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Research on Cultural Gene Extraction and Design Application of Guangdong Hakka Architectural Ornaments from the Semiotic Perspective — Taking Window-door Lattice Grilles and Ridge Decorations as Examples

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Abstract: Hakka architectural ornaments are visual products resulting from the integration of Central Plains immigrant culture and native Lingnan culture, carrying unique ethnic group memories and clan ethics. Taking Guangdong Hakka architectural ornaments as the research object, ancient buildings in Tuocheng as the case site, and focusing on two key components: window-door lattice grilles and ridge decorations, this paper conducts research on cultural gene extraction and design application from the semiotic perspective. It first sorts out the symbolic composition and formal rules of the two categories of components, then decodes their cultural genes from three dimensions: form tracing, semantic analysis, and craft carrier. Through ornament database construction, formulation of trans-translation strategies, and design practice, it explores feasible paths for transforming traditional ornament genes into contemporary cultural and creative (CC) products. The study shows that semiotic approaches can effectively guide the identification and transformation of ornament genes, providing operable paths for the living inheritance of Hakka architectural heritage.

Keywords: Guangdong Hakka Architectural Ornaments; Cultural genes; Window-door lattice grilles; Ridge decorations; Cultural and creative product design

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1. Introduction

Decorative ornaments of Guangdong Hakka architecture are widely distributed on architectural components such as window-door lattice grilles, ridge stucco reliefs, beam and fang wood carvings, reflecting inheritance, selection, and local adaptation of Central Plains culture in its southward spread [1]. Nevertheless, current studies on Guangdong Hakka architectural ornaments mostly focus on art archaeology and form classification

within history and architecture disciplines. Systematic semiotic interpretation of their cultural coding mechanisms is rare, and systematic methodologies for translating them into contemporary design resources are even more insufficient. Taking two of the most representative components — window-door lattice grilles and ridge decorations — as samples, this study adopts semiotic methods to decode their cultural genes. Taking design practices on decorative ornaments of ancient buildings in Tuocheng as an example, it explores feasible paths for transforming Hakka architectural ornaments from "historical relics" into "creative capital."

2. Symbolic categories and morphological characteristics of Hakka architectural ornaments

2.1. Main types and regional distribution of Hakka architectural ornaments

Attached to components such as beam frames, windows and doors, ridge ornaments and wall surfaces, Hakka architectural ornaments can be classified into four major categories: wood carving, brick carving, stucco relief and colored painting. Wood carvings are generally applied to beam fangs, bracket sets and window-door lattice grilles; brick carvings frequently appear on gatehouses, corner piers and under eave bands; stucco reliefs are mostly used for roof ridges and gable wind boards; colored paintings are mostly found on indoor ceilings and under eave wall surfaces [2]. Regionally, wood carved lattice grilles and colored paintings stand out in Meizhou, eastern Guangdong. Brick carvings and stucco reliefs are more prominent in ancestral halls and academies in Heyuan and Shaoguan of northern Guangdong. Ornaments on tulou buildings in western Fujian and southern Jiangxi are relatively concise. The overall pattern is closely related to migration routes and artisan traditions, presenting the feature of "same origin with divergent developments."

2.2. Symbolic composition and formal rules of window-door lattice grilles

The symbols of window-door lattice grilles take muntin combinations as their core. Through horizontal-vertical intersection, oblique interweaving, or curvilinear winding, muntins form continuously repeating geometric units. Common types include square grid, oblique grid, step-by-step brocade, tortoise shell pattern, ice crack pattern, and swastika pattern. Linear combinations convey a sense of order and stability, while curvilinear or broken line forms bring fluidity and agility. The visual focus of lattice grilles lies in the rhythmic contrast between "void" and "solid." Muntin cross sections and arrangement densities determine light filtering effects, balancing shelter, ventilation, and daylighting. Compared with Jiangnan and Cantonese styles, Hakka lattice grilles pursue variations within regularity, with rarely seen complicated curved muntin winding. They embody the character of "substantial yet not clumsy, simple yet not crude." Even within Guangdong Hakka regions, differentiations exist. Adjacent to Chaoshan, some ancestral hall lattice grilles in Meizhou, eastern Guangdong, occasionally adopt the "soft strip" technique with interlaced curved and straight muntins, obviously bearing the delicate stylistic traits of Chaoshan gilded wood carvings. By contrast, lattice grilles in Heyuan and Shaoguan of northern Guangdong are dominated by horizontal and vertical square grids and oblique grids, with sharp corners and scarcely any winding curves, consistent with the vigorous temperament of local brick and stone architecture.

2.3. Symbolic composition and formal rules of ridge decorations

Ridge decorations include chi wei or ao fish ornaments at both ends of main ridges, animal figures or grass dragon ornaments at the ends of sloping ridges, stucco floral patterns and inscriptions in the middle ridge

sections, as well as pearl and gourd ornaments atop ridges. A prominent feature of Hakka roof ridges is "emphasizing both ends while simplifying the middle sections": both ends rise sharply with exaggerated scroll grass curves or fish dragon shapes to form "swallow tail ridges" or "dragon tongue ridges," and the middle ridge sections are filled with stucco interlocking branch patterns. Themes mostly feature flowers and fruits such as peony, lotus, and pomegranate, together with auspicious beasts including bats, cranes, and ao fish, with red, blue, and green as dominant hues [3]. Possessing three-dimensional volume, ridge forms must take into account both distant high-altitude viewing and drainage functions, hence tending toward generalization and exaggeration.

2.4. Differences and correlations between the two component symbolic systems

Window-door lattice grilles and ridge decorations belong respectively to horizontal view and upward view spatial layers. The two-dimensional geometric composition of lattice grilles and three-dimensional sculpting of ridge ornaments determine that the former relies on repetition and variation of linear order, while the latter depends on stacking and echo of volume relations. The "permeability" of lattice grilles generates the signified meaning of "interplay of void and solid," whereas the "solid nature" of ridge ornaments delivers more direct signification. Nevertheless, deep-seated connections exist between them: both display curvilinear forms inherited from Tang dynasty Central Plains architectural traditions, and integrate Lingnan local aesthetic preferences for bright colors and straightforward implied meanings. Lattice grilles evolve toward "ordered abstraction," and ridge decorations toward "symbolic figuration." Together they constitute the overall symbolic layout of "ornate upper sections, simple lower sections; virtual front parts, solid rear parts."

3. Decoding cultural genes of window-door lattice grilles and ridge decorations

3.1. Form tracing: Central plains genealogy and local adaptation in Lingnan

The morphological origins of Hakka architectural ornaments can be traced back to Tang and Song dynasty Central Plains architectural traditions. Geometric patterns such as square grids, oblique grids, and swastika patterns on window-door lattice grilles already appeared in window lattice depictions in Dunhuang murals and the "lattice door" regulations in the Northern Song *Yingzao Fashi* (Treatise on Architectural Methods). Their compositional rules were brought to southern Jiangxi and western Fujian by gentry clans migrating southward from the Central Plains, and later spread to eastern and northern Guangdong. Scroll grass curves and chi wei forms on roof ridges can likewise find prototypes in surviving examples such as the East Main Hall of Foguang Temple built in the Tang Dynasty. After Hakka ancestors settled in Lingnan, original forms underwent systematic local adaptation. On roof ridges, relatively low-profile main ridge curves of official Central Plains architecture were greatly elevated and extended outward to form sharply rising "swallow tail" or "dragon tongue" shapes, reflecting morphological variation and meaning reconstruction of Central Plains forms in alien cultural soil. Within Guangdong, such high-rise features are particularly striking: ridge end upturns of ancestral halls along the Dongjiang River are approximately one quarter higher than those of comparable buildings in western Fujian and southern Jiangxi. Stucco reliefs on ridge bodies also frequently depict Lingnan produce such as litchi and plantain. Clearly, these are products formed centuries after settlement in Guangdong, showing marked differences from concise ridge ornaments retaining Central Plains archaic features from the early southern Jiangxi settlement period.

3.2. Semantic analysis: Symbolic expressions of auspicious concepts and clan ethics

The semantic system of Hakka architectural ornaments is superimposed by two layers. The first layer consists of widely seen auspicious blessing motifs: bats phonetically symbolize "blessing," gourds metaphorize "multi offspring," peonies imply "prosperity and wealth," and swastika patterns signify "continuity." In Hakka regions, these universal motifs are further endowed with clan ethical connotations, and their application scenarios concentrate on clan spaces such as ancestral halls and academies. The second layer represents distinctively Hakka expressions of clan ethics. People in Hakka regions lived in clan communities, and architectural ornaments serve as spatial projections of clan consciousness. Themes such as "Two Phoenixes Facing the Sun" and "Qilin Spitting Out Books," presented via brick or stucco carvings on ancestral hall gatehouses, propagate values of official career success through imperial examinations and embody disciplinary expectations for younger generations. The motif of "ice crack patterns combined with plum blossoms" on window-door lattice grilles carries symbolism: plum blossoms stand for "hardiness and perseverance," echoing Hakka migration history, while "ice crack window openings" imply the moral of "diligent study in cold window conditions." Noteworthy is the "interlocking branch" imagery. Different from purely aesthetic vine curves in Jiangnan literati gardens, coiling interlocking branch motifs in Hakka ornaments are endowed with ethical implications of "clan continuity and enduring ancestral worship," unifying formal aesthetic attributes and collective clan will at the symbolic level.

3.3. Craft carrier: Shaping of ornament forms by material properties and production techniques

Final ornament forms are shaped both by design intentions and strictly constrained by material properties and production techniques [4]. Wood carved ornaments are commonly seen on window-door lattice grilles and indoor beam frames; wood possesses carving workability. Brick carvings are mostly applied to gatehouses and under-eave components. Dense yet brittle blue bricks lead brick carved ornaments toward geometrization and stylization, dominated by bas-relief or flat carving. Concentrated on roof ridges and gable surfaces, stucco reliefs feature high plasticity yet limited surface strength; hence, their contours are bold and details generalized. The shaping effects of different craft carriers can be summarized as follows: wood carving emphasizes layers and tends toward "exquisiteness"; brick carving emphasizes regularity and tends toward "vigor"; stucco relief emphasizes volume and tends toward "grandness" [5].

4. Design trans-translation and application practice of cultural genes

4.1. Ornament gene extraction methodology and database construction

Ornament gene extraction comprises four procedures: field collection, vectorization of line drawings, cultural annotation, and scheme expansion. Taking ancient Tuocheng Town as the field site, multi-angle photography is conducted on ornament-intensive positions (ridge stucco reliefs, gatehouse brick carvings, window-door lattice grilles) of ancestral halls, academies, examination sheds, and arcade street buildings, supplemented by hand-drawn sketches. For line drawing vectorization, image processing software converts photographs into standardized black-and-white line drawings; Bézier curves trace outlines to generate vector files. In the cultural annotation step, structured records are created for each ornament item, with fields including name, theme type, architectural source, craft category, formal features, implied connotations, and color records, forming a basic database. In the scheme expansion phase, AIGC tools take high-weight ornaments from

the database as initial prototypes. Shape grammar transformations such as mirroring, scaling, and rotation generate morphological variants. Designers then screen, adjust, and perform cultural verification to finally build an ornament scheme pool.

4.2. Trans-translation strategies from architectural components to cultural and creative products

Threefold conversion of scale, material, and function exists between architectural components and cultural and creative products. In morphological trans-translation, high-angle upward-view architectural ornaments are transformed into horizontally oriented forms for close-range appreciation and handling. Ornaments originally attached to wood and brick need to be adapted to new material carriers such as ceramics, textiles, and metals. In this process, identifying features of ornaments shall be retained while non-critical details may be generalized. In functional trans-translation, ornaments shall be endowed with practical purposes for contemporary daily life, turning cultural heritage from "objects for viewing" into "objects for use." In contextual trans-translation, original semantic meanings, including clan ethics and auspicious blessings, are converted into cultural narratives perceptible to contemporary consumers. The general principles for trans-translation strategies can be summed up as: "gene fidelity, adaptive morphological change, function embedding and narrative reconstruction."

4.3. Design practice cases

As one of the oldest county seats in the Guangdong Hakka region, the ancestral hall system of Tuocheng embodies not the generalized concept of "Hakka," but the concrete historical context of Dongjiang River Basin Hakka clans dwelling together, compiling genealogies and erecting ancestral halls since the Ming Dynasty. This gives clear regional provenance to visual ornament references.

4.3.1. Silk scarf design with ancestral hall ornaments

Core genes are extracted from the "Two Phoenixes Facing the Sun" motif commonly seen on gatehouse brick carvings of Tuocheng ancestral halls (**Figure 1**). Shape grammar operations are adopted for design deduction: taking the original ornament as prototype R0, the mirror symmetry operation R4 generates a complete composition. Finally, the Bézier curve operation R7 softens the curling degree of phoenix tail lines. Extracted ornament genes, including ao fish, precious asoka flowers, round longevity symbols, auspicious clouds, and interlocking grass patterns, are incorporated. Taking square scarves as carriers, the layout follows the compositional rule of "central medallion beast figures at four corners border framing," forming an overall fourfold symmetrical solemn order echoing the axial layout of ancestral hall architectural decorations. Three color schemes are deduced from the same ornament system: gold on black for steadiness and magnificence; orange and cyan on off-white for brightness and lucidity; light green and color on pale green for elegance and subtlety, fitting scenarios of gift-giving, daily wear, and refined gatherings. Soft textiles carry architectural ornaments, transforming fixed ancestral hall architectural components into wearable, mobile bodily adornments, realizing contextual trans-translation of cultural genes from architectural spaces to everyday life.



Figure 1. Renderings of cultural and creative product schemes based on Tuocheng Hakka ancestral hall ornaments. Source: Student course assignments, 2026

4.3.2. Tea set design

Decorative and morphological genes are extracted from interlocking grass patterns, meander patterns, and geometric compositions of window-door lattice grilles of traditional Hakka buildings in Tuocheng, yielding two sets of schemes: blue-green colored porcelain and gold on black. The blue-green porcelain series includes lifting beam pots, fair cups, and flower rim teacups. Lifting beam arcs and flower rim contours echo the fluidity of interlocking grass patterns. Pot and cup bodies are fully painted with purplish red and stone green interlocking grass scrolls dotted with fish motifs. Meander and lattice grille border patterns frame mouth rims and foot rings, against a blue-green and bean green ground, presenting an elegant and fresh temperament. The gold on black series consists of a square tea tray, a pouring pot, and three teacups. The cross sections of the three teacups are respectively circular, rounded square, and square, elevating lattice grille geometric logic into morphological language for utensils. The tray surface uses meander patterns for borders and medallion zoning. Vessel bodies take interlocking grass patterns as background and fish motifs as main decorations. The pot lid is decorated with golden kui fish patterns inscribed with the character “pin” (tasting) as a thematic accent. The black ground with golden lines delivers a lacquer-and-enamel ware textural quality. One set is elegant, the other luxurious; one adopts full ornamentation and the other medallion framing. Both realize functional and contextual trans-translation of Hakka architectural ornaments into daily-use tea ware.



Figure 2. Renderings of cultural and creative product schemes based on Tuocheng Hakka window-door lattice grille ornaments. Source: Student course assignments, 2026

4.3.3. Ridge beast IP character design

Morphological genes are extracted from ridge beast figures and interlocking grass patterns of Tuocheng Hakka traditional building ridge decorations. Ridge guardian figures are reinterpreted into two mythical beast IP images named “Longchuan” and “Xun’an,” featuring wave-shaped dragon crests on heads, overlapping scales, and fin-shaped wave tails. Two color variants are designed: warm beige gold and pale ice blue. One conveys warmth, the other tranquility, echoing the cultural implication of ridge ornaments for household protection and blessing. Derivative products based on this IP include “Ridge Beast Squad” figurines and mythical beast wind chimes. Figurines take miniaturized roof ridges as bases, suitable for display, balancing, sorting, and collection. Ridge bases adopt tile grey and graphite grey tonalities. Wind chimes string mythical beast figures, bell bodies, and nameplates: Longchuan matches bronze bells while Xun’an matches white porcelain bells. Voice recognition interaction is introduced: wind blow or voice pattern matching triggers exclusive chime sounds, extending user experience from “static viewing” to “auditory perception.” This case reconstructs the guardian narrative of ridge beasts into companion-like interactive everyday objects, completing contextual reconstruction of cultural genes from architectural decorations to emotion-oriented cultural and creative products.



Figure 3. Renderings of Tuocheng Hakka ridge decoration IP character design schemes. Source: Student course assignments, 2026

4.4. Design reflections and maintenance of cultural context

The above-mentioned design practices verify the feasibility of cultural gene extraction and trans-translation approaches, yet also reveal several risks requiring vigilance. First, AIGC tools bring the risk of “semantic drift” in ornament scheme expansion: original auspicious connotations may be diluted or even altered, necessitating screening and revision through designers’ cultural verification. Second, moderation must be exercised in simplification and generalization during trans-translation. Excessive simplification may deprive ornaments of recognizability, while overfaithful reproduction reduces products to mere “cultural relic replicas.” Generally speaking, cultural gene trans-translation seeks “recognizable continuity” between

tradition and modernity, allowing ancient ornaments to reappear in everyday life under renewed forms, thus accomplishing heritage revitalization without destroying cultural context.

5. Conclusion

From the semiotic perspective, this paper reveals the generative logic and meaning structure of Hakka architectural ornaments as cultural symbols. The research indicates that Hakka architectural ornaments embody dual characteristics of "Central Plains inheritance and Lingnan localization" across form, semantics, and craft dimensions. Extraction and design trans-translation of their cultural genes must achieve contemporary formal expression on the premise of respecting authenticity. Design practices based on the Tuocheng case prove that semiotic methodologies can effectively guide ornament gene identification and transformation, offering operable paths for the living inheritance of Hakka architectural heritage. Follow-up research will further expand the coverage of ornament samples and deepen synergistic mechanisms between semiotic methodologies and digital design tools.

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Disclosure statement

The authors declare no conflict of interest.

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