

Biophilic Urbanism:
Redefining Walkability in the Urban Core

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Abstract

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Redefining Walkability in the Urban Core

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As Seattle and other western cities continue to densify, the pedestrian bodily experience becomes an increasingly critical factor in fostering health for city inhabitants and their environment. To frame the effects of the built environment on human well-being, theories of biophilic design and walkability are hybridized to form a new framework of Biophilic Urbanism. This framework seeks to guide the future design of urban streetscapes to be better connected to the natural world and humankind's spatial necessities, resulting in more comfortable, restorative, dynamic, and sustainable pedestrian experiences.

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I. Preface

The genesis of this research began with several recent experiences regarding biophilia and pedestrian vitality in Seattle and abroad in Europe. Daily commutes on foot through Wallingford and several months of navigating Rome as a pedestrian brought forth a changed set of values towards understanding urban life in western cities. In Wallingford, the streets contain a dynamic set of homes overtaken by the landscape, which produces frequent moments of intimate compression (shown in Figure 1.01). In Trastevere, Rome the street performs as a pedestrian-dominant room; the continuous fabric is composed of dynamic moments of relief (shown in Figure 1.02). In the streets of most western cities, the automobile-centric fabric calls for much improvement to promote pedestrian well-being and a decreased dependency on privatized, fossil fuel-intensive transportation. Walkability depends on the reintegration of real and representational elements of the natural world, which, as Figures 1.03-1.06 show, exhibit an inverse relationship with the built environment. This proposal seeks to be a catalyst towards a biophilic utopia, as illustrated in Figure 1.06, where the natural world is fully integrated into the built environment with the intent for it to be restored to its original vitality.



Figure 1.01 Wallingford, Seattle - This mentally restorative, biophilic pedestrian experience includes dynamic moments, memorable smells, and dappled shade.



Figure 1.02 Trastevere, Rome - "a magnet for walkers" (Speck 9).

The Inverse Relationship of Development and Biophilic Influence

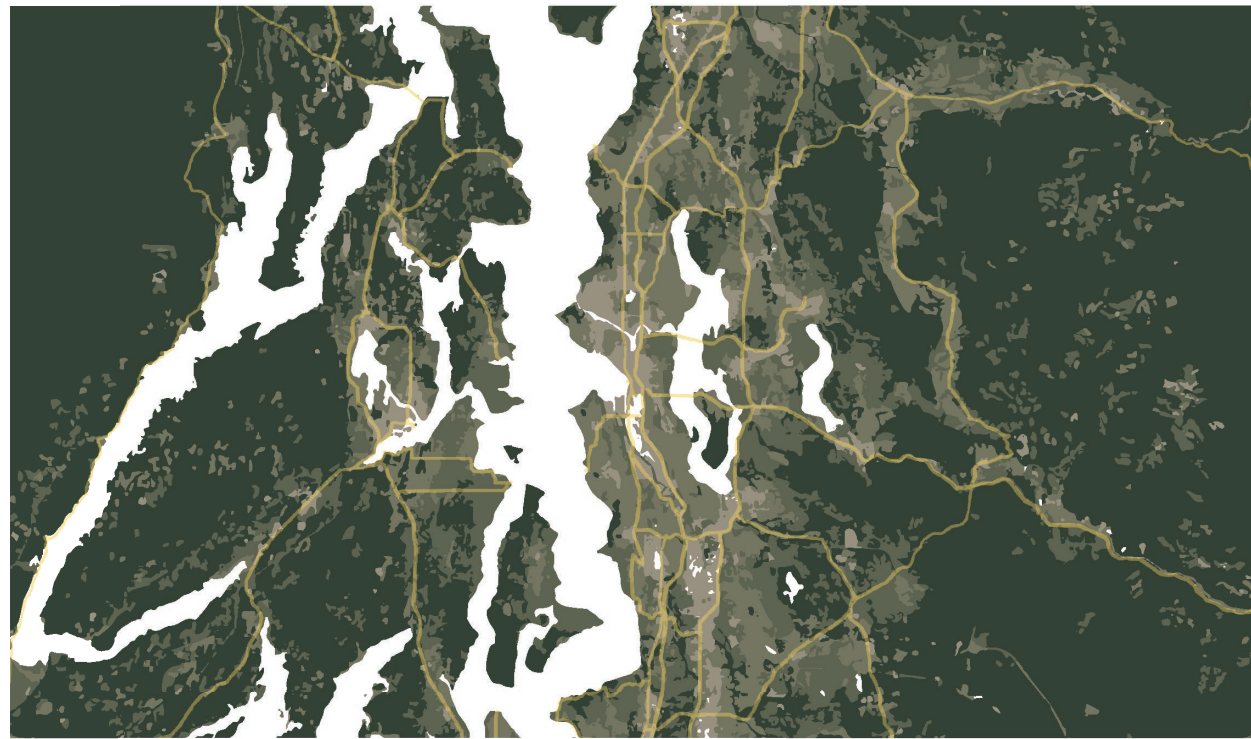


Figure 1.03 The current state of Seattle's built environment.

More developed Less biophilic ■ ■ ■ ■ Less developed More biophilic

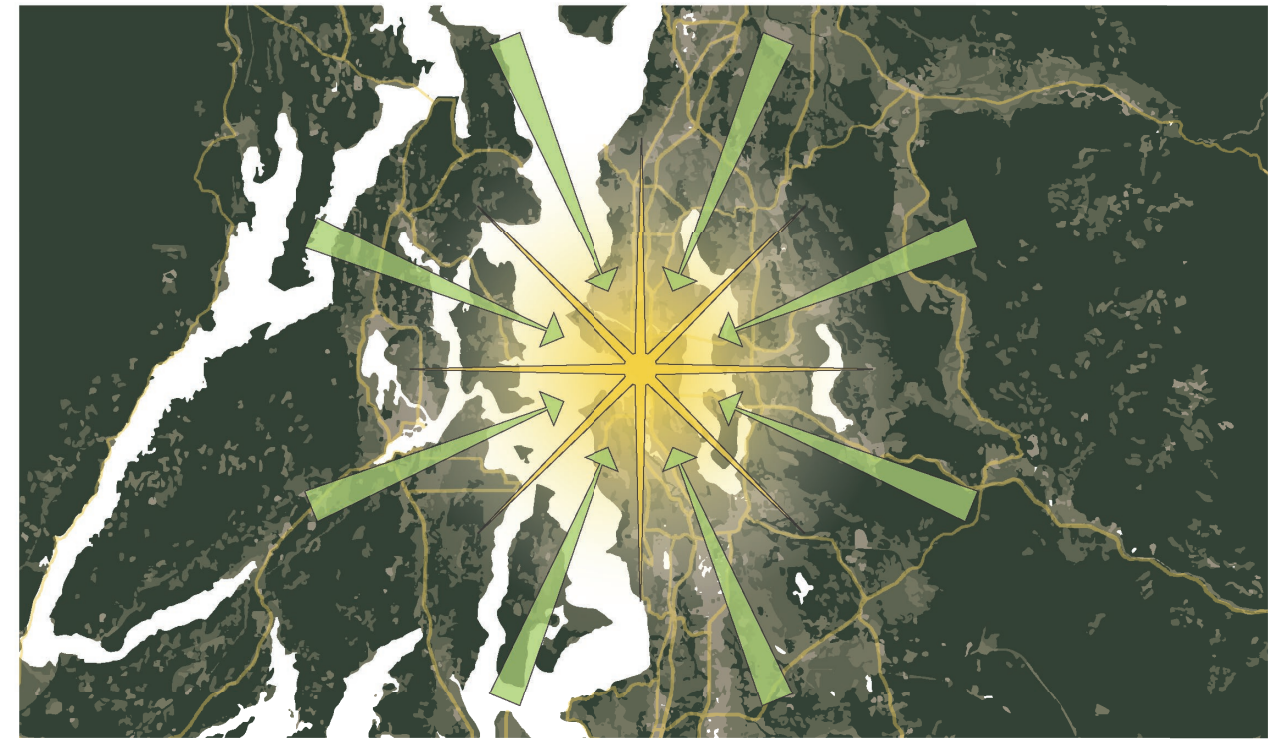


Figure 1.05 The human biological need for proactive reintegration of the natural environment.

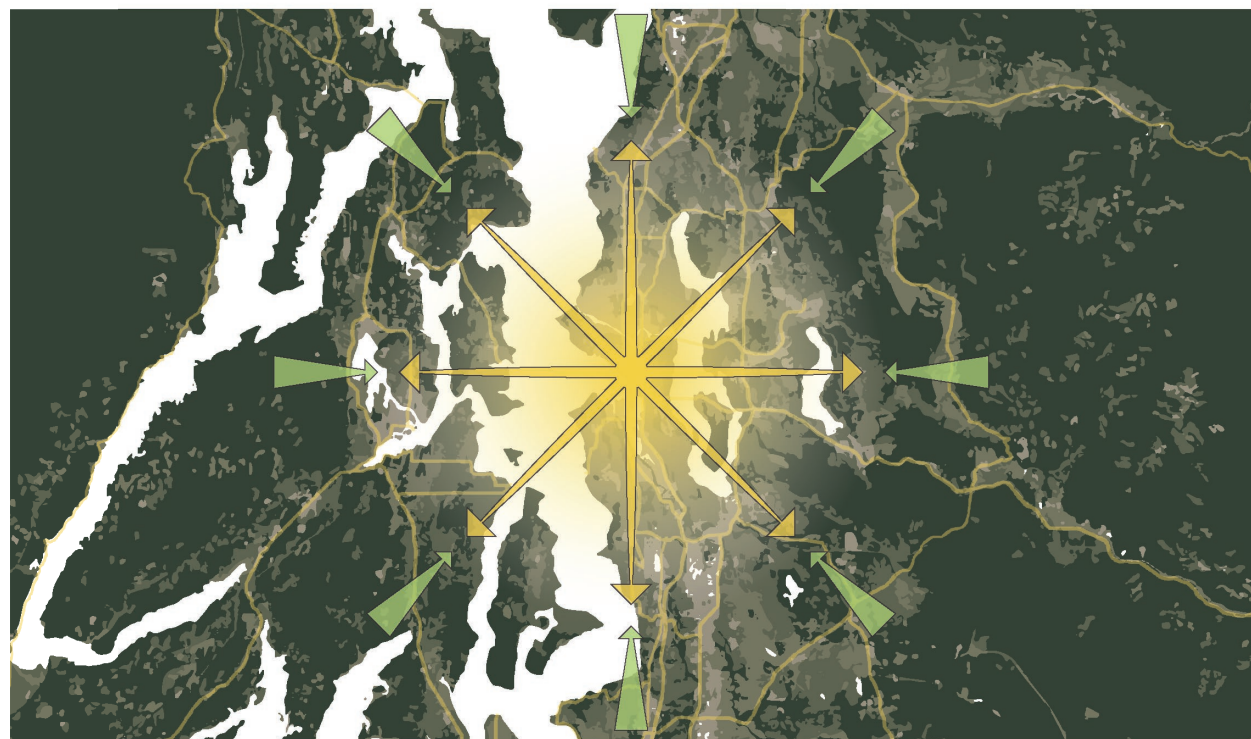


Figure 1.04 The ongoing invasion of the built environment and futile resistance of the natural environment.

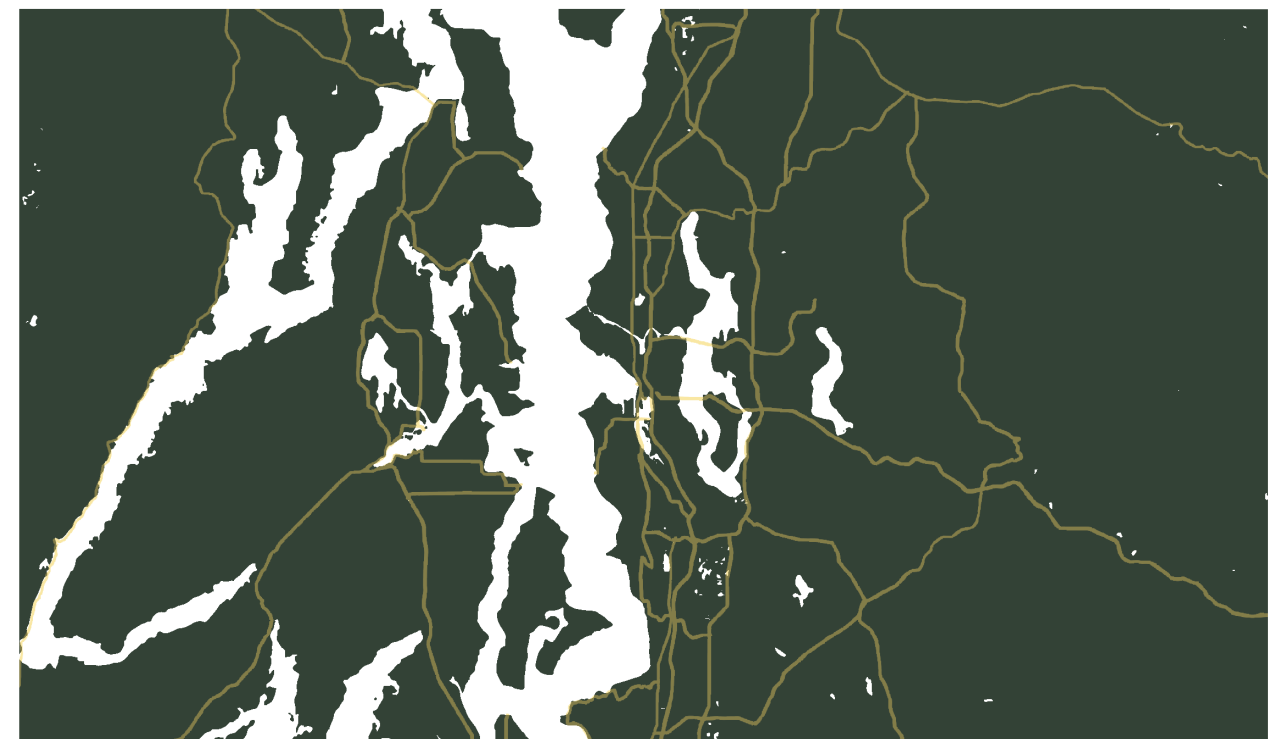


Figure 1.06 The ideal biophilic utopia where human density integrates the original density of the Pacific Northwest forest ecosystem.

II. Introduction

As Seattle and other western cities continue to densify, the pedestrian bodily experience becomes an increasingly critical factor in fostering health for city inhabitants and their environment. Problems of inadequate transportation, poor environmental health, and compromised personal health continue to persist in cities today, largely due to the privatized nature of how the western world has chosen to expand. Current and future efforts of urban sustainability depend on decreasing the use of private transportation and increasing accommodations for walkability, shared, and multi-modal transportation. Strategies to improve walkability and environmental health depend on reevaluating the physical characteristics of the public right of way and the edges of the buildings and landscapes that contain it.

The intersection of architecture and the public realm provides design opportunities for enhancing the pedestrian experience and well-being of city inhabitants. Careful design of the street edge and the public right of way through architectural measures can improve walkability and liveliness in the public realm. Connections to nature and the need to restore urban landscapes to their full biological health are critical in the urban core. As a response to biophilia—“humankind’s innate biological connection with nature” (Browning et al. 4)—and the need to enhance the public realm in the ever-densifying city of Seattle, this thesis will explore the spatial intersection between the disciplines of architecture, landscape architecture, and urban design by developing biophilic strategies for the urban environment that promote walkability, sociability, well-being, and environmental sustainability.

The future of urban walkability relies on the threshold between the architectural street edge and the public realm. The experience here is reimagined through qualitative metrics of comfort, safety, dynamism, and linkage to nature and natural systems. This analysis constitutes *The 7 Principles of Biophilic Urbanism: a strategy guide for designing to promote pedestrian health and well-being in the urban environment.*

III. Research

Walkability measures a pedestrian bodily experience that either inhibits or enhances productivity, sociability, and well-being in the urban realm. Its ideals, along with the ideals of biophilic design, make up the core framework of this exploration. The past 250 years of recent human history, as a small fraction of the last 12,000 years as the entirety of human evolution, has forced a majority of the world population to be distant from biophilic influence from living and working in densely developed, highly fabricated urban environments. While the built environment, particularly in cities, has drastically changed over the past century, “humankind’s innate biological connection to nature” (Browning et al. 4) has not. This disparity is best seen in the urban core, where connections to the natural world are reduced to a scarcity of street trees and scattered ornamentation on historic buildings. The framework of biophilic design offers strategies that can bring back the influence of nature by reconnecting humans to the earth and satisfying their biological needs, even in urban areas. Designing for walkability through the lens of biophilic design intends to create a more sustainably functioning and sustainably-minded city.

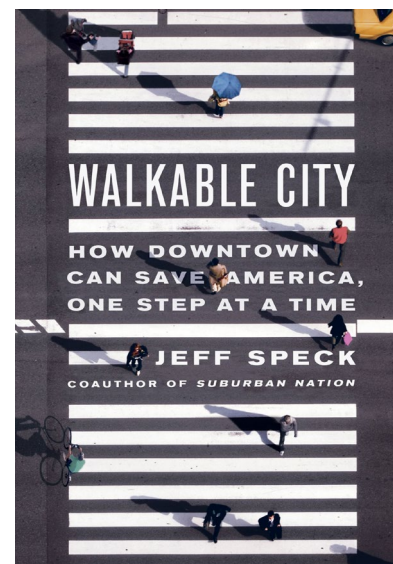
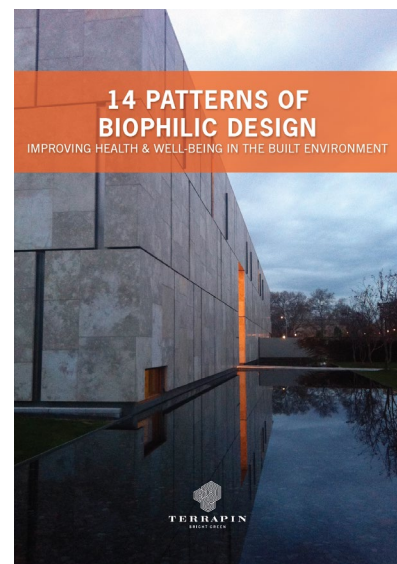


Figure 3.01 Utilization of two key sources (Browning et al., Speck).

Biophilic Design

The enjoyment of scenery employs the mind without fatigue and yet exercises it, tranquilizes it and yet enlivens it; and thus, through the influence of the mind over the body, gives the effect of refreshing rest and reinvigoration to the whole system. – Frederic Law Olmstead (Browning et al.).

Before discussing the different strategies of biophilic design, it is important to first define the terms nature and natural that are integral to Biophilic Design. William Browning, Catherine Ryan, and Joseph Clancy of Terrapin Bright Green provide two polar extreme connotations of nature as either “that which can be classified as a living organism unaffected by anthropogenic impacts on the environment,” or that “everything, including all that humans design and make, is natural and a part of nature because they are each extensions of our phenotype” (8). The authors then conclude that reaching a middle ground between these polar definitions, and “defining nature as living organisms and non-living components of an ecosystem,” is the best understanding for working with the context of biophilic design (8). Through this understanding, the urban environment, in its totality, should be viewed as an ecosystem; how the urban ecosystem impacts all living beings is a major concern of contemporary life that is addressed through the patterns of biophilic design.

Terrapin’s Fourteen Patterns of Biophilic Design formulate an extensive toolkit for creating space that responds to the often-repressed, physiological and psychological needs of humans to connect with the natural world. The fourteen patterns are categorized under three distinct sections: Nature in the Space, Natural Analogues, and Nature of the Space (23).

Nature in the Space

Nature in the Space “addresses the direct, physical and ephemeral presence of nature in a space or place” (Browning et al.). This category may be the least applicable to the urban core, since public space is always contested and a limited commodity in an engineered and highly-constructed downtown fabric. The best Nature in the Space experiences “are achieved through the creation of meaningful, direct connections with these natural elements, particularly through diversity, movement and multi-sensory interactions” (Browning et al. 9). In an urban context, the experience of direct nature is more fabricated and intentional than how these patterns typically occur outside the

urban context. Street trees, vegetated surfaces, and strategic use of water are among the simplest strategies for bringing nature to the urban core.

Natural Analogues

Natural Analogues “addresses organic, non-living and indirect evocations of nature” (Browning et al. 10). This category involves biomimicry – the imitation of nature’s genius. Natural Analogues also provides the most potential in a highly densified environment because it relies on built forms, patterns, order, and materials—which is what makes up the majority of the urban environment. The patterns of Natural Analogues provide direct strategies for integrating naturally sourced materials, biomorphic forms, and biophilic complexity into the architectural street edge and the public right of way.

Nature of the Space

Nature of the Space “addresses spatial configurations in nature,” focusing on prospect and refuge as “our innate and learned desire to be able to see beyond our immediate surroundings” and “a place for withdrawal from environmental conditions or the main flow of activity,” respectively (Browning et al. 10). Nature of the Space has the potential to enhance street life that is generally prospect dominant but could benefit from more transitional, combined prospect-refuge spaces.

The typical urban block is prospect dominant, but the ideal street edge scenario comes from a combination of prospect and refuge through an understanding of the Forest Edge concept; “The edge of a wood is one of the most prevalent of natural prospect-refuge conjunctions” (Browning et al. 46). A prospect-refuge conjunction provides the pedestrian with a transitory space between the public realm of the street and the private realm of what lies beyond the architectural street edge. This condition is similar to the deployment of facade depth that is mentioned by Jeff Speck; both of these understandings unpack the notion of the street as a room that is often successful in the most walkable of cities containing narrow street fabric—particularly ancient city streets, like those of the Trastevere neighborhood in Rome (Speck 9).

Summary

Biophilic design and the research surrounding it “is really just corroborating the rediscovery of the intuitively obvious,” while “too much of our modern design is oblivious to this profound knowledge” (Browning et al. 52). The fourteen patterns and their associative research on benefits of human well-being are illustrated in Figure 3.02.

The purely functional and automobile-dominant nature of western urbanity conflicts with the nature of biophilic design, even in its most palpable form. As Western cities begin to reevaluate their urban form and its consequential health effects, needs for biophilic design will begin to surpass the capitalistic pressures of speed, efficiency, and anonymity of modern-day urbanism.

14 PATTERNS	*	STRESS REDUCTION	COGNITIVE PERFORMANCE	EMOTION, MOOD & PREFERENCE
NATURE IN THE SPACE	Visual Connection with Nature	* Lowered blood pressure and heart rate (Brown, Barton & Gladwell, 2013; van den Berg, Hartig, & Staats, 2007; Tsunetsugu & Miyazaki, 2005)	Improved mental engagement/ attentiveness (Biederman & Vessel, 2006)	Positively impacted attitude and overall happiness (Barton & Pretty, 2010)
	Non-Visual Connection with Nature	* Reduced systolic blood pressure and stress hormones (Park, Tsunetsugu, Kasetani et al., 2009; Hartig, Evans, Jamner et al., 2003; Orsega-Smith, Mowen, Payne et al., 2004; Ulrich, Simons, Losito et al., 1991)	Positively impacted on cognitive performance (Mehta, Zhu & Cheema, 2012; Ljungberg, Neely, & Lundström, 2004)	Perceived improvements in mental health and tranquility (Li, Kobayashi, Inagaki et al., 2012; Jahncke, et al., 2011; Tsunetsugu, Park, & Miyazaki, 2010; Kim, Ren, & Fielding, 2007; Stigsdotter & Grahn, 2003)
	Non-Rhythmic Sensory Stimuli	* Positively impacted on heart rate, systolic blood pressure and sympathetic nervous system activity (Li, 2009; Park et al., 2008; Kahn et al., 2008; Beauchamp, et al., 2003; Ulrich et al., 1991)	Observed and quantified behavioral measures of attention and exploration (Windhager et al., 2011)	
	Thermal & Airflow Variability	* Positively impacted comfort, well-being and productivity (Heerwagen, 2006; Tham & Willem, 2005; Wigö, 2005)	Positively impacted concentration (Hartig et al., 2003; Hartig et al., 1991; R. Kaplan & Kaplan, 1989)	Improved perception of temporal and spatial pleasure (alliesthesia) (Parkinson, de Dear & Candido, 2012; Zhang, Arens, Huizenga & Han, 2010; Arens, Zhang & Huizenga, 2006; Zhang, 2003; de Dear & Brager, 2002; Heschong, 1979)
	Presence of Water	* Reduced stress, increased feelings of tranquility, lower heart rate and blood pressure (Alvarsson, Wiens, & Nilsson, 2010; Pheasant, Fisher, Watts et al., 2010; Biederman & Vessel, 2006)	Improved concentration and memory restoration (Alvarsson et al., 2010; Biederman & Vessel, 2006) Enhanced perception and psychological responsiveness (Alvarsson et al., 2010; Hunter et al., 2010)	Observed preferences and positive emotional responses (Windhager, 2011; Barton & Pretty, 2010; White, Smith, Humphries et al., 2010; Karmanov & Hamel, 2008; Biederman & Vessel, 2006; Heerwagen & Orians, 1993; Ruso & Atzwanger, 2003; Ulrich, 1983)
	Dynamic & Diffuse Light	* Positively impacted circadian system functioning (Figueiro, Brons, Plitnick et al., 2011; Beckett & Roden, 2009) * Increased visual comfort (Elyezadi, 2012; Kim & Kim, 2007)		
	Connection with Natural Systems			Enhanced positive health responses; Shifted perception of environment (Kellert et al., 2008)
NATURAL ANALOGUES	Biomorphic Forms & Patterns	*		Observed view preference (Vessel, 2012; Joye, 2007)
	Material Connection with Nature		Decreased diastolic blood pressure (Tsunetsugu, Miyazaki & Sato, 2007) Improved creative performance (Lichtenfeld et al., 2012)	Improved comfort (Tsunetsugu, Miyazaki & Sato 2007)
	Complexity & Order	* Positively impacted perceptual and physiological stress responses (Salingaros, 2012; Joye, 2007; Taylor, 2006; S. Kaplan, 1988)		Observed view preference (Salingaros, 2012; Hägerhäll, Laike, Taylor et al., 2008; Hägerhäll, Purcella, & Taylor, 2004; Taylor, 2006)
NATURE OF THE SPACE	Prospect	* Reduced stress (Grahn & Stigsdotter, 2010)	Reduced boredom, irritation, fatigue (Clearwater & Coss, 1991)	Improved comfort and perceived safety (Herzog & Bryce, 2007; Wang & Taylor, 2006; Petherick, 2000)
	Refuge	*	Improved concentration, attention and perception of safety (Grahn & Stigsdotter, 2010; Wang & Taylor, 2006; Wang & Taylor, 2006; Petherick, 2000; Ulrich et al., 1993)	
	Mystery	* Induced strong pleasure response (Biederman, 2011; Salimpoor, Benovoy, Larcher et al., 2011; Ikemi, 2005; Blood & Zatorre, 2001)		
	Risk/Peril	* Resulted in strong dopamine or pleasure responses (Kohn et al., 2013; Wang & Tsien, 2011; Zald et al., 2008)		

Figure 3.02 The 14 Principles of Biophilic Design along with their respecting functions (Browning et al. 23).

Walkability

As research continues to surface around walkability's economical, psychological, physiological, and environmental benefits, citizens are becoming more "increasingly aware of how surprising and delightful your quality of life can be when you don't have to get into a car to go every place in your life besides home" (Speck 26). Jeff Speck lays out an extensive body of evidence supporting walkability as the single metric that can save any sized American city from the notoriously unsustainable and unpleasant automobile-dominant culture. He states that, "Get walkability right and so much of the rest will follow" (4). Speck presents a new framework revolving around walkability—called The General Theory of Walkability, noting that, "to be favored, a walk has to satisfy four main conditions: it must be useful, safe, comfortable, and interesting" (11). Through strategic design of all surfaces in the pedestrian environment, with the most prominent and opportunistic being the urban street edge, the pedestrian experience can provide more than just pleasant transit but a place for refuge, restoration, engagement, and sociability.

The Useful Walk

The Useful Walk focuses on program and movement in cities, as organizational systems that either encourage or discourage walkability. Speck argues that the "car and its minions have unnecessarily distorted the way that design decisions are made in American communities," (71) referencing how in American cities, infrastructure and architecture have developed to serve the automobile first and the pedestrian second. For this reason, along with a lack of housing supply, he argues that "most downtowns have an imbalance of uses," advocating for a concentration and a mix of uses to render walkability more pragmatic (71). The framework of The Useful Walk promotes a practical understanding for the influence of spatial and programmatic organization on pedestrians in the urban realm.

The Safe Walk

The Safe Walk unpacks the inevitable competition between the pedestrian and the automobile. In most western cities, the automobile has been the dominant force in shaping the urban fabric, but there are exceptions. Speck attributes this dominance to metrics like block size, lane width, and road geometry, "that determine a car's speed and a pedestrian's likelihood of getting hit (71). He states that smaller blocks make for better cities because smaller blocks create more streets and route options, and

consequentially narrower streets (165). Narrower streets make for safer streets; as Speck bluntly puts it, "widening a city's streets in the name of safety is like distributing handguns to deter crime" (170). As traffic engineers widen lanes and streets in an attempt to make them safer, that is done with the assumption that human behavior will not change. As Speck sarcastically notes, "just as more lanes can't cause more driving, high-speed [wider] lanes can't cause high speeds" (170). Scale and opportunity directly affect how drivers and pedestrians interact downtown, and narrower streets can deter reckless driving behavior and provide shorter pedestrian crossings, while still accommodating the same amount of vehicular traffic.

Speck provides a specific strategy for narrowing the street without compromising traffic capacity, known as the road diet. The road diet turns a four-lane, two-way street into three lanes, with the middle being a dedicated intermediary turn lane (Speck 167). This provides a method for converting automobile space over to the pedestrian, at no expense to the automobile network.

Another strategy for redefining the automobile-pedestrian relationship is the concept of shared space. The goal with shared space is to "create an environment of such utter ambiguity that cars, bicyclists, and pedestrians all come together in one big mixing bowl of humanity" (Speck 176). To achieve this synonymous urban space, street signage, barriers, vertical curbs, and other physical cues are removed to create a more free-flowing space between building fronts, pedestrian space, bike lanes, and automobiles (Speck 176). This intervention, which causes cars to drastically slow down, is in favor of the pedestrian, and is only appropriate in a dense urban scenario.

The Comfortable Walk

The Comfortable Walk brings walkability to an architectural scale, focusing on edges, spatial definitions, and framed space. As a pedestrian navigates through the urban fabric every void, solid, and in-between has an effect on their experience and comfort. Speck investigates the pedestrian bodily experience according to a number of metrics. One major understanding is the dichotomy of "figural space versus figural object," claiming that "figural space is one of the things that allows traditional cities to so generously support pedestrian life," and that, in contrast, figural object is a new phenomenon of contemporary architecture that has caused architects to focus on a building as an object, disregarding the void space it frames on its exterior—resulting in "Object Urbanism" (Speck 216-217). The designer can form the facade to touch the street in a sensitive manner by designing a building with a focus on figural space, as

to enhance the life on the street rather than override it with a figural object that is not contextually sensitive. Speck recommends this is done through the understanding of the “forest edge, where both distant views and physical enclosure were present” (213). Architecturally, there are elements that relate to this condition, including colonnades, loggias, arcades, verandas, and porches (Speck 214). Comfortable street edge conditions can be designed by focusing on the Forest Edge condition and its associated architectural language.

The Interesting Walk

The Interesting Walk explores how the architectural street edge impacts the urban realm. In this section, Speck explores facade depth and detailing to understand foundational strategies for curating street edges to attract visitors and positively influence the pedestrian. The architectural street edge is the most important element of the overall composition of the street; “No single topic has greater impact on the life and attractiveness of city space than active, open, and lively edges” (Speck 240). The edge of a street defines its purpose and character. One limiting factor in western cities is the lack of architectural design stimulus past the property line; the highly-engineered street fabric of downtown is almost entirely anonymous and the buildings that densely line it seldom have any perceivable influence on its character or design.

One base strategy for fostering visual and functional interest on the street edge is the curation of facade depth and orientation. This spatial condition hosts the transition between public and private life in the city. Speck describes the depth as “the degree to which the facade provides opportunities for shelter, leaning, sitting, and other physical engagement, and also how effective the design is at blurring the distinction between public and private while drawing out the experience of entering and exiting” (240). In many cases downtown, buildings are built to maximize their parcel, built right up to the sidewalk, often with good transparency but poor facade depth and a lack of transitional elements for public engagement. Speck suggests incorporating, benches, tables, awnings, and refuge elements blurring the often hard-lined property edge. He also advocates for the use of vertical architectural elements as opposed to horizontal ones that “make distances seem longer and more tiring” to the pedestrian (241). The transition from the street to the architectural edge provides a multitude of opportunity in creating visual interest and engagement for the urban pedestrian.

Summary

Jeff Speck articulates a comprehensive view on walkability, providing a wide range of

indicators through The Useful Walk, The Comfortable Walk, The Safe Walk, and The Interesting Walk. A successful pedestrian experience contains a balance of these four categories. Many of these indicators, like the Forest Edge, share characteristics with biophilic design, which also relies on inherent human comfort, safety, and dynamism.

IV. Conceptual Framework

Source Flow Hybridization

The proposed framework of The 7 Principles of Biophilic Urbanism codifies the research on biophilic design and walkability. The term Biophilic Urbanism does exist

in current literature, but very seldomly and is not thoroughly defined; this provides an opportunity for the genesis of a new set of framework. Figure 4.01 illustrates how the 7 principles are conceived through hybridization of the existing frameworks of Terrapin Group's 14 Patterns of Biophilic Design and Jeff Speck's Ten Steps of Walkability.

14 Patterns of Biophilic Design

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Nature in the Space

1. Visual Connection with Nature
2. Non-Visual Connection with Nature
3. Non-Rhythmic Sensory Stimuli
4. Thermal & Airflow Variability
5. Presence of Water
6. Dynamic & Diffuse Light
7. Connection with Natural Systems

Natural Analogues

8. Biomorphic Forms & Patterns
9. Material Connection with Nature
10. Complexity & Order

Nature of the Space

11. Prospect
12. Refuge
13. Mystery
14. Risk/Peril

The 7 Principles of Biophilic Urbanism

The Street

1. Prioritize the Pedestrian
2. Expose Natural Systems

The Edge

3. Formulate Biomorphic and Fractal Forms

4. Incorporate Vegetation and Biophilic Materials

The Threshold

5. Deepen the Threshold
6. Recreate the Forest Edge
7. Perforate the Envelope

10 Steps of Walkability

© 2012 Jeff Speck

The Useful Walk

- 1: Put Cars in Their Place
- 2: Mix the Uses
- 3: Get the Parking Right
- 4: Let the Transit Work

The Safe Walk

- 5: Protect the Pedestrian
- 6: Welcome Bikes

The Comfortable Walk

- 7: Shape the Spaces
- 8: Plant Trees

The Interesting Walk

- 9: Make Friendly and Unique Faces
- 10: Pick Your Winners

Figure 4.01 Flow diagram illustrating the origin of The 7 Principles of Biophilic Urbanism (Browning et al.; Speck).

The 7 Principles of Biophilic Urbanism

The 7 Principles of Biophilic Urbanism are organized into three spatial conditions: the street, the edge, and the threshold. The street is commonly associated with the profession of Urban Design and Planning while the edge is commonly associated with the profession of Architecture. The threshold provides a lens to explore the transition

Street (urbdp)

[P1] Prioritize the Pedestrian

- [1a] Replace Excess Lanes with Pedestrian Amenity
- [1b] Plant Trees and Vegetation for Protection and Definition
- [1c] Organize Seating where Comfortable and Useful

[P2] Expose Natural Systems

- [2a] Filter Runoff with Bioswales and Native Vegetation
- [2b] Implement Natural Systems with Temporal Components

Edge (arch)

[P3] Formulate Biomorphic and Fractal Forms

- [3a] Investigate Nature as the Inspiration for Formgiving
- [3b] Maximize Dynamism of Sectional Depth
- [3c] Incorporate Fractals with a Scale Factor of Three

[P4] Incorporate Vegetation and Biophilic Materials

- [4a] Integrate Vertical and Horizontal Vegetated Systems
- [4b] Preference Natural Materials for Cladding and Structure

Threshold (urbdp+arch)

[P5] Deepen the Threshold

- [5a] Carve Out Public Pockets where Beneficial
- [5b] Extend the Architectural Experience beyond the Property

[P6] Recreate the Forest Edge

- [6a] Provide Prospect-Refuge Transition Space
- [6b] Emphasize Vertical Elements

[P7] Perforate the Envelope

- [7a] Engage Passersby through Porosity and Transparency
- [7b] Reward Entry and Interaction

between the urban realm and the architecture. Figure 4.02 directly compares the simplified strategies of the 7 principles against a typical urban street section. The typical street edge exhibits a harsh transition between interior and exterior. The goal of the threshold study is to facilitate a space affording simultaneous prospect and refuge, creating a softer transition between interior and exterior. Each principle breaks down into more specific subprinciples which are illustrated in the remainder of the chapter.

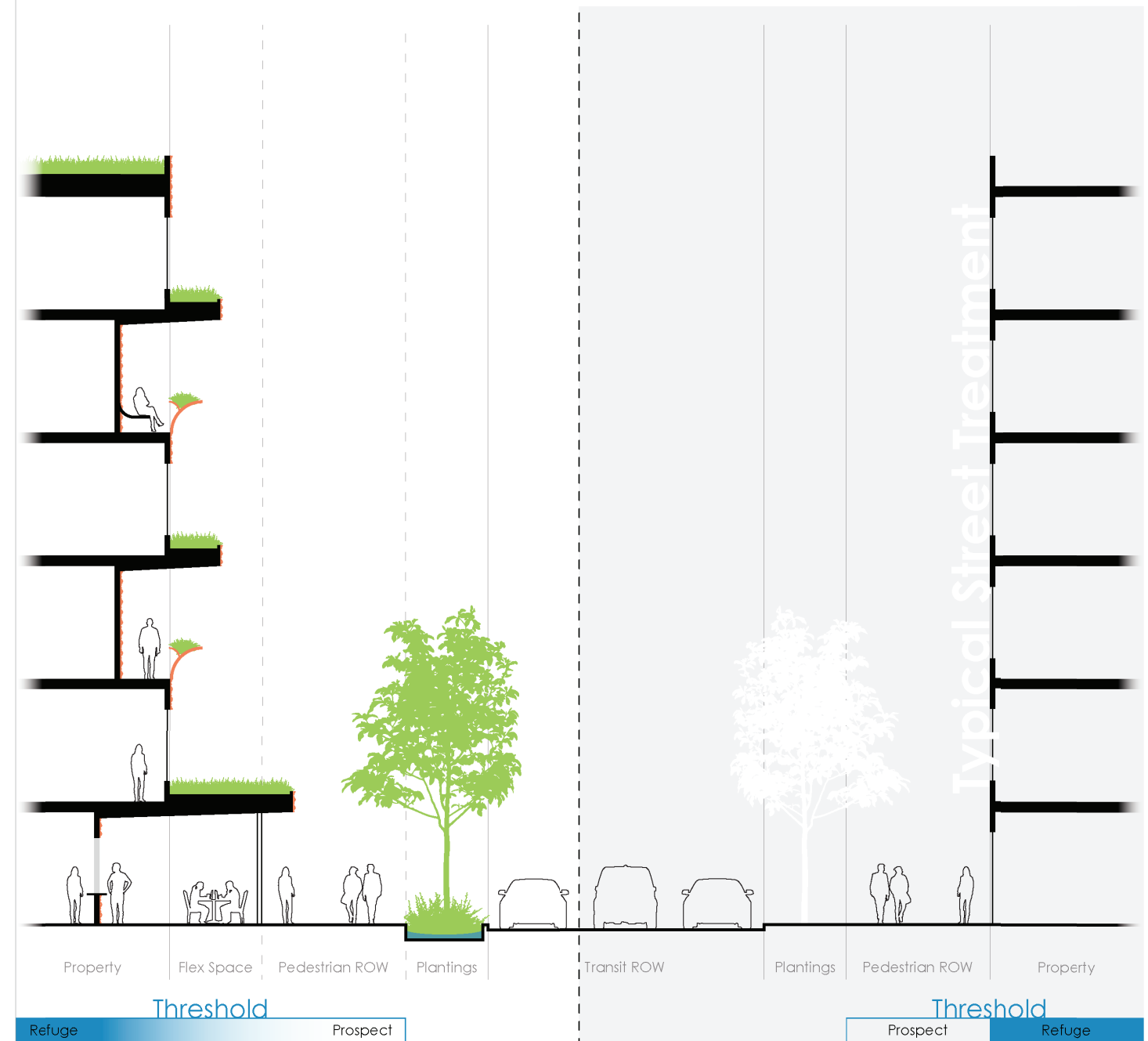


Figure 4.02 The 7 Principles of Biophilic Urbanism compared to typical streetscape treatment.

[P1] Prioritize the Pedestrian

[1a] Replace Excess Lanes with Pedestrian Amenity

In every city there are ways to take space back from the automobile, with opportunities to convert either excess driving or parking lanes. Added sidewalk space gives the designer more freedom for integrating public program, like micro retail, landscaping, or seating, directly into the pedestrian experience.

As Speck notes, initially this cannot be done on every street, but should be conducted systematically through the concept of the “Urban Triage,” where the “worst off must sometimes be sacrificed for the greater good” (Speck 254). This suggests that cities need to formulate a hierarchy to illustrate which streets would benefit first from pedestrian-dominant alterations.

Restoring urban space back to the pedestrian is the first step in a “Paradigm shift from planning the city for cars to planning for people,” quotes Oslo’s Vice Mayor for Urban Development, who has been working to eliminate the remaining 700 parking spaces and prohibit non-residents from driving in downtown Oslo (Elbaum). By reclaiming space from the automobile, Oslo is one of the few cities working to bolster their downtown core’s pedestrian dominance to better human health and well-being in the heart of their city, and its image. As Figure 4.03 illustrates, converting automobile space to pedestrian amenity is the first step in creating an urban experience crafted for the human, as opposed to the automobile.

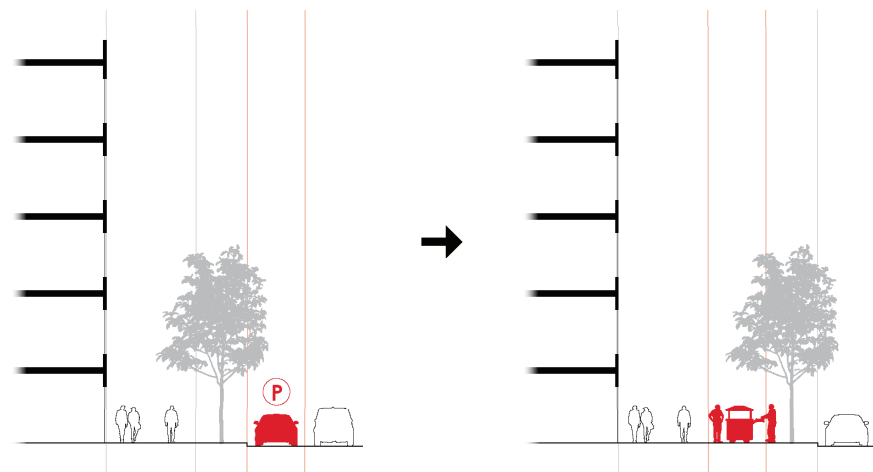


Figure 4.03 Principle [1a] Replace Excess Lanes with Pedestrian Amenity.

[P1] Prioritize the Pedestrian

[1b] Plant Trees and Vegetation for Protection and Definition

Urban trees and vegetation provide a wide array of spatial and sustainable advantages. Along with sustainable benefits of runoff retention and filtration, carbon sequestration, emission absorption, and decreased urban heat island effect, they provide spatial benefits of dynamic and dappled shade, visual connection to nature, street definition, and pedestrian protection (Speck 223). Urban plantings provide direct, multi-sensory connections to the natural world. “The objective of [a visual connection with nature] is to provide an environment that helps the individual shift focus to relax the eye muscles and temper cognitive fatigue” (Browning et al. 26). As research has shown, visual access to nature lowers blood pressure and heart rate, improves mental attentiveness, and positively impacts attitude and overall happiness (Browning et al. 12).

Street trees and vegetation provide a sense of enclosure and cultivate street definition. As Allan Jacobs notes, “Great streets have definition. They have boundaries, usually walls of some sort or another, that communicate clearly where the edges of the street are... that make it a place” (277). He notes that on wider, non-pedestrian dominant streets, trees also act as both vertical definition through their height and horizontal definition through their spacing (227). Jeff Speck has a similar view, noting that trees “also slow cars and improve the sense of enclosure by ‘necking down’ the street space with their canopies” (223). As figure 4.04 illustrates, trees provide protection from passing vehicles and cultivate a more comfortably-scaled and well-defined sidewalk fabric.

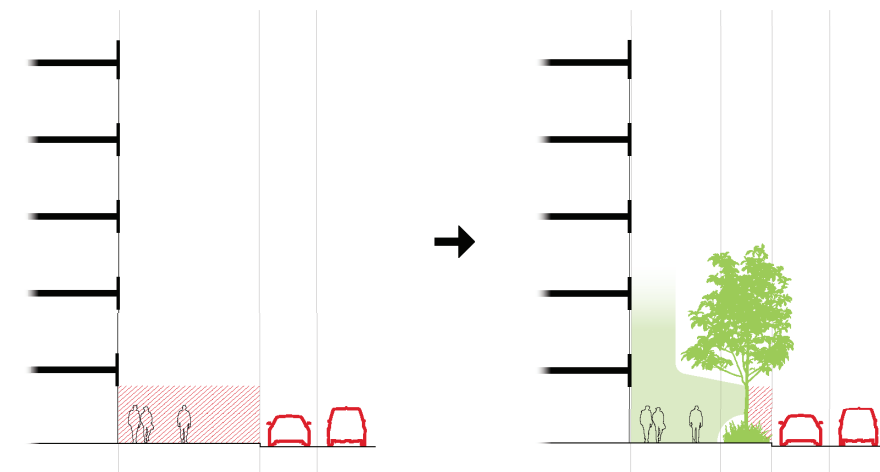


Figure 4.04 Principle [1b] Plant Trees and Vegetation for Protection and Definition.

[P1] Prioritize the Pedestrian

[1c] Organize Seating where Comfortable and Useful

Seating along the public right of way is beneficial in promoting street vitality and providing opportunities for mental and physical restoration. “Benches help people stay on the street; they invite our presence by permitting rest, conversation, waiting for a friend, passing the time. They help to make community” (Jacobs 300). As Jacobs notes, seating is a necessity for street vitality and publicness. Seating should be placed strategically along the public right of way where it is adjacent to program that will activate it and vegetation that will make it enjoyable.

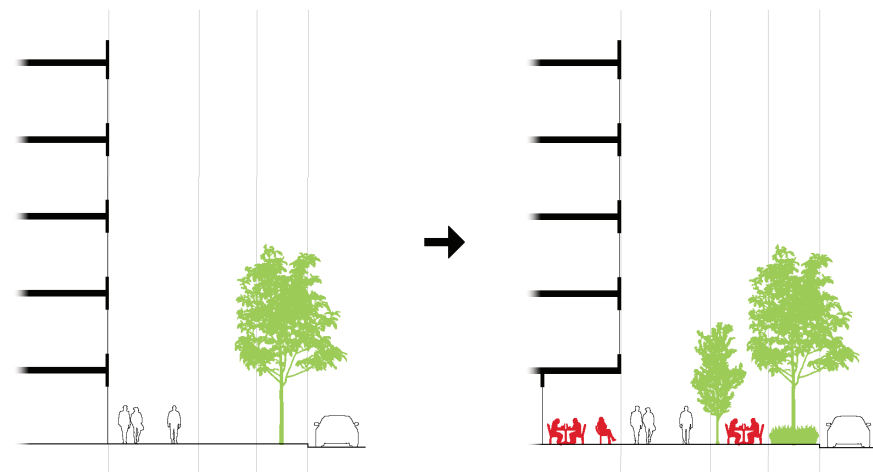


Figure 4.05 Principle [1c] Organize Seating where Comfortable and Useful.

[P2] Expose Natural Systems

[2a] Filter Runoff with Bioswales and Native Vegetation

Dense urban environments often suffer from poor water quality due to untreated and polluted stormwater runoff. If space is made in urban areas to filter and treat stormwater runoff, it will alleviate the overuse of stormwater sewage systems and improve water quality. By treating the runoff from individual parcels and the public right of way through bioswales, the pedestrian experience can be improved with the visual benefit of a natural system, while the environment will also benefit with improved water quality. “Seeing and understanding the processes of nature can create a perceptual shift in what’s being seen and experienced,” noting that the exposure of natural systems enhances the perception of the viewer while also enhancing environmental quality (Browning et al. 36).

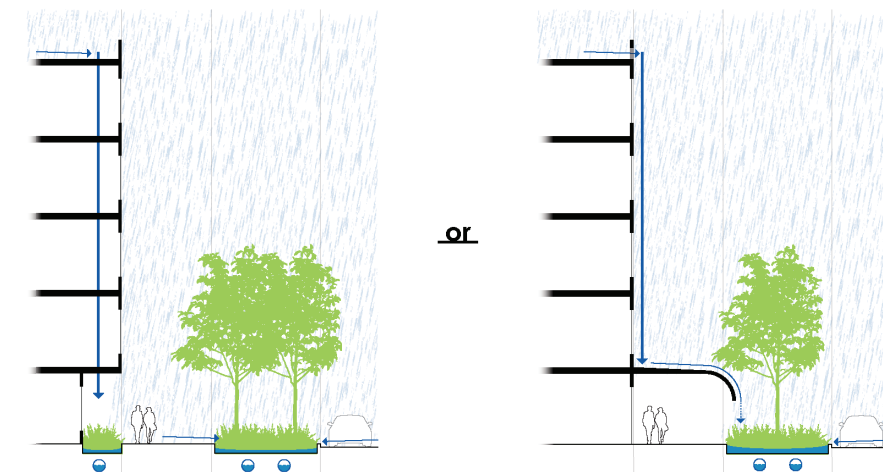


Figure 4.06 Principle [2a] Filter Runoff with Bioswales and Native Vegetation.

[P2] Expose Natural Systems

[2b] Implement Natural Systems with Temporal Components

Implementing and revealing the process of natural systems demonstrates the ephemeral quality of the natural world. Connections with natural systems introduce “a strong temporal element, which can be expressed culturally such as the Japanese love of the ephemerality of cherry blossoms” (Browning et al. 36). Trees and vegetation can exhibit temporal components through flowering or the loss of leaves. Implementation of natural elements with temporal components can “heighten both awareness of natural properties and hopefully environmental stewardship of the ecosystem within which those properties prevail” (Browning et al. 36). This heightened awareness better connects users to the natural world, shifting their perception and value lens on the need for direct connection with living elements of nature.

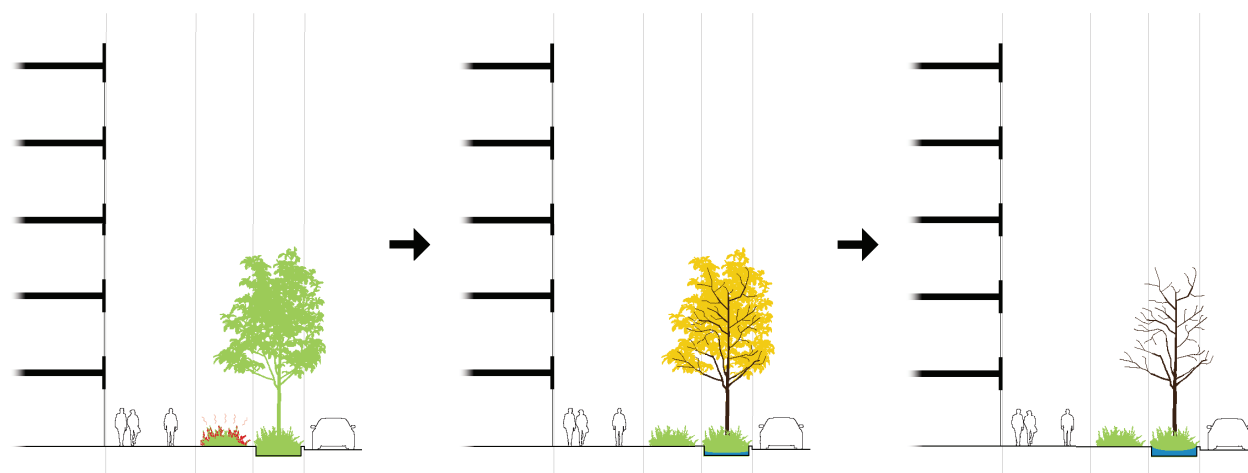


Figure 4.07 Principle [2b] Implement Natural Systems with Temporal Components.

[P3] Formulate Biomorphic and Fractal Forms

[3a] Investigate Nature as the Inspiration for Formgiving

It is no coincidence that certain patterns, ratios, and forms are persistent in nature. For millions of years, elements of nature have adapted and evolved around the environmental success of certain patterns, especially the Fibonacci sequence. For example, the Fibonacci sequence persists in the growth of plant leaves so that new growth does not block the sun from reaching leaves beneath (Browning et al. 38). The Fibonacci sequence also results in the Golden Mean, which, shown in Figure 4.08, roughly equates to the rule of thirds—a rule that can be easily implemented when architects are proportioning and rationalizing geometry. The human eye is attuned to natural patterns, preferring biomorphic forms that have the ability to “reduce stress due to induced shift in focus, and enhanced concentration” (Browning et al. 38). Biomorphic forms can be incorporated as either purely cosmetic components, or as integral to the function or structure of the architecture. Although biomorphic architecture only fosters “symbolic representations of life,” it can elicit a similar mentally restorative response to that of the natural world (Browning et al. 38). As the name of the principle suggests, we do not know everything about the patterns of nature and their functions, so investigation is necessary to uncover new strategies for designing forms that are representational of the natural world.

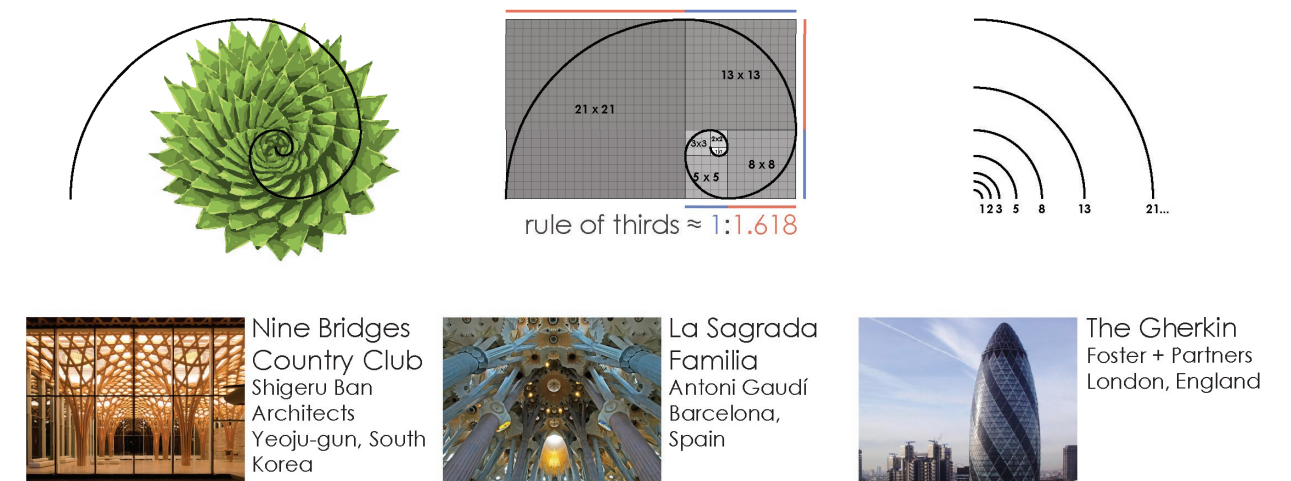


Figure 4.08 Principle [3a] Investigate Nature as the Inspiration for Formgiving (Chen et al.).

[P3] Formulate Biomorphic and Fractal Forms

[3b] Maximize Dynamism of Sectional Depth

Thin and flat facades, which are especially common on newer buildings, often lack a sense of character and do not offer opportunity to cast shadows that change throughout the day. By maximizing the dynamism and depth of a facade, its composition changes depending on the time of day and the angle from which it is being viewed. “Just as variations in lighted surfaces are important for interpreting surfaces... leveraging opportunities for illuminance fluctuation, light distribution and light color variability that stimulate the human eye without causing discomfort will improve the quality of the user experience” (Browning et al. 35). The human eye is drawn to variation, and when a lack of variation exists, as in a flat curtain wall system with spandrel panels, dynamism and depth do not exist and opportunities for mental restoration and curiosity are missed.

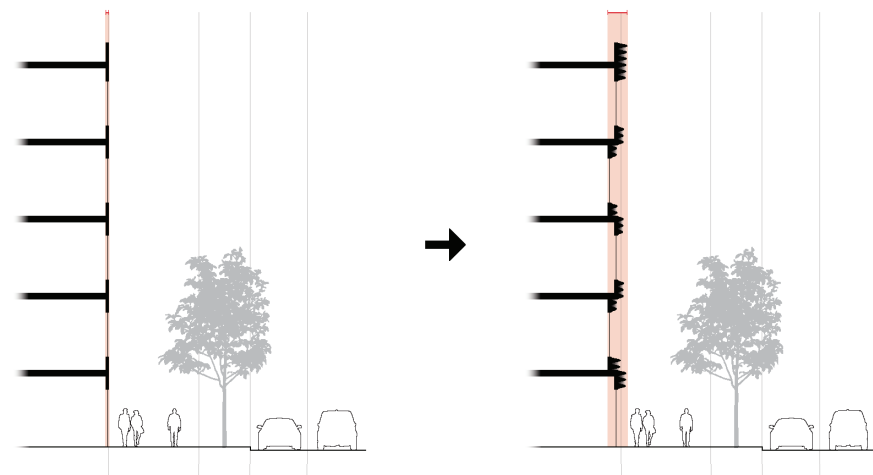


Figure 4.09 Principle [3b] Maximize Dynamism of Sectional Depth.

[P3] Formulate Biomorphic and Fractal Forms

[3c] Incorporate Fractals with a Scale Factor of Three

Fractals are another systematic pattern, similar to, and sometimes derived from, the Fibonacci sequence which persists in nature. Fractals organize a spatial hierarchy, where every piece is an integral part to the whole. Fractals can be found everywhere in the natural world, from the scale of a leaf’s structure to the scale of a watershed’s structure. Incorporating successful fractal geometries in architecture relies on the scale factor; “Nested fractal designs expressed as a third iteration of the base design (i.e., with scaling factor of 3, see illustration [Figure 4.10]) are more likely to achieve a level of complexity that conveys a sense of order and intrigue, and reduces stress” (Browning et al. 42). Fractals also allow complexity to be conveyed in a way that can be more easily interpreted by the human brain; the detailed elements are scaled and proportional to the larger elements. As discovered in a study of a former U.S. Navy office in Mississippi, the overuse of complex patterns that are not fractals or of related forms can create environments that induce nausea, headaches, and dizziness (Browning et al. 42). It is clear that too much complexity and patterning can have adverse side effects, but when fractals are incorporated correctly, they have the potential to create a feel that is “engaging and information-rich as an intriguing balance between boring and overwhelming” (Browning et al. 42). As Speck notes, facades with more detail reveal themselves while the viewer approaches, ultimately rewarding the approach (245). Many modern buildings only offer one scale of detail, so the perception of the form does not change upon the approach (Speck 245). Designing facades with fractal patterning offers the ability to incorporate complexity that is rewarding, captivating, and more effortlessly digested by the human brain.



Figure 4.10 Principle [3c] Incorporate Fractals with a Scale Factor of Three (Chen et al.; Pearce 12, 16).

[P4] Incorporate Vegetation and Biophilic Materials

[4a] Integrate Vertical and Horizontal Vegetated Systems

In an impossible effort to reincorporate the original density of greenery prior to human intervention, vertical and horizontal vegetated systems provide many obvious environmental benefits and some less obvious psychological benefits. Similar to street trees and vegetation, vegetated building systems can promote runoff retention and filtration, carbon sequestration, emission absorption, and decreased urban heat island effect (Speck 223). From a pedestrian standpoint, these systems provide “visual access to biodiversity [which is] more beneficial to our psychological health than access to land area” (Browning et al. 24). Also, “repeated viewing of real nature, unlike non-nature, does not significantly diminish the viewer’s level of interest over time” (Browning et al. 24). Although vegetated facade and roof systems are an effort to maintain, they provide a plethora of benefits, and, as research has shown, the ability to help “the individual shift focus to relax the eye muscles and temper cognitive fatigue” (Browning et al. 25). Integrating visibly accessible vegetated surfaces into facades not only provides environmental benefits, but cognitive benefits as well.

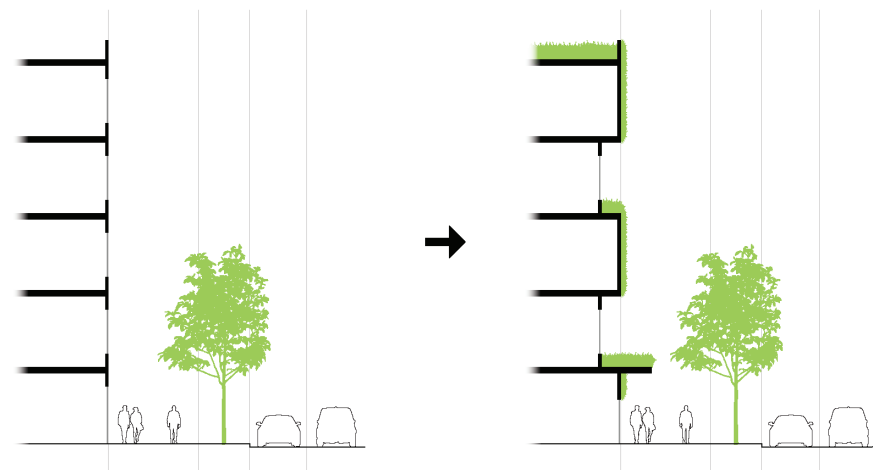


Figure 4.11 Principle [4a] Integrate Vertical and Horizontal Vegetated Systems.

[P4] Incorporate Vegetation and Biophilic Materials

[4b] Preference Natural Materials for Cladding and Structure

In a highly-curated urban environment, it is important to maintain a direct material connection to nature since the presence of real nature is limited by the contested space of the dense city fabric. Since natural materials are considered analogous to nature, due to their refinement after being extracted, they are still good for human well-being, but less so than a connection with unrefined or live nature. Figure 4.12 illustrates an example palette of materials that are derived from nature and refined, but still retain elements that are analogous to nature. As mass timber is becoming more feasible, especially with high rises, it is important to consider that as a structural system, along with environmental benefits of sequestering carbon and being renewable, mass timber structure adds a significant amount of biophilic material to any building. The majority of new structures can be constructed with biophilic materials through utilization of mass timber and naturally-derived cladding.



Figure 4.12 Principle [4b] Preference Natural Materials for Cladding and Structure (Chen et al.).

[P5] Deepen the Threshold

[5a] Carve out Public Pockets where Beneficial

The urban pedestrian experience is often one of overwhelming prospect and lack of refuge. The threshold has boundless opportunities for providing pedestrian refuge, regardless of program. Setbacks on the first floor, as shown in Figure 4.13, provide a refuge pocket with overhead protection. This strategy deepens the threshold experience to “the degree to which the facade provides opportunities for shelter, leaning, sitting, and other physical engagement” (Speck 240). By carving out public pockets, the sidewalk is widened to provide opportunities for refuge spaces that aid in the transition between interior and exterior.

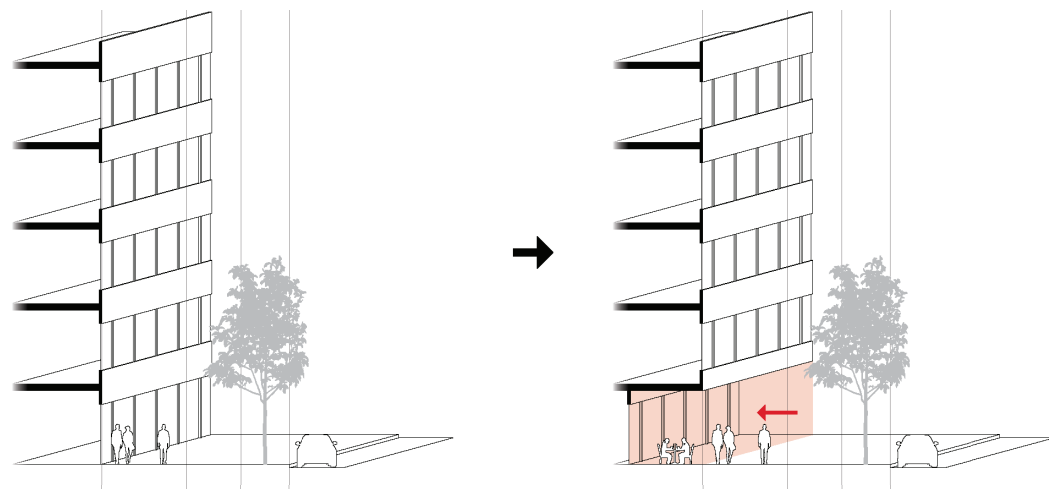


Figure 4.13 Principle [5a] Carve out Public Pockets where Beneficial.

[P5] Deepen the Threshold

[5b] Extend the Architectural Experience beyond the Property

The threshold can also be deepened by extending the architecture into the public realm. This strategy is most commonly accomplished through the use of awnings that “can give a potential shopper the feeling of already being inside the store” (Speck 240). Awnings and other overhead structures provide a sense of refuge on the public right of way, creating hybridized space of both prospect and refuge.

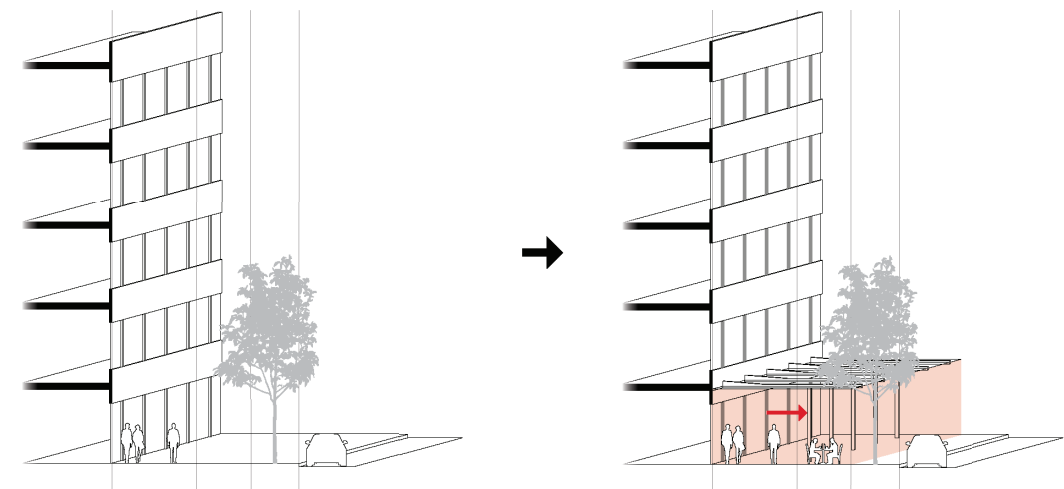


Figure 4.14 Principle [5b] Extend the Architectural Experience beyond the Property.

[P6] Recreate the Forest Edge

[6a] Provide Prospect-Refuge Transition Space

Deepening the threshold through extension and retraction of the architecture provides the most potential for fostering a space containing qualities of both prospect and refuge. Spaces that hybridize qualities of prospect and refuge are the most spatially comfortable. These types of spaces are indicative of the concept of the Forest Edge, which, “is one of the most prevalent of natural prospect-refuge conjunctions (Browning et al. 46). The concept of the Forest Edge derives from when humans were hunter-gatherers, they sought simultaneous protection and surveillance against threats of weather and predators. While prospect is ideal for some activities and refuge for others, a space with both creates a “compounded response [that] is enhanced when the two spatial conditions converge” (Browning et al. 46). Archetypes of “colonnades, loggias, arcades, verandas, even porches” are evocative of the Forest Edge condition, producing some of the most comfortable and appealing spaces (Speck 214). The goal of deepening the threshold is to establish the idealistic spatial condition of the Forest Edge, promoting softer and more comfortable transitions between interior and exterior.

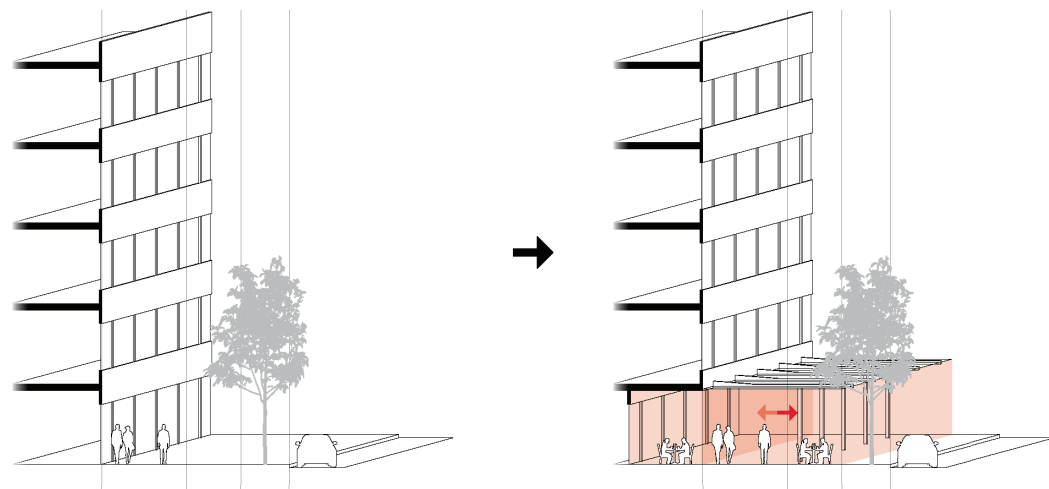


Figure 4.15 Principle [6a] Provide Prospect-Refuge Transition Space.

[P6] Recreate the Forest Edge

[6b] Emphasize Vertical Elements

Along the threshold, the pedestrian experience is directly affected by the organizational elements in the street and on the facade. Vertical elements provide a better rhythm for the pedestrian as they “make walking distances shorter and more interesting,” while, “In contrast, facades designed with long horizontal lines make distances seem longer and more tiring” (Gehl 77). Integral to the concept of the Forest Edge, vertical elements in the street provide an enclosure of semi-refuge, indicative of trees at the edge of a forest. Vertical elements against the facade also create rhythm and definition in the pedestrian experience. Figure 4.16 demonstrates a Forest Edge condition containing both vertical facade elements and freestanding columns in the public right of way; both providing a sense of order and enclosure on the street.

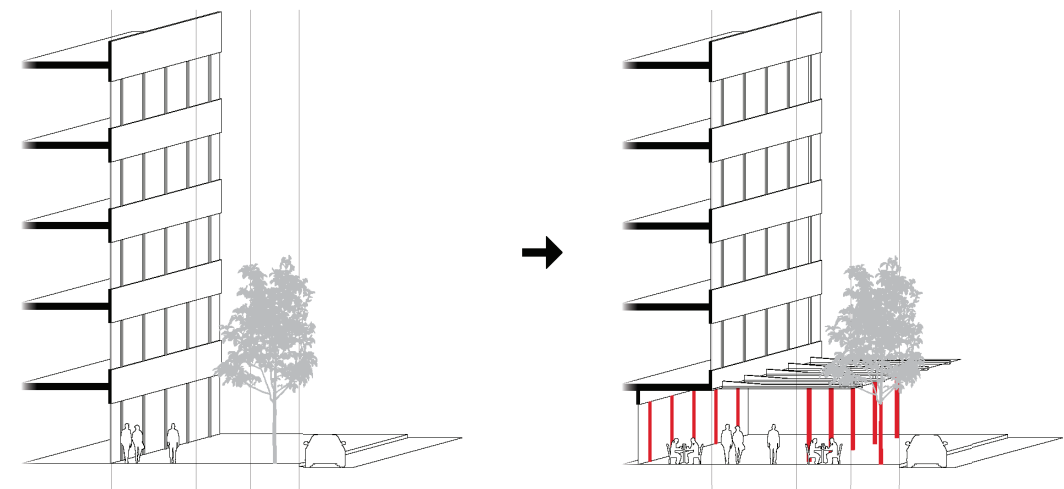


Figure 4.16 Principle [6b] Emphasize Vertical Elements.

[P7] Perforate the Envelope

[7a] Engage Passersby through Porosity and Transparency

The edge of a street, regardless of its depth, needs to engage the passersby as to ensure the street retains active and lively edges. This is done best by “blurring the distinction between public and private while drawing out the experience of entering and exiting” (Speck 240). The threshold, as a transitional space, should make entering and exiting a seamless experience. Perforating the envelope through methods of porosity and transparency aid in this transitional experience. “The best streets have about them a quality of transparency at their edges, where the public realm of the street and the less public, often private realm of property and buildings meet” (Jacobs 285). The strategic use of glazing and welcoming doorways better connects the interior and exterior. Large openings like garage doors, as shown in 4.17, provide the most seamless connection, as they eliminate the streetwall entirely at the ground level. Porosity and transparency can be used in an infinite number of combinations to engage the pedestrian and foster a seamless transition between public and private.

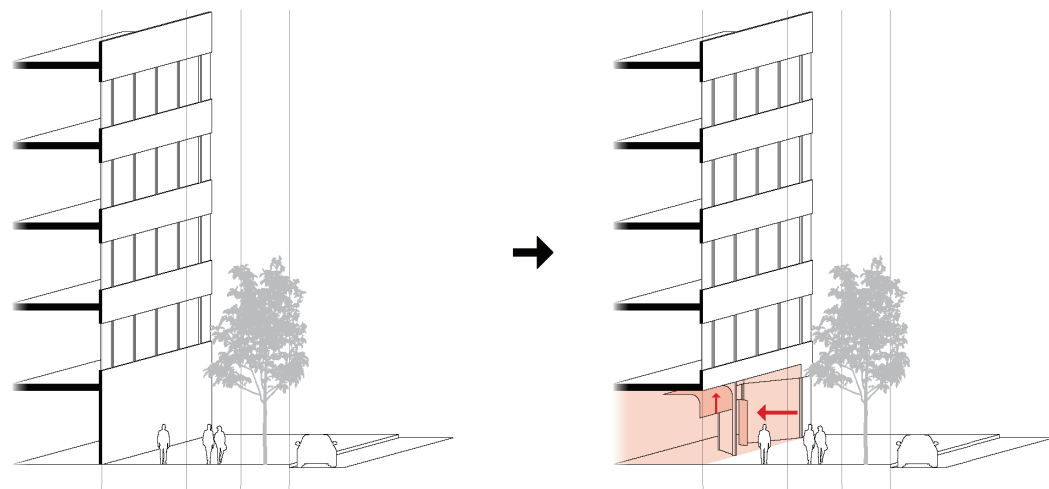


Figure 4.17 Principle [7a] Engage Passersby through Porosity and Transparency.

[P7] Perforate the Envelope

[7b] Reward Entry and Interaction

A street threshold at its liveliest is rewarding and interactive. “No single topic has greater impact on the life and attractiveness of city space than active, open, and lively edges” (Gehl 88). Gehl argues for the use of soft edges over hard edges; soft edges contain interactive program, like a coffee shop window, that directly activates the street, and inviting entries that are signified through articulation of the building mass (both shown in Figure 4.18). “Soft edges signal to people that a city is welcoming” (Gehl 99). Hard edges, at their least active, are blank walls that afford passersby no interaction or transparency. Use of soft edges along the street allow for the street to be engaging and useful to passersby, while hard edges promote dead space that lacks meaning.

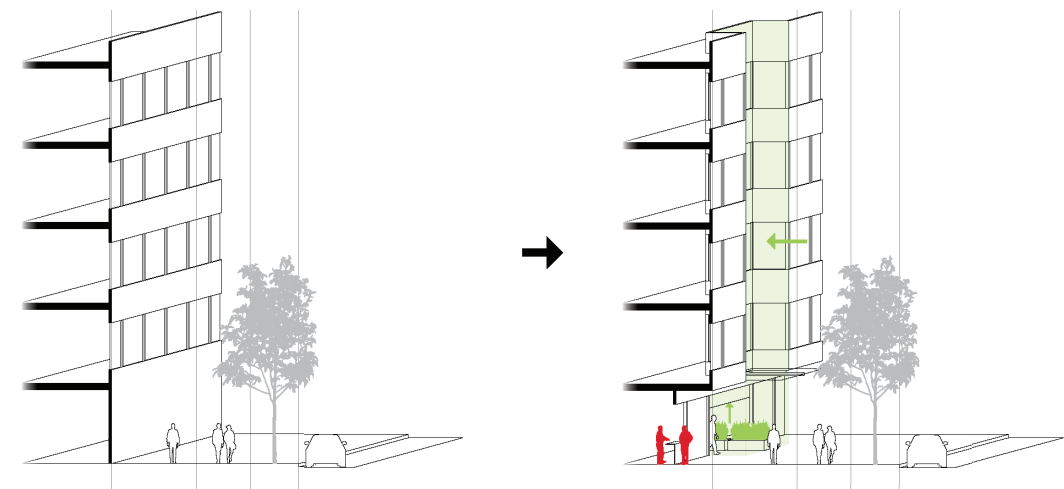


Figure 4.18 Principle [7b] Reward Entry and Interaction.

V. Site Analysis

Why Downtown

Downtown Seattle provides the most potential to manifest change for the majority of the city’s population. Typically, the urban core of any city dominates the identity and inspirational character of its greater metropolitan area. “The downtown is the only part of the city that belongs to everybody,” and, “Each city’s reputation therefore rests in large part on its downtown’s physical attributes” (Speck 260). To demonstrate change and provide the greatest opportunity for universal impact starting in Seattle, The 7 Principles of Biophilic Urbanism must first be applied to the downtown core.

Site of Intervention: Bon Marche Parking Garage

The Bon Marche Parking Garage on Third Avenue in between Pine Street and Stewart Street was chosen as the site of intervention for its location, prominence, and lack of contribution to urban vitality; in many ways it is the antithesis of biophilic design. The parking structure is a monstrosity in the core of downtown that, although contains a large amount of embodied energy, should be demolished and replaced with a project that uplifts and engages busy Third Avenue. In its current state, as Figures 5.01 and 5.02 show, a hodgepodge of ground floor use sits on Third Avenue with a partially covering facade above. The garage’s floor heights are short of ten feet, so preserving its structure for reuse does not seem plausible. Third Avenue is the geographical center and bus arterial of the downtown with a street character and identity that is criticized for lacking in quality of life when compared to adjacent avenues. The site is also situated on Pine, in between Pike Place Market and Westlake Center, the two retail cores of downtown; this relationship affords massive potential for creating a retail link between these two cores.



Figure 5.01 Bon Marche Parking Garage, downtown Seattle from Stewart Street and 3rd Avenue.



Figure 5.02 Bon Marche Parking Garage, downtown Seattle from Pine Street and 3rd Avenue.

Two Contrasting Street Identities

Currently, the City of Seattle categorizes all street types based on their location and provides common spatial allocations and programmatic segmentations for each type. Principle downtown arterials are shown in Figure 5.03 and minor arterials shown in Figure 5.05. These two street types make up the majority of downtown. Their graphic representation provides Seattle’s ideal scenario, which is often not the case in reality of what is currently built in the city. The scenarios also give a range of widths for the frontage zone from zero to six feet—the frontage zone is the most critical zone in manifesting the Forest Edge. As shown by the city’s illustrations, the street is a linearly engineered continuum that shares no relationship with the design of adjacent buildings. Architects should consider incorporating sidewalk design with the design of the adjacent architectural edge in an effort to unify the street as a totality.

Third Avenue Vision

Third Avenue is currently the busiest transit street in the United States, carrying approximately 52,000 passengers a day (Gruber 5). In recent efforts to improve walkability on Third Avenue, a study was conducted on how the 4-lane transit right of

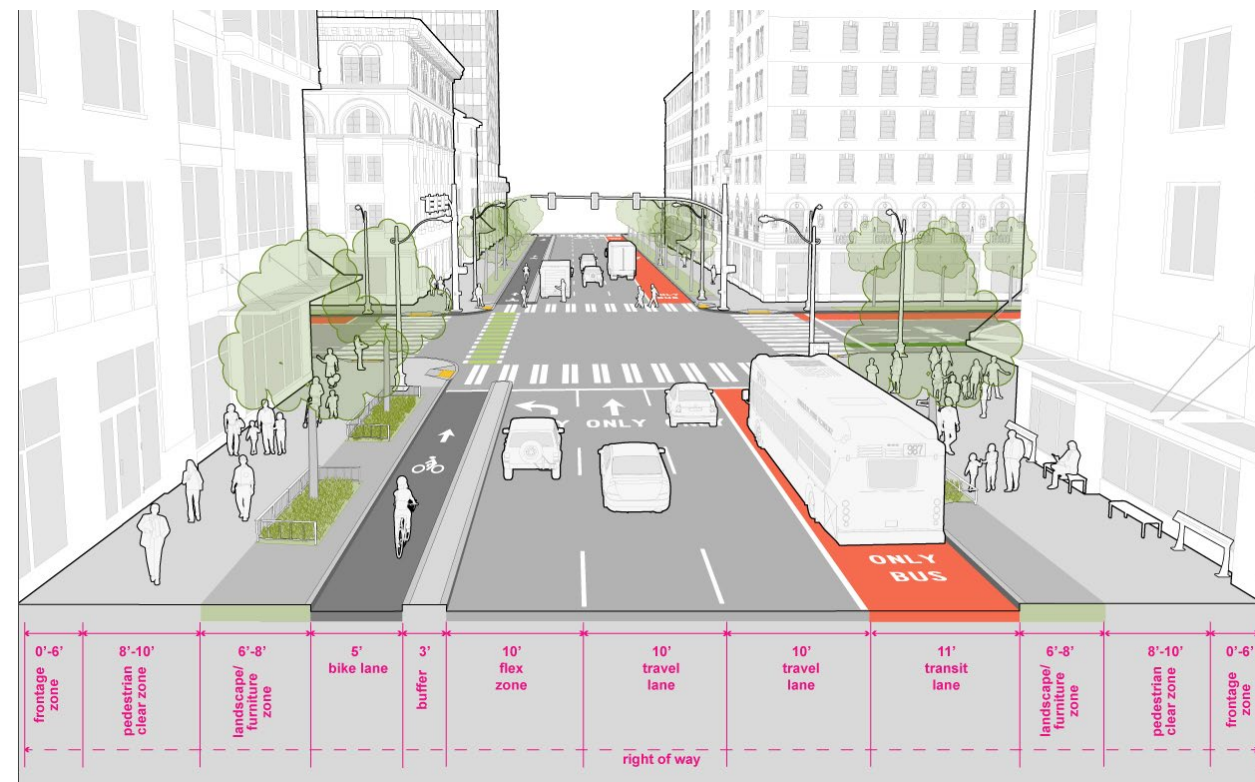


Figure 5.03 Downtown street type standard (Seattle Streets Illustrated).

way can be reduced to either two or three lanes. The Downtown Seattle Association published the study, stating that, “The quality of the pedestrian experience suffers from the lack of sidewalk space, the expanse of the street and the number of buses traveling along Third Avenue” (Gruber 51). Figure 5.04 illustrates the intense volume of buses on Third Avenue in comparison to other major transit corridors. Improvements along Third Avenue that include transit redistribution, sidewalk expansion, and sidewalk rehabilitation are sure to happen as the city begins to reassess its value of the pedestrian experience and how it affects retail vitality and human well-being.

SEATTLE	52,400	290	Third Avenue
VANCOUVER	52,000	89	Granville Mall
MINNEAPOLIS	12,400	60	Nicollet Mall
DENVER	45,000	80	16th Street Mall
SAN FRANCISCO	40,000	170	Market Street
NEW YORK CITY	115,000	150	5th Avenue
LOS ANGELES	95,000	72	Wilshire Corridor

Figure 5.04 Buses per peak hour on Third Avenue and other similarly sized transit corridors (Gruber 10).

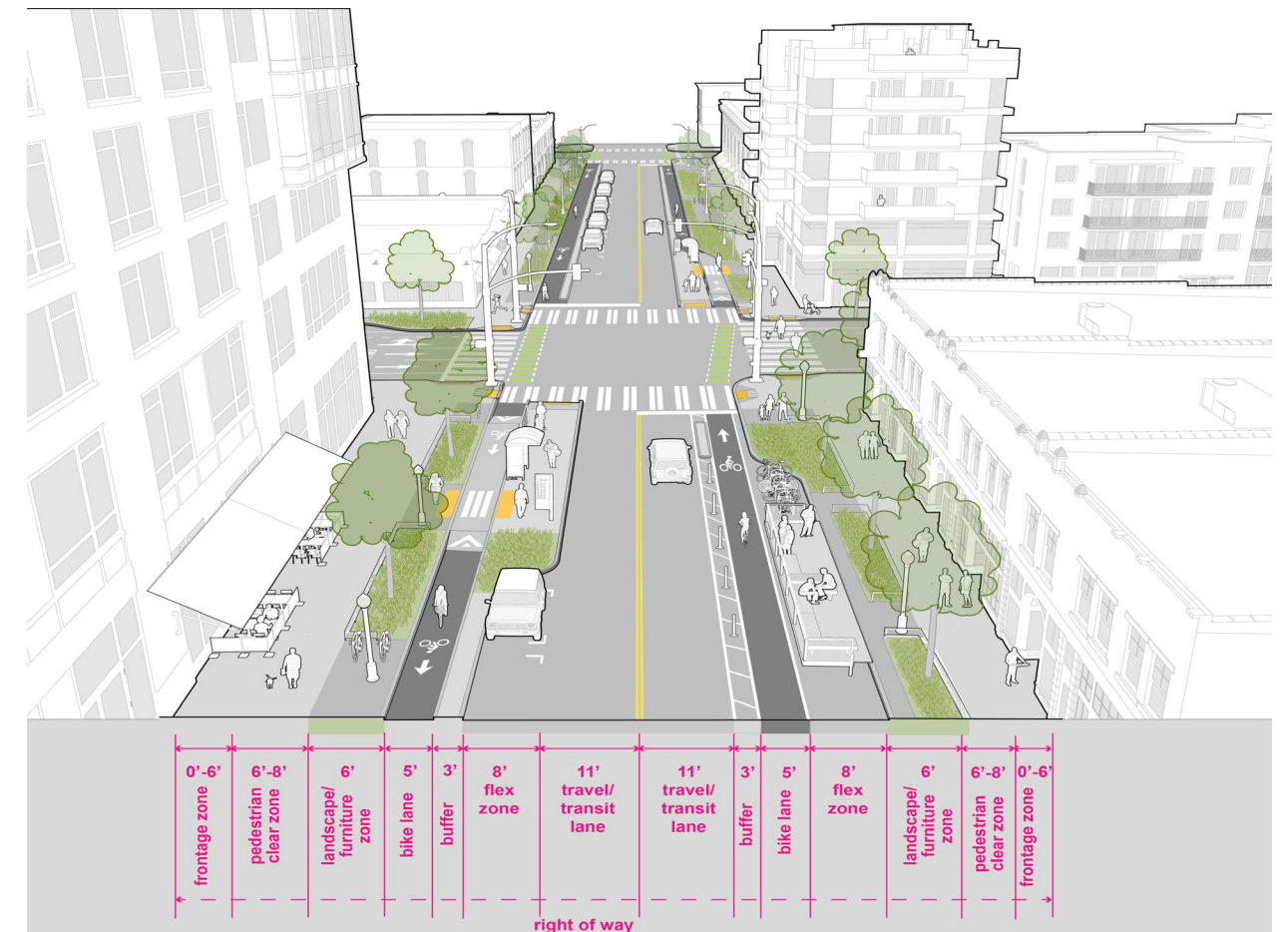


Figure 5.05 Downtown Neighborhood street type standard (Seattle Streets Illustrated).

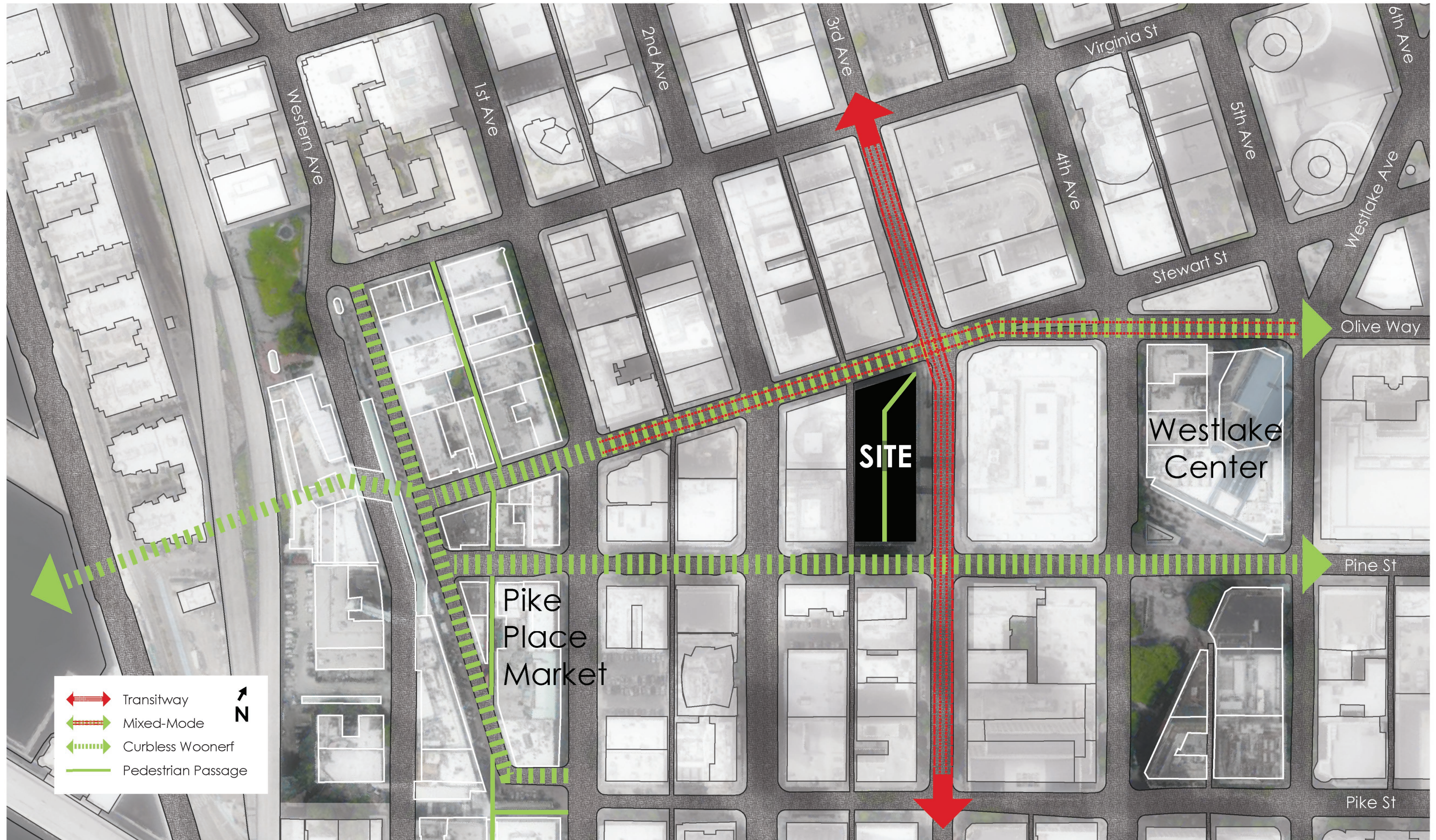


Figure 5.06 Identities of connecting streets. The site of intervention has the opportunity to become a link between the retail cores of Pike Place Market and Westlake Center while promoting Pine Street as a pedestrian woonerf.

VI. Intervention

The goal of the proposed intervention is to demonstrate the 7 Principles of Biophilic Urbanism within the urban core of Seattle. The specific program of this proposal is not as important as its form or urban response; as an anchor between Pike Place Market and Westlake Center, the building contains ground floor retail with work space above.

Responding to the existing street identities shown in Figure 5.06, massing strategies were formed for integrating the pedestrian experience with the design of the building (shown in Figure 6.06). Acknowledging Third Avenue as a transit corridor, the building extends out onto the street to foster a dynamic moment of partial refuge while retaining prospect. On Pine Street, the building is recessed to allow for a refuge porch surrounded by large tree canopies. On the sharp corner of Stewart Street and Third Avenue, the massing lifts up to soften the corner and signify the main entry (shown in Figure 6.04).

The proposed massing integrates vegetation and green features while retaining adequate clear space for the constant circulation of passersby. The City of Seattle recommends eight to ten feet of pedestrian clear (shown in Figure 5.03). The proposal, after eliminating an eleven foot lane on Third Avenue, provides an eleven to thirteen foot pedestrian clear (shown in Figures 6.01 and 6.02). In comparison, the Bon Marche Parking Garage block currently provides 12,200 square feet of pedestrian space and the proposed massing and sidewalk redistribution provides 19,870 square feet of pedestrian space, while also incorporating seating, street trees, and a bioswale system.

The bioswale system wraps the building, and through the movement of gravity, filters all of the sidewalk and building's stormwater runoff into a proposed network of bioswales running along Pine Street (shown in Figure 6.03). Future projects could also link to this district system that provides water filtration and pedestrian amenity, and further defines Pine Street as a pedestrian-dominant corridor spanning from Capitol Hill to the waterfront. The proposal also adds curbless mid-block crossings to slow street traffic and provide the pedestrian with more flexibility for movement.

The structure is comprised of mass timber columns and honeycomb lattice (shown in Figure 6.04 and 6.05). The honeycomb system was chosen because it is structural, biomorphic, and capable of being fractalized. The following diagrams illustrate the design decisions in response to The 7 Patterns of Biophilic Urbanism.

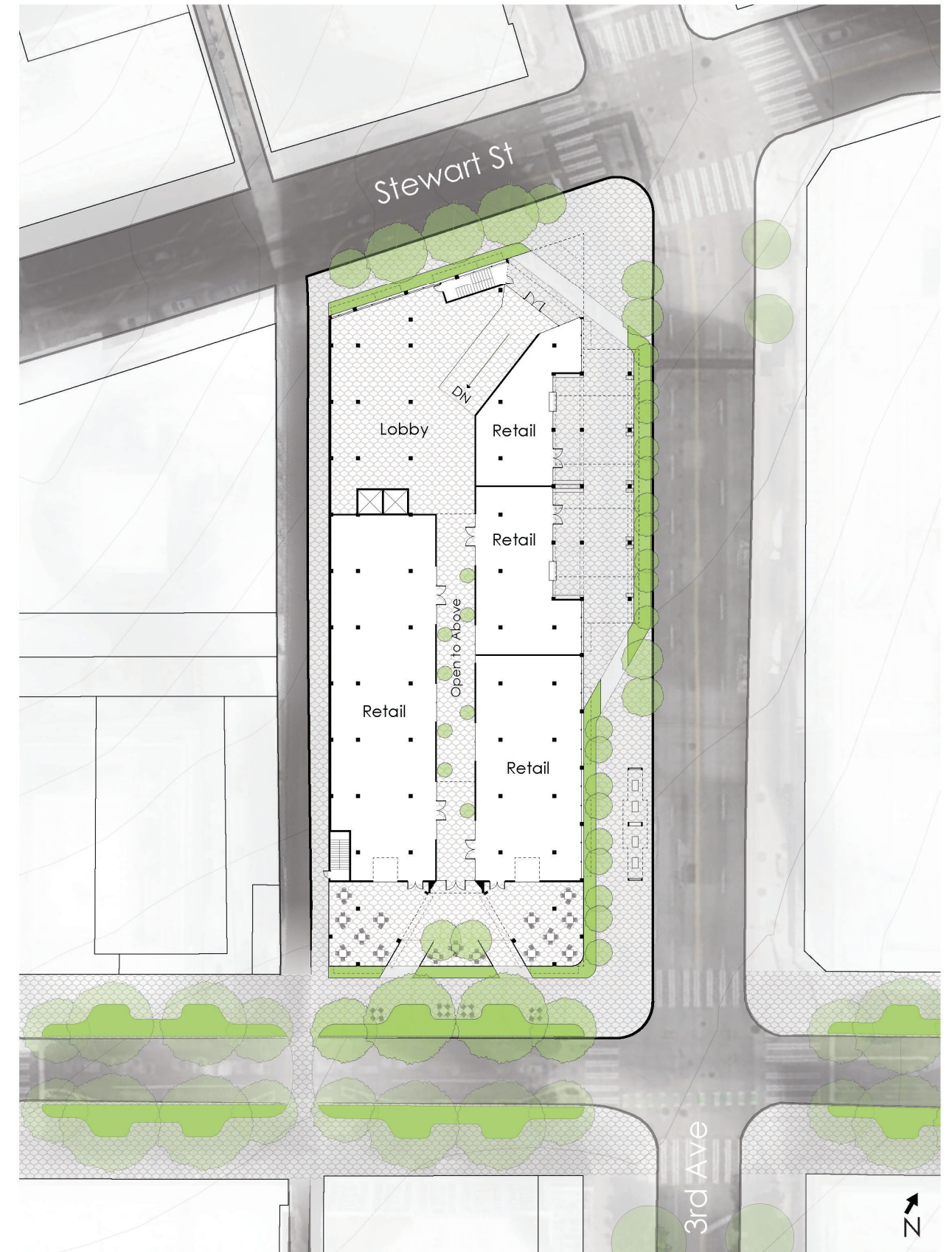


Figure 6.01 Site plan illustrating the reconfiguration of pedestrian space, circulation, and bioswale system.

[P1] Prioritize the Pedestrian

- [1a] Replace Excess Lanes with Pedestrian Amenity
- [1b] Plant Trees and Vegetation for Protection and Definition
- [1c] Organize Seating where Comfortable and Useful

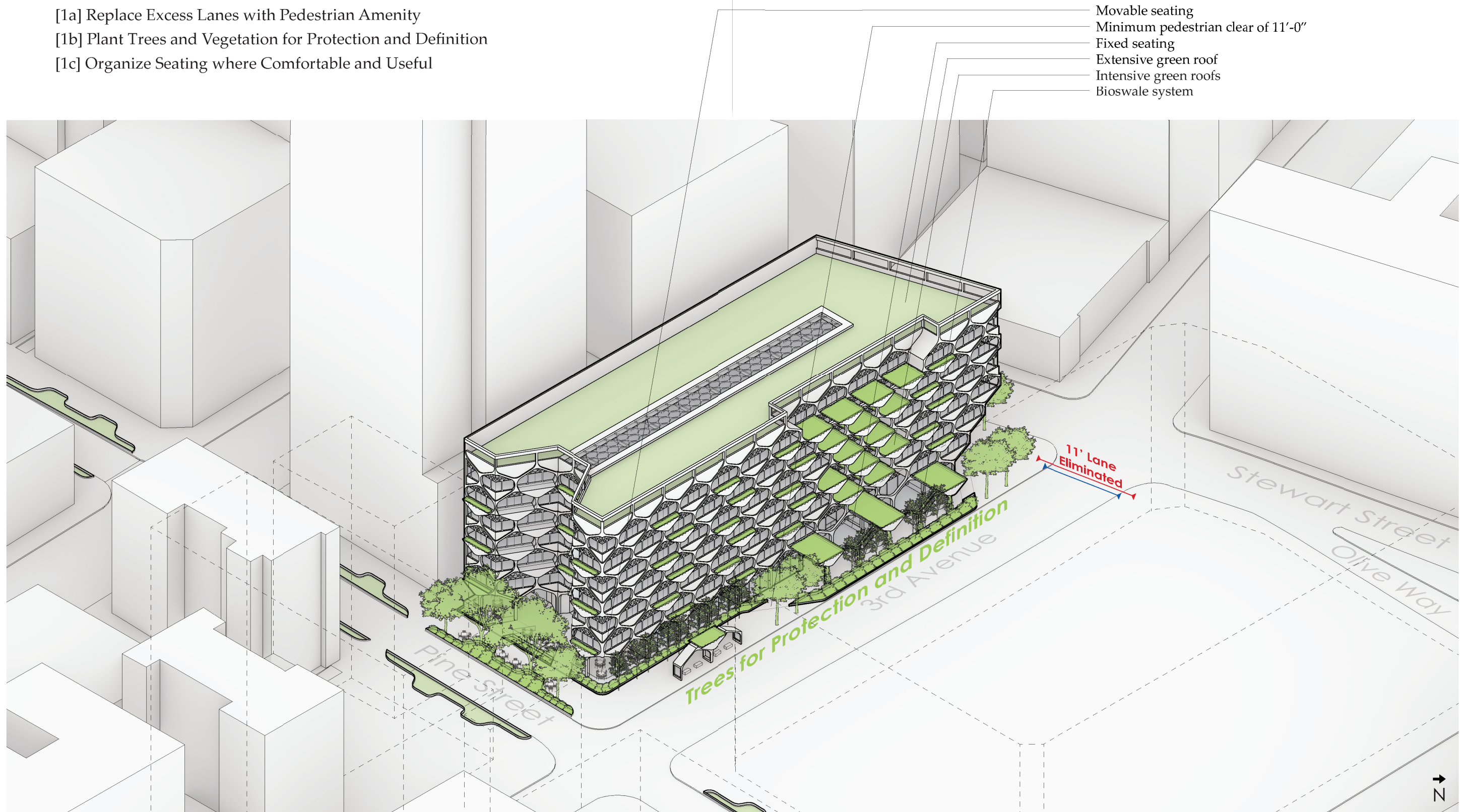


Figure 6.02 Diagram of [P1] Prioritize the Pedestrian.

[P2] Expose Natural Systems

[2a] Filter Runoff with Bioswales and Native Vegetation

[2b] Implement Natural Systems with Temporal Components

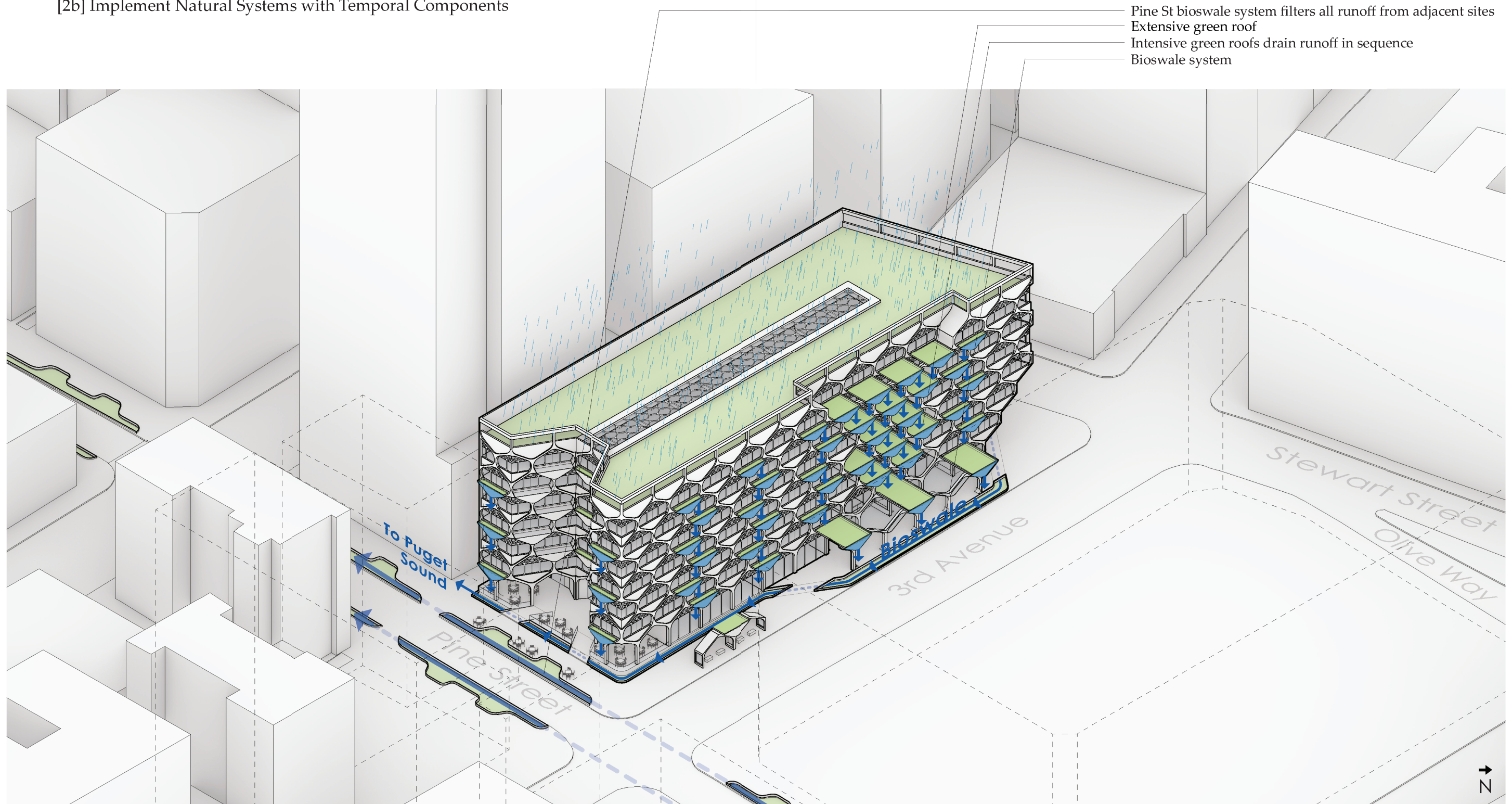
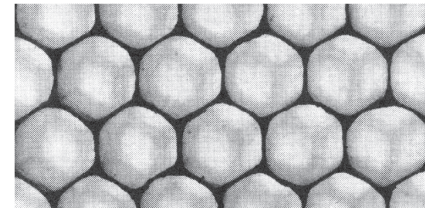


Figure 6.03 Diagram of [P2] Expose Natural Systems.

[P3] Formulate Biomorphic and Fractal Forms

- [3a] Investigate Nature as an Inspiration for Formgiving
- [3b] Maximize Dynamism of Sectional Depth
- [3c] Incorporate Fractals with a Scale Factor of Three



Honeycomb Pattern
Biomorphic
Structural
Fractal Capable

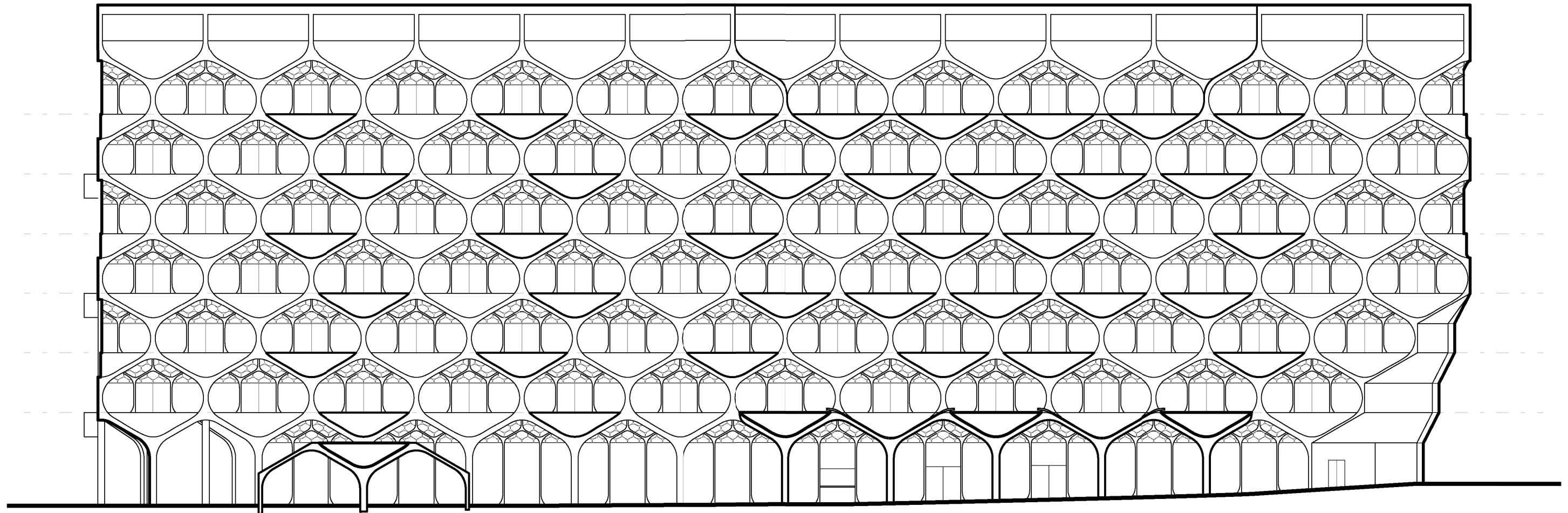
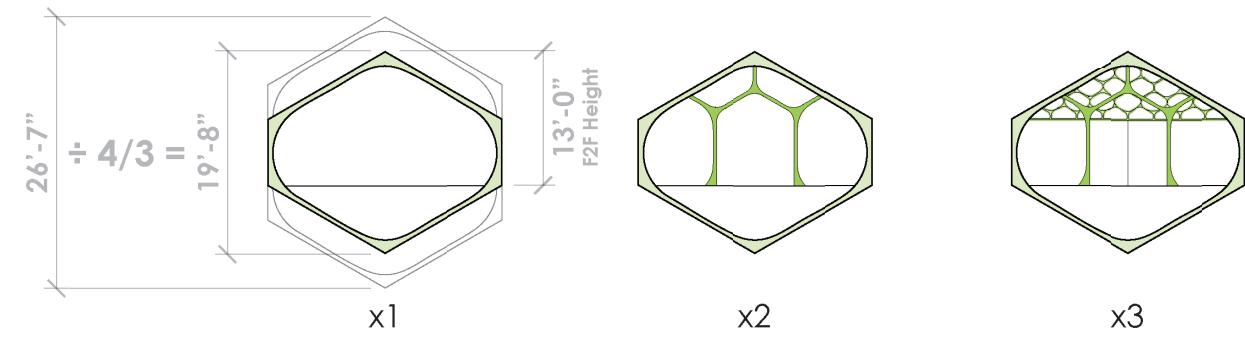


Figure 6.04 Diagram of [P3] Formulate Biomorphic and Fractal Forms (Pearce 10).

[P4] Incorporate Vegetation and Biophilic Materials

[4a] Integrate Vertical and Horizontal Vegetated Systems

[4b] Preference Natural Materials for Cladding and Structure

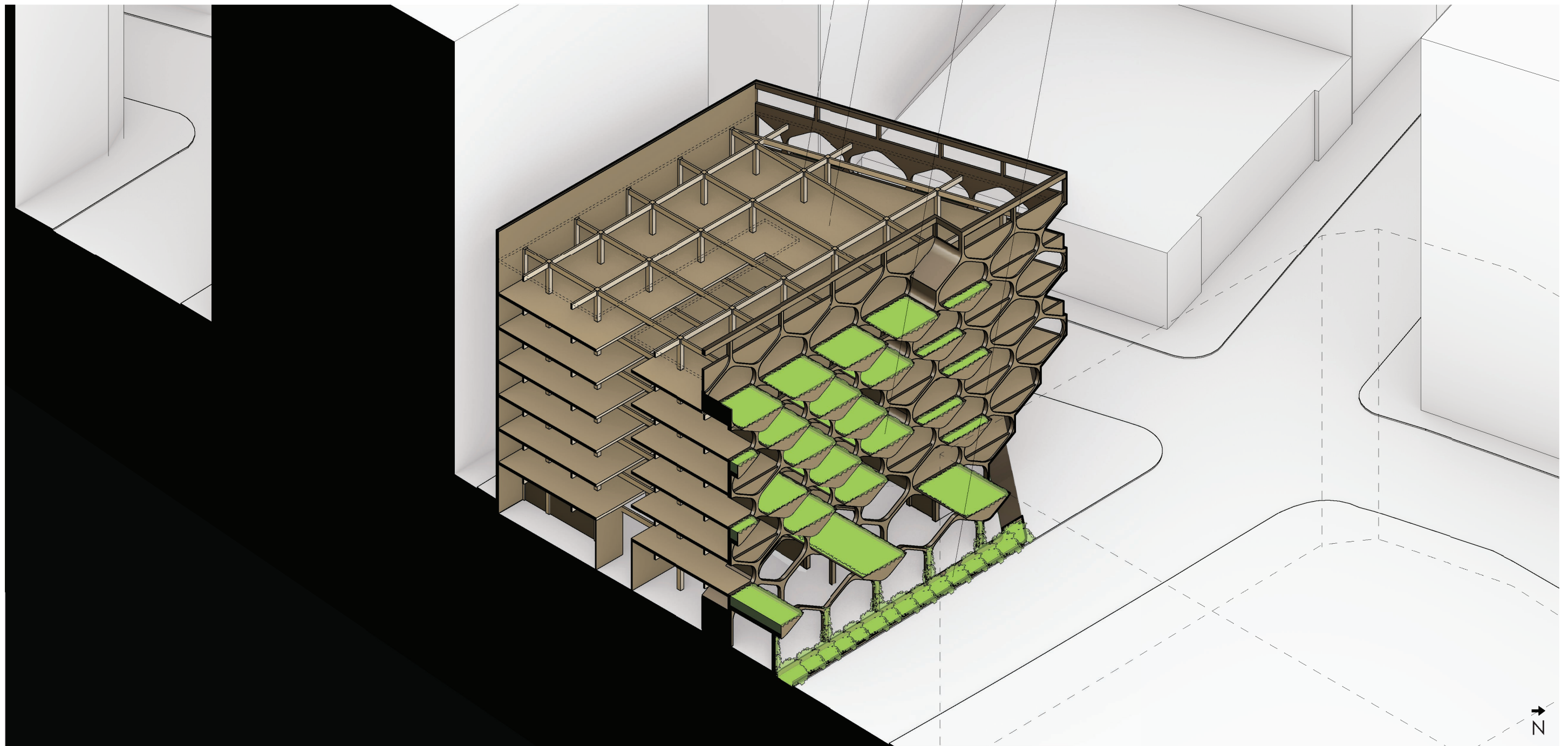


Figure 6.05 Diagram of [P4] Incorporate Vegetation and Biophilic Materials.

[P5] Deepen the Threshold

[5a] Carve Out Public Pockets where Beneficial

[5b] Extend the Architectural Experience Beyond the Facade

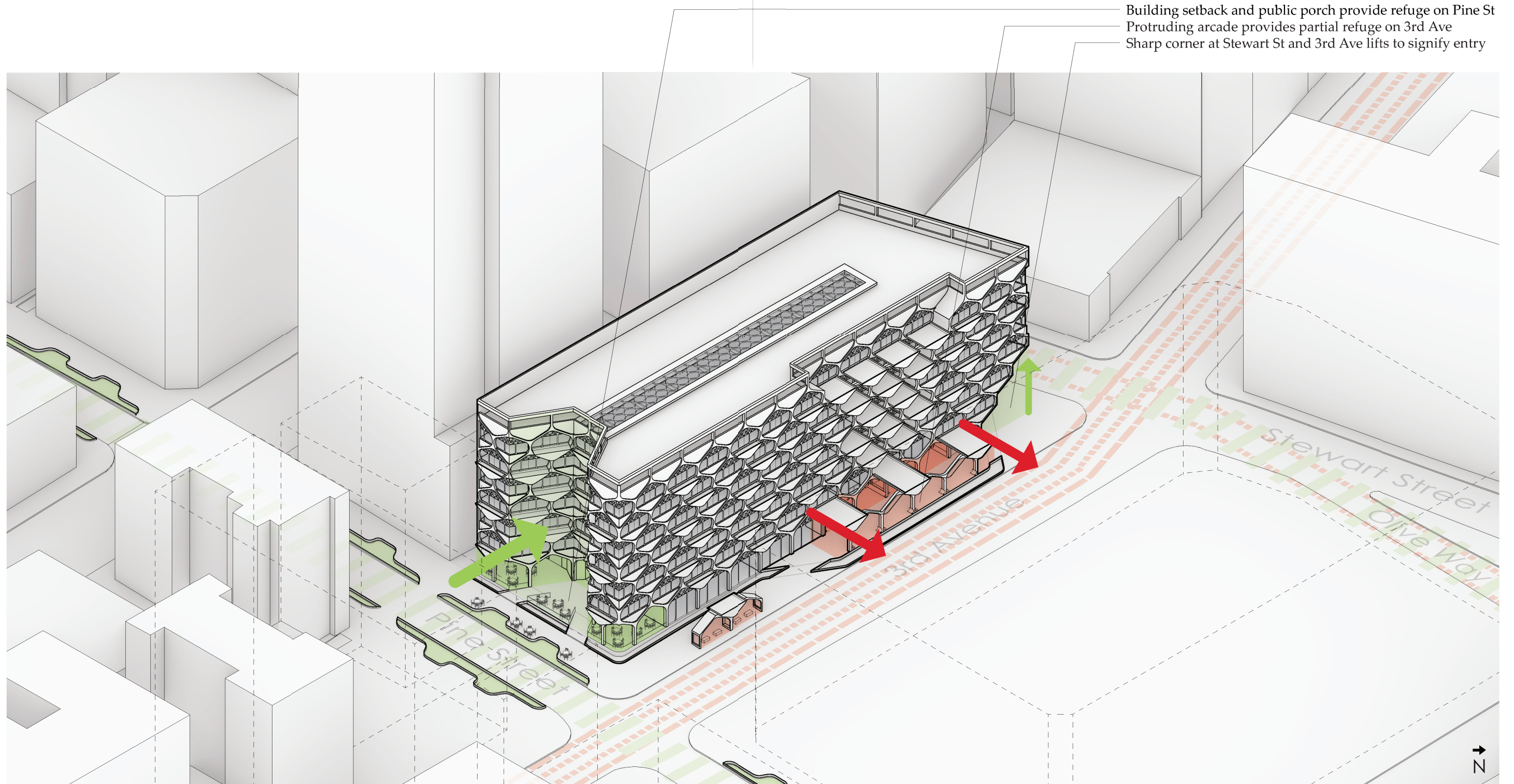


Figure 6.06 Diagram of [P5] Deepen the Threshold.

[P6] Recreate the Forest Edge

[6a] Provide Prospect-Refuge Transition Space

[6b] Emphasize Vertical Elements

[P7] Perforate the Envelope

[7a] Engage Passersby through Porosity and Transparency

[7b] Reward Entry and Interaction



Figure 6.07 View of the Third Avenue pedestrian experience demonstrating the Forest Edge concept.

[P6] Recreate the Forest Edge

[6a] Provide Prospect-Refuge Transition Space

[6b] Emphasize Vertical Elements

[P7] Perforate the Envelope

[7a] Engage Passersby through Porosity and Transparency

[7b] Reward Entry and Interaction



Figure 6.08 View of the Pine Street pedestrian experience demonstrating the Forest Edge concept.



Figure 6.09 Section at Third Avenue demonstrating the dynamism of the facade's depth.



Figure 6.10 View from Third Avenue and Pine Street demonstrating the fractal facade and massing.

Seattle Green Factor

A critical step in justifying the feasibility and value in implementing The 7 Principles of Biophilic Urbanism is to address their associated economic and policy-related concerns. One existing method is to test the metrics of the integrated vegetation against Seattle’s current standards using the Seattle Green Factor. “Seattle Green Factor is a score-based code requirement that increases the amount of and improves the quality of landscaping in new development” (Seattle Green Factor). The project outcomes include improving the look and feel of a neighborhood, reducing stormwater runoff, cooling cities during heat waves, providing habitat for birds and beneficial insects, supporting adjacent businesses, and decreasing crime (Seattle Green Factor). The Seattle Green Factor provides a methodology for assigning environmental value to an architectural intervention and its integrated landscaping.

The proposed intervention scores high on the Green Factor score sheet (shown in Figure 5.01). The minimum requirement for a downtown commercial site is 0.30, while in lowrise residential zones it can be as high as 0.60. Strategic allocation of vegetation is critical in downtown zones to exceed the minimum score, where applicable. The proposed intervention exceeds even the minimum factor for lowrise residential zones, where there is typically more land available for landscaping. This demonstrates that through strategic design, urban areas can boast as much or more greenery as the city’s current standards for lowrise residential neighborhoods.

The Seattle Green Factor is a start in creating a policy that could leverage The 7 Principles of Biophilic Urbanism. The framework covers a similar set of environmental benefits to the 7 principles. The next step in furthering the economic feasibility of implementing the 7 principles is to consider ecosystem services alongside more demanding requirements of the Seattle Green Factor. For example, the amount of anticipated carbon sequestration, filtered runoff, and reduced urban heat island effect can be commodified and added to the metrics of the Green Factor score sheet. The Seattle Green Factor also fails to incorporate the psychological effects that natural elements have on building occupants and passersby. Psychological metrics, based on prior research, can add value to the score sheet in the form of psychological services. The inherent value of ecosystem and psychological services will rise as climate change worsens and more research surfaces around biophilic design, providing the economic leverage for implementing the 7 principles.

Landscape Elements**		Totals from GF worksheet	Factor	Total
A Landscaped areas (select one of the following for each area)				
1	Landscaped areas with a soil depth of less than 24"	0	0.1	-
2	Landscaped areas with a soil depth of 24" or greater	500	0.6	300.0
3	Bioretention facilities	3861	1.0	3,861.0
B Plantings (credit for plants in landscaped areas from Section A)				
1	Mulch, ground covers, or other plants less than 2' tall at maturity	0	0.1	-
2	Shrubs or perennials 2'+ at maturity - calculated at 12 sq ft per plant (typically planted no closer than 18" on center)	0	0.3	-
3	Tree canopy for "small trees" or equivalent (canopy spread 8' to 15') - calculated at 75 sq ft per tree	19	0.3	428
4	Tree canopy for "small/medium trees" or equivalent (canopy spread 16' to 20') - calculated at 150 sq ft per tree	8	0.3	360.0
5	Tree canopy for "medium/large trees" or equivalent (canopy spread of 21' to 25') - calculated at 250 sq ft per tree	5	0.4	500.0
6	Tree canopy for "large trees" or equivalent (canopy spread of 26' to 30') - calculated at 350 sq ft per tree	2	0.4	280.0
7	Tree canopy for preservation of large existing trees with trunks 6"+ in diameter - calculated at 20 sq ft per inch diameter	0	0.8	-
C Green roofs				
1	Over at least 2" and less than 4" of growth medium	0	0.4	-
2	Over at least 4" of growth medium	27907	0.7	19,534.9
D Vegetated walls				
		100	0.7	70.0
E Approved water features				
		0	0.7	-
F Permeable paving				
1	Permeable paving over at least 6" and less than 24" of soil or gravel	0	0.2	-
2	Permeable paving over at least 24" of soil or gravel	0	0.5	-
G Structural soil systems				
		0	0.2	-
H Bonuses				
1	Drought-tolerant or native plant species	3861	0.1	386.1
2	Landscaped areas where at least 50% of annual irrigation needs are met through the use of harvested rainwater	0	0.2	-
3	Landscaping visible to passersby from adjacent public right of way or public open spaces	10,569	0.1	1,057
4	Landscaping in food cultivation	0	0.1	-
		sub-total of sq ft =		36,943
			Green Factor numerator =	26,776

* Do not count public rights-of-way in parcel size calculation.
 ** You may count landscape improvements in rights-of-way contiguous with the parcel. All landscaping on private and public property must comply with the Landscape Standards Director's Rule (DR 6-2009)

Figure 6.11 Estimate of the proposal’s Seattle Green Factor score. Note that improvements to the right of way are included. A score of 0.30 is needed to pass (Seattle Green factor).

VII. Conclusion

As western cities continue to densify, an increasing number of commuters will have the choice of traveling publicly on foot coupled with transit or driving personal vehicles. If cities act now to bolster their streets, dividends will be paid in the improved health and well-being of the general public, as many commuters will be more inclined to walk. The 7 Principles of Biophilic Urbanism provide a new set of framework for designing the street and street edge to be integrated with one another and with the natural world, resulting in a more cohesive and restorative pedestrian experience.

If the pedestrian is prioritized in the public right of way, as with many ancient cities like Rome, citizens will have more incentive to live and commute in the urban core, encouraging a denser and more sustainably-structured city. Providing space for pedestrian amenities like trees and vegetation, micro retail, and seating reinforces the concept of a street as a room and destination, and not just a means to an end.

Exposing natural systems provides much benefit to the pedestrian and their surrounding environment. Nature operates in closed loop cycles that often minimize waste to provide balance and resiliency. Environmental cycles, like the hydrological cycle, should be exposed to the pedestrian to provide inspiration and a reminder on how the operation of the natural world is designed to sustain itself.

As much as the city has opportunity to integrate live elements of nature, it must be acknowledged that it is primarily a built environment, comprised of hard surfaces and refined materials. These built elements have the opportunity to evoke a sense of the natural world and produce contemplative and mentally restorative effects through the way they are formulated and designed. The use of fractals and proportioning of the golden mean are strategies that can be utilized by the designer in an effort to formulate more visually appealing, research-based aesthetics.

The street edge also has the opportunity to incorporate materials analogous to nature and support the presence of live nature in both vertical and horizontal vegetated systems. The more a facade design can resemble natural elements and bear their integration, the more likely the facade's aesthetic is to produce positive psychological responses.

The street and edge both provide opportunity for creating connections to elements that

resemble nature and live instances of nature and its systems. The threshold provides opportunity for creating connections between the street and edge, which are typically designed through the separate disciplines of Urban Design and Architecture, respectively. Through the lens of the threshold, designers can interpret a more meaningful and engaging transition between interior and exterior. Existing archetypes of arcades and porches already provide comfortable threshold transitions, but seldom do variations of these archetypes exist in the urban core.

The concept of the Forest Edge provides a new lens to reimagine the threshold condition. Stemming from prehistoric human needs of simultaneous prospect and refuge, the Forest Edge resembles the most comfortable exterior spatial condition. As the urban core continues to be redeveloped, buildings have the opportunity to integrate the Forest Edge at their entries and interfaces in an effort to foster dynamic moments along the pedestrian experience, while also softening the transition between interior and exterior.

Threshold interfaces and transparencies also play a critical role in better connecting architecture to the street. If a ground floor contains more transparency and openness, it begins to break down the barrier between interior and exterior and becomes more inviting to the observer. Strategic placement of glazed walls, entrances, and large openings like garage doors preferences circulation and visibility for the comfort of the pedestrian.

The framework proposed on biophilic urbanism is nothing strikingly new; The 7 Principles of Biophilic Urbanism is a hybridization of walkability and biophilic design that proposes new priorities in how one should design for a healthier and more sustainable urban environment. The integration of natural elements and elements analogous to nature brings to light the innate connection between humans and the natural world. Efforts to improve walkability through these measures aim to reevaluate current urban environments and how they can better incentivize pedestrian activity. Pedestrian health and well-being is integral to the success of any urban space. As designers continue to write urban form, careful consideration of the natural world and the pedestrian experience can result in spaces that foster psychological restoration and reconnection to nature's systems and beauty, ultimately inspiring a more sustainably-minded city.

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