The Need to Retrofit

• “In developed countries, the majority of buildings which will be standing in 2050 have already been built.” (UNEP, 2009)

• Regenerative design concepts are starting to become well established in frameworks such as the ‘Living Building Challenge’ and ‘One Planet Living’, but the outcomes still seem to be new developments in unique and ideal conditions.

• We currently have the means and technology to achieve regenerative outcomes for building retrofits – a change of **mind** not techniques is required.

Bullitt Center, Seattle, WA – Living Building Certified
This research aims to propose a new approach to retrofitting embedded within a regenerative worldview. This approach will explore how the retrofit design process can not only improve the health and performance of a single building but add positive value to its surroundings.

To do so, this research will:

• Propose a ‘proactive’ approach to building retrofits.
• Develop a regenerative design model to explore the key interactions between physical, human and natural systems within the built environment.
• Develop a set of regenerative design principles to achieve ‘proactive’ retrofit outcomes.
What is Regenerative Design?

- Regenerative design can be roughly defined as the “reconnection of human aspirations and activities with the evolution of natural systems – essentially coevolution.” (Mang & Reed 2012)
Conventional approaches to building retrofits that are focused on energy and cost efficiency are simply ‘reacting’ to a negative event or circumstance.

To be ‘proactive’ requires considering a building’s positive potential to interact with its surroundings by integrating net-positive, restorative and regenerative design concepts.

Developed from original by Charles Krone, in Mang & Reed, 2012
Regenerative Design Model for Building Retrofits

'Reactive' Retrofit Outcomes
(net-positive, restorative, regenerative)

- Identify potential interacting components.
- Extract key interactions to achieve proactive retrofit outcomes.

RESOURCE EFFICIENCY
(Energy Efficient Buildings)

SOCIAL CONNECTIONS
(Occupant Health & Wellbeing)

CONNECTION TO NATURE
(Restore & Enhance Local Ecosystems)

Regenerative Design Principles for Building Retrofits

Renewable Energy
Existing Energy Systems
Material Compatibility
Construction Quality & Integrity
IEQ
Human & Natural Co-Habitation
Ecosystem Restoration
Microclimate Mitigation
Energy Exchange with Surroundings
Resilience

Retrofit Design Solutions

COST-BENEFIT
Identify and Extract Key Interactions

- Identify and extract key interactions between physical, human and natural systems to achieve ‘proactive’ outcomes.

- It is crucial that the interactions cross all three ‘dimensions’ in order to have a ‘proactive’ outcome.
Process Model for Proactive Retrofits

Key 'Proactive' Retrofit Activities

- Set 'Proactive' Retrofit Performance Targets
- Understand 'Place'
- Identify Problems
- Identify and Develop Key Regenerative Design Principles for Building Retrofits to Achieve Performance Targets
- Retrofit Design Solutions

‘Proactive’ Retrofit Design Considerations

- Retrofit considerations for implementation e.g. cost, risk, climate, building condition, etc.
- ‘Place’ based considerations - deeper understanding of building, its surroundings and the complex interactions present to help identify issues and how to solve them
- Identify and extract key interactions between physical, human and natural systems
- Identify strategies and emerging technologies to enable these key interactions
- Management Decision Support
Performance Targets & Indicators

1. Improve human and natural health and co-habitation:

   • A building retrofit should encourage a harmonious relationship between building occupants and their surrounding built and natural environment.

   • A building retrofit should provide infrastructure to increase local biodiversity or new species habitation.

   • A building retrofit should provide shared spaces for natural and human habitats to create opportunities for social interactions and local food production.
Performance Targets & Indicators

2. Support a positive energy exchange with the surrounding built environment:

- A building retrofit should reduce energy consumption by integrating natural systems for improved heating, cooling and ventilation.

- A building retrofit should produce more energy than required through on-site and/or off-site renewable energy generation.

- A retrofitted building’s excess energy should be stored for later use and/or invested in energy sharing strategies and initiatives with its surrounding built environment.
Performance Targets & Indicators

3. Design for resilience:

- A building retrofit should be able to adapt to changing climatic and technological conditions.

- A building retrofit should reduce the impacts of the urban heat island effect and improve outdoor environments.

- A building retrofit should be durable yet flexible to allow for future interventions.
### Alignment of Principles with Performance Targets & Indicators

<table>
<thead>
<tr>
<th>Performance Targets</th>
<th>Indicators</th>
<th>Principles</th>
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<tbody>
<tr>
<td>Improve Human and Natural Health and Co-Habitation</td>
<td>A building should encourage a harmonious relationship between building occupants and their surrounding built and natural environment.</td>
<td>Retrofit to Enable Positive Interactions</td>
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<tr>
<td></td>
<td>A building should provide infrastructure to increase local biodiversity or new species habitation.</td>
<td>Retrofit for Microclimate Mitigation</td>
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<td></td>
<td>A building should provide shared spaces for natural and human habitats to create opportunities for social interactions and local food production.</td>
<td>Retrofit to Restore Local Ecosystems</td>
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<tr>
<td>Support a Positive Energy Exchange with the Surrounding Built Environment</td>
<td>A building’s energy consumption should be reduced by integrating natural systems for improved heating, cooling and ventilation.</td>
<td>Retrofit to Promote Energy Sharing</td>
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Key Regenerative Design Principles
for Building Retrofits

• **Retrofit to enable positive interactions:** a building should support interactions between people, technology and nature to encourage positive occupant behaviour.

• **Retrofit for microclimate mitigation:** new and existing materials should support comfortable internal environments and mitigate the effects of the surrounding microclimate.

• **Retrofit to restore local ecosystems:** the building envelope should integrate natural systems to improve the health of internal environments and restore local ecosystems.

• **Retrofit to promote energy sharing:** a building should actively seek to promote and be involved in energy sharing strategies and initiatives.

• **Retrofit for adaptable buildings:** an existing building should be redesigned to adapt to changing technologies and social conditions.
Hypothetical example

Performance Targets:
• Improve Human & Natural Health & Co-Habitation
• Support a Positive Energy Exchange with the Surrounding Built Environment
• Design for Resilience

Client wishes to maintain overall historic aesthetic
Hypothetical example

Place Based Considerations:
• Building disrupts a habitat corridor – reduced connectivity for local species
• Unused retail space on the ground floor – occupants rarely use/interact with ground floor spaces
Hypothetical example

Identified Problems:
• Disconnected green space within an urban context
• Age of building materials results in reliance on mechanical heating/cooling
• Contributes to UHI effect with low albedo surfaces
Hypothetical example

Key Regenerative Design Principles:
• Retrofit to Restore Local Ecosystems
• Retrofit for Microclimate Mitigation
• Retrofit to Promote Energy Sharing
Hypothetical example

Identify Potential Retrofit Strategies:

Activate street front by reducing ground floor area and recreating a wildlife corridor
Hypothetical example

Identify Potential Retrofit Strategies:

- Retro-reflective material coatings
- Green/Cool Roof
Hypothetical example

Identify Potential Retrofit Strategies:
- Upgrade glazing to reduce energy demand
- Rooftop PV
- BIPV
- Energy exchange with surroundings
Hypothetical example

For each retrofit design option need to consider:
- Cost and risk
- Building specific information (climate, orientation, type, condition, occupancy, etc.)
Significance

• These principles aim to provide high-level guidance to designers in order to *expand* (rather than prescribe) potential retrofit solutions to achieve ‘proactive’ outcomes.

• So rather than any specific techniques, strategies or technologies, the true benefit of ‘proactive’ retrofitting is the underlying shift in mindset that a single building retrofit can add positive value to and interact with its surroundings.
Thank you