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BATH

Resilient and Sustainable Infrastructure

Tim Ibell



Five research centres

BRE Centre for Innovative Construction Materials (BRECICM)

Engineering and Design of Environments (EDEn)

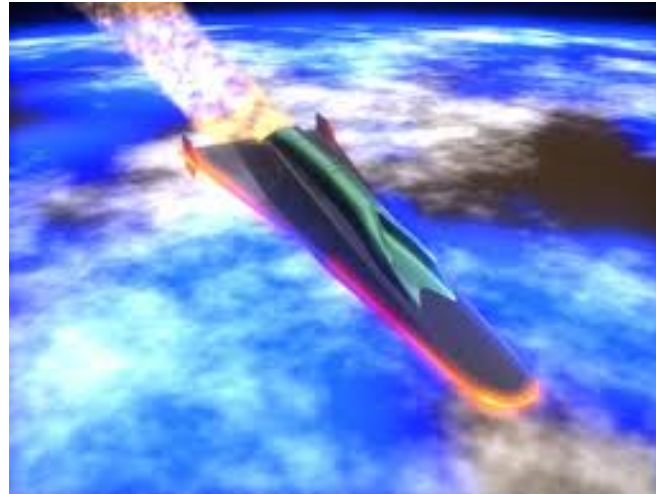
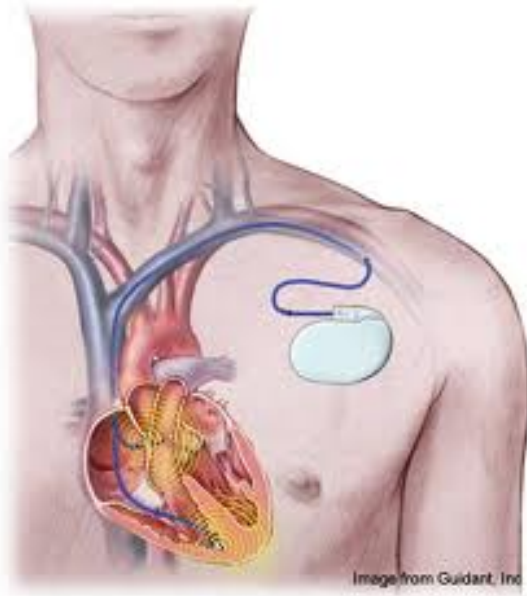
Centre for Advanced Studies in Architecture (CASA)

Centre for Window and Cladding Technology (CWCT)

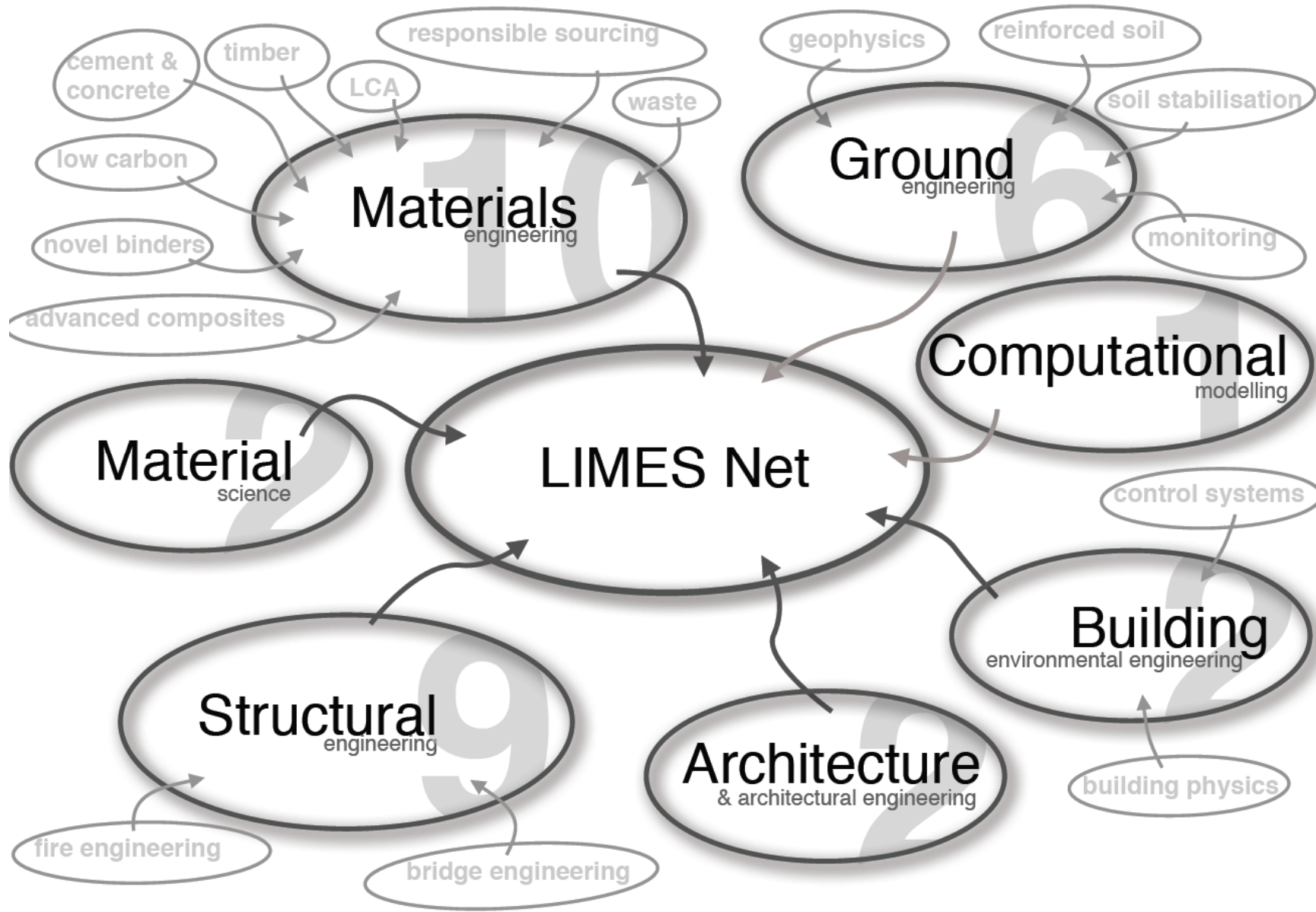
Sustainable Energy Research Team (SERT)

The team

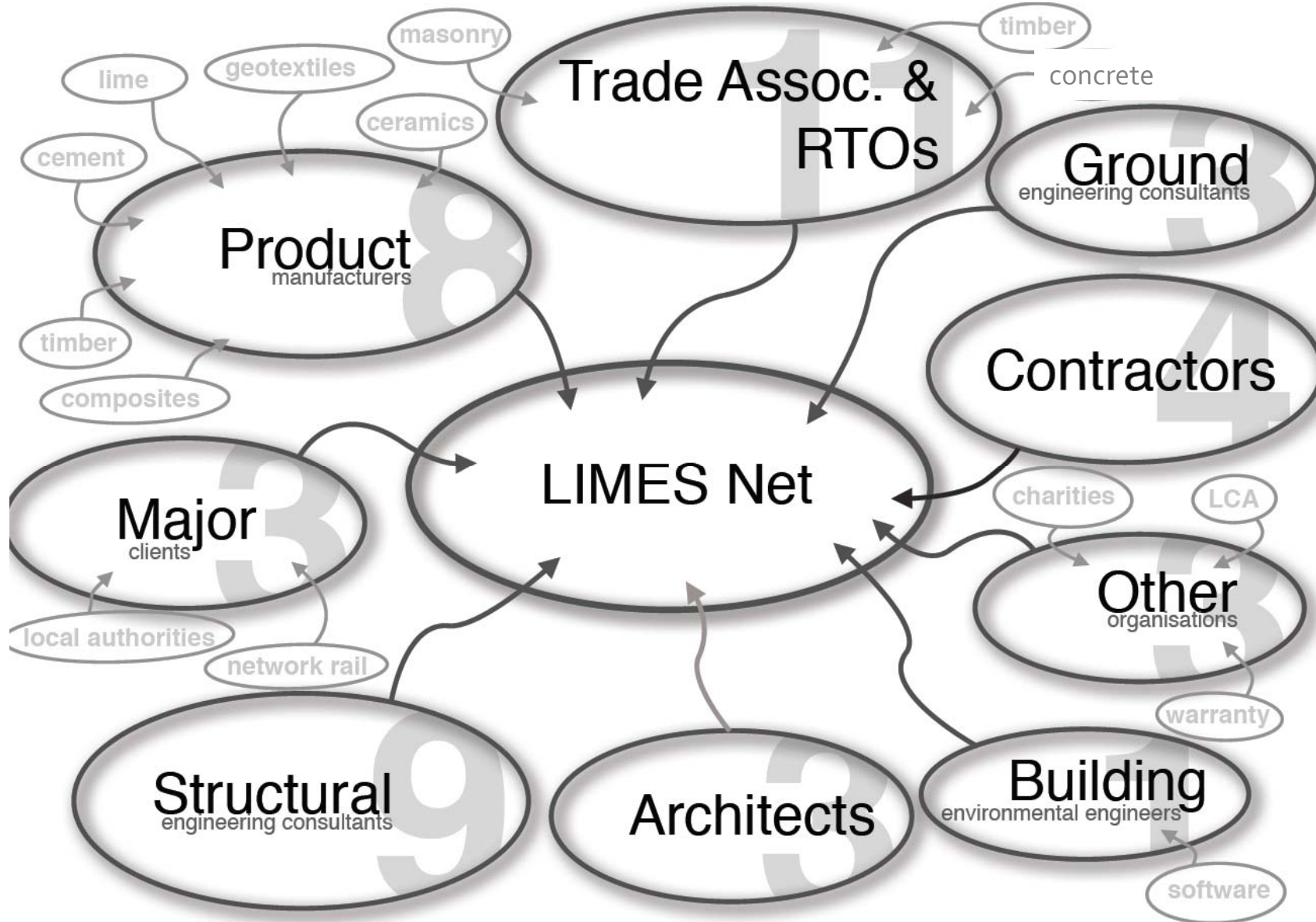




Academic partners



Industry partners



Please also join LIMESNet

Eloise Spark
e.spark@bath.ac.uk

bre **cicm**

the BRE centre for innovative construction materials

Resilience



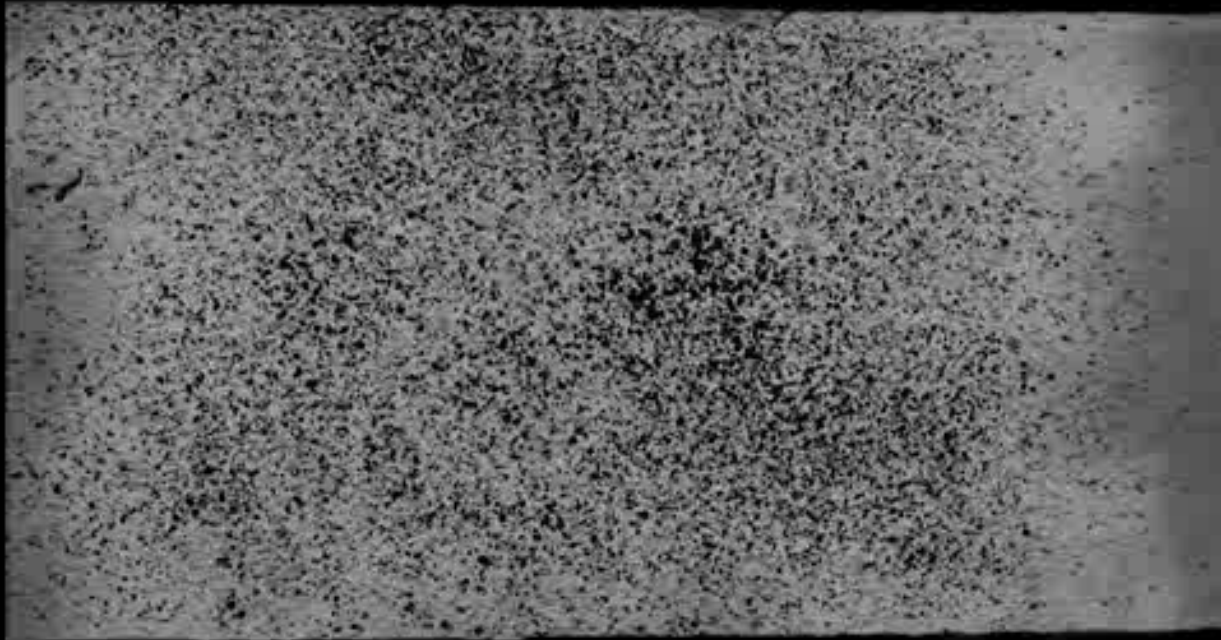


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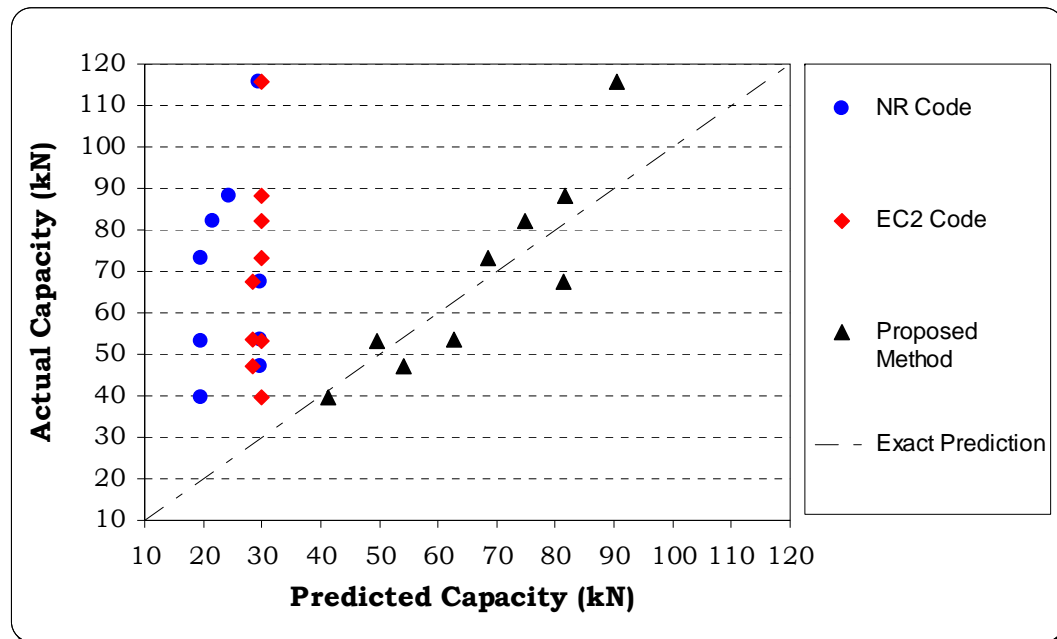
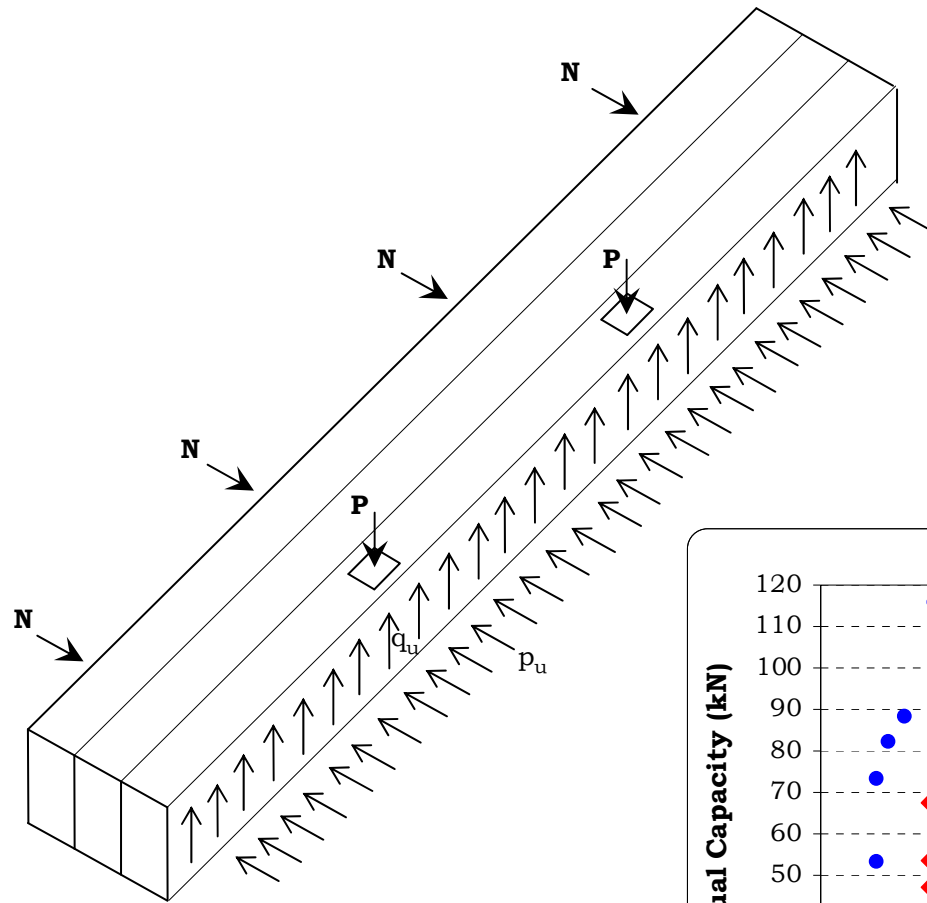


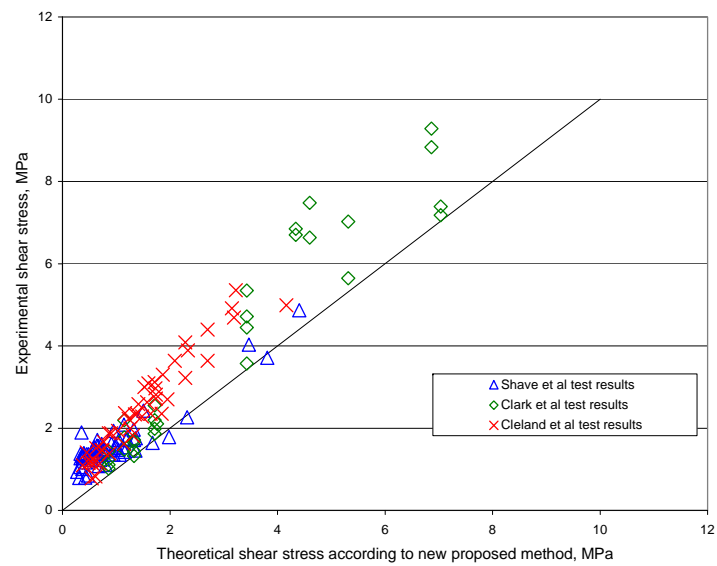
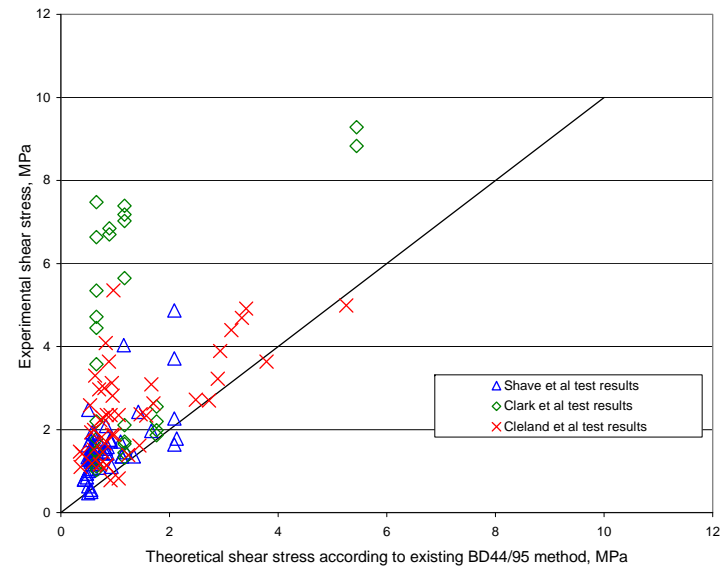
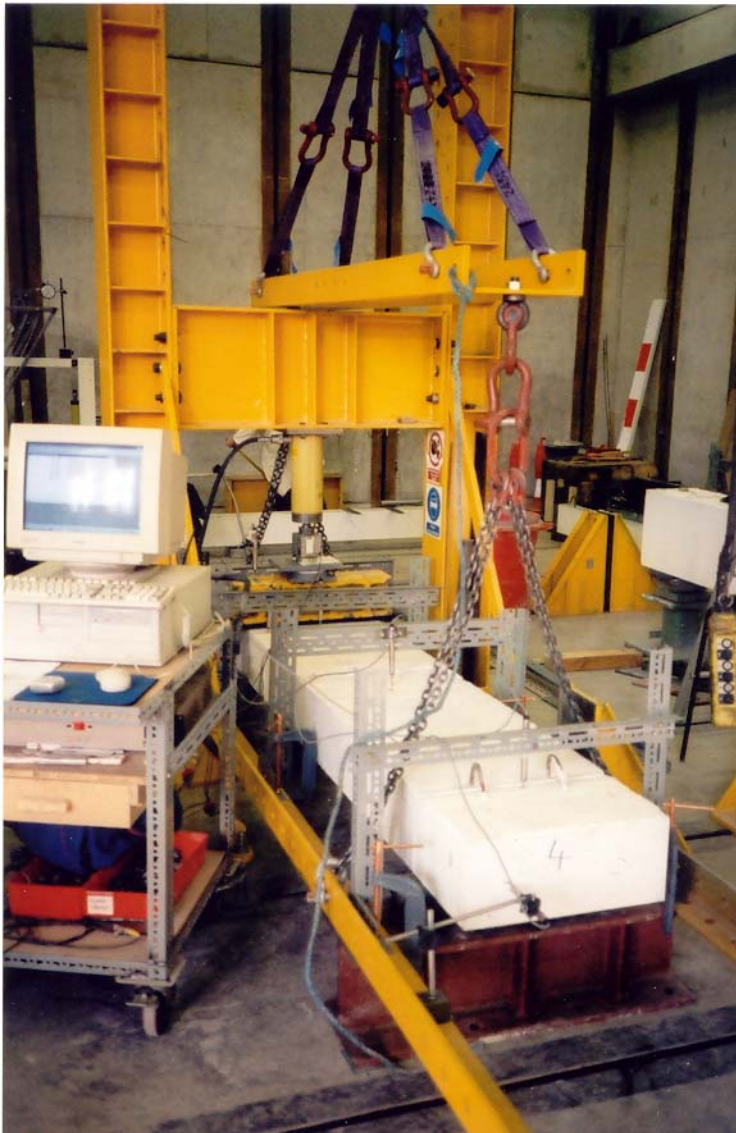


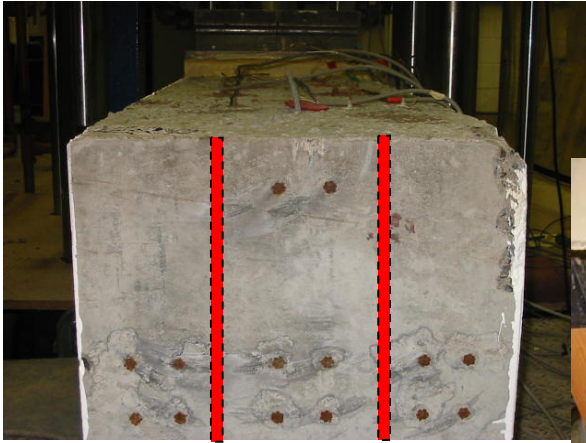
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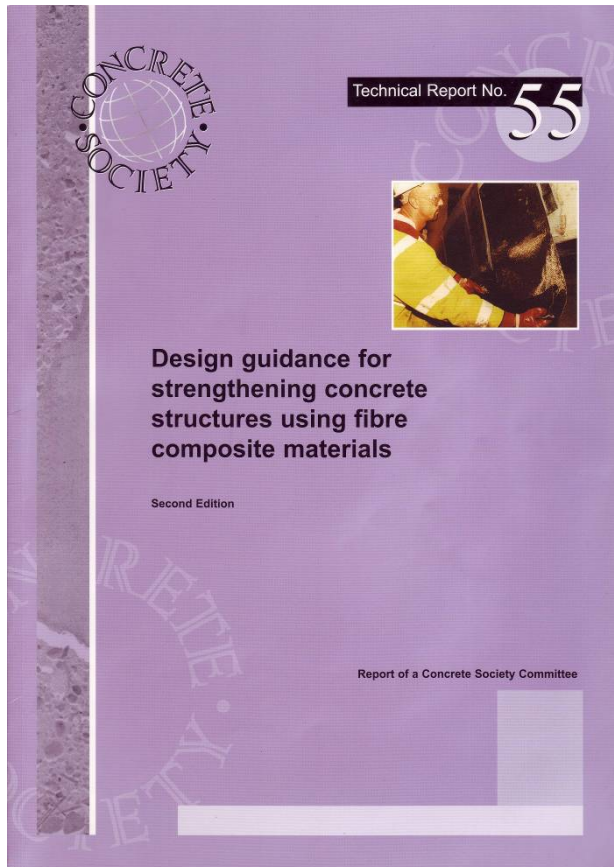












Microsoft Excel - FRP material type my code

File Edit View Insert Format Tools Data Window Help

Product Info Data Input Switch Form Help Security...

W11

FRP Strengthening System - Selection Toolkit

UMR coforce[™] UNIVERSITY OF BATH

Strengthening System Options	Options
FRP feasibility FRP advantages and disadvantages over alternative strengthening methods	Weaknesses
Pre-installation Treatment 1 - Degradation diagnosis	
Diagnosis of potential concrete substrate degradation mechanisms - Environment & general site conditions (insufficient secondary reinforcement, Freeze-thaw etc..)	
Pre-installation Treatment 2 - Crack Treatment	Cracks
Concrete substrate damage - repair and retrofit recommendations (Epoxy repair, Stitching etc..)	Substrate
Pre-installation Treatment 3 - Concrete substrate treatment	
RC Concrete chemical and mechanical preventative repair techniques (Cathodic protection, Realkalisation etc..)	

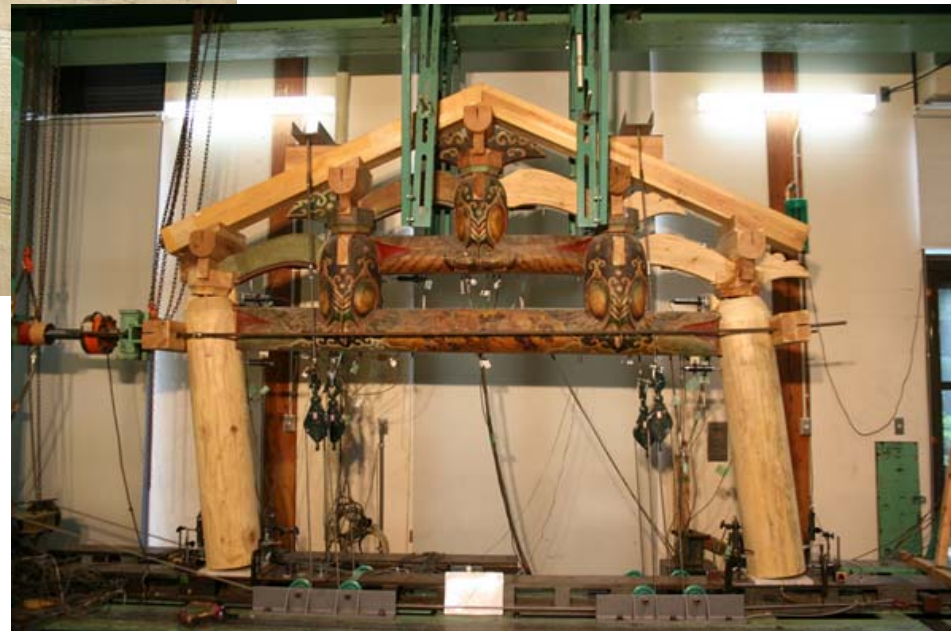
Intro / Options / Material / System / Adhesives / Substrate / Cracks / Weaknesses / Flexural Strengthening (2) / Shear Strengthening

Draw AutoShapes

Ready Circular

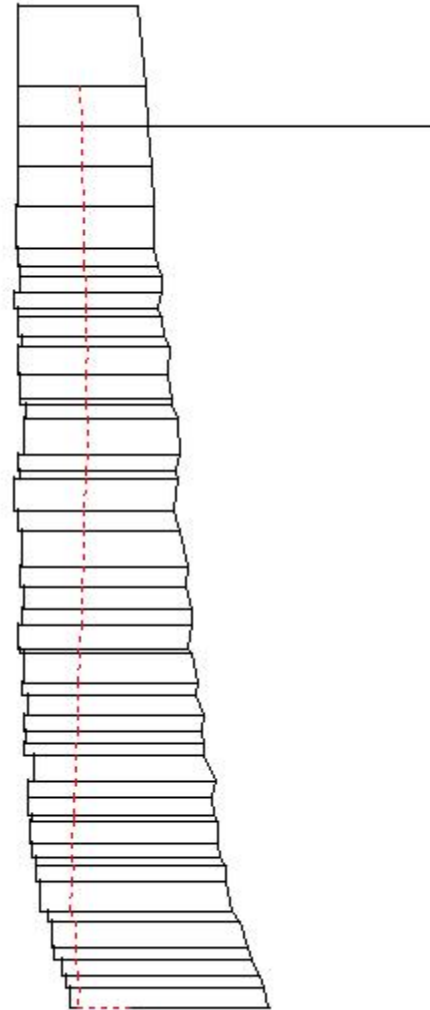
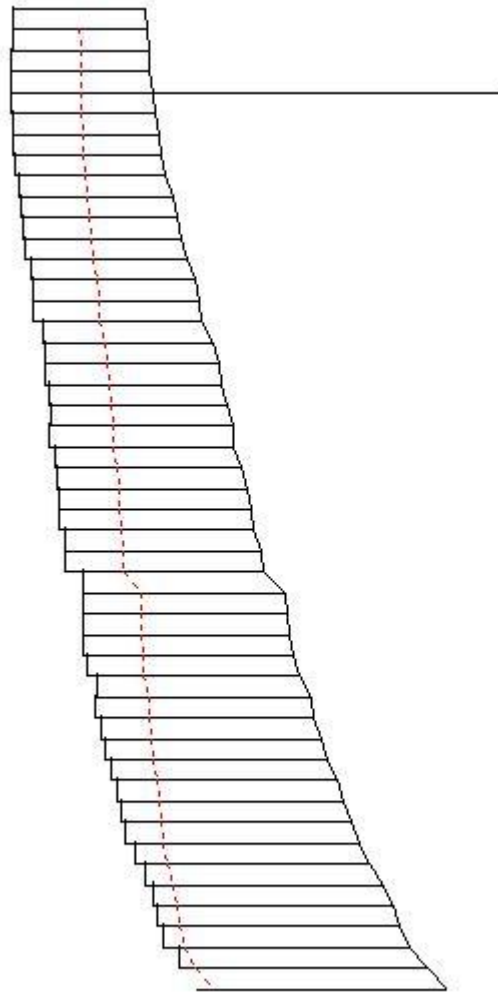
start visual basic dissertation report - ... Microsoft Excel - FRP ... Microsoft Visual Basic ... 21:30





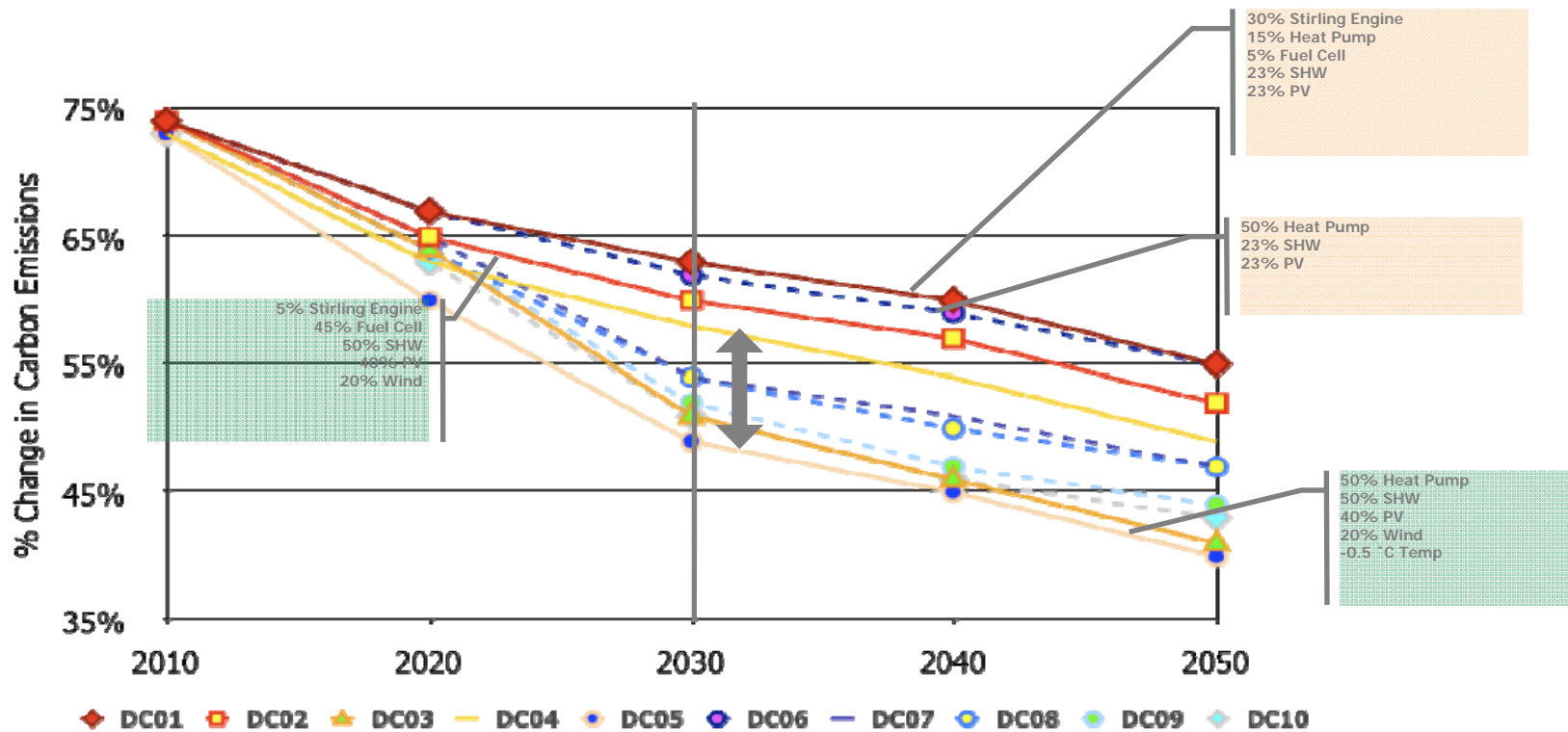








Sustainability



Near & Long Term Targets

Based on the BRE's Step Change 2 Scenario

Inventory of Carbon and Energy (ICE)

Material Profile: Concrete							
Embodied Energy (EE) ICE-Database Statistics - MJ/Kg							
Main Material	No. Records	Average EE	Std Deviation	Minimum EE	Maximum EE	Comments on the Database Statistics:	
Concrete	124	2.92	8.61	0.07	92.50	None	
Concrete, General	112	3.01	9.07	0.07	92.50		
Unspecified Virgin	85	2.12	2.85	0.07	23.90		
Virgin	27	6.02	18.24	0.59	92.50		
Concrete, Pre-Cast	12	2.18	0.78	1.20	3.80		
Unspecified Virgin	8	2.42	0.84	1.36	3.80		
Virgin	4	1.72	0.42	1.20	2.19		
Selected Embodied Energy & Carbon Coefficients and Associated Data							
Boundaries	Cradle to Gate			Data Range	(+/- 30%)		Specific Comments
Material	Embodied Energy - MJ/Kg			Embodied Carbon - Kg CO2e/Kg			
General Concrete	0.75			0.107		It is strongly recommended to avoid selecting a 'general' value for concrete. Selecting data for a specific concrete type (often a ready mix concrete) will give greater accuracy, please see comments. Assumed cement content 12% by mass. Assumed use of weighted average UK cement.	
16/20 Mpa	0.70			0.100		Using UK weighted average cement (more representative of 'typical' concrete mixtures).	
20/25 MPa	0.74			0.107			
25/30 MPa	0.78			0.113			
28/35 MPa	0.82			0.120			
32/40 MPa	0.88			0.132			
40/50 MPa	1.00			0.151			
READY MIX CONCRETE (ICE CMC Model Results)							
BS 8500:2006 CONCRETE DESIGNATIONS							
Material	Embodied Energy - MJ/kg			Embodied Carbon - kgCO2e/kg			NOTE: Cradle to Gate
FLY ASH							
% Cement Replacement - Fly Ash	0% (using CEM I)	15%	30%	0% (using CEM I)	15%	30%	Note 0% is a concrete using a CEM I cement
GEN 0 (6/8 MPa)	0.55	0.52	0.47	0.076	0.069	0.061	Compressive strength designation C6/8 Mpa. 28 day compressive strength under British cube method of 8 MPa, under European cylinder method 6 MPa. Possible uses: Kerb bedding and backing. Data is only cradle to factory gate but beyond this the average delivery distance of ready mix concrete is 8.3

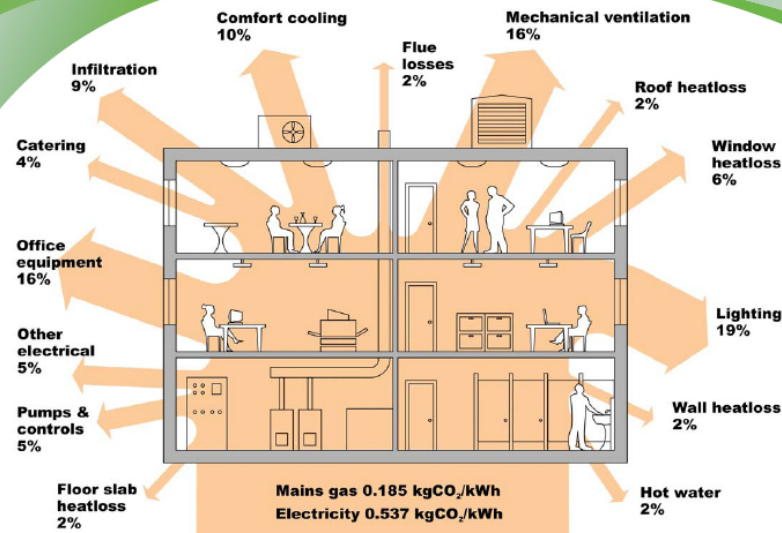


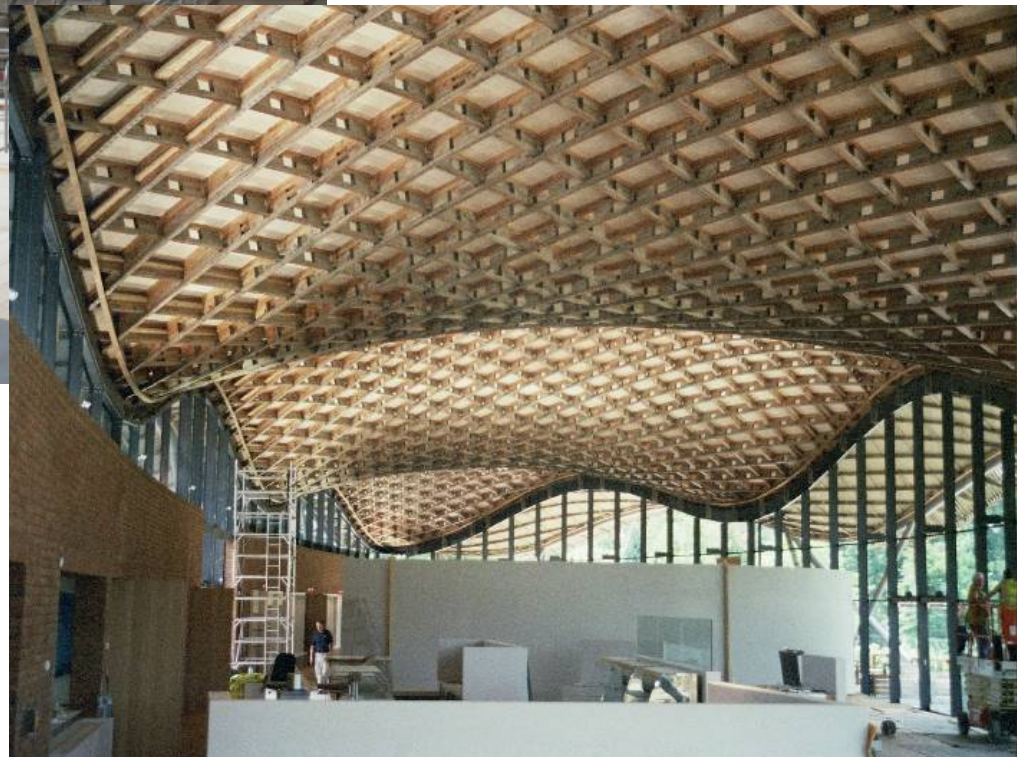
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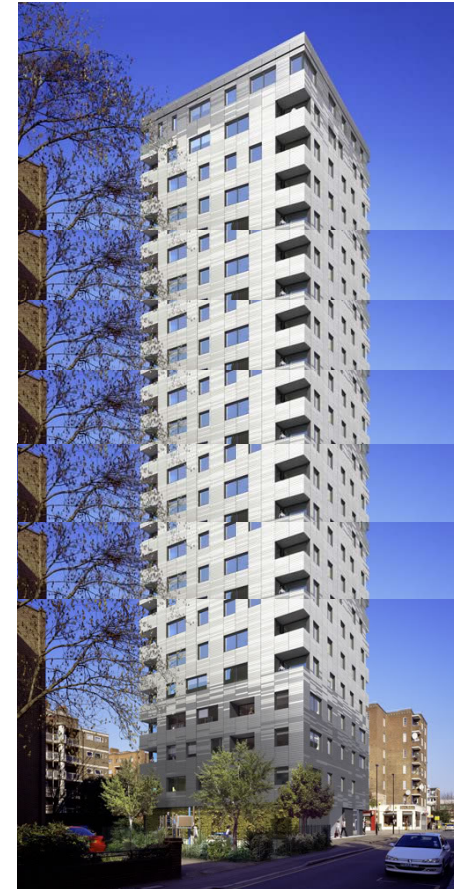
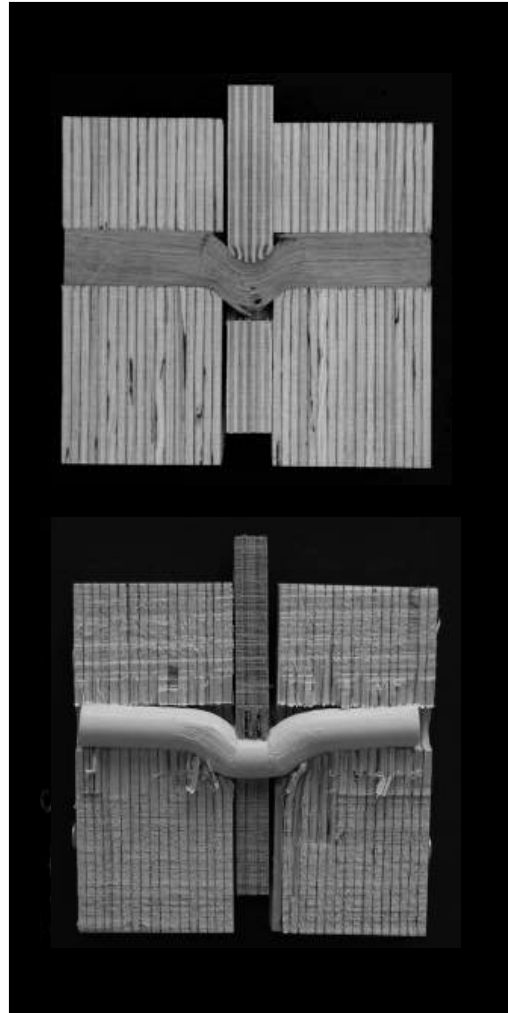


The Royal Academy
of Engineering

Engineering a low carbon built environment The discipline of Building Engineering Physics







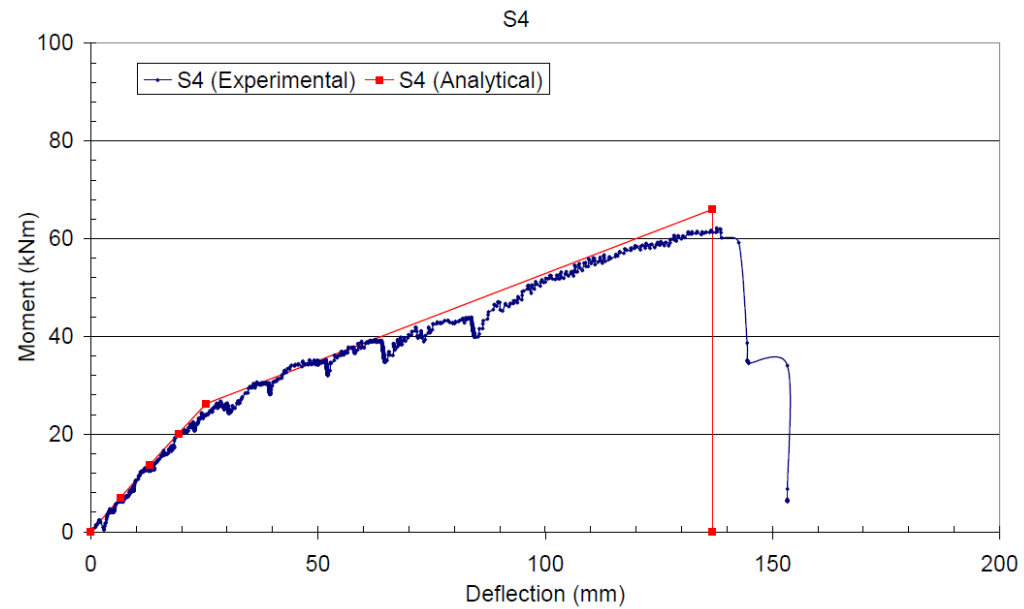
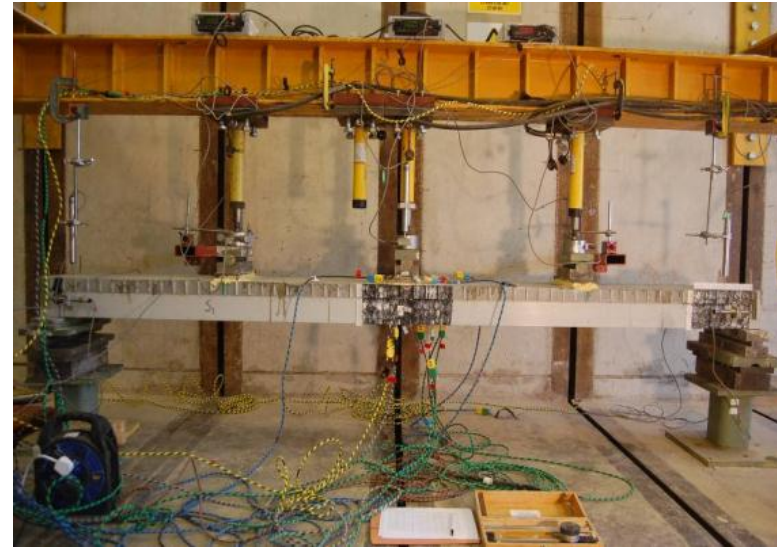




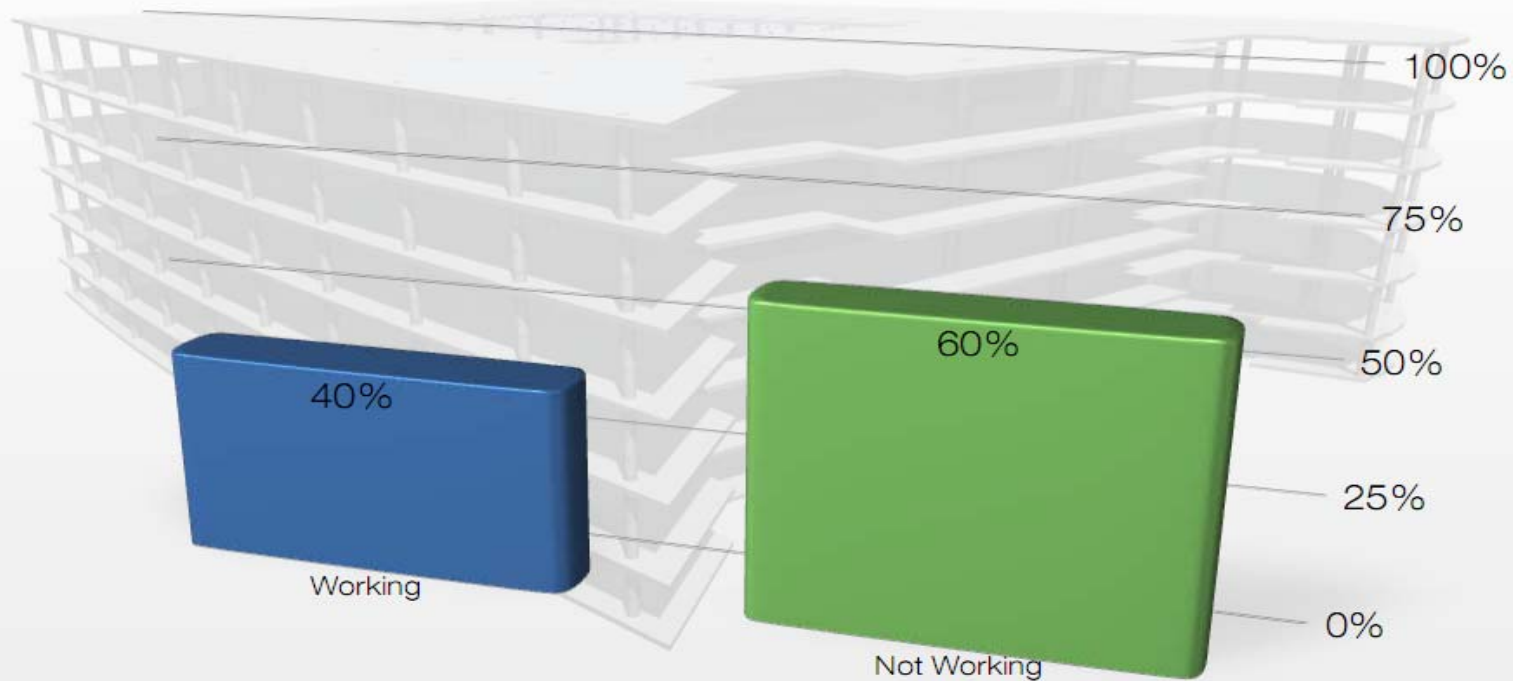






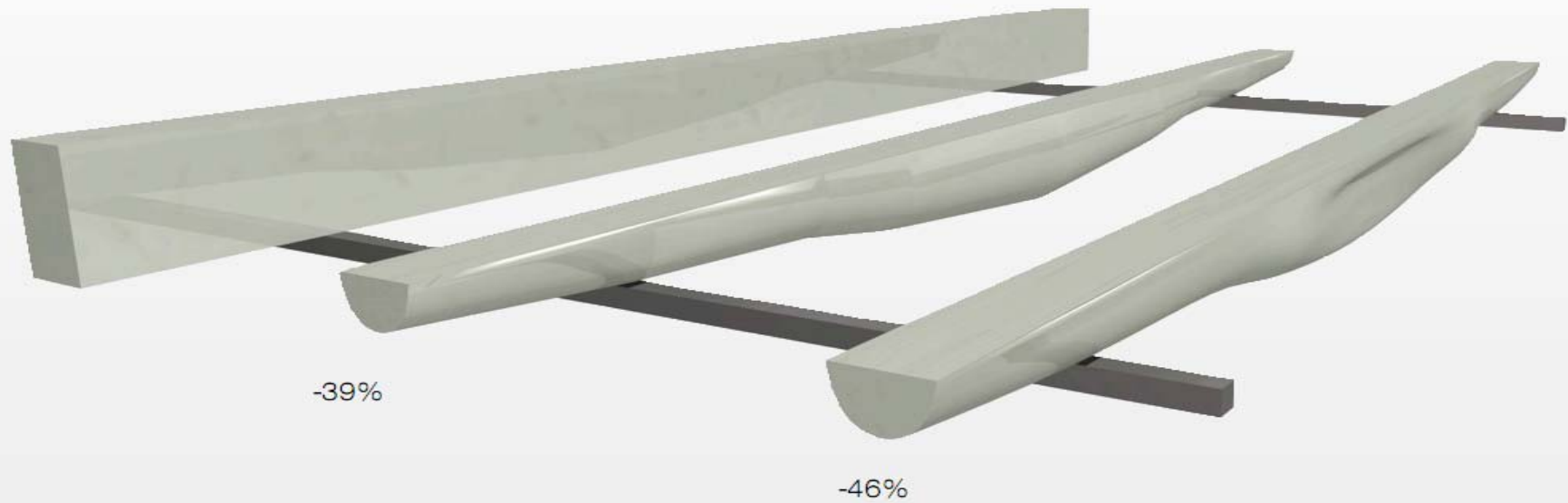


introduction: philosophy





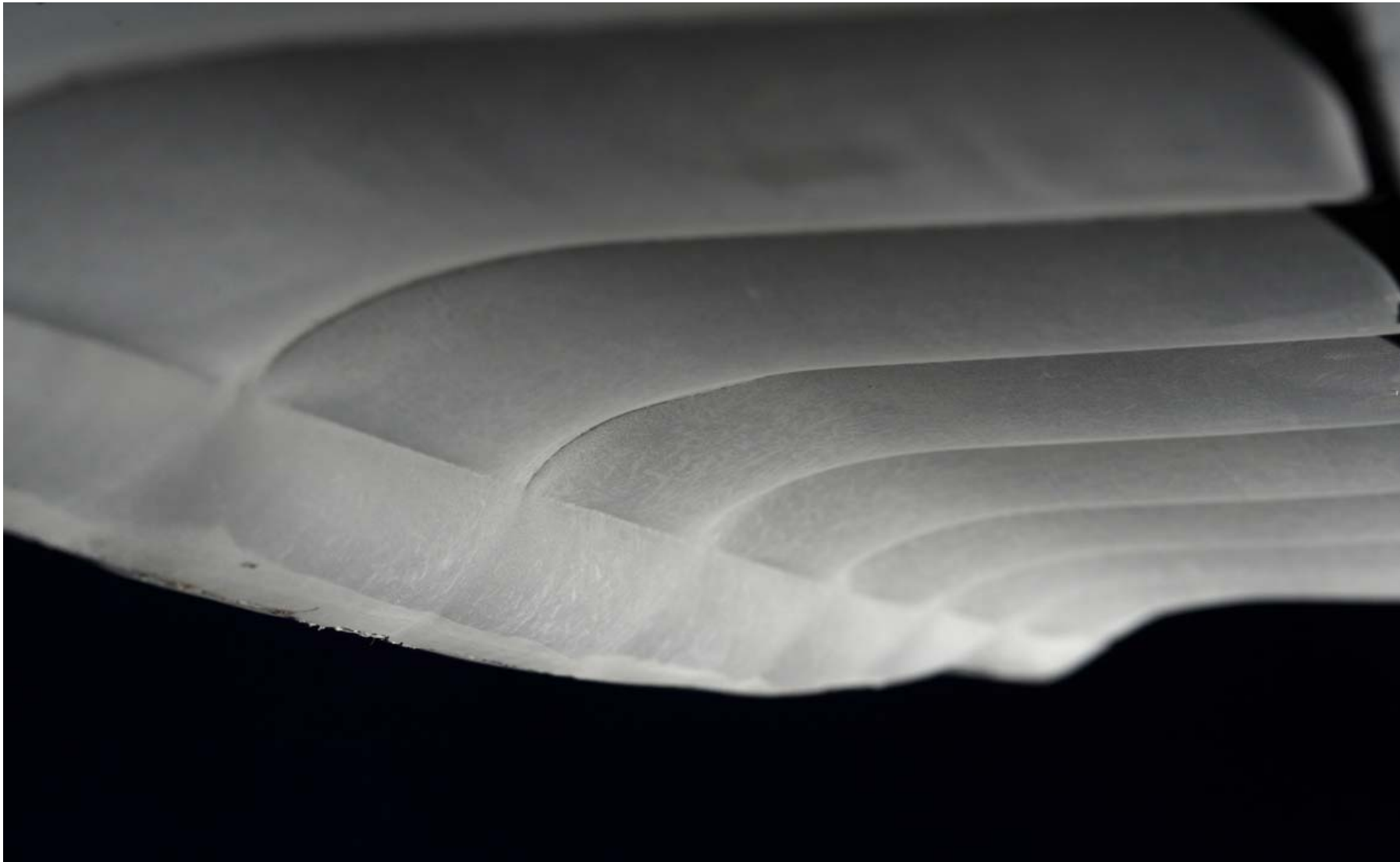
design: advantages





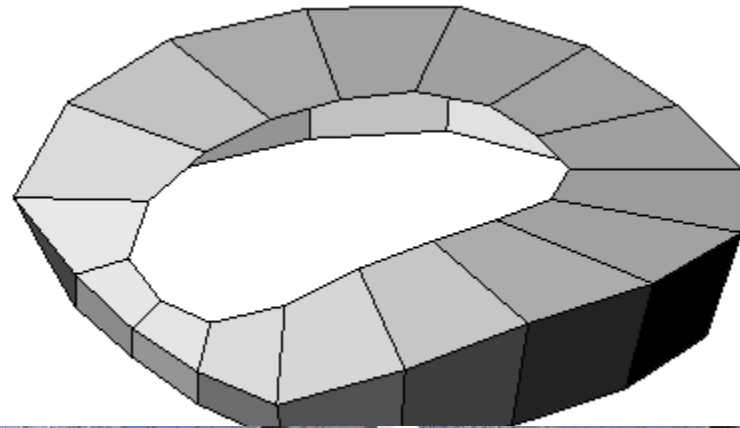
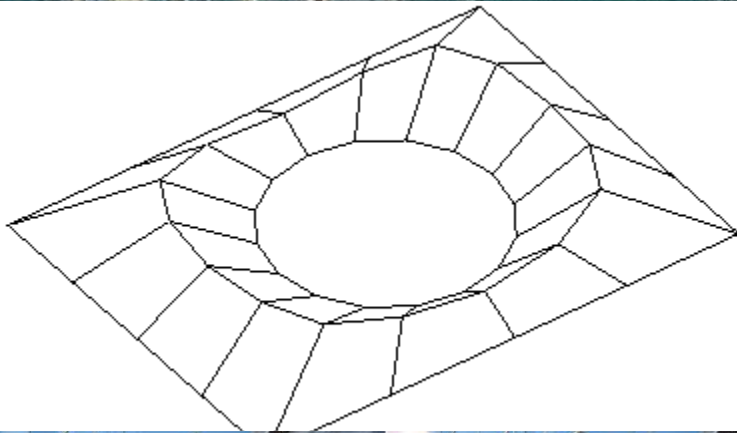
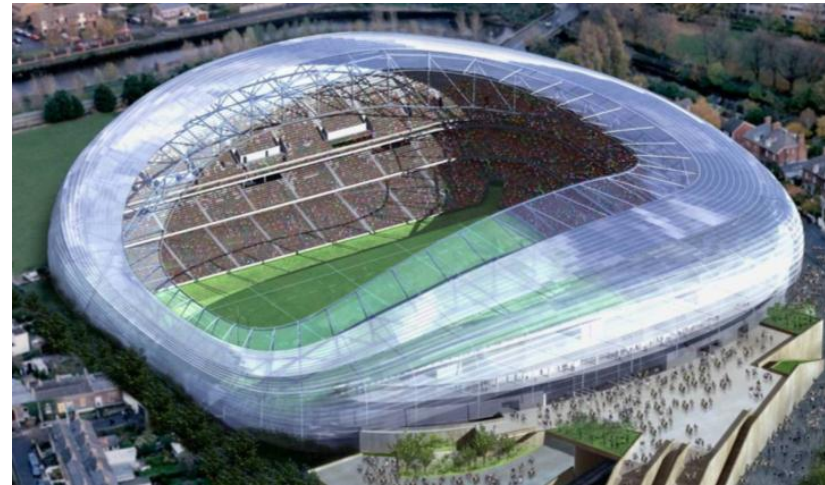


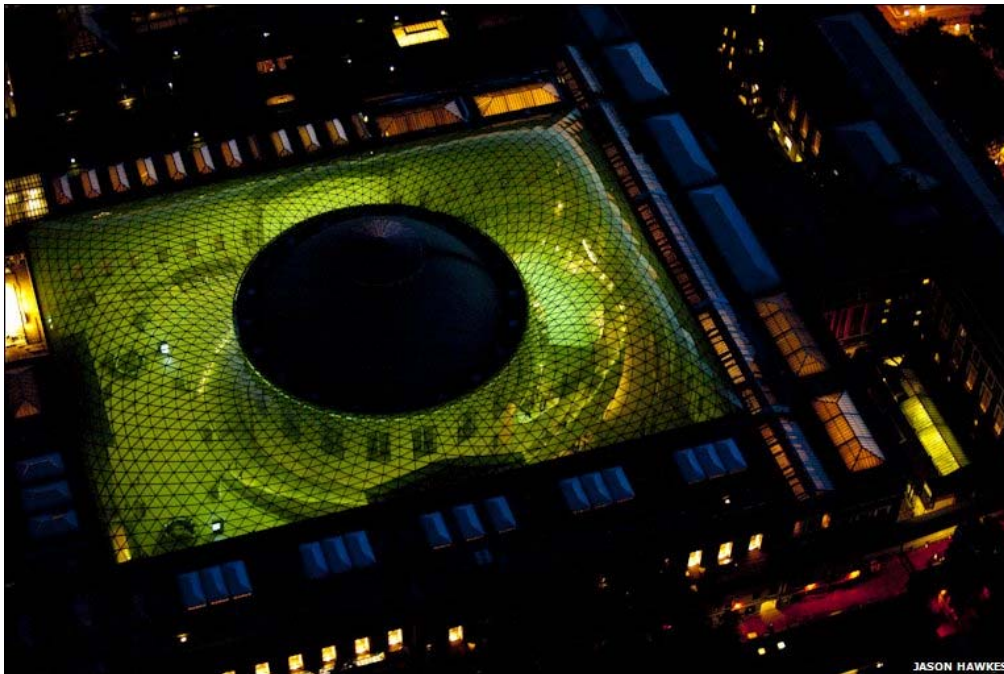
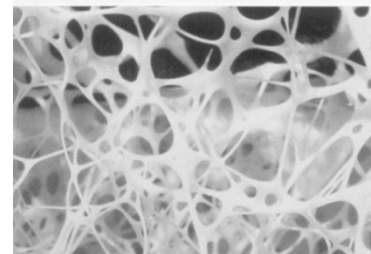
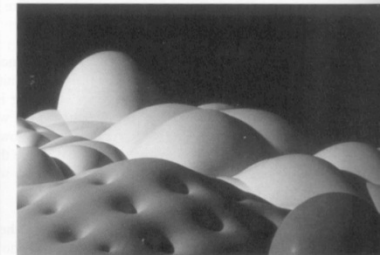
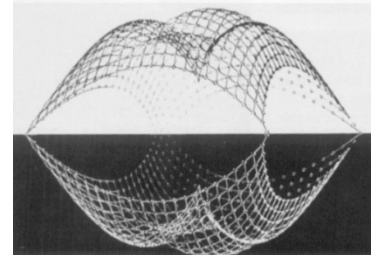
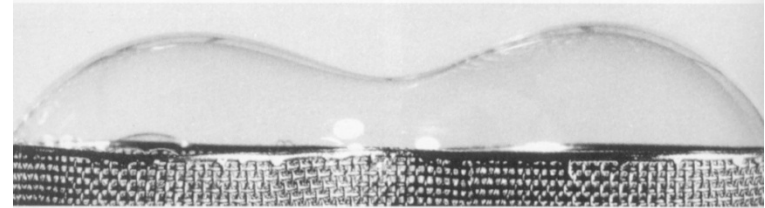
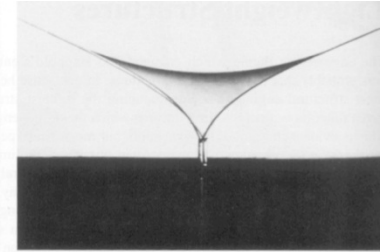
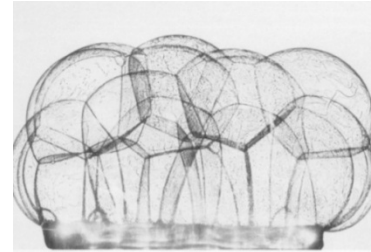
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construction: beams









Andreas Bak – Optimised Fabric Formed SLabs



Dimitra Stathopoulou – Dance Movements



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CENTRE FOR
**WINDOW AND
CLADDING**
TECHNOLOGY



About us	Publications	Courses	Membership	Research
Forum	Design	Specification	Construction	Performance

Latest
Events
Register
Site map

Welcome to CWCT

The Centre for Window and Cladding Technology is a leading information provider and trainer in the field of building envelopes and glazing. It is an industry funded Centre based at the University of Bath.

CWCT sets industry Standards and publishes both [standards](#) and [guidance](#).

A restricted area, [The Cladding Forum](#), contains resources, documents and advice for the Centre's [members](#).

CWCT, through its members, is able to provide a wide range of advice to the whole construction industry on a consultancy basis. ([Contact CWCT](#))

Members' Autumn Meeting - Friday 23 September 2011 - London - [Programme and booking form here](#)

Technical Note on shading devices [here](#)

Revised thermal guidance in line with Part L 2010 [here](#)

Member log-in			Home	Site map
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Major research areas at Bath:

- Realistic structural assessment
- Post-occupancy evaluation (energy)
- Holistic use of materials (multiple use)
- Retrofit (structural and building physics)
- Mitigation against extreme events
- Natural and renewable building materials
- Appropriate structural form
- Understanding loading (the 'forgotten' bit)
- Human tolerance of dynamics
- Conservation of historic buildings
- Health and well-being in earthen buildings

Thank you.

Now please also join LIMESNet

Eloise Spark
e.spark@bath.ac.uk

bre **cicm**

the BRE centre for innovative construction materials