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The Formal Logic and Visual Order of Dunhuang Caisong Patterns in the Early Tang Dynasties

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Abstract: *The Early Tang Dynasty caissons at the Mogao Grottoes in Dunhuang possess highly complex structures and rigorous visual order. Existing research has largely focused on style and symbolism, lacking systematic, verifiable, and quantitative analysis. Guided by iconography and Gestalt theory of visual perception, this study proposes a six-dimensional coding framework: core motif, number of border layers, canopy elements, color gradation, the presence of the Baoxianghua (precious flower) motif, and compositional symmetry. Manual coding of 24 well-preserved Early Tang Dynasty caissons, combined with thematic analysis and inductive methods, reveals several key characteristics of this phase: a strengthened core, simplified borders, and weakened canopy; predominantly axial and radial compositions, with a few exhibiting mirror symmetry; a transition from intense contrast to gradual layering and gradation; and a significant increase in the frequency and spatial extent of the Baoxianghua motif. This framework provides reusable evidence for structural and perceptual research on caissons, advancing not only quantitative research and digital preservation but also methodological support for the translation and application of Dunhuang motifs in contemporary design.*

Keywords: Dunhuang Mogao Caves; Caisson Patterns; Early Tang; Visual Order; Coding Framework

1. Introduction

1.1 Background

The Mogao Grottoes, located in Dunhuang, Gansu Province, boast 735 extant caves, 492 of which contain preserved murals and clay sculptures, and approximately 334 of which feature caisson patterns (Chen et al., 2021). As shown in Figure 1, the caisson pattern is the core element of the ceiling decoration of the Mogao Grottoes in Dunhuang. Its unique composition and visual order reflect the characteristics of integrating multiple cultures and technological innovation during the Sui and Tang dynasties.

Figure 1: Exterior of the Mogao Grottoes in Dunhuang
Source: "Illustrated Dunhuang 254 Caves [Complete Collector's Edition]"

According to Xu Shen's "Shuowen Jiezi," "zao" (a type of ornamentation) resembles a fingerprint (Xu, 1963), and "jing" (a kind of ornamentation) refers to a grid-like structure (Li, 1996). Together, they are called "caisson," the centerpiece of a dome. Different from the traditional wooden caissons in palaces that emphasize load-bearing and religious symbolism, the Dunhuang caissons are mainly composed of stone bucket roofs combined with murals, presenting a spatial structure with a large bottom and a small top, and paying more attention to narrative atmosphere and orderly beauty (Guan, 2010). As shown in Figure 2.

During the early Tang Dynasty, caissons, while inheriting Sui Dynasty traditions, incorporated decorative elements from both the Central Plains and the Western Regions. Their structural form still consisted of a core, borders, and draperies, and their composition displayed a progressive hierarchy from the inside out, with a visual characteristic of "complexity yet order." Addressing the shortcomings of existing research, which has focused on style and meaning and lacked verifiable quantitative evidence, this study focuses on the "formal logic-visual order" framework and proposes a reusable six-dimensional operational framework (core type, number of border layers, canopy elements, color hierarchy, the presence of Baoxianghua flowers, and compositional symmetry). Twenty-four well-dated and well-preserved early Tang caissons were manually coded and thematically categorized, using structural evidence to support interpretations of perceptual effects and providing a methodological reference for digital preservation and contemporary design translation.

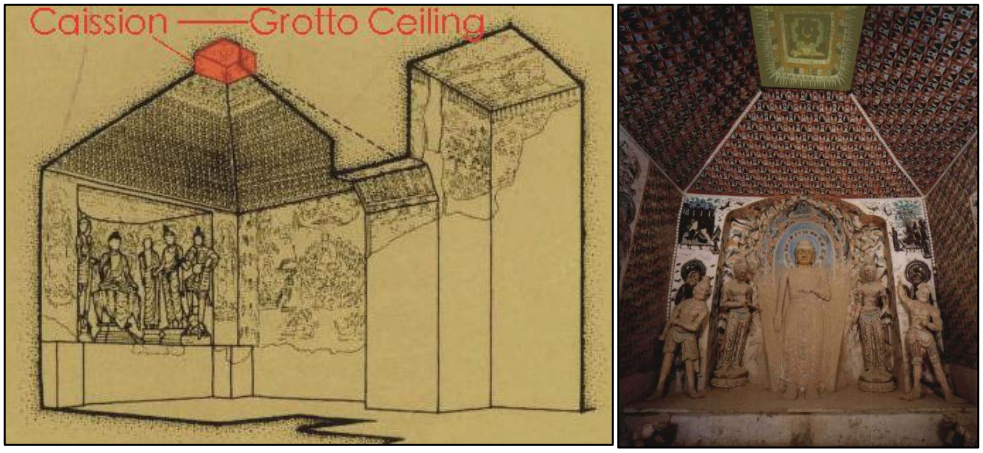

Figure 2: Dunhuang caisson pattern
Source: The Complete Works of the Dunhuang Grottoes, Vol. 22: Cave Architecture, pp. 114 (left) and 105 (right).

1.2 Research question

i. How do the cores, borders, draperies, colors, and motifs of early Tang Dunhuang caissons jointly construct their structural and perceptual characteristics, demonstrating a phased evolution?
ii. How can a six-dimensional coding framework enable a systematic, verifiable, and quantitative analysis of caisson characteristics?

1.3 Research Objectives

i. Systematically reveal the structural characteristics and evolutionary patterns of caisson ceilings from the early Tang Dynasty, providing quantitative evidence for art historical research.
ii. To construct and validate a six-dimensional coding framework, transitioning from descriptive research to structured, statistical analysis, and providing methodological support for digital preservation and cross-case comparisons.

1.4 Research significance

On an academic level, this study, by proposing a replicable terminology system and coding method, shifts from descriptive comparison to structured, statistical analysis. It quantitatively reveals the stylistic evolution of early Tang caisson ceilings, providing new evidence for art historical research.

Methodologically, the establishment of a six-dimensional index system provides a systematic tool for interpreting the "complex yet orderly" visual characteristics of caisson ceilings, enhancing the feasibility and verifiability of the research.

Practically, the research findings provide a quantitative reference for the digital preservation and contemporary redesign of Dunhuang patterns, and can also serve as a basis for cross-cultural display and teaching. Furthermore, the coding table and reliability statistics provided in this study lay an open foundation for subsequent verification and expansion research.

2. Literature Review

Research on Dunhuang caissons has yielded substantial typological and structural histories, generally confirming that they consist of a core, borders, and draperies, with variations in motifs and layers observed over time (Chen, 2018). This research has provided a foundation for identifying the temporal variations in core motif types (e.g., lotus, round-shaped Baoxianghua, grape/pomegranate combinations) and the number of border layers. However, this research has largely remained descriptive, lacking verifiable structured metrics and statistical comparisons.

Debates on compositional symmetry have moved beyond macro-symmetry to specific schemes: cruciform (orthogonal) and “mi”-shaped eight-axis (orthogonal + diagonal) symmetry that guide gaze and stabilize the field, and radial or mirror symmetry (e.g., confronting dragons) that carry narrative and symbolic force (Hui, Razak, & Noh, 2023; Chen, 2018). In line with Gestalt principles—wholeness, symmetry/Prägnanz, continuity—such structures reduce perceptual load and strengthen unity, making complex motifs more readable (Wertheimer, 1923; Wagemans et al., 2012).

In terms of color layering and craftsmanship, literature indicates that early Tang dynasty caissons gradually shifted from using fewer colors and displaying strong contrast to using more

delicate transitions and overlapping patterns, enhancing the overall decorative feel. Furthermore, the placement of the Baoxianghua (precious flower) gradually expanded from the center of the caisson to a combination of the center and the border, demonstrating a growing cohesion of the pattern (Chen, 2018). These conclusions provide a comparable caliber for the coding of color and motif distribution in this study.

Research on digitalization and design conversion attempts to parameterize the structural elements of the caisson: using the extraction of "visual genes" as a path, the hierarchical bands, axis/radial skeletons, and repeated rhythms of the core-edge decoration are transcribed into reusable design rules for pattern extraction and redesign (Chen et al., 2021). However, existing work still needs to be further strengthened in terms of coding consistency, sample coverage, and cross-period comparison to support more universal conclusions.

3. Methodology

3.1 Overview of Research Methods

This study employed qualitative research methods, combining thematic classification analysis with inductive analysis to conduct empirical research. Qualitative research emphasizes the interpretation of cultural phenomena in a specific context and is particularly suitable for visual materials with complex symbolic meanings and structural characteristics (Creswell & Poth, 2018; Braun & Clarke, 2021). Within this framework, thematic classification analysis helps to identify compositional patterns and visual motifs in caisson patterns, while inductive principles support summarizing evolutionary trends and overall characteristics from specific samples. Regarding digital resources, reference can be made to the implementation of knowledge graph models in the digitization of Dunhuang cultural heritage (Wang et al., 2020). To enhance research transparency, this study provides a coding table, variable caliber and consistency assessment, and presents samples and data fragments in the appendix.

3.2 Theoretical Foundations

This study draws on the analytical frameworks of iconography and Gestalt theory of visual perception. Iconography emphasizes the revelation of typological characteristics of patterns through the breakdown of structure and compositional elements (Panofsky, 1970; Cai, 2016). At the same time, Gestalt theory emphasizes visual laws such as symmetry, proximity, and continuity, which can explain how caissons generate a sense of order in complex compositions (Wertheimer, 1923; Wagemans et al., 2012). This combination of the two provides dual structural and perceptual support for this study. Iconography is used to identify and interpret motifs, while Gestalt theory explains compositional organization and perceptual mechanisms, mutually reinforcing each other.

3.3 Data Sources and Sample Selection

This study selected 24 samples of Early Tang Dynasty caissons from the Mogao Grottoes in Dunhuang, covering Caves 57, 203, 204, 205, 209, 211, 287, 321, 322, 323, 329, 331, 333, 334, 335, 340, 341, 372, 373, 375, 381, 386, 387, and 392 (see Appendix A for details). Dating was based on Shi Weixiang (2002), who defines the Early Tang period as 618–704 AD. Sample selection adhered to three criteria: clear dating, relatively complete preservation with clear details, and representative and diverse subject matter and techniques. The image data mainly comes from authoritative catalogs such as "Complete Collection of Dunhuang Grottoes", "Dunhuang Caisong Line Drawing Collection", and "Complete Collection of Chinese Dunhuang Murals", and is supplemented by high-definition images from the Dunhuang Research Institute's "Digital Dunhuang" open database for cross-comparison; this "catalog +

digital resource" material collection path ensures the authority and comparability of the sample, providing a solid foundation for subsequent analysis.

3.4 Coding Framework Design

The six-dimensional coding framework used in this study, as shown in Table 1, was cross-referenced manually and with software to ensure coding consistency (Jackson & Bazeley, 2019; Saldaña, 2021). This framework has been validated in cultural heritage and visual arts research (Byrne, 2022). The complete data for the 24 caisson-shaped ceiling coding cases are provided in Appendix B. The operational definitions and criteria for each dimension are provided in the table, with examples provided in case of ambiguity to mitigate subjective bias.

Table 1: Six-dimensional coding table

Coding dimension	Description	Operational notes
D1 Central motif	Core motif (e.g., lotus, **Baoxianghua**, grape–pomegranate)	Record motif type and any compound relations; identify the visual focal point.
D2 Border layers	Number of peripheral/decorative bands (1–3 or more)	Indicates complexity and depth of compositional hierarchy.
D3 Canopy elements	Presence/absence and style of canopy/sdrapery	Signals sacredness and contributes to spatial decoration.
D4 Color stratification	Richness of color (gradation, contrast, number of hues)	Reveals color organization and visual rendering strategy.
D5 Baoxianghua distribution	Occurrence and location of Baoxianghua (central/border/none)	Identifies how the motif is deployed within the layout.
D6 Compositional symmetry	Radial, axial, or quadrantal symmetry	Explains order logic and balance mechanisms.

3.5 Research Methods

The analysis process consisted of two steps:

The first step was thematic classification analysis. The researchers grouped and compared samples based on a six-dimensional coding method, identifying commonalities and differences in compositional patterns and extracting underlying motifs and color logic (Braun & Clarke, 2021; Byrne, 2022).

The second step was inductive analysis. Based on thematic analysis, the evolutionary logic, structural paradigms, and aesthetic trends of caisson patterns were summarized (Thomas, 2006).

During the interpretation process, the researchers incorporated Gestalt principles to map the abstracted patterns onto perceptual principles such as symmetry, proximity, and closure, revealing the perceptual mechanisms of caisson order (Wagemans et al., 2012). The overall research process is shown in Figure 3.

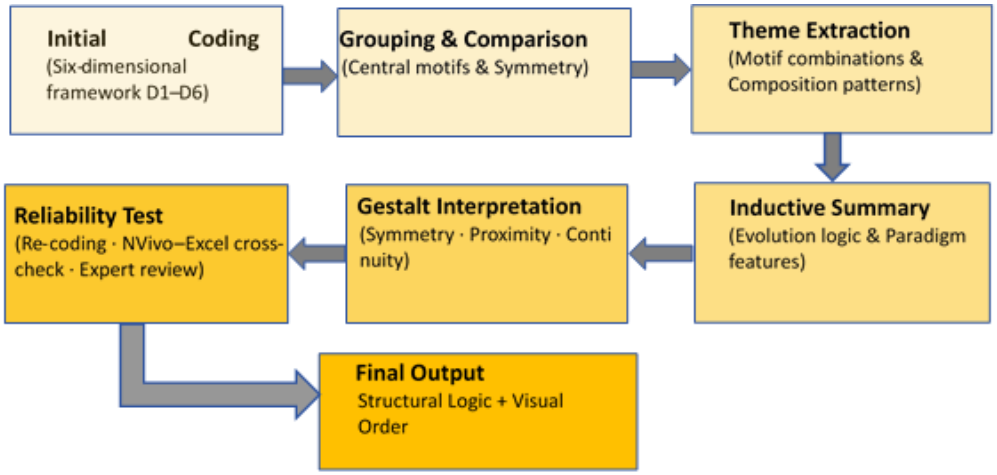

Figure 3: Research Flowchart
Source: Authors

To ensure the reliability of the six-dimensional coding, during the formal coding phase, the researcher and another researcher with an art history background independently coded 24 samples of Early Tang Dynasty caisson ceilings. The two coders' results were subsequently compared and statistically analyzed for consistency. The overall agreement rate reached 92.4%, with a Cohen's Kappa coefficient of $\kappa = 0.87$ ($p < 0.001$), indicating "high consistency" in the coding results (Landis & Koch, 1977). Furthermore, to further verify the robustness of the framework, a specialist in Dunhuang art was invited to conduct a random review of a sample, thereby enhancing the reliability of the findings. The reliability test results for the six dimensions are shown in Table 2.

Table 2: Inter-coder Reliability of Six-dimensional Coding Framework

Dimension (D1–D6)	Agreement (%)	Cohen's Kappa	Level of Agreement
D1 Central motif	95.8	0.91	Almost perfect
D2 Border layers	91.7	0.85	Almost perfect
D3 Canopy elements	96.0	0.92	Almost perfect
D4 Color stratification	90.3	0.84	Substantial
D5 Baoxianghua occurrence	89.5	0.82	Substantial
D6 Compositional symmetry	93.0	0.88	Almost perfect
Overall	92.4	0.87	Almost perfect

**Interpretation based on Landis & Koch (1977): $\kappa = 0.81–1.00$ = Almost perfect; $\kappa = 0.61–0.80$ = Substantial.*

3.6 Summary

This study constructed a six-dimensional coding framework, combining thematic classification and inductive analysis, to reveal the structural logic and visual order of Dunhuang's Early Tang Dynasty caisson ceilings. This approach emphasizes transparency and reliability, and echoes recent trends in the application of qualitative research in cultural heritage and visual art (Braun & Clarke, 2022). This framework provides a solid foundation for the classification of pattern types and the interpretation of visual order.

4. Research Results

This chapter, based on a six-dimensional coding (D1–D6) of 24 early Tang Dunhuang caissons, classifies and compiles statistics regarding the core pattern, number of border layers, canopy elements, color gradation, the presence of the Baoxianghua flower, and compositional

symmetry. Furthermore, a comprehensive analysis of their formal characteristics is conducted within the context of the image's evolution. The results show that, while inheriting Sui Dynasty traditions, early Tang caissons exhibit a trend toward increasing structural complexity, diversified motifs, and enhanced decorative elements.

4.1 Central Motif Types

Among the 24 samples, the lotus motif was the most common (14 cases, 58%), primarily featuring "twelve-petal lotus" and "eight-petal lotus" (e.g., Caves 57, 203, and 204), presenting a regular, central composition. This feature continues the traditional theme of Buddhist caissons in the Sui Dynasty, emphasizing sacredness and solemnity. Meanwhile, the use of the Baoxianghua motif increased significantly (eight cases, 33%), particularly the "round-shaped radiating Baoxianghua" (e.g., Caves 331, 334, and 335), which exhibited a stronger radial and decorative quality, signaling a diversification of decorative styles. Furthermore, some unique motifs, such as the "three rabbit lotus" in Cave 205, embody the interweaving of Buddhist symbolism and secular culture. Overall, the central motifs of the well gradually transitioned from the simple, regular nature of the early period to a more diverse and complex one, with a significant increase in decorativeness and cultural integration, as shown in Figure 4.

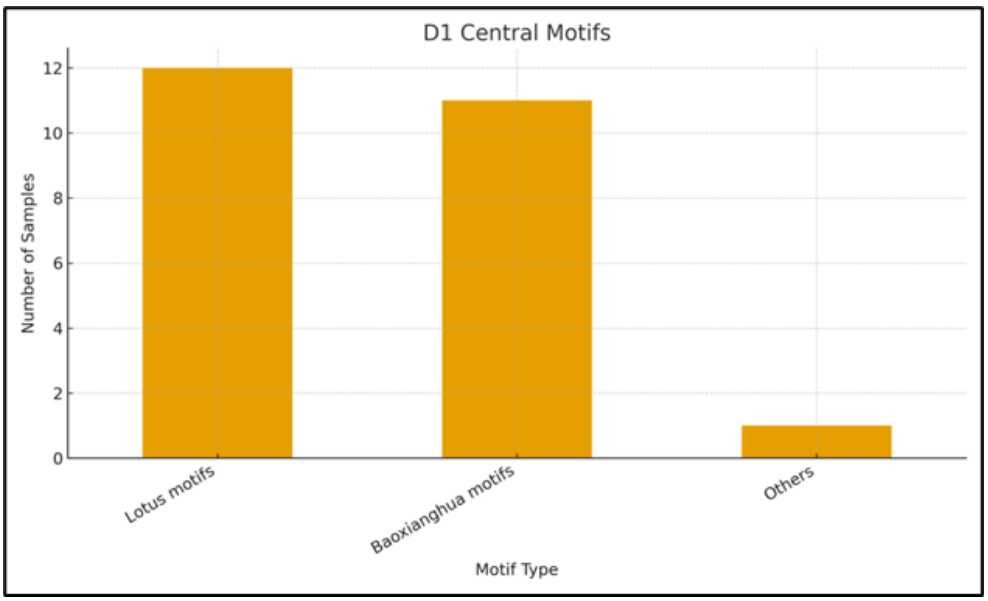

Figure 4: Distribution of central motifs (D1)
Source: Authors

4.2 Border Layers

The distribution of the number of border layers in caissons shows significant variation: two examples have five layers (Caves 329 and 331), six have four (e.g., Caves 321, 322, 334, and 335), and the majority have one to three layers. Examples with fewer layers are often found in the early period (e.g., Caves 57, 203, and 333), characterized by simpler structures. Examples with more layers appear in the middle and later periods, gradually reflecting a sense of spatial depth and decorative complexity. The overall trend is a gradual increase in the number of border layers, evolving from functional perimeter decoration to a core element of the composition. For example, Caves 204 and 209 demonstrate a transition from simplicity to higher levels of decoration, indicating that caisson borders gradually became a crucial component in establishing visual order during the early Tang Dynasty, as shown in Figure 5.

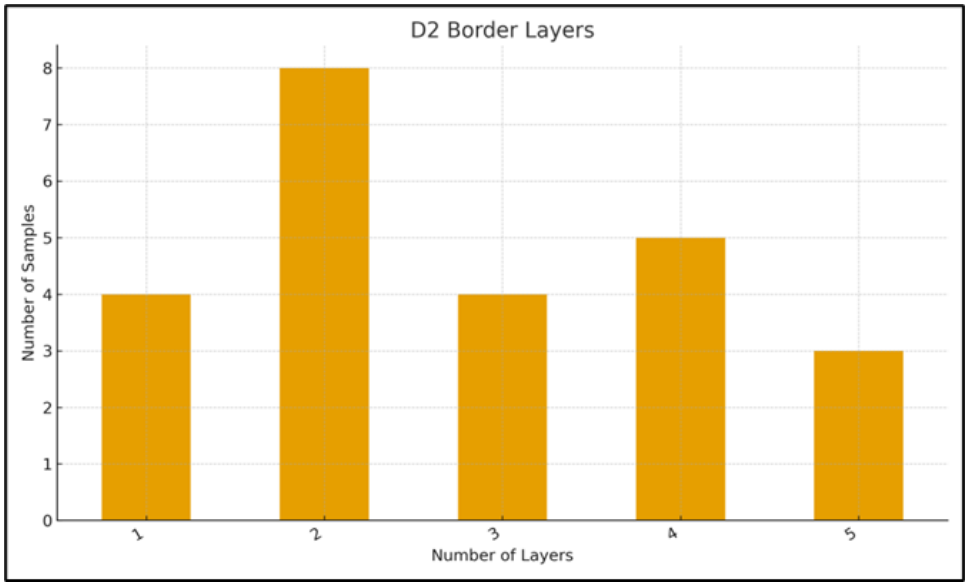

Figure 5: Distribution of border layers (D2)
Source: Authors

4.3 Canopy Elements

Of the 24 samples, 17 (approximately 71%) contain canopy elements, such as Caves 57, 204, 211, and 287. Canopy elements not only emphasize the central hanging sense but also simulate the spatial layout of a Buddhist temple, enhancing the sense of ritual and religious atmosphere. This characteristic demonstrates that the visual effect of the caisson is not simply a flat decoration, but rather aims to create a sacred "dome"-like space. In contrast, 7 samples (29%) lack canopys, such as Caves 205 and 321. These samples emphasize structural and decorative elements, demonstrating the differentiation between religious and secular motifs. Overall, the canopy elements of the early Tang caisson reflect the dual significance of religious space and decorative function, and in most cases, they enhance the solemn atmosphere of Buddhist rituals, as shown in Figure 6.

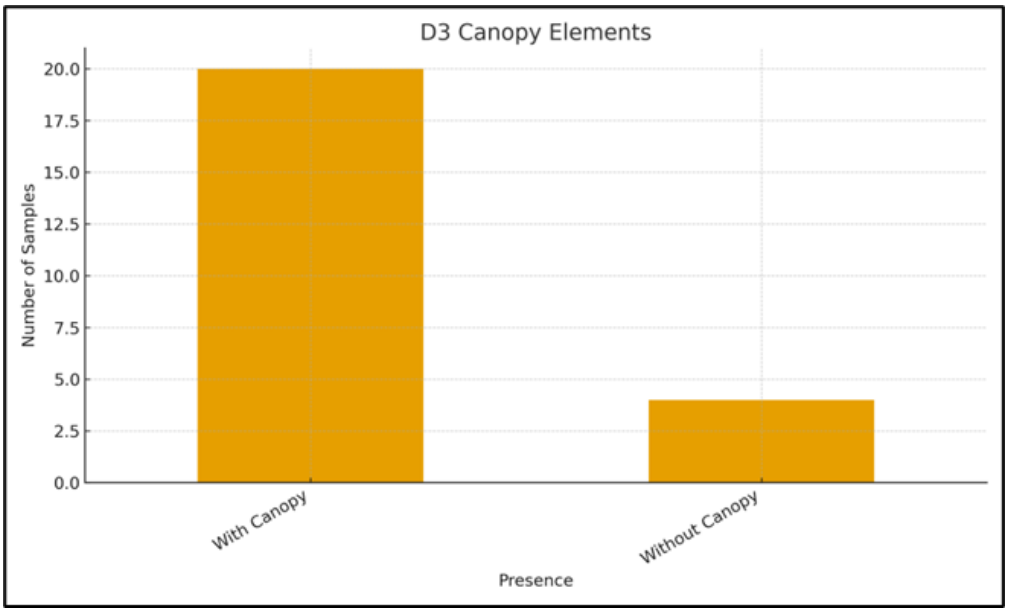

Figure 6: Presence of canopy elements (D3)
Source: Authors

4.4 Color Stratification

The colors of early Tang dynasty caissons can be roughly divided into three categories: simple contrast (8 cases, 33%), featuring a limited use of colors but strong contrast, such as Caves 203, 204, and 375, embodying a restrained aesthetic; brilliant gradation (7 cases, 29%), featuring rich color gradations and delicate transitions, such as Caves 209, 287, and 387, enhancing visual impact; and balanced transition (9 cases, 38%), combining contrast and depth, such as Caves 321 and 323. The overall trend is "from simplicity to complexity": early examples often used restrained colors to enhance compositional regularity, while mid- to late periods saw the gradual adoption of complex gradations and multi-layered compositions, reflecting the maturity of craftsmanship and the advancement of aesthetic pursuits. As shown in Figure 7.

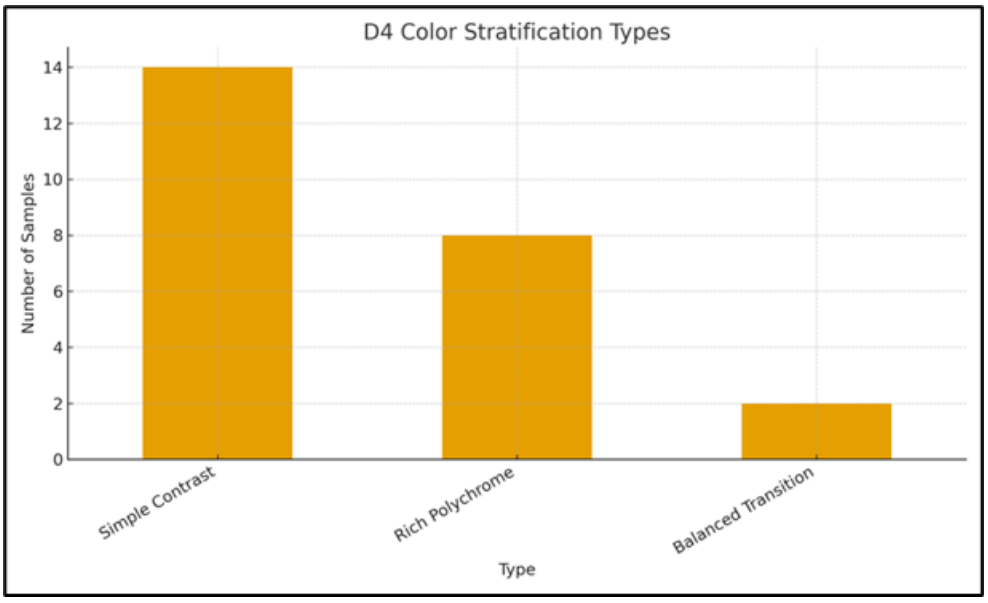

Figure 7: Distribution of color stratification types (D4)
Source: Authors

4.5 Occurrence of the Baoxianghua (Baoxianghua)

As a typical decorative motif of the Tang Dynasty, the Baoxianghua (Baoxianghua) appears in a high proportion of the samples (9 cases, accounting for 38%). Its distribution patterns include: appearing only in the center (e.g., Caves 211 and 329), reinforcing the central symbolism; coexisting in the center and borders (e.g., Caves 321, 323, 334, and 335), demonstrating its dominant role; and being completely absent (e.g., Caves 57 and 203), often found in lotus-themed samples, preserving Buddhist symbolism. Overall, the early Tang caisson gradually incorporated Baoxianghua elements, demonstrating a fusion of foreign decorative culture and indigenous Buddhist art. Its extension from borders to the center also transformed the Baoxianghua from a purely decorative motif into a significant motif imbued with religious symbolism, as shown in Figure 8.

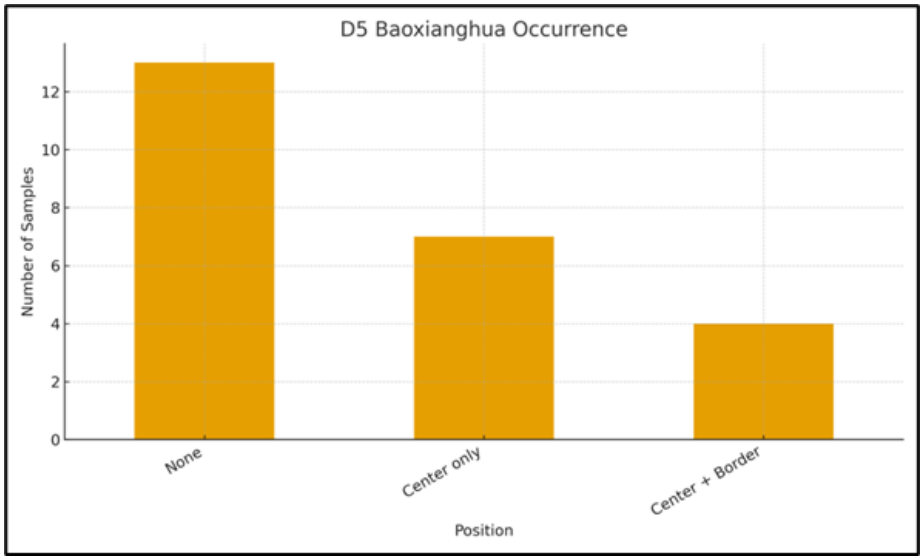

Figure 8: Occurrence and positions of Baoxianghua motifs (D5)
Source: Authors

4.6 Compositional Symmetry

Early Tang dynasty caisson compositions exhibit a variety of symmetries: axial symmetry (7 cases, accounting for 29%, such as Caves 209, 322, and 329), emphasizing stability and order; radial symmetry (10 cases, accounting for 42%, such as Caves 205, 321, and 335), conveying a sense of expansion and dynamic decoration; quadrilateral symmetry (5 cases, accounting for 21%, such as Caves 204, 211, and 373), imbuing the religious connotation of "the center spreading outward in all directions"; and mirror/central symmetry (2 cases, accounting for 8%, such as Caves 57 and 392), reflecting an early tendency towards regularization. Overall, composition gradually shifted from regular axial symmetry to a combination of radial and quadrilateral symmetry, which not only increased formal freedom but also aligned with the Buddhist symbolic logic of "pervading the four directions." As shown in Figure 9.

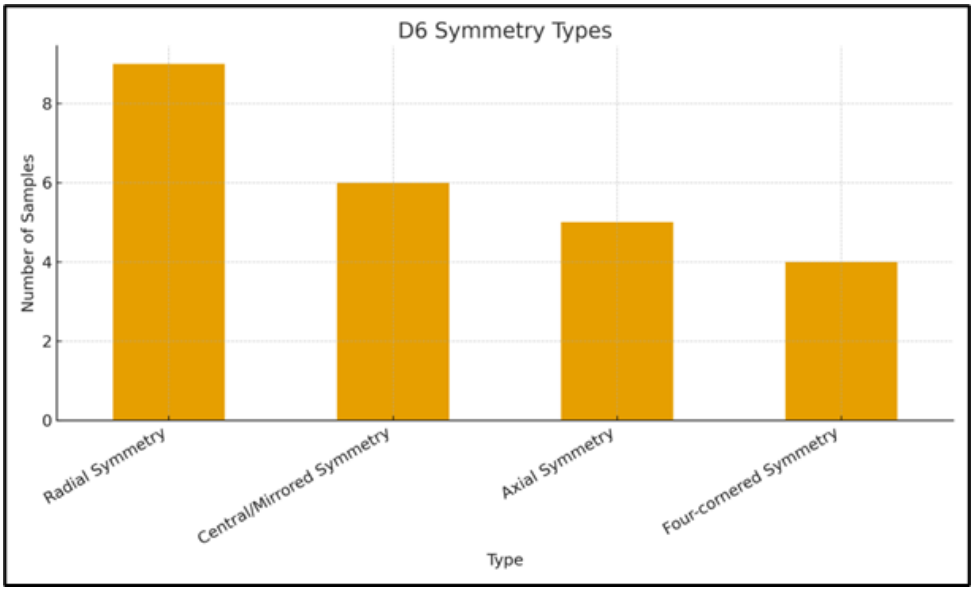

Figure 9: Types of compositional symmetry (D6)
Source: Authors

4.7 Summary

Based on a comprehensive analysis of six dimensions, early Tang caissons exhibit the following trends: In terms of motif structure, the lotus dominated the center, while the use of baoxianghua increased, demonstrating the diversity of subject matter and cultural integration; in terms of spatial composition, the increasing layering of borders accentuated the sense of depth; in terms of religious ornamentation, draperies were prevalent, creating a ritual atmosphere; in terms of color expression, there was a transition from simple contrast to layered gradations, reflecting the advancement of craftsmanship and aesthetics; in terms of decorative motifs, the prevalence of baoxianghua strengthened the integration of decoration and religion; in terms of structural order, the composition evolved from axial symmetry to radial and quadrilateral symmetry, becoming more complex. Overall, while inheriting Sui Dynasty traditions, early Tang Dunhuang caissons exhibited a development trajectory of "from simplicity to complexity, from regularity to diversity." They deepened the expression of Buddhist art while integrating Central Asian decorative elements and local vocabulary, transforming them from a single religious symbol to a comprehensive visual system that combined both decoration and symbolism. These conclusions corroborate the periodic assessments of existing literature.

5. Discussion

This study, based on a systematic coding and statistical analysis of 24 examples of caissons from the Mogao Grottoes in Dunhuang during the early Tang Dynasty, reveals the distinctive characteristics of these caissons during this period, including central motifs, number of border layers, drapery elements, color gradation, the presence of baoxianghua (precious flower ornaments), and compositional symmetry. Overall, while continuing the traditions of the Sui Dynasty, early Tang caissons exhibit a trend toward increased structural complexity, diverse motifs, and enhanced decorativeness. This change not only reflects the deepening process of Buddhist art in the early Tang Dynasty, but also reflects the role of cultural exchanges between China and the West in promoting decorative art.

First, from a cultural perspective, the early Tang dynasty marked a crucial transition period between the Sui and Tang dynasties and the formation of a unified China. As an important symbol of Buddhism, the lotus remains the mainstream motif of well-centered composition, emphasizing the stability and sacredness of the center. However, the widespread introduction of the Baoxianghua marked the integration of Central Asian and Indian decorative traditions, and its appearance ratio in the center and border decorations increased significantly, indicating that religious and decorative functions were gradually integrated. Elements such as grapes and pomegranates reflect the cultural diffusion along the Silk Road, further enriching the visual language of caisson ceilings. The increased level of border decoration and the prevalence of radially symmetrical structures imbued caisson ceilings with greater spatial depth and decorative effect, a trend that aligns well with the open and diverse cultural atmosphere of Tang Dynasty society.

Secondly, previous scholars have focused on the religious symbolism/function and artistic style/typology of caissons (Chen, 2019; Chen & Fan, 2019; Hui, Razak, & Noh, 2023). The coding results of this study show that the Baoxianghua (flower pattern) appears in over one-third of the samples from the early Tang Dynasty. Combined with existing research showing that lotus flowers dominated the centerpieces of caissons during the Sui Dynasty and that Baoxianghua (flower pattern) rose significantly during the Tang Dynasty, this suggests a simultaneous intensification of both decorative and symbolic elements during the early Tang

Dynasty. This further demonstrates that caissons exhibited a structural evolution in their motif composition and visual order.

On a theoretical level, the integration of iconography and Gestalt theory of visual perception provides dual support for understanding caisson patterns. Iconographic analysis helps to interpret the symbolic meaning, cultural origins, and evolutionary logic of motifs, illustrating how motifs such as the lotus and the Baoxianghua flower have acquired multiple interpretations in both religious and secular culture. Gestalt theory, on the other hand, reveals the "complex yet orderly" compositional patterns of caissons: the extensive use of radial symmetry and quadrilateral symmetry enhances the sense of unity, the layered progression of borders and drapes strengthens the spatial focus, and color contrast and overlapping techniques enhance visual balance and aesthetic pleasure. This methodological integration not only enhances the explanatory power of the formal logic of Dunhuang caissons but also provides a generalizable approach for the study of other decorative arts.

Finally, the findings of this study have implications for contemporary design. The "center-edge-layer" structural logic of caissons can provide a visual organizational reference for modern interior soft furnishings. The combination of motifs such as the lotus and the pachysandra flower offers cultural inspiration for design elements such as textiles, wall decorations, and lighting. Furthermore, the use of color gradients and sharp contrasts in caissons offers valuable insights for digital art and cross-media design. However, this study also has limitations: the sample size is limited to 24 caves from the early Tang Dynasty, failing to capture the evolution of caissons throughout the entire Tang Dynasty. The research primarily relies on catalogs and digital platforms, and some images may be subject to restoration and color discrepancies. Future research could expand to include sites from the mid- and late Tang Dynasties, as well as other Buddhist sites, integrating materials science with 3D modeling techniques to more fully reveal the craftsmanship and spatial logic of caisson patterns.

In summary, this study, through six-dimensional coding and analysis, reveals the evolving characteristics of early Tang Dunhuang caissons in terms of motif selection, structural hierarchy, color application, and compositional symmetry. This evolution not only reflects the deepening of Buddhist art and the integration of Chinese and Western cultures during the Tang Dynasty, but also provides a visual language and theoretical resources for contemporary design. Therefore, the results have considerable academic and practical value at the intersection of Dunhuang studies, art history, and design. Future research could expand the sample size and incorporate materials science, color metrology, and 3D reconstruction to validate the robustness of these findings and deepen our understanding of spatial logic.

6. Conclusion

This study examined 24 examples of early Tang dynasty caisson patterns from the Mogao Grottoes, using a six-dimensional coding framework to reveal their structural and perceptual characteristics. The study found that while the lotus motif continued to dominate, elements such as baoxianghua, grapes, and pomegranates gradually increased; the levels of border decoration and color became more complex; the elements of drapery became differentiated; and the overall composition tended to be diversified. These characteristics reflect not only the deepening of the Buddhist iconography system but also the promotion of decorative art by cross-cultural exchanges along the Silk Road.

The academic contributions are mainly reflected in three aspects: first, it proposed a replicable coding framework, realizing the transition from descriptive induction to structured and statistical analysis; second, it combined iconography and Gestalt theory to reveal how symbolic motifs and perceptual laws jointly construct a "complex and orderly" visual logic; third, it provided a transferable paradigm for the study of decorative arts.

On a practical level, the research findings offer insights for contemporary interior soft furnishings and digital design—the compositional logic of "center-edge-layer," motif combinations, and color gradients can all be transformed into modern design resources. This study is limited to the early Tang period and relies on digital images, potentially affected by restoration and color variations. Future research could expand to include caissons from the mid- and late Tang dynasties, incorporating materials science and 3D modeling, and conducting cross-cultural comparisons with Byzantine, Persian, and Central Asian dome decorations to further illuminate the dual evolution of caisson patterns as both religious symbols and aesthetic language.

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Conflict of Interest Statement
The authors declare that there is no conflict of interest regarding the publication of this study.

Reference

Braun, V., & Clarke, V. (2021). One size fits all? What counts as quality practice in (reflexive) thematic analysis? Qualitative Research in Psychology, 18(3), 328–352. https://doi.org/10.1080/14780887.2020.1769238

Byrne, D. (2022). A worked example of Braun and Clarke's approach to reflexive thematic analysis. Quality & Quantity, 56(3), 1391–1412. https://doi.org/10.1007/s11135-021-01182-y

Cai, S. H. (2016). Study on Dunhuang caisson pattern and its application in modern design (Master's thesis, Hubei University of Technology). CNKI. https://kns.cnki.net/KCMS/detail/detail.aspx?dbname=CMFD201602&filename=1016721344.nh

Chen, D., Cheng, P., Simatrang, S., Joneurairatana, E., & Sirivesmas, V. (2021). Innovative design of caisson lotus pattern in Dunhuang. Humanities, Arts and Social Sciences Studies, 21(1), 95–108. https://doi.org/10.14456/hasss.2021.10

Chen, Z. W. (2018). Sui ji Tang qianqi Mogao ku zaojing tu'an yanjiu [Study on caisson patterns of the Mogao Caves in the Sui and Early Tang dynasties] (Doctoral dissertation, Lanzhou University). CNKI. https://kns.cnki.net/KCMS/detail/detail.aspx?dbname=CDFDLAST2018&filename=1018828975.nh

Chen, Zhenwang, & Fan, Jinshi. (2019). Formation and types of Baoxianghua in the caisson ceilings of the Mogao Caves during the Tang dynasty [in Chinese]. Creativity and Design, 2019(1), 40–47. https://qikan.cqvip.com/Qikan/Article/Detail?id=7001684528

Chen, Zhenwang. (2019). A profusion of blossoms: An exploration of Early Tang caisson patterns at the Mogao Caves [in Chinese]. Journal of Dunhuang Studies, (2), 135–152.

Creswell, J. W., & Poth, C. N. (2018). Qualitative inquiry and research design: Choosing among five approaches (4th ed.). Thousand Oaks, CA: SAGE Publications. https://books.google.com/books?id=DLbBDQAAQBAJ

Guan, Y. H. (2010). Dunhuang zhuangshi wenyang [Dunhuang decorative patterns]. Shanghai: East China Normal University Press.

Hui, L., Razak, H. A., & Noh, L. M. B. M. (2023). Symmetry and asymmetry compositional analysis in Dunhuang caisson patterns. International Journal of Academic Research in Business and Social Sciences, 13(9), 729–744. http://dx.doi.org/10.6007/IJARBSS/v13-i9/17665

Jackson, K., & Bazeley, P. (2019). Qualitative data analysis with NVivo (3rd ed.). Thousand Oaks, CA: SAGE Publications.

Landis, J. R., & Koch, G. G. (1977). The measurement of observer agreement for categorical data. Biometrics, 33(1), 159–174. https://doi.org/10.2307/2529310

Li, Y. (1996). Xianqing ouji [Leisure notes]. Beijing: People's Literature Publishing House.

Panofsky, E. (1970). Meaning in the visual arts. Chicago, IL: University of Chicago Press.

Saldaña, J. (2021). The coding manual for qualitative researchers (4th ed.). Thousand Oaks, CA: SAGE Publications.

Shi, W. X. (2002). History of Dunhuang and Mogao Grottoes art. Lanzhou: Gansu Education Press.

Thomas, D. R. (2006). A general inductive approach for analyzing qualitative evaluation data. American Journal of Evaluation, 27(2), 237–246. https://doi.org/10.1177/1098214005283748

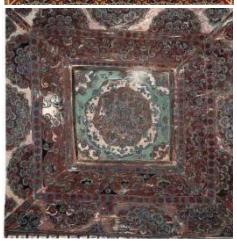
Wagemans, J., Elder, J. H. P., Kubovy, M., Palmer, S. E., Peterson, M., Singh, M., & von der Heydt, R. (2012). A century of Gestalt psychology in visual perception I: Perceptual grouping and figure–ground organization. Psychological Bulletin, 138(6), 1172–1217. https://doi.org/10.1037/a0029333

Wertheimer, M. (1923). Untersuchungen zur Lehre von der Gestalt II. Psychologische Forschung, 4(1), 301–350. https://doi.org/10.1007/BF00410385

Xu, S. (1963). Shuowen jiezi [Explaining graphs and analyzing characters] (Vol. 2). Beijing: Zhonghua Book Company.

Appendix Table A. Early Tang Dunhuang Caisson Samples

No.	Cave No.	Caisson pattern	Source	Preservation status
1	57		Digital Dunhuang (Dunhuang Academy), high-resolution image set	Damaged (soot/smoke)
2	203		The Complete Works of the Dunhuang Grottoes, Vol. 22: Cave Architecture, p. 105.	Well preserved
3	204		The Complete Works of the Dunhuang Grottoes, vol. 14, Ornament Volume, Part II, p. 21	Well preserved
4	205		The Complete Works of the Dunhuang Grottoes, vol. 14, Ornament Volume, Part II, p. 19	Partially preserved
5	209		Dunhuang Pattern Tracings, ed. Fan Jinshi, p. 40	Well preserved
6	211		The Complete Works of the Dunhuang Grottoes, vol. 14, Ornament Volume, Part II, p. 18	Partially preserved
7	287		Digital Dunhuang (Dunhuang Academy), high-resolution image set	Partially preserved
8	321		The Complete Works of the Dunhuang Grottoes, vol. 14, Ornament Volume, Part II, p. 28	Well preserved

9	322		The Complete Collection of Chinese Dunhuang Murals, vol. 05: Early Tang at Dunhuang, p. 26	Well preserved
10	323		The Complete Works of the Dunhuang Grottoes, vol. 14, Ornament Volume, Part II, p. 49	Well preserved
11	329		Dunhuang Pattern Tracings, ed. Fan Jinshi, p. 48	Well preserved
12	331		Dunhuang Pattern Tracings, ed. Fan Jinshi, p. 54	Well preserved
13	333		Digital Dunhuang (Dunhuang Academy), high-resolution image set	Well preserved
14	334		Dunhuang Pattern Tracings, ed. Fan Jinshi, p. 47	Partially preserved
15	335		The Complete Works of the Dunhuang Grottoes, vol. 14, Ornament Volume, Part II, p. 23	Well preserved
16	340		The Complete Works of the Dunhuang Grottoes, vol. 14, Ornament Volume, Part II, p. 24	Well preserved

17	341		The Complete Works of the Dunhuang Grottoes, vol. 14, Ornament Volume, Part II, p. 25	Well preserved
18	372		The Complete Collection of Chinese Dunhuang Murals, vol. 05: Early Tang at Dunhuang, p. 100	Well preserved
19	373		The Complete Works of the Dunhuang Grottoes, vol. 14, Ornament Volume, Part II, p. 17	Well preserved
20	375		The Complete Works of the Dunhuang Grottoes, vol. 14, Ornament Volume, Part II, p. 16	Well preserved
21	381		Digital Dunhuang (Dunhuang Academy), high-resolution image set	Well preserved
22	386		The Complete Works of the Dunhuang Grottoes, vol. 14, Ornament Volume, Part II, p. 20	Well preserved
23	387		The Complete Works of the Dunhuang Grottoes, vol. 14, Ornament Volume, Part II, p. 15	Well preserved

24	392		Dunhuang Pattern Tracings, ed. Fan Jinshi, p. 36	Well preserved

Appendix B. Six-Dimensional Coding of Early Tang Caisson Samples

No.	Pattern ID	D1 / Central motif	D2 Border layers	D3 Canopy elements	D4 Color stratification	D5 Baoxianghua occurrence	D6 Compositional symmetry
1	Cave57	Double-dragon lotus (twelve-petal lotus)	3	Present	Limited palette; high contrast	None	Mirror symmetry
2	Cave203	Flat-petal large lotus (eight-petal lotus)	3	Present	Limited palette; high contrast	None	Axial symmetry
3	Cave204	Flat-petal large lotus (twelve-petal lotus)	2	Present	Strong contrast	None	Central symmetry
4	Cave205	Three Hares lotus	2	Absent	Rich gradation	None	Radial symmetry
5	Cave209	Grape–pomegranate	4	Present	Vivid coloration	None	Axial symmetry
6	Cave211	Baoxianghua (petaled type)	1	Present	Strong contrast	Central	Quadrantal symmetry
7	Cave287	Pomegranate–lotus	3	Present	Vivid coloration	None	Quadrantal symmetry
8	Cave321	Baoxianghua (petaled type)	4	Absent	High contrast; rich gradation	Central + border	Radial symmetry
9	Cave322	Pomegranate–lotus	4	Present	Rich gradation	None	Central symmetry
10	Cave323	Baoxianghua (petaled type)	2	Present	High contrast; rich gradation	Central + border	Radial symmetry
11	Cave329	Baoxianghua	5	Present	Rich gradation	Central	Central symmetry
12	Cave331	Rosette, radiating Baoxianghua	5	Present	Rich gradation	Central	Radial symmetry
13	Cave333	Flat-petal large lotus	1	Present	Limited palette; high contrast	None	Axial symmetry
14	Cave334	Rosette, radiating Baoxianghua	4	Absent	Strong contrast	Central + border	Radial symmetry
15	Cave335	Rosette, radiating Baoxianghua	4	Absent	Limited palette; high contrast	Central + border	Radial symmetry
16	Cave340	Rosette, radiating Baoxianghua	2	Present	Strong contrast	Central	Radial symmetry
17	Cave341	Rosette, radiating Baoxianghua	2	Present	Strong contrast	Central	Radial symmetry

18	Cave372	Rosette, radiating Baoxianghua	1	Present	Strong contrast	Central	Radial symmetry
19	Cave373	Pomegranate–lotus	3	Present	Limited palette; high contrast	None	Axial symmetry
20	Cave375	Pomegranate–lotus	1	Present	Limited palette; high contrast	None	Quadrantal symmetry
21	Cave381	Baoxianghua	2	Present	Rich gradation	Central	Axial symmetry
22	Cave386	Flat-petal large lotus (eight-petal lotus)	2	Present	Limited palette; high contrast	None	Quadrantal symmetry
23	Cave387	Grape–lotus	5	Present	Vivid coloration	None	Central symmetry