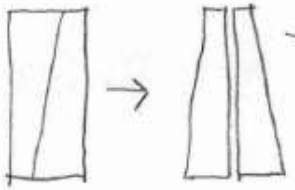
RACE TRACK STRUCTURE

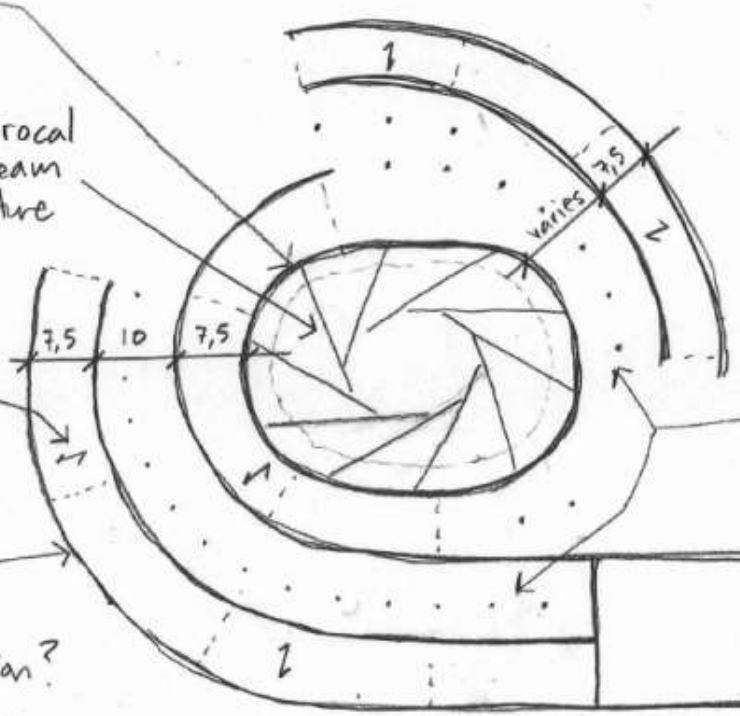
Key points:
- punch window elevations req'd.
- high level of space planning flexibility

balconies:

reciprocal roof beam structure

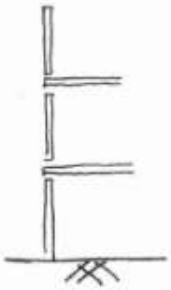
forming tapered/wedges

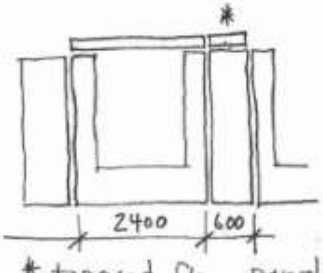




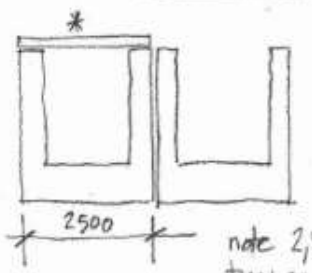
load bearing glulam column lines, no requirement for d/s glulam beams

facade loadbearing preference for platform construction?





OR

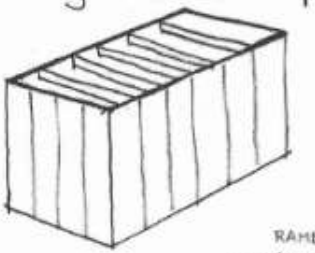


* tapered floor panels

punched window elevations o

note 2,5m wide floor panels transport.....

sport block as SIFS walls av. 162mm thk glulams 880mm dp.



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Future Scenarios

- Demand
- Opportunity
- Leadership

Demand

- Doubling of materials demand by 2050
  - *Due to increase in population and wealth*
- Existing industrial processes already efficient
  - *Predicts maximum 50% emissions savings still to be made (through processes and recycling)*
- Culture of '..substitution of more material for less labour..'


PHILOSOPHICAL TRANSACTIONS OF THE ROYAL SOCIETY A

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Introduction

Material efficiency: providing material services with less material production

Julian M. Allwood[1], Michael F. Ashby[1], Timothy G. Gutowski[2] and Ernst Worrell[3]

[1]Department of Engineering, University of Cambridge, Trumpington Street, Cambridge CB2 1PZ, UK
[2]Department of Mechanical Engineering, Massachusetts Institute of Technology, 77 Massachusetts Avenue, Cambridge, MA 02139-4307, USA
[3]Department of Environmental and Innovation Studies, Utrecht University, Heidelberglaan 2, 3584 CS Utrecht, The Netherlands

Material efficiency, as discussed in this Meeting Issue, entails the pursuit of the technical strategies, business models, consumer preferences and policy instruments that would lead to a substantial reduction in the production of high-volume energy-intensive materials required to deliver human well-being. This paper, which introduces a Discussion Meeting Issue on the topic of material efficiency, aims to give an overview of current thinking on the topic, spanning environmental, engineering, economics, sociology and policy issues. The motivations for material efficiency include reducing energy demand, reducing the emissions and other environmental impacts of industry, and increasing national resource security. There are many technical strategies that might bring it about, and these could mainly be implemented today if preferred by customers or producers. However, current economic structures favour the substitution of material for labour, and consumer preferences for material consumption appear to continue even beyond the point at which increased consumption provides any increase in well-being. Therefore, policy will be required to stimulate material efficiency. A theoretically 'ideal' policy measure, such as a carbon price, would internalize the externality of emissions associated with material production, and thus motivate change directly. However, implementation of such a measure

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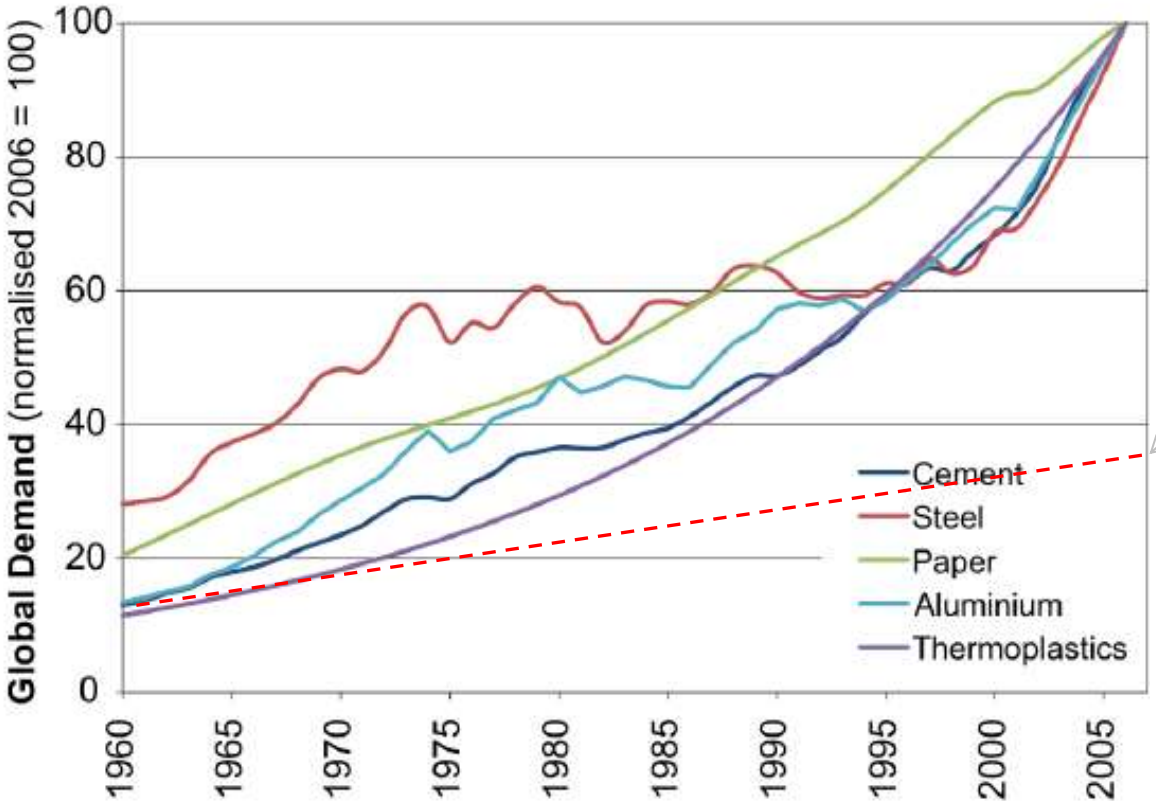
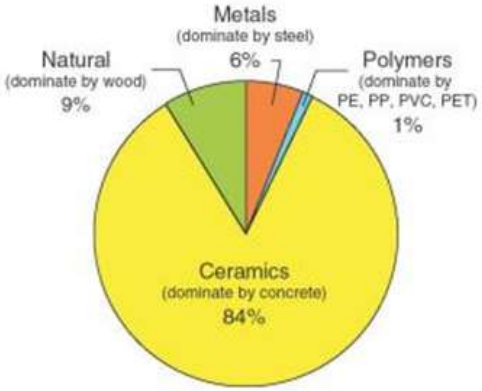
Demand



Global Population



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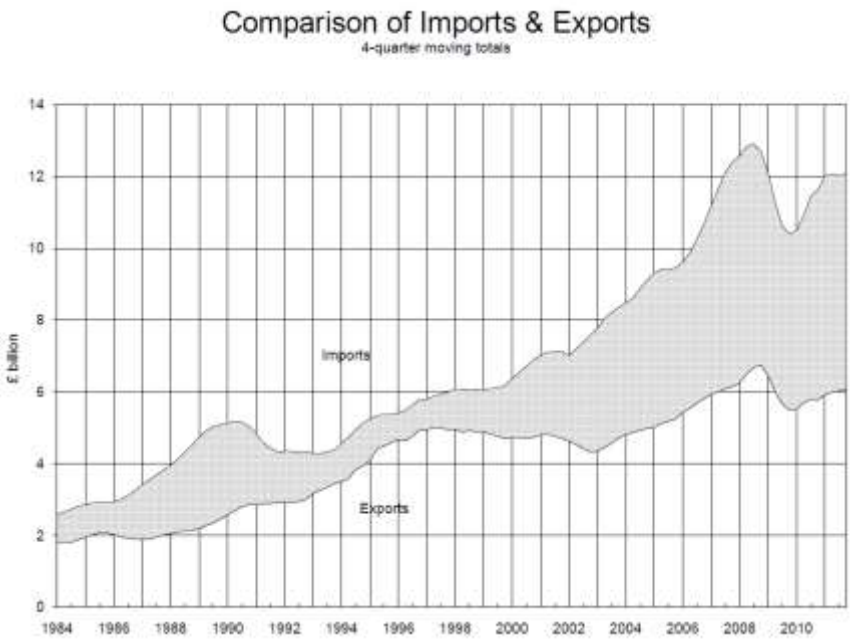
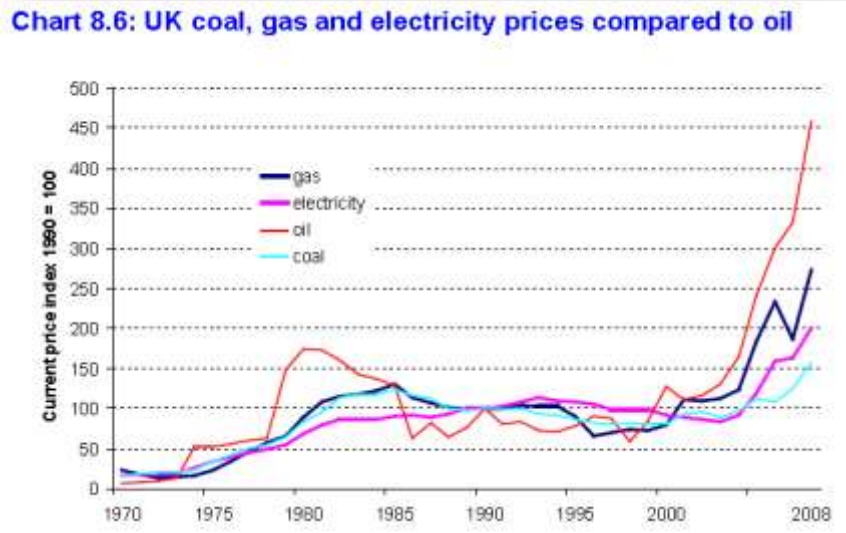
Ref: 'Materials and the Environment' Mike Ashby

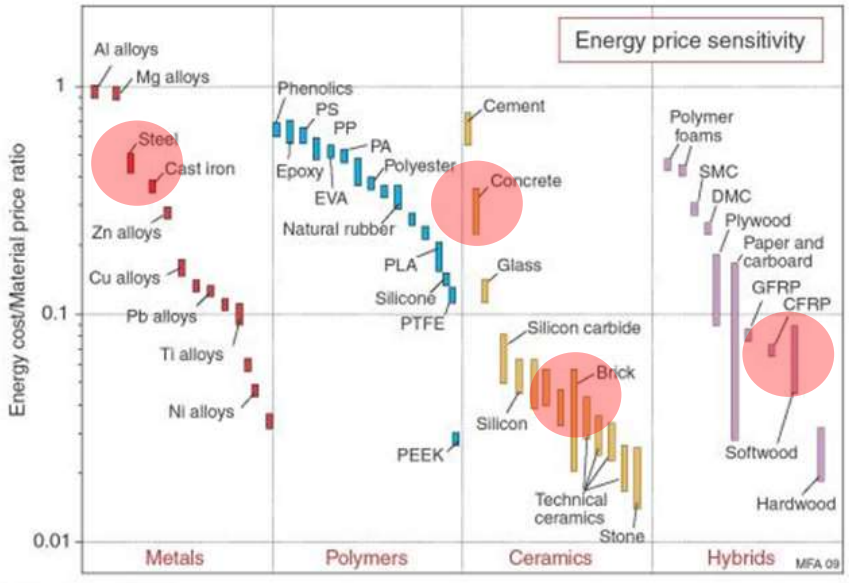
Demand

- **UK – 400mt construction materials used annually (2008)**
  - *1.5mt steel*
  - *100mt concrete*
  - *7.5mt timber*
- **UK has a trade deficit in construction materials/products (2011)**
  - *UK construction products market is £40bn annually*
  - *We import £12bn of construction products annually*
  - *We import £3.5bn from Germany and China*
  - *We export £1.5bn to Ireland and Germany*
  - *We import £650m of steel and export £475m*
  - *We import £110m of cement and export £45m*
  - *We import £135m of rebar and export £50m*
  - *We import £625m of timber*



Demand





← Energy cost represents 100% of material cost

← Energy cost represents 10% of material cost

← Energy cost represents 1% of material cost

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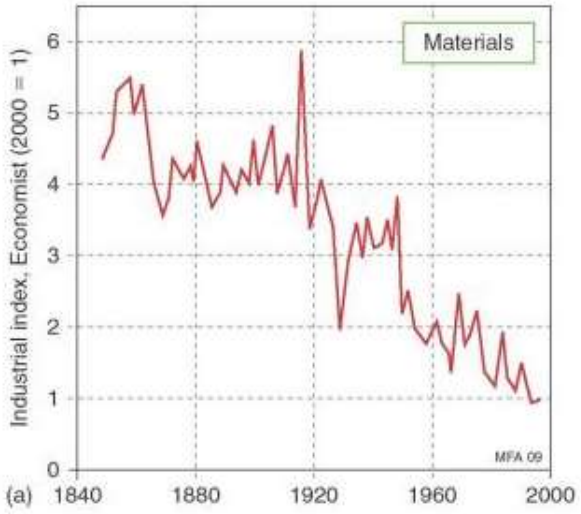
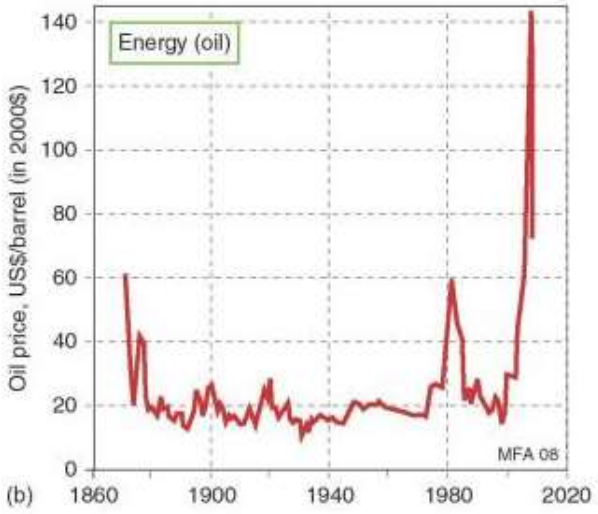
Ref: 'Materials and the Environment' Mike Ashby

Demand

- Increasing cost of thought encourages inefficient design
- Falling cost of materials discourages lean design





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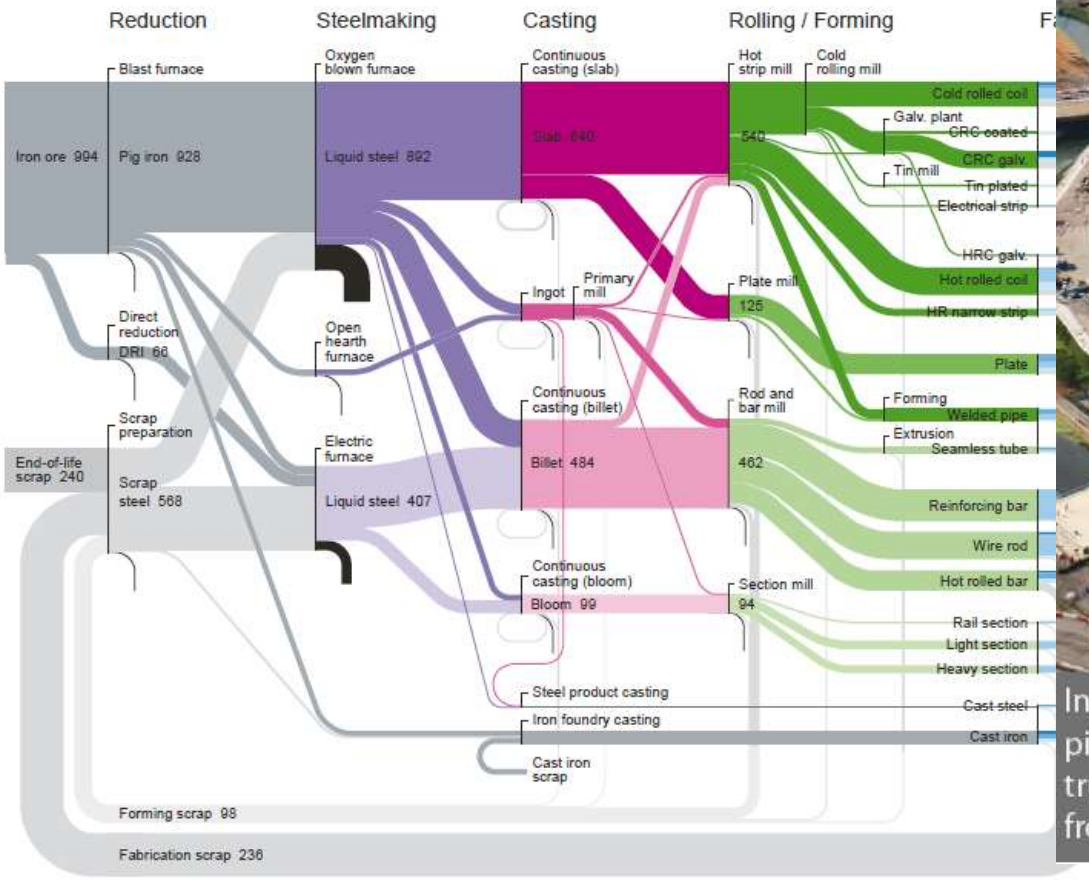
Ref: 'Materials and the Environment' Mike Ashby

Demand

- Steel re-cycling rates



In the Olympic Stadium, 2,500 tonnes of pipeline steel is being reused in the roof truss structure, welded to 15m lengths from 12m stock. (Image: London 2012)

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Ref: WellMet – University of Cambridge

Beijing Stadium

- *World's largest steel structure*
- *42,000t of steel*
- *500kg of steel per seat*

200mm concrete slab…

Spans 21m over 400 seat auditorium

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Opportunity

- Mountain Pine Beetle
- British Columbia Infestation
- Global warming cause
- 700million m^3 of pine killed (50%)

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Opportunity

What could you do with 700milliom m^3 of wood?

- Manufacture 300million m^3 of CLT
  - *Build 7,000,000 homes*
  - *Build 100,000 schools*
- Lock carbon in to buildings
  - *Store 200million t CO2*
- Displace 300million m^3 of concrete
  - *Eliminate 125million t CO2 emissions*

Leadership

- Regulation
- Corporate

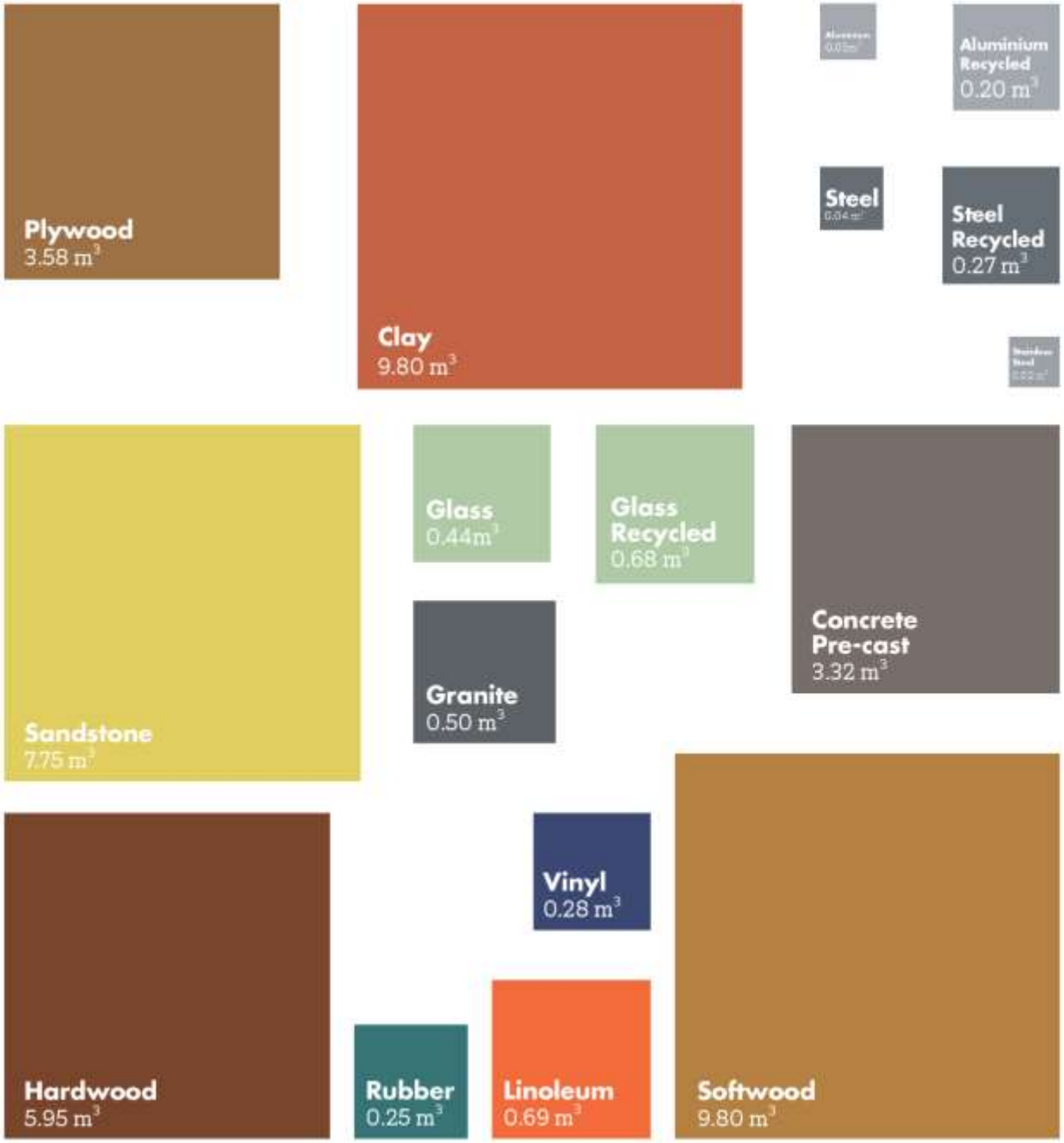
Leadership

Hackney Council ‘WoodFirst’ planning policy

- *Consultation*
- *Stadthaus, Bridport House and Mossbourne Academy are all in Hackney*
- *Not a ‘Wood Only’ policy!*
- *‘Although the Council is keen to promote the benefits of building with wood, it is not considering a policy that would exclude locally sourced building materials or prevent the use of other sustainable building materials in future developments. However, it will take into account the carbon footprint of a new development to ensure it is in line with its sustainability policy and the use of structural timber would help to contribute to this.’*

inthescaleofcarbon.com

Materials Council



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Leadership

- Carbon negative concrete
  - *Uses magnesium silicates in leau of cement*
  - *Process could absorb more CO2 than it produces during manufacture*
  - *UK venture Novacem acquired by Calix in 2012*

Ref: Novacem & Imperial College London

Leadership

- What ~~would~~ will a timber solution look like?

November 2012 – Google give $3m funding to USGBC to research healthy buildings and how building materials affect human health…

Credits

- *'3,000 Years of Design, Engineering and Construction' by Bill Addis*
- *'Materials and the Environment' by Mike Ashby*
- *'Sustainable Materials' by Julian Allwood*
- *St Miles Bridge – Engineering Timelines*
- *Jarrold Bridge – Ramboll, RG Carter*
- *24 Cattle Market Street – English Heritage Listing, Flickr*
- *Surrey Street – English Heritage Listing, Google StreetView*
- *Norwich Sports Park – Concrete Quarterly*
- *Sainsbury Centre – Foster and Partners, Anthony Hunt*
- *Forum – Hopkins Architects, Whitbybird, RG Carter*
- *Open Academy – Sheppard Robson Architects, Ramboll, Kier*