Engineering Biomimetic Strategies for the Built Environment

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We could reverse engineer biology?

- Biomimicry is a powerful tool for improving the sustainability of the built environment.

- However, designers need to be careful to avoid using biomimicry purely as an aesthetic inspiration.

- Instead, engineers can play a key role in translating the biology to technology.

- The task is to make the science predictable and the designs physically realisable.
We could reverse engineer biology?

- How are engineers and engineering scientists putting the methods into practice?
- What are the benefits?
- Three case studies of ‘reverse engineering’ biology:
  1. Aligning industrial processes with natural processes.
  2. Adapting physical characteristics to the built environment.
  3. Reimagining materials and how we construct buildings.
Part 1. Aligning industrial processes with natural processes
What if…

We could create cement in solution?

CO₂ from flue gas (industrial emitters)
Use raw flue gas – no concentration required

CO₂ captured and converted to a solid
Calcium Carbonate novel cement

Used to make a range of building material products

Image: Calera
Calera products:
- Supplementary cementitious material
- Benches
- Plant holders
- Tiles
Part 2. Adapting physical characteristics to the built environment
2a. Fur heat transfer

Image: manyang.com
What if…

We could line building facades with fur?
Fur-lined wall has a lower surface temperature than conventional approach.
2b. Skin heat transfer

Images: M. Webb, manyang.com
Heat is retained by your body

Heat through radiation and convection

(a) Image: cnx.org
(b)
What if…

We could build facades like human skin?

Epidermis

Dermis

Blood vessel

Image: Blue Histology, University of WA
$T_{amb} = 36^\circ C$

$T_{lw,e} = T_{amb}$

$T_MRT = 28^\circ C$

$T_{a,i} = 22^\circ C$
Evaporation remains near zero

Mostly due to radiation

Heat transfer approx 35 W/m²
Part 3. Reimagining materials and how we construct buildings
Are we stuck in the past?

Image: M. Webb

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What if...

We altered our materials and construction?

Image: Neri Oxman, MIT
Disruptive biomimicry

Image: BASF


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In Summary

- The 3 strategies:
  1. Aligning industrial processes with natural processes.
  2. Adapting physical characteristics to the built environment.
  3. Reimagining materials and how we construct buildings.

- Clear sustainable outcomes.

- Holistic approach – function over form.

- We need to accept the challenge to implement the change.