An Adaptable Living Machine for Contemporary Nomads

An unit that allow high level of mobility and satisfying a degree of living comfortability

people who are willing / need to be continuously moving to different locations for
- exploring
- experiencing
- work

to change from one place or position to another

a house, apartment, or other shelter that is the usual residence of a person

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Fascination & Facts

Adaptable
We live in an Era that emphasis movement

World Railways Network
http://www.newscientist.com/data/images/ns/cms/mg20227041.500/mg20227041.500-4_1000.jpg

World Highways Network
http://mrbarlow.files.wordpress.com/2009/04/the-worlds-roads.jpg

World Rivers Network
http://www.newscientist.com/data/images/ns/cms/mg20227041.500/mg20227041.500-6_1000.jpg

Adaptable Living Machine for contemporary nomads

- globalization
- improvement on transportation technologies,
Example of contemporary nomads (constantraveling groups)photographers, explorers, retired travelers, film makers etc.

Example of base camp for photographer
http://www.adultgummies.com/images/scott%20photo-vinson-nov27.jpg

First Airstream trailer designed by Wally Byam in late 1920s
http://www.arcainstreams.co.uk/fresh_airstreams/about/history_of_the_airstream_caravan.png

Not universal enough
-The shape of air steam (for transport consideration rather than comfort living
-The tent used in polar might not work well in warm climate location.

They are flexible enough in terms of the considered aspect when they were design,
but not adaptable to varies condition

Adaptable Living Machine for contemporary nomads
Design Statement

Adaptable

Adaptable Living Machine for contemporary nomads
Adaptation

3 levels of typical design aspect during architecture

Human

Building

Community

Transportation system
- Highways
- railways
- ocean routes

Context
- Urban area
- hill side
- water front

Climate
- Hot / cold
- humid / dry
- snowing / rain

User scenario

Consider the adaptation according to 4 focuses to cover the above 3 aspect

Adaptable Living Machine for contemporary nomads
The envelope are the most important component to form this architecture, because it provided
the essential function, protect

Research Question: How can adaptive (building) envelope be situated in different environments?

Biomimicry - Warm-blooded vertebrate integumentary system

Warm blooded vertebrate (birds and Mammals) lives in wide range of location,

the skin acts as the most important organs to adapt changing environment including
- Protection
- regulation
- insulation
- enhance sensation
etc.

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Inspiration

Adaptive behaviour -> skin + mechanism
How the skin help adapting changing environment

Bird tucking to reduce conduction heat lost
Birds sunning to gain heat from solar radiation
Bird fluffing to retain body temperature and reduce heat lost

Lifting to reduce contact
Increase convection surface area
Decrease in volume and surface area

Adaptable Living Machine for contemporary nomads
Translation from behaviours to mechanism

Drawings of bird wings folding motion
http://www.ornithopter.de/grafik/herzog/faltung_k.gif

Vaned feather

Vaned feather

Flipping & Folding

Interlocking

Overlapping

Adaptable Living Machine for contemporary nomads
Design Objective

The Adaptable Living Machine

Using movement to improve the adaptability of architecture
## Exploration on different Movements

### Volume transformation matrix

<table>
<thead>
<tr>
<th>1 - Direction Movement</th>
<th>X - plate</th>
<th>Y - plate</th>
<th>Z - plate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sliding</td>
<td><img src="image1" alt="Diagram" /></td>
<td><img src="image2" alt="Diagram" /></td>
<td><img src="image3" alt="Diagram" /></td>
</tr>
<tr>
<td>Folding</td>
<td><img src="image4" alt="Diagram" /></td>
<td><img src="image5" alt="Diagram" /></td>
<td><img src="image6" alt="Diagram" /></td>
</tr>
<tr>
<td>Rotating</td>
<td><img src="image7" alt="Diagram" /></td>
<td><img src="image8" alt="Diagram" /></td>
<td><img src="image9" alt="Diagram" /></td>
</tr>
<tr>
<td>Flipping</td>
<td><img src="image10" alt="Diagram" /></td>
<td><img src="image11" alt="Diagram" /></td>
<td><img src="image12" alt="Diagram" /></td>
</tr>
<tr>
<td>Reassembly</td>
<td><img src="image13" alt="Diagram" /></td>
<td><img src="image14" alt="Diagram" /></td>
<td><img src="image15" alt="Diagram" /></td>
</tr>
</tbody>
</table>

### Furniture transformation matrix

<table>
<thead>
<tr>
<th>Change in location</th>
<th>Change in size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rotate</td>
<td>Sliding</td>
</tr>
<tr>
<td>Flapping</td>
<td>Folding</td>
</tr>
<tr>
<td>Gather &amp; Roll Up</td>
<td></td>
</tr>
</tbody>
</table>

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Adaptable Living Machine for contemporary nomads
Design Object Specifications

What is it about?

Who is it designed for?

Where is it located?

How is it work?
What? & Who?

The Object

An adaptive living unit for contemporary nomads that fulfill the 4 concerns of adaptation.

- Functional programs
  - Sleeping area
  - Pantry
  - Dinning area
  - Working area
  - Living area
  - Bathroom

The User(s)

Example:
Documentary film crew work for discovery channel

From individual to a series of clustering

Adaptable Living Machine for contemporary nomads
Site A
Nuuk, Greenland
Continent: North America (North East)
South of Equator
Climate zone: Group E (et)
Climate type: Tundra climate
Latitude: 64° 11’N
Longitude: 51° 45’W
Territory: 690 km²

Site B
Hong Kong Special Administration Region, China
Continent: Asia (South East)
South of Tropical cancer
Climate zone: Group C (cwa)
Climate type: Temperate/mesothermal climates
Latitude: 22° 17’N
Longitude: 114° 08’E
Territory: 1,104 km²
How to Transport?

Considered means of transportation

- Ground transportation
  - Railway transportation for cross countries
  - Highway transportation for cross cities

- Water Transportation
  - River transportation for cross cities and countries
  - Ocean transportation for cross continents

Design Constraints
- Size
  Height: 4 m
  Length: up to 16 m
  Width: 2.55 m, 3 m with specific signage at rear envelope

Adaptable Living Machine for contemporary nomads
Design Objects

The Adaptable Living Machine
The development steps

When moving
Streamline form improve mobility

When stable
Expand surface area to improve stability

Different location
Adaptable (transformable) skin for different condition (Climate)

All scenario
Smart skin to increase possibilities for energy generation

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Movements - Sectional motion diagram

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Adaptable Living Machine for contemporary nomads
ALM Dimension comparison in different conditions

Adaptable Living Machine for contemporary nomads
ALM Elevation comparison and Internal arrangement illustration

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Climatic strategies - massing level consideration

Insulation Performance

Natural ventilation

Overlapping surface -> increase insulation layer
Spread surface -> reduce insulation thickness

Solar radiation Adsorption

Natural Lighting exposure

Increase surface -> increase heat absorption rate
Increase surface -> increase natural lighting surfaces

Indoor air Pollution

Relative Interior Temperature

Increase volume -> reduce internal air pressure
Increase volume -> decrease relative temperature

Assumptions:
- Outdoor temp. remain constant
- Indoor air flow remain constant
- Internal heat source radiation remain constant

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Flexible Orientation

- Response to Sun light
- Response to prevailing wind

E.g.
In windy location: orientate front façade towards wind direction, improve stability by the streamline profile.

E.g.
In cold location: orientate side façade towards longest sun exposure direction, maximize heat absorption surface.
Exterior and Interior ventilation relationship

Ventilation Concept Diagram

Heat source:
Human body heat radiation
Electrical device heat radiation

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Clustering Strategy  - Climatic consideration

Day-lighting consideration

Close neighbourhood
- Adjacent unit’s shadow as shading in hot location

Distanced settlement
- Avoid shaded by adjacent unit’s shadow to maximize sun exposure

Wind direction consideration

Parallel arrangement
- Direct facing wind direction, improve building stability by its streamline profile

Radial grouping
- Create low pressure zone at entrance

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Clustering Strategy - community and function consideration

Community consideration

Isolation
- Setting based on privacy as first priority

Looping
- Setting based on tiny community

Functional consideration

Lose pattern
- Setting based on hygiene consideration, avoiding opening directly facing back of house

Parallel connection
- Setting based on efficient resource supply

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Resource and wastage disposal strategy

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Individual unit flexibility - daily routine adaptation

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Selected Details — Rotation Axle at main structure

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Visualization - Greenland

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Adaptable Living Machine for contemporary nomads
Reflection / summary

**Project Challenge**

**The size**
- Tiny enough for transportation, 3 meters x 4 meters (width x height)
- Big enough for comfortable habitation
- Incorporate essential mechanical installation

**The complicity**
- Material technologies for climatic performances and movements
- Motion joints