BIOPHILIC DESIGN GUIDEBOOK

JUNE 2018

LIVING BUILDING CHALLENGE℠ 3.1

A Visionary Path to a Regenerative Future

INTERNATIONAL LIVING FUTURE INSTITUTE℠

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INTRODUCTION

The International Living Future Institute has developed this guidebook to help Living Building Challenge project teams develop more biophilic projects and comply with the requirements and intent of Imperative 09, Biophilic Environment. The resources include this general overview, as well as descriptions, outlines, and tips for the required elements of the Imperative.

IMPERATIVE 09 BIOPHILIC ENVIRONMENT

I-09 REQUIREMENTS

The project must be designed to include elements that nurture the innate human-nature connection. Each project team must engage in a minimum of one all-day exploration of the biophilic design potential for the project. The exploration must result in a biophilic framework and plan for the project that outlines the following:

- How the project will be transformed by deliberately incorporating nature through Environmental Features, Light and Space, and Natural Shapes and Forms.
- How the project will be transformed by deliberately incorporating nature's patterns through Natural Patterns and Processes and Evolved Human-Nature Relationships.
- How the project will be uniquely connected to the place, climate and culture through Place-Based Relationships.
- How the project will provide sufficient and frequent human-nature interactions in both the interior and exterior of the project to connect the majority of occupants with nature directly.

The plan must contain methods for tracking biophilic design at each design phase. The plan should include cultural, ecological and climatic studies that thoroughly examine the site and context for the project.

"Biophilic design is the deliberate attempt to translate an understanding of the inherent human affinity to affiliate with natural systems and processes—known as biophilia—into the design of the built environment."

Stephen Kellert

BIOPHILIC EXPLORATION

This document consolidates ideas about the structure, content, and goals of Biophilic Explorations as required by the International Living Future Institute for Living Building Challenge v3.1 (LBC) Imperative 09, Biophilic Environment (I-09). The information provided is also applicable to other biophilic design explorations or charrettes.

RECOMMENDED STEPS

The steps listed below represent a recommended approach to planning and executing a biophilic exploration for a compliant capital project, including information that is specific to LBC I-09. Descriptions and recommendations for each step are provided below.

1) Prepare for the Exploration
    - Research and explore the site, ecology and stakeholders
    - Identify attendees and roles
    - Design exercises
    - Determine homework
    - Create agenda
2) Hold Exploration
    - Facilitate Introductions
    - Agree on goals
    - Complete initial exercise
    - Explore context
        - Investigate Biophilic Design
        - Incorporate exercises
        - Brainstorming ideas
    - Integrate Biophilic Design
    - Outline next steps
3) Develop Key Documents
    - Document the Exploration
    - Write up Framework
    - Write up Plan

“Engage a biophilic design consultant who can work with your team. Think about what Biophilic Design elements make the most sense for this place, this purpose, and this time. Approach this as a non-checklist point of view—change your perspective, embrace biophilia.”

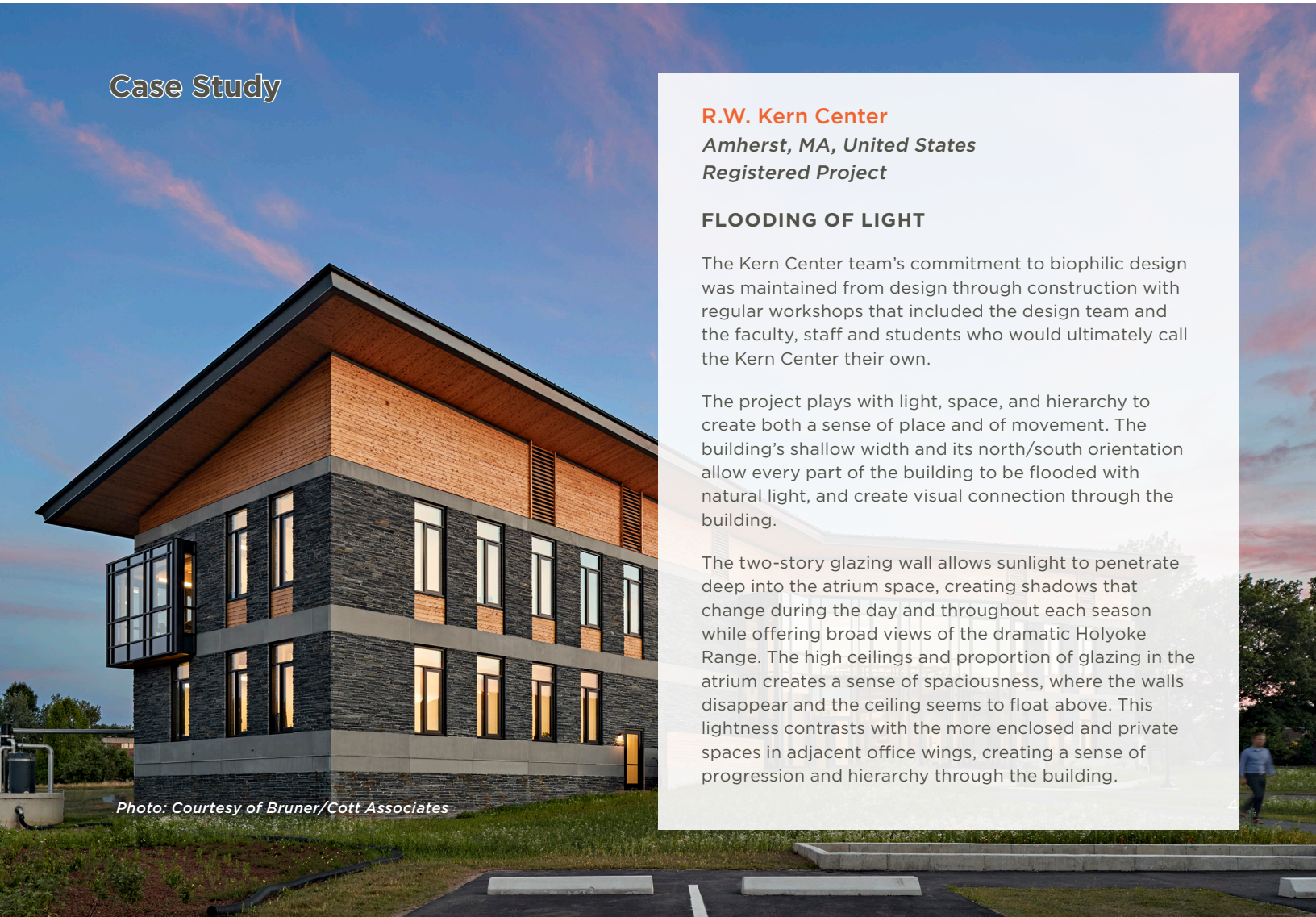
Richard Piacentini, *Executive Director, Phipps Conservatory and Botanical Gardens*

PREPARE FOR THE EXPLORATION

The Biophilic Exploration Day should happen early in the design process, before concepts and forms are set. The exploration is most effective when it occurs at the start of a collaborative process and when there are broad opportunities to "do things differently" and take risks without contravening work that has already occurred. Challenging accepted processes, norms, and hierarchies of decision making is beneficial to finding imaginative and effective solutions to biophilic goals, and participants will be more open and able to work toward such new solutions if they have not already spent time designing the project and getting deeply involved in the details of programmatic concerns. Biophilic design works best if it is the starting point for the concept for the project.

RESEARCH INTO THE SITE, ECOLOGY AND STAKEHOLDERS

A deep understanding of site context, including the history, culture, ecology, and climate of the site, are essential to creating a biophilic building. Consideration of wide-ranging information, types and sources, can provide inspiration for participants. Engaging experts and stakeholders ahead of time allows the team to sufficiently incorporate the resulting information into their day of exploration. Teams should take the time to know the site intimately—physically, spiritually, and emotionally—in order to best explore the biophilic opportunities for the project. The intent is not for the design team to research the site and bring only their analysis, but to include in the research other stakeholders that approach problems differently. This research could include efforts by experts other than designers who can apply a different lens to the project context, such as biological or building science research methods.



Case Study

Photo: Courtesy of Bruner/Cott Associates

R.W. Kern Center
Amherst, MA, United States
Registered Project

FLOODING OF LIGHT

The Kern Center team's commitment to biophilic design was maintained from design through construction with regular workshops that included the design team and the faculty, staff and students who would ultimately call the Kern Center their own.

The project plays with light, space, and hierarchy to create both a sense of place and of movement. The building's shallow width and its north/south orientation allow every part of the building to be flooded with natural light, and create visual connection through the building.

The two-story glazing wall allows sunlight to penetrate deep into the atrium space, creating shadows that change during the day and throughout each season while offering broad views of the dramatic Holyoke Range. The high ceilings and proportion of glazing in the atrium creates a sense of spaciousness, where the walls disappear and the ceiling seems to float above. This lightness contrasts with the more enclosed and private spaces in adjacent office wings, creating a sense of progression and hierarchy through the building.

The team should identify outside resources that might be of particular relevance to the project such as owner or stakeholder values, site context, programmatic requirements, or other factors, but also think broadly about how to expand the information and views in the room. Identified expertise, resources, and issues can inform not only the participation list for the charrette, but also the agenda and the development of exercises to encourage new approaches.

IDENTIFY WORKSHOP ATTENDEES AND ROLES

Attendees for the exploration day should include a broad spectrum of stakeholders and perspectives. Rethinking the attendee list beyond those that might attend a typical design charrette is meant to deepen understanding of opportunities and encourage project teams to incorporate the six Biophilic Design Elements in innovative and effective ways. Professions and expertise outside of the typical project team can enrich the conversation and the collection of perspectives in the room.

Brief presentations by outside experts about history, culture, or ecology can be helpful to share knowledge and spark participation and new ideas. An outside facilitator will free up the design team to fully participate in generating ideas and discourage a focus on preconceived design concepts. The team will also want to ensure the attendee list is not so long that the exploration day becomes unmanageable. It is important to maintain focus and allow deep participation by all attendees.

Some professions to consider inviting as either presenters or participants are listed below.

ATTENDEE SUGGESTIONS

Design team members	• Architect • Landscape Architect • Civil Engineer • MEP Engineers	• Structural Engineer • Sustainability Consultant • Lighting Designer • Acoustic Designer
Direct stakeholders	• Owners/Decision Makers • Occupants	
Environmental Features Natural Shapes and Forms Light and Space	• Geologist • Botanist • Environmental Analyst • Ecologist / Naturalist	• Meteorologist • Biomimicry Specialist • Geomorphologist • Artists
Natural Patterns and Processes Evolved Human-Nature Relationships	• Material Scientist • Biologist • Landscape Architect • Natural Historian	
Connection to place, climate, and culture through Place-Based Relationships	• Community Leaders • Historic Preservation Consultant • Social Ecologist • Anthropologist	• Local Historian (e.g., from a local university)

DESIGN EXERCISES

Exploration exercises are meant to get attendees out of standard lecture or meeting mode. As such they should be designed to draw attendees beyond their typical role toward deeper, more personal participation. They might include a physical element that literally stretches or moves the participants. They might try to tap into memories or subconscious reactions to bring innate responses to the surface. Some examples and best practices for examples are provided below, however, the team should not be limited by specific formats, but should think about what might deeply engage participants and set the right tone for their particular biophilic exploration.

TIP
Writing down ideas on sticky notes and having participants place them where everyone can see encourages those who may not be comfortable sharing their ideas out loud to the group.

The number of exercises, their timing, and format will be different based on the project—its type, context, and stakeholders. That said, there are some recommended best practices. It is generally helpful to connect the concepts of biophilic design to personal experiences, and it is important to help participants understand Kellert's concepts and apply them to the project.

Most participants will be at the Exploration in a professional capacity that may keep them in their professional role, focusing on typical issues such as design concerns and solutions, code compliance, or costs. Exercises are a powerful way to pull people out of those standard roles into more deeply based areas of response. The exercises have three general goals:

- To connect participants with their subconscious, or nature-based, selves;
- To connect dots between personal experience and biophilic design principles; and
- To spark creativity that contributes toward innovative biophilic design.

Teams are encouraged to review the exercise examples provided below, and to customize and innovate exercises that suit their project and process.

TIP
Adding a personal element to the discussion can help participants arrive in the mindset of how people and nature are connected.

DETERMINE HOMEWORK

It is a good idea to assign homework to participants before the Exploration (see Resources for a list of recommended materials). One approach is to have participants arrive with a basic understanding of biophilic design, which can help move the agenda into the specifics of the project more quickly. Another homework option is to reflect on a personal connection to nature and/or to bring a natural object that represents a connection to nature.

At a minimum, some short articles on the connection between people and nature, or a list of Kellert's Elements and Attributes should be sent before the Exploration Day.

CREATE AGENDA

It is possible to have a successful Biophilic Design Exploration with a very structured or very loose agenda, as long as it allows for comfortable participation by participants and moves the project toward successful integration of Kellert's principals.

RECOMMENDED AGENDA ITEMS

The below agenda items are recommendations. They do not all have to be included, and may be executed in a different order or given a different emphasis than outlined here. The recommended items listed below are then annotated in the following sections.

Facilitate Introductions
Agree on Goals
Complete Initial Exercise
Explore Context
- Place Context
- People/Culture Context
- Project Context

Investigate Biophilic Design
Incorporate Exercises
Integrate Biophilic Design
Outline Next Steps

HOLD BIOPHILIC EXPLORATION

The exploration goal is to align stakeholders around specific biophilic design goals and outcomes, and for participants to feel personally invested in connecting the building and occupants to nature.

FACILITATE INTRODUCTIONS

The start of the Exploration is an opportunity to get everyone to speak, set the tone for the day, and provide an overview of the agenda so everyone knows what is coming. Introductions ideally not only clarify why each person is in attendance, but also draws attention to a personal connection to nature. Without each person speaking to a personal connection to nature, the openness to considering biophilic design strategies will be restricted. Questions participants might answer when introducing themselves include:

- What is the most inspiring moment you have ever experienced in nature?
- How does nature influence who you are?
- Describe a natural object and why it is meaningful to you (this might tie into assigned homework).
- Which built space have you been the happiest in?

The facilitator may also want to set the tone for the day by providing some instructions and guidelines, ideally with agreement from the group. Such guidelines might address cell phone use, means to provide input, or recommended communication approaches. Suggested guidelines:

- Project teams are encouraged to approach biophilic design with an experiential intent and understanding of cooperation and valuable contribution of ideas.
- Think outside of the box.
- Encourage collaboration and broad brainstorming; “There are no bad ideas.”
- Build on other’s ideas; suggest using “Yes, and...”
- Work to co-create biophilic design solutions—perhaps give credit for “the assist.”
- Try to weigh in on areas of the project beyond your typical scope of work.

TIPS

Think about poetry, go out on a limb, inspire pause and action.

One conversation at a time. Your team is far more likely to build on an idea and make a creative leap if everyone is paying full attention to whoever is sharing a new idea.

AGREE ON GOALS

The International Living Future Institute has goals for the Biophilic Exploration Day which are stated below. The team, however, will determine their own specific goals for the day based on the current project status, context, building type, and stakeholders. We recommend the team be familiar with ILFI's requirements, and work with Exploration participants to finalize their goals.

ILFI'S GOALS

Stakeholders are to develop ideas that will support the project with regard to biophilic design. By the end of the day, attendees will have a clear understanding of Stephen R. Kellert's Elements and Attributes and an agreement on how they can be a source of support and enrichment for the project. The ideas developed during the workshop will become the basis of the project's Biophilic Design Framework (Framework).

PROJECT'S EXPLORATION GOALS

The project team has an opportunity, in the exploration goals, to focus attention on the four requirements of the Imperative, get buy-in from all attendees, and set other project objectives related to biophilic design. It may be helpful to establish goals + objectives for the day through guiding questions. Some examples are provided below. The team may want to get consensus on the process for determining goals before they jump into brainstorming.

Example guiding questions:

- How familiar are participants with the principals of and research around biophilic design?
- How does biophilic design support the larger mission of the owner?
- How might biophilic design support the goals of the occupants or the surrounding community?
- How will the exploration influence the overall design process?

Example Exploration goals:

- To get buy-in for biophilic design/LBC Imperative goals for the project
- To explore opportunities for engaged inclusion of all attendees and stakeholders
- To identify how the requirements will drive the design concept
- To identify the intent and objectives of biophilic design for this project
- To brainstorm and explore biophilic design as a process
- To hear input from stakeholders that are not on the design team
- To provide a high-level overview of biophilic design principals for attendees/stakeholders
- To explore, identify, interpret, and strategize the application of biophilic design for the project
- To understand the unique patterns of the place through biophilic principals

COMPLETE INITIAL EXERCISE

An initial exercise is an opportunity to enable a connection and an open mindset amongst participants, accept new ideas, reconnect with innate and deeply rooted relationships with nature, and introduce a biophilic frame of mind.

More information on exercises is provided below under incorporating exercises.

EXPLORE CONTEXT

Explorations typically include a combination of prepared information and spontaneous additions to take advantage of and elicit the tacit wisdom in the room. An experienced facilitator will keep this section running smoothly while adapting to the unique interactions of the particular makeup of participants.

PLACE CONTEXT

Get input on relevant site context, then discuss the purpose of the project within that context of the project site. This part of the agenda would typically include brief presentations of research, such as the ecology, climate, geography, etc., including visuals, either live (if able to visit the site) or through other media. Ideally, this section also includes information about the site's significance, such as why the site is unique or typical for the area. Look for opportunities within the location:

- What is a regional material palette?
- Which other senses could come into play: color palette, tactile palette, auditory palette, etc.?
- How do current occupants respond to both climate and weather? Time of day?
- How does this ecosystem work? What is unique about it?
- How can people be connected to the climate and ecosystem of this place?
- What ecosystem services are available, and what other values do they bring (aesthetic, physical, auditory, etc.)?

Case Study

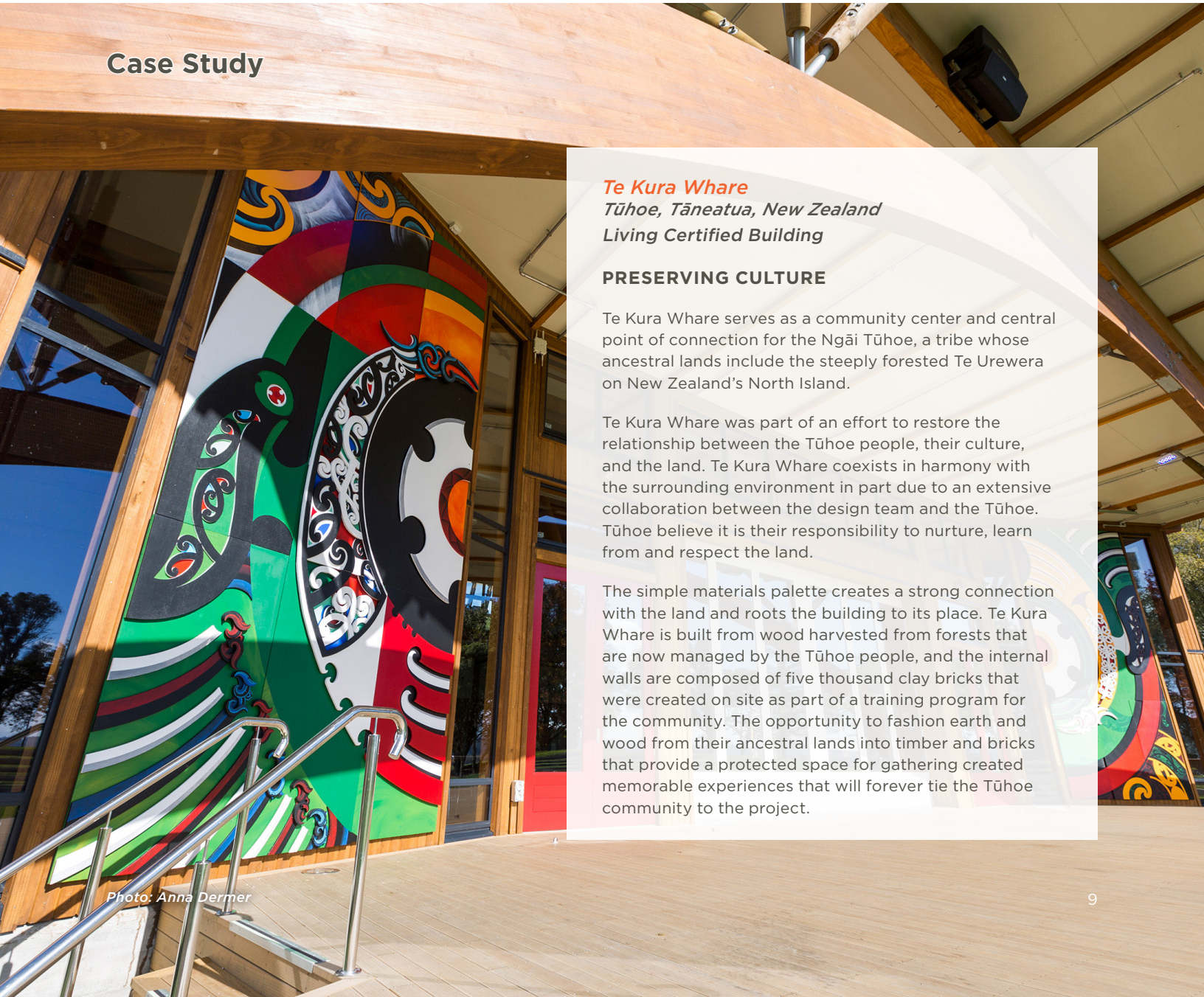


Photo: Anna Dermer

Te Kura Whare

Tūhoe, Tāneatua, New Zealand

Living Certified Building

PRESERVING CULTURE

Te Kura Whare serves as a community center and central point of connection for the Ngāi Tūhoe, a tribe whose ancestral lands include the steeply forested Te Urewera on New Zealand's North Island.

Te Kura Whare was part of an effort to restore the relationship between the Tūhoe people, their culture, and the land. Te Kura Whare coexists in harmony with the surrounding environment in part due to an extensive collaboration between the design team and the Tūhoe. Tūhoe believe it is their responsibility to nurture, learn from and respect the land.

The simple materials palette creates a strong connection with the land and roots the building to its place. Te Kura Whare is built from wood harvested from forests that are now managed by the Tūhoe people, and the internal walls are composed of five thousand clay bricks that were created on site as part of a training program for the community. The opportunity to fashion earth and wood from their ancestral lands into timber and bricks that provide a protected space for gathering created memorable experiences that will forever tie the Tūhoe community to the project.

PEOPLE/CULTURE CONTEXT

The goal of this section is to understand how to create community both within the finished project and in connection to the larger community the project is within. Community connections can happen throughout design, as well as after project completion. Consider who is likely to be using the building and what their relationship to the site, history, and community will be.

Exploring cultural variation in the context of biophilic responses to space, light, color, or other sensory differences will be helpful in the design of space and will help to elicit the emotive aspects of the project.

- How can community be created in this place?
- What are the cultural strengths of this place? How can they be celebrated?
- How can the building occupants be connected to nature from the minute they arrive?
- What are the journeys and interactions with nature from arrival to departure? How do they vary for different occupants?
- Where and how can people celebrate their connections to each other?
- What are the historical and/or cultural influences?
- What are the cultural implications or lessons that might influence the regional palette or be reflected in the spaces?

PROJECT CONTEXT

While it is important to have a general understanding of the project (reason for it occurring, priorities of the program), this section can run the risk of setting a particular focus that limits brainstorming and risk taking. It is wise to limit the time and scope of this section by keeping information general and inspirational, rather than getting very detailed.

- What are the key areas for flexibility or responsiveness, to climate, weather, or occupants?
- How will the aesthetics of the project contrast and/or reflect the existing context?
- How can the project's original goals be supported and enhanced through biophilic design?

INVESTIGATE BIOPHILIC DESIGN

The objective in this section is for everyone to understand what biophilic design is, how it has been categorized and explained by Stephen Kellert, and how other projects have used it to create biophilic buildings.

Biophilic design is about connecting people to nature—keeping this objective in mind will help the group stay focused on strategies that engage the building form, materials, spatial responses, and psychological responses to space rather than simply inserting a few green walls or providing natural daylight. These are both great strategies but alone, neither creates a biophilic building.

TIP

Reporting out by one person can help share information, but it also can result in editing by the "reporter." Consider multiple reporters per group.

Explore each of Kellert's six elements through an exercise and/or brainstorming activity. Be cautious of providing very specific examples that will narrow teams' imaginations. Depending on the project, group, and structure of the Exploration, this section could be the core of the day, generating a myriad of ideas that are later tied to the project, or it could be more of an educational segment that is applied to brainstorming and the specifics of the project later in the day.

BIOPHILIC DESIGN ELEMENTS AND THEIR CORRESPONDING ATTRIBUTES

Environmental features • Color • Water • Air • Sunlight • Plants • Animals • Natural materials • Views and vistas • Façade greening • Geology and landscape • Habitats and ecosystems	**Natural shapes and forms** • Botanical motifs • Tree and columnar supports • Animal (mainly vertebrate) motifs • Shells and spirals • Egg, oval, and tubular forms • Arches, vaults, domes • Shapes resisting straight lines and right angles • Simulation of natural features • Biomorphy • Geomorphology • Biomimicry	**Natural patterns and processes** • Sensory variability • Information richness • Age, change, and the patina of time • Growth and efflorescence • Central focal point • Patterned wholes • Bounded spaces • Transitional spaces • Linked series and chains • Integration of parts to wholes • Complementary contrasts • Dynamic balance and tension • Fractals • Hierarchically organized ratios and scales
Light and space • Natural light • Filtered and diffused light • Light and shadow • Reflected light • Light pools • Warm light • Light as shape and form • Spaciousness • Spatial variability • Space as shape and form • Spatial harmony • Inside-outside spaces	**Place-based relationships** • Geographic connection to place • Historic connection to place • Ecological connection to place • Cultural connection to place • Indigenous materials • Landscape orientation • Landscape features that define building form • Landscape ecology • Integration of culture and ecology • Spirit of place • Avoiding placelessness	**Evolved human-nature relationships** • Prospect and refuge • Order and complexity • Curiosity and enticement • Change and metamorphosis • Security and protection • Mastery and control • Affection and attachment • Attraction and beauty • Exploration and discovery • Information and cognition • Fear and awe • Reverence and spirituality

"We now know about integrative design, about regenerative design—where you're not trying to do a green building but a building that heals the ecosystem and the social system that you're dropping it into. It turns it away from being the object [and] into the relationship."

Jerome Partington,
Senior Associate, *Jasmax*

Some biophilic principles are easier to understand and implement than others. It may be helpful to focus specific attention, through an exercise or a pointed focus on elements that are less familiar to participants, that could spark particularly innovative responses. One strategy would be to explore the less typically integrated elements through an exercise, then discuss and try to come up with ideas specific to the project.

For example, Evolved Human-Nature Relationships, and Natural Patterns and Processes are more psychological, and less explicitly physical than Light and Space or Natural Shapes and Forms. Teams will benefit from going beyond the "low-hanging fruit" that fits into their standard design process (e.g., incorporating natural light and natural materials), to have fun and explore broad options. For example, spaces that are "mysterious" or "scary" are not easily defined by specific physical interventions but can be memorable and stir very strong responses. Similarly, the emotive impact of successful creation of "dynamic balance and tension" or "fear and awe" could be significant.

INCORPORATE EXERCISES

Each eight-hour charrette could have anywhere from two to four exercises depending on the type and length. The exercises should be structured to take the group from thinking big-picture about biophilic design to narrowing down and focusing on strategies for the project and how they will be integrated.

EXERCISE EXAMPLES

Explore Multi-Sensory Design

- Direct Sensory Perception (interactive session)
  - **Description:** Explore possible interventions in our building environment that can enhance our sensory environments to create well-being or happiness.
  - **Methodology**: Focus on the often-neglected sensory environment, especially non-rhythmic sensory stimulation for hearing, vision, and thermal delight.

Explore the Biophilic Design Elements and Attributes

- Indirect Psychological Perception (interactive conversations)
  - **Description:** Explore interventions in our built environment that can connect people and nature.
  - **Methodology:** Focus on the biophilic design elements and attributes, reflecting on their definitions, how they subconsciously engage our psyche, and how their design application can be implemented in the project to stimulate all five senses.

Integration into Practice

- Specific project visioning
  - **Description:** Explore opportunities to bring biophilic design elements to life.
  - **Methodology:** Recognize that the specific context matters a great deal when applying biophilic design elements, and apply the output from the direct sensory perception and the indirect psychological perception exercises to the physical manifestations.

INTEGRATE BIOPHILIC DESIGN

It is critical that Kellert's elements and attributes are applied to the project and the team walks away from the Exploration with strategies and design concepts that help the project to incorporate biophilic design and to meet the requirements of Imperative 09.

The most successful projects address biophilia through a mix of:

- Integration and Connection: Biophilic design that reinforces design interventions for a direct connection to the project setting or space.
- Expression and Emotion: Biophilic design that demonstrates and stirs affection toward project setting or space.
- Experience of Nature: Biophilic design that fosters positive, everyday interactions and relationships with the natural environment.
- Physiological Benefit: Biophilic design that emphasizes human health, fitness, and well-being.

Consider various scales, impacts, locations, and types.

- Landscape strategies
- Building form
- Paths and movement
- Finishes and detailing
- Opportunities to engage the senses (tactile, auditory, olfactory, etc.)

Consider interactions and dependencies.

Identify strategies that will allow a variety of interactions/dependencies.

- Centralization + Decentralization: What functions can be integrated and which need to be separated?
- Flexibility: What are the expected changes of functions over time?
- Flow: Who and/or what moves through the project: goods, services, people.

OUTLINE NEXT STEPS

Ideally, the exploration will leave time at the end to outline and agree on the basic elements of the Biophilic Framework and Biophilic Plan, described below.

By the end of the exploration day, participants should know:

- The agreed-upon goals and themes for the project
- Which Kellert Elements will be prioritized by the project team
- Specific strategy ideas to meet the I-09 requirements—and which of those require more research

DEVELOP KEY DOCUMENTS

Clear documentation is critical to a successful certification. The team should retain relevant information from the exploration, as well as from meetings to track, refine, or revisit biophilia.

DOCUMENT THE EXPLORATION

The project team should keep good records of the attendees, agenda, discussions, inputs, and outcomes of the Biophilic Exploration. The outcomes will become the Biophilic Framework, and the attendees and agenda should be included in Imperative documentation, either as a record in the Framework or as separate documents. Notes and photos of the inputs and decisions can be helpful for the development of the framework and plan, or if questions arise during the implementation of the biophilic design elements.

Recommended documentation:

- Agenda (could be in Framework as a record)
- Attendee List (could be in Framework as a record)
- Input and decisions (notes, photos, etc.)

CREATE THE BIOPHILIC FRAMEWORK

The project's Biophilic Framework outlines the decisions from the exploration: what strategies the team will integrate into the project, what will be investigated further, and what significant decisions need to be made to meet project goals. The framework will evolve throughout the project, but should still remain largely based on the results of the exploration day.

Based on workshop outcomes (who, by when, how detailed for this project), some subsection of participants should create the official framework. Ideally, all participants would have an opportunity to review and comment on that final framework.

TIP

Written notes from multiple authors can help ensure ideas aren't missed.

Review of the consolidated notes by all participants may provide a beneficial feedback loop.

THE FRAMEWORK

- A goal-oriented document that focuses on desired outcomes
- Summarizes the approach of the team toward the integration of biophilic design into the project
- Should be comprehensible to participants, as well as to outside parties such as other teams hoping to learn from the project, and the IFLI Auditor
- May be included in education materials about the project

Case Study

Sustainable Buildings Research Centre

Wollongong, Australia
Registered Project

LANDSCAPE RELATIONSHIP

The Sustainable Buildings Research Centre (SBRC), part of University of Wollongong's Innovation Campus, was created to test and demonstrate technologies to inspire the green building movement in Australia.

The design creates journeys to engage all the senses and invites students, staff, and visitors to explore and experience the Centre. The varied textures and patterns in the building materials and landscape plants encourage people not just to look, but to touch and feel. Occupants are encouraged to harvest and taste the fruits and vegetables from the garden. The courtyard is filled with birdsongs and sounds of the wind rushing through the landscaping plants. During spring and summer, building interiors fill up with the fresh fragrances from the mountains, the tang of coastal dune plants, and the scent of citrus blossoms.

Programming is divided between two buildings, with landscaped areas in between, ensuring that occupants will spend at least part of their day outside. These pedestrian journeys combined with framed views and long vistas from the interior foster direct and indirect connections with nature.

Photo: John Gollins

CREATE THE BIOPHILIC PLAN

The Biophilic Plan (Plan) is meant to ensure the project implementation of the Framework stays on track.

THE PLAN

The Plan is a guiding document that helps the team implement the Framework to meet the project's biophilic design goals. It lays out how to integrate the selected biophilic strategies into the project throughout all phases. The Plan could lay out communication paths and methods, milestones, next steps with responsible parties, and methods to track each element throughout the project. The Plan could also be based around an actual plan of the site/project—pointing out planned interventions and tracking them at each phase to ensure they remain intact or evolve in a way that supports both the project and Imperative requirements. The Plan is:

- An execution-oriented document
- Focused on strategies and steps the team will use to implement the framework throughout the project
- A means to help the team stay on track toward their biophilic design goals

The plan might include:

- Action items (by person or group)
- Timelines and deadlines
- Communication strategies—both within the team and to outside stakeholders
- Prioritization and/or decision-making methodologies
- Documentation of implementation—i.e., visual plan, plan of execution

IMPLEMENT THE FRAMEWORK

Using the Plan, the team must integrate sufficient biophilic design strategies from the Framework to meet at least the minimum Imperative requirements—integration of the required elements of Kellert's framework—into the project. It is effective to have biophilic design integrated throughout the project site and buildings—working in harmony with other design goals. Ideally each goal will be met through strategies that are accessible to a majority of occupants and/or visitors to the building.

The documentation of the Framework implementation should include locations, images, and brief descriptions of each installed or constructed strategy, at a minimum. Non-visual strategies, such as auditory or tactile interventions, might require minimal imagery and slightly longer descriptions.

TRACK THE IMPLEMENTATION

The team should track each of the goals from the exploration day throughout the design and construction process to ensure that they are met. The means to track can be determined by each project's team and circumstances, but should be documented in a clear and simple way. Documentation might include a series of design/construction drawings, written progress reports, or other records. Tracking recommendations include:

- Check-ins at each stage of design to confirm goals are still being met
- Written and/or visual documentation of status of goals at each check-in
- Visual documentation of final implementation

BIOPHILIC FRAMEWORK

OVERVIEW

The Biophilic Design Framework (Framework) is part of the documentation requirements for the Living Building Challenge Imperative 09, Biophilic Environment. It is a reference document, recording the decisions of the Biophilic Design Exploration (Exploration), as well as a document that will evolve over the course of the project development and construction. Therefore, it needs to be established immediately after the Exploration, and updated periodically over the course of the project. Both the initial version, and the final version will ideally be provided as part of the documentation for the project. The Framework is the "what" of biophilic design for the project (vs. the Plan, which is the "how").

Each team will determine the format and complexity of their Framework, which is essentially a scaffold that organizes the biophilic design ideas for the project. The project team will have a record of the ideas from the Exploration that the attendees determined were appropriate and exciting and would most benefit the project and community. The Framework takes those discussions and decisions from the Exploration, consolidating them into prioritized lists of specific goals and strategies to be further explored, detailed and implemented into the project.

The Framework may be fairly simple, but should include the overarching goals for the project, information regarding biophilic and stakeholder priorities and specific strategies and ideas that are on the table. The Framework is the means to communicate what the project team has decided to consider and do to make their project appropriately biophilic for their stakeholders, and which Kellert Elements and Attributes are "in play" based on those decisions.

RECOMMENDED CONTENTS

Teams are not obligated to include everything listed below, but the following types of information are recommended to successfully implement biophilic design and meet the requirements of Imperative 09, Biophilic Environment. Any specific ideas about how those biophilic design approaches might be applied to the project, should also be included.

PROJECT INTRODUCTION

A short description and overview of the project (basic purpose and context) may be helpful, particularly if the Framework will be shared. The Framework is primarily for the team's use, so only a broad overview or re-cap should be needed.

REFERENCE INFORMATION

The Framework might include a link to or list of key documents that the team will reference as the design evolves, such as:

- Imperative 09, Biophilic Environment requirements
- The Kellert Elements and Attributes
- Project/site specific reports and research

PROJECT GOALS

An overview summary of what the project hopes to achieve revealing why Biophilic Design is important to this specific project can be a touchpoint for decision-making. Define "in a nutshell" results—what is your elevator pitch?

For example:

- The PDQ headquarters will use biophilic attributes to increase employee retention, and increase the health and performance of employees through sensory experiences of scents of place, dappled lighting, dynamic and immersive audiovisual environments, and engaging visual complexity and exploration.

• The ABC Travel Agency hopes to entice its customers to explore the world, and support its employees' creativity, through biophilic experiences that are both visual and auditory, connecting concepts of exploration, nature and awe.

or

• The XYZ Education Center will be a hub of biophilic design for the local community, showcasing how focused attention on Kellert's Elements and Attributes can transform similarly scaled spaces into a variety of highly differentiated teaching environments.

STAKEHOLDER PRIORITIES

It is important to capture the priorities that came out of the Exploration. A section listing these priorities provides guide-rails for the design team to reference as they make decisions for the project. What are the objectives across different areas, groups or functions? Which of Kellert's Attributes resonated as particularly relevant for this site/project?

TIP
Create narratives around elements or attributes that resonate with the team. This will help carry the intent forward in future discussions.

For example:

- A mix of sensory stimuli, including those that are visual, tactile, and auditory,
- A connection to the natural areas our clients are likely to visit (tropics, desert...)
- A focus on Sensory Variability and Patterned Wholes Attributes under Natural Patterns and Processes.
- The entry lobby to ABC Travel needs to feel warm, safe, and intriguing, but not overly stimulating.
- Hallways connecting the service areas may have higher levels of stimulus than the lobby, and might change over time (either over the course of the day, or month or year), while still providing clear way finding.
- Service areas might have smaller levels of intervention that can be changed easily as needed. The cafeteria is an opportunity to connect to the local culture though food, music, and patterns that reflect local vernacular and natural forms.

BIOPHILIC DESIGN STRATEGIES

The team will want to identify specific tangible manifestations for each Biophilic Design strategy targeted by the project. It is important to connect project goals and stakeholder priorities through the use of Kellert's Elements and Attributes to ensure that the requirements of the Imperative as well as the goals of the project and stakeholders are met.

- The entry will have a huge green wall that is beautiful and evokes a soft carpet—drawing clients in, evoking lush landscapes, and also helping acoustics and cooling the space. **Attributes:** Plants, Façade greening, Sensory variability, Attraction and beauty, Botanical motifs.
- The colors & patterning in the carpet, flooring, and blinds will be nature-based and loosely tied together to create a space that is vibrant yet coherent. **Attributes**: Patterned wholes, Sensory variability.
- Classrooms will have at least two solid adjoining walls (of storage, boards, etc.) and one wall with large windows that afford views of natural areas where science activities occur. **Attributes:** Prospect and refuge, Security and protection, Natural light.
- Gathering spaces will vary appreciably in size, lighting, color, texture, and acoustics to allow for a range of experiences, group sizes, and uses. **Attributes:** Avoiding placelessness, Curiosity and enticement, Exploration and discovery.

The relationship between strategies and priorities should be tracked throughout the project. This can be done through graphics, narrative, numerical correlations, or other means that work for the team.

LEADING QUESTIONS TO CONSIDER

Below are some questions to consider in the development of the Framework to help ensure proposed strategies are meeting the requirements.

- Who are the responsible parties and stakeholders?
- What are the focus areas and specific ideas?
- What are the preferred types of strategies? (e.g., senses addressed, active or static, interactive vs. passive, scale, location, etc.) How will these strategies meet the goals and requirements?
- What are the minimum number of strategies?
- How accessible/visible are the strategies for various stakeholders?
- What needs additional research?
- What format will work best for the team (a good record and reference, and easily updated)?
- How will the framework document the where and how of the biophilic design strategies?

ORGANIZATIONAL IDEAS

The Framework should be organized in a way that helps the team track the Elements against the requirements, and also against other project goals. How that tracking occurs, however, should be made clear in the Biophilic Design Plan (Plan).

Some organizational options:

- Location in the project
- Biophilic Element
- I-09 Biophilic Environment requirements
- Responsible party
- Stakeholder impact
- Scale of intervention (e.g., a pattern in one area vs. soundscapes throughout the project)
- Type of impact (e.g. multi-sensory experience, connection to nature, etc.)

DOCUMENTATION

The final version of the Framework must be provided as part of the documentation for I-09 Biophilic Environment. It is also recommended that the initial framework be provided to demonstrate that initial effort and how the project evolved.

"With humility and understanding, effective biophilic design can potentially enrich both nature and humanity."

Stephen R. Kellert, *Biophilic Design: The Theory, Science, and Practice of Bringing Buildings to Life*

BIOPHILIC PLAN

OVERVIEW

The Biophilic Design Plan (Plan) is part of the documentation requirements for the Living Building Challenge Imperative 09, Biophilic Environment. It is a reference document, outlining critical information the team needs to implement the decisions of the Biophilic Design Exploration (Exploration), as recorded in the Biophilic Design Framework (Framework). Therefore, it needs to be developed immediately after the Exploration, and referred to, and potentially adjusted periodically, over the course of the project. The Plan is the implementation process that helps achieve what is developed within the Framework.

Because this is a road map for each team to move their specific biophilic design ideas forward, each team will determine the format and complexity of their Plan. The Plan may be fairly simple, but should include information that helps the team communicate, make decisions and track the implementation of their biophilic design strategies. There is no set length or amount of detail, as long as the team successfully implements their Framework. For example, a Plan for a complicated project with multiple stakeholders, or for a team that has never worked together before, would likely be much more detailed and specific, while a Plan for a simple project might only articulate the check-in points and deliverables needed to ensure the project stays on track. The Framework and Plan can be combined, but the resulting document should still clearly articulate both the "what" and "how" of the biophilic design strategy for the project.

RECOMMENDED CONTENTS

Teams are not obligated to include everything listed below, but the following types of information are recommended to successfully implement biophilic design and meet the requirements of Imperative 09, Biophilic Environment. Other information or sections, particularly such as those which might be relevant to the structure of a particular team or project, are also welcome.

DELIVERABLES

Although the biophilic design strategy deliverables (e.g., number and types of strategies) should be outlined in the Framework, it can be helpful to reiterate those and other types of deliverables, such as those related to milestones, tracking, or documentation, in the Plan. In addition to listing deliverables, the Plan might also flesh out more details per the information below (e.g., who is responsible, what do they need to do, by when, etc.) and clearly connect to the goals of the project, including compliance for Imperative 09, Biophilic Environment.

RESPONSIBLE PARTIES

Project team members are generally accountable for implementing the Framework; however, there may be additional parties that need to buy in or contribute. Identify the individual or firm responsible for specific action items as well as supporting parties and roles. The Plan can be made available to all relevant parties, or the project team can be responsible for pulling in other parties as needed.

ACTION ITEMS

It is critical that each update identify what is needed from the team. Action items will vary from research assignments, particularly early on, to purchasing and coordination tasks. More detail is recommended for tasks that are tied to nonstandard systems or interactions. It may be helpful to have an "at a glance" format as well as places to go for more details. For example:

- Coordinate with green wall designer to identify plants and strategies that will evoke the feeling of a forest walk, provide acoustic barriers and cooling for the space, and survive well in the planned location.
- Review sun angles for classroom window walls to ensure glare can be addressed in some fashion that maintains pools of light and views, as well as diffuses natural light throughout the day. The goal is for each classroom to be able to maintain daylight and views throughout the school day (75% of class time).
- Identify the layout and finishes of the variously sized gathering spaces to ensure they provide a range of experiences as identified in the Framework.

DECISION MAKING PROCESS

The Exploration is likely to create a number of questions that need to be resolved by the team. Consensus regarding how decisions will be made, and communication of that process may help keep biophilic design moving forward during project development, from conceptual design through construction. Project pressures (budget, schedule, etc.) or changes to the team can put non-typical strategies (natural forms, sensory interactions, acoustic properties, biomimicry) at risk. Clear decision processes that incorporates critical stakeholders can keep the project on track to meet its goals and priorities, even if the specific means to do so is different from the initial ideas. Decisions should be reviewed at least at each check-in to see if there is anything that needs to be revisited based on new information, and more often if warranted.

EXAMPLE STAKEHOLDERS (INTERNAL + EXTERNAL)

- Project owner (internal)
- Project team (internal)
- Specialty consultants/experts (internal)
- Project occupants (might be internal or external)
- Visitors/Neighbors (external)
- Community leaders (external)
- Subject matter experts (external)

COMMUNICATION STRATEGIES

Communication with internal and external (or absent) stakeholders may be different than on typical projects. Biophilic design can push teams towards new design strategies and involve stakeholders that are not used to working on construction projects. Therefore, the team may need to carefully consider their communication strategies, particularly for external parties with a vested interest in the final form of the project. Project meetings, the typical means to communicate project decisions internally, may need to be supplemented by public forums or directed communications with graphics, links, or descriptions that clearly articulate the updates, changes, or questions of which stakeholders should be aware.

TRACKING METHODS

The requirements for Imperative I-09 explicitly state that the Plan "must contain methods for tracking biophilia at each design phase". How it is tracked, however, is left up to each team. The team may want to use a combination of written and graphic information to capture the attention (and imagination) of a variety of stakeholders. Just as the Framework could have many different organizational structures, so could the tracking method. Regardless of the way biophilic design evolution and implementation are tracked, there should exist a clear connection back to the Framework, including the priorities and attributes that were identified through the Exploration. The tracking method should also provide clear indicators to the responsible parties if something is getting off track.

It is often beneficial to record how the project's strategies evolved, and what forces influenced the changes. Did the project start with broad visionary concepts and home in on the specifics, or were they intrigued with many small interventions that came together into a integrated or multi-faceted design concept? Knowing how the project moved from start to finish can provide insights for future projects or other teams.

REFERENCE STUDIES

Imperative I-09 states that the Plan "should include cultural, ecological, and climatic studies that thoroughly examine the site and context for the project." Such studies ideally occur before the Exploration so the information that is discovered can inform the priorities and goals of the project. Those studies should be included in the Plan as reference documents for the team. In addition, other studies may come out of the team's post-Exploration work, to be referenced and eventually included in the Plan.

LEADING QUESTIONS TO CONSIDER

DELIVERABLES + ACTION ITEMS

- What does the project plan need to deliver?
- What are the immediate and longer-term steps that have been identified so far?
- How will deliverables and actions be identified? By intervention type, responsible party, location, other?
- Is there an "at a glance" format for action items that can be supplemented by more details elsewhere, or is everything in one document?
- What is the process to update the deliverables and action items?

TIP

Explore biophilic design not only at the building scale. Consider larger community involvement, and details that could have an exponential impact whether through surprise, repetition, or craft.

TIMING + CHECK-INS

- How and when will the team measure biophilic impacts?
- How often will the biophilic design scope be reviewed?
- What are the milestones of outside parties (e.g., permit review, funding, board meetings) that need to be considered in the timeline to ensure "buy-in" by all determining parties?
- How will the team know if they are "getting behind"?

CHECK-INS

- Who needs to be there? (This will likely vary across the span of the project.)
- Is the project on track toward the Framework goals?
- Is documentation being kept and organized for easy translation into the final Framework for Imperative 09?

DECISIONS + COMMUNICATION

- How will decisions that touch on biophilic design be made, and how will stakeholders be keep abreast of any changes?
- Are there outside parties that are not part of the project team, contractually, but that need to be referenced or included? If so, how?
- Which stakeholders need to be involved in which decisions, and how is that determined?
- Is the process used different based on scope, budget/schedule impacts, stakeholder impacts?

DOCUMENTATION

The team needs to provide a substantial illustrated Plan that demonstrates successful implementation of their Framework. It should include any ecological, climatic, or cultural studies, and the illustrations should clearly document the final design, and ideally, its impacts.

Information about how the community engaged, and what worked well (or did not) in the tracking process can be helpful to include in the I-09 Case Study narrative for I-20, Education + Inspiration, but is not required as part of the Plan documentation.

TIP
Review successful built examples of biophilic design that provide information regarding the design process and what worked well.

POST OCCUPANCY EVALUATION (POE)

While a POE is not required, it can help project owners and designers understand how biophilic design has impacted the occupants and whether the implemented strategies are having the intended effect. A POE for biophilic design can be coordinated with the survey for I-19 Beauty + Spirit.

DO YOUR BIOPHILIC INTERVENTIONS...

- **Enhance** characteristics and features of the natural environment: air, sunlight, plants, color, etc.?
- **Develop** designs that stimulate a variety of senses: sight, hearing, touch, smell, taste?
- **Ensure** access to nature?
- **Increase** direct personal experience with nature?
- **Express** connections between buildings and distinctive geographical, ecological, and cultural characteristics of particular places and localities?
- **Provide** diversity contained in nature?

"When we go to see a dance performance and the dancer makes a gesture, we experience something: maybe bird-like, maybe frog-like—something that's not actually there. Buildings that are in touch with their locations—those that have been invested with heart by the people who design and make them—do that. They're dynamic, living things."

Jonathan Wright, *Construction Manager, Wright Builders Inc.*

DEFINITIONS

Biophilia
The innate, genetically determined affiliation of human beings to nature and other living organisms.

Biomimicry
The copying or imitation of the phenomenons occurring in nature or an environment's efficiency and survival mechanisms in manufacturing processes (in applied, case-based reasoning).

Fractals
A figure of surface generated by successive subdivisions of a simpler polygon or polyhedron, according to some iterative process.

Genius of Place
A Genius of Place looks to nature in a particular place to provide guidance on locally attuned design strategies. By asking, "How have organisms and ecosystems solved this challenge here?" we discover a suite of design strategies that are well-adapted to place.

Geomorphology
The study of the characteristics, origin, and development of landforms.

RESOURCES

CASE STUDIES

Biophilic Case Studies.
Terrapin Bright Green. 2015.
https://www.terrapinbrightgreen.com/report/biophilic-design-case-studies/.

Certifed LBC Case Studies
living-future.org/lbc/case-studies/

Biophilic Design Map
living-future.org/lbc/case-studies/

Creating Biophilic Buildings
https://living-future.org/product/creating-biophilic-buildings/

RESEARCH

"Inducing physiological stress recovery with sounds of nature in a virtual reality forest — Results from a pilot study."
Annerstedt, Matilda, Peter Jönsson, Mattias Wallergård, Gerd Johansson, Björn Karlson, Patrik Grahn, Åse Marie Hansen, and Peter Währborg. ***Physiology & Behavior*** 118 (May 2013): 240-50. doi:10.1016/j.physbeh.2013.05.023.

"Workplace Wellness Programs Can Generate Savings."
Baicker, K., D. Cutler, and Z. Song. ***Health Affairs*** 29, no. 2 (February 2010): 304-11. doi:10.1377/hlthaff.2009.0626.

"The influence of school architecture on academic achievement."
Tanner, C. Kenneth. ***Journal of Educational Administration*** 38, no. 4 (February 2000): 309-30. doi:10.1108/09578230010373598.

Biophilia & Healing Environments: Healthy Principles for Designing the Built World.
Salingaros, Nikos & Ryan, Catherine. 2015. Terrapin Bright Green & Metropolis Magazine.
https://www.terrapinbrightgreen.com/report/biophilia-healing-environments/.

LIVING BUILDING CHALLENGE 3.1

A Visionary Path to a Regenerative Future

https://living-future.org
lbc.support@living-future.org

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