



Kharkiv State Academy of Design and Arts
Graphic design department
Visual Communication Design

TRANSFORMATION OF HAN DYNASTY MIRROR PATTERNS IN MODERN CULTURAL AND CREATIVE DESIGN USING SHAPE GRAMMAR FORMALIS

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Thesis Information

MASTER'S THESIS TOPIC

Design of Han Dynasty Bronze Mirror Patterns from the Perspective of Shape Grammar: A Study Based on the Xuzhou Museum Collection

OBJECT OF RESEARCH

Han Dynasty bronze mirrors and their decorative patterns in the Xuzhou Museum collection.

SUBJECT OF RESEARCH

The extraction, transformation, and application of Han mirror patterns using shape grammar.

RESEARCH METHODS

● Literature Review

Review research on Han bronze mirrors, decorative patterns, and shape grammar.

● Field Research

Document original artifacts and patterns at Xuzhou Museum.

● Visual Analysis

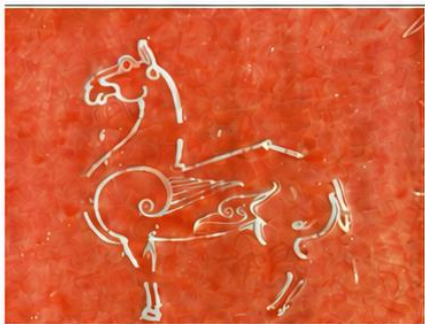
Analyze pattern structures, motifs, and composition rules.

● Design Practice

Generate new patterns and develop cultural creative products.

Visual Research

The Xuzhou Museum houses nearly 10,000 artifacts, many dating to the Han Dynasty—including jade burial suits, terracotta figures, and richly ornamented stone reliefs.



HAN PICTORIAL ART

Archaeological Rubbings



MUSEUM COLLECTION

Han-Dynasty Cultural Relics



BRONZE MIRRORS

Ancient Bronze Mirror Relics



DIGITAL ARCHIVES

Online Literature &
Digital Resources

5W1H Analysis

What / Who / When / Where / Why / How

WHAT

Research Object

Decorative motifs on cultural artifacts in the Xuzhou Museum collection, including geometric, animal, plant, and narrative motifs on bronze, jade, lacquer, and relief stone.

WHEN

Historical Period

Han Dynasty, 206 BCE–220 CE

Research Period

2024–2026

WHERE & WHO

Research Context

Han tombs in the Xuzhou area, including Shizishan, Guishan, and Beidongshan.

Research Participants

Xuzhou Museum, university laboratories, researchers, designers, and museum visitors.

WHY

Cultural Heritage

Han Dynasty ornaments are an important part of Chinese visual culture.

Design Innovation

Contemporary transformation gives traditional ornaments renewed practical value.

Academic Research

Shape grammar provides a systematic method for studying ornament structures.

HOW

- ① Extract shape-grammar rules
- ② Deconstruct ornament structures
- ③ Generate parametric pattern variations
- ④ Verify applications through design practice

Target Audience Persona

Target Positioning

Primary Group

Cultural enthusiasts and designers aged 25–45; regular museum visitors.



Secondary Group

University faculty and students, creative-product consumers, and tourists.

Core Traits

High cultural literacy; interest in heritage and innovation; preference for culturally meaningful creative products.

Audience Characteristics

Cultural Literacy

High cultural and aesthetic standards, with strong expectations for design quality.



Interests

Traditional culture, cultural heritage, and innovative design practices.

Behavior

Active on social media and willing to share cultural experiences and creative discoveries.

Needs Analysis

Functional Needs

Cultural learning, aesthetic experiences, and practical products.



Emotional Needs

Cultural identity, historical connection, and aesthetic satisfaction.

Social Needs

Conversation topics, identity expression, and shareable cultural value.

Xuzhou Museum Cultural Resources

Xuzhou, historically known as Pengcheng, is an important center of Han culture. The museum collection offers diverse mirror types, inscriptions and ornamental structures.

SAMPLE SELECTION CRITERIA

01 Regional Relevance

Connection to Xuzhou Han culture and museum context.

02 Image Integrity

Readable pattern structure and sufficient visual detail.

03 Typical Composition

Representative symmetry, bands and motif organization.

04 Design Potential

Capacity for transformation across multiple carriers.

The selected mirrors support both cultural interpretation and formal analysis.

Historical Prototypes · Source Corpus

Four representative Han mirror families provide the cultural and formal basis of the design system.

01



DRAGON-PHOENIX

Persimmon-stalk core and paired phoenix imagery

Auspicious union · harmony

02



TLV-FOUR SYMBOLS

Square-circle order and directional guardians

Cosmic order · protection

03



FIGURAL NARRATIVE

Four scene fields and fine linear storytelling

Memory · ritual · narrative

04



DRAGON-TIGER

Opposing mythical beasts around the center

Balance · vitality · protection

SOURCE STRATEGY

Primary context: Xuzhou Museum and Han culture in Pengcheng. Comparative museum examples clarify the four motif categories and their formal logic.

Prototype 02 · TLV Four Symbols Mirror

HISTORICAL PROTOTYPE



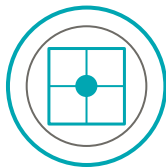
TLV Four Symbols Mirror

Late Western Han Dynasty · Diameter 23.2 cm

Comparative collection example

Image reference: Yu Jen historical mirror record

01 TRACE



Identify the center,
main motif band
and border.

02 EXTRACT



Keep the most
recognizable visual
unit.

03 GENERATE



Rebuild order
through
controlled grammar
rules.

MODIFICATION LOGIC

I preserved the square-inside-circle structure and directional logic, then reduced the T, L and V signs to clear geometric modules.

GRAMMAR OPERATIONS

Unit extraction · 90° rotation · motif substitution · concentric nesting

INTERPRETATION

HISTORICAL READING

The Four Symbols represent the four directions and protective power; the TLV system reflects cosmological order.

FORMAL STRUCTURE

Square central field, T/L/V markers, four directional zones, central boss and concentric borders.

MEANING RETAINED

The redesigned pattern keeps order, orientation and protection as its core ideas.

CONTEMPORARY OUTPUT

Modular grid and radial pattern for scarves, notebooks, interfaces and packaging systems.

Prototype 03 · Figural Narrative Mirror

From miniature historical scenes to a readable visual narrative

HISTORICAL PROTOTYPE



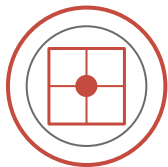
TLV Figural Pictorial Mirror

Early Eastern Han Dynasty · Diameter 16.5 cm

Palace Museum collection

Image/reference: The Palace Museum

01 TRACE



Identify the center, main motif band and border.

02 EXTRACT



Keep the most recognizable visual unit.

03 GENERATE



Rebuild order through controlled grammar rules.

MODIFICATION LOGIC

I selected recognizable gestures, reduced figures to silhouettes, unified line weight and reorganized scenes into a clear sequence.

GRAMMAR OPERATIONS

Simplification · scaling · recombination · circular sequencing

INTERPRETATION

HISTORICAL READING

Hunting, the lunar palace, fishing and bird release create a layered narrative of belief and social memory.

FORMAL STRUCTURE

Four image fields around the center, fine engraved lines, scene separation and a TLV spatial framework.

MEANING RETAINED

The redesign retains movement and narrative relationships while improving contemporary readability.

CONTEMPORARY OUTPUT

Story icons, educational graphics, digital timelines and exhibition interpretation panels.

Prototype 04 · Dragon–Tiger Mirror

From opposing mythical beasts to a dynamic protective emblem

HISTORICAL PROTOTYPE

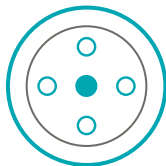


Four-Boss Dragon–Tiger Mirror

Han Dynasty · Diameter 14 cm
Guangdong Dagan Museum collection

Image/reference: Guangdong Dagan Museum

01 TRACE



Identify the center,
main motif band
and border.

02 EXTRACT



Keep the most
recognizable visual
unit.

03 GENERATE



Rebuild order
through
controlled grammar
rules.

MODIFICATION LOGIC

I retained the counter-facing tension, exaggerated the body curves and standardized the motifs into two compatible modules.

GRAMMAR OPERATIONS

Mirroring · scaling · alternating repetition · circular recombination

INTERPRETATION

HISTORICAL READING

Dragon and tiger symbolize balanced forces, vitality and protection against harm.

FORMAL STRUCTURE

Two opposing animal types, four bosses, circular movement and a strong continuous border.

MEANING RETAINED

The redesigned emblem preserves protective power and visual tension rather than literal animal anatomy.

CONTEMPORARY OUTPUT

Protective emblem for badges, tote bags, accessories and cropped supergraphics.

Cultural Meaning of Han Mirror Patterns

01

Dragon and Phoenix

Harmony, auspicious union and elevated status

02

Four Symbols

Cosmic order, direction and protective power

03

Figures and Chariots

Social memory, ritual movement and narrative

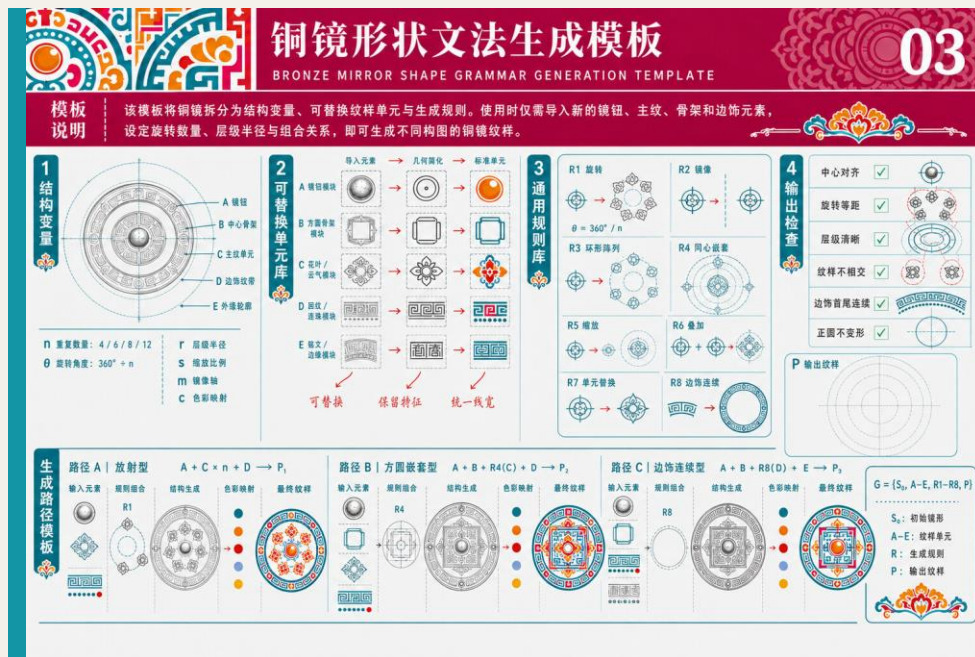
04

Dragon and Tiger

Balance, vitality and the warding of harm



Formal Structure of Han Mirror Ornament



STRUCTURAL LAYERS

01

Center

Mirror knob and central field

02

Core Geometry

Square framework or central medallion

03

Main Motif Band

Animals, figures or symbolic units

04

Supporting Band

Cloud, bead and geometric patterns

05

Outer Border

Continuous edge and visual closure

Shape Grammar Framework

$$SG = (S, L, R, I)$$

S shape set

L spatial labels

R generation rules

I initial shape

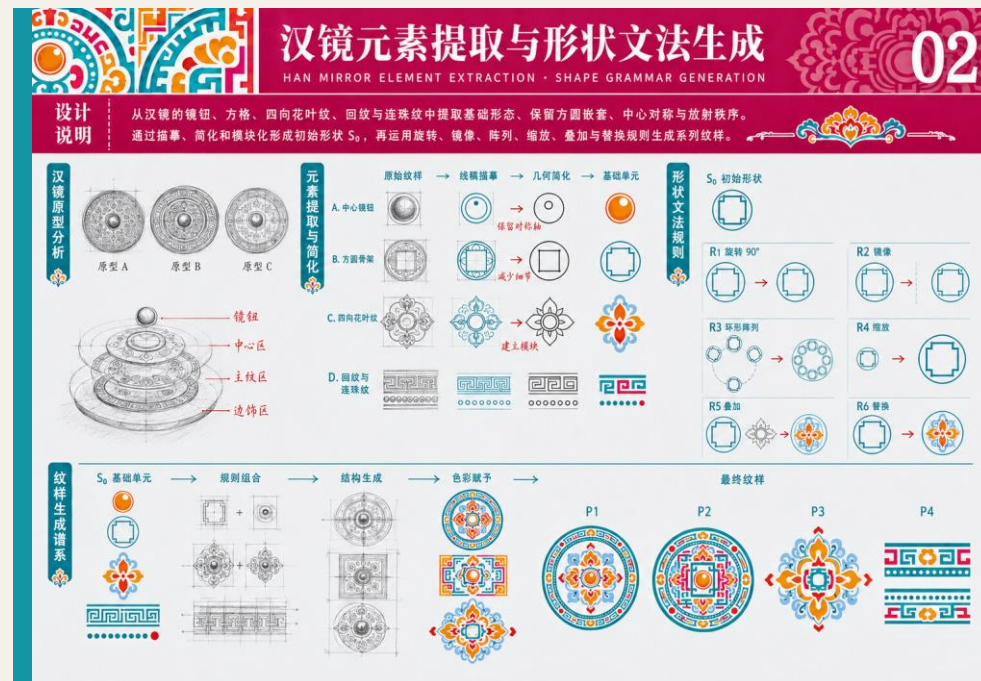
TWO STAGES

Analysis

Extract visual units, structural relations and cultural attributes.

Generation

Apply controlled rules and screen the resulting patterns.



The method explains how a pattern is constructed before deciding how it may change.

Shape Transformation Rules

01 Rotation

Build four-way and radial order

02 Reflection

Create bilateral balance

03 Scaling

Adjust hierarchy and density

04 Repetition

Extend motifs into bands

05 Substitution

Exchange compatible cultural motifs

06 Recombination

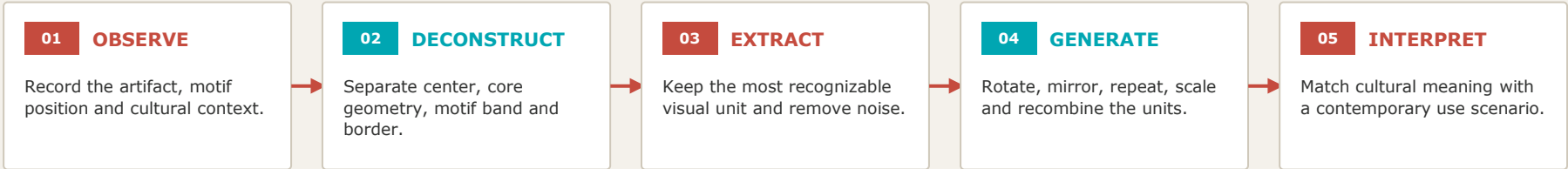
Create new square-circle relations

SCREENING CRITERIA

Cultural recognition visual completeness product suitability

How I Modified and Interpreted the Patterns

The transformation is controlled by cultural meaning, formal structure and shape grammar rules.



PATTERN FAMILY	FORM RETAINED	MEANING RETAINED	GRAMMAR OPERATION	DESIGN OUTPUT
Dragon-Phoenix	Paired motion and four-part rhythm	Harmony and auspicious union	Reflection + radial rotation	Radial ceremonial motif
TLV-Four Symbols	Square-circle order and directions	Cosmic order and protection	90° rotation + substitution	Modular structural grid
Figural Narrative	Gestures and scene sequence	Memory and storytelling	Simplification + recombination	Story icons and timeline
Dragon-Tiger	Counter-facing dynamic tension	Balance and protective power	Mirroring + alternation	Protective emblem

DESIGN PRINCIPLE

Do not copy the ornament directly. Preserve cultural identity, simplify visual form and rebuild it through controlled grammar rules.

Evidence of Transformation · Source to Derived Pattern

The completed pattern board records how each historical prototype was modified into a contemporary visual family.

PROJECT EVIDENCE



Existing project board: four core pattern families and their derived motifs

HOW TO READ THE BOARD

01 SOURCE

The original mirror establishes cultural authenticity and the structural reference.

02 EXTRACT

A recognizable animal, figure or geometric unit is selected and traced.

03 TRANSFORM

The unit is simplified, mirrored, rotated, scaled or recombined.

04 DERIVE

The new motif becomes a circular, square, cropped or continuous pattern family.

The final forms remain traceable to their historical sources.

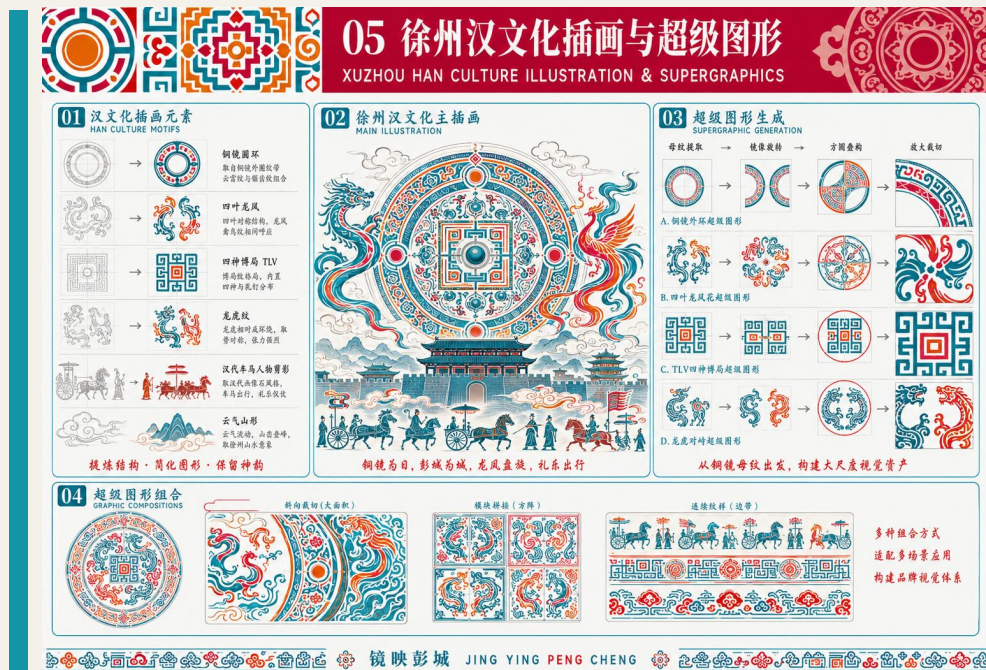
Design Theme and Core Concept

JING YING PENG CHENG

Mirror imagery reveals the cultural memory of Pengcheng.

CORE IDEA

- **Cultural carrier:** the Han mirror provides form, imagery and meaning.
- **Design method:** shape grammar controls extraction, generation and recombination.
- **Communication goal:** bring Xuzhou Han culture into contemporary daily life.



Logo Design

DESIGN SOURCE

- **Round mirror:** defines the outer silhouette and central focus.
- **Square framework:** preserves the square-circle relationship found in mirror structure.
- **Four-petal motif:** forms the central rhythm through rotation and reflection.

LOGO VARIANTS

Full color single color reversed horizontal lockup



Auxiliary Graphics and Icon System



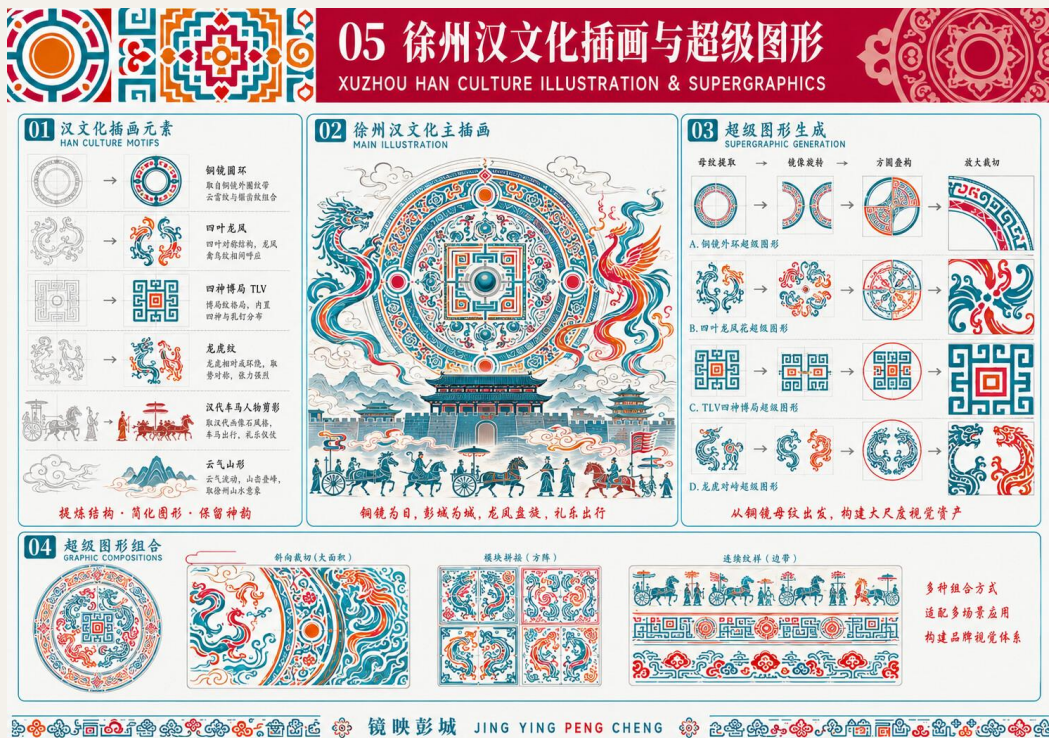
AUXILIARY GRAPHICS

- Sources:** four-petal motifs, TLV structures, bead patterns and cloud forms.
- Operations:** rotation, continuity, scaling and square-circle recombination.

ICON LANGUAGE

Mirrors, mythical beasts, mountains, city gates, museum objects and chariots share one line-weight system.

Core Illustration and Supergraphics

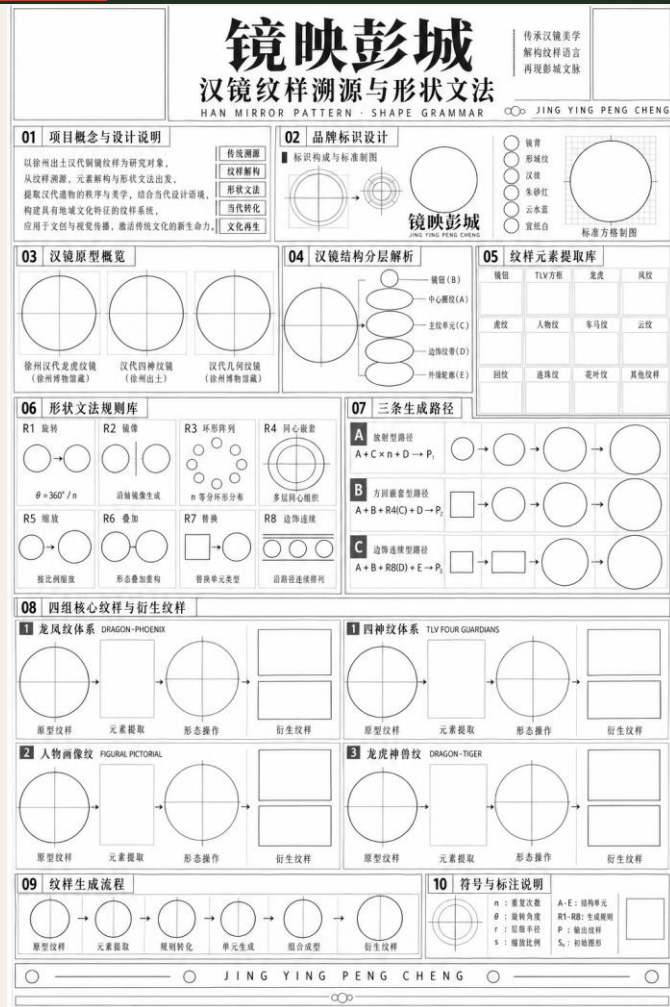


COMPOSITION LOGIC

- **Anchor:** a circular mirror controls the main composition.
- **Place:** Xuzhou gates, mountains and chariot imagery connect the design to Pengcheng.
- **Continuity:** symmetry and concentric bands retain the artifact's structural identity.

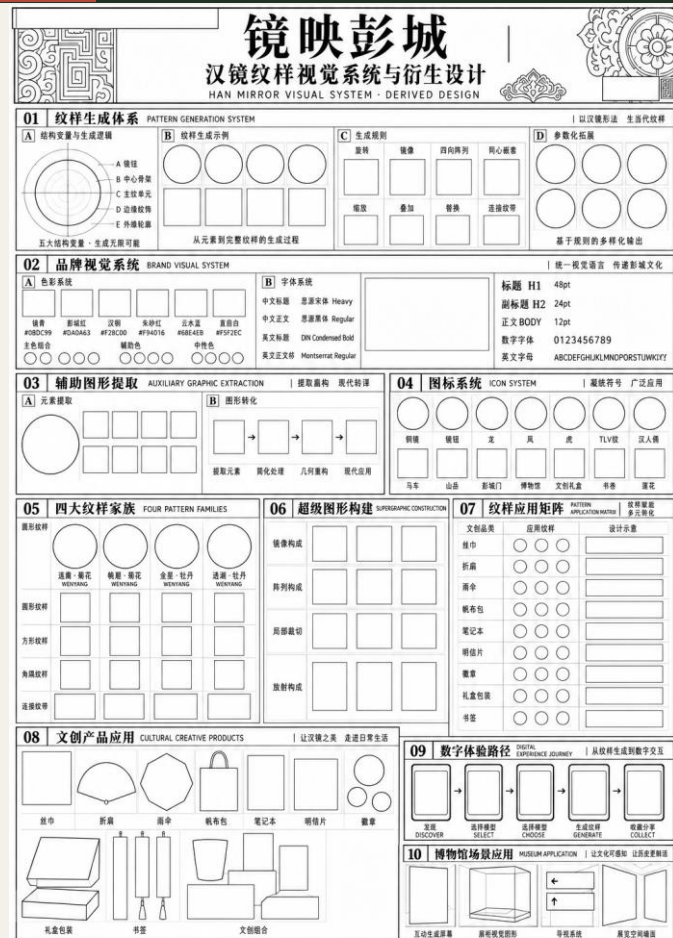
The illustration supports packaging, display and communication.

This design draft mainly presents the transformation of Han dynasty bronze mirror patterns through shape grammar. Based on the Han mirror resources of the Xuzhou Museum, the design organizes the research into several sections, including the project concept, logo construction, mirror classification, structural analysis and motif extraction. Circles, grids and layered diagrams are used to clarify the concentric structure and square-circle relationship of Han mirrors. The shape grammar section demonstrates the main generation rules, including rotation, reflection, scaling, repetition, substitution and continuous arrangement. Three generation paths further explain how the extracted elements are transformed into radial patterns, square patterns and continuous borders. The contrast between thick and thin lines establishes a clear information hierarchy, while blank areas reserve space for subsequent graphic insertion and color application. Overall, the design systematically presents the complete process from cultural research and formal analysis to pattern generation and contemporary visual transformation.



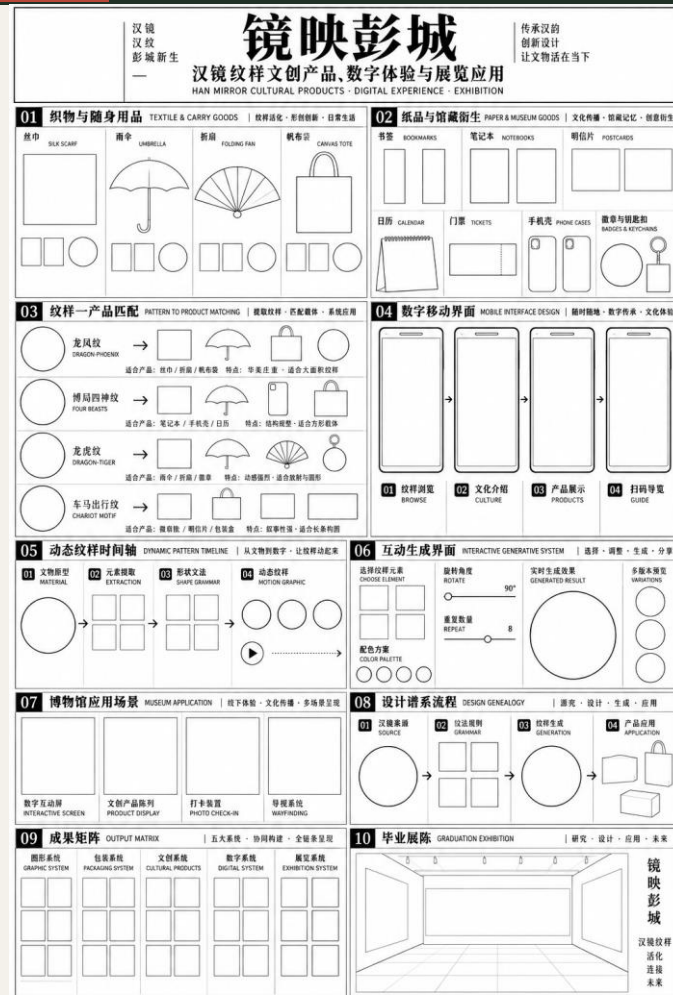
Information infographic black-and-white draft

This design draft focuses on the construction of the “Jing Ying Peng Cheng” visual system and its derivative applications based on Han dynasty bronze mirror patterns. The pattern generation section explains the relationships among structural variables, generation rules and diversified outputs through circles, grids and modular diagrams. The brand visual system further integrates color, typography, auxiliary graphics and icons to establish a unified visual language. Four representative pattern families are developed into circular, square, cropped and continuous forms, while the application matrix connects different patterns with appropriate product carriers. Cultural products, digital interfaces and museum displays extend the visual system into practical contexts. Through the contrast of thick and thin lines, the draft creates a clear information hierarchy, while blank areas reserve space for subsequent pattern insertion and color application. Overall, the design presents a systematic process from pattern generation and brand construction to product and exhibition application.



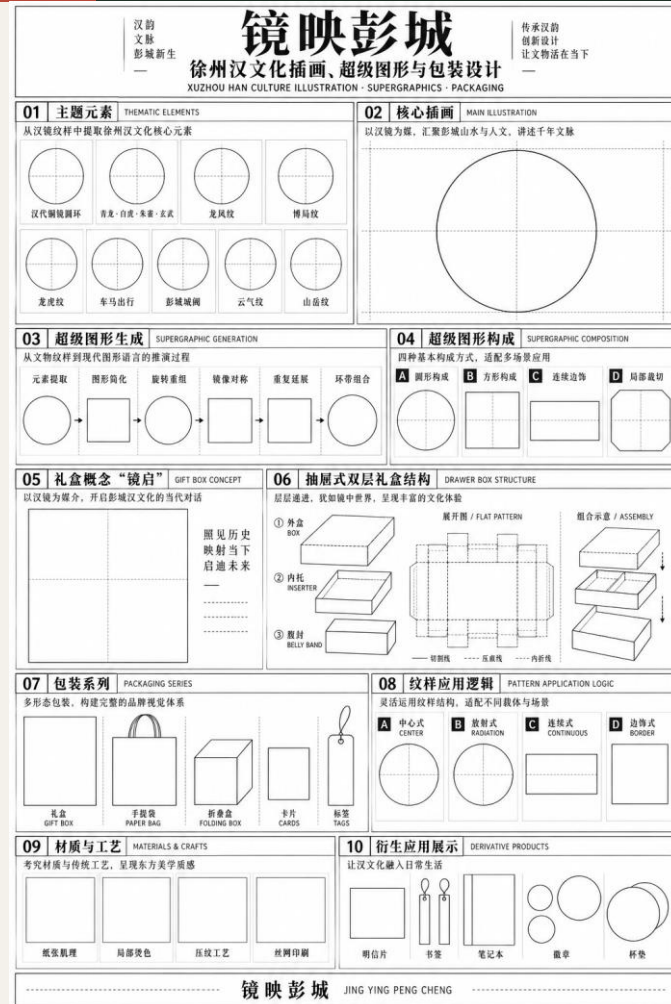
Information infographic black-and-white draft

This design draft explores the application of Han mirror patterns in cultural products, digital experiences and exhibition spaces. The product section organizes the design into textiles, carry goods, paper products and museum souvenirs, showing how different pattern structures correspond to scarves, umbrellas, folding fans, tote bags, notebooks, postcards, badges and other carriers. The pattern-to-product matching system considers composition, scale and product form to improve visual adaptability. Digital applications include mobile interfaces, a dynamic pattern timeline and an interactive generation system, presenting the transformation from cultural source and motif extraction to pattern generation and user selection. Museum displays, wayfinding and exhibition scenes extend the design into physical spaces. The design genealogy and output matrix summarize the relationships among research, rules, generation and application. Through clear grids, varied line weights and blank areas, the draft establishes an organized framework for later image insertion, color design and final presentation.



Information infographic black-and-white draft

This design draft presents the development of Xuzhou Han cultural illustration, supergraphics and packaging design. It begins by extracting representative elements from Han bronze mirrors and regional culture, including mirror structures, dragons, phoenixes, TLV motifs, chariots, city gates, clouds and mountains. These elements are integrated into a central illustration that connects Han mirror imagery with the cultural identity of Pengcheng. The supergraphic generation section demonstrates the transformation process through extraction, simplification, rotation, reflection, repetition and circular combination. Four composition formats—central, radial, continuous and cropped—support applications across different carriers. The “Mirror Opening” gift box and its drawer structure further translate the visual language into packaging form, while the packaging series, material studies and derivative products demonstrate its practical adaptability. The black-and-white layout uses varied line weights and blank placeholders to clarify the design process and reserve space for subsequent visual development.



Pattern Application Logic

01

Circular

Gift boxes, badges and medallions

02

Square

Scarves, notebooks and cards

03

Continuous

Borders, straps and package edges

04

Cropped

Large surfaces and exhibition graphics



ADAPTATION VARIABLES

Scale density orientation color contrast

PRODUCT SYSTEM



The Mirror Opening gift box, scarves, umbrellas, folding fans, tote bags, badges, bookmarks and paper goods share one visual system while responding to different surfaces.

Digital Media and Exhibition Applications

DIGITAL EXPERIENCE



EXHIBITION SYSTEM



The digital interface supports pattern browsing and generation previews. The exhibition sequence explains source, grammar, generation and application.





镜映彭城

汉镜纹样文创礼盒

HAN MIRROR · CULTURAL GIFT COLLECTION



汉镜纹样·系列礼盒



镜映彭城

— 汉镜纹样丝巾系列 —
HAN MIRROR · SILK SCARF COLLECTION



镜映彭城
JING YING
PENG CHENG



汉镜纹样胸针

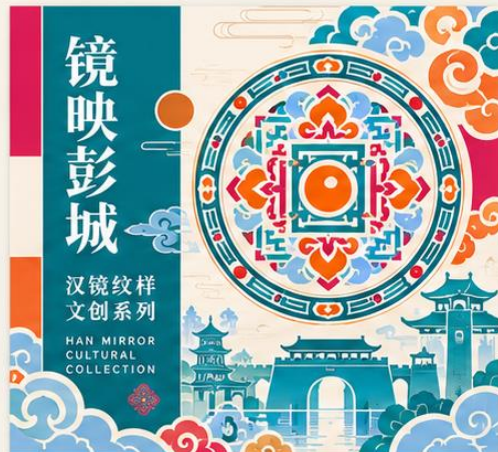




镜映彭城

汉镜纹样文创系列

JING YING PENG CHENG





镜映彭城

HAN MIRROR • CULTURAL GIFT SET

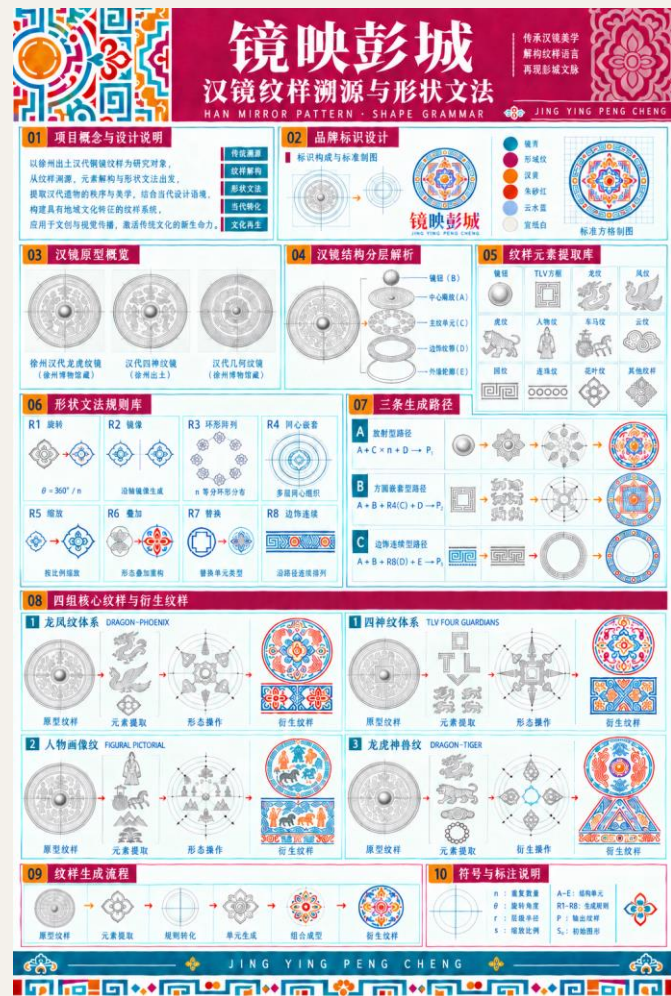


Infographic completed

This design focuses on the cultural origins and generative transformation of Han dynasty bronze mirror patterns, following the logic of “cultural source—structural analysis—rule construction—pattern generation.” The exhibition board first introduces the project concept and the visual identity of “Jing Ying Peng Cheng,” establishing a unified cultural context through the logo, color system, and standard grid. Representative Han mirrors from the Xuzhou region are then classified and decomposed into the mirror knob, central area, main decorative zone, border zone, and outer rim, clarifying their concentric structure and square-circle relationship.

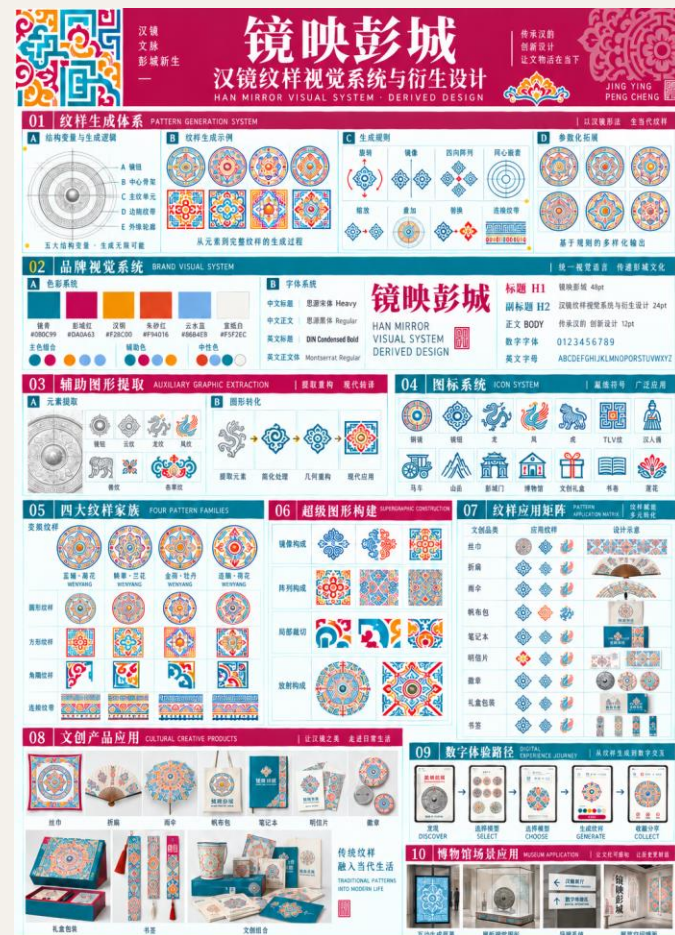
The motif library extracts representative elements, including TLV patterns, dragons, phoenixes, tigers, human figures, chariots and horses, cloud motifs, and continuous borders. Based on these elements, shape grammar rules are constructed through rotation, reflection, circular arrays, concentric nesting, scaling, superimposition, substitution, and continuous repetition. Three generative paths further illustrate how the original elements are transformed into radial patterns, square-nested patterns, and continuous borders.

The design ultimately develops four core pattern systems: Dragon–Phoenix, TLV Four Guardians, Figural Pictorial, and Dragon–Tiger Mythical Beasts, establishing a connection between the original artifacts and their derivative designs. Mirror Teal, Pengcheng Rose, Han Orange, Cloud-Water Blue, and Xuan-Paper White form the visual color system, creating a vivid yet unified visual effect. Overall, the exhibition board systematically presents the complete design process, from historical research and formal analysis to pattern innovation and contemporary visual transformation.



Infographic completed

This exhibition board presents the visual identity and pattern derivation of the “Jing Ying Peng Cheng” project, following the logic of “element extraction—rule-based generation—visual unification—design application.” Decorative elements such as mirror knobs, TLV motifs, dragons, phoenixes, tigers, human figures, chariots and horses, clouds, and continuous borders are extracted from representative Han dynasty bronze mirrors found in Xuzhou. These elements are reorganized through shape grammar operations, including rotation, reflection, scaling, arrays, superimposition, and substitution, to develop four core pattern systems: Dragon–Phoenix, TLV and Four Symbols, Figural Pictorial, and Dragon–Tiger Mythical Beasts. The brand identity system further standardizes the logo, typography, color palette, auxiliary graphics, and icons. These patterns are then extended to packaging, stationery, portable cultural products, and digital interfaces. A modular grid clarifies the information hierarchy, while Mirror Teal, Pengcheng Rose, Han Orange, Cloud-Water Blue, and Xuan-Paper White create a unified visual language that transforms Han mirror culture into a contemporary brand identity.



Infographic completed

This exhibition board presents the transformation of Han mirror patterns into cultural packaging designs. Basic forms are extracted from the circular outlines, concentric structures, and square-circle relationships of Han mirrors, and are enlarged, combined, and continuously arranged to create supergraphics suitable for packaging surfaces. The gift box adopts the concept of “Mirror Awakening,” symbolizing the use of Han mirrors as a medium through which audiences can explore the culture of the Han dynasty in Xuzhou. Its double-layer drawer structure creates a coherent visual experience across the lid, sleeve, sides, lining, and internal compartments, while allowing different cultural products to be stored separately. The board also presents a coordinated range of shopping bags, cards, tags, gift boxes, and related products, together with structural diagrams, usage procedures, material selection, and printing techniques. By maintaining a consistent system of colors, motifs, and graphic elements, the packaging integrates cultural meaning, visual recognition, practical function, and series-based product design.



Infographic completed

This exhibition board focuses on the application of Han mirror patterns across cultural products, digital media, and exhibition spaces, following the path of “product application—interactive experience—cultural communication—spatial display.” The four core pattern systems are applied to silk scarves, umbrellas, folding fans, canvas bags, badges, keychains, notebooks, postcards, and other products. According to the form, size, and function of each carrier, the patterns are arranged through radial composition, four-corner symmetry, circular expansion, partial cropping, and continuous repetition, allowing the graphics to correspond naturally with the product structure. The digital section presents mobile interfaces, pattern browsing, cultural interpretation, and animated generation processes, helping viewers understand how Han mirror elements are extracted, reorganized, and transformed. Museum guidance systems, promotional materials, and graduation exhibition renderings further demonstrate the project in practical settings. Together, these applications establish a complete design system that connects artifact research, pattern innovation, cultural products, digital communication, and spatial experience.

