Biomimetic Approaches To Architectural Design For Increased Sustainability

Maibritt Pedersen Zari
Victoria University of Wellington
maibritt.pedersen@vuw.ac.nz
Marc Brunel - Tunnelling Shield, Thames Tunnel 1843
C02 Solutions - Carbon Sequestration
Process mimicry at the organism level
Biomimicry for sustainability?
<table>
<thead>
<tr>
<th>Level</th>
<th>Mimicry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organism level</td>
<td>(Mimicry of a specific organism)</td>
</tr>
<tr>
<td>Behaviour level</td>
<td>(Mimicry of how an organism behaves or relates to its larger context)</td>
</tr>
<tr>
<td>Ecosystem level</td>
<td>(Mimicry of an ecosystem)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Projects</th>
</tr>
</thead>
<tbody>
<tr>
<td>DaimlerChrysler Bionic car</td>
</tr>
<tr>
<td>Waterloo International Terminal</td>
</tr>
<tr>
<td>Carbon Sequestration</td>
</tr>
<tr>
<td>The Lotus Effect</td>
</tr>
<tr>
<td>Brunel Tunnelling Shield</td>
</tr>
<tr>
<td>CH2 project</td>
</tr>
<tr>
<td>Teatro del Agua</td>
</tr>
<tr>
<td>Lloyd Crossing Project</td>
</tr>
</tbody>
</table>
Approaches to biomimicry

Designers looking to the living world
Bionic car

Biology influencing design
The Lotus Effect
organism level

behaviour level

ecosystem level
The building looks like a termite.

The building is made from the same material as a termite (a material that mimics termite exoskeleton/skin for example).

The building is made in the same way as a termite (it goes through various growth cycles for example).

The building works in the same way as an individual termite (it produces hydrogen efficiently through meta-genomics for example).

The building functions like a termite in a larger context (it recycles cellulose waste and creates soil for example).

The building looks like it was made by a termite (a replica of a termite mound for example).

The building is made from the same materials that a termite builds with (using digested fine soil as the primary material for example).

The building is made in the same way that a termite would build in (piling earth in certain places at certain times for example).

The building works in the same way as a termite mound would (by careful orientation, shape, material selection and natural ventilation for example), or it mimics how termites work together.

The building functions in the same way as a termite mound would (by careful orientation, shape, material selection and natural ventilation for example), or it mimics how termites work together.

The building looks like an ecosystem (a termite would live in).

The building is made from the same kind of materials that a termite ecosystem is made of (it uses naturally occurring common compounds, and water as the primary chemical medium for example).

The building is assembled in the same way as a (termite) ecosystem (principles of succession and increasing complexity over time are used for example).

The building works in the same way as a (termite) ecosystem (it captures and converts energy from the sun, it stores water for example).

The building is able to function in the same way that a (termite) ecosystem would and forms part of a complex system by utilizing the relationships between processes (it is able to participate in the hydrological, carbon, nitrogen cycles etc in a similar way to an ecosystem for example).
The building looks like a termite. The building is made from the same material as a termite (a material that mimics termite exoskeleton/skin for example). The building is made in the same way as a termite (it goes through various growth cycles for example). The building works in the same way as an individual termite (it produces hydrogen efficiently through metagenomics for example).

### Organism level
(Mimicry of a specific organism)

**Form**
- The building looks like a termite.

**Material**
- The building is made from the same material as a termite (a material that mimics termite exoskeleton/skin for example).

**Construction**
- The building is made in the same way as a termite (it goes through various growth cycles for example).

**Process**
- The building works in the same way as an individual termite (it produces hydrogen efficiently through metagenomics for example).

### Behaviour level
(Mimicry of how an organism behaves or relates to its larger context)

**Form**
- The building looks like it was made by a termite (a replica of a termite mound for example).

**Material**
- The building is made from the same materials that a termite builds with (using digested fine soil as the primary material for example).

**Construction**
- The building is made in the same way that a termite would build in (piling earth in certain places at certain times for example).

**Process**
- The building works in the same way as a termite mound would (by careful orientation, shape, material selection and natural ventilation for example), or it mimics how termites work together.

**Function**
- The building functions like a termite mound in a larger context (it recycles cellulose waste and creates soil for example).

### Ecosystem level
(Mimicry of an ecosystem)

**Form**
- The building looks like an ecosystem (a termite would live in).

**Material**
- The building is made from the same kind of materials that a termite ecosystem is made of (it uses naturally occurring common compounds, and water as the primary chemical medium for example).

**Construction**
- The building is assembled in the same way as a (termite) ecosystem (principles of succession and increasing complexity over time are used for example).

**Process**
- The building works in the same way as a (termite) ecosystem (it captures and converts energy from the sun, it stores water for example).

**Function**
- The building is able to function in the same way that a (termite) ecosystem would and forms part of a complex system by utilizing the relationships between processes (it is able to participate in the hydrological, carbon, nitrogen cycles etc in a similar way to an ecosystem for example).
Form / process mimicry at the organism level

Grimshaw Architects - Waterloo International Terminal, London
The building looks like a termite.

The building is made from the same material as a termite (a material that mimics termite exoskeleton / skin for example).

The building is made in the same way as a termite (it goes through various growth cycles for example).

The building works in the same way as an individual termite (it produces hydrogen efficiently through meta-genomics for example).

The building functions like a termite in a larger context (it recycles cellulose waste and creates soil for example).

The building looks like it was made by a termite (a replica of a termite mound for example).

The building is made from the same materials that a termite builds with (using digested fine soil as the primary material for example).

The building is made in the same way that a termite would build in (piling earth in certain places at certain times for example).

The building works in the same way as a termite mound would (by careful orientation, shape, material selection and natural ventilation for example), or it mimics how termites work together.

The building functions in the same way as a termite mound would (by careful orientation, shape, material selection and natural ventilation for example), or it mimics how termites work together.

The building looks like an ecosystem (a termite would live in).

The building is made from the same kind of materials that a termite's ecosystem is made of (it uses naturally occurring common compounds, and water as the primary chemical medium for example).

The building is assembled in the same way as a (termite) ecosystem (principles of succession and increasing complexity over time are used for example).

The building works in the same way as a (termite) ecosystem (it captures and converts energy from the sun, it stores water for example).

The building is able to function in the same way that a (termite) ecosystem would and forms part of a complex system by utilizing the relationships between processes (it is able to participate in the hydrological, carbon, nitrogen cycles etc in a similar way to an ecosystem for example).
Process / function mimicry at the behaviour level

Mick Pearce - Eastgate Building, Harare & CH2 project, Melbourne.
The building looks like a termite.
The building is made from the same material as a termite (a material that mimics termite exoskeleton/skin, for example).
The building is made in the same way as a termite (it goes through various growth cycles, for example).
The building works in the same way as an individual termite (it produces hydrogen efficiently through meta-genomics, for example).
The building functions like a termite in a larger context (it recycles cellulose waste and creates soil, for example).
The building looks like it was made by a termite (a replica of a termite mound, for example).
The building is made from the same materials that a termite builds with (using digested fine soil as the primary material, for example).
The building is made in the same way that a termite would build (piling earth in certain places at certain times, for example).
The building works in the same way as a termite mound would (by careful orientation, shape, material selection, and natural ventilation, for example), or it mimics how termites work together.
The building functions in the same way as a termite mound (careful orientation, shape, material selection, and natural ventilation, for example), or it mimics how termites work together.
The building looks like an ecosystem (a termite would live in).
The building is made from the same kind of materials as a termite (ecosystems are made of naturally occurring common compounds, and water as the primary chemical medium, for example).
The building is assembled in the same way as a termite ecosystem (principles of succession and increasing complexity over time are used, for example).
The building works in the same way as a termite ecosystem (it captures and converts energy from the sun, stores water for example).
The building is able to function in the same way that a termite ecosystem would and forms part of a complex system by utilizing the relationships between processes (it is able to participate in the hydrological, carbon, nitrogen cycles, etc., in a similar way to an ecosystem, for example).
Function mimicry at the **ecosystem level**

*Mithūn Architects and GreenWorks Landscape Architecture* Lloyd Crossing Project proposed for Portland, Oregon.
Mithūn Architects and GreenWorks Landscape Architecture Lloyd Crossing Project proposed for Portland, Oregon.
Biomimicry for sustainable architecture
Multiple levels of mimicry

Process / function mimicry at the organism and ecosystem levels

Grimshaw Architects
Teatro del Agua
Mimicry and integration

McDonough and Partners
Adam Joseph Lewis Center for Environmental Studies at Oberlin College, Ohio.

Process mimicry at the ecosystem level
Organism level (Mimicry of a specific organism)

Behaviour level (Mimicry of how an organism behaves or relates to its larger context)

Ecosystem level (Mimicry of an ecosystem)

---

DaimlerChrysler Bionic car

Waterloo International Terminal

Carbon Sequestration

The Lotus Effect

Brunel Tunnelling Shield

CH2 project

Teatro del Agua

Lloyd Crossing Project
Changing design metaphors?
Biomimetic Approaches To Architectural Design For Increased Sustainability

Maibritt Pedersen Zari
maibritt.pedersen@vuw.ac.nz

School of Architecture
Victoria University
Wellington
New Zealand
‘From my designer’s perspective, I ask: Why can’t I design a building like a tree?

A building that makes oxygen, fixes nitrogen, sequesters carbon, distils water, builds soil, accrues solar energy as fuel, makes complex sugars and food, creates microclimates, changes colours with the seasons and self replicates.

This is using nature as a model and a mentor, not as an inconvenience. It’s a delightful prospect…’

(McDonough and Braungart, 1998)
The building looks like a termite.
The building is made from the same material as a termite (material that mimics termite exoskeleton/skin for example).
The building is made in the same way as a termite (process goes through various growth cycles for example).
The building works in the same way as an individual termite (function produces hydrogen efficiently through meta-genomics for example).
The building functions like a termite in a larger context (form recycles cellulose waste and creates soil for example).
The building looks like it was made by a termite (form a replica of a termite mound for example).
The building is made from the same materials that a termite builds with (material using digested fine soil as the primary material for example).
The building is made in the same way that a termite would build in (construction piling earth in certain places at certain times for example).
The building works in the same way as a termite mound would (process careful orientation, shape, material selection and natural ventilation for example), or it mimics how termites work together.
The building functions in the same way as a termite mound would (function it captures and converts energy from the sun, it stores water for example).
The building looks like an ecosystem (form a termite would live in).
The building is made from the same kind of materials that a termite ecosystem is made of (material it uses naturally occurring common compounds, and water as the primary chemical medium for example).
The building is assembled in the same way as a (termite) ecosystem (construction principles of succession and increasing complexity over time are used for example).
The building works in the same way as a (termite) ecosystem (process it captures and converts energy from the sun, it stores water for example).
The building is able to function in the same way that a (termite) ecosystem would and forms part of a complex system by utilizing the relationships between processes (function it is able to participate in the hydrological, carbon, nitrogen cycles etc in a similar way to an ecosystem for example).
Organism level
(Mimicry of a specific organism)

Behaviour level
(Mimicry of how an organism behaves or relates to its larger context)

Ecosystem level
(Mimicry of an ecosystem)

form
material
construction
process
function