

CONNECTING PEOPLE WITH REGIONAL ECOSYSTEMS  
BY DESIGNING FOR SEASONAL CHANGE

by

DANÁE BURCK

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Erin Moore

This thesis places architecture within in the context of seasonal change in the natural environment. It critiques the current relationship between people and nature, arguing that architecture tends to separate rather than connect people with the richness of the natural environment. This issue is significant because of the impact the separation has on the sustainability of regional ecosystems as well as human experience of built environments and human wellbeing. I propose that architectural patterns and design strategies for seasonally transforming space (structure and experience) and occupant responses (adaptive opportunities) connect people with natural phenomena, which is a necessary part of connecting people to their regional ecosystems. This thesis examines and critiques several existing visitors centers throughout Oregon using a process of visual analysis, represented in two taxonomies: “Space: Structure and Experience” and “Response: Adaptive Opportunities.”

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## **List of Accompanying Materials**

1. Visual Taxonomy - “Space: Structure and Experience”
2. Visual Taxonomy - “Response: Adaptive Opportunities”

## Context

### Defining “Nature”

The relationship between humans and the natural environment is constantly evolving, and it has shifted many times over the last centuries. Humans are especially conscious of the idea of nature when we view ourselves, and our work, as separate from it. However, it is hard to provide a solid definition for “nature,” because it is more of a cultural construct than a universal view. From the Classical worldview, in which nature is the wild beast that architecture tames, to the Romantic worldview, in which nature is the picturesque that architecture imitates, nature as a cultural construct has taken on many different meanings. Within the last several decades, the western concept of nature has shifted to include a more ecological viewpoint in which nature is defined in “biological terms, focusing on living things and living systems.”<sup>1</sup> For the purpose of this paper, nature is defined as phenomena of the natural environment. I am not concerned with the idea of emphasizing “pure” nature, but rather with reinforcing the essential interconnectedness of people with the regional ecosystems of this environment. Seasonal change is integral to this regional context, so it is crucial to examine natural rhythms to better understand and connect with the environment.

### The Human / Nature Divide

As a result of contemporary design and technology, people are often disconnected from the seasons. Buildings protect us from climate extremes throughout

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1. Diana Balmori, “Across the Divide: Between Nature and Culture.” In *Groundwork: Between Landscape and Architecture* (New York: Monacelli Press, 2011), 39.

the year and help facilitate our daily lives, but many designs cut off their inhabitants from the environment rather than integrating with the natural processes around them. Stephen Kellert, an author and professor at Yale University, articulates how we have “encountered nearly ubiquitous environmental damage and a feeling of alienation from nature” in recent years that results from the human tendency to dominate natural phenomena by controlling seasonal change.<sup>2</sup> The development of environmental control systems (such as artificial lighting, ventilation, heating, and cooling) provides independence from natural processes, and solidifies this separation from the seasons. However, a connection with the seasons is crucial in architecture, especially when considering building sustainability, livability, and quality of experience. David Orr, an architectural theorist and professor, argues that designing with nature is “not just about making things, but rather remaking the human presence in the world in a way that honors life and protects human dignity.”<sup>3</sup>

Although there has been an increasing focus on sustainable design in recent years, most efforts have focused almost entirely on building performance, overlooking the need to connect humans with natural phenomena experientially. Landscape and urban designer Diana Balmori articulates this concept by stating that, “One fallacy of contemporary notions of ecology... is that green or sustainable design atones for the alienation of human beings from the natural environment.”<sup>4</sup> Designing for energy

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2. Stephen Kellert, *Building for Life: Designing and Understanding the Human-Nature Connection* (Washington D.C.: Island Press, 2005), 3.

3. David Orr, *The Nature of Design: Ecology, Culture, and Human Intention* (New York: Oxford University Press, 2002), 4.

4. Balmori, “Across the Divide,” 39.

performance alone solves only part of the problem, but the larger issue of human disconnection from regional ecosystems still remains.

### **Research Argument**

Relationships with natural rhythms through designed spaces and occupant responses are critical to reinforcing the essential interconnectedness of people with regional ecosystems. Architectural patterns of seasonally transforming structure and experience engage *space* to connect people with natural phenomena. Opportunities for seasonal adaptations engage *occupant response* to connect people with natural phenomena. These spatial patterns and adaptive opportunities should be guiding principles for future architectural design in order to build supportive relationships that integrate people and the environment.

## Significance

### Multiple Facets of Sustainability

Connecting architecture with natural phenomena is more than a symbolic gesture. It provides many benefits to the environment and to the people who inhabit the designed spaces. Reduced environmental damage and energy savings are some of the obvious advantages. However, to design more effectively for people and for the environment, our idea of what makes a building “sustainable” must be broadened. Using integral theory, architectural theorist Mark DeKay argues the necessity of multiple sustainability perspectives, encompassing (1) Experiences: “self and consciousness,” (2) Behaviors: “science, mechanics and performance,” (3) Cultures: “meaning, worldviews and symbolism,” and (4) Systems: “social and natural ecologies and contexts.”<sup>5</sup> Through this process of “Integral Sustainable Design,” architects can design buildings that connect their occupants with the seasons and lead to “The formation of whole, unified, and complete plans and schemes that conserves the natural environment for future generations.”<sup>6</sup> In contemporary sustainable design, these principles are not fully engaged in the design process. This creates buildings that disconnect people experientially from natural phenomena despite being labeled “energy-efficient” or “sustainable.” A balanced design process integrates all four of DeKay’s principles so that the end product supports the individual, the building program, the culture, and the environment. The Behaviors principle is by far the most

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5. Mark DeKay, *Integral Sustainable Design: Transformative Perspectives* (Washington D.C.: Earthscan, 2011), xxv.

6. *Ibid.*, 6.

heavily emphasized in conventional design, which is evidenced by the Leadership in Energy and Environmental Design (LEED) rating system that dedicates over 90% of its metrics to building performance.<sup>7</sup> The Systems principle also has significant recognition from the growing emphasis on ecological design in recent years that looks beyond the building itself to interact with its surrounding context.<sup>8</sup> The Behaviors and Systems principles are often emphasized to the detriment of the Experiences and Cultures principles, which only occasionally enter into the sustainability discussion. However, these two overlooked perspectives are crucial in reconnecting architecture and its inhabitants with the natural environment and the seasons. As Kellert argues, “low environmental impact design ignores the equally important need to restore beneficial contact between people and nature in the built environment.”<sup>9</sup>

### **Designing a Relationship with the Environment**

Experience and culture are sustainability issues, because they relate to the quality of environments (and therefore the quality of life) that architects are creating for people as well as for regional ecosystems. A design that only focuses on how a building performs does not create a suitable environment for people to live, eat, sleep, play, learn, and work in, because it ignores how a building feels and how it impacts people and culture. Orr contends that architecture must engage all of the senses, and to be considered “sustainable” a “design must offer more to meet the eye—and the ear, nose, and the skin.”<sup>10</sup> The emerging field of Biophilic Design incorporates both the

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7. DeKay, *Integral Sustainable Design*, 29.

8. Balmori, “Across the Divide,” 39.

9. Kellert, *Building for Life*, 5.

10. Lance Hosey, *The Shape of Green: Aesthetics, Ecology, and Design* (Washington D.C.: Island Press, 2012), 8.

Experiences and Cultures perspectives. Kellert has even called biophilia “the missing link in sustainable design.”<sup>11</sup> This theory of biophilia holds that “a love for nature” is innate in humans, and therefore a relationship with natural phenomena is indispensable to human life.<sup>12</sup> Kellert writes that Biophilic Design can achieve this connection through a combination of organic design (which encompasses the Experiences principle) and regional design (which encompasses the Cultures principle).

Organic design focuses on people’s experience, aiming to “directly, indirectly, or symbolically elicit people’s inherent affinity for the natural environment.”<sup>13</sup> Kellert argues that “fostering positive experiences of nature in the built environment” through organic design improves human wellbeing and increases appreciation for nature, therefore reducing environmental degradation.<sup>14</sup> Research on the effects of natural phenomena on human life demonstrate that a connection with nature is linked to improvements in productivity, anxiety reduction, mental acuity, childhood development, and physical healing.<sup>15</sup> Not only is the human quality of life improved by a relationship with nature, but the quality of the environment becomes a more important value as well. In his book, *The Shape of Green*, architect Lance Hosey asks the question, “How long will something last if it fails to excite the spirit and stir the imagination?”<sup>16</sup> He argues that contemporary architecture must address aesthetics and sensory experience in order to be sustainable. DeKay also addresses this idea, arguing

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11. Alex Wilson, “Biophilia in Practice: Buildings That Connect People with Nature” (Environmental Building News 15, no. 7, July 2006), 1.

12. Ibid.

13. Kellert, *Building for Life*, 5.

14. Ibid.

15. Wilson, “Biophilia in Practice,” 12.

16. Hosey, *The Shape of Green*, 6.

that a personal connection with nature is crucial in driving sustainability, because “Experience Begets Relationship Begets Meaning.”<sup>17</sup>

Regionally specific design presents a sustainability issue as well, because it is invested in place and connects “culture, history, and ecology within a geographic context.”<sup>18</sup> Contemporary architecture has lost much of its integrity with place.

However, architecture professor Ralph Knowles, author of *Ritual House: Drawing on Nature’s Rhythms for Architecture and Urban Design*, contends that designing for the “rhythms of nature... can help meet the needs of future generations.... [and] cause profound changes in the way people identify with their environments” leading to a strong cultural integration with natural phenomena.<sup>19</sup> These natural rhythms are manifested through seasonal change, which has both cultural and environmental significance. Architecture has the opportunity to respond to these rhythms and shape how we interact with our environment. Regionally specific architecture can create positive cultural identity with the environment through design strategies that encourage interaction with regional ecosystems.

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17. DeKay, *Integral Sustainable Design*, 359.

18. Kellert, *Building for Life*, 5.

19. Ralph Knowles, *Ritual House: Drawing on Nature’s Rhythms for Architecture and Urban Design* (Washington D.C.: Island Press, 2006), 6.

## Research Methods

### Outcome

Create visual taxonomies to document spatial patterns and design strategies for transforming architecture in response to natural rhythms (as observed through five case studies).

### Case Studies

Five visitors centers were selected throughout Oregon's main climate regions (coast, valley, mountain, gorge, and desert). A case study was conducted at each of the sites to determine how the designs support or limit a connection with seasonal change. The buildings are not necessarily designed with seasonality or a connection to natural phenomena in mind, but visitors centers are intended to connect people with a specific context, so they present an opportunity to analyze responses to the natural environment. Within the scope of this project, Oregon provides a wide range of climates in which to analyze this building typology throughout different seasonal rhythms.

#### *Coast*

For a coastal visitors center, I studied the Oregon Coast Aquarium in Newport, Oregon. Situated in the "Coastal Forest Zone," this location experiences cool summers and mild wet winters.<sup>20</sup> It sits on the edge of the Yaquina Bay, bridging the gap between

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20. Stephen Whitney, *A Sierra Club Naturalist's Guide to the Pacific Northwest*, (San Francisco, CA: Sierra Club Books, 1989), 91.

the wetlands and the disturbed industrial habitat in the surrounding area. SRG Partnership designed the aquarium, and it opened in 1992.<sup>21</sup>

### *Valley*

The Museum of Natural and Cultural History (MNCH) in Eugene, Oregon, served as a visitors center for the Willamette Valley. This site is located in the largest of Oregon's interior valleys, which has warm dry summers and mild wet winters.<sup>22</sup> The museum sits in the middle of the University of Oregon campus in a historic oak woodland setting that is now an urban disturbed habitat.<sup>23</sup> It was originally built in 1987 by Ratcliff Architects, but has since undergone many major renovations, most recently by Robertson/Sherwood Architects in 2009.<sup>24</sup>

### *Mountain*

For a mountain visitors center, I studied the McKenzie River Ranger Station on the McKenzie Highway in Oregon. The site is located on the western slope of the Cascade Range, at approximately 1485 feet above sea level.<sup>25</sup> It receives significant annual precipitation and is considered a Douglas-Fir Rain Forest.<sup>26</sup> As such, the forest

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21. "Oregon Coast Aquarium" (Srgpartnership.com. SRG. Accessed January 15, 2017); The Associated Press, "Visitors Call Aquarium a Great Catch for Coast," (*Eugene Register Guard*. May 24, 1992, A1 & A4).

22. Whitney, 49, 65, and 132.

23. Peter Alden and Dennis Paulson, *National Audobon Society Field Guide to the Pacific Northwest*, (New York: Alfred A. Knopf, Inc., 1998), 44.

24. Ed Teague, "The Architecture of the University of Oregon: Museum of Natural and Cultural History," (library.uoregon.edu. *UO Libraries*. <https://library.uoregon.edu/architecture/oregon/mnch.html>).

25. "McKenzie River Ranger Station – Willamette National Forest" (44°10'46.29" N and 122°06'57.91" W, *Google Earth*, 26 July 2016. Accessed 2/3/17).

26. Whitney, 89.

sustains a wide diversity of plant and animal life in its understory.<sup>27</sup> The station was designed by PIVOT Architecture and constructed in 2001.<sup>28</sup>

### *Gorge*

For a gorge visitors center, I studied the Celilo Village Longhouse in Celilo, Oregon. The site is situated within the Columbia River Gorge, between a cliff to the south and the river to the north. The site is exposed to the high winds of the Gorge in the summer, created by cool coastal air being drawn through the Gorge like a funnel into the warmer inland areas.<sup>29</sup> These winds reverse in the winter, bringing cold air and often snow and ice.<sup>30</sup> The surrounding area is a highly disturbed habitat, with Interstate-84 running between the river and the longhouse. It is also notable as the historic site of Celilo Falls, which was flooded in 1957 by the construction of The Dalles Dam.<sup>31</sup> The Army Corp of Engineers built the new longhouse in 2000 for the Celilo Tribe, based on the tribe's traditional longhouse design.<sup>32</sup>

### *Desert*

For a desert visitors center, I studied the High Desert Museum near Bend, Oregon. The climate at this location is influenced by the rain shadow of the Cascade Mountains, which creates a very arid environment characteristic of Oregon's high

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27. Whitney, 89.

28. "McKenzie Ranger Station," (pivotarchitecture.com. *PIVOT Architecture*. Accessed January 16, 2017); "Projects : : Commercial," (2G Construction, Accessed February 24, 2017, <http://www.2gconstruction.com/projects/commercial.php>).

29. Whitney, 46; Cliff Mass, *The Weather of the Pacific Northwest*, (Seattle, WA: University of Washington Press, 2008), 120.

30. Mass, *The Weather of the Pacific Northwest*, 163.

31. Katrine Barber, *Death of Celilo Falls* (Seattle: Center for the Study of the Pacific Northwest in association with University of Washington Press, 2005), 3.

32. Sadie Babits, "Celilo Village Is Rebuilt, But Poverty Remains," (opb.org. *Oregon Public Broadcasting*, July 12, 2009).

desert.<sup>33</sup> The museum is located in the Deschutes National Forest and surrounded by a ponderosa pine forest, which is one of the main “ecological communities” of the high desert.<sup>34</sup> The original building, constructed in 1982, was designed by GHA Architects out of Portland.<sup>35</sup> Hacker Architects designed an expansion for the museum in 1996 and continues to provide master planning for the complex.<sup>36</sup>

### **Data Collection**

For this study, each of the sites was visited once over the course of several weeks in the fall of 2016 from September 24th to October 29th. At each location, the conditions were observed and documented with photographs, sketches, diagrams, and written observations of the building’s response to nature, including the architecture, interior design, landscape design, and occupant intervention. While on site, I conducted informal interviews with visitors center personnel. These interviews were not used as data, but supplemented the observations, helping to broaden my documentation of the building’s year-round response to natural phenomena.

### **Data Analysis**

After observing and documenting all five of the sites, I analyzed how each of the visitors centers connects people with natural phenomena through the spatial impact and occupant responses to seasonal change. Using a combination of pictures and diagrams, I began to develop a visual taxonomy of seasonal change at each of the visitors centers.

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33. Whitney, 44.

34. Whitney, 66; “High Desert Museum Interpretive Nature Walk” (Ranger Script for Nature Walk, High Desert Museum. Accessed October 8, 2016).

35. Randy Gragg, "Design Demon" (*The Oregonian*, March 17, 1991), p. R1.

36. “High Desert Museum,” (Hackerarchitects.com. *Hacker*. Accessed January 16, 2017. <http://hackerarchitects.com/high-desert-museum#>).

This type of analysis is based on precedents such as Robert Venturi's "form analysis as design research" in *Learning from Las Vegas*.<sup>37</sup> For this analysis, I built on my research question to use "space" (defined as structure and experience) and "response" (defined as adaptive opportunities) as the lenses through which to examine the connections or disconnections to natural phenomena at the visitors centers. All of the visitors centers were then evaluated within the framework of these taxonomies.

### *"Space" Lens*

The "space" lens focuses on the relationship between architecture and natural phenomena (See Visual Taxonomy - "Space: Structure and Experience"). It examines how architectural patterns of seasonally transforming structure and experience reconnect occupants with natural phenomena. The broader concept of "natural phenomena" is broken down into four categories within my analysis, which are influenced by Indra Purs' research on seasonality and landscape architecture.<sup>38</sup> Her research reveals different ways of thinking about seasonality, including a "space" category that specifically addresses how seasonality influences landscape design through changing sensory structure and experiences such as "touchscape," "soundscape," light and color, weather, ecology, and/or use.<sup>39</sup> I expanded on this concept by determining the main sensory aspects of seasonal change, which then became the categories for examining structure and experience at each site: landscape, lightscape, touchscape, and atmosphere.

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37. Robert Venturi, Denis Scott Brown, and Steven Izenour, *Learning from Las Vegas* (Cambridge, MA: MIT Press, 1972).

38. Indra Purs, "Concept of Seasonality for Landscape Architecture" (Latvia University of Agriculture: Landscape Architecture and Art 3, no. 3), 103.

39. Purs, "Concept of Seasonality," 103.

Within each category of the space taxonomy, I use a key diagram or parti (an architectural diagram that represents the organizational concept behind a design) to explain the relationship of space to that particular natural phenomenon. Building on this concept, I highlight two spatial patterns that came out of my analysis of how the relationship of space and natural phenomena impact people at each site. The landscape parti reveals organizational interactions between building and site. This category's "plants as barriers" pattern considers how plantings can define space in addition to typical building elements. Its "structure as a filter" pattern demonstrates how designs can blur the lines between inside and outside. For lightscape, the daylight parti reveals how light enters the five visitors centers. The structural patterns, "filtered Light" and "light-shaped space," show how light can impact the sensory experience of spaces. Next, touchscape examines the materiality of each of the visitors centers through texture, which is illustrated with high-contrast black and white images showing characteristic materials of the site. Spatial patterns for touchscape include "flora or fauna interactions" and "weathering of materials," which both highlight tactile changes of the spatial experience over time. Finally, for the Atmosphere phenomenon, microclimates partis show how the visitors center designs subdivide the site to create different zones of temperature, smells, and sounds. The "curating seasonal sounds" and "fragrant flora or fauna" patterns result from combination of factors such as siting, programming, and planting choices.

### *"Response" Lens*

The second lens, "response," addresses the relationship between people and natural phenomena (See Visual Taxonomy - "Response: Adaptive Opportunities"). It

examines opportunities (taken or provided) for occupants to engage with changing natural phenomena through four adaptive opportunities: migration, metabolism, transformation, and ritual. The structure for this section was taken from architecture professor Ralph Knowles' *Ritual House*. In his book, Knowles examines architecture alongside seasonal rhythms. He analyzes how space (structure and experience) is adjusted in response to seasonal changes through migration (adaptive movement through space), metabolism (adjustment of energy production and consumption), and transformation (alteration of physical space), all of which form seasonal rituals.<sup>40</sup> DeKay's *Integral Sustainable Design* elaborates on Knowles' theory by examining "ritual" as an adaptive mode alongside migration, metabolism, and transformation. He also proposes patterns and strategies for accomplishing each category.

Although DeKay narrowly focuses on climate as the main component of seasonal change, I have applied his strategies to a broader conception of seasonal phenomena through the lens of response that includes: natural light, elements, flora, and fauna. He argues that, "We are connected to Nature when a variety of indoor, outdoor, and in-between climatic experiences facilitate migration."<sup>41</sup> So, the migration filter in my taxonomy specifically looks at how people move through the space seasonally. His strategy for metabolism is that, "We are connected to Nature when design creates spatial patterns of indoor climate."<sup>42</sup> So, the metabolism filter in my taxonomy reveals how people engage with seasonal change by adjusting energy production and consumption patterns. For transformation, he argues that, "We are connected to Nature

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40. Knowles, *Ritual House*, 7.

41. DeKay, *Integral Sustainable Design*, 355.

42. *Ibid.*, 356.

when design encourages human interaction with building elements in response to changing conditions.”<sup>43</sup> This means that the transformation filter highlights opportunities for occupants to physically modify the space to adjust to seasonal change. Lastly, he argues that, “We are connected to Nature when design is configured to support ritualized human activities, anchored in particular spaces such that the dynamics of natural rhythm are made evident.”<sup>44</sup> So, this filter examines annual events through which occupants respond to seasonal phenomena.

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43. DeKay, *Integral Sustainable Design*, 357.

44. Knowles, *Ritual House*, 7.

## Findings

### Space: Structure and Experience

#### *Landscape*

The landscape partis reveal the strength of different site organizational concepts at the visitors centers. The parti at the High Desert Museum is successful, because the building generously lets landscape push and pull the building envelope. The structure is integrated seamlessly with respect to the water features, trees, and topography. Landscaping at the Oregon Coast Aquarium is also highly successful, because it communicates with the edges of the buildings and helps to shape them. At the McKenzie Ranger Station, the parti reveals that there is little of this push-and-pull between the building and the site. The landscaping forms a border around the building with no reciprocal action from the structure, so it has much less of an impact on the spatial experience. The landscaping at the Museum of Natural and Cultural History could also be perceived as a border around the building. However, the building does have limited interaction with the open grassy area that marks its front entrance. The Celilo Longhouse has the weakest parti because the building is essentially an object floating in the middle of an asphalt and gravel-covered area. Therefore landscape does not push and pull with the building to create a significant spatial experience. Despite the lack of designed landscaping on site, though, the orientation of the longhouse parallel to the nearby cliff edge influences the spatial experience dramatically.

The “plants as barriers” and “structure as filter” patterns at each of the visitors centers reveal different levels of success connecting people with landscape through

structure and experience. All of the visitors centers, except the longhouse, do well at including plantings around the edges of paths. Designs that define the edges of landscaped areas create a more pronounced spatial experience. Taller, denser plantings as well as plantings on multiple sides make this experience stronger at the desert museum and aquarium than at the MNCH and ranger station. The structure as filter pattern demonstrates how filtering landscape through the building's structure creates a very strong spatial connection as well. The desert museum uses structure very effectively to filter landscape with several holes punched through the building's core to blur the separation. In one part of the aquarium, occupants walk through middle of a shark tank, which creates a very dynamic interface with the "landscape" of water on all sides. The longhouse also provides a unique filter with a packed dirt floor that creates a connection with landscape in a simple but powerful way.

### *Lightscape*

Daylight partis demonstrate the success of how light is introduced into the spaces. The High Desert Museum allows light to push and pull with its edges, inundating the spaces from different angles and transforming the quality of light in different ways to draw attention to the phenomenon. Light also enters the Oregon Coast Aquarium in a variety of ways throughout its spaces. It is treated carefully in each space to fit the desired experience. The McKenzie Ranger Station also provides many opportunities for daylit spaces, especially through the use of clerestories that bring light farther back into the building. In contrast, light in the Celilo Longhouse is restrained. However, a narrow strip of light from above and the shape of the building section effectively fill the room with light. Lastly, the Museum of Natural and Cultural History

has the weakest daylight parti, because there is only one significant opportunity to experience daylight in the main entrance lobby. The rest of the MNCH is generally cut off from daylight.

The “filtered light” and “light-shaped space” patterns define the special qualities that emphasize the lightscape phenomenon. At the desert museum, a combination of flora and structure (such as mullions and trellises) create areas of filtered light. Light at the aquarium is also filtered in multiple ways, through flora, structure, and water. This filtered light creates interesting compositions and shadow patterns that are constantly changing throughout the day and seasons. Light-shaped spaces are another way to impact spatial experience. Skylights at the desert museum are more than holes in the ceiling plane; they have depth, which gives the emanating light a stronger formal presence. The aquarium also creates light-shaped space with clerestory openings just below the ceiling. These openings bring light deep into the space at a dramatic angle. The lightscape at the longhouse is uniquely shaped by the spiritual axis it forms between the heavens and the earth. This purely top-lit space ensures that the focus is entirely on the quality of light rather than the views.

### *Touchscape*

Texture illustrations for the visitors centers reveal the success of different material palettes in forming spatial patterns of touchscape. Wood is a common material at all of the sites with wood siding and wood or timber columns present at each. The wood shingle siding at the Museum of Natural and Cultural History was not as prominent, though, because it is partially replaced in areas with fiber cement board that has a much weaker sensory presence. The Oregon Coast Aquarium and the Celilo

Longhouse provide diverse material palettes using concrete as a contrast to wood, which creates a successfully varied touchscape. The High Desert Museum’s material palette juxtaposes wood with a porous volcanic rock, creating another strong diversity of texture.

The patterns, “weathering of materials” and “flora or fauna interactions” demonstrate how the textures around the site interact with—or are created by—seasonal change. Although the McKenzie Ranger Station displays timber columns, they are beginning to rot, which produces a destructive transformation from seasonal phenomena rather than a connection. The more successful uses of wood at the other sites create a positive connection with touchscape from the natural weathering and fading of the material over time. In addition to wood, the copper figureheads at the MNCH have changed color with weathering and stained the pavement beneath from dripping as well. Other site “materials” that can influence touchscape are flora and fauna. The desert museum’s touchscape is influenced by the pine needles that cover most of the surfaces and crunch underfoot to create a sensory experience. At the aquarium, fauna engage touchscape with an interactive tide pool that allows people to touch the creatures.

### *Atmosphere*

The microclimates partis reveal the level of atmosphere diversity around the visitors centers. The Oregon Coast Aquarium’s design actively establishes numerous successful microclimates around the building edge and site. There are different climatic zones provided by building overhangs, trees, and artificial rock formations that transform the experience of the spaces. The use of water in animal habitats and around the site also impacts this climatic spatial experience. The High Desert Museum is also

successful in utilizing many of the same features (such as trees, water, and varying levels of openness) to create a variety of microclimates around its site. The Museum of Natural and Cultural History is also successful creating microclimates around its perimeter, despite the considerably smaller size of its site. This success is achieved through a variety of open and closed spaces and different zones of vegetation. The Celilo Longhouse has minimal microclimate diversity because the zones do not have much interaction with the building edges; the main cause of distinction in the zones is the solar orientation of the building. In addition, it only creates a small pocket of a wind shadow on the east edge of the building during the summer months, but the rest of the site is exposed without any zones for other atmosphere experiences. The McKenzie Ranger Station also relies only on solar orientation to form most of the microclimates around its edges. However, it is a little more successful than the longhouse. The spatial structure has some influence on the atmosphere of this visitors center, mainly with the patio on the south side of the building that capitalizes on the experience of the southern exposure to the sun.

“Curating seasonal sounds” and “fragrant flora or fauna” as patterns show how a network of ecosystems creates a successful atmosphere. At the ranger station, bushes that surround the patio create a habitat and food source for birds, which curates a distinct seasonal experience. The roofs over the MNCH’s covered pavilions and entry also provide places for birds to roost, creating an impact on the auditory spatial experience of occupants. At the aquarium, seasonal sound and smell also mark numerous ecosystem zones. The animal habitats, marine forest area, and the estuary edge highlight the unique coastal ecosystem. Not every location has a distinct sound or

smell, but the contrast between the quiet/loud and bland/fragrant areas of each zone draws attention to its presence when it is there. Although its zones are more blended, the desert museum also utilizes contrast to highlight its diversity of microclimates with a variety of trees, native plants, streams, and animal habitats. Plantings around the edges of the MNCH and its site highlight regional ecosystems by utilizing native species to create different qualities of microclimate (through sun and shade) as well as different qualities of smell (through the more fragrant plants).

### **Response: Adaptive Opportunities**

#### *Natural Light*

Migration as an adaptive response is facilitated by a variety of spatial experiences. Migration throughout the Oregon Coast Aquarium is successful due to a variation in levels of daylight exposure in different spaces. This allows for occupants, as well as events or displays, to change location based on the preferred daylight condition and highlight seasonal migration. The High Desert Museum also successfully provides a mixture of spaces that are fully or partially daylit, or even entirely cut off. Overall, though, most of the museum is exposed to daylight; the biggest variable is where the light is coming from (top or side) and how much there is, which occupants can adjust by moving between these varying spaces.

For a metabolic response, the Celilo Longhouse is the only visitors center that reveals an effective response to changing Natural Light. Inside the longhouse, the occupants adapt by leaving the lights off when the sun is out, whereas the other visitors centers leave all of their lights on (even in fully daylit zones).

Transforming spaces with operable shading devices has mixed success. The Museum of Natural and Cultural History design provides an opportunity to interact with daylight through operable window shades, but these street level blinds can be closed due to other factors such as privacy, unwanted views, or program needs. The effect of these other needs is disconnection from Natural Light when it is not desired. The McKenzie Ranger Station also provides blinds, but only on the lower set of windows to prevent glare on the working surfaces, and the upper clerestory windows continue to provide ambient light. This allows people to adjust the level of intensity of daylight while maintaining a strong connection with the natural phenomenon. Occupants in the desert museum can also adjust blinds in the south facing clerestories, which are utilized mainly to diffuse the direct sunlight and not block it completely. The desert museum allows for the most space-altering interaction with daylight through the sliding cable awning on its deck, which can be adjusted for varying levels of sunlight. The awning also impacts the interior space by shading the bottom portion of the window.

Annual rituals that celebrate changing Natural Light are effective at connecting people with this seasonal phenomenon. At both the aquarium and MNCH, occupants can respond to the diminishing natural light in the winter with annual events and decorations. The aquarium's seasonal lights celebrate this time of the year as part of an annual "Sea of Light" event. The MNCH also celebrates the winter solstice annually, which includes strings of electric lights to respond to the lack of daylight. These are both successful in connecting people with seasonal change by ritualizing the rhythm of Natural Light.

## *Elements*

Building enclosures are generally designed to keep the elements out, but designs that provide shelter for in-between spaces facilitate migration. The Oregon Coast Aquarium successfully provides many opportunities for occupants to respond to the elements with covered breezeways between buildings as well as semi-enclosed outdoor rooms that facilitate migration. At the High Desert Museum, a variety of covered pavilions along its paths facilitate migration around the site, allowing occupants to choose the desired level of shelter/exposure in different seasonal weather phenomena. Both the Museum of Natural and Cultural History and the McKenzie Ranger Station provide large roof overhangs at their entry points, which allows occupants to respond by migrating to the covered edge of the building. The ranger station also provides benches underneath this cover, increasing the opportunity to experience the elements there. While the MNCH does not provide benches under the roof overhang, it does have two other pavilions along the path that provide additional cover to assist migration. In contrast, the Celilo Longhouse does not provide much opportunity to interact with the elements, but occupants have used the small overhangs above the doors as outdoor sitting areas. However, the overhangs are not large enough to be convenient for that purpose, because people must sit in the flow of traffic.

In general, the visitors centers relied on mechanical HVAC Systems (heating, ventilation, and air conditioning systems), which do not provide a connection between people and the natural phenomenon of the elements. The occupants of the longhouse can control the metabolic balance with ceiling fans when the interior of the longhouse becomes too hot in the summer, which allows for somewhat of a metabolic response.

However, traditional longhouses relied solely on natural ventilation through the open roof peak. In the contemporary design, this open peak is permanently closed with corrugated plastic, which creates a thermal imbalance. It would be a more effective response if the design included operable glazing at the roof peak rather than ceiling fans to create a metabolic balance through natural ventilation.

Designs that provide opportunities to create seasonal indoor-outdoor spaces connect people with the elements through transformation. Occupants at the aquarium have taken the opportunity to transform several spaces by propping open exterior doors on nice days. This response is somewhat successful, but it could be made more intentional with operable windows. The desert museum provides several opportunities for transformation in response to the elements. Its most significant transformation opportunity is a folding window wall around the two exterior edges of a presentation room in its Birds of Prey Center. This allows the entire space to be opened so that occupants can experience the natural phenomena of the elements.

### *Flora*

Designs that provide a network of native plants around the site facilitate movement between ecosystems to connect people with flora. The Oregon Coast Aquarium's nature trail and accompanying plant guide successfully facilitate migration around the site to experience flora. Throughout the trail, there are benches and other places where occupants can pause to observe natural phenomena. In addition to labeling native species at the High Desert Museum, the program also provides daily nature walks guided by a ranger. At the Museum of Natural and Cultural History, a similar idea of labeled native species around the site facilitates migration at a smaller scale. Although

the Celilo Longhouse site does not provide labeled native plants, or any plants for that matter, occupants of the longhouse have adapted their own migration strategy by creating footpaths that climb the steep grassy hillside just south of the site. This method is less successful, though, because there is not a clear connection to the longhouse, and there is no connection to flora on the site itself. The McKenzie Ranger Station does not label plant species either, but its closest on site connection to flora through migration is the south patio that is surrounded by different plants and can be occupied during warmer times of the year. Despite the on-site limitations, the station is centrally located in the Willamette National Forest, which provides numerous hiking trails and other seasonal activities to facilitate migration.

Metabolism through flora is successfully provided at both the ranger station and the desert museum by highlighting the lifecycles of plants. At the desert museum, a small garden demonstrates metabolic responses to photosynthesis and human metabolism. On the opposite end of the cycle, a fallen tree at the ranger station was left to decompose on the site and provide nutrients for other organisms. Both of these simple flora interactions have a significant and noticeable impact on the lives of local ecosystems.

The desert museum and ranger station also demonstrate transformation in response to seasonal flora cycles. The garden at the museum is a clear picture of this transformation in addition to demonstrating metabolism. The ranger station transforms the local ecosystem more indirectly, as it is the location to obtain forest product permits, which bring people into contact with seasonal flora cycles in the area.

Rituals that celebrate the seasonal patterns of flora connect people with this natural phenomenon. The aquarium makes a subtle acknowledgement to flora with pumpkins that are set out during the autumn season. These decorations are not necessarily tied to an event at the aquarium, but they recognize the cultural significance of pumpkins at this time of year. The First Foods Ceremony at the longhouse is centered on honoring edible plants such as berries and roots in order to connect people with the seasonal cycles of growth, and it successfully strengthens the tribe's connection to the natural phenomenon of flora each year.

### *Fauna*

Designs that connect various fauna habitats around the site help people build a relationship with their local ecosystem through migration. The High Desert Museum effectively provides a variety of both indoor and outdoor habitats for people to move around and respond to the seasonal phenomena that fauna display. In addition to similar habitat exhibits, the Oregon Coast Aquarium also provides an estuary-viewing platform with an "animal guide" sheet that helps people connect with the wildlife of the larger ecosystem as well. Although the MNCH and the McKenzie Ranger Station do not provide exhibits like the aquarium and desert museum, on a much smaller scale they still provide an opportunity to use migration to connect with the birds that inhabit the buildings' large roof overhangs.

Opportunities to support the life cycles of fauna connect people with this seasonal phenomenon through metabolism. Again, the habitats at both the aquarium and desert museum are successful at this, because they provide viewing areas for regular animal feedings. A more informal method, although still effective, is the bird feeder on

the ranger station site. In contrast, the Celilo Longhouse provides a different response to the local ecosystem with the salmon roasting pits that successfully connect people to the end of the seasonal fauna life cycles.

Designs that allow occupants to interact with animal habitats connect people with the fauna of their local ecosystem through transformation. At the aquarium, visitors are encouraged to interact with sea anemones and other marine life in the tide pool exhibit and transform the habitat through their interactions. The desert museum also provides opportunities for direct encounters with different local fauna.

The aquarium's Tuna Fisheries Day every summer connects people through this ritual to the yearly migration of tuna past the Oregon coast.<sup>45</sup> At the longhouse, The First Foods Ceremony also recognizes the seasonal migration of salmon every spring.

### **Summary of Findings**

These findings reveal a spectrum of connectedness to natural phenomena through the space and response lenses. Looking through the lens of space, successful human connections with landscape, lightscape, touchscape, and atmosphere require architectural patterns of seasonally transforming structure and experience to engage with natural phenomena. From the space taxonomy I found three key spatial patterns that connected people more successfully with regional ecosystems. These spatial patterns are: building edges that interact with natural phenomena, structure that filters natural phenomena, and natural phenomena that have a sensory presence. The case

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45. "Tuna takes Spotlight for Oregon's Summer Fisheries," (Oregon Coast Aquarium. August 18, 2015. Accessed February 19, 2017).

studies reveal that structures that allow natural phenomena to push and pull with their edges create a more dynamic relationship to engage space with seasonal change. Next, structures that filter natural phenomena, rather than blocking it off completely, create unique spatial connections with regional ecosystems. Finally, structure that gives natural phenomena a sensory presence through sight, sound, smell, and touch, experientially highlight the seasonally changing regional ecosystems.

The response lens reveals that successful connections with natural light, elements, flora, and fauna hinge on a variety of adaptive opportunities to engage occupants with seasonal change. This taxonomy demonstrates several key strategies that create these adaptive opportunities. First, designs that provide migration through a network of diverse spaces for occupants to respond to changing conditions connect people with the phenomena of their local ecosystems. Next, designs that provide energy controls allow occupants to respond to changing energy needs throughout the year and create an energy balance with natural rhythms. In addition, opportunities for physical alterations of space to create flexible spaces that respond to seasonal change bring occupants into direct communication with natural phenomenon. Lastly, annual rituals that anchor seasonal rhythms in space give occupants the opportunity to celebrate and appreciate the natural phenomenon of their regional ecosystems.

### **Future Work**

The purpose of my research is to provide a framework for visual analysis that can be used as a guide in future research and design. The visitors centers that I analyzed were very revealing, but five is only a small sample of the built environment. Therefore, this data would be greatly benefited by the additional analysis of a larger and more

diverse research sample. In addition, I was not able to visit the sites during all four seasons due to time constraints. Observing the sites throughout the year would give a more complete picture of how they interact with seasonal change. A more comprehensive data set could also include detailed light, temperature, and weather variations as well as more detailed observations of specific occupant adaptations in response to changing conditions. There is still significant design innovation yet to be developed and applied to connect people with seasonal change. This is an important area of future work. My research establishes a guide for designers to consider issues of seasonal change and the sustainability of regional ecosystems early in the design process. Seasonal change is often overlooked in architecture, so further research and publications will be crucial in persuading designers of its importance.

## **Conclusion**

My taxonomies show how certain design elements can either connect or disconnect people and natural phenomena. The space and response lenses that I have presented give helpful insights into how contemporary designs can embrace natural phenomenon, and these lenses can be used as a basis to explore more effective measures of sustaining regional ecosystems. The crucial design task is to learn how to build relationships with natural phenomena through structure, experience, and adaptive opportunities, because these are essential for connecting with the environment.

It is important to build up our relationships with these ecosystems, because people will preserve the things they care about. The built environment plays a crucial role in developing these relationships, so it is imperative that designers consider how they are shaping human experience and interactions with natural phenomenon. A relationship between architectural space and natural phenomena is created when design patterns are seasonally transforming structure and human experience. A relationship between occupants and natural phenomenon is created when adaptive opportunities allow a response to seasonal change. Through my research and findings, I demonstrate that sustainability is more than a measure of efficiency or building performance. It is a matter of reinforcing the essential interconnectedness of people with regional ecosystems and supporting the natural environments that surround us through design.

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