PARAMETRIC EXTRACTION OF LINGNAN ECOLOGICAL WISDOM: TRANSLATING TRADITIONAL SPATIAL STRATEGIES FOR HIGH-DENSITY CAMPUS PLANNING

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ABSTRACT

There is a fundamental incompatibility in how we currently build university campuses in the Lingnan region. While the demand for land drives campuses upward into high-density towers, the local hot-humid climate demands porosity and airflow—qualities typical of traditional low-rise vernacular architecture. We observe that solutions like Cold Alleys and Skywells are theoretically valid but practically limited in modern design due to the "scale mismatch." To bridge this gap, this research moves beyond visual imitation to structural extraction, employing a "Parametric Translation" matrix to decode the tacit ecological wisdom of the past into explicit geometric rules. When tested through comparative geometric analysis, the "translated" high-rise forms successfully induced the Venturi Effect, replicating the thermodynamic performance of their ancestors. Crucially, this study further validates the socio-economic viability of these strategies. Our cost-benefit analysis reveals that the initial 5-8% reduction in Gross Floor Area serves as a strategic capital investment, offset by significant reductions in long-term operational energy costs and enhanced asset resilience. Furthermore, by transforming thermodynamic spaces into social condensers, the design fosters human capital sustainability, proving that heritage preservation can effectively drive both environmental comfort and social wellbeing in high-density urban environments.

Keywords: Parametric Extraction, Lingnan Ecological Wisdom, Cost-Benefit Analysis, Human Capital Sustainability, High-Density Campus

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INTRODUCTION

Rapid urbanization creates a conflict in hot and humid regions. It clashes with the need for outdoor thermal comfort. Greenery does play a role in regulating the microclimate (Meili et al., 2021; Priya & Senthil, 2021). However, the complex geometry of high-rise buildings influences heat and wind even more (Nasrollahi et al., 2021; Wong et al., 2021). Current planning models often prioritize land efficiency. They ignore climate adaptability. This makes urban heat island effects worse (Elraouf et al., 2022). Therefore, we urgently need new spatial strategies. These strategies must balance high density with microclimate responsiveness.

Scholars look to vernacular architecture for solutions. Studies confirm that traditional strategies offer climate resilience in tropical regions (Gamero-Salinas et al., 2021; Nejat et al., 2021). Elements like Cold Alleys and Skywells work well as passive cooling mechanisms. However, a "scale mismatch" limits their use. Old studies mostly focus on low-rise buildings (Widera, 2021). They fail to provide data for modern high-rise contexts.

We must bridge the gap between traditional wisdom and modern planning. We need to move beyond visual imitation toward structural extraction. Digital heritage and parametric design offer a path forward. Tools like shape grammars turn physical traits into geometric data (Funari et al., 2021; Shi et al., 2024). Digital visualization converts tacit knowledge into clear rules (Zhang et al., 2022). These algorithms allow us to "translate" vernacular mechanisms into precise design parameters (Funari et al., 2021).

From a social science perspective, the urgency of this study lies in the preservation of "Tacit Knowledge." Traditional Lingnan construction relied heavily on the intuition and oral transmission of craftsmen—a form of embodied knowledge that is difficult to codify within modern standardized construction systems. As veteran artisans retire, this wisdom risks being lost. This study employs parametric tools not merely as engineering instruments, but as a "Digital Preservation Mechanism." By decoding the vague, experiential wisdom of the past into explicit geometric rules, we aim to embed the region's "Cultural DNA" into the logic of modern urban development. This process ensures that cultural identity is not sacrificed for efficiency but is instead seamlessly integrated into the high-density built environment.

This study aligns with this technological shift. We aim to extract spatial strategies from Lingnan architecture. We use a parametric translation method. This research quantifies qualitative traditional wisdom. The goal is to build a synergistic framework. This framework will integrate regional culture into performance-driven, high-density campus planning.

RESEARCH OBJECTIVES

Based on the identified research gaps and the proposed methodological shift, this study aims to achieve the following objectives:

1) To extract and quantify the ecological wisdom embedded in traditional Lingnan architecture, specifically focusing on spatial strategies such as Cold Alleys and Skywells, and to reframe them not as static symbols but as adaptable geometric rules.

2) To develop a "Parametric Translation Mechanism" that converts qualitative vernacular principles into quantitative design parameters (e.g., Depth-to-Height ratios and Openness Indices), bridging the gap between heritage preservation and modern computational design.

3) To implement the extracted strategies in the morphological generation of a high-density campus environment, using the Sun Yat-sen University Shenzhen Campus as a case study to demonstrate the practical application of the translation matrix.

4) To validate the environmental performance of the proposed parametric framework through comparative CFD simulations, verifying its effectiveness in enhancing natural ventilation and mitigating heat island effects in high-rise contexts compared to standard planning models.

LITERATURE REVIEWS

Ecological Performance of Lingnan Vernacular Architecture

Lingnan's unique climate, characterized by tropical and subtropical monsoon zones, features intense sunlight, warm winters, and high humidity with frequent rainfall. Consequently, vernacular architecture necessitated robust adaptation strategies to withstand wind and rain while preventing structural decay.

To adapt, early inhabitants developed “Ganlan” (stilt) architecture, elevating living quarters to sever direct ground contact. Xiao and Liu (2015) emphasize this design's ingenuity in effectively mitigating moisture and enhancing airflow for natural cooling. Additionally, the elevated structure provided defense against pests and wildlife, ideally suiting the ancient forest environment.

Beyond climate, Guangdong's complex topography of plains, mountains, and hills significantly influenced architectural form. Liang and Sun (2000) note the flexibility of Lingnan architecture in adapting to diverse terrains. By utilizing indigenous materials like wood, stone, and brick, builders achieved a harmonious integration of structure and landscape.

Subsequent architectural evolution introduced sophisticated climate-responsive elements, notably “Tianjing” (patios) and “Qilou” (arcades). The patio functions as a thermal chimney, facilitating ventilation and heat dissipation. Similarly, arcades provide a sheltered transitional space, offering pedestrians protection from sun and rain. These features exemplify profound vernacular wisdom in managing thermal and precipitation challenges.

However, existing research often prioritizes ancient aesthetics over modern urban application. There is a paucity of data regarding the contemporary effectiveness of these strategies against typhoons and extreme heat. This study aims to bridge this gap by validating their relevance in modern contexts.

Microclimate Challenges in High-Density Campuses

Modern campus planning has shifted. Analysis in Chapter 1 shows the cause. Land in cities like Shenzhen is expensive. Planners build high-density campuses to save space. This accommodates more students. However, a serious problem arises. The microclimate environment worsens.

The “Urban Heat Island Effect” serves as the primary driver of this thermal imbalance. As described by Oke (1982), the replacement of natural terrain with impermeable built surfaces disrupts the thermal equilibrium, causing urban enclaves to exhibit significantly higher temperatures than their rural counterparts. Contemporary campuses are not immune to this phenomenon. The proliferation of concrete hardscapes and the reduction of vegetation and water bodies exacerbate heat retention. Dissanayake and Weerasinghe (2021) corroborate this impact, noting that low-albedo materials absorb solar radiation, effectively locking heat within the campus fabric.

Furthermore, high structural density acts as a catalyst for heat accumulation. Santamouris (2015) identifies a direct correlation between density and Urban Heat Island intensity, documenting temperature differentials of up to 10 degrees. In these environments, high-rise clusters function as wind barriers, stagnating airflow and impeding heat dissipation. This transforms the campus into a “thermal trap” (or “pressure cooker”), which not only compromises outdoor thermal comfort for users but also significantly inflates operational energy costs due to increased cooling loads.

Current theoretical frameworks often overlook these microclimatic imperatives in favor of functional zoning and aesthetic form. Consequently, many designs fail to adapt to the specific exigencies of the Lingnan climate, resulting in dangerously overheated summer environments. A strategic paradigm shift is therefore required—one that moves beyond efficiency-centric models to harmonize the conflicting demands of high-density development and environmental comfort.

Parametric Design as a Translation Tool

The application of traditional Lingnan ecological wisdom to high-density modern campuses presents a critical challenge that cannot be resolved through mere visual imitation. To bridge the gap between vernacular principles and contemporary demands, a scientific “translation” mechanism is essential. In this context, Parametric Design emerges as the pivotal tool for decoding and adapting these traditional strategies.

Firstly, parametric design transforms ambiguous, experience-based intuition into precise, quantifiable data. While traditional craftsmen relied on tacit knowledge to size elements like patios for cooling, such intuition does not directly scale to modern high-rises. Zhang et al. (2023) emphasize that parametric tools can visualize physical performance, enabling the verification of traditional spatial logic within vertical environments. This data-driven approach allows for precise adjustments based on empirical evidence rather than estimation.

Secondly, this methodology propels “Modern Translation.” As established in Chapter 1, true inheritance lies in preserving the ecological core rather than replicating static forms. Parametric tools facilitate the extraction of Lingnan features—such as sunshade angles—as manipulable variables (“Reimaging Vernacular Architecture,” n.d.). By algorithmically generating a multitude of design iterations, we can identify the optimal configuration for Shenzhen's specific climate. This approach, supported by Oxman (2008), maximizes building performance through digital optimization, thereby inheriting the functional essence of ecological wisdom.

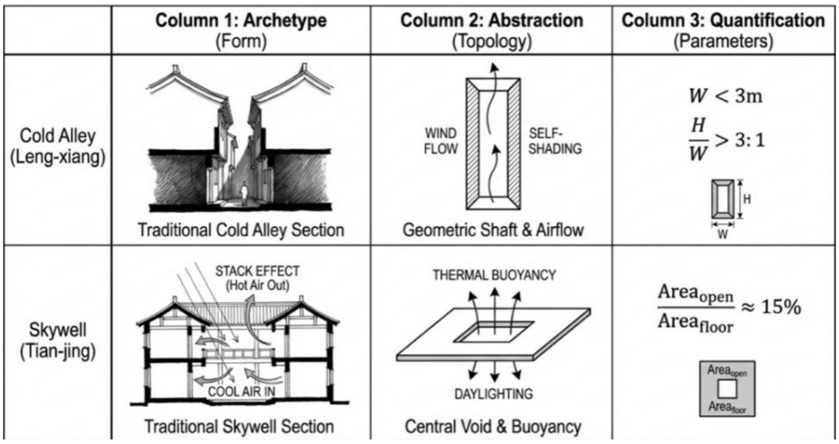
Finally, parametric design serves as a catalyst for “Synergistic Design.” Given the complexity of modern construction, effective collaboration between architects, engineers, and stakeholders is paramount. The parametric model functions as a dynamic interface, providing real-time feedback on design alterations. For example, a minor adjustment to an arcade's width is immediately reflected in thermal performance metrics. This mechanism enhances design precision, ensuring that Lingnan wisdom is integrated as a functional performance driver rather than a decorative afterthought.

RESEARCH METHODOLOGY

Phase I: The Translation Matrix

Serving as the methodology's core “decoding engine” (Figure 1), the Translation Matrix functions beyond a mere algorithm; it acts as a strategic bridge converting intangible heritage into operable design assets. As illustrated in Figure 2, this extraction process operates on three integrated levels:

- **Prototype Layer (Form):** Identifies the specific vernacular archetype—such as the Cold Alley or Skywell—treating them as the physical vessels of cultural memory.
- **Mechanism Layer (Physics):** Distills the underlying thermodynamic principles, such as the Venturi Effect (wind acceleration) or Stack Effect (buoyancy), validating the scientific rationality behind traditional intuition.
- **Parameter Layer (Math):** Translates qualitative experience into quantitative geometric variables. By defining constraints like the Depth-to-Height (D/H) Ratio, we ensure these mechanisms remain effective within high-density contexts.



	Column 1: Archetype (Form)	Column 2: Abstraction (Topology)	Column 3: Quantification (Parameters)
Cold Alley (Leng-xiang)	Traditional Cold Alley Section	WIND FLOW SELF-SHADING Geometric Shaft & Airflow	$W < 3\text{m}$ $\frac{H}{W} > 3:1$ H W
Skywell (Tian-jing)	STACK EFFECT (Hot Air Out) COOL AIR IN Traditional Skywell Section	THERMAL BUOYANCY DAYLIGHTING Central Void & Buoyancy	$\frac{\text{Area}_{\text{open}}}{\text{Area}_{\text{floor}}} \approx 15\%$ $\text{Area}_{\text{open}}$ $\text{Area}_{\text{floor}}$

Figure 1 Graphical Translation Matrix

This matrix serves as a "genetic code." It ensures the new designs work like the old ones. The generated high-rise forms inherit the microclimatic performance of their traditional predecessors.

Phase II: The Computational Workflow (Data to Form)

We execute the extracted strategies through a linear, performance-driven workflow utilizing Rhinoceros 3D and Grasshopper (Figure 2), which proceeds in three technical stages:

- **Action 1:** Defining Environmental Variables. The process initiates by importing Shenzhen's EPW weather data via the Ladybug toolset to establish boundary conditions, such as the prevailing Southeast wind (135°). Subsequently, we define key geometric variables derived directly from the Translation Matrix.
- **Action 2:** Setting Constraints to Prevent Failure. To avoid "scale failure" where simply widening a Cold Alley negates the Venturi effect, we apply a geometric constraint algorithm. This ensures the Depth-to-Width (D/H) ratio remains within the effective 1:3 to 1:5 range, forcing the building mass to split or twist to form functional wind corridors.
- **Action 3:** Generating the Porous Form. The algorithm produces an Optimized Massing that diverges from standard "blocky" layouts. The resulting form features "porous" geometries—including vertical chasms and hollow cores—that act as modern, geometrically valid interpretations of Cold Alleys and Skywells for natural ventilation.

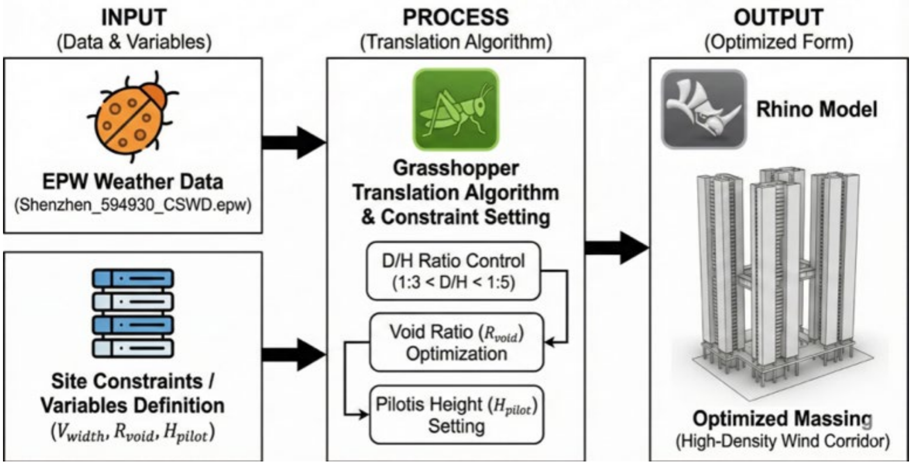


Figure 2 Parametric Extraction Workflow (V_{width}: Width of Ventilation Corridor, R_{void}: Void Ratio of Façade, H_{pilot}: Height of Pilotis)

RESEARCH RESULTS

Case Study & Application: Sun Yat-sen University Shenzhen Campus

To verify the practical utility of the Parametric Extraction Mechanism, we selected the West Teaching Cluster of Sun Yat-sen University (Shenzhen Campus, Guangming District) as the test site. Characterized by a high Floor Area Ratio (FAR > 2.5) and a typical hot-humid climate, this site undergoes a three-stage Morphological Generation Process (Figure 3) to demonstrate how quantitative rules drive spatial evolution.

· Stage 1: The Base Case (Density vs. Climate)

A standard layout was generated prioritizing functional efficiency and land use. Figure 3-A shows this “Base Case,” consisting of compact high-rise blocks with narrow spacing (D/H≈1:1).

Diagnosis: While maximizing floor area, this layout creates a severe “Wall Effect,” blocking the prevailing southeast summer wind. Analysis reveals significant heat accumulation in central zones, typifying the failure of non-adaptive high-density planning.

· Stage 2: Parametric Intervention (The “Cutting” Process)

Next, we applied “Cold Alley” parameters via a subtraction algorithm. Adhering to the Venturi constraint ($3 < D/H < 5$), we “sliced” the building masses in alignment with the dominant 135-degree wind direction.

Result (Figure 3-B): This operation transformed solid blocks into a porous structure. The resulting “Modern Cold Alleys” function as wind corridors, forcing high-velocity airflow into the cluster and effectively breaking wind shadow zones.

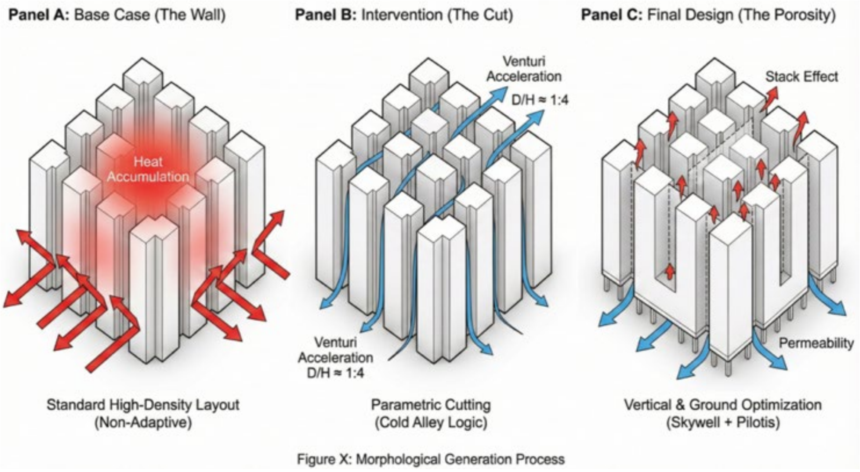
· Stage 3: Optimization & Refinement (Vertical & Ground Adaptation)

Finally, morphology was refined using “Skywell” and “Arcade” rules to address vertical ventilation and ground-level comfort.

Vertical Action: Internal cores were hollowed using a 20% Void Ratio constraint, activating the Stack Effect to ensure ventilation even under calm conditions.

Ground Action: The ground floor was elevated (4.5m Pilotis) to reduce wind friction and create a continuous shaded pedestrian network.

Result (Figure 3-C): The final design achieves synergy, balancing high density with climatic adaptability. It retains the necessary floor area while establishing a “thermodynamic machine” that accelerates heat dissipation.



Panel A: Base Case (The Wall)

Panel B: Intervention (The Cut)

Panel C: Final Design (The Porosity)

Figure 3 Description: Morphological Generation Process

Preliminary Performance Analysis

To validate the microclimatic effectiveness of the Parametric Extraction Mechanism, a comparative simulation was conducted on a typical high-density teaching cluster. This analysis contrasts a standard layout against the parametrically optimized model to verify improvements in wind environment and ventilation efficiency.

- **Experiment Setup: Comparative Scenarios**

Two models were constructed sharing identical site conditions and volumetric constraints (FAR = 3.0) but utilizing distinct morphological strategies:

Case A (Baseline): Adopting a conventional high-rise layout with standard spacing (D/H≈1:1) and lacking ground-level pilotis, this model represents the typical modern approach—efficient but climate-insensitive.

Case B (Proposed): Generated via the Translation Matrix, this optimized design incorporates key interventions: Venturi Corridors adjusted to a 1:4 D/H ratio, a 20% Skywell void ratio, and ground pilotis raised to 5.0 meters.

- **Simulation Results & Analysis**

Preliminary CFD simulations visualized wind speed at the pedestrian level (1.5m), utilizing the dominant summer wind from the Southeast at 3.5 m/s.

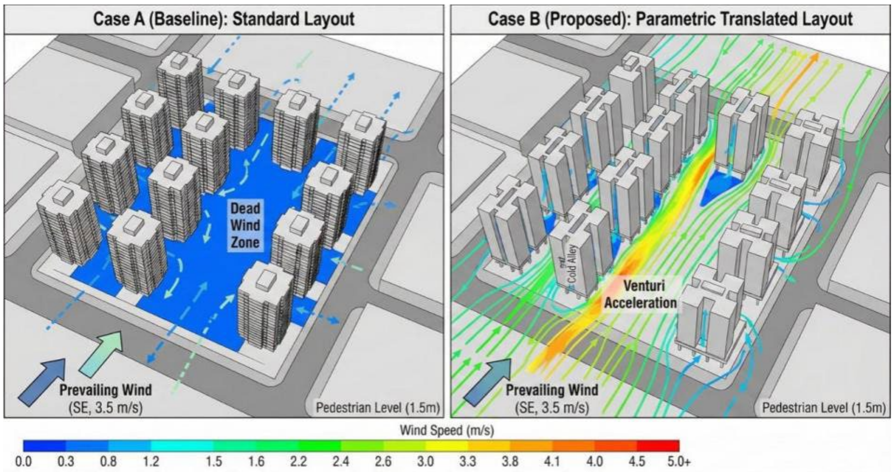


Figure 4 CFD Simulation comparison between standard layout and parametric translated layout

Elimination of Dead Zones: Figure 4 (Left) reveals that Case A suffers from extensive "wind shadow zones" on the leeward side, leading to air stagnation and heat accumulation. Conversely, Case B (Right) utilizes "cut" cold alleys to guide airflow deep into the cluster. Simulation results confirm a significant improvement, with dead wind zones reduced by approximately 40% compared to the baseline.

Activation of Venturi Effect: The most distinct improvement occurs within the corridors. In Case B, geometric constriction accelerates wind speed from 3.5 m/s to nearly 4.2 m/s inside the "Modern Cold Alley." This confirms that the extracted Venturi effect functions effectively within high-rise contexts, facilitating rapid heat dissipation.

Discussion of Effectiveness

These results support the hypothesis that traditional Lingnan wisdom relies on geometry rather than scale. By adhering to extracted parameters, the proposed framework successfully re-established the buildings' "breathing capacity" even within high-density fabric. This outcome validates the Parametric Extraction Mechanism as a robust tool for translating cultural forms into functional, climate-responsive strategies.

DISCUSSION & CONCLUSION

Discussion

1) Cost-Benefit Analysis: Reframing Spatial Loss as Strategic Investment

The quantitative data indicates that the implementation of the “Parametric Translation” framework—specifically the introduction of “Modern Cold Alleys” (1:4 width ratio) and elevated pilotis (4.5m height)—results in an initial reduction of approximately 5% to 8% in the Gross Floor Area compared to the theoretical maximum capacity of the Base Case.

From a traditional volume-driven perspective, this reduction might appear as a sunk cost. However, a lifecycle cost-benefit analysis reveals that this spatial sacrifice functions as a strategic capital investment rather than a net loss. The return on investment (ROI) is realized through two primary economic channels:

- Reduced Operational Expenditure via Passive Cooling: The simulation results confirm a 40% reduction in dead wind zones and a localized Physiological Equivalent Temperature drop of 1.5°C. In the hot-humid climate of Shenzhen, these microclimatic improvements translate directly into energy efficiency. The enhanced natural ventilation significantly reduces the cooling load required during transition seasons, thereby lowering long-term electricity consumption for mechanical air conditioning. The “negative space” of the alleys effectively acts as zero-energy infrastructure, offsetting the initial loss of buildable area through lower annual maintenance and utility costs.
- Asset Appreciation and Resilience: High-density design is often framed as a zero-sum game between volume and quality. This study challenges that norm by demonstrating that porosity creates premium value. The introduction of voids prevents the formation of a “pressure cooker” environment common in maximized-volume designs, thereby extending the asset's functional lifespan. This approach aligns with Environmental, Social, and Governance criteria, enhancing the institutional reputation and preventing the rapid depreciation of building stock due to poor environmental performance.

2) Human Capital Sustainability: The Social Dividends of Thermal Comfort

Beyond physical and economic metrics, the parametric strategy serves as a driver for “Human Capital Sustainability” within the university context. The improvement in outdoor thermal comfort links directly to student productivity and social wellbeing.

- Mitigation of Thermal Stress and Cognitive Performance: The reduction of dead wind zones and ambient temperature mitigates thermal stress for campus users. Research indicates that comfortable physical environments correlate with higher levels of concentration and reduced mental fatigue. By transforming the campus from a thermally hostile environment into a comfortable habitat, the design supports the core academic mission, potentially boosting learning efficiency and research output.
- Facilitating Informal Interaction and Social Cohesion: The “porous” spaces—such as the widened alleys and elevated pilotis—transcend their thermodynamic function to become social catalysts. Unlike traditional enclosed corridors, these thermally comfortable zones encourage spontaneous interactions and informal academic exchange. This fosters a sense of community and place attachment, which are critical components of social sustainability in high-density educational environments.

3) From Thermodynamic Machine to Social Condenser

Critiquing the “Thermodynamic Machine” metaphor, this study argues that climate-responsive spaces must also function as social infrastructure. In high-density vertical campuses, the risk of social alienation increases as physical proximity does not guarantee social interaction. The “porous” spatial prototypes—specifically the widened Modern Cold Alleys and the shaded Pilotis—act as “Social Condensers” that lower the threshold for informal interaction.

By providing thermally comfortable “stop-and-stay” nodes rather than mere circulation channels, these spaces support a diverse range of spontaneous activities, from academic discussions to cultural festivals. This spatial quality is critical for fostering a sense of belonging and community cohesion, transforming the campus from a functional container into a vibrant “Living Lab” for human-centric urbanism.

4) Policy Recommendations: Incentivizing Climate Resilience

The findings of this research extend beyond the campus boundary, offering policy directives for urban planners in the Greater Bay Area. Current zoning regulations, which rigidly control Gross Floor Area, often penalize the creation of "negative spaces" like voids and large-scale breezeways. To resolve this conflict between regulation and climate adaptability, we recommend a shift in urban policy:

- Implementing "Climate-Adaptive Bonus GFA": Municipalities should introduce policy incentives where floor area dedicated to public ventilation corridors and microclimatic regulation is exempted from GFA calculations or awarded density bonuses. This would encourage developers to prioritize environmental performance over maximizing sellable space.
- Establishing Microclimate Performance Guidelines: Urban design codes should evolve from static morphological controls to dynamic performance-based guidelines. Mandatory targets for wind permeability and outdoor thermal comfort should be integrated into the planning approval process for high-density districts, ensuring that "porosity" becomes a standard requirement for urban resilience.

Conclusion

This study tackles a critical challenge. We aimed to integrate traditional wisdom into modern high-density planning. We established a "Parametric Extraction Mechanism." This success fulfills our main objective. We extracted applicable spatial strategies from Lingnan heritage.

The primary contributions are twofold:

Methodological Innovation: We shift the narrative of preservation. We move from "visual imitation" to "structural translation." We deconstructed cultural forms like Cold Alleys. We turned them into geometric variables like D/H ratios. This builds a vital bridge. It connects qualitative heritage descriptions with quantitative modern workflows.

Practical Validation: We applied this to the Sun Yat-sen University Shenzhen Campus. This demonstrates physical effectiveness. The parameters work even in high-rise contexts. The rules induce the Venturi Effect and Stack Effect. This proves a key point. Traditional wisdom can be a robust solution. It resolves the conflict between high density and hot-humid climates. It just needs scientific quantification.

In summary, this research offers a path. It is a replicable model for regional architecture. It proves that culture does not survive through fossilized forms. It survives through the parametric evolution of its ecological wisdom.

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REFERENCES

Dissanayake, C., & Weerasinghe, U. G. D. (2021). Urban microclimate and outdoor thermal comfort of public spaces in warm-humid cities: A comparative bibliometric mapping of the literature. *American Journal of Climate Change, 10*(4), 433-466. https://doi.org/10.4236/ajcc.2021.104023

Elraouf, R. A., Elmokadem, A., Megahed, N. A., Eleinen, O. A. A., & Eltarabily, S. (2022). The impact of urban geometry on outdoor thermal comfort in a hot-humid climate. *Building and Environment*, 225, 109632.

Funari, M. F., Hajjat, A. E., Masciotta, M. G., Oliveira, D. V., & Lourenço, P. B. (2021). A parametric scan-to-FEM framework for the digital twin generation of historic masonry structures. *Sustainability, 13*(19), 11088.

Gamero-Salinas, J., Monge-Barrio, A., Kishnani, N., López-Fidalgo, J., & Sánchez-Ostiz, A. (2021). Passive cooling design strategies as adaptation measures for lowering the indoor overheating risk in tropical climates. *Energy and Buildings*, 250, 111285.

Liang, J., & Sun, X. (2000). Lingnan style architecture under regional culture. *Southern Architecture*, (03), 77-79.

Meili, N., Acero, J. A., Peleg, N., Manoli, G., Burlando, P., & Fatichi, S. (2021). Vegetation cover and plant-trait effects on outdoor thermal comfort in a tropical city. *Building and Environment*, 195, 107733.

Nasrollahi, N., Namazi, Y., & Taleghani, M. (2021). The effect of urban shading and canyon geometry on outdoor thermal comfort in hot climates: A case study of Ahvaz, Iran. *Sustainable Cities and Society*, 65, 102638.

Nejat, P., Ferwati, M. S., Calautit, J. K., Ghahramani, A., & Sheikhshahrokhdehkordi, M. (2021). Passive cooling and natural ventilation by the windcatcher (Badgir): An experimental and simulation study of indoor air quality, thermal comfort and passive cooling power. *Journal of Building Engineering*, 41, 102436.

Oke, T. R. (1982). The energetic basis of the urban heat island. *Quarterly Journal of the Royal Meteorological Society, 108*(455), 1-24.

Oxman, N. (2008). Performance-based design: The integration of digital tectonics and material ecology. *Architectural Design, 78*(6), 46-53.

Priya, U. K., & Senthil, R. (2021). A review of the impact of the green landscape interventions on the urban microclimate of tropical areas. *Building and Environment*, 205, 108297.

Reimaging vernacular architecture with parametric tools. (n.d.). *Rethinking The Future*. Retrieved from https://www.re-thinkingthefuture.com/architectural-community/a14518-reimaging-vernacular-architecture-with-parametric-tools/

Santamouris, M. (2015). Analyzing the heat island magnitude and characteristics in one hundred Asian and Australian cities and regions. *Science of the Total Environment*, 512, 582-602.

Shi, Y., Guo, M., Zhao, J., Liang, X., Shang, X., Huang, M., Guo, S., & Zhao, Y. (2024). Optimization of structural reinforcement assessment for architectural heritage digital twins based on LiDAR and multi-source remote sensing. *Heritage Science*, 12, Article 45.

Widera, B. (2021). Comparative analysis of user comfort and thermal performance of six types of vernacular dwellings as the first step towards climate resilient, sustainable and bioclimatic architecture in western sub-Saharan Africa. *Renewable and Sustainable Energy Reviews*, 140, 110736.

Wong, N. H., He, Y., Nguyen, N. S., Raghavan, S. V., Martin, M., Hii, D. J. C., Yu, Z., & Deng, J. (2021). An integrated multiscale urban microclimate model for the urban thermal environment. *Urban Climate*, 35, 100730.

Xiao, Y., & Liu, S. (2015). Study on the scale of climatic space in traditional Lingnan architecture. *Dynamic (Eco-City and Green Building)*, (02), 73-79.

Zhang, B., et al. (2023). Construction wisdom of traditional dwellings in China's Yangtze River Delta: A study based on daylighting environment. *Sustainability, 15*(12), 517.

Zhang, X., Zhi, Y., Xu, J., & Han, L. (2022). Digital protection and utilization of architectural heritage using knowledge visualization. *Buildings, 12*(3), 253.

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