



FRAMED VIEWS: NATURE-INSPIRED LATTICE WINDOWS AND LIGHT-SHADOW TRANSLATION IN CONTEMPORARY INTERIOR SPACE

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Abstract

This paper explores how Huizhou lattice motifs can be translated into modular perforated screens for contemporary interior spaces, so that they function as spatial boundaries rather than surface decoration. Based on field photography in southern Anhui, four motifs—ice-crack plum blossom, ancient coin, lingzhi, and begonia—were redrawn and simplified in AutoCAD to generate repeatable modules, which were then developed into screen panels and tested through digital interior scenarios in 3ds Max. To move the study a step beyond digital visualisation, a model-scale physical prototype of the lingzhi-based screen was fabricated from basswood plywood using laser engraving and cutting to examine modular repetition, wall integration, and visual permeability. In addition, a structured visual assessment rubric was used as an analytical aid to compare daylight filtering, shadow readability, visual permeability, and graded privacy under controlled scenario conditions. The findings show that differences in module density, opening distribution, and edge continuity influence how the screens filter daylight, cast readable shadows, and shape graded privacy within interior space. The study proposes a practical motif-to-module process and contributes to the discussion of heritage-sensitive, lightweight, and reversible interior boundary design.

Keywords: Huizhou lattice, modular perforated screen, interior boundary, heritage-sensitive design, design-based research

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INTRODUCTION

Traditional lattice windows and screens in Huizhou architecture demonstrate how interior space can remain connected to nature through patterned openings and daylight. Although many motifs are derived from natural forms, these elements were historically not used as decoration alone; they operated as spatial devices that temper incoming light, support ventilation, and maintain visual links across boundaries, allowing spaces to feel connected without being fully exposed (Wang, 2023; see Figure 1). What makes lattice work especially spatial is its changing behaviour over time: the motif is present as a visible pattern, yet it also reappears as shadows that travel across interior surfaces (Fu, 2017). As daylight shifts throughout the day, the same boundary can feel lighter, softer, or more protective—producing a dynamic experience of framed views and moving shadows. In this sense, lattice screens function as environmental mediators: they shape atmosphere and spatial perception by filtering light, guiding views, and creating degrees of separation rather than a fixed divide (Jiang, 2015; Mohd Nawayai et al., 2020).

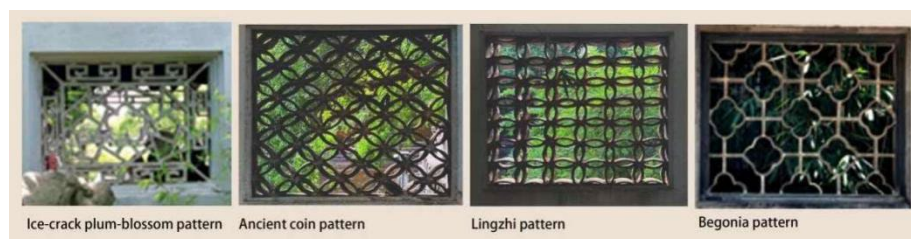


Figure 2: Traditional lattice windows in architecture

Source: Author's own work

In many contemporary interiors, however, lattice motifs are often reintroduced mainly as style references—printed, engraved, or applied as decorative panels. Once detached from their original spatial role, the pattern becomes a surface graphic rather than an active boundary, weakening its capacity to filter light, support privacy, and shape atmosphere, while cultural meaning is reduced to a static visual symbol. This gap matters because the strength of lattice work was never only its appearance; it lay in how pattern, light, and permeability worked together to shape everyday comfort. Yet design-based studies that provide a clear and reusable framework for reinterpreting Huizhou lattice logic as buildable interior boundary elements—elements that can be combined and tested across realistic spatial scenarios—remain limited.

This study therefore examines how nature-inspired Huizhou lattice motifs can be reintroduced into modern interior spaces as modular perforated screens that operate as active spatial boundaries. Rather than replicating historical window forms, it translates lattice logic—view filtering, light—shadow

expression, and graded privacy—into modular units that can be fabricated, assembled, and deployed across interior situations. To keep the exploration specific and comparable, four motifs commonly found in Huizhou lattice windows are selected: ice-crack plum blossom (binglie meihua), ancient coin (tongqian), lingzhi, and begonia (haitang). These motifs represent different geometric logics—networked fragmentation, circular repetition, curvilinear outlines, and density variation—and are abstracted into repeatable units for consistent testing (Figure 2). The study follows a traceable motif-to-module process in which motifs are abstracted into repeatable modules, recomposed into screen panels, and then examined through scenario-based visual comparisons under consistent viewing conditions. It focuses on two questions: how Huizhou lattice motifs can be translated into buildable modular perforated screen units for modern interior spaces, and how module geometry and screen placement shape light–shadow behaviour, visual permeability, and privacy gradients across interior scenarios.

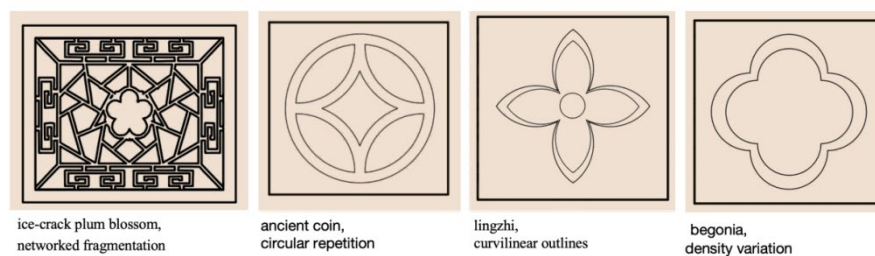


Figure 2: Selected Huizhou lattice motifs and their geometric logics for module translation

Source: Author's own work

This paper proposes a motif-to-module approach that translates Huizhou lattice patterns into working interior boundary elements for contemporary spaces. It focuses on how module geometry and placement affect light filtering, shadow expression, permeability, and privacy within controlled interior scenarios. The main analysis remains qualitative and comparative, but in order to move beyond digital rendering alone, the study also includes a model-scale physical prototype of the lingzhi-based screen. This prototype serves as an initial step in examining motif repetition, panel composition, and spatial integration in a contemporary bedroom setting. The study also introduces a structured visual assessment rubric to make the qualitative comparison more transparent and to support the preliminary design validation of the motif-to-module process. While full-scale testing is beyond the present scope, the study aims to provide a clearer translation path from traditional motif to interior application.

LITERATURE REVIEW

Huizhou lattice windows and framed views: morphology and meaning

Research on Huizhou lattice windows often begins with motif traditions, craft techniques, and symbolic interpretation (Wang & Qin, 2014). For interior space, however, the key point is that these motifs were historically embedded in a boundary system rather than treated as surface graphics. A lattice boundary is formed through an opening frame, a repeatable pattern, and a calibrated relationship between solid and void that is experienced through light, view, and everyday use (Zhao, 2024). This is what makes lattice work spatial: it sustains connection while still shaping separation and comfort (Mao & Sun, 2022).

In this study, framed views do not mean turning an opening into a picture. They refer to the way a boundary organises seeing. A lattice screen does not simply open or close a view; it structures how the view is encountered through partial reveal, filtered contact, and a controlled sense of distance (Fu, 2019). The spatial meaning is therefore not carried by the motif alone, but by how the motif operates as part of a boundary—how it guides attention, softens exposure, and changes the interior’s relationship to outside conditions (Chen & Sun, 2018). For contemporary translation, this shifts attention away from surface resemblance and towards boundary logic and spatial effect.

Huizhou lattice work also includes recurring motif families that can be discussed not only by meaning but by geometric structure—networks, circular repetition, curvilinear outlines, and density variation (Yang, 2018). This lens matters for translation because it clarifies what is being carried forward: not the image alone, but the logic that organises openings (Fu & Zhao, 2018). Based on this understanding, the present study selects four motifs—ice-crack plum blossom (binglie meihua), ancient coin (tongqian), lingzhi, and begonia (haitang)—as representatives of distinct geometric logics that can be abstracted into repeatable units and compared under consistent scenarios (Zhao, 2025). Taken together, the literature supports a shift from motif-as-image to motif-as-boundary logic, which provides a clear basis for motif selection and geometric abstraction in this study.

Perforated screens as interior boundaries: daylight, privacy, and atmosphere

Perforated screens are widely used in contemporary interiors because they divide space without full enclosure. They retain continuity while introducing separation, which matches everyday needs where openness and privacy often have to coexist (Hu, 2016). As boundary elements, these screens operate by shaping what passes through them—light, views, and a sense of presence between zones—rather than by blocking everything completely (Zhang, 2019).

From a daylight perspective, the aim is often not “more light” but usable light. Perforated boundaries can soften direct sun, reduce glare, and create calmer transitions rather than harsh contrast (Feng, 2024). Shadow becomes part of the boundary experience as the screen is read through the pattern it casts; interior atmosphere may shift across the day as daylight changes (Jiang, 2025). In this sense, perforated screens can be time-sensitive and responsive even when the boundary itself does not move (Maria & Prihatmanti, 2017).

Privacy, similarly, is rarely an all-or-nothing condition. Many interior situations require partial concealment rather than full blocking, and porous boundaries are often used to support graded visibility—allowing connection while reducing exposure (Chen & Qian, 2023). Here, permeability is not only visual but also experiential: it shapes how close or distant zones feel and how comfortable occupants feel about being seen or not seen (Zhang & Huang, 2021).

Ventilation is sometimes mentioned as a benefit of porous boundaries, but it is difficult to claim without measurement and context-specific modelling. In this study, airflow is treated as a potential implication rather than an evaluated outcome. The analysis therefore focuses on boundary behaviours that can be examined through design and visual evidence—daylight and light-shadow behaviour, visual permeability, and graded privacy. Overall, the literature frames perforated screens as interior boundary devices whose effects are readable through light-shadow expression and controlled visibility, supporting the evaluation criteria adopted in this study.

Heritage-sensitive translation and research gap

Heritage-inspired interior design often reintroduces traditional motifs as visual identity. The risk is that the motif becomes a surface reference while its original boundary role disappears (Yu & Sha, 2014). An experience-oriented perspective therefore asks a simpler question: when the motif returns, does it still do work at the boundary—shaping light, visibility, and everyday comfort—or does it remain a graphic layer?

Direct replication is rarely effective in modern interiors. Materials, construction constraints, scale, and patterns of use differ from historical contexts, and copying historic forms can produce a mismatch between appearance and performance (Yu, 2014). Translation is often more workable: extract motif logic, simplify it, rebuild it as a modular system, and deploy it in ways that make sense for contemporary interior boundaries (Zhao, 2013). This approach depends on explicit design decisions and benefits from design-based research in which knowledge is produced through making, prototyping, and structured reflection rather than description alone.

Existing studies provide useful foundations—some examine lattice symbolism and craft, while others discuss perforated boundaries as spatial

devices for light and privacy. However, there remains limited work that connects these streams in a reusable way for contemporary interior application (Fu, 2019). What is still missing is a clear and transferable chain that links motif logic to buildable modular screens and to comparable interior experience evidence. In other words, few studies show—through traceable design steps and consistent visual comparisons—how Huizhou lattice motifs can be translated into screen systems that operate beyond stylistic reference. This gap motivates the present study’s motif-to-module workflow and its scenario-based comparison method, which together connect heritage logic, buildability, and evaluable interior experience. Figure 3 summarises this conceptual link and clarifies how the literature leads to the motif-to-module workflow and the structured visual assessment focus adopted in this study.

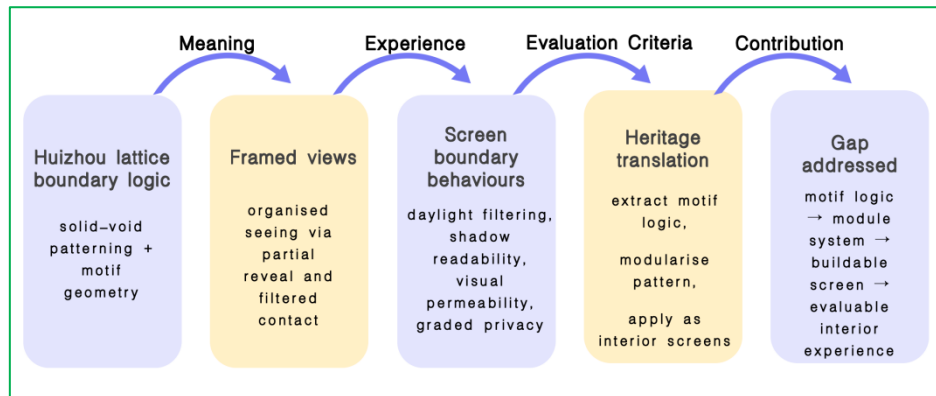


Figure 3: Conceptual link between Huizhou lattice boundary logic, motif-to-module translation, and modular screen evaluation

Source: Author's own work

RESEARCH METHODOLOGY

This study adopts a qualitative, design-based research approach to translate Huizhou lattice window motifs into modular perforated screens for contemporary interior boundary design. The method is structured as a traceable workflow with three phases: field documentation and motif selection, motif-to-module translation and digital prototyping, and scenario-based evaluation through controlled visual comparison. Each phase produces design artefacts—photographs, reconstructed drawings, modules, screen compositions, and scenario visuals—that support the analysis.

Motif-to-module translation and digital prototyping

An extract–transform–apply process is used to translate Huizhou lattice motifs into modular perforated screen units (Figure 4). Four motifs—ice-crack plum

blossom (binglie meihua), ancient coin (tongqian), lingzhi, and begonia (haitang)—are selected to represent distinct geometric logics (network fragmentation, circular repetition, curvilinear outlines, and density variation) and to enable systematic comparison. Motifs are reconstructed as clean linework in AutoCAD for consistent scaling and alignment, then simplified through geometric abstraction to retain relationships that shape boundary reading at interior scale (opening distribution, edge continuity, and density). Each abstracted geometry is developed into a repeatable module and recomposed into screen panels through rotation, mirroring, and tiling strategies, before being modelled as digital prototypes in 3ds Max.

Model-scale physical prototype

A model-scale physical prototype of the lingzhi-based screen was produced to supplement the digital scenario study. The prototype was fabricated from basswood plywood using a laser engraving and cutting machine. The lingzhi motif was first simplified into modular linework, then repeated into a screen panel and laser-engraved and cut into the plywood surface. The panel was assembled within a bedroom wall model to examine motif repetition, panel composition, wall integration, spatial layering, and visual permeability at model scale. Because the prototype was produced as a model-scale design study rather than a full-scale building component, no fixed architectural scale ratio was applied. Its purpose was to provide preliminary design validation of the motif-to-module translation process, rather than to test structural strength, fire performance, long-term durability, or code compliance.

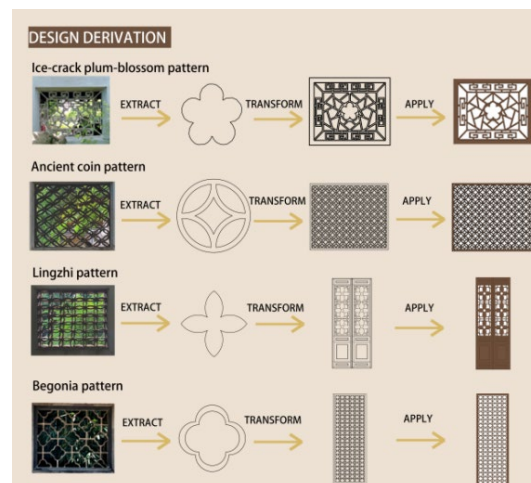


Figure 4: Motif-to-module workflow (extract–transform–apply) for the four Huizhou lattice motifs

Source: Author's own work

Scenario-based evaluation protocol

The screens are tested in a small set of interior scenarios modelled at interior scale. To ensure cross-motif comparability, room layout, screen size and placement, lighting and camera settings are held constant, while only the perforation module (motif logic) is varied. Evaluation focuses on criteria readable through visual evidence: light–shadow behaviour (daylight moderation and shadow legibility), visual permeability (filtered contact across zones), and graded privacy (degrees of visibility rather than open/closed). Comparisons follow a controlled-variation logic: either module geometry is adjusted with deployment fixed, or deployment factors (position, extent, orientation) are adjusted with module logic fixed. Figures 5 and 6 pair dimensioned drawings with scenario views to document scale, positioning, and the evaluation set-up.

To strengthen the transparency of the qualitative comparison, a structured visual assessment rubric was introduced as an analytical aid rather than as an instrument-based measurement method. Four criteria were assessed: daylight filtering, shadow readability, visual permeability, and graded privacy. Each criterion was rated on a three-point scale, where 1 = low, 2 = medium, and 3 = high. Daylight filtering refers to the degree to which the screen softens and distributes incoming light. Shadow readability refers to the clarity and legibility of the cast pattern on adjacent floors and walls. Visual permeability refers to the extent to which views remain partially connected through the screen. Graded privacy refers to the degree to which direct visibility is reduced without fully closing the spatial boundary. The assessment was conducted under the same room model, screen size, lighting conditions, and camera viewpoint, so that differences could be attributed mainly to motif geometry and perforation logic.

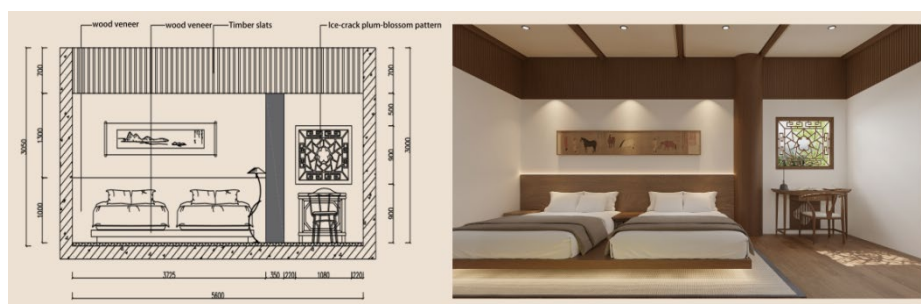


Figure 5: Dimensioned drawing and scenario view used to clarify scale and positioning (ice-crack plum blossom module)

Source: Author's own work

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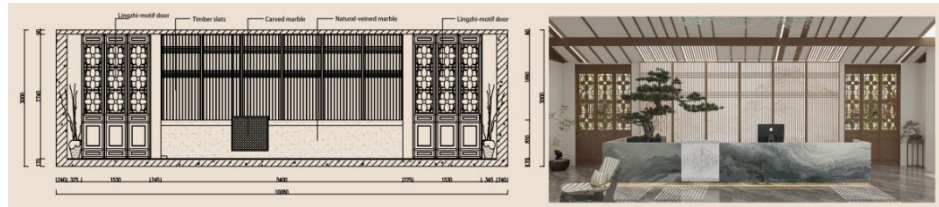


Figure 6: Dimensioned drawing and scenario view used to clarify scale and positioning (lingzhi module)

Source: Author's own work

RESULTS AND DISCUSSION

This section analyses the outcomes of translating four Huizhou lattice motifs into modular perforated screens and discusses how their boundary behaviours become readable at interior scale. The prototypes are derived from ice-crack plum blossom (binglie meihua), ancient coin (tongqian), lingzhi, and begonia (haitang). Each motif is abstracted into a repeatable module and recomposed into screen panels for interior boundary use. Evidence is presented through reconstructed drawings, scenario views produced under controlled comparison conditions, and a model-scale physical prototype.

The model-scale lingzhi-based prototype provides preliminary design validation of the motif-to-module translation process. It shows that the abstracted lingzhi geometry can be repeated as modular units, assembled into a screen panel, and integrated into a bedroom wall setting. Compared with digital scenario views, the physical prototype makes the panel depth, edge condition, repeated openings, and wall relationship more directly observable. However, this validation remains design-based and model-scale. It supports modular composition and visual permeability, but does not verify full-scale construction performance, structural stability, fire safety, long-term durability, or code compliance.



Figure 7: Model-scale lingzhi-based screen prototype showing modular repetition, wall integration, and visual permeability

Source: Author's own work

At close interior scale, boundary effects register most clearly through daylight filtering and shadow readability. In the bedroom scenarios, incoming daylight is moderated into a softer distribution, while cast patterns remain legible on adjacent surfaces, extending the boundary effect beyond the screen (Figure 8). Across motifs, cut-out geometry alters shadow density and edge clarity, producing distinct boundary readings without full enclosure.



Figure 8: Close interior views showing daylight filtering, shadow legibility, and partial visual separation

Source: Author's own work

In larger and more open interiors, the boundary effect relies less on enclosure and more on controlled permeability and spatial layering. The screens maintain continuity across zones while reorganising sightlines and reducing direct exposure, producing a more comfortable privacy gradient. Patterned daylight can spread across wider floor areas, reinforcing boundary presence and spatial legibility in open-plan settings (Figure 9).



Figure 9: Entrance scenario showing filtered sightlines, spatial continuity, and cast patterns

Source: Author's own work

To clarify recurring trade-offs, Table 1 presents a structured visual assessment of the four motif modules using four shared criteria: daylight filtering,

shadow readability, visual permeability, and graded privacy. The scores are comparative visual judgements rather than instrument-based measurements, derived from the same digital scenario conditions, including room setting, screen placement, daylight direction, and camera viewpoint. This allows the boundary effects of different motif geometries to be compared within the qualitative design-based scope of the study.

Table 1: Structured visual assessment of observed boundary behaviours

Motif module	Daylight filtering	Shadow readability	Visual permeability	Graded privacy
Ice-crack plum blossom	3	2	2	3
Ancient coin	2	3	2	2
Lingzhi	2	2	2	2
Begonia	3	1–2	3	1–2

Note: 1 = low, 2 = medium, 3 = high. Intermediate scores indicate an observed tendency between two levels. Scores are based on controlled visual comparison and should be read as comparative visual judgements rather than instrument-based measurements.

Source: Author's assessment based on controlled scenario comparison.

Overall, the analysis indicates that once Huizhou lattice motifs are translated into modular perforated screens, their value is best interpreted through boundary behaviour rather than surface appearance. Differences in openness, shadow legibility, and graded privacy—together with screen placement—shape interior readings through daylight–shadow expression, perceived permeability, and privacy without full enclosure (Figure 10). This supports the study's focus on framed views and light–shadow translation as experience-oriented outcomes.



Figure 10: Interior application showing porous boundary performance, daylight modulation, and graded privacy

Source: Author's own work

A key implication is a shift from motif-as-decoration to motif-as-working boundary. When positioned at an interior threshold, the translated motifs operate as boundary devices by filtering visibility, clarifying edges between zones, and enabling separation without breaking connection, linking motif geometry to porous boundary performance in interior space (Chen & Sun, 2018).

The findings also inform heritage-sensitive interior renewal. Rather than direct replication or complete replacement, translation carries forward boundary logic—how a porous screen mediates daylight, sightlines, and everyday privacy under contemporary conditions. In adaptive reuse, homestay upgrades, and small refurbishments, modular perforated screens offer a lightweight and reversible way to reorganise zoning and visibility without permanent partitions. In experience terms, the outcomes suggest a passive design direction: softened daylight and readable cast patterns may support comfort and atmosphere through visual and spatial modulation (Zhang & Huang, 2021). The four motifs also function as a practical decision set for balancing daylight filtering, shadow readability, visual permeability, and graded privacy (Yuan, 2021). The physical prototype of the lingzhi-based screen further shows that the translated motif can be organised as a repeated modular system in interior space, rather than remaining only as a graphic composition.

Implementation considerations for real interior application

For real interior implementation, the translated lattice screen should be understood as a non-load-bearing interior boundary element rather than a structural wall. While the model-scale prototype was fabricated from basswood plywood, future full-scale applications may consider locally available native wood, such as Melia wood, to support local material use and cultural continuity. Before application, the selected timber should be properly dried and treated with sealing primer and protective coating to improve dimensional stability, moisture resistance, and surface durability. In terms of installation, simplified mortise-and-tenon joints may be considered for lattice components, while reversible mechanical fixing methods may also support disassembly, maintenance, and replacement. Practical application would still require consideration of panel stability, fire-retardant treatment, material durability, and compliance with relevant local building codes. Therefore, full-scale construction testing, material durability assessment, joinery and fixing assessment, fire-safety verification, and code-compliance review remain necessary before real interior application.

This study has limitations. Evidence remains mainly qualitative and visual, without measured lighting performance, user-perception surveys, or instrument-based privacy evaluation. Although a model-scale prototype was added, the study has not yet reached full-scale fabrication or user-based testing in real interiors. The motif set is selective, and the scenarios are designed for

comparability rather than full real-world variation. Future work should include quantitative lighting analysis, larger-scale prototyping, local timber verification, material testing, joinery and fixing assessment, safety assessment, code-compliance review, and on-site observation.

CONCLUSION

This study repositions Huizhou lattice motifs from surface styling to working interior boundary devices through a traceable motif-to-module workflow. Four motifs—ice-crack plum blossom (binglie meihua), ancient coin (tongqian), lingzhi, and begonia (haitang)—were documented, abstracted into repeatable modules, and recomposed into modular perforated screen panels for contemporary interior use. The scenario-based comparisons show that motifs become spatially meaningful when treated as boundary logic rather than graphic imagery. At close range, the screens moderate daylight and produce readable cast patterns; in more open settings, they filter sightlines and shape graded privacy through controlled permeability.

The structured visual assessment further clarifies cross-motif trade-offs in daylight filtering, shadow readability, visual permeability, and graded privacy, supporting selection decisions based on intended boundary outcomes. The model-scale physical prototype also supports the motif-to-module process by demonstrating modular repetition, wall integration, and visual permeability. Together, these findings suggest a heritage-sensitive strategy for translating traditional lattice logic into lightweight and reversible interior boundary design.

This study remains limited by its qualitative and visual mode of evaluation. It does not include measured lighting performance, real interior testing, material carbon calculation, life-cycle assessment, or energy-performance analysis. Future work should extend the study through measured lighting evaluation, full-scale prototyping, material testing, safety and durability assessment, code-compliance review, and on-site observation.

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DISCLOSURE STATEMENT

The authors declare no conflict of interest.

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