UK Structural Engineers Declare Climate & Biodiversity Emergency

So, what should universities be doing?

Tim Ibell

Signatures:

119

Adept Consulting Engineers Ltd
AECOM UK & Ireland
Agile Engineering
AKSWard Ltd
AKT II
Applied Engineering Design Limited
ARCADIS
Arup
Atkins
BAC Engineering Consultancy Group
BDP
Beta Design Consultants
Betts Associates Limited
Blue Engineering
Booth King Partnership Limited
Bryden Wood
BuroHappold Engineering
Cake Industries
Capstone Consulting Engineers
CGA Consulting
changebuilding
Chris Pike Associates
Civic Engineers
Cobb & Company
Conisbee
CORA Consulting Engineers
Craddys
CRE8 Structures
Cundall
Curtins
Davies Maguire
Define Engineers Ltd
Design Engineering Workshop
Design ID
Dice
Dudleys Consulting Engineers
DYSE
Eckersley O'Callaghan
Edge Structures Limited
Elliott Wood Partnership Ltd
Ellis and Moore
Engenuiti
Engineeria Ltd
engineersHRW
Entuitive
Evolve Consulting Engineers Limited
Expedition Engineering
Foster + Partners
Free4m Consulting Ltd
Gawn Associates
GHD
Glass Light and Special Structures
Hardman Structural Engineers Ltd
Heyne Tillett Steel
Hydrock
IABSE - International Association for Bridge and Stuctural Engineering
Ian Firth Structural Engineering
Imagine Engineering
Integral Engineering Design
JAM Structural Design
Jensen Hunt
Jon Carr Structural Design
Knight Architects
Legacy Structural Engineers
Light Earth Designs
London Structures Lab
Lyons O'Neill
Mason Navarro Pledge
MEICON
Michael Aubrey Partnership
Michael Barclay Partnership LLP
Michael Hadi Associates Ltd.
Momentum
Morph Structures
Mott MacDonald
Parmarbrook Limited
Patrick Ryan Associates
PK & Partners
Price & Myers
Ramboll
RISE Structures
Robert Bird Group
RPS Consulting
Rushmoor Engineering Services
RWDI
scale consulting
SD Structures
Simple Works
Smith and Wallwork
STRUCTeam Ltd
Structural & Civil Consultants Ltd
Structure Workshop
Structured Environment
StructureMode
Studio One Consulting Limited
Subteno Ltd
think tank engineering
Thisolutions Ltd
Thornton Tomasetti
Tongji Architectural Design (Group)
Tony Gee and Partners LLP
University - Abertay, School of Applied Science
University - Bath, Dept of Architecture and Civil Eng
University - Bradford, Civil and Structural Engineering
University - Bristol, Dept of Civil Engineering
University - Brunel, Department of Civil & Environmental Engineering
University - Glasgow Caledonian, Dept of Environmental Civil Engineering
University - Leeds, School of Civil Engineering
University - Liverpool John Moores, School of Engineering
University - Loughborough, School of Architecture Building and Civil Engineering
University - Plymouth, School of Engineering, Computing and Mathematics
University - Sheffield, Dept Civil & Structural Engineering
University - Warwick, School of Civil Engineering
University of Dundee - Civil Engineering
Walsh
web structures
Webb Yates Engineers
Whitby Wood
WSP

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Messaging

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Climate change

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Climate change

equals

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Climate change

equals

WAR

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$10,000,000,000,000

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$10,000,000,000,000

(1% savings pays for all drug discovery)

Bringing this to the human scale..

- Going vegan will reduce your carbon footprint by around ***two tons per year***
- A typical structural engineer responsible for 4000m² of new building per year, at a typical carbon footprint of 250kg/m², is responsible for ***1000 tons of carbon per year***
- Every 1% saving by the structural engineer is ***five times*** more than going vegan and ***10 times*** more than flying to New York
- (The superstructure of a London high-rise can easily have an embodied carbon footprint of 100,000 tons)

UNSDGs
(the big picture)

Source: Will Arnold, Arup

But with some focus..

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Operational energy

Material efficiency

Appropriate loads

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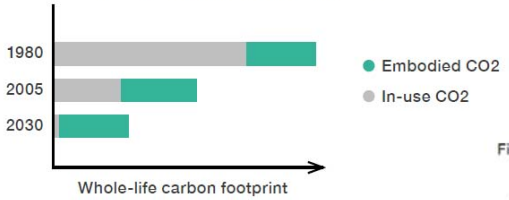
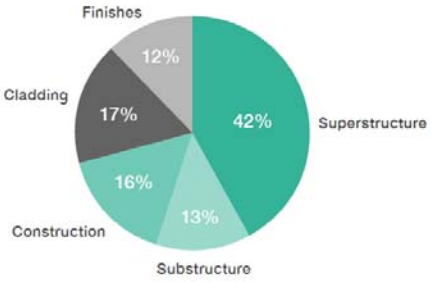
Material efficiency

In-use CO2 versus embodied CO2



Source: Cole and Kernan (1996); Sturgis and Roberts (2010) and Lane (2007)



Source: S.C. Kaethner and J.A. Burridge, Embodied CO2 of Structural Frames, The Structural Engineer, Vol 90, May 2012, pp33-40

MEICON

"Thank you for reaching out, however as a structural engineer I am not heavily involved in the energy/sustainability side of the industry. Please remove me from this request list."

And no more!

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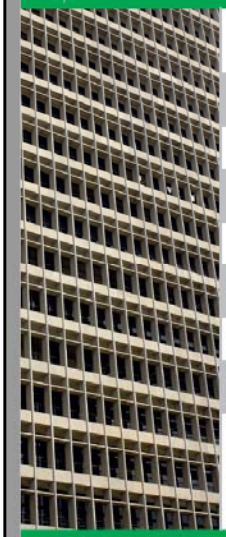
Loading

Minimising Energy in Construction

www.meicon.net



Design occupancy for office building with 16 floors and 30,000m² office area

Calculations are approximate to illustrate variation between disciplines.

Ventilation — **3,000 people**

BSRIA Rules of Thumb Guidelines for Building Services 5th Edition, Table 3

10m² per person = 3,000 people

Space Planning — **3,750 people**

BCO Specification for Offices, 2014

High Density = 8m² per person = 3,750 people

Low Density = 13m² per person = 2,308 people

Fire Design — **7,500 people**

BS 9999:2017 Table 9, Typical Office Floor Space Factors

High Density = 4m² per person = 7,500 people

Low Density = 10m² per person = 3,000 people

Structural Design — **85,500 people**

BS EN 1990, BS EN 1991-1-1

Ultimate Limit State, γ_Q = 1.5 (partial factor for live load), α_n = 0.5 (reduction factor >10 storeys)

q_k = 3kN/m² over 95% of floor area (Typical value not including partitions or 5% more heavily loaded areas)

Total load ($\gamma_G \alpha_n q_k A$) = 64MN. Assuming each occupant = 0.75kN = **85,500 people**

Without area reduction α_n = *171,000 people*

Serviceability Limit State, γ_Q = 1.0 (partial factor for live load), α_n = 0.5 (reduction factor for multi-storey)

Total load ($\gamma_G \alpha_n q_k A$) = 43MN. Assuming single occupant 0.75kN = **57,000 people**

Without area reduction α_n = *114,000 people*

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It's nuts!

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How do we ACTUALLY make zero-carbon buildings?

Structural Engineers need tools NOW

Things to instil in our students:

It is possible to make beautiful buildings which are good in all ways

Ability to design low-, zero- and negative-carbon structures

Holistic understanding of materials

Measurement, monitoring and evaluation of previous projects

Excitement for refurbishment and conservation

Understanding of 'old materials' to achieve this

Asking the big what ifs (no cement, no steel, no new buildings, etc)

Great engineering can be to suggest doing nothing

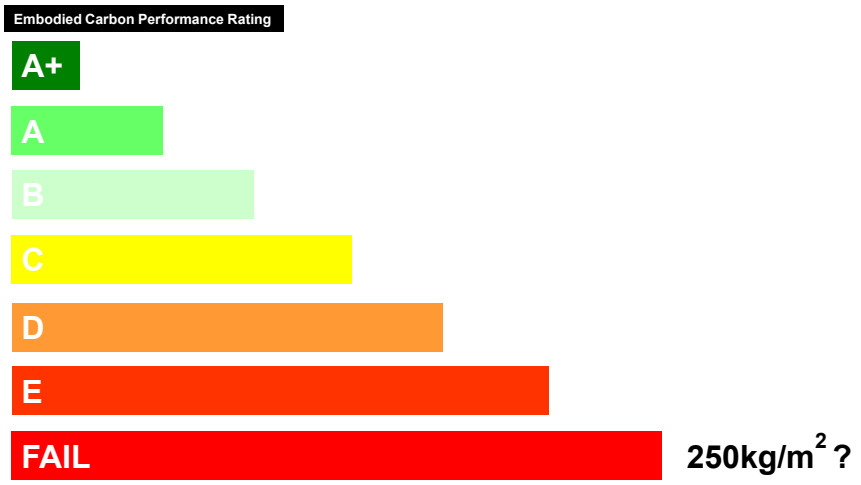
Empowerment to question the brief and to say no!

Questioning the loads, material use and legacy

Collaboration for holistic design to drive materials and energy efficiency

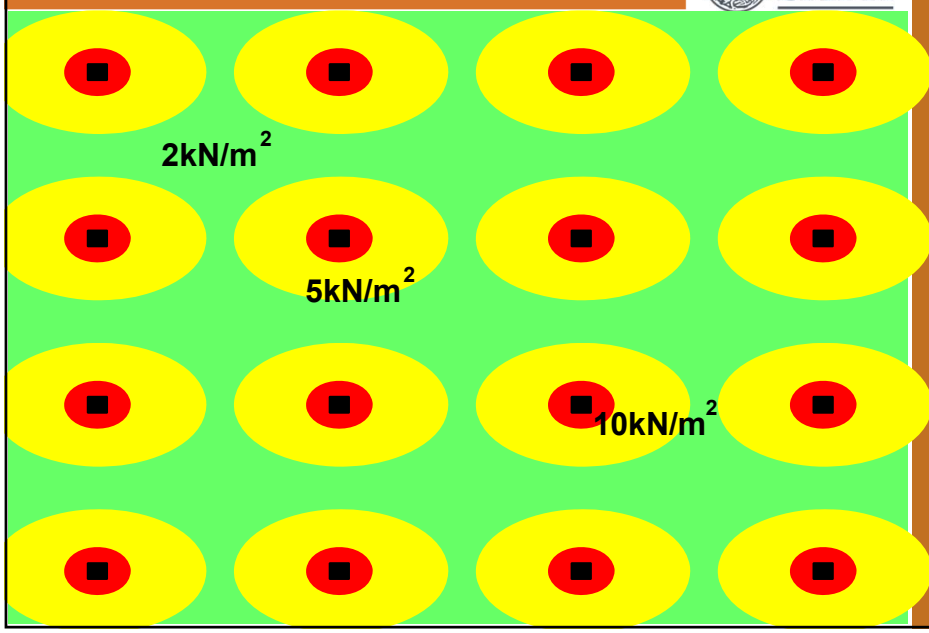
Exploitation of technology (parametric design, automation and traffic lights)

Performance Charts for Embodied?



250kg/m^2 ?

Contour maps?



Thank you.

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the BRE centre for innovative construction materials