School of Collectively Building
Proceedings Series 01.2

Climate, Cities, and Cultures

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INTRODUCTION

Climate, Cities, and Cultures

In today's fast-paced and rapidly growing world, have we forgotten quality over quantity? Is this the way progress should happen? Are we learning from history or overlooking its lessons? Are old cities truly great, and are new cities good? Have we neglected culture and traditions in the pursuit of future development? These questions and many more – need to be discussed and explored collectively.

At SOCB, we invite interdisciplinary and international universities, organizations, companies, design studios, and research institutes to participate in the Climate, Culture, and Cities International Conferences in Austria.

This conference aims to bring together professors, research scholars, and professionals from the design and construction industries to share knowledge and ideas. The goal is to empower one another through a collective approach that benefits our environment, communities, climate, culture, and cities. Additionally, the conference seeks to bridge academia, research institutions, and practicing organizations to create sustainable cities and preserve culture and climate for the future. We believe every effort should be meaningful, shared, and explored across various disciplines.

This conference serves as a platform to bring together voices from the past, present, and future. It invites discussions on how history, art, heritage, culture, craft, architecture, construction, and technology shape education, research, design, and construction practices while addressing the themes of climate, culture, and cities.

EDITORIAL NOTES

The opening chapters of this proceeding establish an important intellectual foundation for the discussions that follow, exploring the intricate relationship between cities, nature, and culture in an era of unprecedented global transformation. While each contribution approaches the subject from a distinct perspective, together they reveal a common understanding that sustainable futures cannot be achieved through technological advancement alone. Rather, they emerge from a careful balance between innovation and identity, between environmental responsibility and human experience, and between the complexity of contemporary urban life and the enduring values that have shaped settlements throughout history.

One of the central ideas that connects these contributions is the evolving nature of urban identity. Cities today are no longer defined solely by their physical boundaries or architectural landmarks but by complex networks of digital technologies, social interactions, economic systems, and cultural exchanges. As globalization and digitalization continue to redefine how people inhabit and experience urban environments, questions surrounding the meaning of place and belonging become increasingly significant. The research presented encourages readers to reconsider what constitutes the essence of a city and how urban identity can remain authentic while adapting to rapidly changing social and technological realities. Alongside this reflection on cities, the proceedings emphasize the enduring wisdom of nature as a source of design intelligence. Rather than treating sustainability as a collection of technical solutions, the contributions demonstrate that natural systems offer principles capable of informing more holistic and resilient approaches to architecture. Bio-inspired strategies illustrate how environmental performance, human well-being, and ecological responsibility can coexist within the design process. The relationship between daylight, space, and the natural environment is presented not simply as a matter of efficiency but as an opportunity to create healthier, more engaging, and more meaningful places for people to inhabit.

The importance of cultural and environmental context also emerges as a defining theme. Architecture is portrayed as more than the construction of buildings; it is an expression of memory, landscape, and collective identity. The dialogue between built form and natural setting reveals how places acquire meaning through their connection to local histories, ecological conditions, and sensory experiences. Such perspectives remind us that successful architecture resonates with its surroundings, allowing contemporary interventions to strengthen rather than diminish the cultural narratives embedded within a place.

Collectively, this proceeding chapters demonstrate that the challenges facing cities today are interconnected and cannot be addressed through isolated disciplines or singular solutions. Climate change, urban expansion, technological transformation, and cultural preservation require collaborative approaches that integrate research, design, environmental science, and social understanding. The diversity of ideas presented reflects the value of interdisciplinary scholarship and highlights the importance of bringing together different perspectives to address shared global concerns.

Ultimately, these opening contributions set the tone for the proceeding by presenting sustainability as a dynamic and evolving process rather than a fixed objective. They argue that the future of cities depends upon the ability to rethink established assumptions, learn from both natural systems and cultural traditions, and embrace innovation without losing sight of identity and place. In doing so, they invite readers to view architecture and urbanism not merely as technical professions but as cultural practices that shape the quality of human life and the resilience of communities for generations to come.

CITINESS OF LAGOS, RETHINKING URBAN IDENTITY IN THE AGE OF DIGITAL COMPLEXITY.

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INTRODUCTION

Conceptual Foundation, from Analytic to Synthetic

Traditional urban analysis fragments the city into objects: buildings, roads, metrics, and zones. synthetic computation, by contrast, listens to relations the moods, contradictions, and resonances that make a city alive. In this paradigm, AI is not a calculator but a listener, attending to the polyphonic urban voice. It listens to data, noise, and narrative as equally significant.

We ask:

- What does Lagos say when all its voices are allowed to speak at once?
- How does the city feel when read as a continuous conversation between people, images, and code?

This approach transforms urban study from representation to relation, from zoning to resonance.
Here, Lagos becomes not an object of planning, but a medium of listening, a living syntax of affect, rhythm, and improvisation.

Noise is not only something we suffer; it is what makes communication possible. Michel Serres, Genesis (1995)

1.1 The Lagosness of Lagos: Probabilistic Citiness

Lagosness is the emotional topology of the city, its probabilistic structure of meanings, contradictions, and moods. Where the European city represents civitas and order, Lagos manifests stochastic coexistence, a city that continuously composes itself through improvisation and feedback. Each image, tweet, and story are a probability node in the collective system of Lagosness. Across all clusters, Lagos behaves not as a deterministic design but as a probabilistic field, a computation of chaos that stabilizes through rhythm. In this sense, Lagos is both dataset and dreamscape: an urban neural network where form and feeling are algorithmically entangled.

Synthetic Urban Experiment, Listening to Four Lagos Districts

To demonstrate this epistemology, we selected four urban ecologies, two informal and two formal.

TYPOLOGY	AREA	DESCRIPTION
INFORMAL	Makoko	Amphibious slum, floating homes, fluid socio-spatial identity
INFORMAL	Ajegunle	Hyper-dense, economically improvisational, linguistic diversity
FORMAL	Lekki	Planned expansion zone, infrastructure-driven modernity
FORMAL	Ikeja	Administrative and commercial hub, digital and corporate core

Table 1: Location description.

Each area's digital traces tweets, images, and posts were collected over 6 years period. These datasets were then processed through a multimodal AI pipeline, integrating.

- Sentiment analysis (BERT & Wolfram Classify models)
- Image clustering (CNN + OpenCLIP embeddings)
- Geo-spatial mood mapping (kernel density estimation & sentiment-weighted heatmaps)
- Text vectorization (Word2Vec and t-SNE projections)

Each stage of the pipeline corresponds to a philosophical operation.

COMPUTATIONAL STEP	PHILOSOPHICAL INTERPRETATION
DATA COLLECTION	Listening to digital traces, the voices of the city
SENTIMENT CLASSIFICATION	Quantifying affect, Lagos as emotional field
TEXT EMBEDDING	Mapping meaning, the grammar of Lagos speech
IMAGE EMBEDDING	Seeing mood, visual phenomenology of the city
MULTIMODAL FUSION	Synthetic listening, merging sensory dimensions
KERNEL DENSITY MAPPING	Emotional topology, probabilistic mood space
VISUALIZATION	Computational collage, Lagosness as affective data structure

Table 2: Computational steps and interpretations.

STEP-BY-STEP EXPERIMENTAL PIPELINE: LISTENING TO LAGOS THROUGH COMPUTATION

This experiment transforms Lagos from a geographical subject into a computational dialogue.
Each step links data and philosophy, what computation performs, and the city interprets.

Step 1: Import and Process Urban Image Data. Text Processing and Sentiment Analysis. Text corpora for each zone were cleaned to remove URLs, numbers, and usernames, then tokenized and processed using BERT-based sentiment classification. Sentiment was classified as positive, neutral, or negative, with manual validation on a 500-tweet sample showing 78% agreement for standard English. We acknowledge known weaknesses for Nigerian Pidgin and culturally embedded expressions (e.g., "wahala," "no wahala"), treating outputs as probabilistic indicators requiring interpretive caution.

Step 2: Image Clustering. Approximately 12,000 geotagged photographs were standardized to 224×224 pixels and analyzed using a pre-trained CNN (ResNet-50) to extract feature vectors. K-means clustering (k=5, determined through elbow method) identified recurring visual archetypes within each zone. These clusters function as probability distributions of visual attention what inhabitants and visitors look at and share when representing place.

Step 3: Multimodal Integration. Text and image embeddings were projected into shared latent space using OpenCLIP, enabling cross-modal similarity measurement. Alignment scores reveal coherence between narrative and visual expression across zones, indicating where what people say matches what they show.

Step 4: Geospatial Mood Mapping**.** Kernel density estimation with sentiment weighting generated mood topology maps, revealing emotional geography beyond administrative boundaries. This transforms emotion from subjective experience to mappable spatial phenomenon.

2.4 The Citiness Index

The Citiness Index (CI) quantifies what probabilistic synthesis reveals, providing a comparative measure of how urban emotional complexity registers in digital traces:

Component	Definition	Measurement	What It Reveals
Emotional Diversity (ED)	Complexity of affective terrain	Shannon entropy of sentiment distribution	Morphological complexity; coexistence of multiple spatial conditions
Narrative-Material Resonance (NMR)	Coherence between visual and linguistic attention	Correlation between dominant archetypes and associated sentiment	Spatial legibility; alignment between form and experience
Spatial Embeddedness (SE)	Intensity of digital attention	Density of geotagged data normalized by population estimate	Public salience: how intensely a zone registers in digital sphere

Table 2: Computational steps and interpretations.

CI = f (ED, NMR, SE) where the function is a normalized, weighted sum for cross-zone comparison. The index does not rank zones hierarchically but provides a comparative reading of how urban emotional complexity registers in digital traces.

Expected Outcome. The Listening City

The result is not an analytical model but a synthetic ear, an AI that listens. From thousands of images and tweets, Lagos is reconstituted as a living computation of emotion, contradiction, and rhythm.
We begin to see emotion and measure atmosphere to experience the city as a distributed consciousness, constantly recalculating itself through its people.

Through this pipeline, the city is treated not as an object of planning, but as a living computation a probabilistic ensemble of digital, social, and architectural noise. Experiment pipeline performs computational ethnography through multimodal AI. It listens to the rhythm of Lagos across three dimensions.

Methodological Limitations

Three methodological constraints require explicit acknowledgment. First, clustering thresholds (k=5) and sentiment weighting parameters influence outcomes; sensitivity analysis suggests stability within ±8% variation. Second, digital divide means informal settlements are systematically underrepresented, their actual emotional complexity would likely be higher with equitable data. Third, pre-trained models (BERT, CLIP) encode Western linguistic and visual biases, creating interpretive distortion for Nigerian contexts. These limitations bound our epistemological claims: findings represent the digitally mediated urban layer, not the city in totality.

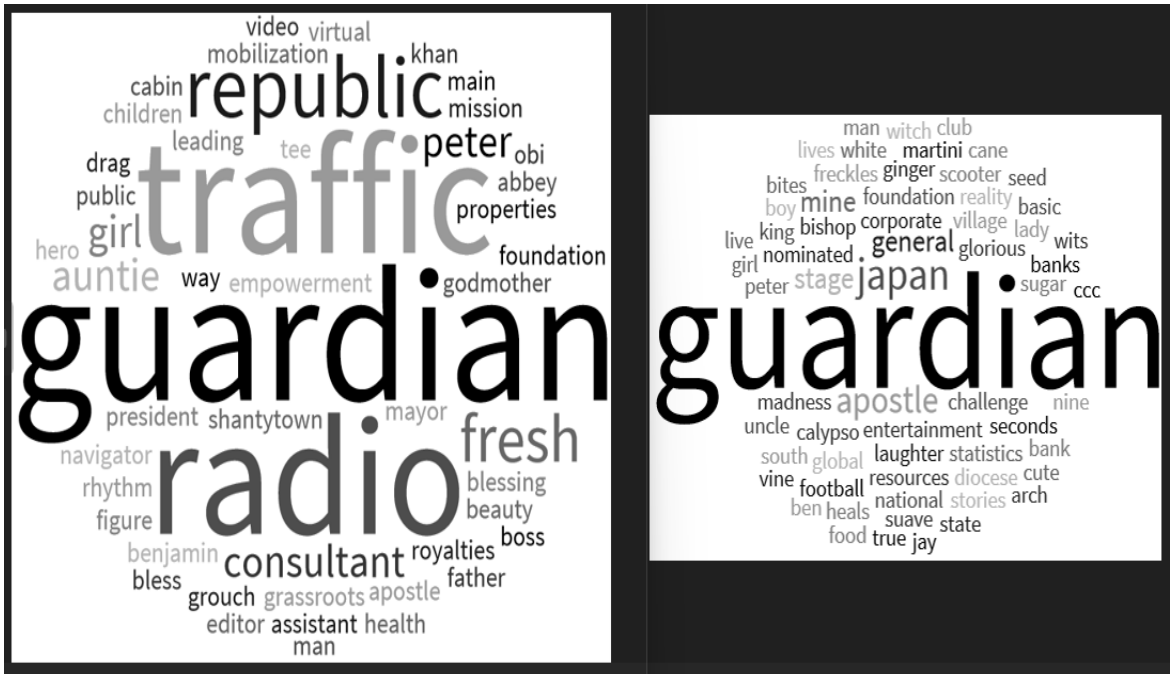

Figure 1. The results were obtained by clustering text data crawled from X using the hashtags #Ajegunl and #Makoko.

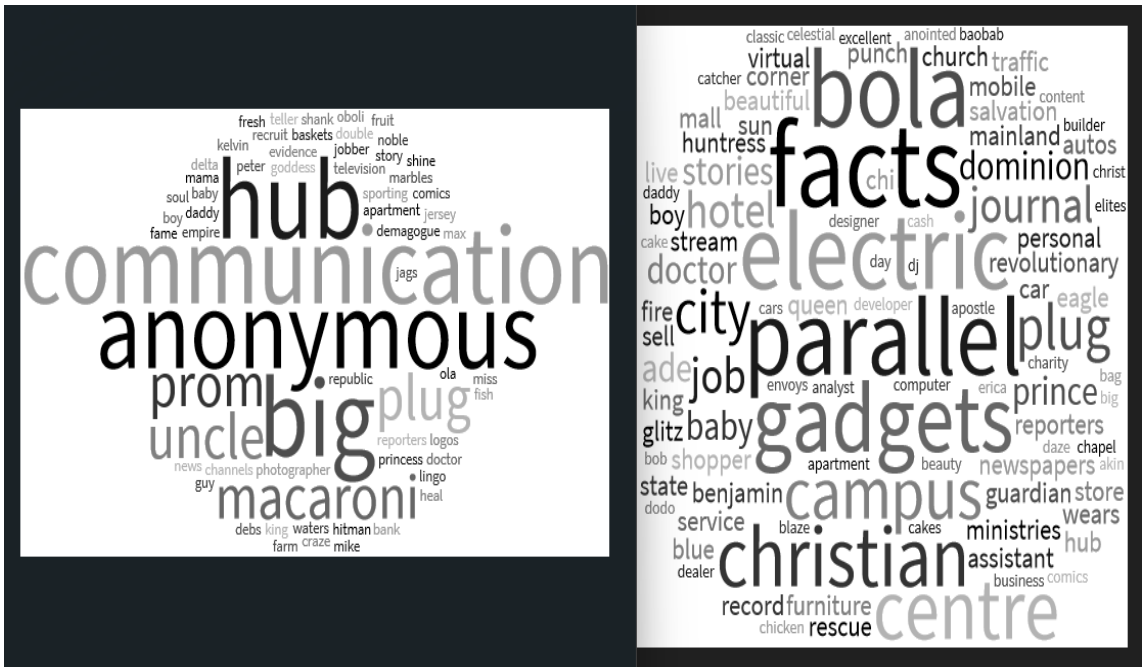

Figure 2. The results were obtained by clustering text data crawled from X using the hashtags #Lekki and #Ikeja.

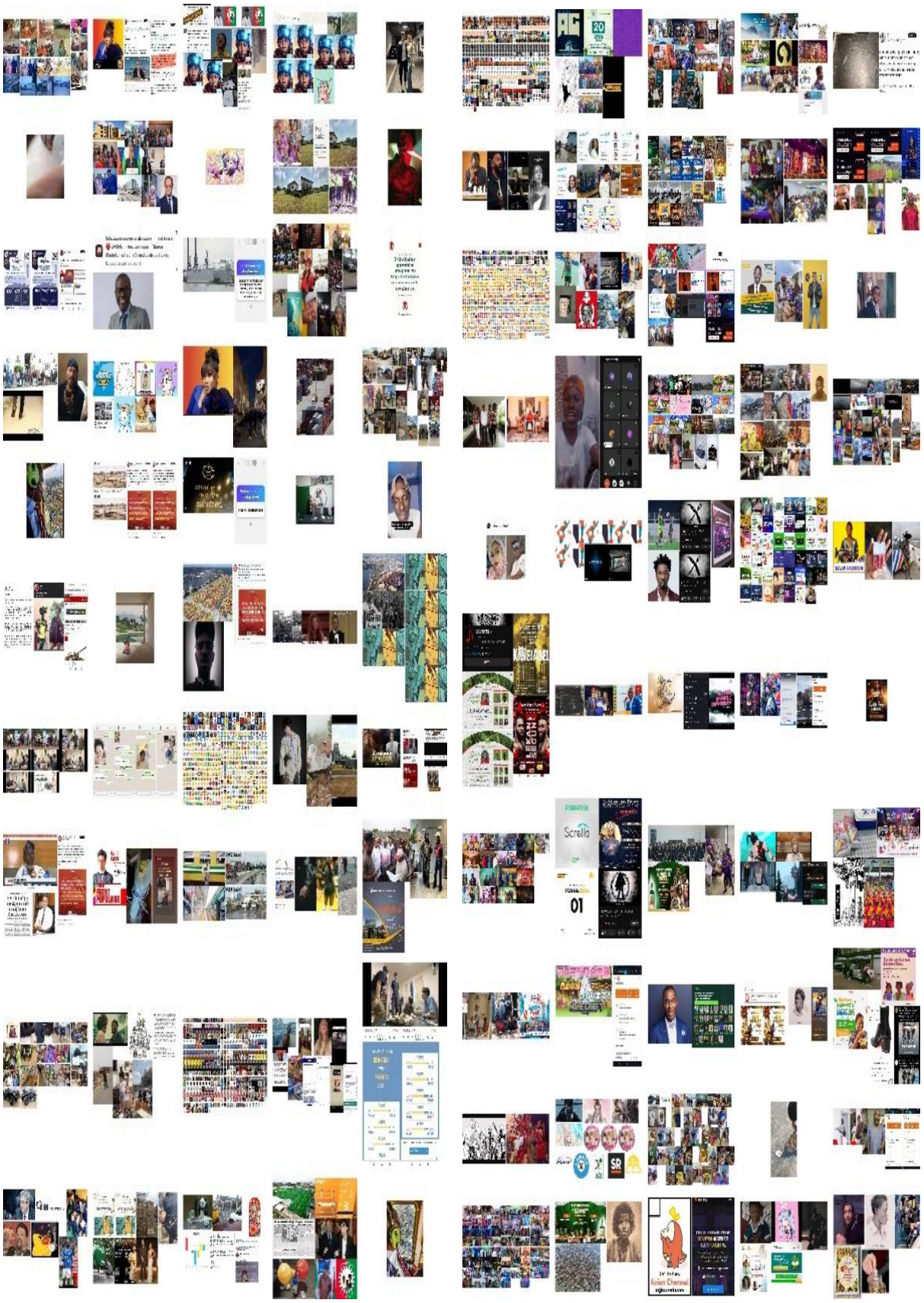

Figure 3. The results were obtained by clustering text data crawled from X using the hashtags #Ajegunl and #Makoko.

Figure 4. The results were obtained by clustering text data crawled from X using the hashtags #Lekki and #Ikeja.

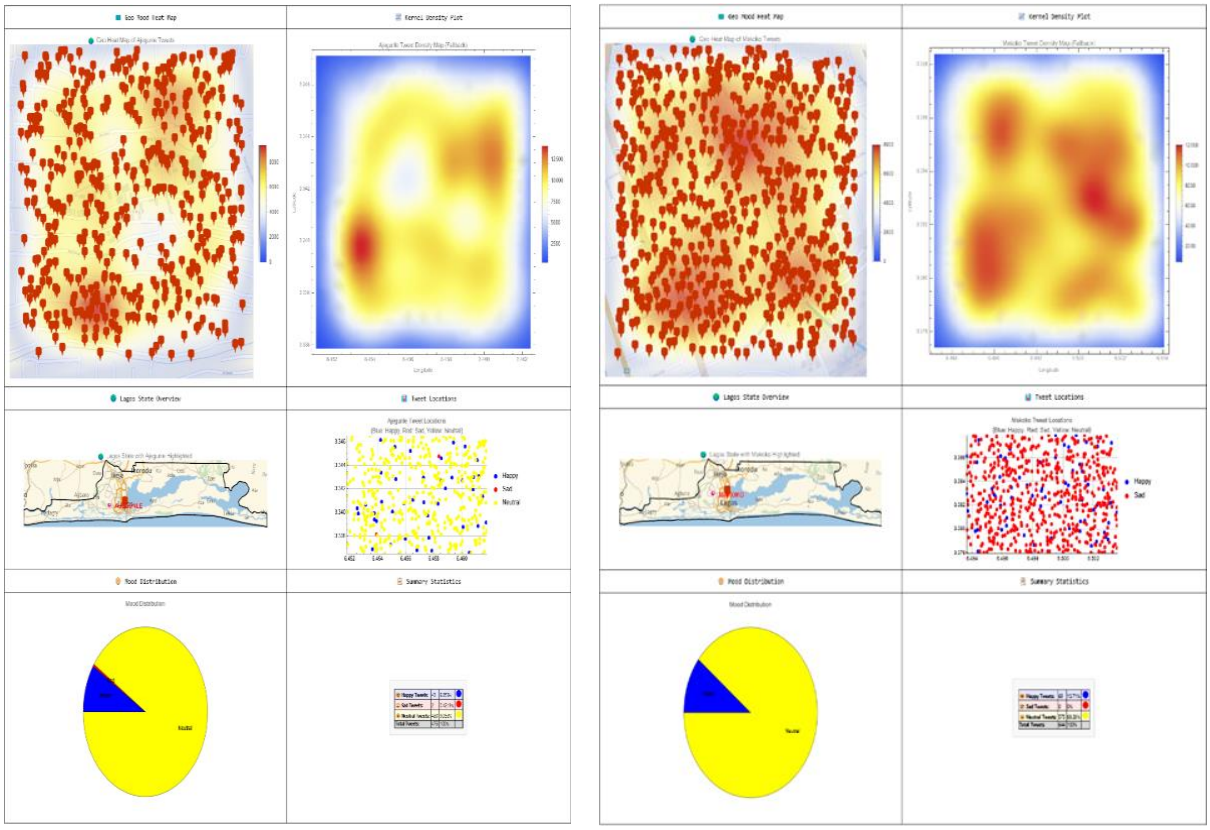

Figure 5. Ajegunle mood density - Experiment Analysis, and Makoko mood density - Experiment Analysis. Based on text and image data crawled from X (formerly Twitter).

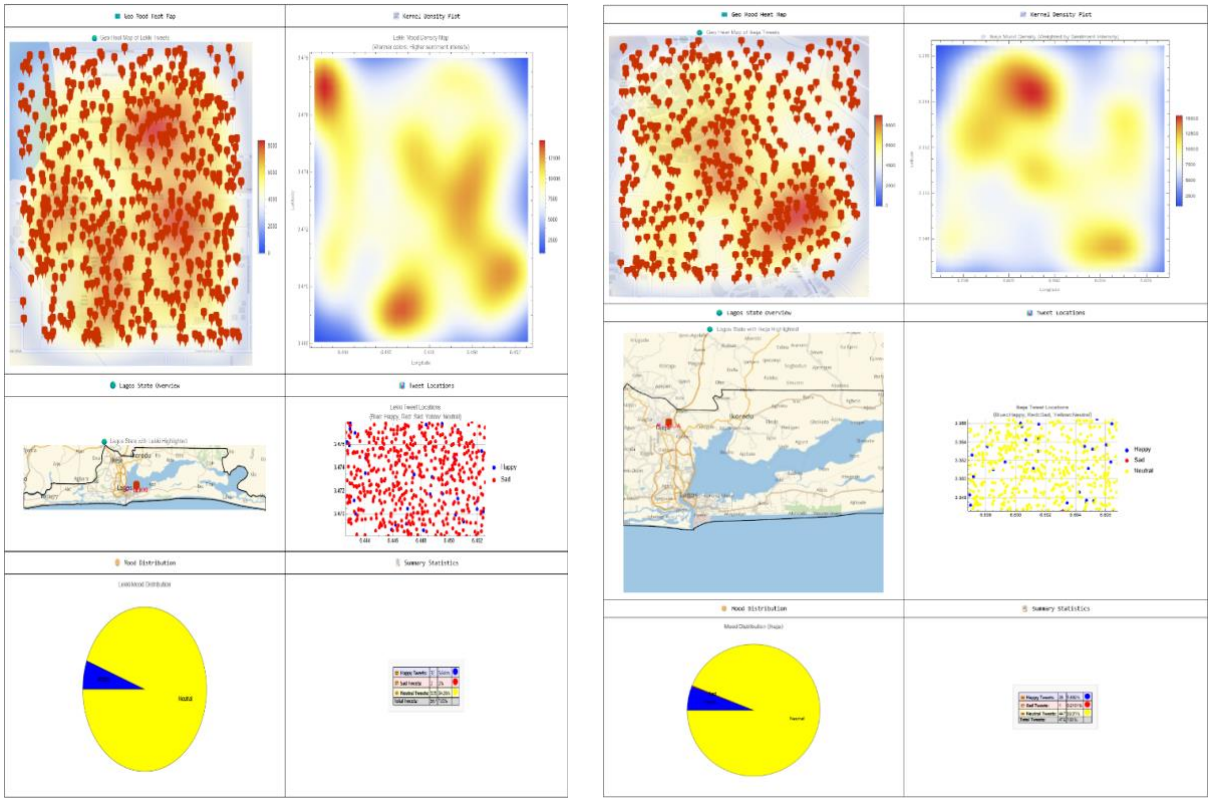

Figure 6. Lekki mood density - Experiment Analysis and Ikeja mood density - Experiment Analysis. Based on text and image data crawled from X (formerly Twitter).

Findings, From Data to Resonance

MODALITY	CAPTURES	ANALYTICAL LAYER
TEXT	Emotion, narrative, slang	Sentiment + Semantic Clustering
IMAGE	Atmosphere, pattern, material	Visual Clustering
GEO	Place, proximity, density	Mood Topology

Table 3: Difference between Text, Image and geo location.

Together, they form a synthetic listener, an algorithmic urban ear attuned to the probabilistic language of Lagos. The goal was not to analyze Lagos, but to listen to it, to detect the emotional and relational currents that define its citiness.

Findings, From Data to Resonance

(a) Ikeja (Formal Lagos).
In Ikeja, tweets displayed positive sentiment peaks around airports, cafés, and malls, expressing pride and efficiency.
The mood density plot revealed clusters of happiness around digital infrastructures and emergent emotional zone of techno-optimism.
Word clouds emphasized work, network, light, and traffic an urban mood of controlled chaos.

(b) Lekki.
Lekki exhibited dual emotionality, optimism around urban luxury and frustration around traffic and flooding.
Tweets oscillated between hope and irony, showing a digitally literate but infrastructurally weary citizenry.

(c) Makoko (Informal).
In Makoko, tweets and images leaned toward neutral or negative sentiment, though rich in affective language words like water, home, resilience, life.
Images of floating houses and communal life reflected poetic realism, turning precarity into performance.
Makoko's citiness is improvisational: architecture as adaptation, not ambition.

(d) Ajegunle.
Ajegunle radiated joyful entropy, a linguistic ecosystem of Pidgin, humor, music, and faith.
Despite economic strain, its sentiment maps were colored blue (positive), correlating with collective resilience.

This zone exhibited digital orality, where memes and slogans replaced formal narratives emotional urbanism through voice and laughter.

Discussion, Lagos as a Synthetic Urban System
Lagos, across all its districts, reveals itself as a probabilistic structure of feeling, a city of emotional computation.

Dimension	Analytic Urbanism	Synthetic Urbanism (Lagos)
Model	Top-down, metric	Bottom-up, relational
Data Function	Measurement	Listening
Architecture	Infrastructure	Atmosphere
Plan	Grid	Pulse
Urban Theory	Deterministic	Probabilistic
City Definition	Designed	Performed

Table 4: Difference between analytic and synthetic urbanism.

Through computation, we no longer seek the average Lagos, but the distribution of Lagosness, the probabilistic field where meanings arise, overlap, and contradict.

This synthetic method reframes data as dialogue:

- A road is not infrastructure it is a storyline.
- A market is not a function it is a social algorithm.
- A flood is not failure, it is feedback.

Toward a Probabilistic Theory of Urban Listening. Lagos invites us to replace planning with listening, and form with feedback. Architecture becomes computation, computation becomes empathy. Through probabilistic synthesis:

- The AI acts as an interpreter of emotion, not an enforcer of order.
- Urban design evolves into synthetic cartography mapping feelings, not zones.
- The city becomes its own observer, self-describing through data.

Lagos as a Living Algorithm

Each tweet is a probability vector, each image a sensory node, each sentiment a frequency in the larger wave of Lagosness. In this living field, what we call noise, is actually the city, thinking.

Conclusion, The City That Listens Back.
Lagos teaches us that citiness is not engineered, it emerges. Its apparent chaos is a grammar of coexistence, a signal encoded in urban noise. By fusing architecture, code, and narrative, Lagos becomes a computational ecology of emotion and improvisation a prototype for a new kind of city-making, not predictive, but probabilistic, not representational, but synthetic. Lagos is not a plan.
Lagos is a pulse. Lagos is the algorithm of its people.

STRENGTHS & WEAKNESSES OF THE DATA-DRIVEN APPROACH

Strengths	Weaknesses
Captures real time sentiment and spatial emotion	Digital divide may exclude non literate or offline populations
Multimodal (text-image) AI uncovers emergent patterns	Sentiment classifiers may misinterpret cultural nuances
Challenges rigid masterplans with adaptive models	Needs local ground-truthing to ensure accuracy

Table 5: Strengths and weaknesses.

Strengths:

1. Multimodal Integration.
   By combining text, image, and geospatial data, this framework transcends single discipline analysis.
   It merges architectural observation, social emotion, and digital behavior, revealing how the city feels as well as how it functions.
2. Probabilistic Insight, Not Deterministic Output.
   Instead of seeking exact predictions, the model captures tendencies, fluctuations, and contradiction qualities intrinsic to Lagos's organic evolution.
   It represents a shift from linear cause and effect models to fields of urban possibility.
3. Synthetic Listening as Method.
   Unlike conventional analytics that isolate noise as error, this process treats noise as information.
   In Michel Serres's sense, the parasite (the interference) becomes part of the message Lagos's chaos is not subtracted, it is interpreted.
4. Visual Transparency and Public Communication.
   Through word clouds, mood maps, and density plots, the city's hidden emotional structure becomes visible and communicable to planners, architects, and citizens.
   This democratizes data, everyone can see how the city feels.
5. Cultural Calibration.
   The model respects informality as intelligence recognizing Makoko's improvisation as design, Ajegunle's humor as resilience, and Lekki's frustration as aspiration.
   It decentralizes Eurocentric planning epistemologies by listening to African urban rhythms on their own terms.

Weaknesses:

1. Bias in Digital Representation.
   Social media data privileges those with internet access. Informal settlements often appear underrepresented, creating a skewed emotional geography favoring digitally connected elites.
2. Language and Contextual Ambiguity.
   AI sentiment models trained on Western English can misread Nigerian Pidgin, sarcasm, or culturally embedded expressions (e.g., wahala, no wahala, God abeg).
   This introduces interpretive distortion within emotional classification.

3. Temporal Volatility.
   Emotions are transient. Data from one month may differ drastically the next, meaning the mood of Lagos is ephemeral, not absolute. The city's emotional map is alive but also unstable.
4. Aesthetic over Empirical Precision.
   The computational visualizations privilege poetic pattern over strict statistical validation.
   While this supports interpretive depth, it limits reproducibility in conventional scientific terms.
5. Ethical Concerns.
   Aggregating personal posts, even anonymized, raises issues of consent and surveillance the same technologies that can listen may also watch.

LIMITATIONS

1. Incomplete Data Ecosystem.
   Lagos's informal digital ecosystems (WhatsApp, offline networks, market radios) remain largely inaccessible to text-mining methods. Hence, this project listens only to the digitally audible city, not the full spectrum of its communication.
2. AI as Interpreter, Not Oracle.
   The system can approximate mood but cannot feel it. It interprets signals statistically not experientially. This underscores the gap between data emotion and lived emotion.
3. Non-linearity of Urban Time.
   Computational models assume continuity. Lagos, however, thrives on discontinuity, blackouts, floods, spontaneous markets.
   The data fails to fully capture event-based rupture, a key component of Lagos's identity.
4. Dependence on Pre-trained Models.
   Models like BERT and CLIP are trained on global datasets, not Lagos specific corpora.
   Hence, there remains a semantic dissonance Lagos speaks with an accent the AI does not yet understand.

ARCHITECTURAL IMPLICATIONS & QUESTIONS

1. From Planning to Listening.
   Can urban design shift from prescriptive planning to probabilistic listening where architects act as interpreters of urban feeling rather than engineers of form?
2. Emotional Infrastructure.
   What if infrastructure were designed not only to move people but to stabilize emotion, for instance, by mapping where anxiety or joy densifies in public space?
3. Algorithmic Atmospheres.
   If buildings and roads can emit data, can architecture respond to the emotional temperature of its context?
   These points toward responsive design ecologies informed by real-time sentiment sensing.
4. Pedagogy of Noise.
   In architectural education, noise has long been treated as interference. What happens when we teach noise as material, not distraction, the raw matter of collective expression?
5. Ethics of Urban Listening.
   Who controls the algorithm that listens to the city?

The act of listening is never neutral, it implies selection, exclusion, and power.
Hence, computational urbanism must evolve an ethics of attention.

FURTHER RESEARCH

1. Developing a Lagos-Trained Language Model.
   Create an AI model trained on Nigerian linguistic corpora (Pidgin, Yoruba English hybrid) to interpret digital emotion with cultural accuracy.
2. Temporal Layering of Mood Maps.
   Evolve the static mood density plots into time-based simulations, revealing how the emotional topography of Lagos changes hourly, daily, and seasonally.
3. Integrating Sensorial Data Streams.
   Incorporate environmental sensors temperature, sound, and pollution to correlate atmospheric emotion with physical conditions.
4. Cross-City Comparison.
   Apply the Citiness framework to other African megacities (Nairobi, Accra, Johannesburg) to test its generalizability and contrast their emotional architectures.
5. Architectural Prototyping.
   Translate data findings into architectural interventions public installations, responsive façades, or sound-driven lighting systems that visualize the city's mood in real time.
6. Human-AI Collaboration.
   Develop tools that allow citizens, not just machines, to participate in emotional cartography crowdsourcing the feeling of the city through participatory interfaces.

SYNTHETIC CLOSURE

This framework positions Lagos as a living algorithm of emotion.
Its contradictions are not failures, they are feedback.
Through computation, Lagos ceases to be a city we describe; it becomes a city that describes itself.
To design for such a city is not to impose order but to compose resonance
to build not from plans, but from pulses.

Supplementaries & Revised Figures.

- Figure 1: Lagos Mood Density Plot, Heatmap of urban sentiments
- Figure 2: Fractal City Logic vs. Zoning Logic
- Figure 3: Urban Motif Frequency from Image Analysis (Makoko vs. Ikoyi)
- Appendix A: Code snippets for Word2Vec and ImageNet extraction

NOTES

[1] Michel Serres, Genesis, trans. Geneviève James and James Nielson (Ann Arbor: University of Michigan Press, 1995), 7.

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[3] Kim Dovey and Hesam Kamalipour, "Informal/formal morphologies," in The Routledge Handbook on Informal Urbanization, ed. Kim Dovey et al. (New York: Routledge, 2018), 45-58.

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[19] Tunde Onilude and Rita Vaz, "AI and Informal Urban Mapping in the Global South," Journal of Computational Urbanism 4, no. 2 (2021): 89-107.

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Olaniran, Taofeek, and Tunde Aule. "Systematic approach to informal settlements in sub-Sahara Africa." Cogent Social Sciences 11, no. 1 (2025): 2495660.

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Willis, Katherine, and Alessandro Aurigi. The Hackable City. London: Routledge, 2020.

Supplementary.
Appendix A: Tweeter crawler/ Bot. https://github.com/Frank-lab01/Python-Crawler-with-PyCharm-Selenium./tree/d11d3416bcb6bb2c50df600a5eac39cfa23eafa0/Twitter%20Crawler

Appendix B: Wolfram Mathematica data visualization codes. https://www.wolframcloud.com/obj/kezfrank01/Published/Citiness%20of%20Lagos%20Experiment%2022.nb

Then as alternative you can download the wolfram notebook from google drive link:
https://drive.google.com/file/d/1Q2B6csNe64bwRrnBN9VND8W-wKcA5h5l/view?usp=sharing

Appendix C: Lagos Mood Density Plot (2023-2024)
Appendix D: Ethnographic transcript samples

BIO-INSPIRED DAYLIGHTING DESIGN PROCESS AND TOOLS: Comparing Biophilic and Biomimetic Strategies

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INTRODUCTION

This paper explores strategies, methods, and outcomes from a bio-inspired design process that addressed potential daylighting interventions in an existing subterranean space with limited access to natural light. The paper discusses qualitative dimensions of the visual experience and quantitative metrics of visual comfort from a biophilic and biomimetic perspective. The exploration focuses on the room scale, but the potential benefits of bio-inspired design translate to the building, site, community, and urban scales. The paper compares assessments of strategies to improve illuminance levels and visual comfort, create a welcoming environment, and enhance connections to nature. The opportunities and limitations of the biophilic and biomimetic approaches are summarized to help designers and students enhance the luminous environment through daylighting design.

BIO-INSPIRED DESIGN METHODOLOGY

A six-step design process was used, based on the biomimetic structure developed by product designers Fayemi et al. (2017).[1] Figure 1 illustrates a simplified version of the six-step process and shows how this process was adapted for the daylighting design investigation.[2] This paper also discusses initial research with biologists to explore Steps 1-3 and define the daylighting design problem in terms of biological models. The paper then compares opportunities of biophilic and biomimetic daylight strategies in Steps 4-6.

Design strategies were developed using Rhinoceros (Rhino) and Grasshopper programs.[3] Quantitative assessments of included seasonal and diurnal illuminance simulations and glare studies using Climate Studio and Grasshopper for parametric design developments. Qualitative assessments included iterative seasonal renderings using Enscape, and experiential virtual reality studies using Meta Quest Oculus with Enscape Virtual Reality (VR).[4]

Design Project, Site, and Context

Based on a previous collaboration with a team of biologists, the project explored design interventions to an existing subterranean community space in the Ecology Building at the University of Minnesota in St. Paul. The space has little natural light, as the building is oriented on a north-south axis with a multi-story building shading to the east and south. The community space is entered on the upper level, with site access limited to the west and north facades and to the roof. *Figure 2* illustrates the site and solar constraints and includes photos of the community space. Working with faculty and students from the Ecology Department, the community space was selected to test design interventions intended to improve poor quality lighting, overcome a lack of connection to the site, nature, and natural forces, and create a more welcoming atmosphere.

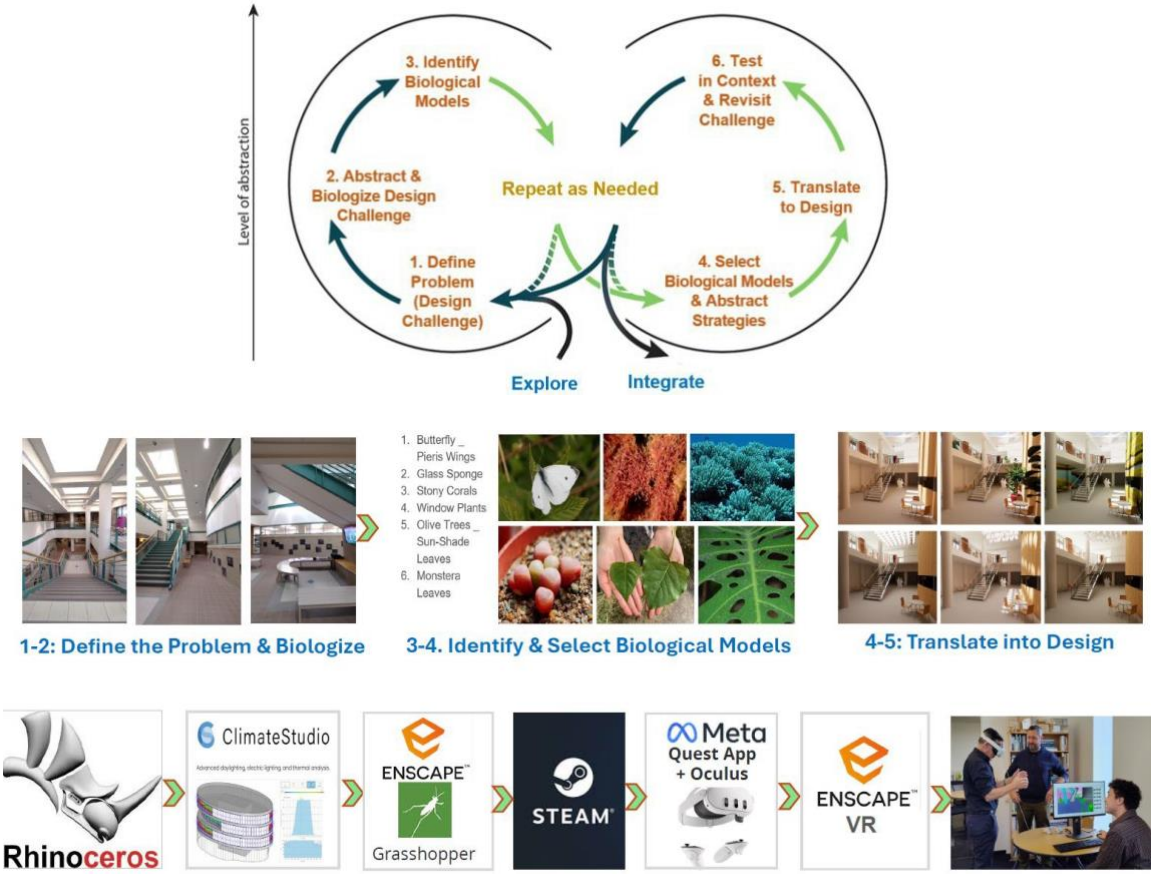

Figure 1: Top: Six-step bio-inspired design process. Adapted from Fayemi et al, (Snell-Rood et al., 2023). Bottom: Six-step bio-inspired design process for daylighting design; Diagram by Authors.

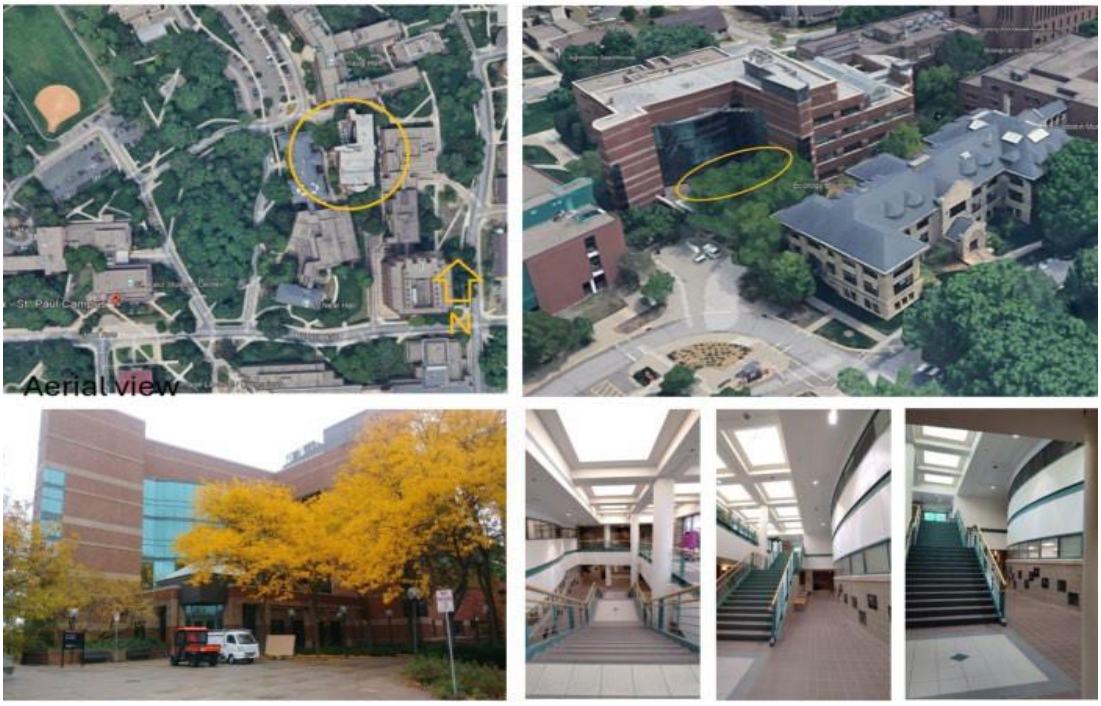

Figure 2: Top: Aerial view of site; Bottom: northwest entry, view to lower-level Top photo by Google Earth; bottom photos by Authors.

BIOPHILIC AND BIOMIMETIC PARAMETRIC DESIGN PROCESS

The team developed and evaluated a total of 90 design interventions in three phases, including:

1) Phase One: Modest interventions to the façade glazing, the skylights, the colours and values of surface materials, and adjustments to floor-to-ceiling height in the lower-level circulation corridor.

2) Phase Two: Moderate interventions to flooring and ceiling colours and materials, reducing the size of the stairs and adding transparent railings and stair risers, simplifying the form of the existing skylight to increase daylight, adding high performance clear glazing, and testing nature murals and plants.

3) Phase Three: Significant interventions to the skylights employing biophilic and biomimetic forms combined with select strategies from Phases One and Two.

Qualitative and Quantitative Daylight Assessment

The goals of the daylighting interventions included the following: 1) Create a welcoming and inviting atmosphere; 2) Increase seasonal and diurnal illuminance levels (achieving at a minimum Illuminating Engineering Category D: 200-3000-500 lux and a contrast ratio of less than 1:10 in the field of view);[5] 3) Improve visual comfort by addressing direct and reflected glare in the task areas; 4) Consider protection of materials and finishes by including solar controls and shading on windows and skylights, and 5) Improve the overall atmosphere and quality of the space.

Various qualitative and quantitative tools and metrics were used to compare parametric daylighting and virtual reality studies. Iterative parametric studies were developed to test seasonal and diurnal illuminance levels and assess the comfort of glare using Climate Studio, while Enscape was used to assess corresponding atmospheric qualities. Figure 3 illustrates example simulations for illuminance, glare, and qualities of space.

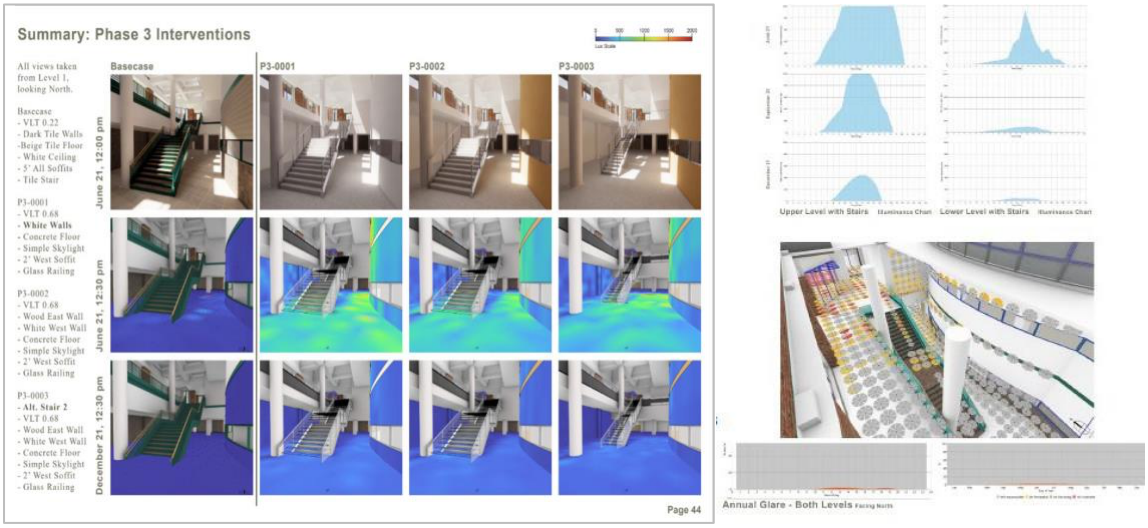

Figure 3: Left: Example illuminance studies with Climate Studio and renderings using Enscape; Right: Example glare study with Climate Studio, Renderings by Julie Oelkers.

Select Biophilic and Biomimetic Interventions

The following discussion will focus on two representative design interventions (one biophilic and one biomimetic) from Phase Three, comprising interventions P3-0013 and P3-0042. These two

interventions combine biophilic or biomimetic skylight designs with changes to glazing, materials, stairway size, the addition of glazed handrails and risers, and increased floor to ceiling heights in the lower-level circulation space. The biophilic strategy employs a series of organic undulating reflective surfaces beneath a combination of horizontal glazing and north-facing clerestories, while the biomimetic approach employs a grid of toplit skylights based on the form of the window plant. A detailed discussion of the design interventions is presented in the sections on Biophilic Design Strategies and Biomimetic Design Strategies.

BIOPHILIC DESIGN STRATEGIES

The concept of biophilia (love of life) was introduced by psychologist Eric Fromm in his 1973 book *The Anatomy of Human Destructiveness*: *"*Biophilia is the passionate love of life and of all that is alive; it is the wish to further growth, whether in a person, a plant, an idea, or a social group.*"*[6] Biologist and naturalist E.O. Wilson popularized the term in his seminal 1984 text *Biophilia: The Human Bond with Other Species*, which includes his "Biophilia Hypothesis." This hypothesis suggests that there is an "innate emotional affiliation of human beings to other living organisms."[7] Over the past several decades, a growing body of scientific research has demonstrated measurable physiological and psychological benefits of contact with nature, which can be achieved through design features such as gardens, views, daylight, materials, and nature imagery.[8]

In their book *Biophilic Design*, Kellert, Heerwagen, and Mador et al. (2008) establish a foundational theory, science, and proposed practice of biophilic design.[9] The consulting firm Terrapin Bright Green published a complementary resource entitled *Terrapin's 14 Patterns of Biophilic Design* (Browning, Ryan, and Clancy 2014).[10] A 15th Pattern, "Awe" was added to this list in 2020. Building on the earlier work of Kellert et al., Terrapin's patterns provide a conceptual framework, tangible goals, and biophilic strategies to implement across design issues and scales.

Table 1 summarizes biophilic design strategies that were studied using six Terrapin Patterns of Biophilic Design and identifies how the six patterns were translated into biophilic design strategies. Terrapin's patterns fall into three main categories: Nature in Space, Nature Analogues, and Nature of Space.

TERRAPIN'S Patterns 1, 6, 8, 9, 11, and 12 used for the Study		
Nature in Space Patterns	**Nature Analogue Patterns**	**Nature of Space Patterns**
1) Visual connection with nature: - Glazing: improved visible light transmittance and solar control - Glass handrails to enable views from the lower level. - Glass stair risers to provide views through and above the stair to surround space. - Skylight interventions to provide views of the sky and weather. 2) Non-visual connection with nature 3) Non-rhythmic sensory stimuli 4) Thermal & airflow variability 5) Presence of water 6) Dynamic & diffuse light: Skylight alterations to allow direct sunlight on a seasonal basis. 7) Connection with natural systems	8) Biomorphic forms & patterns: - Organic undulating skylight form to provide sky views. - Application of nature murals on the east and west walls on the lower level. 9) Material connection with nature: Material tests including wood, tiles, and glass. 10) Complexity & order	11) Prospect - Increased floor to ceiling height in lower-level circulation to optimize distribution of light and to create a more open and spacious atmosphere. - Glass stair risers and railings to optimize views. - Sizing the stair to provide more space on the lower level while meeting code requirements. 12) Refuge Preserving an intimate sheltered space on the north portion of the lower level. 13) Mystery 14) Risk/peril 15) Awe

Table 1. Terrapin's 15 Patterns of Biophilic Design (underlined text identify the strategies employed), Table by Authors.

Biophilic Design Interventions & Outcomes

The example biophilic daylight interventions illustrated in Figures 4-6 achieved targeted light levels by increasing the visible light transmission of the glazing, increasing the size of the skylight, adding clear skylight glazing, reducing the area of the stairway to allow more light to reach the floor area, adding glazed railings and stair risers, and increasing the surface reflectance through the colour of walls. Based on the illuminance studies, supplemental electric lighting would be needed in the winter mornings and afternoons, given the short winter days and low levels of exterior illumination in Minnesota at 45 degrees north latitude. The atmosphere and quality of the space were improved by adding warm-coloured wood materials on the east wall, organic forms to the skylight, more access to the skylight, additional physical space on the lower level, increasing views through the space and to the upper level with glass rails and stair risers, and opening the space by higher floor-to-ceilings in the lower level circulation corridor (see Table 1 summary of the biophilic strategies). Figure 4 includes illustrations of an exploded axonometric drawing with the biophilic strategies and the sectional attributes of the subterranean space.

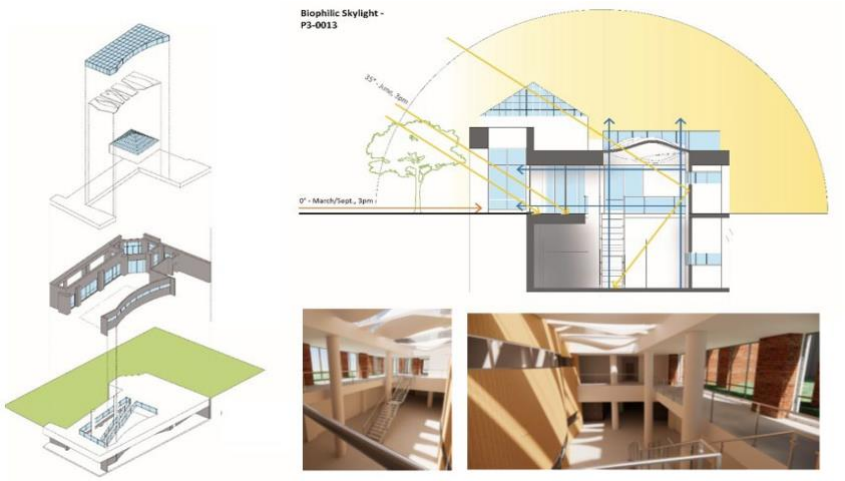

Figure 4: Biophilic interventions: exploded axonometric and section; Renderings by Julie Oelkers.

Figures 5 and 6 illustrate example biophilic interventions that demonstrate the increased illuminance levels and new quality of space as compared to the existing base case. The studies compare qualitative diurnal and seasonal Enscape renderings to evaluate the changing quality and experience of space in time.

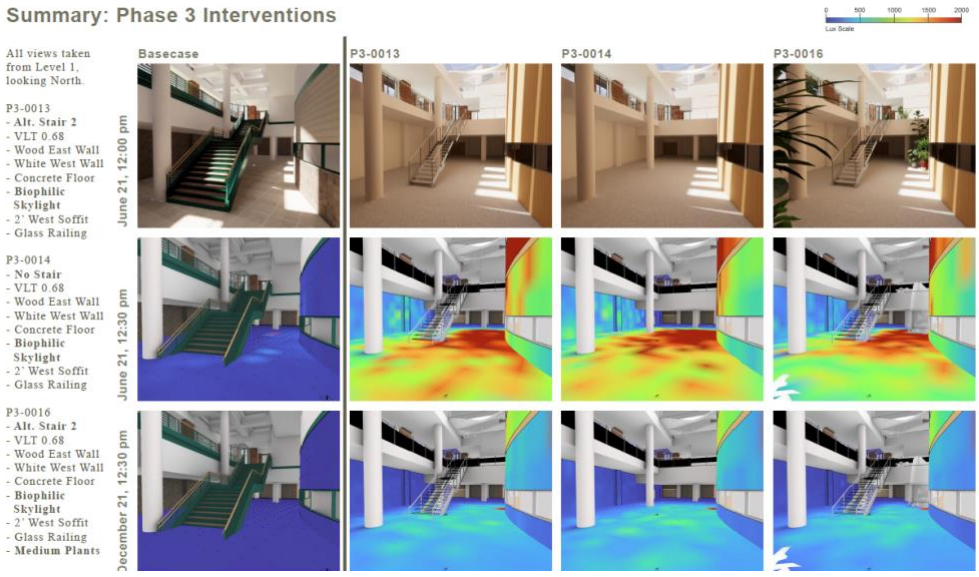

Figure 5: Biophilic interventions: example quantitative illuminance renderings using Climate Studio

and qualitative renderings using Enscape, Renderings by Julie Oelkers.

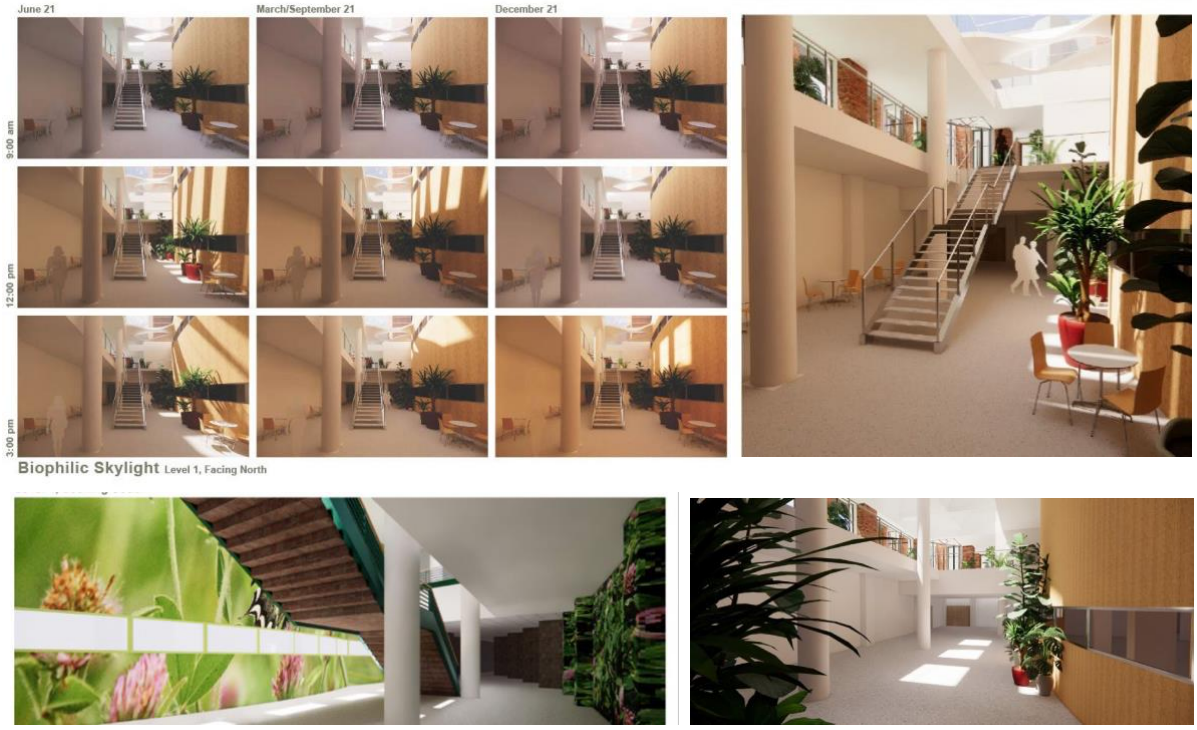

Figure 6: Top: Biophilic interventions: qualitative diurnal and seasonal renderings using Enscape. Bottom: Example biophilic interventions with nature imagery, materials, and plants, Renderings by Julie Oelkers.

BIOMIMETIC DESIGN STRATEGIES

This project explores biomimicry as a generative methodology. In *Biomimicry in Architecture* (Pawlyn 2016), the author notes that *"*The term 'biomimicry' first appeared in the scientific literature in 1962, and grew in usage particularly among material scientists in the 1980s*"*.[11] The term had been brought to the attention of design professionals by Janine Benyus in her book *Biomimicry: Inspiration Inspired by Nature* (2002).[12] She identified three core biomimetic concepts (Model, Measure, and Mentor), which form both a methodology and a philosophy for the current study. Benyus and Dana Baumeister (2013) further define biomimicry as *"*…learning from and emulating of natural forms, processes, patterns, and systems".[13] Finally, as Kennedy and Marting (2016) note, biomimicry is "…an eco-design tool that is suitable for introduction in the front end of innovation…*"*, in contrast to other tools used to *"*...validate proposed solutions."[14]

In application, the two main approaches to biophilic design are "solution-driven" (starting with biology, with technology pushed from the bottom up) and "challenge-driven" (starting with a challenge or problem, with technology pulled from the top down).[15] [16] In both approaches, function serves as a bridge between human application to analogous biological traits.[17] Here we used the latter, which aligns with the adapted the previously-discussed six-step design process. Steps 4 through 6 of the six-step process were used for the study and are discussed below. It is important to note that biomimicry is interdisciplinary in practice that brings together the fields of biology, engineering, and design.

Zari (2007) proposed a framework for the application of biomimetics. It is organized in three levels (Organism, Behaviour, and Ecosystem), based on the aspect of biology that is being mimicked. Each level is further divided into five dimensions, including: Form, Material, Construction, Process, and Function.[18] This framework is useful in applying biological knowledge to design and articulating paths for application.

Using nature as a metric is a key component of biomimicry. Benyus (2002) articulated several "principles of life" that can be translated into measurable qualities in design. These include: *nature*

runs on sunlight, uses only the energy it needs, fits form to function, recycles everything, rewards cooperation, banks on diversity, demands local expertise, seeks balance, and taps the power of limits.[19] This project focuses on the first of these metrics – running on sunlight - and frames the analysis on the level of "Organism", as defined above by Zari (2007). Running on sunlight for the current study emphasizes reducing energy use through improving daylighting in interior spaces and fitting form to function.

Biomimetic Design Interventions & Outcomes

The iterative biomimetic design process described below is structured on Steps 4, 5, and 6, as were illustrated in Figure 1, from Fayemi et al.[1] In practice, the steps are not strictly discrete - they overlap, with small and large feedback loops informing the design in a nonlinear process.

Step 4: Select Biological Models and Abstract Strategies

The biomimetic design methodology for the project took a top-down approach. Several design functions were explored to develop a list of applicable biological models, including how nature manipulates, adapts, optimizes, reflects, shapes, and harvests light. A list of biological traits associated with these models was provided by participating biologists and by inputting related terms into AskNature.org and ChatGPT.[20] [21] The resulting list of organisms that manifested these traits offered a diverse selection of adaptive mechanisms across taxonomic groups. Six options were selected from the list of biological models to compare in this study (Figure 1, top middle). From these options, the example of "window plant" was selected for the design exploration, due to the equivalence of biological function and design challenge, i.e., the goal for both living plant and design iteration is to bring the energy of light down into structures that exist beneath the surface of the earth (Table 2).

Step 5: Translation to Design

The design intent was to gather light from above and deliver it to the lower level of the two-story space (Figure 7). Exploring the translation from nature to design involved examining the form and function of a window plant in section to inform the design of the skylight (see Table 2).[22] [23] The three-foot diameter glazed dome protruding above the roof plane mimics the ground surface above which the plant grows. Likewise, the plant's roots that receive the energy from the sun above are represented by a cylinder (cowl) that drops four feet below the ceiling before opening to allow light to flow into the room. Subsequently, a suncatcher module was developed and placed in a rectilinear array to replace the existing skylight. This module was used for further design iterations (Figure 8).

Biological Model: Window Plant		
Trait	**Function**	**Mechanism**
The top of the plant has a domed lens that is light permeable located above the ground surface. Subterranean vertical void below the dome with water and photosynthesizing cells along the vertical sides.	The domed lens functions to minimize surface area exposed to the arid conditions of the desert environment. The surface has spectral selectivity of light that passes through to the interior to allow for photosynthesis.	The top of a window plant's stem is transparent, allowing sunlight to pass through into the stem below. The waxy surface filters out the highest-energy light, allowing only about 10 percent of the total light into the plant, preventing the insides from overheating. The interior surfaces are both absorptive (for photosynthesis) and reflective to bounce light around the space of the stem.
Design Implications		
Scales of application Room: Consider the shape and form of the room below the skylights to reflect light to the lower subterranean space. Roof and Ceiling: Consider inverting the form of the roof to gather light and redirect it down to the lower space. Window Apertures: Consider the design of the skylight to gather, reflect, and selectively filter daylight to lower space. *Materials:* Consider spectral selective glazing systems to maximize visible light into the space across the visible light spectrum. *C*onsider highly reflective surfaces that reflect light directionally.		

Table 2: The biological attributes of the window plant and design interpretations, Table by Authors.

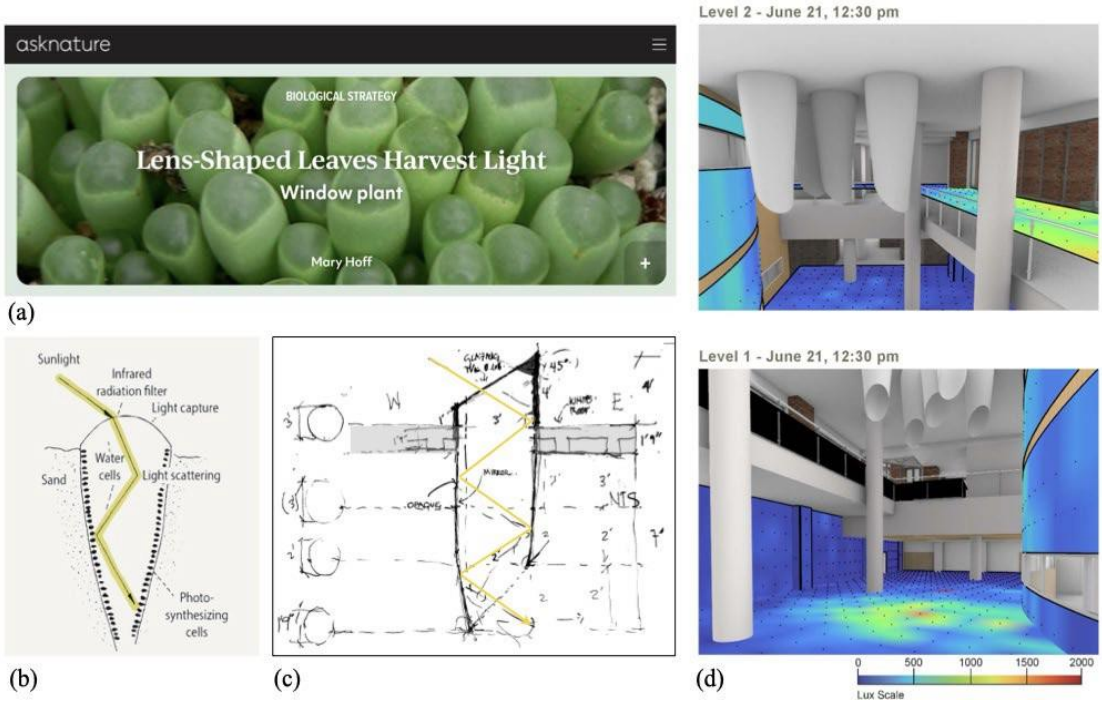

Figure 7: (a) Diagram of the Window Plant (fenestraria aurantiaca) to inform the design of the skylights to bring daylight into the subterranean space and (b) section diagram of window plant (c) suncatcher section of skylight design (d) illuminance test, Renderings by Julie Oelkers.

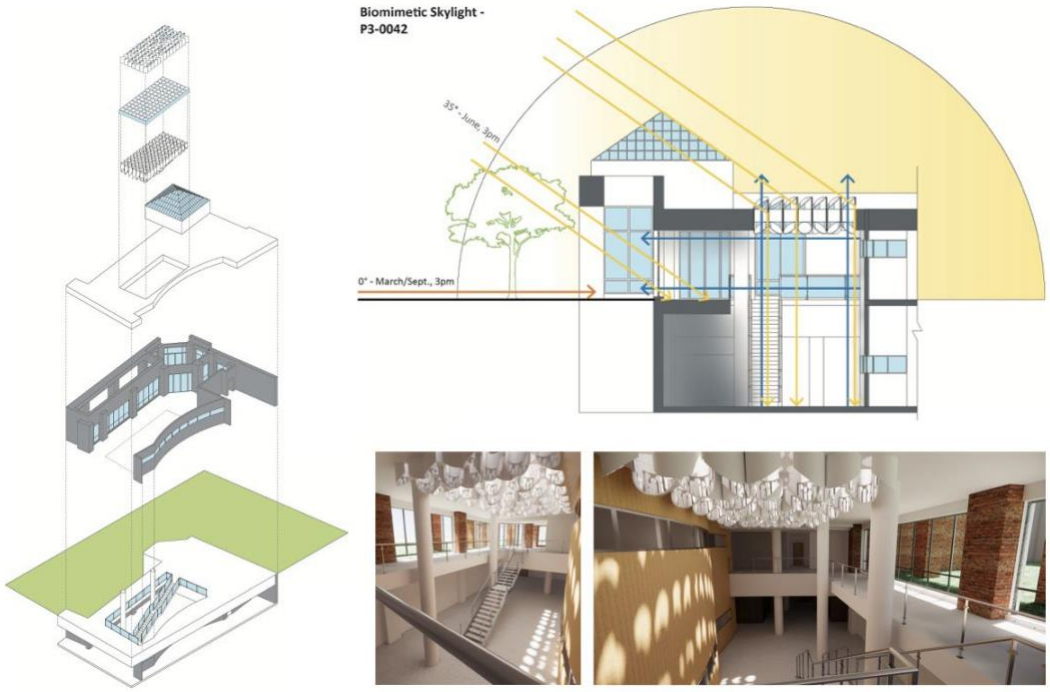

Figure 8: Biomimetic intervention: exploded axonometric and sections; select interior renderings, Renderings by Julie Oelkers.

Step 6: *Test in context and revisit the design challenge*

The assessment of early design iterations, using seasonal and diurnal illuminance simulations, showed little increase in the overall illuminance on the floor of the lower level (Figure 9, left base case). While seasonal renderings demonstrated improvements in the even distribution of light, the static field of suncatchers dropped from the ceiling plane dominated the space and did little to animate the space (Figure 9).

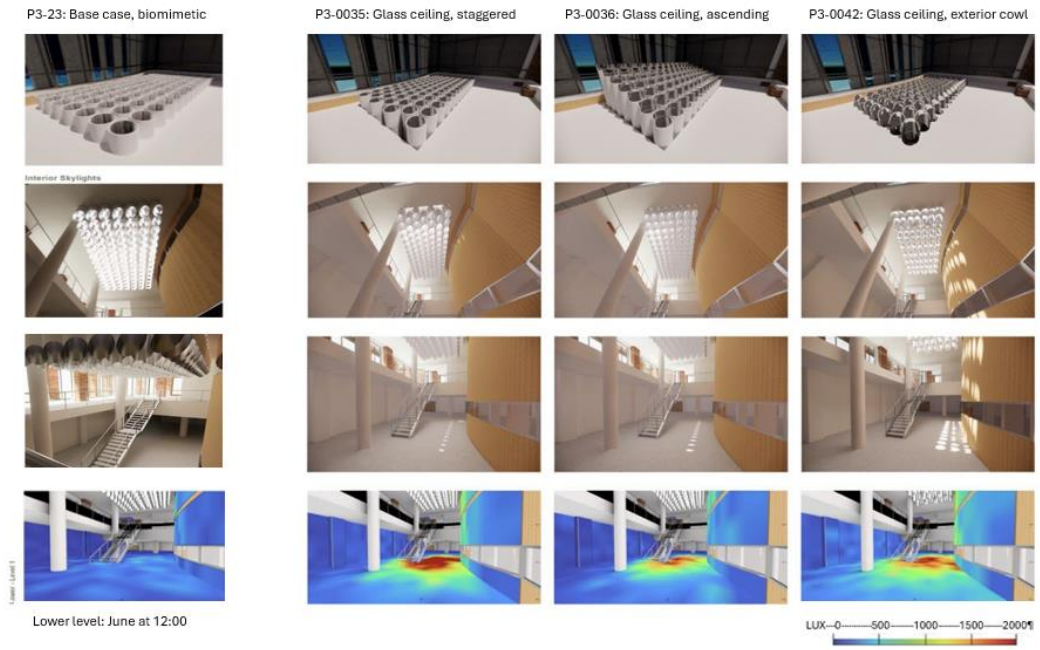

Figure 9: Exterior and interior suncatcher design variations exploring cowls height and orientation; stepped heights of the suncatcher to prevent self-shading; staggered grids; glazing between suncatchers; and varying the interior orientation to increase illumination levels, Renderings by Julie Oelkers.

Revisiting the window plant, it was noted the height, diameter, orientation, and cluster patterns of the plant needed to be varied to avoiding self-shading. Design variations mimicking these traits, coupled with modifications to the interior suncatcher form, increased the amount of light captured, which resulted in higher illuminance levels and greater animation of light across surfaces. (Figure 9). Grasshopper software was introduced late in the project, with some success, to generate randomized variants focused on increasing illuminance levels and animating the light in the space. (Figure 10).[24]

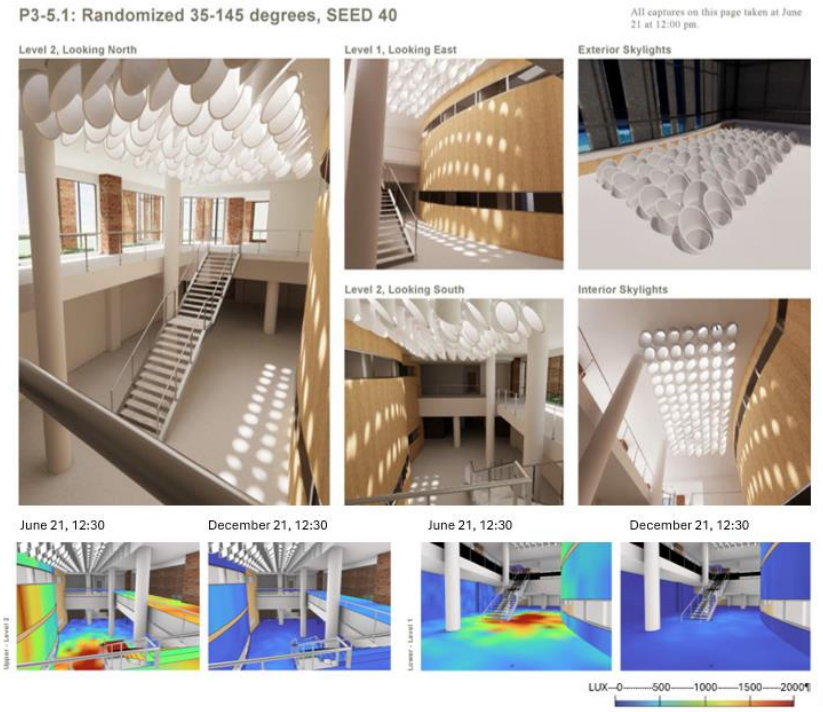

Figure 10: Design interventions explored with Grasshopper software include variable cowl depth (2' to 4'), and orientation (45 or 65 degrees north or south of east), Renderings by Julie Oelkers.

The exploration of a window plant as a model for skylight design led to improvements in illuminance levels and the experiential quality of the space. The heavily shaded site conditions proved challenging due to the lack direct light for most of the year. Future research into biological models more closely aligned with site conditions could expand the design vocabulary. Use of Grasshopper earlier in the process with biomimetic form tied to quantitative metrics would provide condition responsive solutions tuning the design.

CONCLUSIONS

The outcomes of the research exploration include the following specific lessons and considerations:

1) *Integrated Tools*: Perhaps most successful was the pilot test, which integrated a suite of design tools that are typically not integrated. While a variety of tools are commonly used in practice, the research demonstrated the ease of coupling Climate Studio for energy and climate analysis, Enscape for qualitative assessment, and VR software. Going forward, the integrated tools could include physical models at varied scales and detail, digital 3D printing, and rapid prototyping.
2) *Biophilic Strategies*: Terrapin's 15 Patterns of Biophilic Design provided a tangible set of design strategies that inform different scales of design exploration. Given their flexibility, they are easily integrated with quantitative performance investigations for illuminance levels, glare, and visual and thermal comfort, among other quantitative performance considerations.
3) *Biomimetic Strategies*: The six-step bio-inspired design process provides a strong and accessible framework to incorporate biomimicry into a generative design process for solutions across scales. An interdisciplinary team of biologist and designers is essential to identify and build understanding of the biological models for optimal technical solutions that emulate natural forms, processes, patterns, and systems.
4) *Integrated Strategies*: Based on these preliminary findings, the biophilic strategies are flexible, diverse, and effective in creating a more welcoming and warmer quality in the community space, while also increasing illuminance levels and visual comfort. The biomimetic strategies were easily integrated with the biophilic strategies. They proved more limiting in enhancing the overall quality of the space, since the biomimetic focus was on the design attributes of the skylight. Research questions remain about whether the biological model of the window plant could be effective in reconsidering window glazing and material attributes.
5) *Next Steps:* Based on the findings of this pilot study, the team hopes to move forward to further refine the integration of design tools, methods, and interdisciplinary collaboration. Three items are particularly important: a) The collaboration with biologists through the process to improve translation of biological models into design, b) Having robust expertise in virtual reality, as the technology can be inconsistent, requiring expert troubleshooting, and c) The selection of a site and design project with fewer solar limitations to more robustly compare potential qualitative and quantitative daylighting strategies.

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ECHOES OF MÝVATN: IN SEARCH OF RESONANCE IN ARCHITECTURE

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INTRODUCTION

Human wellbeing is profoundly shaped by our relationship with nature. However, contemporary urbanisation and modern lifestyles have led to an increasing alienation from the natural world, contributing to a rise in psychological distress, reduced attention restoration, and a diminished sense of meaning.[1] The concept of resonance, as proposed by sociologist Hartmut Rosa (2019), provides a compelling framework for addressing this divide. Resonance refers to a mode of being in the world characterised by reciprocal, transforming relationships with our surroundings. When individuals experience resonance with nature, they feel emotionally engaged, heard, and transformed, conditions essential for integral wellbeing.

Urbanism and architecture can amplify these experiences by treating landscape as an active framework rather than a backdrop. Landscape urbanism prioritises ecological processes, integrating natural systems to support a dynamic, human-nature interaction.[2]

Our project takes place in the Mývatn region in northern Iceland, where geothermal landscapes, ice, winds, wetlands, volcanic formations and northern lights offer immersive, multisensory environments. Through responsive and strategic interventions, this landscape fosters emotional and temporal connections between visitors and the land. Mývatn exemplifies how landscape urbanism can cultivate resonance by engaging landscape features, cultural narratives, and embodied experiences. In this way, urban and rural spaces alike can be designed to restore a more reciprocal, connected, and meaningful relationship between people and nature.

Framing the problem: Alienation

Nature plays a crucial role in human health and overall wellbeing; however contemporary lifestyle and an increasingly urbanised landscape is associated with reduced contact with Nature. Rapid urbanisation not only leads to severe habitat loss but also to pollution and environmental degradation which can contribute to respiratory diseases, cardiovascular conditions, the spread of infections and zoonotic diseases.[3] On the other hand, mental health is increasingly recognised as essential components of overall health which has been affected by rapid social, economic and technological advancements. Recent research indicates that the “prevalence of mental health disorders such as

depression, anxiety and burnout, has been steadily increasing in recent decades posing significant public health challenges"[4] where an alarming number of people suffer from mental health issues: depression affects 300 million people globally, social anxiety disorder impacts nearly 264 million people while burnout was classified in 2019 by the WHO as an occupational phenomenon particularly present in high-pressure industries.[5]

In summary, galloping urbanisation and fast-paced contemporary lifestyle inevitably influence health and overall wellbeing leading to increasing social and ecological disconnection. German sociologist Harmut Rosa describes this condition as Alienation "a specific form of relationship to the world in which subject and world confront each other with indifference or hostility (repulsion) and thus without any inner connection".[6] Alienation understands modern life as driven by the imperatives of acceleration, efficiency, and constant innovation that severs the deep, responsive relationships that individuals once had with the world around them. He writes, a society or institution is modern when "its stabilization mode is dynamic, i.e., when it systematically requires (material) growth, (cultural) innovation, and (technological) acceleration in order to maintain its socioeconomic and institutional status quo."[7] Rosa's argument of how modern life's obsession with efficiency and control leads to alienation has strong implications for wellbeing, particularly in our capacity to feel connected or fulfilled. Thus, the condition of alienation is characterised by a growing sense of disconnection -from nature, from community, and even from oneself, thus, it has direct implications for well-being. Urban environments can intensify these effects by cutting people off from natural spaces and, without meaningful engagement with the world, individuals are more prone to mental health conditions with reported stress on the rise.[8]

A SEARCH TO RESONATE

Principles of the Idea

As the "counterpart" to alienation, Rosa introduces the concept of Resonance that can be understood as the quality of relations that "(…) rest on the idea of an intrinsic connection or correspondence, a mutual reaction in the sense of a genuine response."[9] It is dynamic, reciprocal and non-controllable encounter with the world where we are affected by it and we respond to it.

However, Rosa's notion of Resonance is not entirely a novelty. It shares deep affinities with other concepts rooted in non-western philosophies such as the *Buen Vivir* (good living) in the Indigenous Andean cultures, the *Ubuntu* concept in Africa or the Buddhist principle of *pratītyasamutpāda* which states that all phenomena arise in dependence upon multiple, ever-changing causes and conditions. While some of these concepts are more Cosmo centric and advocate for nature and community well-being that precedes individualism and/or capital, Resonance is a sociological and philosophical critique rooted in Western theory; however, all of them emphasize in relationality over control and promote reciprocal, life-affirming connections.

The notion of Resonance can also be found in the field of architecture and design, particularly in ancient societies where the relationship between landscape and built environment was mutually shaped. From the Inca terraced settlements of Peru to sacred architecture in Greece, ancient societies built their settlements attuned to their landscape. In *The Earth the Temple and the Gods*, Vincent Scully (1962) describes how ancient Greek sacred architecture was deeply rooted in its natural and cultural setting and points out how "modern culture has little connection with the earth or, rather,

normally fails to perceive a connection with it."[10] He explains how temple placement and orientation in ancient Greece responded to mountains, seas, and skies, creating a dialogue between built and natural worlds, linking their cultural beliefs through interpretation of local deities in the landscape. Temples embodied myth and ritual, shaping collective experience and identity.

In Iceland, the ancient word for intuition *"innsæi"* refers to an exploration of our inner world to feel regenerated and reconnected with the world around us. It has three meanings: *"the sea within"* referring to the borderless nature of our inner world, of vision, feelings and imagination; *"to see within"* to know yourself, and *"to see from the inside out*" to have a strong inner compass to navigate your way in our ever-changing world. Thus, Nature is not just the external environment of mountains, rivers, oceans, forests, etc., but our internal environment of thoughts, feelings and imagination through which we perceive all.

The role of landscape and design

Over recent decades, growing awareness of the ecological crisis and its impact on human life has driven design disciplines to explore new ways of integrating nature into the built environment, at scales ranging from territory to architecture. Approaches such as landscape urbanism, ecological urbanism, and biophilic design seek to integrate nature and landscape features in the design process, not merely as surface aesthetics but as a fundamental element for shaping of space. Thus, the landscape is not only the backdrop but the configurator of design approaches. Vincent Scully emphasised that architecture is inseparable from place and meaning, functioning not as isolated objects but as "active mediators" between landscape, divinity, and community. The same thought is found in secular architecture where recent examples include Frank Lloyd Wright's Falling Water or the Leca Swimming pool project by Alvaro Siza which are renowned examples of architecture working in direct engagement with geological and hydrological conditions (Figure 1).

Research continues to show that various types of nature experience are associated with mental health benefits, for instance 20 minutes spent in nature significantly reduces levels of cortisol.[11] Moreover, research has also identified three types of human-nature experience that contribute to health and wellbeing:

1) "Indirect interactions" only through visual connection to nature,

2) "Incidental interactions" while carrying out other activity (e.g. walking), and

3) "Intentional interactions" by purposely visiting a park or garden.[12]

It is here that architecture and design become fundamental in providing opportunities for human-nature experiences. By explicitly addressing alienation and fostering resonance through site-specific design we address the root causes of declining health because of fast-paced modern life.

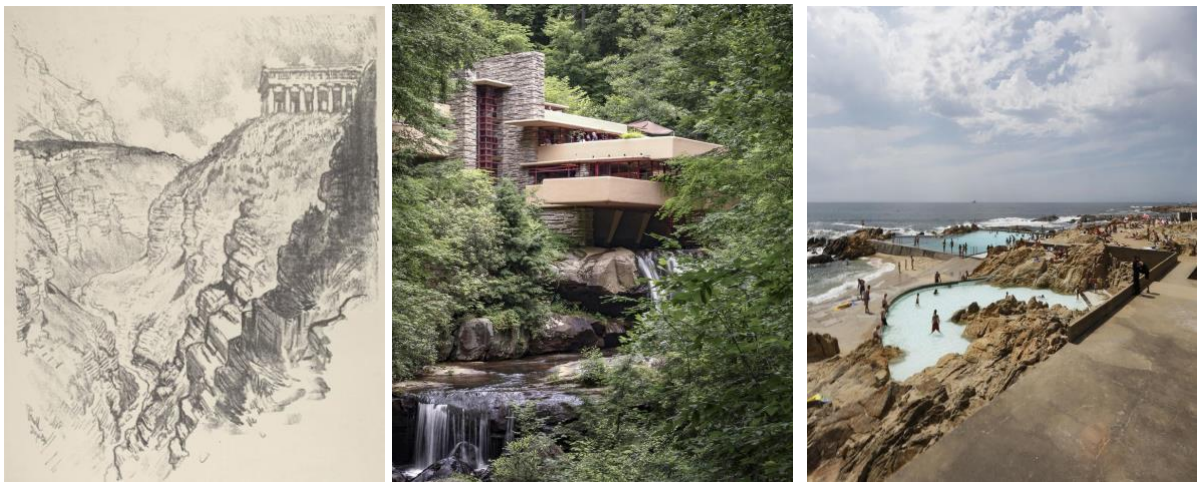


Figure 1. Three examples of Architecture as mediator between landscape and human experience. Left to right: J. Pennell, Temple over cannon, Segesta, Italy. (1913); Wright, F. Fallingwater (1936); Siza, A., Leca swimming Pool, 1966.

THE SITE

Mývatn, Iceland

Essential condition for the emergence of a resonant experience is the encounter of the subject with a fragment of the world (site) that he or she has not yet assimilated, that is foreign or unfamiliar to him or her or interpreted as hostile.[13] Mývatn in Iceland provides the perfect setting to trigger such experiences.

Iceland is a 103,000 km² volcanic island on the North Atlantic Ocean. It offers a unique landscape composition including (at least) thirty active volcanoes, vast glaciers such as Vatnajokull (8200 km²), over 10,000 powerful waterfalls, some of them seasonal; and geothermal areas with hot springs and geysers such as the famous Strokkur.[14] Its natural features make of Iceland a preferred destination for nature-based tourism and a landscape to protect. In 2024, the total coverage of nature conservation was 20.67km² [15], this represents 20% of Icelandic territory, the highest coverage of any OECD country.[16] The Mývatn and Laxá area are particularly interesting.

The Mývatn area has unique geological and biological conservation values. Precipitation is trapped by the porous volcanic bedrock and moves beneath the surface until it reappears in a series of springs which supply systems of rivers and lakes. Lake Mývatn (37 km²) is situated 278 meters above sea level and contains more than 50 islands. The landscape around the lake and in many of the islands is dominated by perfectly shaped pseudo craters, formed by steam explosions as hot lava flowed into the lake some 2300 years ago.[17] The area is also a Ramsar site where fifteen species of duck permanently breed. The area has been protected since 1973, however according to law no. 97 in 2004, construction and development here is restricted or subject to approval by the Environment Agency of Iceland. The objective is to promote nature conservation according to the principles of sustainable development and to ensure that the ecological limits of the region will not be endangered.[18]

The contrasting landscapes of the Myvatn area -with a backdrop of desolated volcanic landscape in contrast with green and lush vegetation in the lakeshore- is an ideal site to trigger a reciprocal and affective bond with the surrounding (figure 2). Andrea Kahn and Carol J Burns (2021) explain that site is "a relational construct that acquires meaning and value through situational interaction and exchange."[19] Hence, it is through architecture (and urbanism) that a dialogue between the site and humans can be generated. Moneo writes "Without the site, without a singular, unique site, architecture doesn't exist (…) A site is more than a simple frame; it also provides the clues to the correct direction for the process of building. As such, the site is an expectant reality, always awaiting the event of construction, through which its otherwise hidden attributes will appear." [20] Thus, to aim for a resonant relationship with the landscape, the site and the architecture should be inextricably linked. Nature is not only the backdrop but the guiding element of design.

Figure 2. Lake Mývatn shows the shallow lake and pseudo craters with scattered settlements along the main access road. In the background, the hills and volcanos emerge from the flat surface. Source: https://guidetoiceland.is/travel-iceland/drive/northeast.

The territorial vision

The premise for the intervention is that human-nature experience has positive incidence in mental health and wellbeing. Multi scalar spatial interventions will offer opportunities for resonance between human and nature by providing a site-specific experience that directly engages in three types of human-nature interaction: Indirect, incidental and intentional.

Macro strategies:

(1) To create **soft mobility network** that complements the existing road infrastructure and which is mainly focused on pedestrian-friendly paths, biking paths, trail, leisure walk, water routes, etc. The trails are designed for short and multiday hikes. (2) To create **strategic interaction zones** destined to accommodate few new built structures and uses for different purposes including wellness, educational and recreational activities. Such interaction zones are located along the soft mobility path which allows direct access to spaces for temporary huts and campsites as well as more permanent built structures and (3) is the creation of **diverse typologies** –both building and recreation areas. That avoid

standardised solutions and respond and adapt to the particularities of each site -the wetland or the hills- but also to different users including families, solo travellers, school groups, researchers, etc.

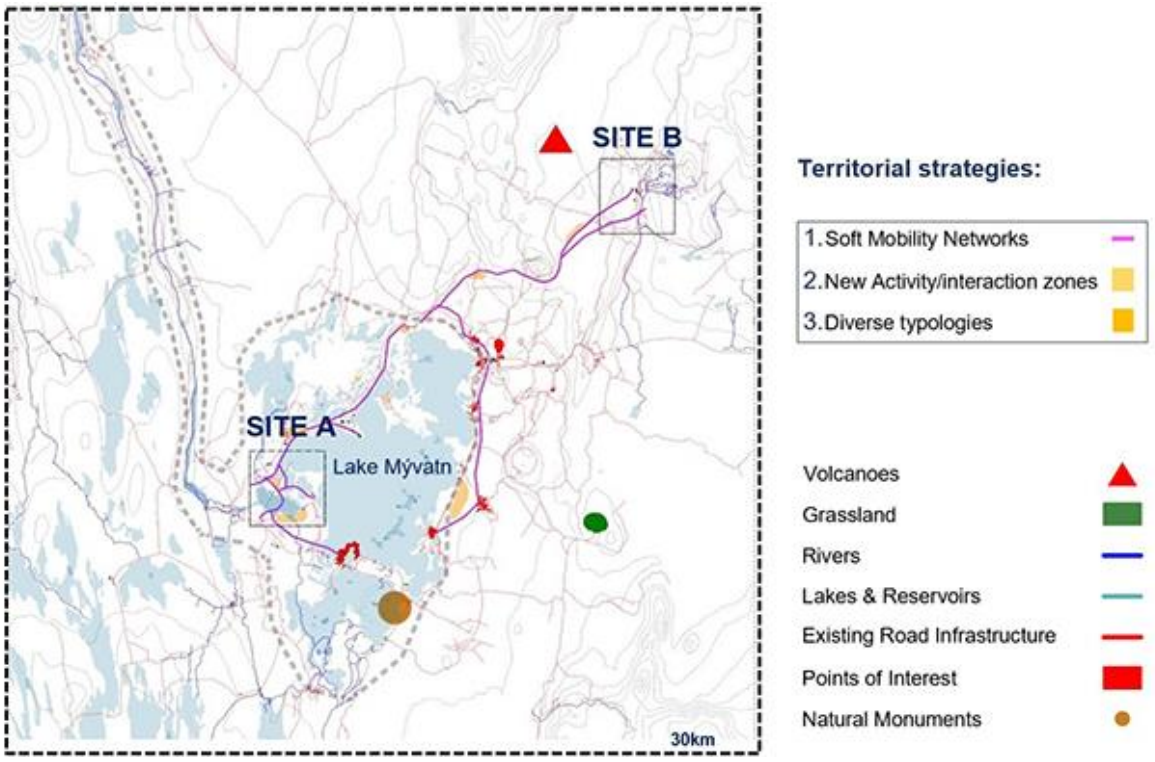
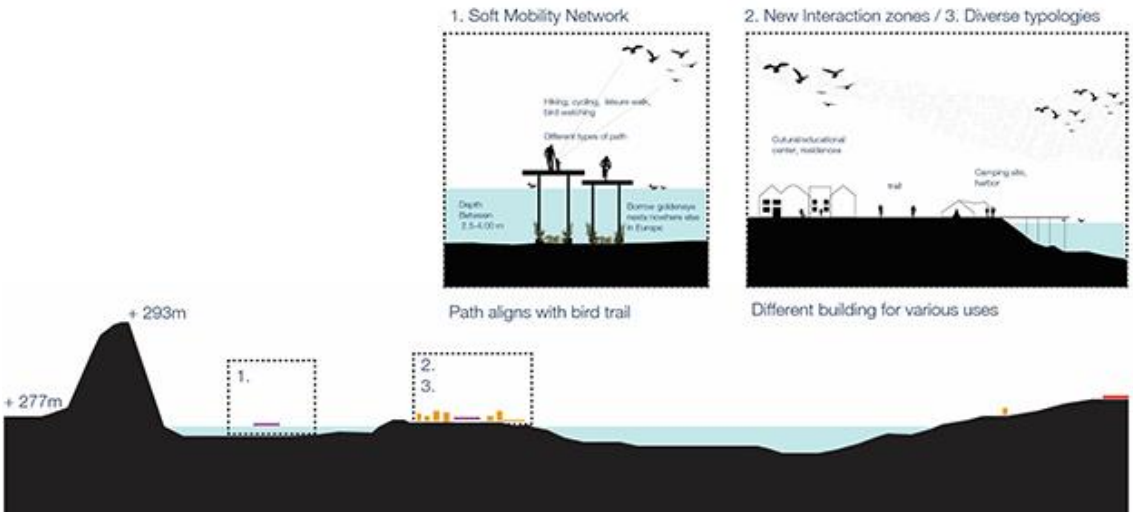


Figure 3. Conceptual masterplan.
The territorial vision is designed as a route to navigate the contrasting landscape, from the flat wetlands (Site A at +27 masl) to the steep hills (Site B at 442 masl) working as two ends of a journey through the landscape. Drawing AA+D team.



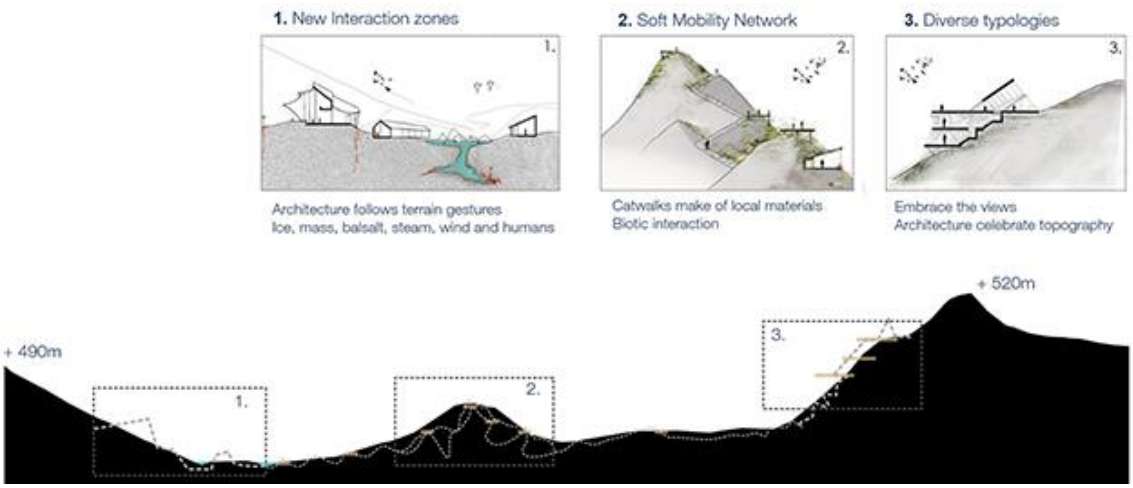


Figure 4. Conceptual sections of Site A and B.
The soft mobility network is the structural element that reconfigures these areas. Different types of paths over water or land connect interaction zones. Drawing AA+D team.

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A strategic project: The Inner Retreat

Within the three macro strategies, the Inner Retreat is a strategically located project within Site B. It emerges from the idea of *bringing buildings to nature* with the premise that architecture works as a mediator between the site, nature and human experience, co-creating rather than imposing. Awareness of the natural forces allows the building to have a living encounter with landscape (Figure 5). The Inner Retreat is situated on the hillside as an architectural response to its natural context shaped by water channels, topography and vegetation (or lack thereof). The design is not constrained to the building but embraces the ecosystem. The slope is dry due to deforestation and water diversion by the local geothermal plant; the proposed reservoir irrigates existing water courses (Figure 6). This strategy complements native moss, fern and birchwood (Betula pubescens) reforestation which can withstand harsh winters. This forest strategy aligns with the Icelandic Government's objective to restore 5% of Iceland's land cover with native forest by 2030. The reforestation plan seeks to combat increasing soil erosion, provide windbreak, sequester carbon and to increase biodiversity particularly bird life.[21] The key is to build the eco-system from the valley and spread up the mountain slopes alongside watercourses.

Figure 5. The Inner Retreat is a strategic project of the territorial vision. Image by AA+D team.

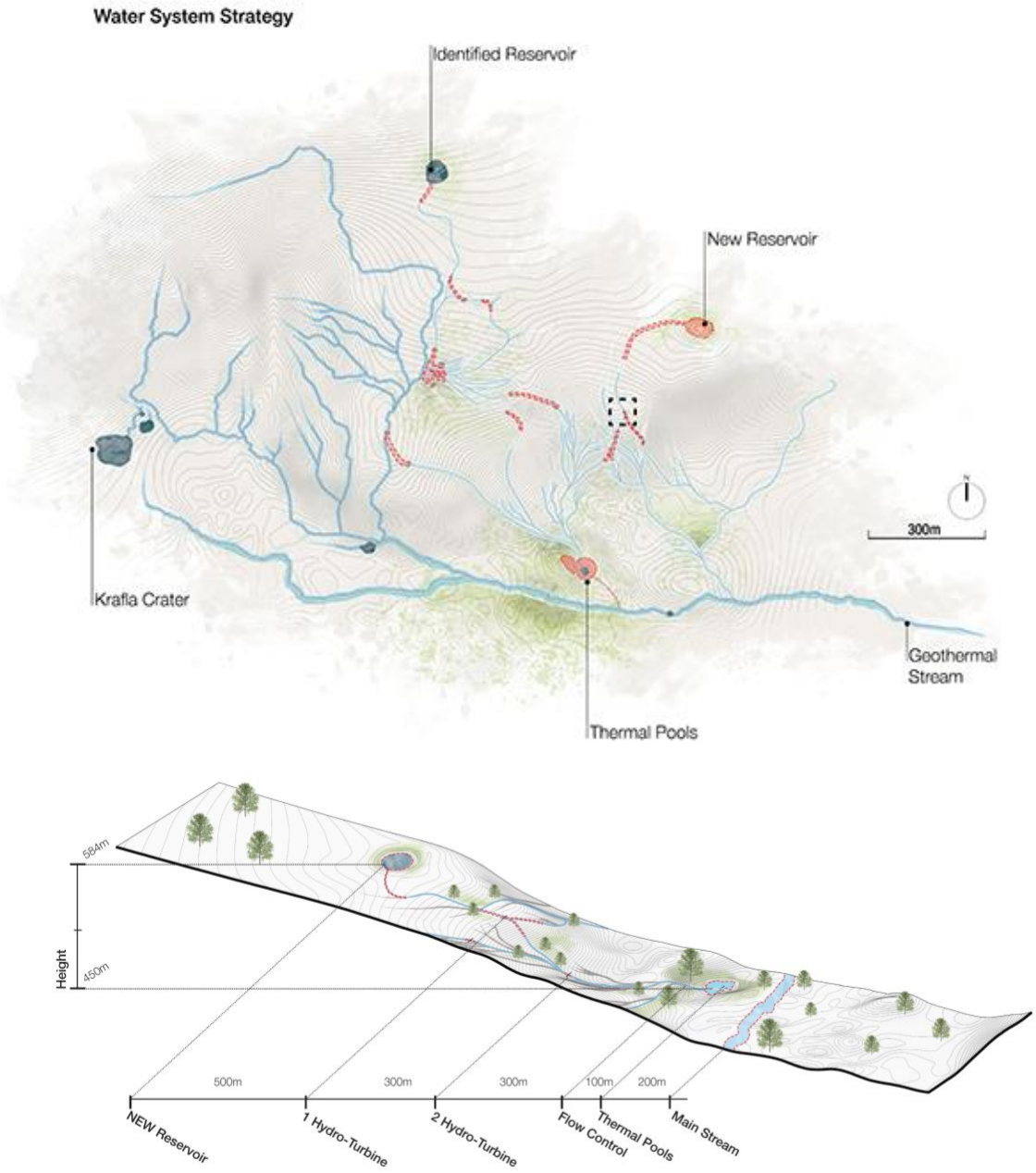

Figure 6. Water and vegetation strategies are two long-term approaches to regenerate the landscape. Drawings by AA+D team.

Within the area of influence of the Inner Retreat, intentionally scattered shelter units are embedded in quarried slabs drilled together to create clusters, as wind shields. Their design evokes a sheltered experience for visitors, allowing them to engage first hand with Iceland's raw climate and landscape while remaining protected within the volcanic forms. Nevertheless, not everything is designed and built. Much of the site is left to be explored. In the words of Moneo, "The action building takes possession on the site, but as a counterpoint it also allows us to discover its attributes."[22] The strategic location of the Inner Retreat -in the open but easily accessible landscape- offers the possibility of exploration of the immediate surrounding through hiking trails that lead visitors and locals to discover "what lies beyond." Through this exploration the project seeks to enhance the human experience by

inserting “varying degrees of uncontrollability” that can trigger emotional responses to the site while also fostering awareness and education through direct exposure to nature.[23] See figures 7 and 8.

Figure 7. A journey into the landscape. The circulation of the inner retreat connects accommodation within the hotel with exterior shelters and outdoor activities. Drawing by AA+D team.

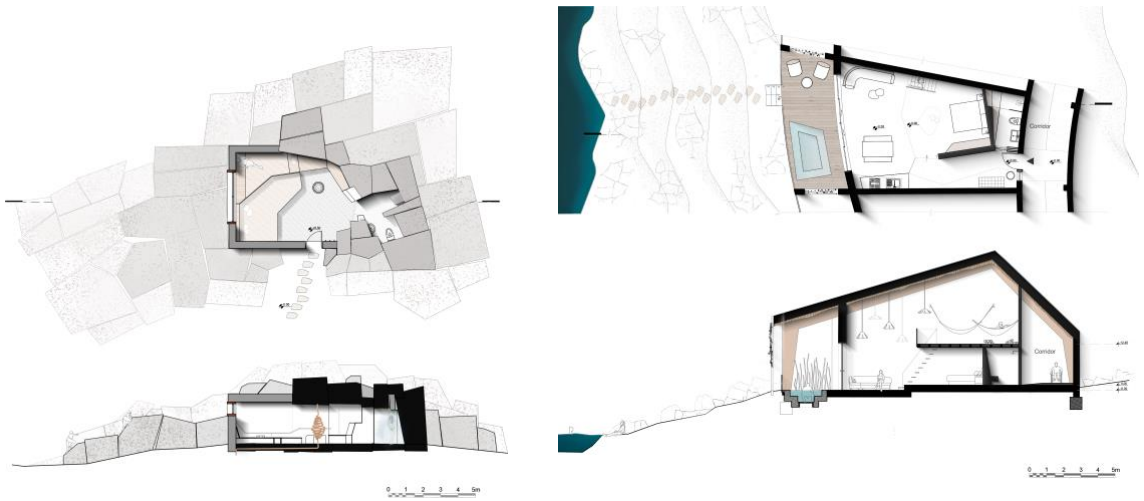

Figure 8. Water and topography as key elements of design. Quarried basalt used in the shelter units (left) and water is incorporated in the apartment typologies (right). Drawing by AA+D team.

At the architectural scale, the hotel’s geometry follows and blends to the logic of the topography, its form is shaped by bioclimatic performance, optimising orientation, sunlight and natural ventilation. This is reflected in the choice of locally provided bio-based materials (timber, basalt) -in the structure, roof and insulation system. While the construction strategy focuses on adapting to the irregular terrain through a modular system. Building morphology proposes a spread design that blends with the terrain. Departing from the compact typologies typical of extreme climates, it remains efficient through geothermal technology, passive performance, material economy and landscape integration (Figure 9).

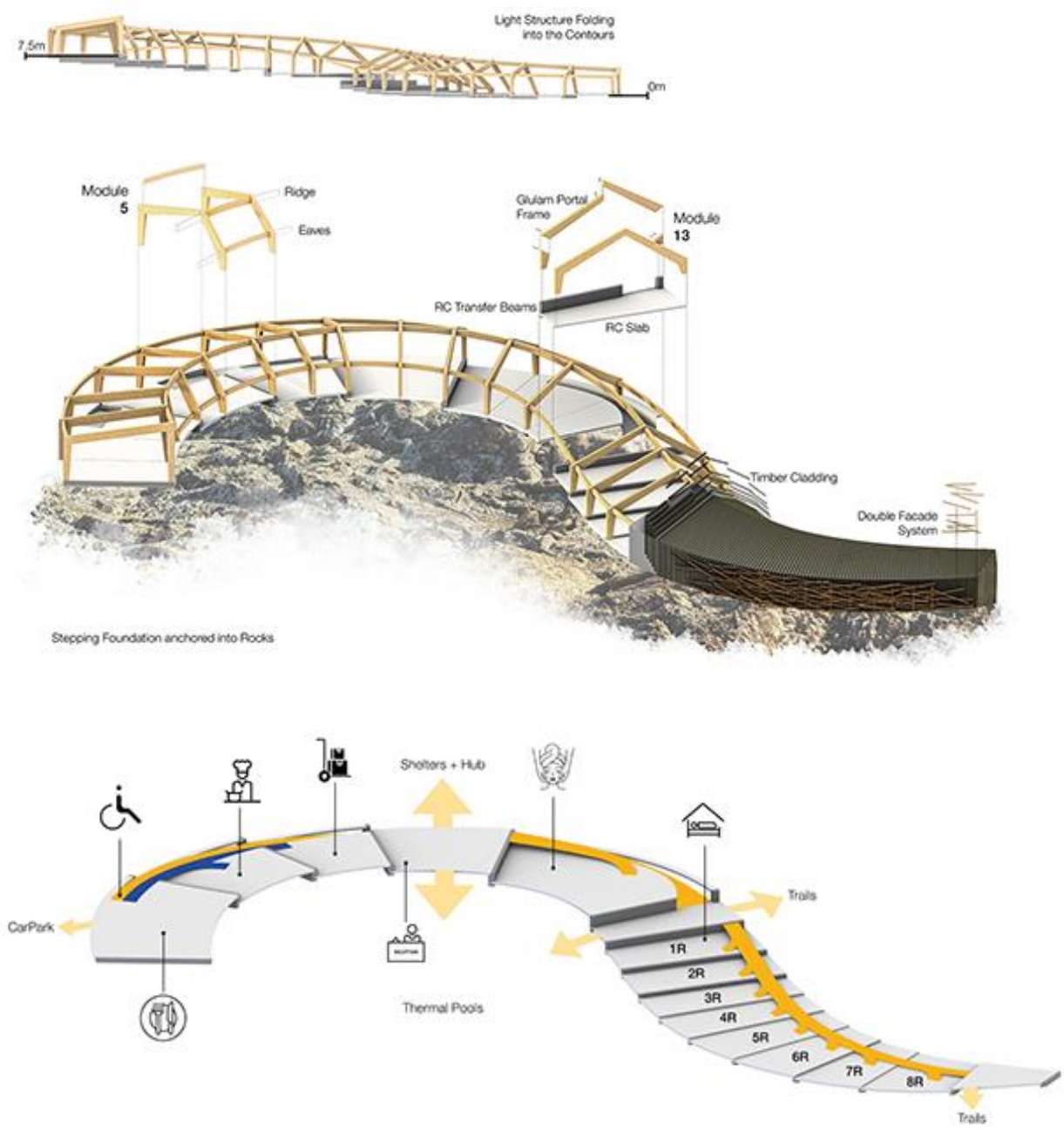

Figure 9. Hotel morphology blends with the topography. Drawing by AA+D team.

Figure 10. View of the thermal pools and Hub from the hotel. Image by AA+D team.

CONCLUSION: A triadic relationship - *architecture, landscape, and resonance*

In today's world, characterized by acceleration, efficiency, and increasing detachment from the natural world, the search for resonance becomes a practical imperative for design and wellbeing. In this paper, the concept of resonance (Rosa, 2019) was examined as a mode of responsive, reciprocal engagement between humans and their environment as an essential condition for wellbeing. Addressing this divide requires design approaches that re-establish meaningful connections between people and the natural world. In this sense, architecture and landscape design acquire an ethical dimension: they can either perpetuate disconnection or foster renewed relationality.

The Mývatn project exemplifies how landscape urbanism and architecture, when guided by principles of resonance, can reframe the relationship between humans and their environment. By embracing the site's dynamic geological and ecological processes, the design does not impose form upon nature but allows for co-creation: between water and land, permanence and change, built and unbuilt, controlled and uncontrolled. The proposal's strategies (1) soft mobility networks, (2) interactive zones, and (3) diverse typologies through context-sensitive architecture- create an infrastructure for emotional, sensory, and temporal engagement. Here, architecture functions less as an object and more as a mediator, facilitating moments of reflection, immersion, and transformation. Designing for resonance entails more than aesthetic or functional integration with nature. It requires experiential reciprocity, spaces that invite participation, reflection, and transformation. Such environments have the potential to alleviate the psychosocial consequences of alienation by developing a renewed sense of belonging and responsiveness to the world. As the Mývatn case demonstrates, when urban and architectural interventions are grounded in ecological processes and cultural specificity, they can serve as catalysts for individual and collective wellbeing. In conclusion, reorienting design practice toward resonance offers a critical framework for addressing the intertwined crises of environmental degradation and mental health. It calls for a paradigm shift in which architecture and urbanism are understood not as instruments of control but as co-creators, between humans, nonhuman life, and the landscapes they co-inhabit. Through such a shift, design can contribute meaningfully to the restoration of both ecological integrity and human wellbeing.

NOTES

[1] Gregory N. Bratman et al., “Nature and Mental Health: An Ecosystem Service Perspective,” *Science Advances 5*, no. 7 (2019): 1-14.

[2] James Corner, “Terra Fluxus,” in *The Landscape Urbanism Reader*, ed. Charles Waldheim (New York: Princeton Architectural Press, 2006), 21-33.

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[11] Hunter, MaryCarol R., Brenda W. Gillespie, and Sophie Yu-pu Chen, “Urban Nature Experiences Reduce Stress in the Context of Daily Life in the Context of Daily Life Based on Salivary Biomarkers,” *Frontiers in Psychology 10*, (2019): 1-16.

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[19] Andrea Kahn and Carol J. Burns, eds., *Site Matters: Strategies for Uncertainty through Planning and Design*, 2nd ed. (New York: Routledge, 2021), 7.

[20] Rafael Moneo, quoted in Kahn and Burns, *Site Matters*, 153.

[21] Mossy Earth Ltd., “Reforesting Iceland,” https://www.mossy.earth/projects/reforesting-iceland. (accessed October 5, 2025).

[22] Rafael Moneo, quoted in Kahn and Burns, *Site Matters*, 153.

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