THAI GINGERBREAD FRETWORK PATTERNS AS INSPIRATION FOR CONTEMPORARY DESIGN APPLICATIONS

By

Miss Kanlayanee PHUEAKNAMPHOL

A Thesis Submitted in Partial Fulfillment of the Requirements

for Doctor of Philosophy Design Arts (International Program)

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Miss Kanlayanee PHUEAKNAMPHOL : Thai Gingerbread Fretwork Patterns as Inspiration for Contemporary Design Applications Thesis advisor : Professor Eakachat Joneurairatana, Ph.D.

This research explores Thai gingerbread fretwork as inspiration for contemporary design. It aims to (1) document and analyse the forms, techniques, and meanings of fretwork motifs, (2) identify the distinctive characteristics of patterns from the Chanthaboon Waterfront Community, and (3) develop methods for reinterpreting traditional motifs into modern applications. Fieldwork involving photographic documentation and motif analysis revealed floral, vine, geometric, and emblematic designs. A Pattern Development Matrix, based on five principles—cultural integrity, formal harmony, adaptability, semantic relevance, and sustainability—guided the reinterpretation. The study demonstrates how fretwork motifs can evolve into modular patterns for textiles and ceramics. The *Yam Rung* (Dawn) collection features translucent fabric designs that evoke light and renewal, while the *Yam Kum* (Dusk) collection applies motifs to ceramic lamps and textiles that capture evening warmth. Sustainable materials, such as mussel-shell glaze and recycled fabrics, highlight ecological innovation. The research offers a methodological framework for cultural reinterpretation and affirms fretwork as a living design language that harmonises tradition, creativity, and sustainability.

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Kanlayanee PHUEAKNAMPHOL

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CHAPTER 1 INTRODUCTION

1.1 Significant of the Research

Architecture and their decoration reflect our culture, our values, and our way of life. They can tell us about both the past and shaping the future (Yasar, 2024). They serve us an aesthetic expression, a phenomenon that is directly related to the cultural values, historical background and social structure of the society (Hays, 1984). For example, the temples of Angkor Wat in Cambodia tell us about the Khmer Empire and its culture. The skyscrapers of Manhattan tell us about the growth and power of New York City. And the traditional houses of Japan tell us about the Japanese people's relationship with nature. Architecture and their decoration reflect are powerful tools for communication. They can tell us about ourselves and about the world around us.

Wood carving plays an important element in architecture decorating for ages. Fretwork, an ornament style of wood carving that can be found all over the world. No one knows who first used fretwork as decoration. The ancient Egyptians used small wooden ornament as furniture, jewelry box, and other objects. Byzantine cut out openwork patterns with fret saws and decorated their house. Christianity applied the symbolic basic from Byzantine fretwork, the crossed, vines, leaves, and grapes. Around the eighth century, the Arabic used straight line and geometric pattern on door, shutters, windows, and ceilings of mosque. The late nineteenth century witnessed a rising of Victorian fretwork pattern in Europe and America (Jenson, 1990).

Thai people and others in the tropical rainforests around the equator have all lived with wood. Thai houses in the past, regardless of region, were all made of wood. In the Sukhothai era, although there is no evidence of houses left, there is other evidence that the houses of that era were all wooden houses with gables,

often with high ground floors. In the Ayutthaya era, European-style buildings began to appear in the form of European-style buildings (Punjabhan & Nakhonphanom, 1992). In the Rattanakosin era, a type of wooden house called a European-style gable house appeared. The roof was tiled without a gable and collided at an angle. Later, there were Manila houses, along with gingerbread houses that came into the country at that time, which were popular in the reign of King Rama V (1868 – 1910) (Nor Na Paknam [pseud.], 2012). The wood carving art that decorated the gables and doors and windows, which was originally Thai traditional art, changed to wood carving that decorated the eaves under the influence of Eastern art.

Gingerbread houses are colonial-style architecture decorated with gingerbread pattern fretwork associated with Victorian Style (1873-1910). It is assumed that Thailand was influenced by the Western culture of the openwork wood carving pattern, which is curved and connected like lace. This pattern flourished during the reign of Queen Victoria of England. In the colonial era, Thailand had to modernize the country to prepare for the colonization of Western countries. Thailand had to improve architecture, housing, clothing, and transportation to be comparable to Westerners. Gingerbread house spread from Bangkok to other major cities in the country. Each region adapted the gingerbread house to its own climate, materials, and taste. Gingerbread fretwork was popular throughout the reigns of King Rama V and King Rama VI but declined during the reign of King Rama VII (1893-1941) (Kuamsub, 2017b).

As globalization has progressed, cultural values, traditional decorative practices, and people's lifestyles have changed due to technology exposure. It difficult to preserve local culture, maintaining a balance between the local and the global has gained particular importance today (Mihaila, 2014). Gingerbread houses are no longer as popular as they once were. Existing gingerbread houses and gingerbread fretwork decorations have declined due to natural causes, such as wind, rain, floods, and fires, and the aging of wood, which is not as durable as concrete. One way to preserve the gingerbread fretworks is to incorporate their elements into product design. This can

help to create products that are both unique and meaningful, and it can also help to promote cultural understanding and appreciation. There is a growing body of research on the benefits of reinteresting culture to product design objects. One study found that products that incorporate local cultural features can fit into the contemporary market while retaining meaningful cultural value (Lin, Sun, et al., 2007b). Another study found that such products are also more likely to be purchased by consumers (Qin et al., 2019).

Thai gingerbread fretwork patterns, when reinterpreted as contemporary design motifs, have the potential to bridge tradition and modernity while preserving cultural heritage. By transforming these intricate forms into adaptable patterns, they can be applied across diverse design fields such as ceramics, textiles, graphic design, and architectural surfaces. The visual qualities of fretwork—particularly their interplay of light, shadow, and negative space—offer rich inspiration for generating atmospheric depth and dynamic pattern systems. This approach not only emphasizes the artistic and historical significance of the motifs but also revitalizes them through innovative design methods. As versatile design elements, these patterns can be integrated into both functional and decorative contexts, ensuring their continued relevance in today's globalized creative industries. By positioning traditional craftsmanship within the broader framework of contemporary design, gingerbread fretwork motifs embody cultural identity while simultaneously stimulating artisanal economies, preserving endangered traditions, and promoting the sustainable integration of heritage into modern lifestyles.

In Thailand, there has been much research on architecture and decorative patterns related to foreign influences (Maneenetra, 2015). Most of this research has focused on an architecture (Mamat et al., 2019), and some has examined the characteristics of gingerbread fretwork decoration by region (Kuamsub, 2017b; Panthupakorn & Tonyapirom, 2004; Siriwan & Satthatanapat, 2017), there has been little focus on systematically documenting these patterns as a resource for design innovation. This dissertation seeks to analyze and reinterpret gingerbread fretwork

motifs in order to develop adaptable design patterns. By translating architectural ornament into contemporary creative applications, the study contributes to the preservation of this fading art form and promotes its cultural identity and relevance in modern design contexts.

1.2 Statement of the Problem

Thai gingerbread fretwork, historically recognized for its craftsmanship and cultural significance, is at risk of disappearing. Contributing factors include not only material deterioration and a declining number of skilled artisans but also insufficient design-oriented research that could integrate this traditional art form into contemporary creative practices.

While the architectural significance of gingerbread fretwork is well documented, its potential to inform adaptable and contemporary design patterns has received limited scholarly attention. Most existing studies focus on historical and architectural aspects, with minimal emphasis on practical methodologies for abstracting and applying these motifs in innovative contexts. This gap in research impedes efforts to preserve, reinterpret, and revitalize this cultural heritage for future generations.

This study aims to address these challenges through the following objectives:

1. To systematically document and analyze Thai gingerbread fretwork motifs, identifying their formal, symbolic, and aesthetic characteristics as a foundation for design.
2. To highlight the distinctive features of fretwork in the Chanthaboon Waterfront Community as a representative case study, providing concrete examples for analysis
3. To propose a methodology for adapting these motifs into contemporary design patterns, demonstrating their application in products that combine aesthetic value with cultural significance.

1.3 Research Hypothesis

Thai gingerbread fretwork patterns embody diverse motifs, carving techniques, and symbolic meanings that reflect cultural and historical contexts.

The unique characteristics of gingerbread fretwork from the Chanthaboon Waterfront Community represent a distinctive cultural identity and provide a valuable source for design inspiration.

Designers can use gingerbread fretwork patterns to integrate cultural heritage with modern aesthetics, supporting their preservation and relevance.

1.4 Objective of the Research

To systematically analyze and document Thai gingerbread fretwork motifs, highlighting their diversity of forms, techniques, and symbolic meanings.

To identify and emphasize the unique characteristics and cultural significance of gingerbread fretwork from the Chanthaboon Waterfront Community as a representative case study.

To develop contemporary design applications by transforming fretwork motifs into adaptable patterns that integrate functionality, aesthetics, and cultural value.

1.5 Scope and Area of Research

This study systematically analyzes Thai gingerbread fretwork patterns from the late 19th and early 20th centuries, with a focus on their aesthetic peak. The motifs in the Chanthaboon Waterfront Community, Chanthaburi Province, are examined as a case study, highlighting its unique architectural and cultural hybridity.

This research documents and analyzes exterior fretwork patterns, supported by secondary sources like historical records and academic literature. It also employs

creative experiments, such as controlled light-and-shadow studies, to gain a deeper understanding of the motifs' aesthetic qualities.

The research will produce a methodology for adapting traditional patterns to contemporary designs. This will be demonstrated by creating a versatile design collection that showcases the use of motifs in ceramics and textiles. The study does not include mass production or commercial use of these designs.

1.6 Research Methodologies

This study employs a mixed-methods research approach, integrating both qualitative and practice-based methodologies to achieve its research objectives. The research process unfolds in two sequential phases as follows:

Phase 1: Qualitative Research and Analysis

This phase aims to establish a foundational understanding of Thai gingerbread fretwork. Data will be gathered from primary and secondary sources. These include a literature review of books, academic journals, and historical records. Field visits to the Chanthaboon Waterfront Community will systematically document and photograph exterior fretwork motifs. In-depth interviews with historians will provide expert insights.

The collected data will be analyzed through observational studies and comparative analysis. Motifs will be cataloged and classified by their formal and symbolic characteristics. This analysis will serve as the foundation for the next phase and ensure that the design exploration remains grounded in a strong academic and cultural context.

Phase 2: Practice-Based Research and Application

This phase builds on findings from Phase 1. It focuses on translating qualitative insights into practical design applications. The process uses a systematic design framework, such as the Double Diamond model. This phase includes three key stages:

1. Ideation and Experimentation: Documented fretwork motifs will be reinterpreted through creative experimentation. The research will explore their transformation into flexible design patterns. Techniques include sketching and digital visualization. Light-and-shadow experiments will be conducted in a controlled setting to analyze the visual qualities and spatial dynamics of the motifs.

2. Pattern Development: Selected patterns will be refined into a modular design system. This ensures adaptability for various applications while retaining cultural integrity.

3. Prototyping and Evaluation: The developed patterns will be applied to a series of design prototypes, including textiles and ceramics. Feedback will be gathered from relevant stakeholders to evaluate effectiveness and guide further refinement. This confirms the viability of the developed methodology.

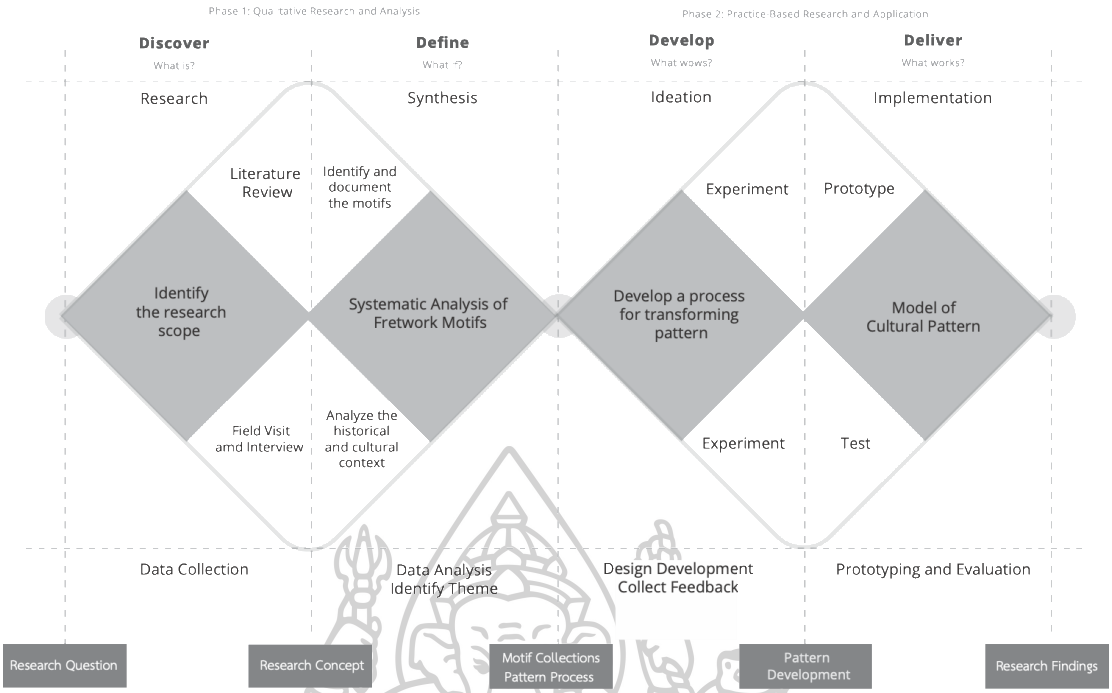

Figure 1 Double Diamond Design Process

(Source: Kanlayanee Phueakhampol, 2023)

1.7 Conceptual Framework

This conceptual framework offers a roadmap for this interdisciplinary study. It shows the systematic process of transforming cultural heritage into new design knowledge. The framework is divided into three interconnected domains: Cultural Heritage Analysis, Reinterpretation Methodology, and Contemporary Design Application.

1. Cultural Heritage Analysis This domain forms the basis of the research. It systematically examines Thai gingerbread fretwork. This includes documenting motifs from the Chanthaboon Waterfront Community and exploring their historical context, symbolism, and aesthetics. The aim is to define the core design principles of the fretwork to guide later stages of the study.

2. Reinterpretation Methodology This domain is the research's central intellectual contribution. It utilizes findings from the Cultural Heritage Analysis to propose a structured approach for reinterpreting traditional motifs into adaptable,

contemporary design patterns. This process requires creative experimentation, motif abstraction, and exploration of visual principles. The goal is to keep the cultural integrity of the patterns while giving them a modern look.

3. Contemporary Design Application This domain puts the developed methodology into practice. It leads to the creation of a design collection that displays the versatility of the reinterpreted motifs used in various creative media, including ceramics, textiles, and architectural surfaces. The final stage aims to demonstrate the viability of the methodology and support the preservation and revitalization of Thai gingerbread fretwork. It does so by showing the relevance of these motifs in modern contexts.

1.8 Research Outcome

The expected benefits of this research are as follows:

This research will produce a new body of knowledge by systematically analyzing and documenting the unique formal and symbolic characteristics of Thai gingerbread fretwork. The findings will establish a foundational resource for future studies on the revitalization of traditional motifs in contemporary design.

The study's key contribution will be the development of a structured reinterpretation methodology. This framework provides designers with a systematic process for translating cultural motifs into adaptable design patterns, thereby bridging the gap between historical heritage and modern aesthetics. The final design collection will serve as a practical example, demonstrating the versatility of the methodology across multiple creative fields, including textiles, ceramics, and graphics.

By transforming an endangered art form into a relevant resource for contemporary creativity, this research contributes to the long-term preservation and revitalization of Thai gingerbread fretwork. It will foster a renewed appreciation for

cultural heritage among the public and the design community, ensuring that this unique art form remains a vibrant and meaningful part of modern Thai identity.

1.9 Limitation of the Research

1. The study's specific focus on the Chanthaboon Waterfront Community may not fully represent the diversity of gingerbread fretwork patterns across different regions of Thailand.

2. Limited access to private interiors restricts the documentation of architectural elements to exterior fretwork patterns only.

3. The decline of traditional craftsmanship and the scarcity of skilled artisans limit opportunities for gaining firsthand insights into original techniques and cultural contexts.

1.10 Definition of Terms

Colonial Style Building refers to a specific architectural style that emerged during the late 5th to 6th reigns of the Chakri Dynasty in Thailand, approximately B.E. 2411-2468. This style represents a fusion of Western and local Thai architectural influences. It is characterized by several distinctive features, including incorporation of western elements, two-story buildings, wooden and brick construction, roof emphasis, decorative details, French windows, and balconies and verandas.

Gingerbread Pattern is a decorative motif known as a gingerbread pattern, which gets its name from the word "gingerbread". It is characterized by twisting and bending patterns that resemble ginger roots. Since Queen Victoria II's reign and throughout World War I, this elaborate pattern has been a common architectural decoration throughout Europe.

Chathaburi Province is an eastern region province in Thailand. It has a history dating back over 2,000 years, with evidence of ancient villages and prehistoric settlements. It includes various ruling powers and ethnic groups, including the Khmer and Chong. Chanthaburi, known for its natural wealth, produces gems, spices, pepper, dried shrimp, and mat weaving.

The Chanthaboon Waterfront community is an important historical site with a history dating back at least 300 years. The community began during King Narai the Great's reign. Residents of the community built roughly 200 houses along 850 meters road length on both sides of the Chanthaburi River.

Cultural Product Design is a product with a cultural element. By infusing elements of ritual and spirituality into products, designers can make them more culturally meaningful and significant. This not only adds depth to the design but also helps connect the product to the cultural values and beliefs of the local community, making it more relevant and resonant with their identity and heritage.

1.11 The Relationship between Research Objectives (RO), Research Questions (RQ), Research Methodology (RM), and Research Outcomes (ROC)

RESEARCH OBJECTIVES (The purposes of this research are)	RESEARCH QUESTIONS (Develop this RQ based on the Objective)	RESEARCH METHODOLOGY (Identify the RM based on the objectives)	RESEARCH OUTCOMES (What are the outcomes that you want from this objective?)
Obj. 1 To systematically analyze and document Thai gingerbread fretwork motifs, highlighting their diversity of forms, techniques, and symbolic meanings.	How can the motifs, forms, carving techniques, and symbolic meanings of Thai gingerbread fretwork be systematically analyzed and categorized to create a comprehensive design resource?	Qualitative Research and Analysis • Observation, Documentation, and Systematic Classification	A comprehensive, systematically categorized archive of Thai gingerbread fretwork motifs, forms, carving techniques, and symbolic meanings to serve as a foundational design resource for future studies and creative practices.
Obj 2 To identify and emphasize the unique characteristics and cultural significance of gingerbread fretwork from the Chanthaboon Waterfront Community as a representative case study.	What are the distinctive characteristics of gingerbread fretwork at the Chanthaboon Waterfront Community, and how do these features reflect the unique cultural hybridity of the region?	Field Documentation • On-site photography, sketches, and digital tracing of fretwork motifs on building exteriors.	The unique aesthetic and cultural significance of fretwork from the Chanthaboon Waterfront Community
Obj 3 To develop contemporary design applications by transforming fretwork motifs into adaptable patterns that integrate functionality, aesthetics, and cultural value.	How can traditional gingerbread fretwork motifs be abstracted and transformed into adaptable design patterns?	Practice-Based Research and Application • Methodology • Development Prototyping • Evaluation & Feedback	A proposed methodology for reinterpreting cultural motifs into contemporary design patterns, along with a collection of prototypes that demonstrate its viability and effectiveness in bridging heritage and modern design.

CHAPTER 2 LITERATURE REVIEW

The architectural heritage of Thailand is a rich tapestry woven from indigenous traditions and external influences, reflecting the nation's cultural evolution over centuries. Among the various architectural styles that emerged, the gingerbread fretwork of the late 19th and early 20th centuries stands out as a distinctive feature introduced during the colonial era. This ornate wood carving, often adorning Thai colonial-style houses, is a testament to the blending of Western design principles with local craftsmanship, creating a unique architectural identity. This chapter explores the historical, cultural, and artistic dimensions of Thai gingerbread fretwork within the broader context of its architectural significance. The discussion is structured as follows:

2.1 Western Influence of Thailand Architecture in A.D. 1868-1925

2.2 Gingerbread Fretwork as Architectural Ornamentation

2.3 The Aesthetic of Thai Gingerbread Fretwork Motifs and Patterns

2.4 Case Study: Chanthaboon Waterfront Community

2.5 Pattern Design and Cultural Inspiration

2.6 Applications of Pattern Design in Contemporary Creative Fields

2.7 Synthesis and Research Gap

2.1 Western Influence of Thailand Architecture in A.D. 1868-1925

The period between 1868 and 1925 marked a transformative era for Thai architecture, driven by Western influences and the push toward modernization. During the reign of King Rama IV (1851–1868), Thailand began its transition into a modern state as Western powers expanded their colonial presence in Southeast Asia. In response, Thailand implemented various reforms in architecture, housing, attire, and transportation to align itself with Western standards and avoid colonization (Punjabhan & Nakhonphanom, 1992). This momentum continued and intensified

during the reigns of King Rama V and King Rama VI, shaping the architectural landscape of the time.

King Rama V (1868–1910) played a pivotal role in Thailand's architectural evolution. His numerous trips abroad—to Singapore, Batavia, Java (1870), India (1871), and Europe (1897 and 1907)—exposed him to Western architectural styles, particularly during England's Victorian era. Upon his return, King Rama V initiated reforms to modernize Thailand in multiple areas, including governance, infrastructure, and architecture. Foreign architects, engineers, and artisans were employed to introduce new construction techniques and design principles. These foreign influences began with government buildings and royal palaces and eventually extended to private residences. King Rama V also encouraged Thai elites, including members of the royal family, to study abroad, further solidifying the integration of Western architectural elements into Thai society (Maneenetra, 2015).

Under King Rama VI (1910–1925), Western influence in Thai architecture expanded further. Infrastructure projects, such as roads, railways, and communication systems, facilitated greater interaction with foreign ideas. During this period, architectural trends shifted toward preservation and adaptation, with notable examples including the construction of Sanam Chandra Palace in Nakhon Pathom and Maruekhathaiyawan Palace in Phetchaburi (Punjabhan & Nakhonphanom, 1992).

The later years of King Rama V's reign and the entirety of King Rama VI's reign saw a decline in traditional Thai housing styles in Bangkok, replaced by Western-inspired homes. These new structures were predominantly two-story buildings emphasizing roof design, such as hip roofs (Pan-Ya) and gable roofs (Manila), often incorporating gingerbread fretwork as decorative elements (Panthupakorn & Tonyapirom, 2004). The fusion of Western styles with Thai traditions gave rise to what is commonly known as Colonial Architecture or Colonial Style, which can be categorized by roof types and decorative features into the following styles: Pan-Ya (Hip Roof), Manila

(Gable Roof), Ka-La-Pa Buildings, Mission Buildings, Gingerbread Houses (Pussadee Tiptus, 1982).

Building Type	Example	Description
(A) Pan-Ya (Hip Roof)		A traditional European-style wooden house with a hip roof. The roof slopes down on all sides in a pyramid shape with no gable. This type of roof is the most classic of traditional roofs.
(B) Manila (Gable Roof)		A wooden house with the same characteristics as a Pan-Ya. Most of them are made of wood and have a gable.
(C) Ka-La-Pa Building		A hipped-roof house with a front porch, which can either be a single-story wooden house with a raised floor and open space underneath, or a building with an elevated floor supported by a constructed base.
(D) Mission Building		Houses with hipped roofs or gabled roofs often feature surrounding balconies, with the ground floor typically left open as a spacious area.

Table 1 Colonial Style Building in Thailand

2.2 Gingerbread Fretwork as Architectural Ornamentation

2.2.1 Definition and Characteristics of Gingerbread Fretwork

Nor Na Paknam (2020, p. 27) defines "Gingerbread Houses" as buildings adorned with carved and perforated wooden patterns. The style derives from the elaborate decorations of traditional Western gingerbread, characterized by intricate embellishments and ornamental scalloped edges, like those found in the country retreat of President Eisenhower.

Supat Boonyaritthikit (2018, p.116) describes gingerbread houses as a type of wooden house commonly found during the period when a significant number of

foreigners resided in Thailand, bringing with them certain construction styles. These houses are characterized by their decorative wooden fretwork, prominently featured on gables and eaves. The term “gingerbread house” originates from the word "gingerbread," which refers to the design’s resemblance to the intricate patterns often seen on gingerbread cookies. (Bunyarittikit, 2018)

Patravadee Siriwan and Rungpassorn Satthatanapat defined the meaning of gingerbread patterns in the Journal of the Association of Researchers (2019, Vol. 24 No.1, p.65) that gingerbread fretwork is a type of wood carving used to decorate architecture. It is characterized by intricate, undulating patterns that resemble ginger. Gingerbread fretwork is influenced by Gothic art, and it has evolved significantly from its original form. The most iconic gingerbread fretwork patterns are tulips, both upright and inverted. Other common patterns include scrolls, geometric shapes, droplets, and fruits and vegetables. Gingerbread fretwork is popular in the Greater Bangkok area, particularly in Nakhon Pathom province (Siriwan & Satthatanapat, 2017).

The term "gingerbread fretwork" is derived from "gingerbread," referring to a type of decorative pattern used in architecture. These patterns often feature intricate, curved, and whimsical designs resembling the irregular shape of ginger roots. Delicate and charming, they gained immense popularity in architectural decoration throughout Europe, particularly during the reign of Queen Victoria II of the United Kingdom, continuing until the period of World War I (Panthupakorn & Tonyapirom, 2004).

The "gingerbread fretwork" refers to a type of intricate perforated wood carving, characterized by its interconnected, swirling patterns. The curves and flowing designs are crafted according to the imagination and skill of the artisan. This fretwork is often used as decorative elements in architectural structures, visible even from a distance. It adds a sense of softness, elegance, and visual appeal to historical buildings

adorned with these patterns, akin to lace embellishments on a woman’s attire (Kuamsub, 2017b).

Summary, a decorative motif known as a gingerbread pattern, which gets its name from the word "gingerbread," is characterized by twisting and bending patterns that resemble ginger roots. Since Queen Victoria II's reign (1837-1910) and throughout World War I, this elaborate pattern has been a common architectural decoration throughout Europe. It involves delicately carved woodwork with linked swirls and curls that gives buildings a delicate appearance. While 'gingerbread' can have various interpretations, this research will specifically focus on the decorative carving technique known as 'gingerbread fretwork' or ‘gingerbread patterns’ to ensure clarity and consistency. Gingerbread fretworks are created by carving out the wood to form delicate designs. The patterns used to decorate houses are inspired by Gothic art, including the cloverleaf, cross, and flame patterns. However, the gingerbread pattern has evolved from its original form and now includes unique elements such as tulip patterns, both vertical and horizontal, Kankhot (coiled stem) patterns, geometric patterns, paisley patterns, and vegetable and fruit patterns.

Figure 2 Gingerbread Fretwork in Victorian Fretwork book

Source: John T.Jenson, 1990, pp. 13, 44, 91, 92.

The Victorian era, spanning the 64-year reign of Queen Victoria of the United Kingdom (1837–1910), is renowned for its distinctive artistic and cultural characteristics, ranging from decorative arts to fashion. This period is referred to as the Victorian era. Victorian architecture, named after Queen Victoria, does not follow a single, specific style but rather represents a fusion of various popular styles of the time. Its key features include intricate decorations, the use of geometric forms, and natural botanical motifs. Prominent decorative styles of the era include: Queen Anne Style, Stick Style, and Second Empire Style (Jenson, 1990).

Queen Anne Style is Characterized by conical towers with triangular shapes, large windows, balconies, stained glass, and half-timbered walls. This style often incorporates ornate wood carvings on gables and eaves. Stick Style is a popular architectural form featuring half-timbered walls with wooden planks arranged in vertical, horizontal, and diagonal patterns. It includes projections on building facades

but avoids large or tall windows and excessive ornamentation. Second Empire Style is recognized for its use of Mansard roofs, a design trend popular during the reign of Napoleon III.

Figure 3 Victorian Style Architecture

Source: (A) Christine Huckins Franck, Queen Anne Style, accessed Nov, 3, 2023, available from https://christinefranck.com/2012/02/14/queen-anne-style/
(B) Mouldings One, Stick Style Style, accessed Nov, 3, 2023, available from https://www.mouldingsone.com/architectural-styles/stick-architecture/#gallery-1-4
(C) Christine Huckins Franck, Second Empire Style, accessed Nov, 3, 2023, available from https://christinefranck.com/2012/02/07/second-empire-style/

Gingerbread frentwork is one of the key elements that enhance the charm and elegance of Queen Anne-style houses, showcasing the meticulous craftsmanship of Victorian-era design. These intricately carved wooden details are widely used across various parts of the house to add aesthetic value and signify the status of the homeowner. Gingerbread frentwork often appears along the eaves and roof gables, adding dimension and character to the structure. The patterns may feature floral designs, vine motifs, or geometric shapes. The front balconies are typically adorned

with lace-like trim to increase their decorative appeal and create a sense of luxury. The designs of Gingerbread frentwork vary by region and country, influenced by local cultures and the craftsmanship techniques of artisans. The most frequently used patterns include Floral and Vine Patterns, Geometric Patterns, and Lace Patterns (Long, 2002).

Figure 4 Gingerbread trim on a Victorian-era house in Cape May, New Jersey
Source: Wikipedia, Gingerbread (architecture), accessed Oct, 28, 2023, available from https://en.wikipedia.org/wiki/Gingerbread_(architecture)

In the 19th century, England was considered the origin of gingerbread fretwork, which later spread to France, Switzerland, Austria, and Germany. As European nations embarked on colonial expeditions, they brought this decorative style to Asian countries. Additionally, some influences came from Muslim communities in the southern regions, while others might have been influenced by northern styles from Burma (Siriwan & Satthatanapat, 2019).

2.2.2 Historical Development of Gingerbread Fretwork in Thailand

In Thailand, gingerbread fretwork patterns were introduced during the reign of King Rama V, influenced by efforts to modernize the country and the increased presence of foreigners. Gingerbread-style architecture can be found in various key areas of Bangkok, which historically served as residential, commercial, and expatriate quarters. Notable neighborhoods include Thewet, Lan Luang, Wang Burapha, and Sao Ching Cha. Prominent examples of gingerbread-style buildings in Bangkok include the Dusit Palace complex, the monastic residences at Wat Suan Phlu, and the shophouses along Song Wat Road. Beyond Bangkok, this architectural style also gained popularity in provincial towns, such as Bang Pa-In Railway Station, the Tsarévich Pavilion on Koh Si Chang, Vongburi House in Phrae, Phra Thanet House in Sanam Chandra Palace, and the Chanthaboon Waterfront Community in Chanthaburi.

Figure 5 Gingerbread Fretwork Architectural Decorations in Siam

Source: Nor Na Paknam, 2018

A famous example of gingerbread-style architecture is the Vimanmek Mansion, commissioned by King Rama V within the Dusit Palace. Constructed entirely of golden teakwood, the mansion was relocated from the Mundhaturatanaroj Residence

at Phra Chuthathut Palace on Koh Sichang. The intricate fretwork designs adorning the gable, fascia boards, and eaves, commonly referred to as "gingerbread patterns," were highly popular during that era.

The adoption of gingerbread fretwork in Thailand during King Rama V's reign was not only a stylistic choice but also a reflection of the socio-economic changes of the era. The rise of the merchant class, particularly Chinese traders in Bangkok and provincial towns, played a crucial role in popularizing this architectural feature. Wealthy merchants commissioned buildings adorned with gingerbread patterns as symbols of prestige and modernity, while still incorporating traditional Thai and Chinese elements. This is particularly evident in areas like Chanthaboon Waterfront Community in Chanthaburi, where gingerbread fretwork patterns blend seamlessly with local materials and Chinese-inspired designs (Kamphusaen, 2009).

The geographic diffusion of gingerbread architecture extended beyond Bangkok to key provincial centers, facilitated by the development of railways and improved transportation networks. These infrastructure projects enabled the movement of craftsmen, materials, and ideas, spreading gingerbread patterns to places like Phrae, Nakhon Pathom, and Phetchaburi. Notable examples include the Vongburi House in Phrae and Mrigadayavan Palace in Phetchaburi, where gingerbread fretwork complemented the natural surroundings and emphasized the royal patronage of Western-style architecture (Kruaraya, 2014).

Additionally, the adaptation of gingerbread fretwork in Thailand showcased the ingenuity of local craftsmen in balancing aesthetics with functionality. The perforated designs were calculated to provide natural ventilation and shade, crucial for tropical climates. Craftsmen simplified and stylized traditional Thai patterns, such as floral and geometric motifs, to suit the delicate carving process while maintaining structural integrity. This harmonious blend of form and function is a testament to the skill and creativity of Thai artisans during this transformative era (Kuamsub, 2017b).

Figure 6 The Royal Ceremony for the Inauguration of Vimanmek Mansion
Source: Silpawattanatham, The Royal Ceremony for the Inauguration of Vimanmek Mansion, accessed Nov, 3, 2023, available from https://www.silpa-mag.com/old-photos-tell-the-historical-story/article_55870

2.3 The Aesthetic of Thai Gingerbread Fretwork Motifs and Patterns

Gingerbread fretwork serves dual purposes in both functional and aesthetic dimensions. It is designed to enhance ventilation in tropical climates, with intricate open patterns that allow air to circulate freely within buildings. This natural airflow helps cool interiors and reduce humidity, addressing the challenges posed by Thailand's hot and humid environment.

Wooden fretwork allows for the construction of lightweight yet durable components, minimizing the overall weight on structures. This was particularly advantageous during the colonial period when wood was the predominant building material (Punjabhan & Nakhonphanom, 1992). The carving process requires using sturdy wood, as the remaining parts must support themselves after the wood has been cut away. Craftsmen must calculate the carvings, as excessive detailing can compromise the visual appeal from a distance. The design of the patterns has no fixed rules; it depends on the project, the decorative space, the building owner's preferences, and the craftsmanship or architectural style.

Gingerbread patterns differ from traditional Thai art patterns, which have specific names such as ‘prajamyam’ and ‘kanok’. The patterns are commonly referred to as floral patterns, geometric patterns, ornamental patterns, and typographic patterns. This is because gingerbread fretwork involves a design approach that simplifies and reduces the shapes and forms of natural elements like branches, leaves, flowers, fruits, and vines (Kuamsub, 2017b).

The characteristics of patterns based on wood carving can be categorized into two types: attached and detached pattern. Attached patterns refer to designs where all elements are connected, with the pattern visible in the remaining wood surface. These are often larger designs and are commonly found in areas such as gables, kho-song (horizontal beams), and above doors and windows. Detached patterns, on the other hand, are designs where sections are carved out, creating open spaces within the pattern or image. These are typically used for decorative purposes in areas like eaves, air vents, windows, balustrades, and balconies.

The gingerbread fretwork pattern can be divided into five key components: the pattern base, the pattern frame, the pattern stem, the main flower, and the supporting flowers and leaves (Kruaraya, 2014).

1. Central Motif: The central motif is usually positioned in the middle as the starting point for creating the pattern, such as Ba Khanat or Flower Pot.

2. Pattern Frame: The frame of the pattern is determined by the size and shape of the space it occupies, such as curved panels or window panes.

3. Pattern Stem: The structure of the pattern, such as spiral stems or vine motifs.

4. Main Flower: The primary flower motif located at the ends of the pattern, clearly identifiable as flowers like Buddhan (cotton rose), Sa Flower, or Parichat Flower.

5. Additional Flowers and Leaves: These are supplementary floral or decorative leaves used to fill gaps in the pattern, which can also enhance the strength of perforated designs.

2.3.1 Comparative Analysis of Gingerbread Fretworks in Thailand

The architectural development during the reign of King Rama V began in central regions. When King Rama V reformed the traditional administrative system into the Provincial Administration (Monthon Thesaphiban) system, cities that served as centers of the Provincial Administration became more developed than others. For example, in the Nakhon Si Thammarat Monthon, Thailand's first railway was laid to Nakhon Si Thammarat. Consequently, the development of Western-style houses was particularly prominent in these major cities. The forms of Hip Roof building (Pan-Ya house) and Manila building, which are not traditional local architectures, became common in these areas (Pestonji & Nakthong, 2012).

Buildings in different regions, however, varied according to the local geography, climate, and construction materials. These included wooden houses, brick buildings, and row houses. Such structures were primarily found in central cities, areas with affluent merchants, residences of prominent individuals, locations with foreign communities, royal palaces, and historically significant business districts. Examples include the royal residence on Si Chang Island in Chonburi Province, the monk’s quarters at Wat Niwet Thammaprawat in Bang Pa-In District, Ayutthaya Province, old

houses along the streets in Mueang District, Lampang Province, Sanam Chandra Palace in Nakhon Pathom Province, Chinese communities in Mueang District, Tak Province, and various houses in Mueang District, Chiang Mai Province.

2.3.1.1 Gingerbread Fretwork in Bangkok Area

During this period, Western-influenced buildings adorned with gingerbread fretwork architecture could be found in Bangkok. Notable examples include Vimanmek Mansion, Dusit Palace, Phraya Narai Palace, Bangplu Palace, M.C. Chartchusak Thaveewong's Palace, the monastic quarters of Wat Bowonniwet Vihara, Wat Bangplu, Wat Suanplu, Wat Devaraj Kunchorn, Wat Kalayanamitr, Wat Intharam, Bang O Mosque, the pavilion at Santa Cruz Church, the pavilion at Wat Intharawas, Ban Ekanak, shophouses along Song Wat Road, Ban Kanompang (Sao Chingcha), Windsor House, the Customs House, Water Police Residences, and the Somdej Chaophraya Museum Home.

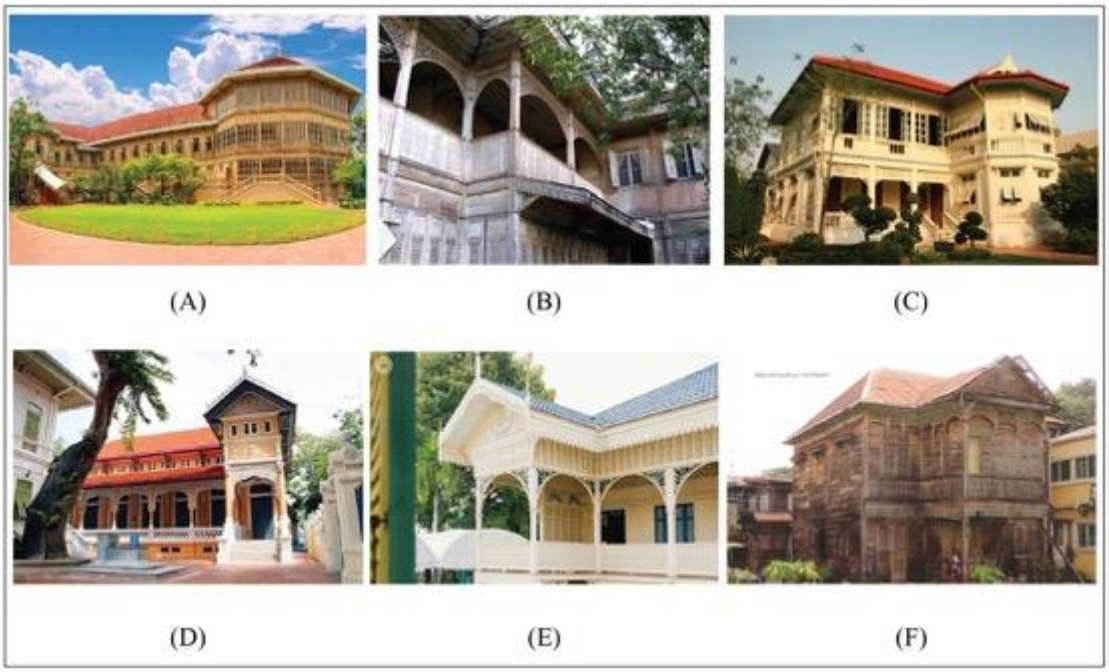

Figure 7 Building with gingerbread decoration in Bangkok area

Source:

(A) The Princess Maha Chakri Sirindhorn Anthropology Centre, Vimanmek Mansion Museum and Museums in Suan Dusit Palace, accessed Oct, 28, 2023, available from https://db.sac.or.th/museum/museum-detail/29

(B) Wikipedia, Wang Bang Phlu, accessed Oct, 28, 2023, available from https://th.wikipedia.org/wiki/wangbangphu

(C) The Princess Maha Chakri Sirindhorn Anthropology Centre, Ban Somdej Chaopraya Museum, accessed Oct, 28, 2023, available from https://db.sac.or.th/museum/museum-detail/114

(F) MGR Online, Phra Tamnak Petch in Wat Bowonniwet Vihara, accessed Oct, 28, 2023, available from https://mgronline.com/travel/detail/9560000134583

(E) The Cloud, Jalern Wittaya Buildid in Bang O Mosque, accessed Oct, 28, 2023, available from https://readthecloud.co/bang-o-mosque/

(F) Museum Siam, Winsor House, accessed Oct, 28, 2023, available from https://www.museumsiam.org/km-detail.php?CID=16&CONID=3320

The Vimanmek Mansion (Phra Thi Nang Wimanmek) is one of the best examples of gingerbread houses that were popular in Thailand during King Rama V's reign. It was built in 1900, in Ko Sichang, Chonburi Province, but was dismantled on the orders of the king and reconstructed at Dusit Palace in 1901. It is entirely made of teak It is a European and Thai-Contemporary style that combines intricate fretwork on windows and air passageways to create detailed ornamentation. This mansion is decorated with gingerbread-patterned wood carving on the gables, eaves, and railings. Abhisek Dusit Throne Hall is one of the first throne halls built in Dusit Palace.

It was built in 1904 as an audience hall and entertainment venue for the Dusit Palace complex. It is a single-story building made mostly of wood, with intricate wood carvings called "Bungha (Potpourri)" patterns. It is also decorated with stained glass and plasterwork on the pediment, in the Moorish style.

Figure 8 Vimanmek Mansion and Abhisek Dusit Throne Hall

Sources: Wikipedia, Vimanmek Mansion and Abhisek Dusit Throne Hall, accessed Nov 3, 2023, available from https://en.wikipedia.org/wiki/Dusit_Palace

The patterns predominantly consist of gingerbread fretwork, characterized by wooden perforated designs, primarily featuring botanical motifs. These patterns are typically found on gables, porches, eaves, under gable roofs, fascia boards, ventilation panels, braces, walls, and above doors and windows, as well as on

balustrades. The patterns can be categorized into solid patterns and openwork patterns.

Solid patterns are fully connected, with the design visible through the remaining wood surface, usually in larger scales. These are often found on gables, fascia boards, and above doors and windows. Openwork patterns, on the other hand, feature perforations that create standalone designs or images. These are commonly used to decorate eaves, fascia boards, balustrades, and balconies.

The Gingerbread pattern used to decorate houses is inspired by Gothic art, such as the cloverleaf pattern, cross pattern, and flame pattern. However, the Gingerbread pattern has evolved from its original form and now includes unique elements such as tulip patterns, both vertical and horizontal, Coiled stem (Kankhot) patterns, geometric patterns, paisley patterns, and vegetable and fruit patterns.

1. Dusit Palace

(a) Vimanmek Mansion

(d) Abhisek Dusit Throne Hall

Decoration Location: Gable end, Gable top, Siding, Running trim, Bracket, Turned spandrils, Railings, Corbels, Eaves, Fringes, Ventilation panel

Pattern/Motif Type: Floral pattern, Geometric Pattern, Bungha motif, Kalsh motif (Moorish Architect, Art Nouveau, Neo-Classic Influence), Tulip Motif

2. Phra Tamnak Petch in Wat Bowonniwet Vihara

Decoration Location: Pediment, Ventilation panel above the door, Decorative corbels, Eaves

Pattern/Motif Type: Floral pattern, Geometric Pattern, Phuttan Motif, Fruit Motif, Tulip Motif

3. Jalern Wittaya Building in Bang O Mosque

Decoration Location: Gable end, Gable top, Decorative corbels, Railings, Bracket

Pattern/Motif Type: Floral pattern, Geometric Pattern, Alphabet Motif

4. Ban Ekkanak Museum

Decoration Location: Gable end, Gable top, Siding, Running trim, Bracket, Turned spandrils, Railings, Corbels, Eaves, Fringes, Ventilation panel

Pattern/Motif Type: Floral pattern, Geometric Pattern, Alphabet Motif

5. Ginger Bread House, Sao Ching Cha

Decoration Location: Eaves, Fringes, Ventilation panel

Pattern/Motif Type: Floral pattern, Geometric Pattern, Alphabet Motif

Table 2 Building with gingerbread fretwork decoration in Bangkok area

2.3.1.2 Gingerbread Fretwork in Central Area

Central region gingerbread fretworks do not differ significantly from Gingerbread fretworks style in Bangkok areas. Most of them are influenced by Western architectural styles. Notable examples of central region gingerbread houses include Sanam Chandra Palace, Bang Pa-In Railway Station, Sam Khok District Office, His Majesty's Palace at Bang Pa-In, and Wat Niwet Thammaprawat.

Figure 9 Building with gingerbread fretwork decoration in center of Thailand

Source:

(A) Designated Areas for Sustainable Tourism Administration, Sanam Chandra Palace, accessed Oct, 31, 2023, available from https://cbtthailand.dasta.or.th/ webapp/ relattraction/content/626/

(B) Bangtoey Subdistrict Municipality, Sam Khok District Office, accessed Oct, 31, 2023, available from http://mubangtoey.go.th/public/landmark/data/detail/ landmark_id/ 2/menu/138

(C) The Ecclesiastical Data Center of the Buddhist Sangha, Region 14, Music Pavilion, accessed Oct, 31, 2023, available from https://www.sangha14.org/ index.php?url=templebuild&id=389

(D) Bang Pa-in Subdistrict Municipality, Bang Pa-in Railway Station, accessed Oct, 31, 2023, available from https://bangpaincity.go.th/public/list/data/ index/menu/1545

(E) Bang Pa-in Subdistrict Municipality, His Majesty's Palace, accessed Oct, 31, 2023, available from https://bangpa-incity.go.th/public/list/data/detail/id/ 2324/menu/ 1545/page/1

(F) Bang Pa-in Subdistrict Municipality, Wat Niwet Thammaprawat, accessed Oct, 31, 2023, available from https://bangpa-incity.go.th/public/list/data/ detail/id/2323/menu/ 1545/page/1

1. Ruen Phra Thanesuan in Sanamchan Palace

Decoration Location: Running trim, Railings, Corbels, Eaves, Fringes, Ventilation panel

Pattern/Motif Type: Floral pattern, Geometric Pattern

2. Wat Niwet Thammaprawat and other area in Sanam Chandra Palace

Decoration Location: Gable end, Gable top, Siding, Running trim, Bracket, Turned spandrils, Railings, Corbels, Eaves, Fringes, Ventilation panel

Pattern/Motif Type: Floral pattern, Geometric Pattern, Flora; Motif

3. Bann Manee Rach, Bann Sila Suwan, and Bann Leer Pra Sert near Tha Chin River, Samutsakorn

Decoration Location: Gable end, Gable top, Siding, Running trim, Bracket, Turned spandrils, Railings, Corbels, Eaves, Fringes, Ventilation panel

Pattern/Motif Type: Floral pattern, Geometric Pattern

Table 3 Gingerbread fretwork decoration in Central Thailand

2.3.1.3 Gingerbread Fretwork in Northern Area

Western influences have transformed Thai architecture, yet adaptations have been made to align with Thai beliefs and way of life. This is particularly evident in the architecture of the Lanna people. The residences of affluent Lanna merchants often took the form of “Galae Houses,” which utilized natural boundaries to demarcate property limits (Charernsupkul & Temiyabandha, 1978).

The houses were constructed with solid wooden walls, with the main living area located on the upper floor, while the ground floor was often used for household industries. The roofs were gabled, with a long rectangular plan and steep gable ends, featuring bird-wing roof extensions. The gable ends were adorned with “Galae” finials, while the gables themselves were decorated with carved wooden ornaments. Windows came in various styles, and “Hamyons” (ornamental carvings above important doorways) were crafted either as low-relief carvings or as perforated designs to allow ventilation. In addition, the patterns demonstrate a clear influence of Chinese artistry, as seen in motifs like the Dok Phut Tan or Peony, symbolizing wealth and prosperity, and the Ruyi pattern derived from the Lingzhi fungus, which

represents longevity, immortality, and fulfilled wishes. The Ham Yon patterns also reflect Western influences introduced by Burmese and Tai Yai communities during the reign of King Rama V. An example is the Ba Khanat or pineapple motif (Kruaraya, 2014).

One type of traditional wooden house popular in the northern region, particularly in Phrae and Lamphun provinces, is the Saranai House. The term Saranai (also spelled Sanai) refers to the carved column-like ornament placed at the ridge or the center of the gable end of the house. It is hypothesized that the term may have originated from the word Chiaranai (polishing) or Pi Sanai (a type of flute). Saranai is typically crafted from wood and intricately carved. This architectural style gained popularity around 1884, during the period when Western civilization began to influence Thailand. However, Saranai was not originally part of the local indigenous material culture. Houses featuring Saranai were typically residences of nobility, affluent merchants, or prominent community leaders. Examples of architecture incorporating Saranai include Wongburi House and Khum Chao Luang Phrae.

On the other hand, Gingerbread Houses were adopted by Northern Thai nobility, influenced by architectural styles from the royal court in Bangkok. In Phrae, noble houses retained the functional layout of traditional indigenous houses but featured decorative gingerbread fretwork. These elaborate designs became a hallmark of Lanna architecture. Additionally, many government buildings in the northern region adopted the gingerbread style, such as the old Muang Kamphaeng Phet District Office Building.

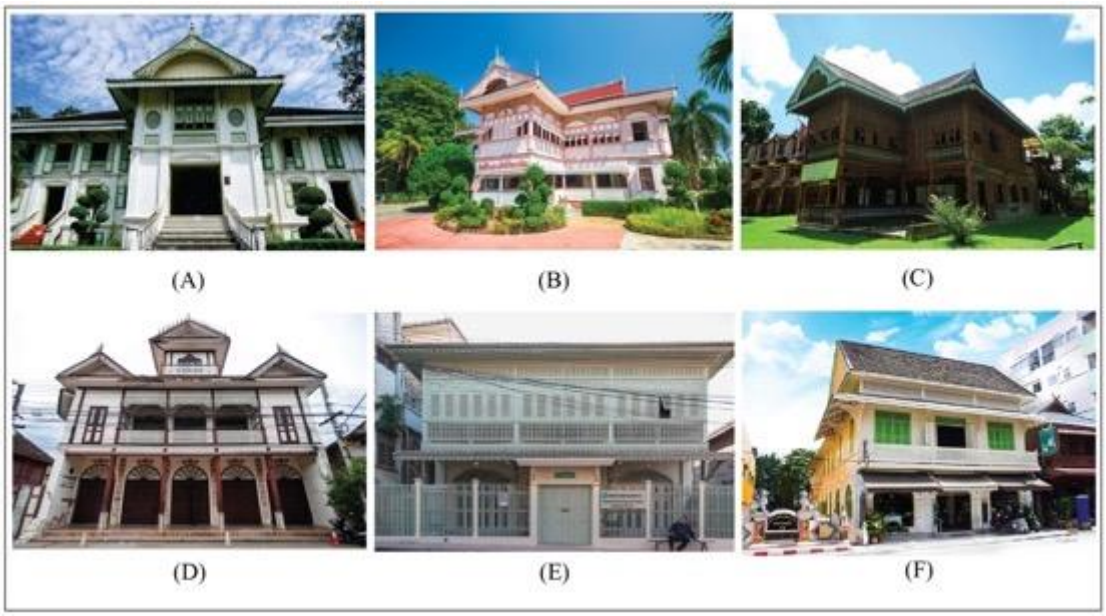

Figure 10 Building with gingerbread fretwork decoration in northern of Thailand

Source:

(A) Tourism Authority of Thailand, Vongburi House Museum, accessed Oct, 31, 2023, available from https://thai.tourismthailand.org/Attraction/baanwongburi-koomwongburi

(B) Museum Thailand, Muang Phrae Museum, accessed Oct, 31, 2023, available from https://www.museumthailand.com/en/museum/The-Residence-of-Phrae-Governor

(C) Museum Thailand, Wichai Ratcha Residence, accessed Oct, 31, 2023, available from https://www.museumthailand.com/th/3517/storytelling/kumwichieacha

(D) The Cloud, Mong Ngoy Sin Shop, Kad Kong Ta, Lampang, accessed Oct, 31, 2023, available from https://readthecloud.co/moungngwezin-lampang/

(E) The Princess Maha Chakri Sirindhorn Anthropology Centre, Lampang Performing Arts Center (Booriboon House), accessed Oct, 31, 2023, available from https://db.sac.or.th/ museum/museum-detail/1499

(F) Changpuak Magazine, Raming Tea House Siam Celadon, accessed Oct, 31, 2023, available from https://changpuakmagazine.com/thaiarticle/ramingreahouse/241815/

1. Khum Chao Luang (Muang Phrae Museum), Phrae

Decoration Location: Gable end, Gable top, Running trim, Bracket, Corbels, Eaves, Fringes, Ventilation panel

Pattern/Motif Type: Floral pattern, Geometric Pattern

2. Vongburi House Museum, Phrae

Decoration Location: Gable end, Gable top, Running trim, Bracket, Corbels, Eaves, Fringes, Ventilation panel

Pattern/Motif Type: Floral pattern, Geometric Pattern

3. Wichai Ratcha Residence, Phrae

Decoration Location: Gable end, Running trim, Bracket, Corbels, Eaves, Fringes, Ventilation panel

Pattern/Motif Type: Floral pattern

4. Wat Jom Sawan, Phrae

Decoration Location: Gable end, Gable top, Running trim, Bracket, Corbels, Eaves, Fringes, Ventilation panel

Pattern/Motif Type: Floral pattern, Geometric Pattern

Table 4 Gingerbread pattern fretwork in Northern Thailand

2.3.1.4 Gingerbread Fretwork in Eastern Area

In the early stages, houses in the Eastern region of Thailand were typically built facing rivers, such as the Bang Pakong River and the Chanthaburi River, which served as primary transportation routes. Later, with the establishment of urban planning, buildings were oriented along roads, and residential and administrative zones were systematically separated. Public buildings and government residences were heavily influenced by Western architectural styles, modeled after those in the capital city. However, the core architectural elements retained local characteristics blended with foreign influences, resulting in Eastern-style houses that exhibit a mix of cultures.

A survey of 33 architectural structures from the period between 1894 and 1910 revealed that government offices, public buildings, and government residences followed the centralized standards. Cities or provinces serving as administrative centers were more developed than others, such as Mueang Prachinburi District and Mueang Chanthaburi District. Examples of notable structures include provincial halls, district offices, land registry offices, and residences for provincial governors, often designed in classical or gingerbread styles. These buildings were typically constructed of concrete or wood and were either single-story or two-story structures. Most floor plans were rectangular, with buildings oriented toward rivers or main roads. Roof styles included hipped roofs, Manila-style roofs, or hybrids of the two, with staircases usually located at the front of the building (Thaothong et al., 2003).

In rural areas, the design of houses was adapted to the local geography, such as coastal homes. Local houses often featured uneven elevations and relatively low gables, with walls made of interlocking wooden panels or vertical tongue-and-groove wooden planks. Eaves extended to cover the sides of the house, and interiors were usually open without room partitions. Religious buildings in rural areas, while less

ornate than those in Bangkok, reflected practicality in space usage, simple decorations, and artistic elements blending Western, Chinese, Khmer, and Vietnamese influences with local art forms (Thaothong et al., 2003).

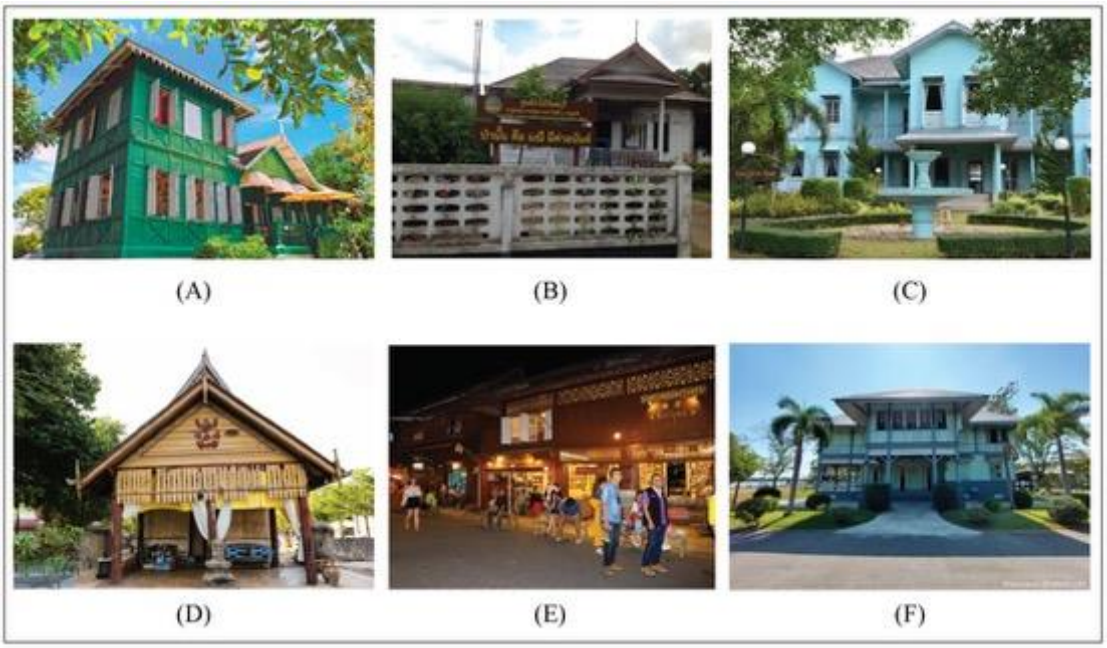

Figure 11 Building with gingerbread fretwork decoration in western of Thailand

Source:

(A) Office of Arts and Cultural Management, Chulalongkorn University, Wooden House in Phra Chudhadhuj Palace, accessed Oct, 28, 2023, available from https://www.cuartculture.chula.ac.th/about/ departments/phra-chudhadhuj-ratchasthan-palace-museum/

(B) Chanthaburi Provincial Forestry Office, accessed Oct, 28, 2023, available from https://promptpai.com/p/10245453#modal

(C) Thainews, Chanthaburi Governor's Residence, accessed Oct, 28, 2023, available from https://thainews.prd.go.th/th/news/detail/TCATG200619194844351

(D) Social Rayong, Wat Kod Tim Ta Ram, accessed Oct, 28, 2023, available from https://www.socialrayong.com/1605/

(E) Thainews, Houses along Yomjinda Road, Rayong Province, accessed Oct, 28, 2023, available from https://thainews.prd.go.th/th/news/detail/TCATG191222222836756

(F) City Museum, Chachoengsao Province, accessed Oct, 28, 2023, available from https://khunnaiver.blogspot.com/2023/02/About-Chachoengsao%20Museum .html

1. Wooden House and Asdang Bridge in Phra Chudhadhuj Palace, Koh Sri Chang

Decoration Location: Gable end, Gable top, Running trim, Bracket

Pattern/Motif Type: Floral pattern, Geometric Pattern

2. **Wat Kod Tim Ta Ram, Rayong**

Decoration Location: Louvered panels under the gable

Pattern/Motif Type: Geometric Pattern

3. Chanthaboon Waterfront Community

Decoration Location: Ventilation panels, Decorative windows, Doors, Eaves, and Balconies
Pattern/Motif Type: Floral pattern, Geometric Pattern

Table 5 Gingerbread fretwork decoration in Western Thailand

2.3.1.5 Gingerbread Fretwork in Northeastern Area

The traditional houses of northeastern Thailand, or Isan, were historically arranged with a layout that included a residential house, a rice granary, a courtyard, a vegetable garden, and livestock enclosures (Bunyarittikit, 2561). Western-style houses were introduced during the reign of King Rama V, coinciding with administrative reforms.

The architectural characteristics of houses in the northeastern region, particularly in Nakhon Ratchasima province—a major city in the region—can be observed in a study of 16 buildings by Chewin Pestonji and Bancha Nakthong (2012) in Nakhon Ratchasima City. The hipped roof and Manila-style houses were among the first European-style houses to be widely adopted in Thailand. These houses typically faced the street, were elevated on stilts, and featured a prominent front porch extending outward. The eaves extended only slightly, while the underside of the ceiling was designed with wooden slats for ventilation, running horizontally around the house. Some porches had gable ends adorned with decorative motifs, such as sunburst patterns (half-circle sunray gables). The decorative elements included intricately carved wooden fascia boards, ventilation panels, and transom windows above doors and windows. These designs likely originated in Bangkok (Pestonji & Nakthong, 2012).

Similarly, gingerbread-style houses in Ubon Ratchathani featured intricate wood carvings for decorative purposes above doors, window frames, corbels, and

eaves. Examples include the former office of Krungsri Bank and the Jeawkee Restaurant (Joolakoat, 2022).

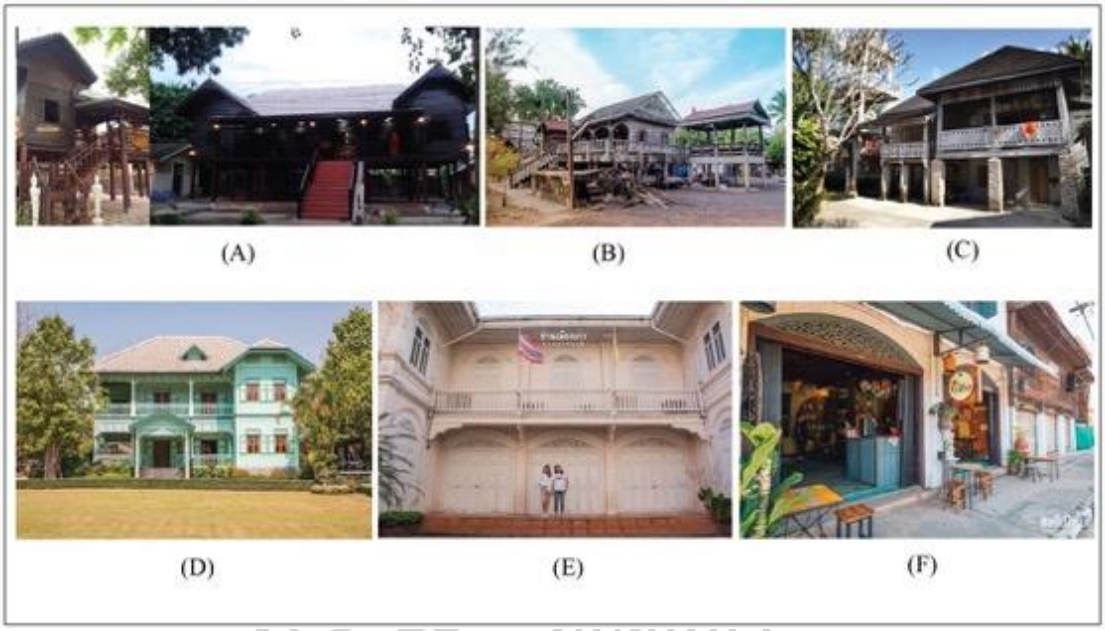

Figure 12 Building with gingerbread fretwork decoration in northeastern of Thailand

Source:

(A) Museum Thailand, Monk's Residence at Wat Maniwanaram (Wat Pa Noi), Ubon Ratchathani, accessed Oct, 31, 2023, available from https://www.museum thailand.com/en/3069/storytelling/museumresidence /

(B) Museum Thailand, Small Monk's Residence at Wat Bupharam, Nakhon Ratchasima, accessed Oct, 31, 2023, available from https://www.museumthailand.com/ en/1173/storytelling/ตามกาลเวลา/

(C) Art Nana Studio, Wat Sri Chan in Loei Province, accessed Oct, 31, 2023, available from https://www.esanart.com/wat_srijan/

(D) The Princess Maha Chakri Sirindhorn Anthropology Centre, Villa Musee, accessed Oct, 31, 2023, available from https://db.sac.or.th/museum/museum-detail/1500

(E) artswagens in Pantip, Ubon Old Town, accessed Nov, 6, 2023, available from https://pantip.com/topic/35288018

(F) Pluempiti Joolakoat, Jeaw Kee Restaurant, Ubon Ratchathani, accessed Oct, 31, 2023, http://ir-ithesis.swu.ac.th/dspace/handle/123456789/2240

1. Monk's Residence at Wat Maniwanaram (Wat Pa Noi), Ubon Ratchathani  Decoration Location: Gabel top, Ventricular Panel, Under Beam Pattern/Motif Type: Floral pattern, Geometric Pattern
2. The Villa Musée,  Decoration Location: Ventricular Panel, Door, Eaves Pattern/Motif Type: Floral pattern, Geometric Pattern
3. Ubon Old Town  Decoration Location: Door, Window Pattern/Motif Type: Floral pattern, Geometric Pattern

Table 6 Gingerbread fretwork decoration in Northeastern Thailand

2.3.1.6 Gingerbread Fretwork in Western Area

In the western region of Thailand, gingerbread fretwork emerged prominently during the late 19th to early 20th centuries, particularly under the influence of Western architectural styles. The construction of royal and noble residences, such as the Phra Nakhon Khiri Palace in Phetchaburi, marked the introduction of European aesthetics into local architecture. These structures reflect a blend of Baroque and

Victorian influences, commonly characterized by their intricate wooden fretwork, hip roofs, and the application of stucco ornamentation (Cheepchol, 2016).

During King Rama V's reign, vacation homes for the elite were built in this region, showcasing a mix of architectural styles. Notable examples include Ban Puen Palace, which incorporates Baroque designs with traditional Thai elements. Local houses often adapted Western roof designs, such as hipped roofs (Pan-Ya) and gable roofs (Manila), while utilizing indigenous materials and craftsmanship. The decorative gingerbread patterns served dual purposes: adding visual appeal and ensuring natural ventilation in the tropical climate

The use of gingerbread fretwork in the western region underscores the cultural integration of Western design principles with Thai traditions. The skilled local artisans played a vital role in this adaptation, translating imported aesthetics into designs that resonated with regional identities and functions. These architectural features not only enhanced the aesthetic value of the structures but also became a testament to the modernization of Thai society during this transformative era.

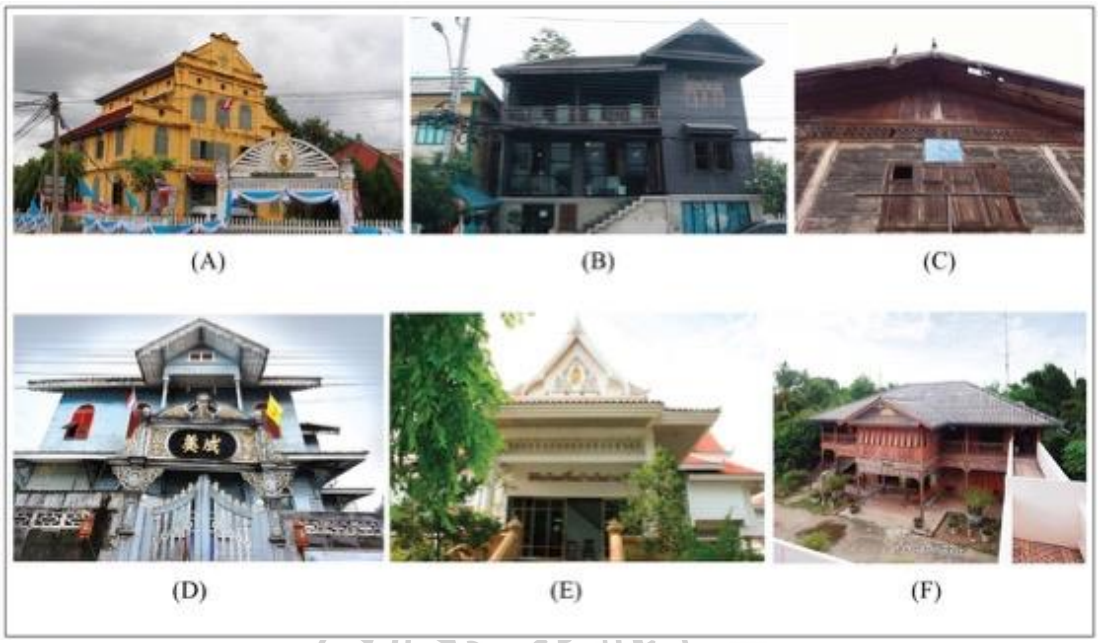

Figure 13 Building with gingerbread fretwork decoration in Western Thailand

Source:

(A) Ratchaburi Kwang Court, Old Ratchaburi Kwang Court, accessed Oct, 31, 2023, available from https://rcbmc.coj.go.th/th/content/page/index/id/56

(B) Praphansarn, Tao Hong Tai d Kunst Contemporary Art Gallery, accessed Oct, 31, 2023, available from https://www.praphansarn.com/content/1210

(C) Wikipedia, Watparkaow School, Petchaburi, accessed Oct, 31, 2023, available from https://th.wikipedia.org/wiki/ watparkaowschool

(D) The Princess Maha Chakri Sirindhorn Anthropology Centre, Trok Ban Chin Museum, accessed Oct, 31, 2023, available from https://db.sac.or.th/museum/ museum-detail/500

(E) Museum Thailand, Wat Muang Folk Museum, Ratchaburi, accessed Oct, 31, 2023, https://db.sac.or.th/museum/museum-detail/500

(F) Baanlaesuan, Luang Sit Heritage House, accessed Oct, 31, 2023, available from https://www.baanlaesuan.com/214391/houses/ architectural-heritage-houses

1. Watparkaow School, Petchaburi  Decoration Location: Gable top, Ventilation Panel, Under Beam Pattern/Motif Type: Floral pattern, Geometric Pattern
2. Pakphraek Community, Kanchanaburi  Decoration Location: : Gable top, Ventilation Panel, Under Beam, Running trim, Eaves, Fringes Pattern/Motif Type: Floral pattern, Geometric Pattern
3. Trok Ban Chin, Tak  Decoration Location: Gable end, Gable top, Running trim, Bracket, Corbels, Eaves, Fringes, Ventilation panel Pattern/Motif Type: Floral pattern, Geometric Pattern

Table 7 Gingerbread fretwork decoration in Western Thailand

2.3.1.7 Gingerbread Fretwork in Southern Area

The geography of southern Thailand is characterized by a peninsula extending to the border with Malaysia, flanked by seas on both sides. This region experiences abundant rainfall due to its climatic conditions. Its population comprises Thai Buddhists, Thai Chinese, and Thai Muslims. The design and structure of southern Thai

houses do not differ significantly from those in other regions but are adapted to suit local materials, the natural environment, beliefs, and practical needs.

The types of houses include ruen krueng phuk (tied-frame houses), ruen krueng sab (timber-framed houses), and masonry houses. Ruen krueng phuk are constructed using ropes, vines, or rattan for the framework, with roofs thatched with nipa palm, phaek grass, sugar palm leaves, or sago palm leaves, and walls made of woven bamboo or thatch. Ruen krueng sab, on the other hand, involve construction techniques such as mortise and tenon joints and wooden pegs, resulting in sturdier structures than tied-frame houses. Over time, tiled roofing became common for these houses.

Masonry houses often feature hip roofs and are influenced by architectural styles from Batavia (modern-day Jakarta). These structures, called tuk kalapa, refer to buildings with hip roofs and are adapted with a front porch and typically built as single-story houses (Bunyarittikit, 2561).

Examples of southern Thai houses featuring gingerbread fretwork include Wang Yaring in Pattani Province, Wang Phiphitphakdi in Pattani Province, Suwannakhiri Pavilion at Wat Chathing Phra, Aho Mosque, houses in the Talubo community, and Chontara Singhe Temple in Narathiwat Province.

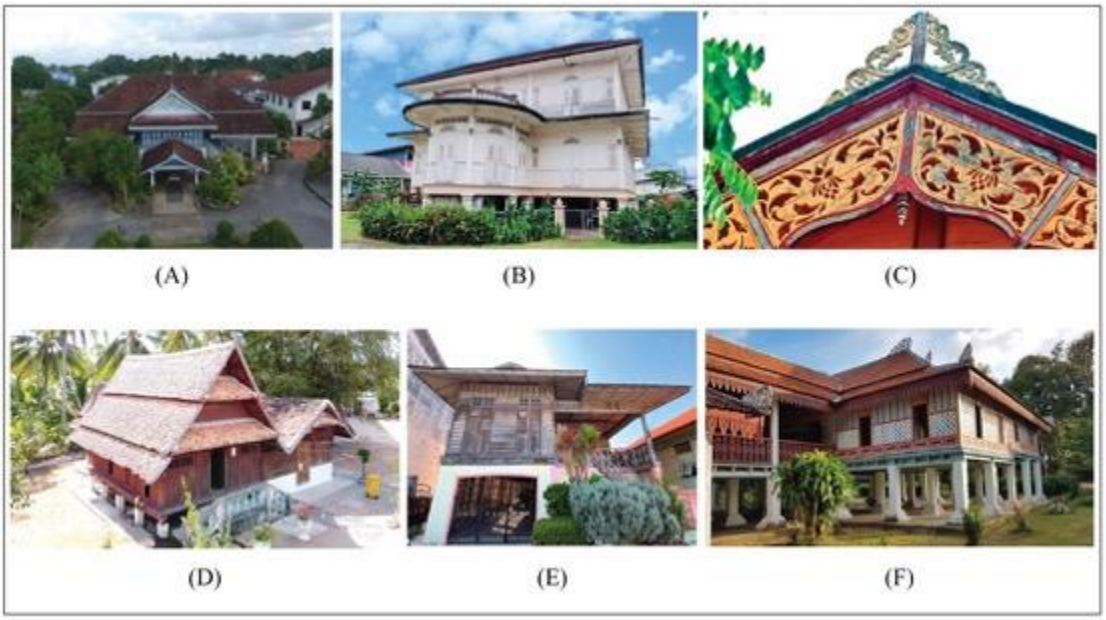

Figure 14 Building with gingerbread fretwork decoration in southern of Thailand

Source:

(A) Pattani Heritage City, Wang Yaring, accessed Oct, 30, 2023, available from https://pattaniheritagecity.psu.ac.th/pattanistory

(B) Pattani Heritage City, Wang Pipitphakdi, Pattani Province, accessed Oct, 30, 2023, available from https://pattaniheritagecity.psu.ac.th/pattanistory

(C) Local Southern Information, Kuti Suwannakhiri, Wat Chathing Phra, accessed Oct, 30, 2023, available from https://clib.psu.ac.th/southerninfo/content/1/16cf2162

(D) Pattani Heritage City, Sulao Aho, accessed Oct, 30, 2023, available from https://pattaniheritagecity.psu.ac.th/pattanistory

(E) Pattani Heritage City, Thai-Muslim houses in Pattani, accessed Oct, 30, 2023, available from https://pattaniheritagecity.psu.ac.th/pattanistory

(F) Wikipedia, Chontara Singhe Temple, accessed Oct, 30, 2023, available from https://th.wikipedia.org/wiki/chontarasinghetemple

One example of a house adorned with fascinating gingerbread fretwork patterns is Wang Yaring Palace. Wang Yaring Palace, built in 1895, is a Malay classical palace in Ya Mu, Tambon Yamu, Yaring district, Chang Wat Pattani. It is an example of cultural syncretism between the Malay, Siamese as well as the Chinese. This palace is

referred to as a "classicalized" vernacular with a sense of symmetry and order. It is a layered gabled roof with a distinctively wood decorative, the elongated casement window, and the decorated ventilation panel around doors. The ornate decorative panel at the top of the door called locally known as the ‘pola pemida’ which contain local ornamentation in local vegetal style in simple and framed design (Mamat et al., 2019).

The architectural elements commonly decorated include ventilation panels, light openings, gables, gable apexes, balustrades, beams, and column bases. These decorations reflect influences from Islamic religion and folk art (Nanta Rojanodomchart, 1982). They are characterized by three main features: calligraphic, floral, and geometric.

The calligraphic involves the use of Arabic alphabets as decorative patterns. The floral utilizes continuous symmetric floral patterns, with the design balanced symmetrically on both sides from the core. The geometric excludes depictions of humans and animals, in adherence to Islamic teachings.

1. Wang Yaring, Pattani

Decoration Location: Gable end, Gable top, Running trim, Bracket, Corbels, Eaves, Fringes, Ventilation panel

Pattern/Motif Type: Floral pattern, Geometric Pattern, floral and vegetable motifs

2. Chontara Singhe Temple, Narathiwat

Decoration Location: Gable end, Gable top, Running trim, Bracket, Corbels, Eaves, Fringes, Ventilation panel

Pattern/Motif Type: Floral pattern, Geometric Pattern

3. Thai-Muslim houses, Pattani

Decoration Location: Gable end, Gable top, Running trim, Bracket, Corbels, Eaves, Fringes, Ventilation panel

Pattern/Motif Type: Floral pattern, Geometric Pattern, Plant in jar motif

Table 8 Gingerbread fretwork decoration in Southern Thailand

While Thai gingerbread fretwork showcases shared functional and aesthetic principles, regional variations reflect unique adaptations to local culture, environment, and external influences. Each region preserves its identity while incorporating shared Thai heritage and external aesthetics.

For similarities, all regions incorporate functional designs like ventilation with decorative elements that reflect cultural and environmental considerations. Traditional woodcarving is prominent, using both attached and detached patterns to enhance building aesthetics and structural functionality. Gingerbread fretwork across Thailand has been influenced by Gothic architecture, featuring cloverleaf, flame, and geometric patterns. Each region blends local traditions with imported styles to reflect the unique societal, cultural, and environmental context of the area.

For differences, prominent in royal residences and palaces (e.g., Vimanmek Mansion) with symmetrical layouts and open courtyards reflecting European palace influences In Central Region. It was found that the patterns exhibit great diversity and delicacy. They are more abundant, appear in various parts of the architecture, and are more extensively documented.

Lanna-style homes often feature Galae and Ham Yon motifs, integrating Chinese and Burmese artistic influences. Eastern architecture integrates influences from Chinese and Khmer styles with local materials, emphasizing practicality. Northeastern Region: Houses in this Northeastern region, such as in Nakhon Ratchasima, feature Manila-style roofs and gable-end decorations. In Southern Region, Strong Islamic and Malay influences are evident in calligraphic, geometric, and floral designs.

About material, Bangkok and the Central Region tend to use more polished wood, while Northern and Eastern regions emphasize simpler materials suited to their environments. Moreover, it found that there are cultural and religious influences in The South and The North. The South incorporates Islamic motifs, while the North integrates traditional Lanna and Chinese patterns

2.4 Case Study: Chanthaboon Waterfront Community

Chanthaburi is a province in eastern Thailand. It is located on the Gulf of Thailand and shares borders with Cambodia to the east and the provinces of Chachoengsao, Rayong, and Chonburi to the west. Because they're close to mountains, the majority of Chanthaburi's areas are high. In the estuaries closest to the sea, there are plains, the majority of which are low flood plains. The current city of Chanthaburi is situated on a tall hill on the southern bank of the Chanthaburi River, a river that originates in Khao Sa Bap and runs into Soi Dao Valley. The Chanthaburi River flows through the city of Chanthaburi to the southeast to the sea

at Laem Sing (Sarakhan, 2012). Overall, the province has a diverse landscape, including coastal areas, hills, and fertile plains. The fertile land and access to waterways have made the province an important agricultural area, known for its fruit orchards and gemstones. The coastal areas have also been a hub for fishing and trade.

Figure 15 Map of Chanthaburi

Source: Google Map, 2023

2.4.1 Chanthaboon Waterfront Community

The Chanthaboon Waterfront community is an important historical site with a history dating back at least 300 years. The community began during King Narai the Great's reign, when he ordered the relocation of Chanthaburi city from the east bank of the Chanthaburi River to the opposite bank in the west surrounding Ban Loom, which is now the community area of the Chanthaboon Waterfront Community. This settlement grew into a commerce route and living community for Chinese, Vietnamese, and Thai people of diverse occupations: nobles, rulers, merchants, and citizens.

Figure 16 Ban Loom

Source: Chandaboon Riverfront Community Development Committee, n.p.

Residents of the community built roughly 200 houses along a one-kilometer road length on both sides of the Chanthaburi River. This road is the first road in the province, formerly known as Leab Na Tee Road, later renamed Sukhapiban Road. Talad Nuea (north market) is the community's northern district with a large port that serves as a commercial and transportation hub as well as the site of the government headquarters. The middle section is known as Talad Klang (central market) and serves as a wholesale and retail shopping area. There are ports for shipping several ports mixed in with houses to live in. Talad Lang (lower market), at the end of the road, is the hub of handicraft manufacturing and unrelated trade, including mat weaving, blacksmithing, as well as fishery products, savory dishes, and various local confectionery because most of them are inhabited by the Catholic Vietnam (Yuan) and Chinese.

Figure 17 The northern large port at the community (Tha Luang port)

Source: Chanthaboon Riverfront Community Development Committee, n.p.

The community has been growing steadily. While the Chanthaburi gem trade grew, the Chanthaburi Waterfront Community also became a source of gem production. Throughout the reigns of King Rama VI to King Rama VIII, the Community of Baan Luem followed the country's events during the Indochina War and the Greater East Asia War. From 1941 to 1945, after World War II and the western colonial phase of Field Marshal Papibul Songkhram, the road replaced the river that used to travel, and the community's role in trade and transportation was reduced. The town faced a major disaster in 1990 because of the fire that destroyed the house. Subsequently, in 1999, there was a large flood, and the previously flourishing jewelry trade slowed.

In 2009, The Ministry of Commerce has implemented a creative economy policy aimed at stimulating the country’s economy by leveraging the commercial identity of each province. Therefore, the Ministry of Commerce and the Chanthaburi Provincial Commerce Office are promoting and developing the local business district of Chanthaboon Waterfront Community and the Gem Market area. They have been proposed as cultural conservation zones and cultural tourism attractions. These initiatives are community-driven, with active participation from residents.

Historically, this area had various names based on its piers, without a unified identity. The community committee's naming contest was the first public relations initiative that established the name "Chanthaboon Waterfront Community." Continuous engagement with residents followed, along with free promotional materials for tourists and plaques installed on significant houses to enhance the cultural narrative of the community.

Moreover, the Chanthaboon Waterfront Community is a historic settlement over 100 years old, marked by its trading activities and relatively slow pace of change compared to neighboring areas. Its diverse social culture reflects European influences from an 11-year period of French occupation (Khruapan, 1991). As a result, the community retains various styles of gingerbread fretwork, resisting modern societal trends. The Chanthaboon Waterfront Community is thus a valuable case for studying the composition of gingerbread patterns.

2.4.2 Architecture in Chanthaburi Riverfront Community

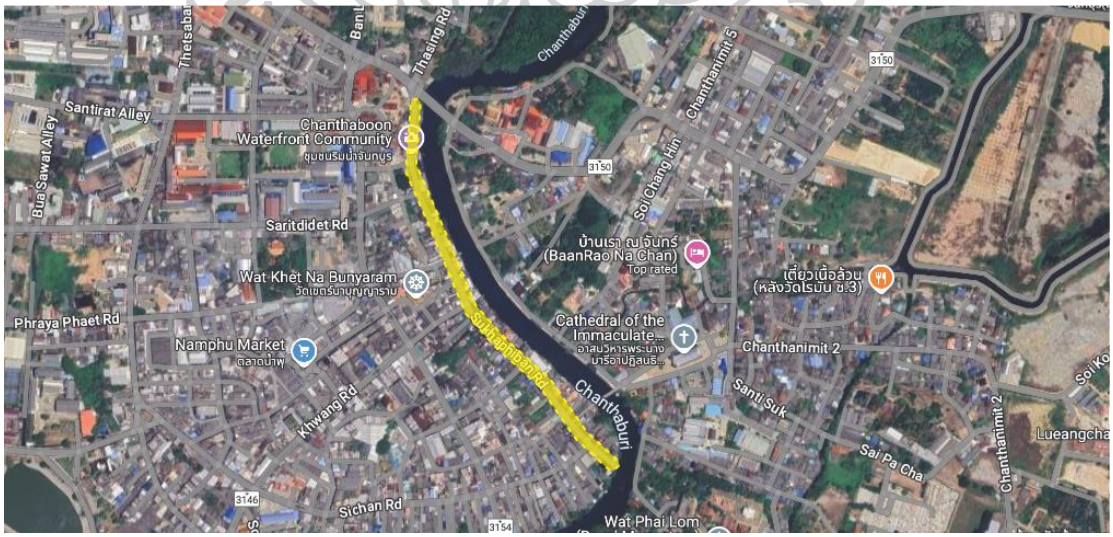

Figure 18 Chanthaburi Riverfront Community Map

Source: Google Map, 2023

The community is located along Sukhaphiban Road, Wat Mai Subdistrict, Mueang District, Chanthaburi Province, beginning at the Wat Chan Bridge and continuing in a line via Talad Nuea (north market) until reaching the Talad Lang (lower market) area. At the end of the road, there is a pier named Ta Rea Jang. The community's length along the road is roughly 850 meters. The community buildings are relatively near to one another.

The architecture is a house, a row house, or a row building. As the community center, the building faces the street. It consists of residential and semi-commercial structures on both sides of the road. Every building on the riverfront faces Sukhaphiban Road. The road is roughly 3.5 meters wide, and the sidewalk that extends from the building line is about 30 cm broad. The route appears to be quite narrow so that car movement is only one way.

Figure 19 Building facing the road

Source: Kanlayanee Phueaknamphol, 2017

Thai villages in the past usually relied on the river for many purposes, particularly transportation, thus they built houses and temples facing the river. However, because of the increase of Chinese and Vietnamese immigrants, the architectural style of the Chanthaboon Waterfront community differs significantly compared to other Thai historical community.

Chinese people were probably the first to establish in this region before other nationalities (Khruapan, 1991). They lived in groups by constructing large houses and living with many people. Furthermore, because the Chinese people have a trading culture, they are used to dense community situations with easy interaction in commercial rather than being separated or relocated to a distant area. The buildings in Chanthaburi's waterfront community face the road and back onto the river. The road area is used as a connector between buildings on both sides of the road that are commercial places.

Originally, houses were built with large structures with popular gable roofs. The materials used are local materials, mainly hardwood and palm leaves. Buildings on both sides of the street were frequently built with overhanging eaves for easier trading. There used to be a semi-residential commercial structure that was afterwards expanded into a 2-story structure.

As for the Western-style architecture, they were constructed in 112 R.E., during the French occupation of Chanthaburi, and are known as the Farang Chang Yuan building (French style building construct by Vietnamese). The building styles are either Western or a mixture of local and Western styles. Wooden houses became more popular during the reign of King Rama V. They were houses with hipped roofs decorated with various patterns of wood fretwork on the air vents (Khruapan, 1991). The architectural style of the Chanthaburi Waterfront Community is a fusion of Thai, Chinese, and French influences, but what makes Chanthaburi buildings different is the use of wood, particularly for the fretwork pattern doors and air vents that decorate the building. Due to the area's connections to other countries and the fact

that it serves as a port for incoming lumber and forest goods, it is special. As a result, wood is widely available and was once a common resource for construction and decoration (Kamphusaen, 2009).

The architecture remaining in the Chanthaboon Waterfront Community can be categorized into three types based on construction materials: entirely wooden buildings, half-cement half-wooden buildings, and entirely concrete buildings (Kamphusaen, 2009). However, based on their architectural styles as evidenced by historical records from different periods, the building styles can be categorized into four types: single-story wooden gable-roof houses, Chinese-style buildings, Western-style buildings, and hipped-roof houses (Khruapan, 1991). Therefore, to better understand the various types of buildings still present in the community, the researcher classified them based on construction materials: wooden buildings, concrete buildings, and half-cement half-wooden buildings. Additionally, the classification was expanded to include Chinese-style buildings and modern concrete buildings, reflecting the historical architectural development for a comprehensive understanding of the remaining structures in the community.

2.4.3 Ornamentation in Chanthaboon Waterfront Community

Building in Chanthaboon Waterfront Community was influenced by Western styles. The use of Gingerbread fretworks is also part of the community. Most patterns feature botanical motifs crafted by Vietnamese artisans, commonly seen in many houses throughout the community. The decorative elements are typically found on the front sections of buildings, including the second-story air vent, doors, windows, window frames, shutters, balconies, interior beams, ventilation panels, eaves, columns, and brackets. In particular, the second-story ventilation panel, located between the ceiling and the main structure, often features horizontally aligned gingerbread-style fretwork, crafted as large panels approximately the size of one bay. This is the most found decorative style in the area.

Figure 20 Ornamentation on the second-story ventilation panel

Source: Kanlayanee Phueaknamphol, 2023

Concrete buildings often feature arched doorways with gingerbread fretwork designs applied specifically to doors or windows. Wooden buildings, on the other hand, commonly showcase gingerbread fretwork decorations on roof beams, ventilation panels above doors, and as embellishments on doors and windows.

Figure 21 Ornamentation above doors area

Source: Kanlayanee Phueaknamphol, 2024

Doors and windows are typically made with wooden panel frames or fixed wooden louvered shutters. They can be opened in various styles, including double swing doors, folding doors, and casement windows. An eaves is often installed above the windows or doors. Ventilation panels above doors and windows are usually crafted with intricately carved Gingerbread patterns. Concrete buildings commonly have plaster moldings decorating the tops of windows, while columns are sculpted in styles such as Doric, Ionic, and Corinthian.

Figure 22 Ornamentation under beams

Source: Kanlayanee Phueaknamphol, 2023

Figure 23 Ornamentation at window frame

Source: Kanlayanee Phueaknamphol, 2023

Figure 24 Ornamentation at balcony

Source: Kanlayanee Phueaknamphol, 2023

The gingerbread fretwork patterns observed in Chanthaburi during the reigns of King Rama V and King Rama VI exhibit contemporary styles like those found in Bangkok of the same period. However, the gingerbread patterns in Chanthaburi retain distinct local characteristics, reflecting the preferences of the local people, ethnicities, and skilled artisans in the area. The patterns include vertical designs constructed from 2–3 wooden planks forming a single pattern, repeated horizontally. Popular perforated motifs include flame shapes, leaves, three-petal flowers, and four-petal flowers. When assembled, these patterns often resemble various styles of floral garlands, interspersed with other decorative elements.

Some of these patterns were introduced by artisans from Bangkok, but most were crafted by local artisans. Larger horizontal designs, characterized by varying thickness, were predominantly created by local craftsmen, particularly skilled Vietnamese-descended woodworkers, who were highly regarded in Chanthaburi (Panthupakorn & Tonyapirom, 2004).

The patterns can be categorized based on their design characteristics and framing styles into attached patterns and detached patterns, with further subdivisions based on the shape of the frames:

A) Attached patterns within horizontal frames: These are mostly large patterns, typically found under the beams on the first and second floors.

Figure 25 Attached patterns within horizontal rectangular frames

Source: Kanlayanee Phueaknamphol, 2023

B) Attached patterns with curved frames: This large pattern is commonly found above doors or windows and is often seen in houses made of concrete.

Figure 26 Pattern attached with a curved frame

Source: Kanlayanee Phueaknamphol, 2023

C) Attached patterns with vertical frames: This pattern is located on balconies.

Figure 27 Pattern attached with vertical frames

Source: Kanlayanee Phueaknamphol, 2023

D) Detached pattern with a vertical frame: This type of pattern is found in ventilation panels above first-floor doors and under interior beams.

Figure 28 Detached pattern with a rectangular frame

Source: Kanlayanee Phueaknamphol, 2023

E) Mix pattern: This type of pattern is found at the eaves of the roof.

Figure 29 Mix pattern

Source: Kanlayanee Phueaknamphol, 2023

Summary, Chanthaboon Waterfront Community, a community in Chanthaburi province renowned for its beautiful gingerbread-style architectural decorations. As a result, gingerbread patterns can be seen almost throughout the street. Furthermore, the Chanthaboon Waterfront Community is a historic settlement over 100 years old, characterized by its trading activities and relatively slow pace of change compared to

surrounding communities. It features a diverse social culture, influenced by European presence due to French occupation for 11 years. As a result, various styles of gingerbread patterns remain, having resisted the shifts of modern social trends. The Chanthaboon Waterfront Community, therefore, represents a valuable area for studying these patterns.

2.5 Pattern Design and Cultural Inspiration

2.5.1 Pattern Design

Pattern design constitutes a foundational concept in art, architecture, and craft traditions, and is closely associated with the notions of motif and ornament. A pattern typically denotes a decorative design produced by the systematic repetition of motifs. This process incorporates rhythm, order, and symmetry, which collectively transform individual visual elements into a unified composition.(Crowe, 1988). A motif is the smallest unit of a pattern, defined as a figure, image, or illustrative element, which may be symmetrical or asymmetrical, and which serves as the generative component of larger compositions. (Worbin, 2010). In contrast, ornament extends beyond mere repetition to convey aesthetic, cultural, and symbolic values; it is often embedded in architectural or craft contexts as a means of embellishment and identity (Saad Fathalla, 2019).

From a design perspective, these elements are interconnected. Principles such as repetition, symmetry, balance, and proportion are central to pattern design across cultures, ensuring unity and coherence while allowing variation and rhythm (Chen et al., 2012). These principles regulate visual order, ensuring unity and coherence, while also allowing diversity through variation and rhythm. In essence, pattern design is not only an aesthetic practice but also a cultural language, embedding symbolic meaning into visual form and linking functional craft with artistic expression.

2.5.2 Cultural Inspiration

Patterns play a crucial role in reflecting cultural identity and values. Not only do they serve as decorative forms, but they also function as symbolic languages, communicating collective memory, social beliefs, and community identity across generations (Saad Fathalla, 2019). The use of recurring motifs—whether floral, geometric, or abstract—in many societies distinguishes local traditions and reinforces a sense of belonging.

Building on this, patterns are also recognized as part of intangible cultural heritage, embodying knowledge and practices transmitted through craft traditions. For instance, Malay woodcarving motifs preserve spiritual and philosophical meanings, where floral and vegetal designs symbolize harmony between humanity and nature

(Said & Kamarudin, 2008). Similarly, textile patterns such as sin tin chok in Northern Thailand are viewed as both aesthetic compositions and cultural signifiers, reflecting local identity and continuity of heritage (Kunkhet & Chudasri, 2022).

These connections are further illustrated by regional case studies that demonstrate how traditional patterns in architecture and craft preserve intangible values. In Southeast Asia, carved wooden panels and fretwork convey symbolic protection and social status, while woven textiles embody narratives of ancestry and ritual practices (Crowe, 1988). Such examples highlight how cultural inspiration drawn from patterns extends beyond visual ornamentation to become carriers of heritage, identity, and meaning in both traditional and contemporary contexts.

2.5.3 Applications of Pattern Design in Contemporary Creative Fields

The transformation of traditional patterns into contemporary design applications illustrates the dynamic relationship between cultural heritage and creative innovation. Designers frequently reinterpret motifs from local crafts, architecture, and textiles, embedding them into modern forms that resonate with both global and local audiences. This process allows traditional visual languages to remain relevant while expanding their functions in new creative fields (Kunkhet & Chudasri, 2022).

Applications of pattern design span across multiple disciplines. In product design, patterns are adapted onto surfaces of household objects and packaging to convey cultural distinctiveness. In graphic design, traditional motifs are stylized into visual identities for branding and communication. In textiles, weaving and printing techniques integrate both heritage motifs and digital technologies to produce hybrid aesthetics (Hann, 2018).

Figure 30 Contemporary Thai Graphic

Source: Leelavannasuk, T. (2018, May 2). Thai inspiration: 'Chiang Mai Group' and the design project of everyday clip art to transform the Thai graphic design scene. The Cloud. Retrieved from https://readthecloud.co/scoop-48/

Figure 31 Fashion show with Thai motifs

Source: MThai. (2016, August 3). Thai contemporary fashion show by four designers in celebration of HM Queen's 84th birthday. Retrieved September 21, 2025, from https://women.mthai.com/fashion/catwalk-show/253069.html

Ceramics have employed fretwork and floral motifs to enhance both form and narrative, while **architecture** continues to adapt ornamental vocabulary—such as woodcarving and fretwork—into modern facades, screens, and structural details (Saad Fathalla, 2019). These examples highlight the versatility of patterns as cultural resources for contemporary creative industries.

Figure 32 Thai Pattern on Ceramic

Source: Manager Online. (2022, March 6). "Porcelain Tiger Pattern Shirt" by "Warinburi" among 30 works by renowned artists in the Tiger Trail campaign for tiger conservation. Retrieved September 27, 2025, from https://mgronline.com/greeninnovation/detail/9650000022153

Figure 33 Pattern facades: Weekend by Michael Lin, Thailand Bienales 2023
Source: Kanlayanee Phueaknamphol, 2023

Despite these opportunities, challenges remain. The adaptation of traditional motifs must negotiate the tension between preserving cultural authenticity and fostering innovation. Over-simplification or commercial exploitation may risk cultural dilution, while excessive adherence to tradition may hinder creative progress. Thus, successful applications of pattern design in contemporary fields require a balance between sustaining cultural identity and enabling innovation through new materials, technologies, and design methodologies (Chen et al., 2012).

2.5.4 Principles of Culture Pattern Design

The design of cultural patterns is guided by principles that extend beyond formal aesthetics to encompass symbolic, functional, and socio-cultural dimensions. Unlike generic decorative motifs, cultural patterns embody collective memory, values, and intangible heritage, which must be understood and interpreted at multiple levels.

To articulate this complexity, Siu's (2005) and Qin & Ng (Qin & Ng, 2020) Outer–Intermediate–Inner framework for cultural product design can be applied to cultural pattern design. This approach conceptualizes multilayered expression: outer (visual motifs and forms), intermediate (contextual practices and uses), and inner (symbolic

meanings and cultural values). Through this perspective, it becomes clear that cultural patterns should be preserved, interpreted, and innovated holistically rather than reduced to surface decoration.

Building on this framework, recent scholarship identifies several guiding principles. Cultural respect and integrity emphasize maintaining continuity with symbolic origins while avoiding misrepresentation (Lin, Cheng, et al., 2007; Lin, Sun, et al., 2007a; Saad Fathalla, 2019). Formal harmony highlights rhythm, repetition, symmetry, balance, and proportion as essential for coherence in composition (Crowe, 1988; Hann, 2018). Variation and adaptability ensure that motifs can be applied across diverse creative media without losing their cultural distinctiveness (Kunkhet & Chudasri, 2022). Semantic and emotive relevance emphasizes that patterns serve as communicative symbols, conveying affective resonance—such as harmony, fertility, or protection — in Malay and Thai woodcarving (Said & Kamarudin, 2008). Finally, sustainability and technical feasibility necessitate aligning traditional motifs with contemporary design processes, such as digital fabrication, parametric modeling, and computational methods (Chen et al., 2012; Hu, 2023).

Taken together, the application of these principles positions cultural pattern design as an integrative practice that links heritage preservation with design innovation and socio-cultural engagement. Furthermore, these principles serve as the theoretical foundation for the framework developed in this study. These principles are synthesized and operationalized into a structured model to guide the systematic development and adaptation of Thai gingerbread fretwork patterns for contemporary design applications.

2.6 Synthesis and Research Gap

2.6.1 Synthesis of Key Literature

The review of existing scholarship highlights three overarching insights into the role of pattern design in art, culture, and contemporary creative practices. First, definitions and principles of pattern design emphasize the interrelationship between pattern, motif, and ornament. Patterns emerge through the systematic repetition of motifs, guided by principles such as rhythm, symmetry, proportion, and balance, while ornaments extend these visual structures to convey symbolic, aesthetic, and cultural values (Crowe, 1988; Saad Fathalla, 2019). This establishes pattern design as both a technical framework and a cultural language.

Second, the literature underscores the cultural significance and inspiration drawn from traditional patterns. Motifs embedded in architecture, woodcarving, and textiles act as vehicles of identity and collective memory, often serving as carriers of intangible cultural heritage. Studies on Malay woodcarving and Thai textiles demonstrate how traditional motifs embody philosophical, spiritual, and communal values, thereby reinforcing cultural distinctiveness across generations (Kunkhet & Chudasri, 2022; Said & Kamarudin, 2008).

Third, scholarship reveals the growing emphasis on contemporary applications of pattern design in creative fields. Traditional motifs have been reinterpreted across various product designs, textiles, ceramics, graphic communications, and architectural applications. These adaptations demonstrate the ability of cultural patterns to remain relevant in the modern context, while also highlighting the challenges of balancing cultural authenticity with innovation (Chen et al., 2012; Hann, 2018).

Taken together, these strands of literature affirm that pattern design operates simultaneously as a design principle, a cultural repository, and a creative driver for innovation. This synthesis lays the groundwork for identifying the research gaps that this study aims to address.

2.6.2 Identified Research Gap

Despite a substantial body of literature on pattern design and cultural motifs, several research gaps persist. Primarily, a systematic study of Thai gingerbread fretwork motifs is lacking. While extensive research has addressed Malay woodcarving, Islamic ornaments, and Southeast Asian textile traditions, Thai fretwork—especially within domestic architecture from the late nineteenth to early twentieth centuries—remains under-examined. Existing works are predominantly descriptive or preservation rather than analytical and design driven.

Second, few studies explicitly connect cultural dimensions with contemporary design practice. While motifs serve as markers of identity and intangible heritage, systematic demonstrations of their transformation into adaptable design languages for creative industries are rare. This is particularly evident in Thailand, where fretwork motifs are culturally prominent but seldom leveraged for innovation in modern design.

Third, the integration of advanced design techniques—such as digital fabrication, parametric modeling, and computational design—into reinterpretations of traditional motifs remains largely unexplored. Although certain research uses mathematical methods, symmetry analysis, and generative systems in pattern design, applications to Thai gingerbread fretwork are absent. This limited exploration curtails opportunities to expand cultural heritage through innovative responses to contemporary materials and aesthetics.

Recognizing these gaps highlights the necessity for research that systematically documents and analyzes Thai gingerbread fretwork while repositioning it within contemporary design frameworks.

2.6.3 Positioning of the Present Study

In response to identified research gaps, this study systematically explores Thai gingerbread fretwork motifs. It aims to bridge cultural heritage and contemporary design. First, it provides a comprehensive analysis of fretwork patterns, focusing on their forms, construction techniques, and symbolic meanings. Using visual documentation and comparative analysis, the study goes beyond description. It offers a structured framework for understanding the diversity and logic within the motifs.

Second, the research uses the Chanthaboon Waterfront Community as a case study. This highlights the local identity and cultural distinctiveness of this historic settlement. By situating the motifs in their contexts, the study emphasizes their role as carriers of community heritage. The case study offers a concrete lens for examining broader issues such as cultural sustainability and heritage preservation.

Third, the study aims to adapt traditional fretwork motifs for contemporary creative fields. By using design methodologies, it explores applications in product design, ceramics, architecture, and home décor. The research demonstrates how cultural patterns can be revitalized to meet contemporary needs. This approach values cultural authenticity while supporting innovation, design experimentation, and the use of digital tools, such as modeling and fabrication.

Through these contributions, the study fills a gap in Thai gingerbread fretwork scholarship. It positions itself at the intersection of cultural heritage studies and contemporary design. The research provides valuable insights relevant to academic inquiry and the creative industries.

CHAPTER 3 RESEARCH METHODOLOGY

3.1 Research Methodology

The research methodology for this study incorporates both qualitative research and practice-based research, designed to explore and transform Thai gingerbread fretwork patterns into contemporary design. This mixed approach ensures a comprehensive understanding of the cultural, historical, and aesthetic aspects of fretwork patterns while applying creative practices to develop innovative designs.

3.1.1 Phase 1: Qualitative Research and Analysis

This phase focuses on an in-depth exploration of Thai gingerbread fretwork, employing qualitative methods to provide the foundational insights for the subsequent design phase.

Literature Review

The study will review academic sources, including books, journal articles, and historical records, with a focus on the historical and cultural documentation of fretwork patterns in Thai architecture during the late 19th and early 20th centuries, as well as their evolution under Western influence.

Primary Data Collection

A multi-faceted approach will be used to collect and analyze primary data, ensuring a robust understanding of the subject.

Field Documentation: Observational research will be conducted at the Chanthaboon Waterfront Community. Fretwork motifs on building exteriors will be systematically documented through detailed photographs and digital tracing. Special attention will be given to design elements and placement. The collected data will then be categorized by form, placement, and symbolism to create a systematic classification of motifs.

Interviews: Semi-structured interviews with experts in history and design will provide context on fretwork and assess its potential for modern applications.

Survey: A survey using convenience sampling will be distributed online to gather supplementary data from individuals interested in design and cultural products. Primarily, closed-ended questions will assess preferences in terms of aesthetics, functionality, and cultural significance. Cochran's Formula (Cochran, 1977) was used to calculate a minimum sample size of 384 for statistical reliability.

$$n_0 = \frac{Z^2 .p(1-p)}{e}$$

Where:

n_0 = Minimum required sample size

Z = Z-score corresponding to the desired confidence level

p = Estimated proportion of the population with the attribute of interest

e = Margin of error

Assume a confidence level of 95%, margin of error at 5%, and $p = 0.5$

$$n_0 = \frac{(1.96)^2 \cdot (0.5)(0.5)}{(0.05)^2} = \frac{3.8416 \cdot 0.25}{0.0025} = \frac{0.9604}{0.0025} = 384.16$$

Descriptive statistics will be used to analyze the results and inform the next design phase.

3.1.2 Phase 2: Practice-Based Research and Methodology Development

This phase builds on insights from Phase 1's qualitative analysis. It uses a practice-based research approach to devise a methodology for transforming traditional motifs into contemporary design patterns. This process bridges the gap between theory and creative practice. It emphasizes hands-on experimentation and iterative design.

Methodology Development

This phase focuses on a systematic process of experimentation and pattern organization. Insights from qualitative research will inform the creative process. This ensures that new design motifs remain culturally authentic and visually original. This phase includes the following steps:

Pattern Adaptation: Investigating ways to abstract and modify traditional fretwork motifs into modular, scalable design elements suitable for varied uses.

Material and Process Testing: Experimenting with different materials and techniques, such as ceramics, textiles, and printing media, to assess compatibility with the adapted patterns.

Light and Shadow Studies: Performing controlled experiments to observe how the redesigned patterns engage with light, aimed at producing dynamic effects that evoke the original architectural context.

Application and Evaluation

This methodology will be tested through the development of tangible design prototypes. This iterative process includes two key components:

Prototyping: Developing a design collection that demonstrates the versatility of the new patterns across multiple creative fields, such as ceramics, textiles, and printing media.

Evaluation: Collect feedback from stakeholders, including product designers and potential users. Use this feedback to measure the prototypes' function, visual impact, and cultural fit. The results will further refine the methodology and validate its success in merging traditional artistry with contemporary design.

Summary: This study is grounded in a pragmatic and constructivist philosophy, recognizing that cultural meanings of gingerbread fretwork are socially constructed while practical design inquiry generates new knowledge. The research employs a practice-based approach, where creative design and artifact production serve as both the process and outcome of the investigation. A mixed-methods strategy was employed, integrating qualitative methods—such as literature review, field documentation, comparative analysis, and expert interviews—with quantitative

validation through a user survey (n = 385). This methodological integration enhances validity, triangulates findings, and ensures both cultural depth and design applicability.

3.2 Design Process

The design process is structured around the Double Diamond Framework, divided into four key phases: Discover, Define, Develop, and Deliver. Each phase is broken into actionable steps as depicted in the diagram, ensuring a comprehensive and iterative approach to design.

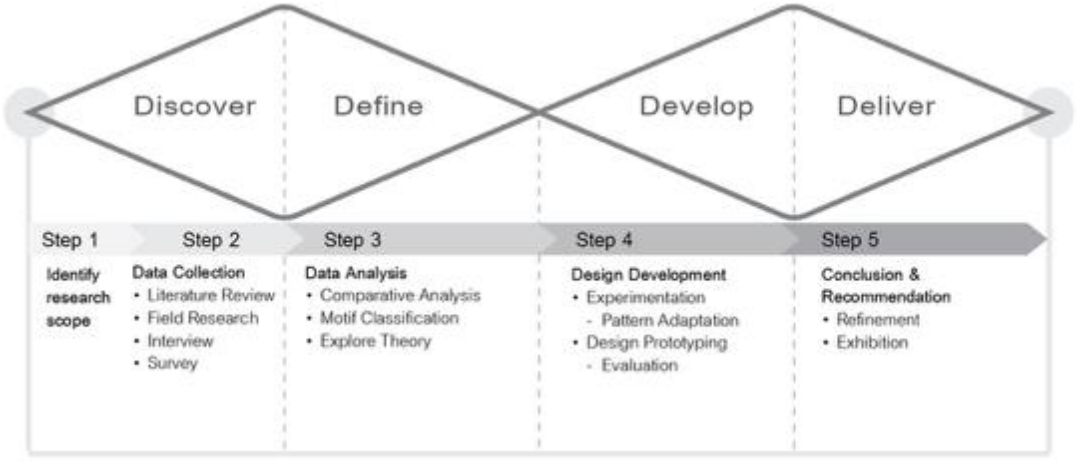

Figure 34 Design Process

Source: Kanlayanee Phueaknamphol, 2024

Discovery

The Discover phase involves understanding the research scope and gathering data to inform the design process.

Step 1: The research scope is identified, with the central aim of adapting Thai gingerbread fretwork motifs into contemporary design applications. Objectives are set to explore the cultural, historical, and aesthetic aspects of fretwork.

Step 2: The second step involves data collection, including a literature review and a field study to identify the historical, cultural, and symbolic dimensions of Thai gingerbread fretwork. This includes conducting a literature review to analyze books, journal articles, and research reports on gingerbread fretwork patterns and their cultural significance. Field visits to the Chanthaboon Waterfront Community are carried out to document fretwork motifs and their placement. Additionally, a historical expert and two product designers were interviewed to gain insights into cultural relevance and the adaptation of design. Online questionnaires were distributed to target groups to capture preferences related to aesthetics, functionality, and cultural value.

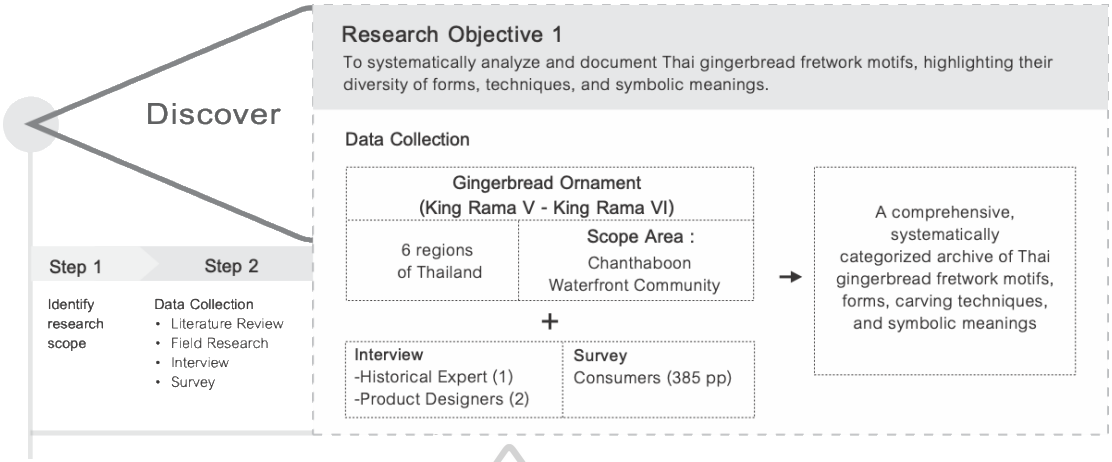

Figure 35 Discovery Phase

Source: Kanlayanee Phueaknamphol, 2024

Define

The Define phase synthesizes the collected data to set a direction for design development.

Step 3: This data analysis step focuses on three key areas. This involves documenting and classifying fretwork motifs into categories such as floral, geometric, and symbolic, and highlighting their unique stylistic and cultural characteristics; examining the historical and cultural background of the Chanthaboon Waterfront Community to understand the cultural meanings embedded in gingerbread fretwork motifs; and reviewing cultural design principles and pattern design applications to build a conceptual framework for adapting traditional motifs into contemporary design.

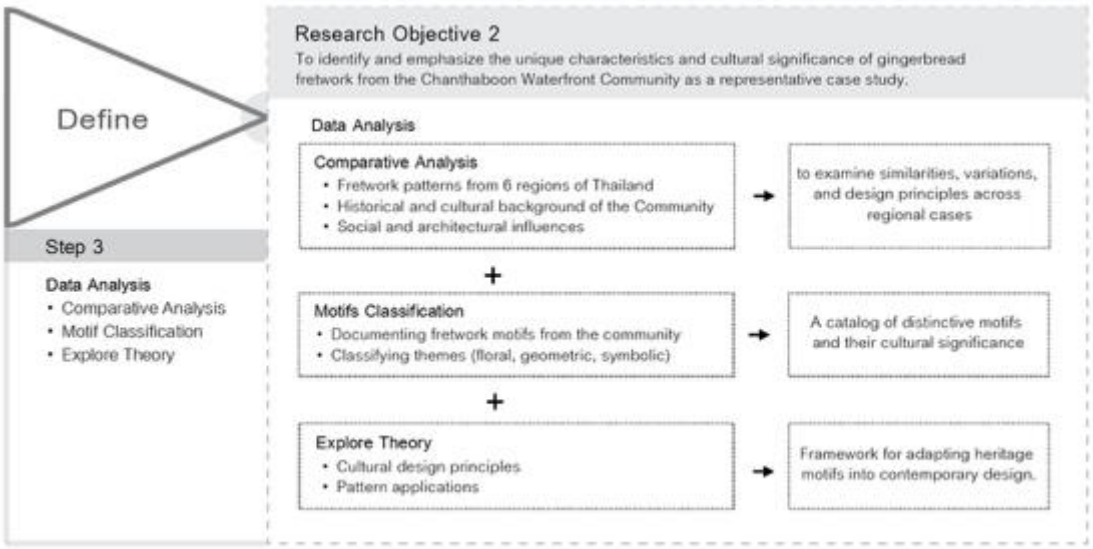

Figure 36 Define Phase

Source: Kanlayanee Phueaknamphol, 2024

Develop

The Develop phase focuses on transforming research insights into tangible design outcomes through experimentation and prototyping.

Step 4: This step involves first developing design artifacts informed by the framework, starting with material exploration and pattern adaptation. Material exploration involves testing materials to assess their durability, workability, and aesthetic quality. Pattern adaptation translates gingerbread fretwork motifs into adaptable design elements through abstraction, scaling, and modular arrangement, allowing for a versatile and dynamic approach. After identifying suitable materials and effective design techniques, prototypes are created by applying production techniques to produce physical models that embody the selected motifs and material processes.

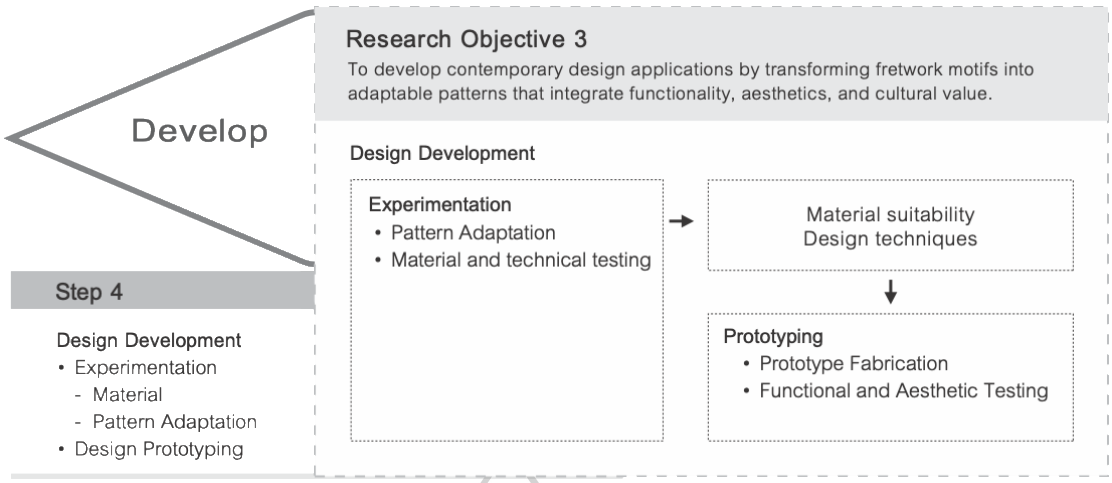

Figure 37 Develop Phase

Source: Kanlayanee Phueaknamphol, 2024

Deliver

The Deliver phase finalizes research findings and confirms them through targeted evaluation and dissemination, revising and strengthening the framework based on evaluation outcomes.

Step 5: Collect feedback from potential users and design experts on functionality, aesthetics, and cultural value, and iterate the designs to ensure cultural authenticity and contemporary relevance. After validation, disseminate the outcomes via a pattern archive, a prototype exhibition, and knowledge-sharing platforms, showcasing the final design applications and research that demonstrate Thai gingerbread fretwork motifs as adaptable resources in contemporary design.

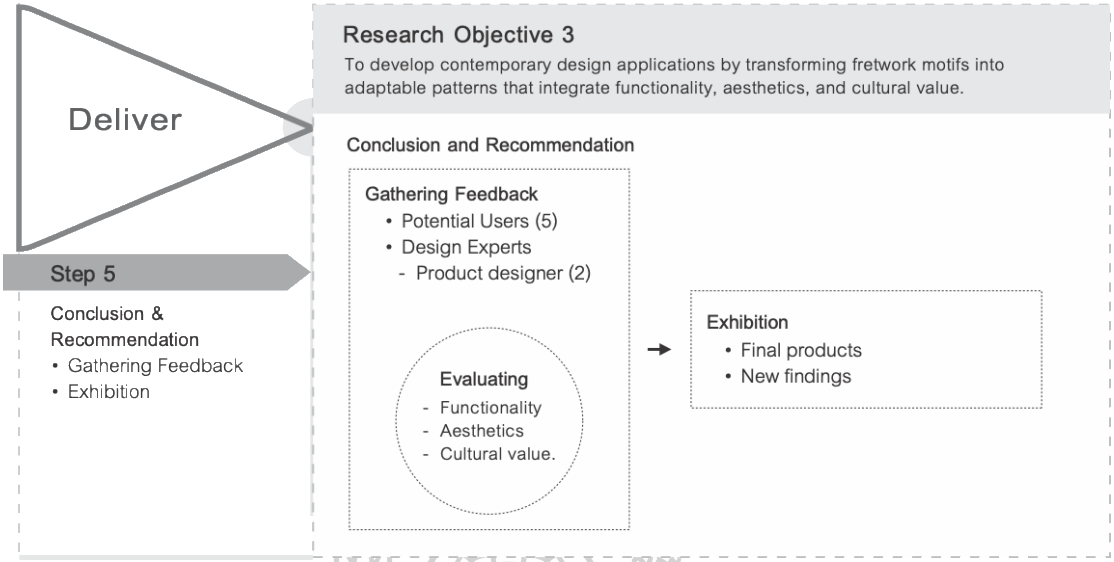

Figure 38 Deliver Phase

Source: Kanlayanee Phueaknamphol, 2024

In summary, the design process follows the Double Diamond Framework—Discover, Define, Develop, and Deliver—to ensure a structured and iterative pathway. Data on Thai gingerbread fretwork motifs are first collected and analyzed to establish design directions. Insights are then applied through experimentation, material exploration, and prototyping, transforming traditional motifs into adaptable contemporary design applications that balance functionality, aesthetics, and cultural value.

3.3 Data Analysis

3.3.1 Comparative Study of Patterns in Different Regions of Thailand

3.3.1.1 Overview of the Regions Studied

Based on the review of Chapter 2, which included a comprehensive analysis of documents, research studies, theses, photographs, and online sources, along with insights from an interview with Professor Paradee Panthupakorn, a historian specializing in gingerbread fretwork (and author of "A Study of the Gingerbread Motif of Chanthaburi School, 2024), several findings emerged. It was discovered that most gingerbread fretwork patterns in Thailand originated from Bangkok. These patterns were either adapted to fit local contexts or directly applied to houses as prefabricated carved wooden elements. Local craftsmen often measured the specific dimensions of areas where the patterns were to be installed and then designed motifs based on templates from Bangkok.

The crucial variable influencing regional variation in patterns lies in the craftsman's background. When local craftsmen with distinctive regional expertise adapted the designs, the resulting patterns incorporated elements of the region's unique artisanal identity. Thus, while the fundamental designs were consistent across the country, subtle regional differences emerged due to the craftsman's influence.

To specify the methodology used in comparing patterns across regions, the researcher relied solely on secondary data sources such as documents, research studies, theses, photographs, and online sources, without conducting field surveys, except in Bangkok and Chanthaburi. In these two locations, fieldwork was carried out to analyze the connection between the study areas and the original sources of the patterns. During the fieldwork, photography was primarily used to document the patterns, which were then analyzed for their characteristics and influences.

3.3.3.2 Comparative Analysis of Patterns

The comparative study of fretwork patterns across different regions of Thailand reveals both similarities and differences, showcasing unique characteristics shaped by local culture, environmental conditions, and historical influences.

Organic Motif	 Central	 Northern	 Northeastern
	 Western	 Eastern	 Southern
Function Features	Ventilation / Light Filtration / Aesthetic and Decorative Purpose		
Architecture Integration	Above doors, windows, and on gables		
Decorative Technique	(1) fretwork as decorative motifs carved into wooden panels 	(2) fretwork as patterns created by voids where wood is removed. 	
	The designs often exhibit symmetry.		
Western Colonial Impact	Victorian and Gothic influences, introduced through European architectural trends during King Rama V's reign.		
Chinese Artisanship	The integration of Chinese elements 		
Local Adaption	Central : emphasizing elegance and sophistication Southern : integrates Islamic and Malay influences Eastern : shaped by the area's trade history, which brought Thai, Vietnamese, and Chinese Northern : a blend of Lanna influences with traditional Northern Thai designs and Western and Chinese elements.		

Table 9 The comparative study of fretwork patterns across different regions of Thailand

Similarities:

Use of Organic Motifs: Most regions share an affinity for natural patterns like floral, vine, and leaf motifs.

Functional Features: Fretwork serves both decorative and practical purposes, including ventilation and light filtration. When sunlight passes through, the patterns cast intricate shadows on the house's surfaces, creating a natural beauty derived from gingerbread fretwork.

Integration with Architecture: Patterns are commonly positioned above doors, windows, and on gables, seamlessly blending with architectural elements.

Shared Decorative Techniques: The common use of fretwork for ventilation and aesthetic purposes is evident in two forms: (1) fretwork as decorative motifs carved into wooden panels, and (2) fretwork as patterns created by voids where wood is removed. The designs often exhibit symmetry.

Western Colonial Impact: Thai fretwork designs reflect Victorian and Gothic influences, introduced through European architectural trends during King Rama V's reign.

Differences:

Chinese Artisanship: In Phrae, the integration of Chinese elements, such as auspicious symbols, highlights the historical presence of Chinese craftsmen in the region.

Local Adaptations: Regional adaptations in Chanthaburi were shaped by the area's trade history, blending Thai, Vietnamese, and Chinese cultural elements. Phrae Province incorporates Lanna influences, blending traditional Northern Thai designs with Western and Chinese elements.

3.3.2 Design Analysis on Chanthaboon Waterfront Community's Gingerbread

The Chanthaboon Waterfront Community holds significant historical and cultural value, making it an ideal case study for analyzing gingerbread fretwork patterns. Historically, this community served as a central hub for the eastern region of

Thailand during the reigns of King Rama V and King Rama VI, reflecting its prosperity as a key trading and administrative center. Its unique architectural heritage showcases a harmonious blend of Thai, Chinese, Vietnamese, and French influences, underscoring the community's multicultural identity.

The gingerbread fretwork patterns found in Chanthaboon are remarkably well-preserved, retaining their intricate designs and craftsmanship despite the passage of time. These patterns, prominently adorning gables, eaves, doors, and balconies, exhibit the soft, ornate qualities characteristic of Victorian and Gothic styles while reflecting adaptations to the local climate and aesthetic preferences.

Moreover, as Chanthaboon was once under French influence, the community developed unique regional variations of gingerbread designs, setting it apart from other parts of Thailand. These elements collectively establish Chanthaboon as a representative model of gingerbread architecture in the eastern region, highlighting its cultural and architectural significance.

Given its historical prominence, cultural diversity, and architectural uniqueness, the Chanthaboon Waterfront Community offers invaluable insights for preserving and understanding the artistic heritage of gingerbread fretwork in Thailand.

3.3.2.1 Architectural Features and Locations

A survey of 94 houses within the 900-meter stretch of the Sukaphiban Road in the Chanthaboon Waterfront Community revealed 15 houses adorned with gingerbread fretwork (House Nos.7- 9, 73, 75, 89, 106, 110, 129, 137, 150, 166, 240, 242, 252, 255, and 273). Based on construction materials, these 15 houses were categorized as follows: 8 wooden buildings (House Nos. 7- 9, 73, 89, 110, 129, 140, 242, 273), 2 half-concrete-half-wood buildings (House Nos. 106 and 137), and 5 concrete buildings (Nos. 75, 150, 166, 252, and 255).

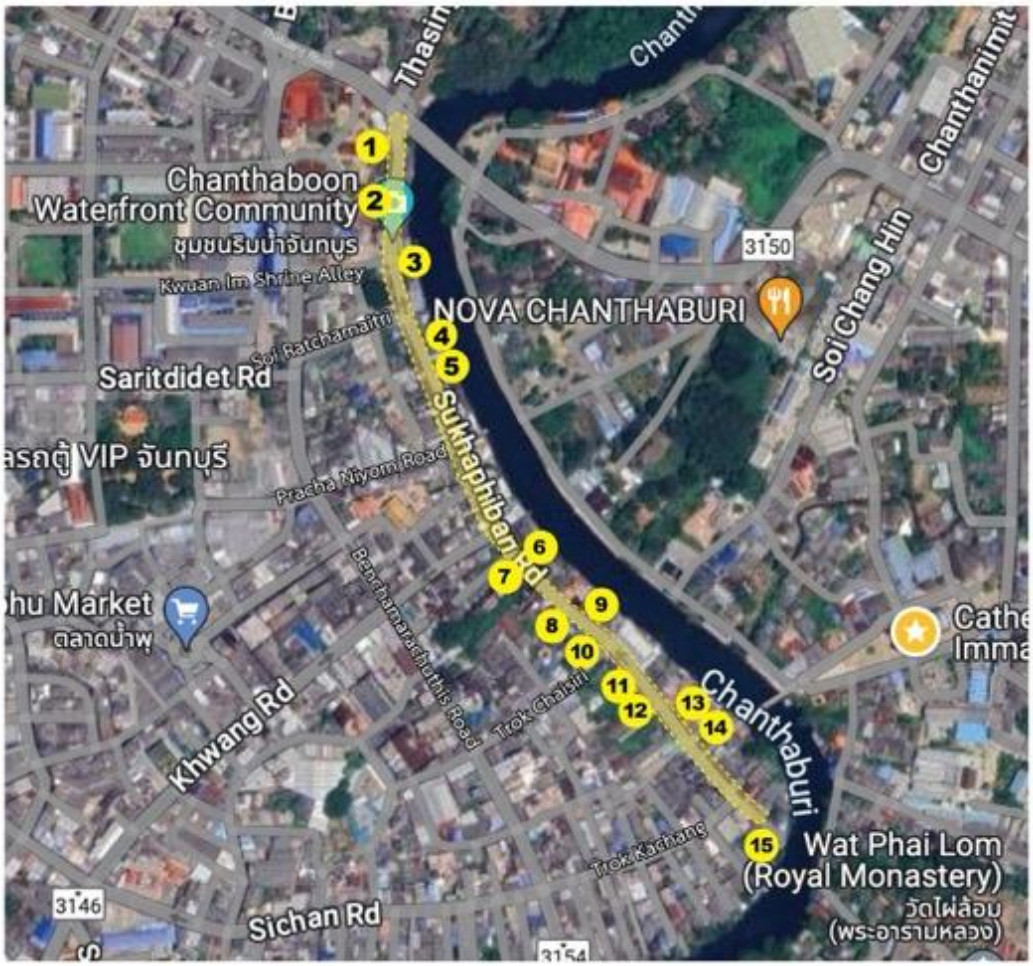

Figure 39 Map indicating the locations of 15 houses featuring gingerbread fretwork
Source: Kanlayanee Phueaknamphol, accessed January 6, 2025, available from https://so04.tci-thaijo.org/index.php/NAJUA/article/view/274768/186498

In wooden houses, gingerbread patterns are commonly found horizontally above the doors on the first floor, in the ventilation spaces below the ceiling on the second

floor, and above doorways. For example, in a three-unit building where each unit has a different facade width, gingerbread fretwork is located above the doors at the building's front. Although the width of the fretwork varies to fit each unit's facade, the pattern remains consistent, with horizontal extensions on both sides to accommodate the differences in facade width (e.g., House No. 129, 89, 73).

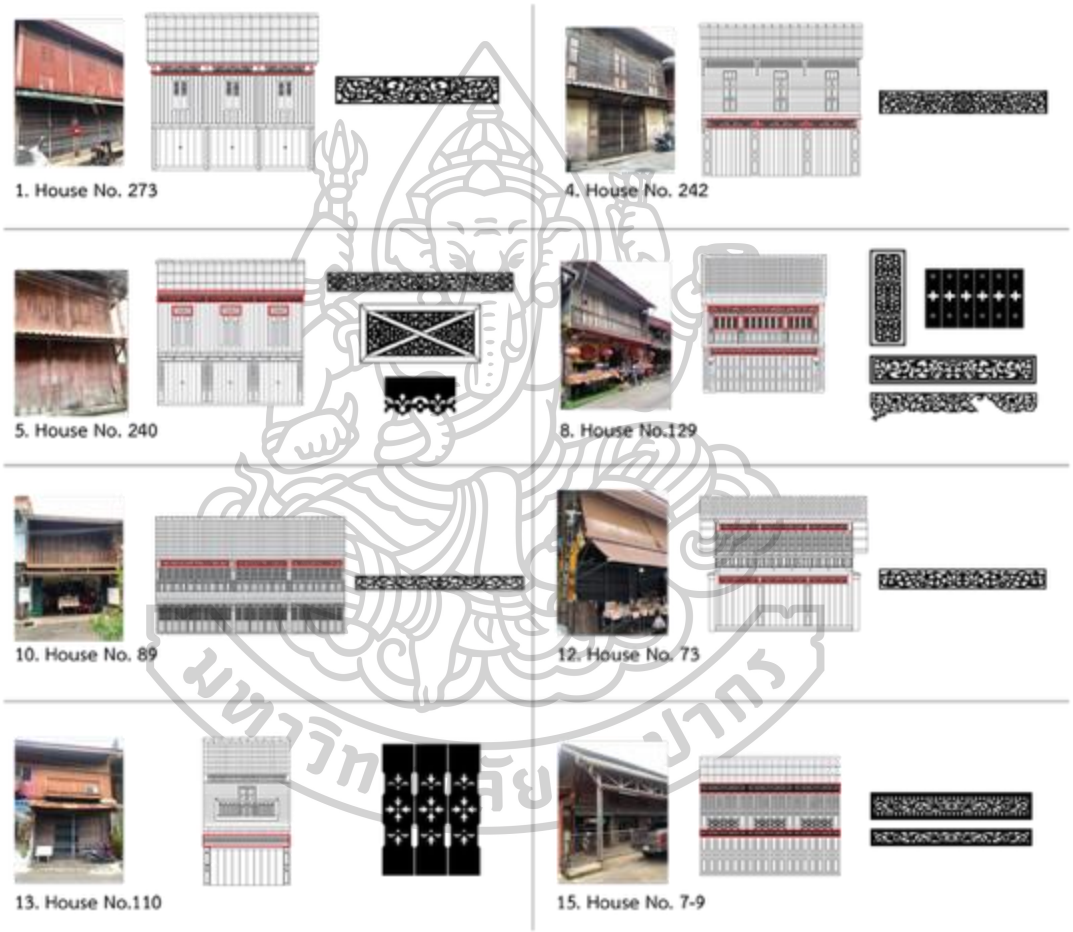

Figure 40 Wooden building

Source: Kanlayanee Phueaknamphol, 2024

In half-concrete-half-wood buildings, such as House No. 106, gingerbread patterns are exclusively found in the balcony area. Meanwhile, in concrete buildings, gingerbread fretwork appears on the eaves, canopies, balconies, and above windows. Notably, in House No. 255, 150, and 75, a unique half-circle frame pattern is present—an element not observed in wooden houses. This pattern may reflect the influence of curved door and window designs prevalent in Western architecture at the time.

Figure 41 Half-concrete-half-wood buildings

Source: Kanlayanee Phueaknamphol, 2024

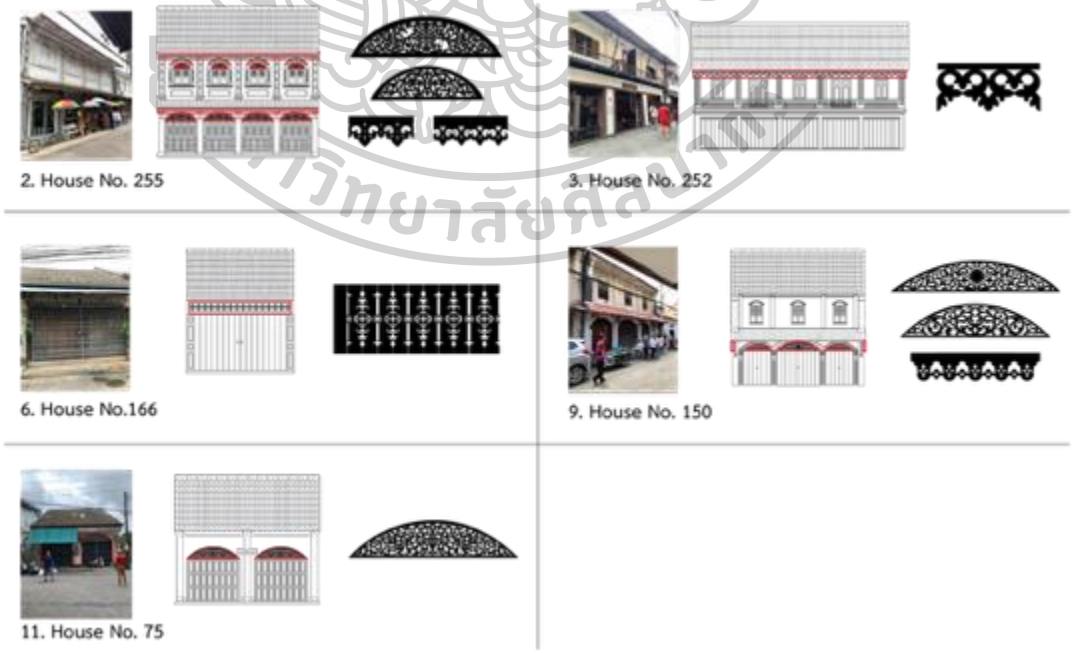

Figure 42 Concrete buildings

Source: Kanlayanee Phueaknamphol, 2024

In some cases, multiple gingerbread patterns are observed in different parts of the same building. For example, House No. 242 features fretwork above the windows, doors, and eaves, while House No. 150 displays patterns on both the door vents and the eaves. According to Poochai Kuamsub's book Gingerbread Fretwork: Aesthetics of Rattanakosin (Kuamsub, 2017b), gingerbread patterns in Bangkok are typically found on gables, eaves, ventilation panels, boards, walls, windows, doors, low doors, and balustrades. However, the survey in Chanthaboon Waterfront Community found no gingerbread patterns on gables. This absence is likely due to the narrow roads, which make gables less visible to passersby. Instead, fretwork is concentrated in highly visible areas such as above windows, doors, and ventilation panels. Additionally, no gingerbread patterns were found on low doors in this community.

A total of 26 distinct patterns were identified on these buildings, primarily located on the eaves, doors, windows, ventilation panels, balconies, and internal beams. The observed patterns are predominantly botanical, featuring coiled stem designs with main and secondary stems, as well as buds, leaves, and fully bloomed flowers.

Gingerbread fretwork patterns can be oriented vertically or horizontally, depending on their specific placement. For example, a semi-circular ventilation opening above a door is often complemented by a matching semi-circular floral pattern, with the design adapted to fit the spatial constraints.

The researcher assigned pattern codes sequentially, starting from the first house in the northernmost part of the community and progressing southward. This systematic coding allowed for clear documentation of the patterns' distribution and characteristics.

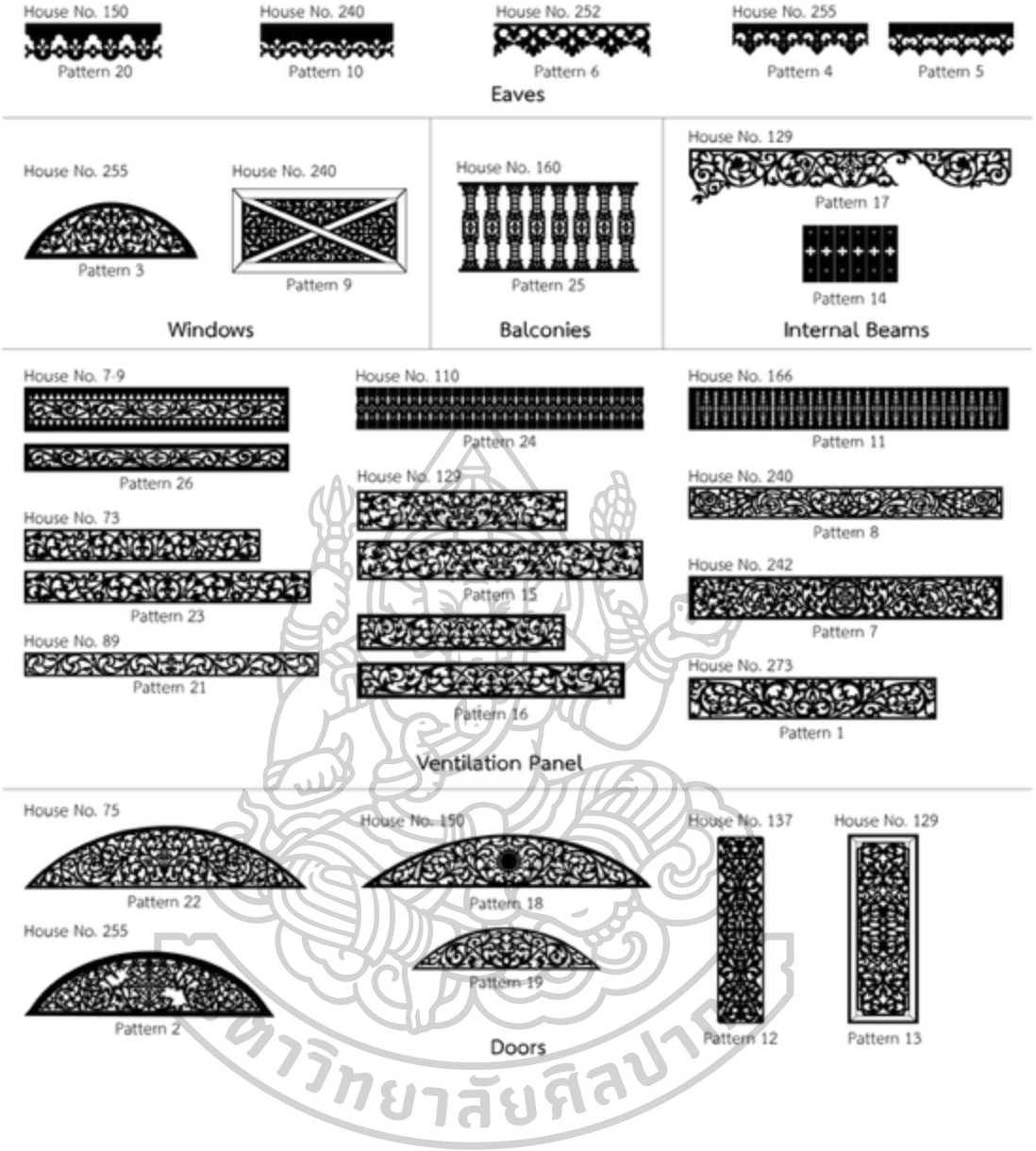

Figure 43 Gingerbread fretworks categorized by placement on the building

Source: Kanlayanee Phueaknamphol, 2024

3.3.2.2 Patterns and Motifs

Gingerbread patterns can be categorized based on their characteristics into three types: attached, detached, and mixed. Attached patterns (a) are created by carving out the unwanted parts of a single wood piece to reveal the gingerbread-like pattern. This pattern is the most common, often found in larger sizes. The patterns are typically found with semicircular (a1), horizontal (a2), and vertical (a3) frames, most often above door and second-floor vents. Vertical frames are typically found on casement windows and doors, whereas eaves, porches, and interior beams often lack frames. Detached patterns (b) are created by carving out the desired pattern, leaving the rest of the wood as the background. This less common pattern is found in various sizes typically above second-floor windows and doorways. Mix patterns (c) are a combination of attached patterns and detached patterns. This pattern is uncommon and is typically found on eaves.

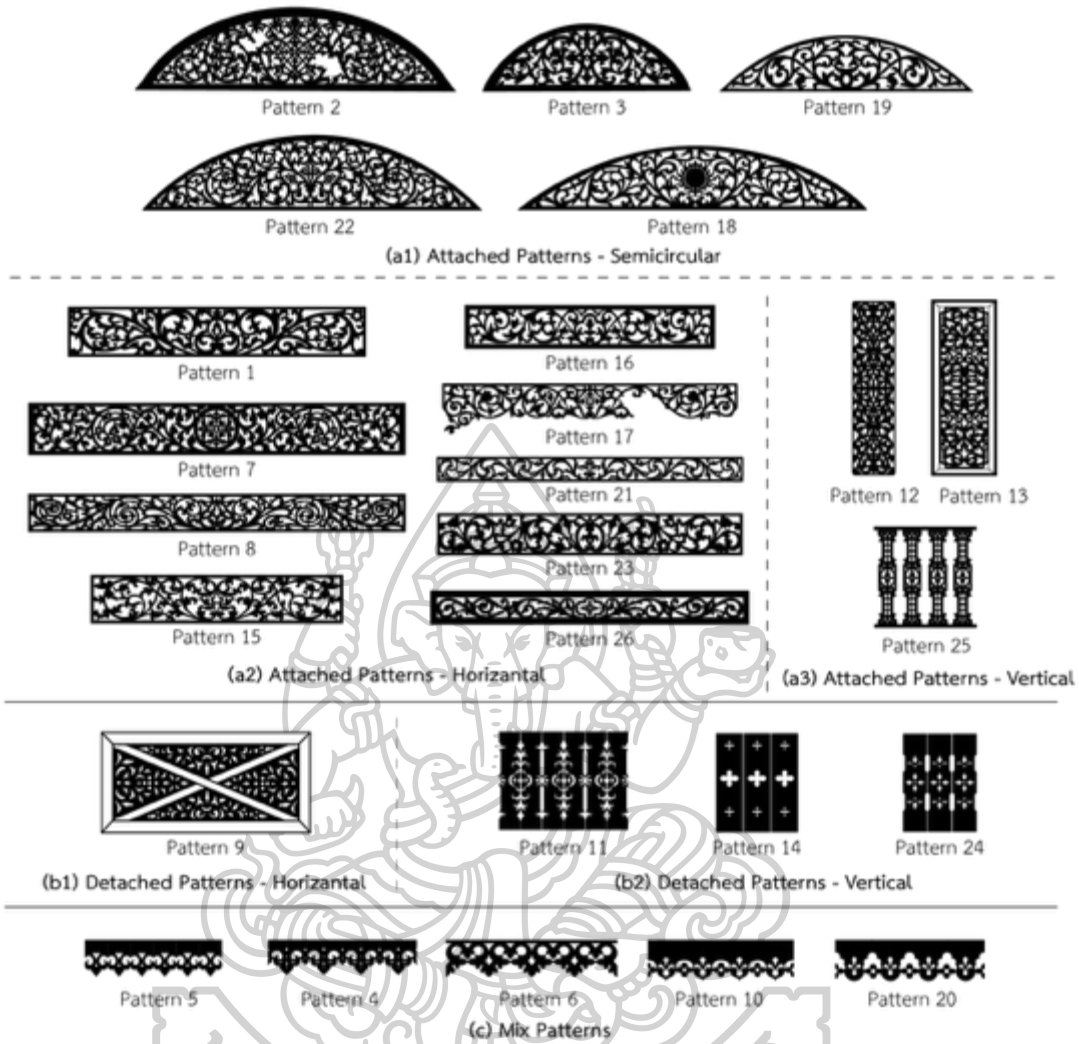

Figure 44 Gingerbread patterns categorized by characteristics

Source: Kanlayanee Phueaknamphol, 2024

In attached patterns with semicircular (a1) and horizontal rectangle frames (a2), the patterns are arranged in a way that the central flower pattern expands to the left and right using curved stems. The stems are then extended to the end of the frame and filled in with leaves, buds, and flowers. The center or focal point of the pattern is dominated by a main pattern that includes flowers, geometric patterns, and sun motifs. The left and right sides of the pattern are identical, with a central axis of symmetry.

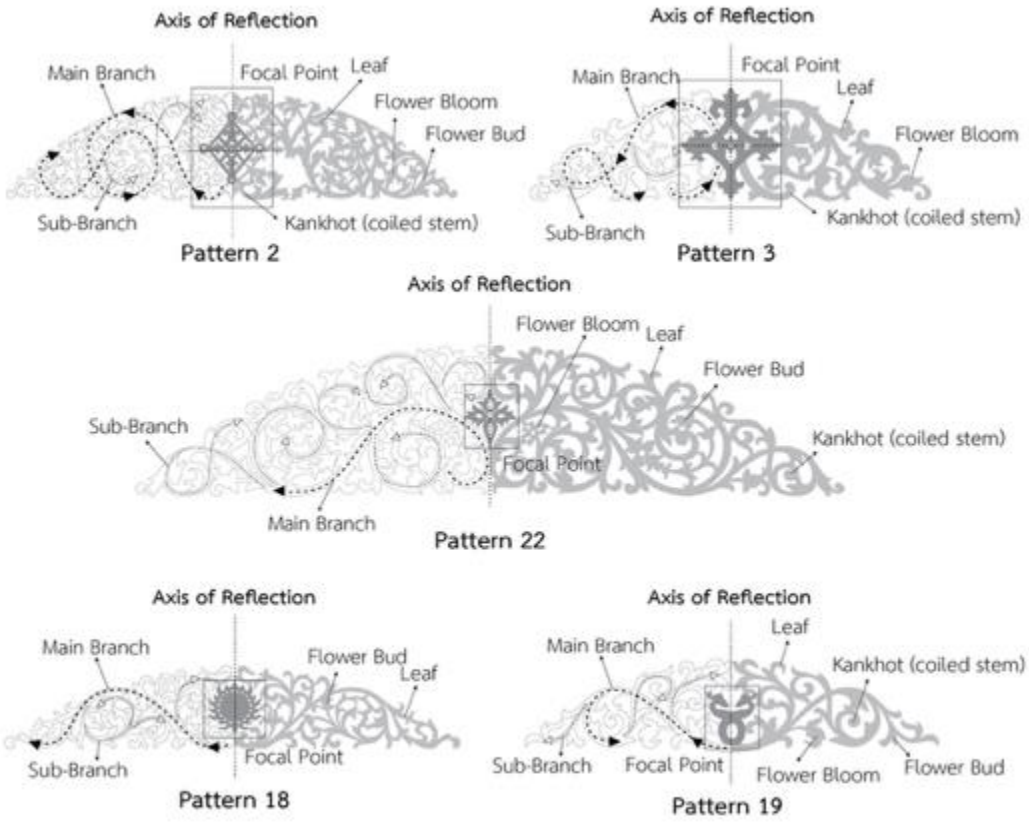

Figure 45 a1 Attached Patterns – Semicircular

Source: Kanlayanee Phueaknamphol, 2024

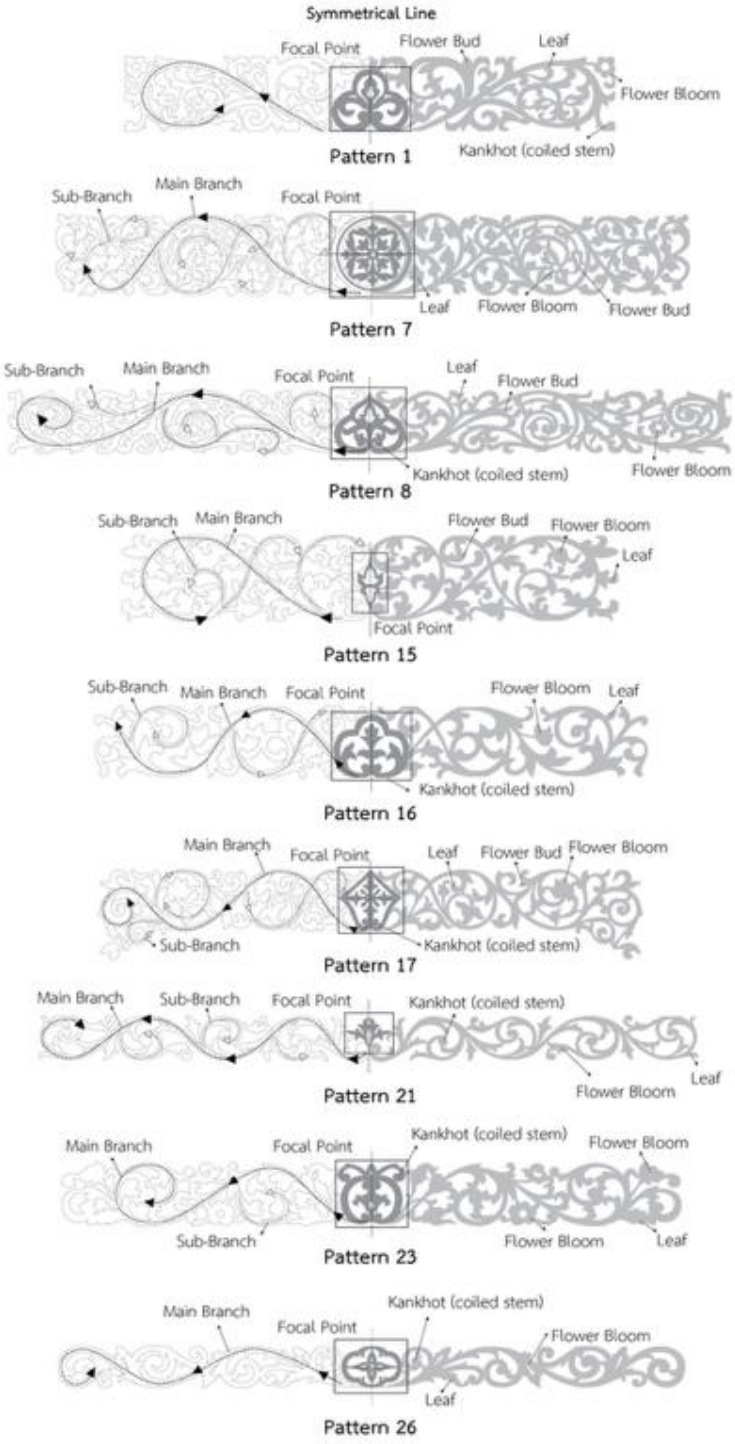

Figure 46 a2 Attached Patterns – Horizontal Rectangle

Source: Kanlayanee Phueaknamphol, 2024

Attached patterns with vertical frames (a3) are divided into two types: framed and unframed patterns. The patterns are symmetrical along two axes, vertical and horizontal, which intersect at the center of the pattern. Framed patterns consist of motifs of stems, leaves, buds, and flowers. However, the main curved stem is not clearly visible. The curved stem is divided into four parts in the areas divided by the axes of symmetry. Unframed patterns consist of motifs that are simplified from leaves and flowers to almost geometric shapes. The only motif clearly indicating its floral origin is the coiled stem or Kankhot motif.

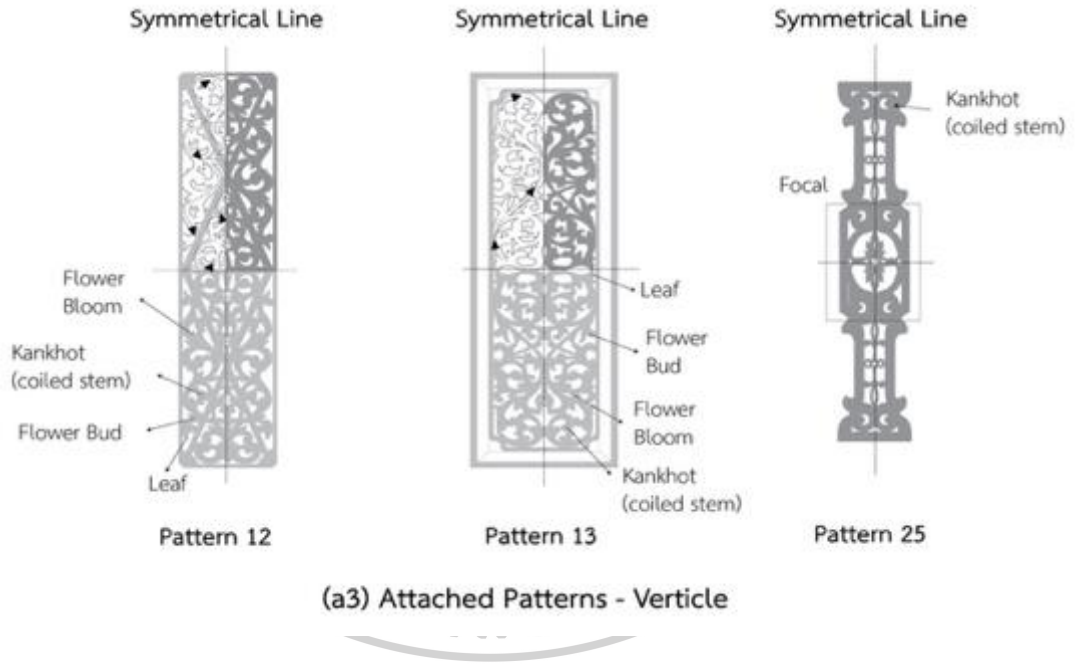

Figure 47 a3 Attached Patterns – Vertical

Source: Kanlayanee Phueaknamphol, 2024

Detached patterns are also symmetrical along two axes, horizontal (b1) and vertical (b2), which intersect at the center of the pattern. Unlike attached patterns, detached patterns use motifs instead of curved stems to create their designs. The detached pattern in a vertical rectangle consists of a series of identical sheets of

wood that are arranged in a long line. In some cases, two sheets of wood with different motifs are arranged, with patterns positioned at the edges of the wood. When the two sheets of wood are placed alternately, the patterns are created from the opening space at the edge of the wood and in the middle of the sheet of wood. The motifs found in detached patterns include geometric shapes, flowers, leaves, and buds.

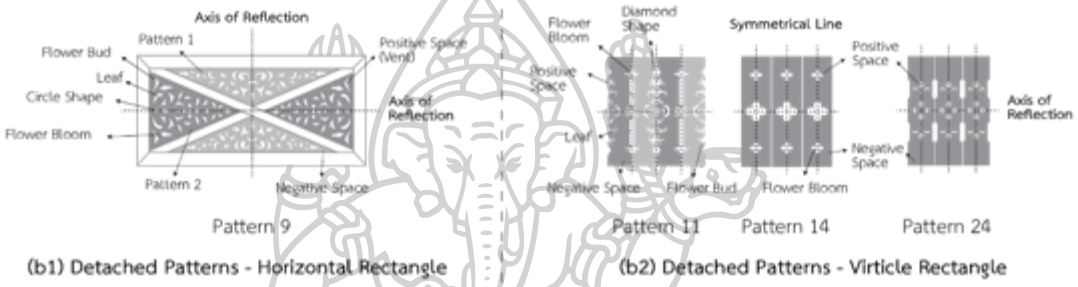

Figure 48 Detached patterns b1, b2

Source: Kanlayanee Phueaknamphol, 2024

Mix patterns are repeating patterns formed by arranging one or two sets of motifs in a horizontal row. The motifs can be arranged in vertical reflection pattern or zigzag arrangement. The pattern is also symmetrical. A line of symmetry can be drawn through the center of the pattern, dividing it into two identical halves. The motifs found in mix patterns can be geometric shapes, flowers, or leaves.

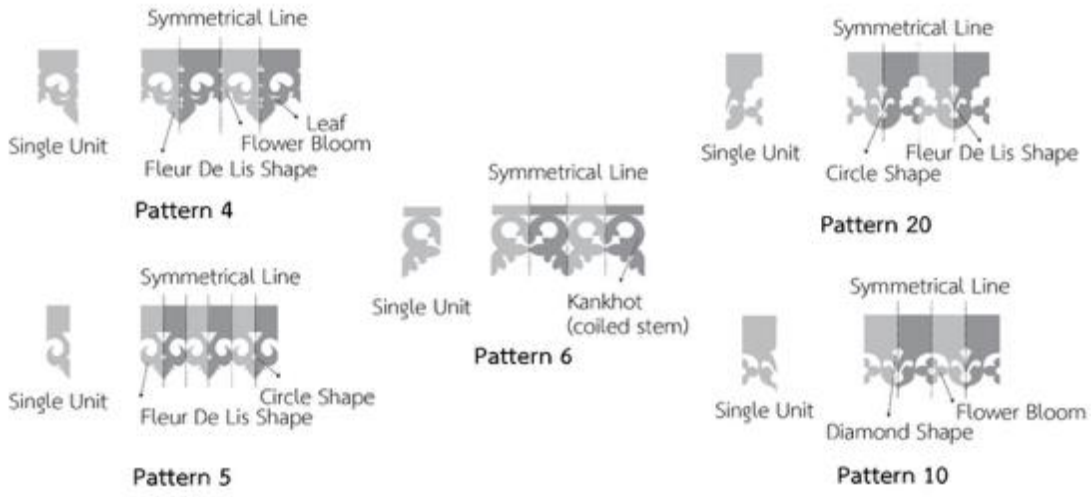

Figure 49 c1 Mix patterns – Horizontal

Source: Kanlayanee Phueaknamphol, 2024

Most motifs are derived from nature, including leaves, flower buds, coiled stems, flowers, and geometric shapes, often arranged in S-curve patterns. Unique motifs, such as suns, coats of arms, Chinese characters, flower bouquets, and pairs of swans serve as focal points, generating additional subsidiary patterns. The tulip or fleur-de-lis motif, in various orientations, is a characteristic feature of gingerbread fretwork.

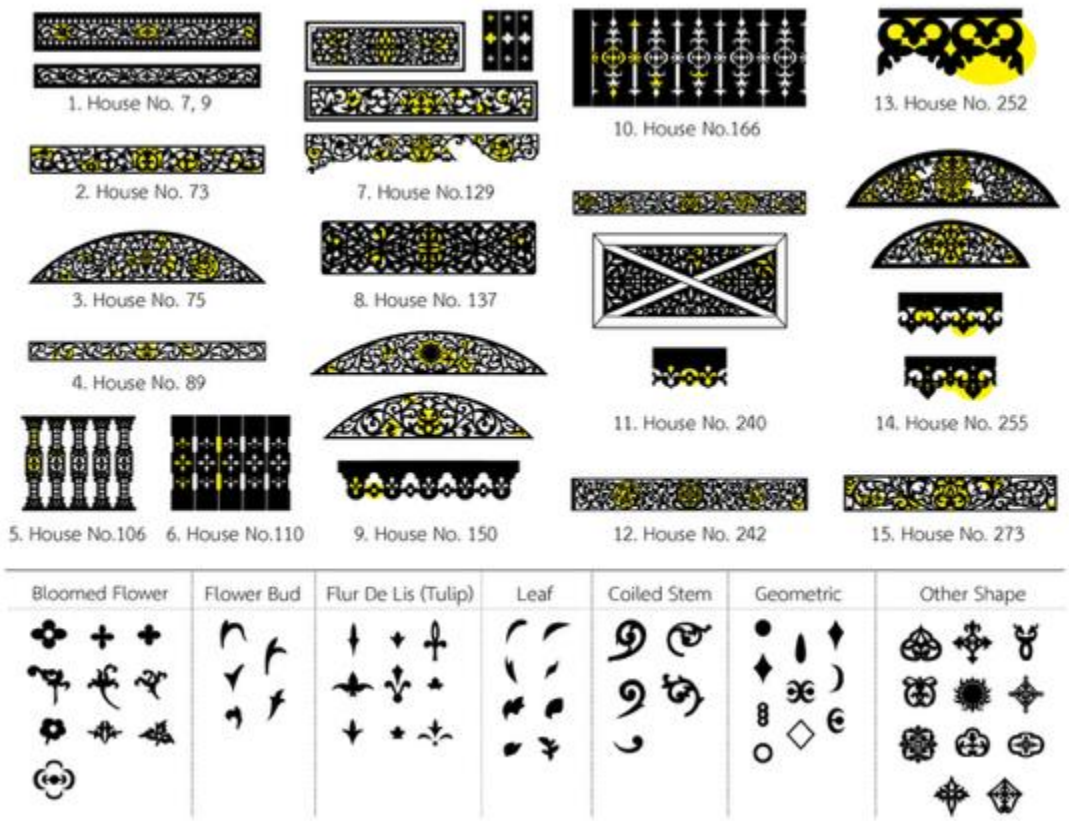

Figure 50 Motifs of Gingerbread fretwork

Source: Kanlayanee Phueaknamphol, 2024

The study of gingerbread fretwork patterns in the Chanthaboon Waterfront Community provides valuable insights for future design applications. The patterns' unique blend of floral and geometric motifs, influenced by both Western styles and local adaptations, offers rich inspiration for contemporary designs. The symmetrical nature and detailed craftsmanship of the patterns can serve as a foundation for creating modern home decor items, such as wall panels, decorative tiles, lighting fixtures, and furniture, while retaining their cultural essence.

The practical and aesthetic integration of fretwork in ventilation panels, eaves, and balconies demonstrates how these designs can be functional as well as

ornamental. This dual-purpose approach can be reinterpreted in modern contexts to create products that enhance light, and shadow play within interior spaces. Furthermore, the categorization of patterns—attached, detached, and mixed—provides a framework for modular design, allowing flexibility in adapting these motifs to different scales and mediums.

3.3.3 Expert Interview Analysis

Expert interviews with a historical scholar and product designers served to validate cultural interpretations of gingerbread fretwork and explore its suitability for modern design. Thematic analysis of these interviews revealed distinct perspectives that provided clear and complementary guidance for design development.

The historical expert highlighted Chanthaburi's gingerbread fretwork as a cultural hybrid, shaped by influences from Thai, Chinese, Vietnamese, and Western cultures. The expert stressed that adapting fretwork must not compromise its symbolic integrity; motifs such as flowers signified prosperity, while geometric shapes indicated social class and foreign influence. Preserving these meanings is essential for cultural authenticity in reinterpretation.

Product designers focused on functionality and market appeal, noting that simplified motifs can modernize fretwork while maintaining cultural resonance for contemporary consumers. They also emphasized modularity and versatility, suggesting applications in fretwork for panels, partitions, and lighting to enhance adaptability and relevance. Their input reinforced the need for balancing aesthetics with usability and consumer needs.

Together, these interviews confirm three key domains: safeguarding cultural authenticity, striking a balance between aesthetic detail and feasibility, and tailoring designs to meet user and market needs.

3.3.4 Survey Data Analysis

To complement the qualitative findings and to validate design directions with potential users, a structured questionnaire survey was conducted with 384 respondents. The survey aimed to capture consumer perceptions, preferences, and purchasing behaviors regarding home décor products inspired by Thai gingerbread fretwork. Data were analyzed using descriptive statistics (frequency, percentage, mean, and standard deviation) and reliability testing (Cronbach's α) to ensure consistency within thematic categories.

The questionnaire was organized into four main sections:

Demographics – Basic information including gender, age, education, occupation, income level, and prior exposure to traditional crafts. This data helped establish the profile of target consumer groups. Most respondents are expected to be female (around 70%) and aged between 25 and 45 years, representing young to middle-aged consumers with purchasing power for cultural crafts. Most have mid-level education and stable income, reflecting an urban target group interested in lifestyle products that blend tradition with modern design. This demographic profile suggests that culturally inspired designs appeal to an emerging consumer base that values both identity and contemporary aesthetics.

Perceptions of Aesthetics – Respondents were asked to evaluate aspects such as balance, proportion, rhythm, and overall harmony of proposed design samples, as well as the ability of patterns to communicate atmosphere and emotion. Respondents are likely to place high importance on balance, proportion, and visual harmony. Simplified fretwork patterns are perceived as more attractive than overly intricate ones, as they strike a balance between cultural recognition and contemporary taste.

Functionality and Sustainability – Questions assessed consumer interest in adaptability across different materials (wood, ceramic, acrylic, and recycled plastic), the versatility of use in multiple contexts (lighting, partitions, and decorative panels), and willingness to support eco-friendly materials and sustainable production. Consumers show interest in designs that can be adapted to multiple materials (e.g., ceramics, acrylic, recycled plastic) and functions (e.g., lamps, partitions, panels). Practical usability is valued alongside aesthetic appeal. A significant proportion of respondents express positive attitudes toward sustainable products, with many willing to consider recycled or eco-friendly materials. However, sustainability alone is not the top priority; it is preferred when combined with functionality and pleasing aesthetics.

Cultural Significance and Identity – Items explored perceptions of cultural authenticity, including whether simplified motifs still reflected Thai identity, the importance of preserving symbolic meanings (e.g., floral motifs representing prosperity, vines symbolizing continuity), and whether designs evoked nostalgia or cultural pride. Respondents generally agree that modern adaptations of gingerbread fretwork should still retain Thai cultural identity. Simplified motifs are acceptable if symbolic meanings are preserved, such as floral motifs representing prosperity or vines representing continuity. Many respondents report feelings of nostalgia and cultural pride when encountering fretwork-inspired designs, showing that cultural resonance remains a strong motivator for acceptance and purchase.

Market and Purchasing Behavior – Respondents identified key purchase factors (pattern, material quality, price, sustainability, brand, functionality), acceptable price ranges, and their overall willingness to purchase products inspired by gingerbread fretwork. The key factors influencing purchase decisions are likely to be patterns and colors (aesthetic value), material quality, price, and sustainability considerations. The acceptable price range for most respondents falls between 300 and 1,500 THB, aligning with mid-range consumer markets. Approximately two-thirds of respondents express interest in culturally blended ceramic designs, suggesting strong market

potential if cultural heritage can be translated into lifestyle products with accessible pricing and modern usability.

3.4 Integration and Synthesis

The integration stage consolidated findings from multiple sources of evidence in order to construct the matrix for pattern development. Each source contributed distinct insights, which, when synthesized, provided a comprehensive framework for evaluating and guiding the design applications of Thai gingerbread fretwork.

Documentary research and field study supplied the historical context, typologies, and symbolic meanings of fretwork motifs, highlighting their hybrid origins and local adaptations. A comparative analysis clarified the distinctive characteristics of Chanthaburi fretwork in relation to other regions, identifying unique cultural markers that could be emphasized in the design. Expert interviews validated cultural interpretations and offered professional perspectives on technical feasibility, material challenges, and contemporary design translation. Survey data provided quantitative evidence of consumer perceptions, preferences, and market expectations regarding aesthetics, functionality, sustainability, and cultural identity.

By synthesizing these strands, the research distilled five critical dimensions—Cultural Integrity, Formal Harmony, Variation and Adaptability, Semantic–Emotive Meaning, and Sustainability—which together form the Pattern Development Matrix. This framework serves as both an evaluative rubric and a generative tool, ensuring that design outcomes remain culturally authentic, aesthetically balanced, functionally versatile, emotionally resonant, and environmentally responsible.

3.4.1 Cultural Integrity Method

The principle of cultural integrity emphasizes the necessity of preserving the symbolic meanings, historical context, and cultural values embedded in traditional motifs when reinterpreting them for contemporary design. This approach avoids trivialization or misrepresentation of cultural heritage, ensuring that patterns remain authentic to their origins (Lin, Sun, et al., 2007a; Saad Fathalla, 2019).

The development of this method draws upon fieldwork conducted in the Chanthaboon Waterfront Community, where motifs were systematically documented through photography and motif tracing. These motifs were then subjected to visual and symbolic analysis to evaluate their cultural relevance and authenticity. Compared with other regions—for example, the North, where zodiac animals often reflect homeowners' birth years—Chanthaboon fretwork reveals fewer direct references to beliefs or philosophy. Instead, only selected motifs embody culturally shared symbols of auspiciousness. Floral, leaf, and vine motifs, for instance, symbolize abundance and growth, while the fleur-de-lis (tulip motif) signifies purity, power, good fortune, and protection.

The Chanthaboon gingerbread fretwork further incorporates motifs such as the sun, double swans, and shields, which emerged as culturally distinctive features. The sun symbolizes vitality and prosperity; the double swans represent love, unity, and grace; and the shield, often placed at the heart of a panel, conveys protection and strength. These intricate designs narrate cultural stories, blending Western influences with the refined uniqueness of Thai craftsmanship. Moreover, detailed fretwork often indicated the social status and wealth of homeowners. Intricate designs were predominantly found in high-status residences—such as mansions, noble houses, and royal palaces—particularly in Bangkok and Phrae. Reinterpreting such motifs, therefore, requires sensitivity to their dual role as both aesthetic expression and social markers of prestige.

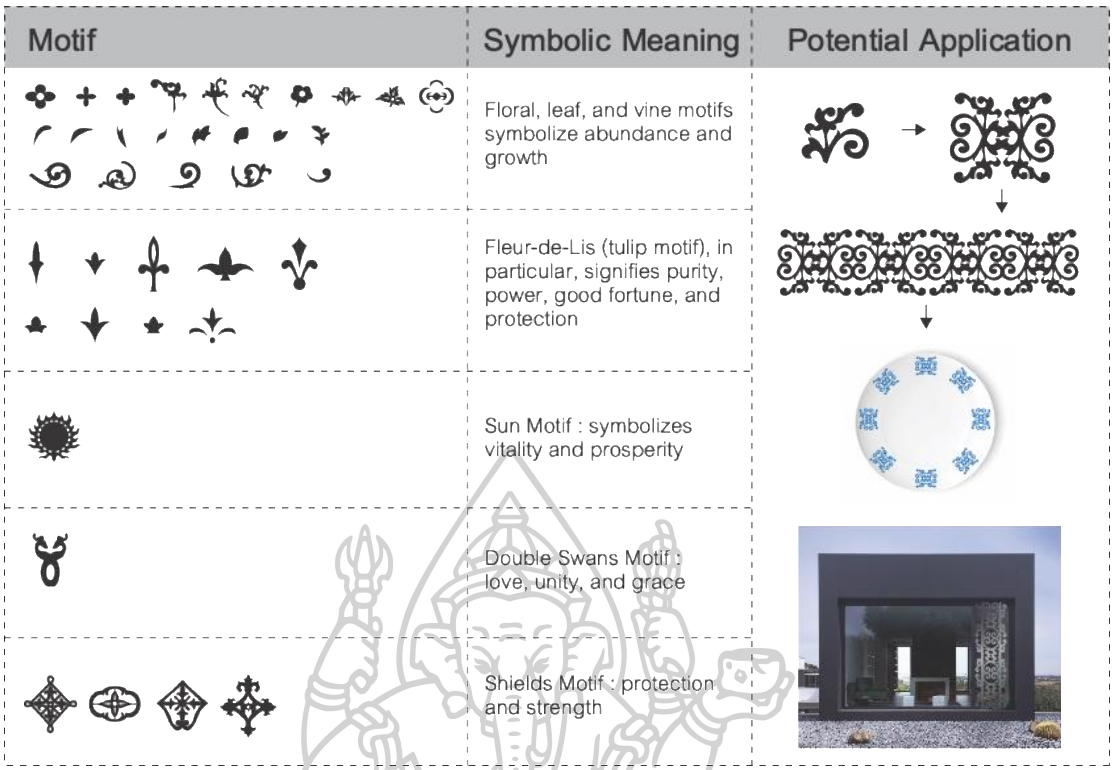

Figure 51 Symbolic motifs, meaning, and potential application

Source: Kanlayanee Phueaknamphol, 2024

The selected motifs were subsequently reinterpreted into new pattern designs for graphic design, ceramics, and home décor while maintaining their symbolic integrity. For example, floral motifs representing fertility were adapted as surface textures for tableware, while vine motifs suggesting continuity were applied in decorative panels. The design process emphasized continuity between cultural meaning and contemporary functionality, ensuring that reinterpreted patterns operate simultaneously as aesthetic elements and cultural signifiers.

3.4.2 Formal Harmony Method

The principle of formal harmony emphasizes the role of symmetry, proportion, balance, and rhythm in shaping coherent and aesthetically pleasing patterns. These elements are central to the organization of motifs, ensuring that individual forms combine into unified compositions. In the reinterpretation of Thai gingerbread fretwork, formal harmony guides the arrangement of vernacular motifs into balanced and repeatable design systems(Crowe, 1988; Hann, 2018).

This method analyzed the fretwork motifs collected from the Chanthaboon Waterfront Community by focusing on their line flow, reflective symmetry, and rhythmic repetition. Instead of deconstructing motifs into abstract geometric elements, the analysis traced how vine-like curves and floral stems create movement and rhythm, while mirrored or rotational arrangements generate symmetry. Motifs were then aligned within grid systems to study how balance and proportional relationships contribute to visual harmony. This process preserved the recognizable cultural motifs while also revealing the structural logic that allows them to be adapted into systematic design modules.

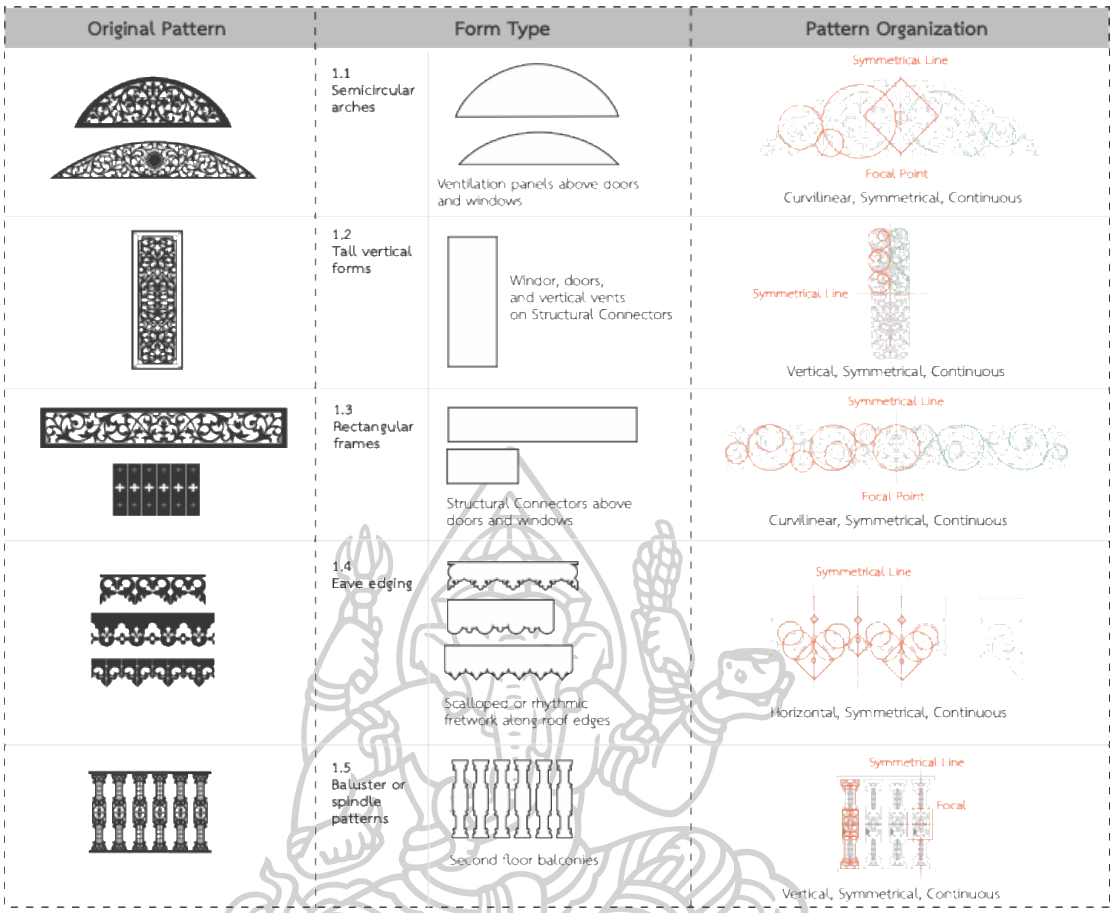

Figure 52 Pattern and Form Geometric Breakdown

Source: Kanlayanee Phueaknamphol, 2024

The reinterpreted motifs were developed into design patterns that emphasize balance and coherence across different creative fields. In architectural façades, fretwork-inspired grids function as decorative screens or shading devices. In ceramic tiles, symmetrical arrangements ensure repeatability and modular integration. In graphic and packaging design, rhythmic repetitions establish consistent visual identity. Across these applications, formal harmony ensured that reinterpretations of gingerbread motifs maintained both cultural depth and visual balance.

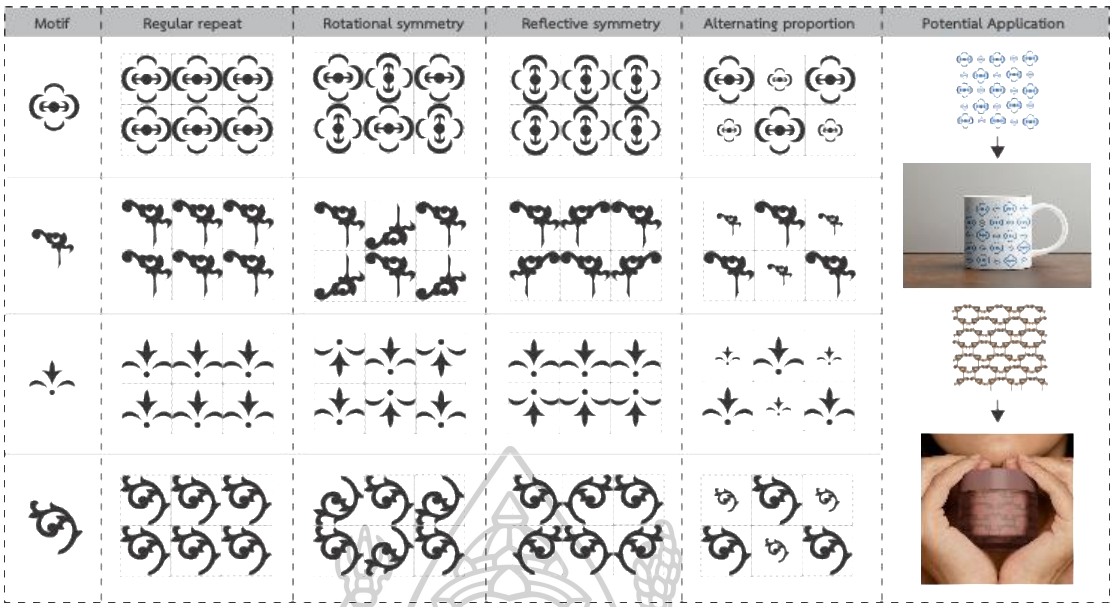

Figure 53 Grid-based layouts of fretwork motifs

Source: Kanlayanee Phueaknamphol, 2024

3.4.3 Variation and Adaptability Method

The principle of variation and adaptability highlights the need for cultural motifs to be flexible and responsive across diverse design contexts. While traditional motifs were originally created for fixed architectural or craft applications, their reinterpretation in contemporary design requires adaptability to new scales, materials, and media. Variation is achieved through techniques such as rotation, reflection, scaling, and modular recombination, which enable motifs to maintain cultural identity while fitting new functions and aesthetics (Kunkhet & Chudasri, 2022)

In this method, fretwork motifs collected from the Chanthaboon Waterfront Community were transformed into **modular units** that could be repeated, rotated, mirrored, or scaled. Each motif was tested for its adaptability within multiple configurations—linear friezes, tiled grids, radial compositions, and layered arrangements. This experimental process revealed how motifs retain cultural

recognizability while expanding their potential applications. By emphasizing adaptability, the motifs became **design modules** that can be integrated into different surfaces, products, and scales without losing their cultural resonance.

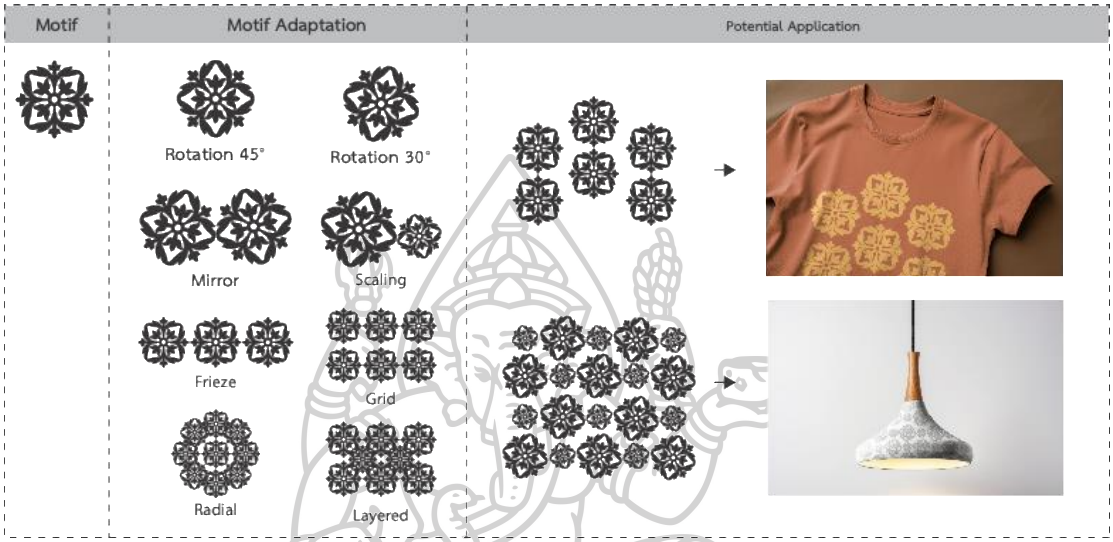

Figure 54 Modular compositions of a fretwork motif arrangement

Source: Kanlayanee Phueaknamphol, 2024

The adaptable motifs were applied to various creative fields, demonstrating their versatility. In textiles, repeated modules created patterned fabrics suitable for both fashion and interior applications. In furniture and surface design, rotated or scaled motifs generated flexible decorative panels. In digital graphics and branding, modular motifs provided adaptable visual identity systems. Through these applications, variation and adaptability ensured that fretwork-derived patterns could move fluidly across media, from tangible crafts to digital platforms, while preserving their cultural roots.

3.4.4 Semantic and Emotive Relevance Method

While cultural integrity ensures that traditional motifs remain authentic to their symbolic roots, the principle of semantic and emotive relevance emphasizes their role in shaping user perception and emotional experience. Motifs are understood as cultural signifiers that not only convey meaning but also trigger affective responses such as comfort, elegance, vitality, or protection (Said & Kamarudin, 2008).

Motifs from the Chanthaboon Waterfront Community were mapped to their symbolic associations and evaluated for their potential to generate emotional impact in contemporary contexts. For example, floral motifs evoke feelings of abundance and hospitality; vine motifs suggest vitality and continuity; and swan motifs communicate grace and unity. The focus was not only on preserving meaning but also on how those meanings can be felt and experienced by users in new design settings.

Reinterpreted motifs were applied in design contexts where meaning and emotional resonance play a key role. In **home décor**, motifs with protective or auspicious associations (e.g., shield or sun) were integrated into lighting or panel designs to evoke a sense of security and wellbeing. In **ceramics**, floral patterns were reinterpreted for tableware to enhance the symbolic connection with fertility and nourishment. In **graphic design**, motifs such as swans or vines were incorporated into visual identities to evoke unity, and continuity. Across these applications, semantic and emotive relevance ensured that designs were not only aesthetically appealing but also capable of conveying cultural meaning and emotional impact.

However, the experiments revealed that applying Semantic and Emotive Relevance through symbolic motifs alone was insufficient to clearly communicate emotional resonance in contemporary design. While motifs such as flowers, suns, or shields carried cultural meaning, their symbolic values did not always translate into strong user experiences. To address this gap, the study turned to the lived context

and functional purpose of gingerbread fretwork itself. Historically, fretwork was designed not only as an ornament but also as a functional architectural element—to provide ventilation, filter sunlight, and enhance the beauty of façades. Its aesthetic power emerges most vividly when sunlight passes through the perforations, casting intricate shadows onto surrounding surfaces. These shadow patterns are not static; they shift with the movement of the sun and are particularly striking at sunrise and sunset, when light and shadow dramatize the architecture. Recognizing this, the design concept evolved to draw inspiration from the atmospheric moods of dawn (Yam Rung) and dusk (Yam Kum). These times of day resonate with lived experience and cultural rhythms, embedding emotion not only in motifs but in the interplay of light, shadow, and time. By situating gingerbread fretwork within its natural context of sunlight and daily life, the reinterpretation process achieved a more profound semantic and emotive connection, transforming traditional patterns into contemporary design concepts that carry both symbolic depth and atmospheric resonance.

Figure 55 Shadow Survey on Morning Light

Source: Kanlayanee Phueaknamphol, 2024

Figure 56 Shadow Survey on Evening Light
Source: Kanlayanee Phueaknamphol, 2024

From the observation of daily life, it was found that the periods of dawn and dusk exhibit distinct characteristics in terms of light quality, emotional atmosphere, human activities, symbolic associations, and physical environments. These differences not only shape cultural practices but also influence how architectural elements such as fretwork patterns interact with light and shadow. By synthesizing these observations, the contrasting qualities of dawn and dusk were organized into a diagram that highlights their unique atmospheres and symbolic meanings.

Yum Rung (Dawn)

Yum Rung (Dawn) is the time around 6 a.m. when the first sunlight softly lights the sky. The moment is calm and fresh, with cool air and pale blue colors evoking a sense of peace and renewal. As sunlight passes through carved wood, it creates soft shadows, inspiring new beginnings. In Thai culture, this peaceful start connects closely to daily routines: monks collect alms in the neighborhoods, families gather to eat breakfast together, and children and adults prepare for school or work. These morning actions embody the values of community, respect, and renewal. Imagery of the rising sun, roosters, or morning bells further captures these themes. Thus, dawn brings clarity, hope, and optimism, helping people feel productive and uplifted at the start of the day.

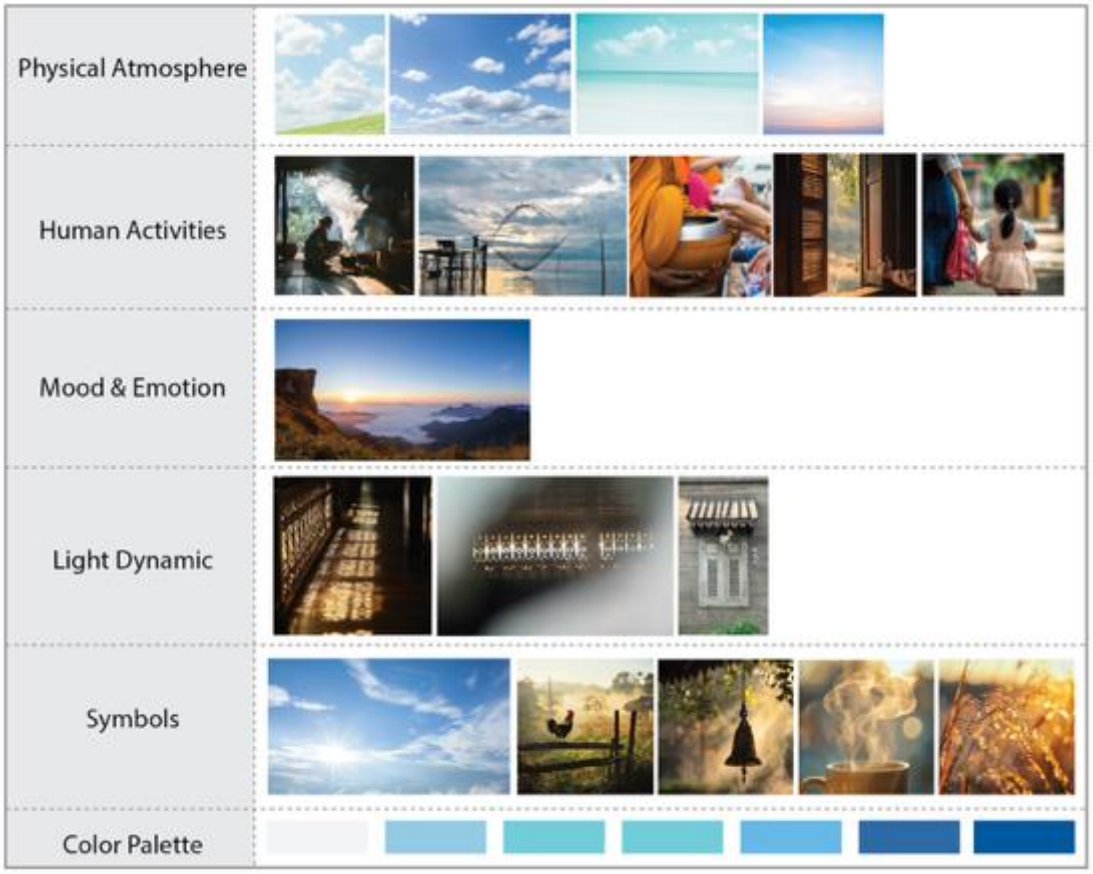

Table 10 Conceptual Analysis of Yam Rung (Dawn)

Physical Atmosphere: Dawn brings cool, refreshing air and clarity, with the environment still fresh and less polluted. Natural sounds mingle with gentle human activity, as a soft airflow enhances the tranquil and invigorating quality of early morning.

Human Activities: Human activities in the morning reflect cultural routines and the start of a new day. People offer alms to monks, students go to school, fishermen begin their work along the river, and households prepare breakfast, filling the space with renewal and a sense of livelihood. Simple gestures, like opening windows to welcome the day, underscore the shift into a more active environment.

Mood & Emotion: The mood of Yam Rung (Dawn) is quiet, fresh, and peaceful, evoking a sense of awakening and new beginnings. This atmosphere brings comfort, calmness, and hope, symbolizing renewal and positive energy for the day ahead.

Light Dynamic: The light dynamic at dawn is marked by the first tender rays of sunlight that softly illuminate the landscape, casting elongated shadows and a golden radiance. The low sun angle accentuates object contrasts, while the natural light infuses the moment with understated beauty and a sense of gentle transformation, marking the beginning of a new day.

Symbols: Yam Rung (Dawn)'s symbolism conveys cultural and emotional meaning through elements marking the day's start. The rising sun represents renewal, the temple bell chime spirituality, and the rooster's crow awakening and rural rhythm. Dewdrops sparkling in the rice fields signify purity and abundance, while steam from coffee reflects the comfort and intimacy of morning rituals. Together, these symbols embody hope, vitality, and harmony between nature, culture, and daily life.

Color Palette: Ranging from light blue to deep navy, the dawn palette reflects cool air, clarity, morning mist, and dew's bluish tones. These shades suggest freshness and tranquility, aligning with the serene emotions and cultural meaning of dawn. The gradient from pale blue to darker tones captures the subtle brightness of early sunlight and the lingering night, providing a harmonious palette for the design process as it transitions to evening.

Yam Kham (Dusk)

Yam Kham (Dusk) occurs around 6 p.m. as the sun sets and the day's final rays fade into twilight. This transition creates a quiet and contemplative atmosphere, with orange, red, and grey hues softening into evening shadows. The air grows cooler and calmer, inviting a shift in rhythm from activity to relaxation.

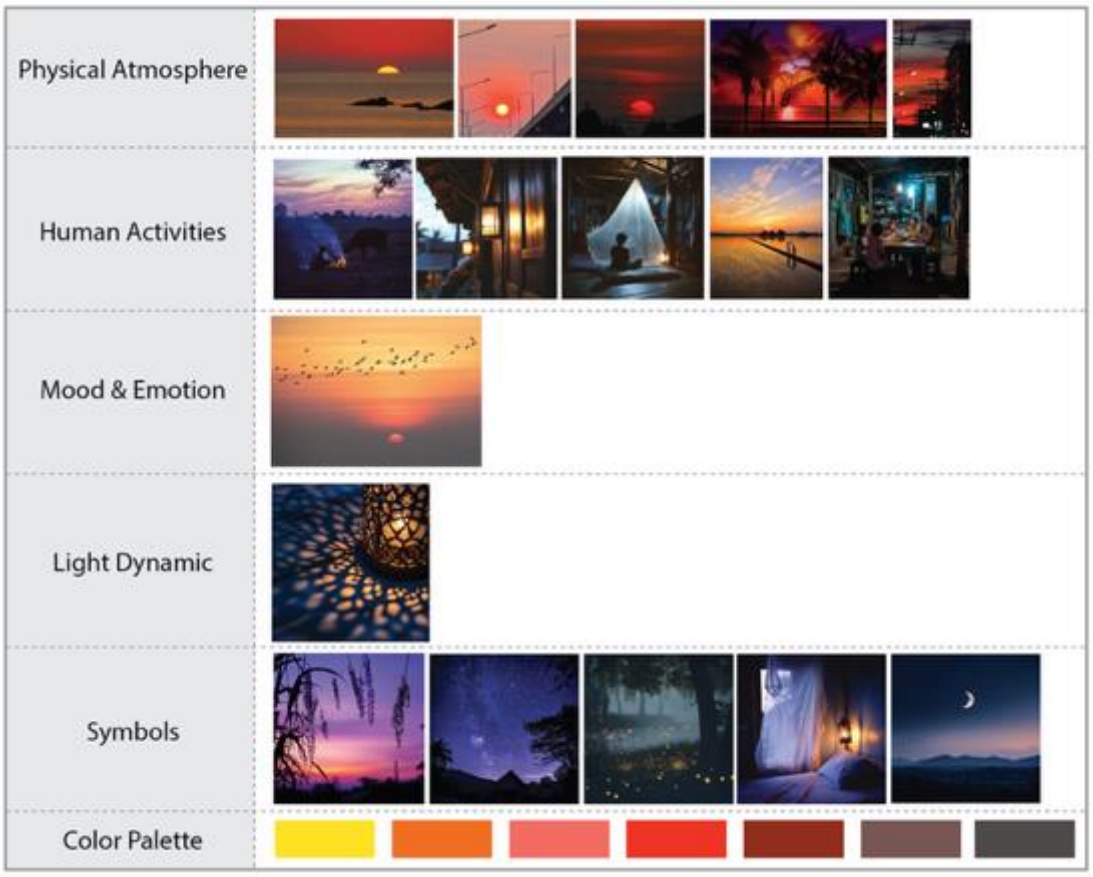

Table 11 Conceptual Analysis of Yam Kham (Dusk)

Physical Atmosphere: At dusk, the environment shifts into cooler and quieter tones. Slanting light blends into shadows. Twilight blue, dusky purple, shadow grey, and other cool hues emerge. The air becomes calm. A dim light gradually begins to glow, creating a serene and contemplative atmosphere.

Human Activities: This period is marked by daily routines coming to a close. Family members prepare for dinner, villagers light smoky fires, and farmers return home with their buffalo. People also gather at community spaces to relax after a long day, and villagers may take a bath in the river. These activities reflect the

transition from work to rest, embodying a sense of closure and preparation for the night.

Mood & Emotion: The atmosphere of dusk evokes a slowing down of time, fostering reflection and closure. It carries a mix of nostalgia, warmth, and quiet transition as the day gradually fades into the night. The overall mood is slow, romantic, and meditative, offering a gentle space for emotional connection.

Light Dynamic: Light at dusk is dramatic. The setting sun creates long, slanting shadows that shift with the evening breeze. Lanterns and artificial lights begin to glow. They cast warm patterns and textures on walls and floors. The fading natural light blends with emerging artificial illumination, enriching the atmosphere with depth and beauty.

Symbols: Dusk is represented by meaningful cultural and natural symbols, including the setting sun sinking into the horizon, lamps and lanterns glowing in the darkness, fireflies flickering in the fields, the first stars appearing, and households preparing for rest. These symbols carry strong associations of transition, restfulness, and renewal.

Color Palette: The gradient of orange to brown tones, represented in the side strip, is derived from the evening sky and the natural play of light during dusk. The warm, orange hues emanate from the glow of the setting sun, while deeper browns reflect the shadows, earth tones, and the dimming horizon. These shades embody warmth, intimacy, and groundedness, making them ideal for design applications that aim to capture the cultural, emotional, and atmospheric qualities of dusk.

Figure 57 Atmospheric Comparison of Dawn and Dusk for Design Inspiration

Source: Kanlayanee Phueaknamphol, 2024

In design, the Dusk set draws inspiration from this ambiance by using gingerbread fretwork patterns in lamp design. The interplay of light and perforated shadows on walls creates an atmosphere of warmth, intimacy, and nostalgia, reflecting the elegance of traditional fretwork while offering users a soothing and reflective end to the day.

In addition to field observations, the researcher also conducted a controlled light-and-shadow study in the studio to analyze how fretwork patterns behave under different light angles. The experiment tested three light positions—low (5–15°), medium (15–30°), and high (30–45°)—corresponding to times of sunrise and sunset.

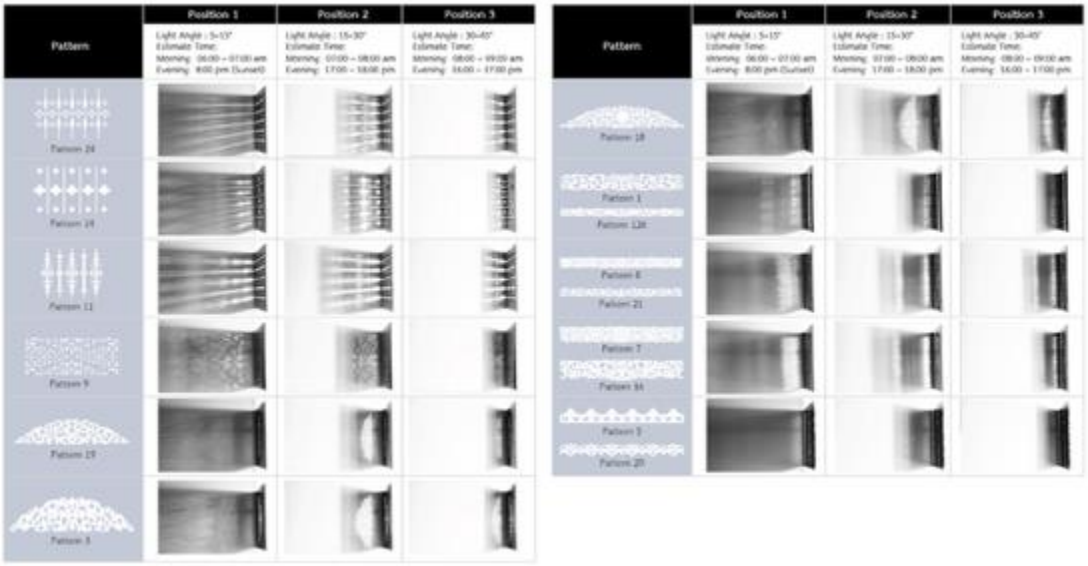

Figure 58 Light Experiment

Source: Kanlayanee Phueaknamphol, 2024

The chart presents comparative shadow studies of multiple fretwork patterns under varying light angles. Each row corresponds to a specific motif (e.g., Pattern 24, Pattern 14, Pattern 11, etc.), while the columns display the shadow effects created at different light positions. At lower angles (5–15°), shadows appear elongated and dramatic, emphasizing linear rhythm. At medium angles (15–30°), shadows become denser and more legible, showcasing the full intricacy of motifs. At higher angles (30–45°), shadows shorten and soften, gradually losing detail. These results reveal how gingerbread fretwork interacts dynamically with sunlight across the day, shaping distinct atmospheric effects that inform design inspiration for the collection.

In summary, the semantic and emotive relevance method demonstrated that gingerbread fretwork motifs carry symbolic meanings and emotional potential, yet their resonance becomes most vivid when situated within the lived context of light and shadow. Observations of dawn (Yam Rung) and dusk (Yam Kum) revealed how the interplay of sunlight, atmosphere, and daily activities enriches the emotive

quality of patterns, transforming them from symbolic ornaments into cultural experiences. This insight established a foundation for reinterpreting motifs not only as static symbols but as dynamic elements that embody time, emotion, and human life—providing a bridge toward sustainable and technically feasible design applications.

3.4.5 Sustainability and Technical Feasibility Method

The principle of sustainability and technical feasibility emphasizes the integration of ecological responsibility and practical design execution. Cultural motifs, when reinterpreted, must not only preserve heritage values but also align with sustainable practices and contemporary production methods. This involves considering material efficiency, adaptability to digital fabrication processes, and the long-term durability of products. By embedding sustainability within cultural design, patterns can serve as bridges between traditional aesthetics and modern environmental priorities (Chen et al., 2012; Hu, 2023).

In this method, motifs from the Chanthaboon Waterfront Community were tested for their adaptability to sustainable materials and fabrication techniques. The process included experimenting with the use of recycled or low-impact resources testing how motifs could be translated into CNC cutting, or 3D printing, and evaluating whether motifs with complex details could be simplified into modular, manufacturable forms while retaining their symbolic integrity.

Ceramic glaze from waste mussel shells

In this study, the researcher sourced waste mussel shells from local community enterprises in Khao Sammuk, Chonburi Province. These shells, discarded after meat is sold, often pile up in empty lots and decompose slowly, causing unpleasant odor, attracting pests, and disrupting the view. The researcher addressed this by transforming the shells into a ceramic glaze material, demonstrating both

environmental responsibility and technical feasibility. We created a new glaze made from Wollastonite (38%), Sada Feldspar (31%), Kaolin (8%), Quartz (9%), Frit (5%), and Mussel Shells (9%). Mussel shells provided calcium oxide and replaced limestone, thereby reducing the need for industrial raw materials and utilizing local waste. The glaze ensures durability, good surface quality, and environmental responsibility. This supports sustainable ceramic production. Our method demonstrates a practical approach to circular design, reintegrating local food industry waste into the ceramic production process. This solution addresses environmental issues and provides a model for utilizing community waste in innovative materials.

Figure 59 Mussel shells glaze production

Source: Kanlayanee Phueaknamphol, Bunyarid Sriurai, and Sittiphong Inthawong, 2024

Recycled plastics cap - The process involved developing three-dimensional models using Rhino3D and 3D printing to test modular assembly and form. Simultaneously, recycled plastic bottle caps were processed into plastic sheets through a heat-press technique in collaboration with the local community enterprise “Transforming Waste into Value, Save the Sea, Charm of Ban Amphoe” in Chonburi.

These sheets, measuring 35 × 35 × 1 cm, were then CNC-cut into intricate gingerbread fretwork patterns for modular assembly. Each unit, consisting of patterned and connecting sheets, required approximately 3,083 recycled bottle caps, demonstrating both material feasibility and cultural integration in the design outcome.

Figure 1 From 3D model to recycled plastic sheet and CNC-cut fretwork patterns

Source: Kanlayanee Phueaknamphol, Bunyarid Sriurai, and Sittiphong Inthawong, 2024

In summary, this material explorations—ceramic and recycled plastic—demonstrated the versatility of gingerbread fretwork motifs when reinterpreted through contemporary fabrication techniques. Ceramic lamps retained the closest link to traditional heritage, combining symbolic integrity with sustainability through mussel-shell glaze. Recycled plastic panels successfully addressed community waste reduction and enabled modular design adaptability, yet conveyed a more contemporary mood distinct from the authenticity of ceramic work.

3.4.6 Synthesis into Design Applications

At this stage, the research consolidated prior analyses and experimental findings into a Pattern Development Matrix, which systematically mapped motifs to symbolic meanings, geometric structures, emotional associations, material adaptations, and fabrication methods. Serving as a decision-making tool, this integrative framework guided the design process across multiple dimensions. Motifs were first aligned with their symbolic values for cultural authenticity, and then translated into balanced compositions through geometric grids and structural breakdowns. Variation techniques—including rotation, mirroring, and modular recombination—enhanced adaptability across diverse product types. Semantic and emotive mapping further connected motifs and their shadow effects to experiential atmospheres, such as the freshness of dawn and the serenity of dusk. Sustainable material strategies—such as recycled plastics and mussel-shell glazes—were paired with feasible fabrication methods, including handcraft, CNC, and laser cutting, ensuring that cultural resonance, aesthetic value, and technical feasibility could all be realized in contemporary design applications.

CHAPTER 4 DESIGN DEVELOPMENT

Building upon the framework established in Chapter 3, this chapter presents the design outcomes developed through experimentation and prototyping. The pattern development matrix guided the selection of motifs, adaptation methods, and material choices.

4.1 Design Development

The design development phase utilized the Pattern Development Matrix, synthesized in Chapter 3, as the guiding framework. The process involved selecting gingerbread fretwork motifs, adapting them into contemporary design forms, and experimenting with material applications. Design exploration proceeded in two parallel directions: (1) the creation of mock-ups to test pattern adaptation, composition, and visual impact, and (2) the development of prototypes to examine technical feasibility, material performance, and user interaction. This dual approach ensured that the design outcomes were not only conceptually aligned with cultural and aesthetic values but also tested in practice for structural, functional, and market viability.

4.1.1 Yam Rung (Dawn)

4.1.1.1 Set Yam Rung – Design Set 1 (Mock-up)

The Pattern Development Matrix served as a guiding framework for this design set. Fretwork motifs were reimagined as modular patterns to convey the softness and optimism of dawn. By drawing from Chanthaboon architectural elements, motifs were recomposed with symmetry and rhythm, then matched with gradient palettes inspired by the morning sky—deep blue, pale yellow, and warm orange. These

transitions emulate the gradual advance of light and the dynamic play across surfaces.

The primary design demonstrates how rhythmic repetition and gradual tonal shifts can evoke the clarity and freshness of morning. Secondary applications extend the motifs into textiles and lifestyle surfaces, such as socks and upholstered furniture. The use of recycled fabrics is central to the design's sustainability focus, both highlighting environmentally responsible practices and enhancing tactile comfort.

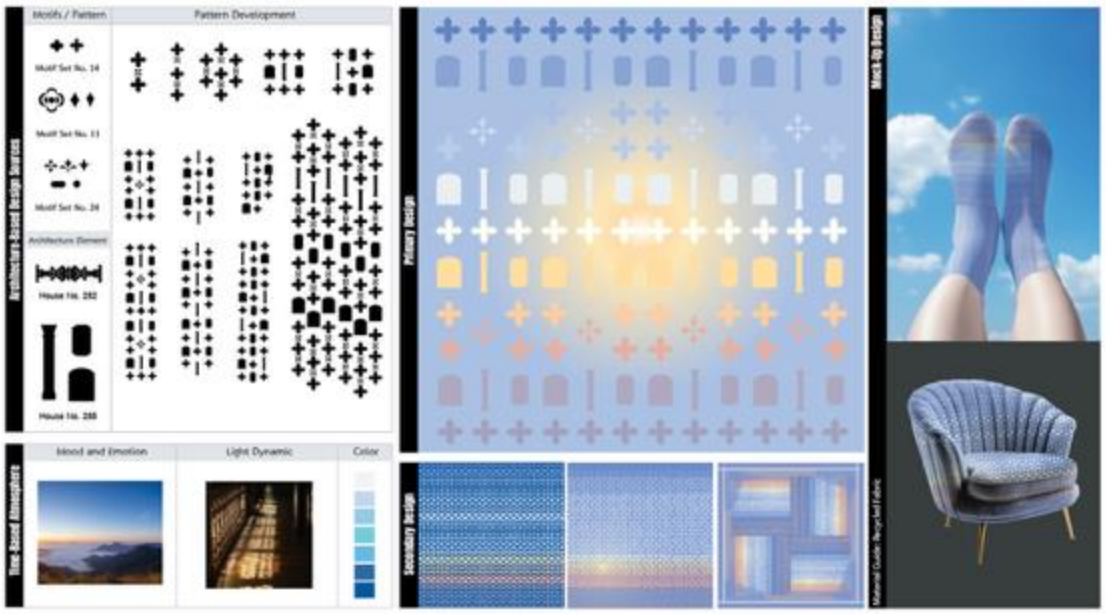

Figure 60 Set 1 : Yam Rung (Dawn) – Design and Mock-up

Source: Kanlayanee Phueaknamphol, 2024

4.1.1.2 Set Yam Rung – Design Set 2 (Mock-up)

This set utilized the Pattern Development Matrix to evoke an early morning light and a calm seaside mood. Motifs from Chanthaboon houses—such as curved stems, floral details, and column forms—were arranged into modular patterns that

highlighted openness, balance, and flow. Gradient blues, turquoises, and pale yellows from dawn skies enhance clarity and renewal.

The primary design demonstrates how modular fretwork patterns, when reinterpreted with light gradients, can embody both structural harmony and the softness of morning light. Secondary designs explored layering and repetition to produce dynamic compositions adaptable to textiles and surface products. Sustainable practices are emphasized through the use of recycled fabric in beach wraps, tote bags, and accessory pouches, demonstrating the integration of eco-friendly materials into fretwork-inspired motifs for contemporary lifestyle products.

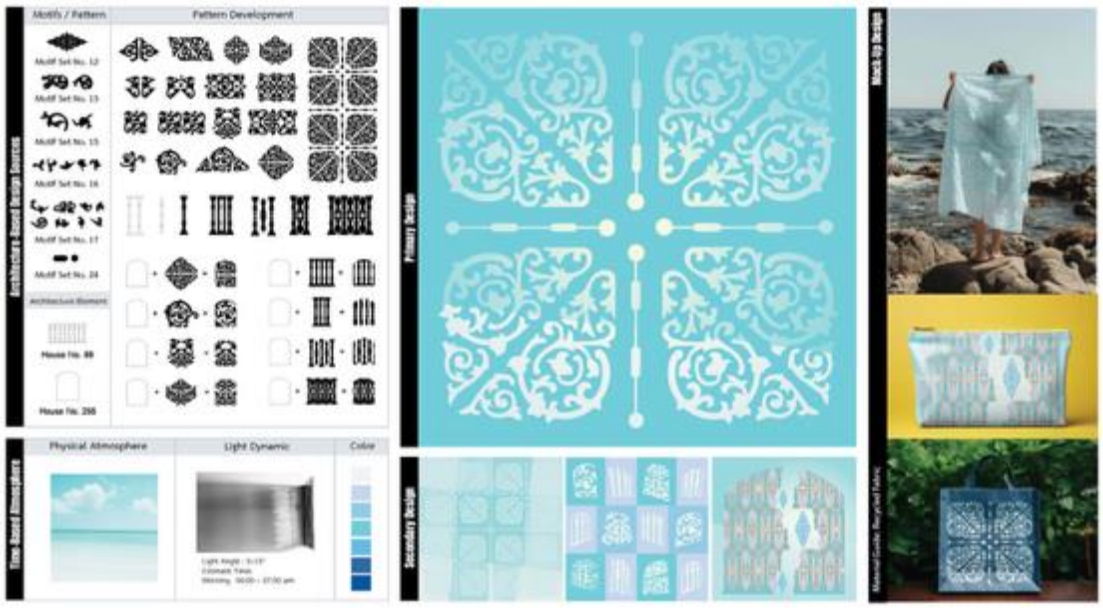

Figure 61 Set 2 : Yam Rung (Dawn) – Design and Mock-up

Source: Kanlayanee Phueaknamphol, 2024

4.1.1.3 Set Yam Rung – Design Set 3 (Mock-up)

Utilizing the Pattern Development Matrix, this design set emphasizes the symbolic and atmospheric qualities of the morning sun. Sunbursts, floral details, and

window-like frames—motifs inspired by fretwork—form structured arrangements focused on symmetry, radiance, and clarity. In the primary design, a soft blue gradient background, accented with floral details, evokes the freshness of daylight as it fills interior spaces.

Secondary designs extend these ideas through rhythmic repetition and radial compositions, simulating the gradual spread of sunlight across surfaces. Mock-ups were developed for ceramic plates, umbrellas, cushions, and textiles, prioritizing sustainability by proposing recycled fabrics and mussel-shell-glazed ceramics as key materials. These choices reinforce the project's ecological focus and ensure cultural motifs are translated into practical, environmentally meaningful outcomes.

Figure 62 Set 3 : Yam Rung (Dawn) – Design and Mock-up

Source: Kanlayanee Phueaknamphol, 2024

4.1.1.4 Set Yam Rung – Design Set 4 (Mock-up)

With this design set, the Pattern Development Matrix helps explore how morning light casts elongated shadows through fretwork panels. Motifs drawn from eave forms are arranged in diagonal and modular rhythms, reflecting the oblique angle of dawn sunlight. In the primary design, gradients of blue, green, and white capture the cool, fresh atmosphere and the transition from night to day.

The secondary designs extend these principles by employing frieze sequences, diagonal gradients, and modular compositions, reinforcing the dynamic quality of sunrise. Sustainability is integrated through mock-ups across multiple applications, including a recycled-fabric scarf, mussel-shell-glazed ceramic plates, and lifestyle textiles such as sportswear. These examples show how cultural motifs, when combined with responsible material choices and rhythmic compositions, embody both the vitality and serenity of dawn.

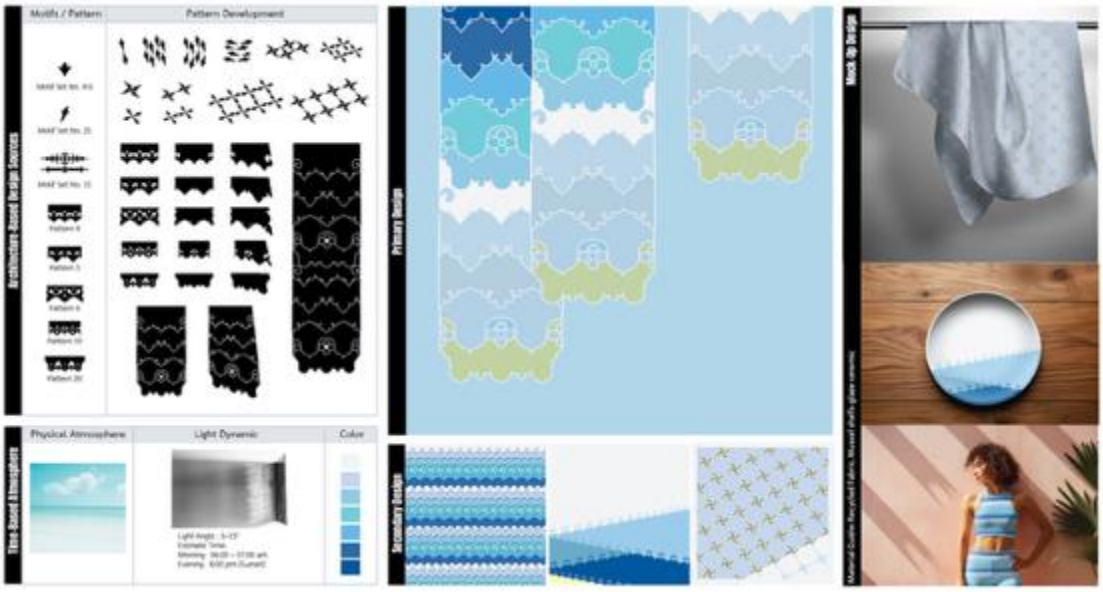

Figure 63 Set 4 : Yam Rung (Dawn) – Design and Mock-up

Source: Kanlayanee Phueaknamphol, 2024

4.1.1.5 Set Yam Rung – Design Set 5 (Mock-up)

For this design set, the Pattern Development Matrix focuses on Dawn's symbolic and emotional qualities. Colorful fretwork motifs—drawn from floral patterns, curved stems, and eaves—are reconfigured into modular arrangements that express vitality, openness, and rhythmic harmony.

The primary design incorporates these motifs into a gradient background that transitions from pale blue to warm pink, simulating the soft illumination of early morning skies. Birds and foliage were incorporated as symbolic accents, reinforcing associations with freedom, renewal, and natural abundance.

Secondary designs explored modular tiling, border arrangements, and layered compositions, demonstrating adaptability across textiles and lifestyle surfaces. Mock-ups, including recycled-fabric apparel, reinforce the sustainable dimension of the framework. Through this synthesis of cultural motifs, atmospheric color palettes, and eco-conscious material choices, the design set captures the optimism and energy of dawn, illustrating how heritage patterns can be transformed into vibrant, contemporary lifestyle products.

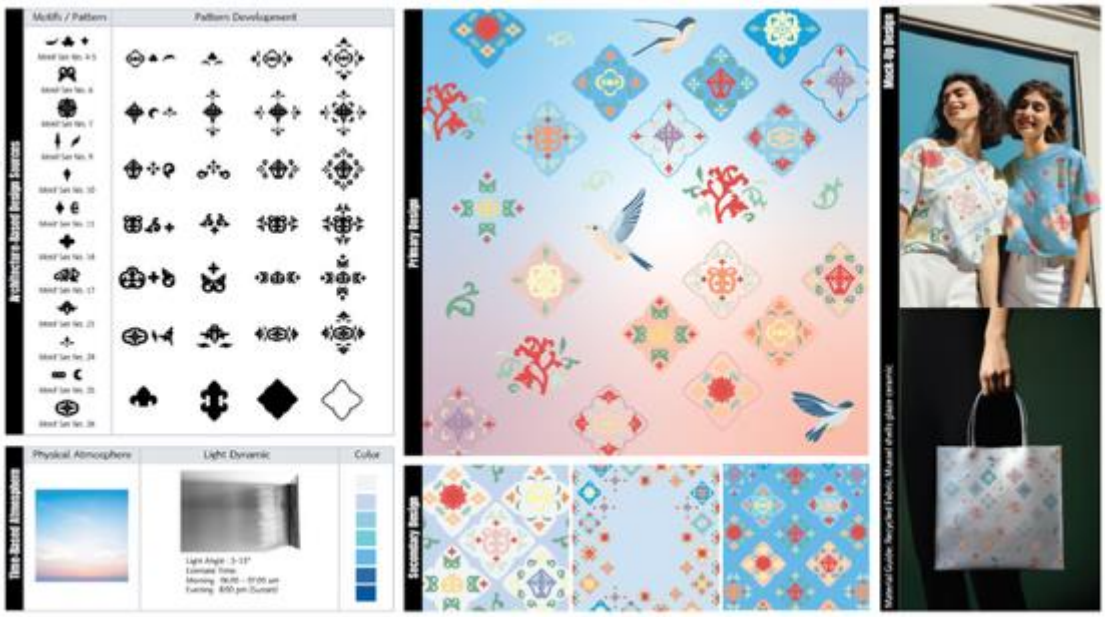

Figure 64 Set 5 : Yam Rung (Dawn) – Design and Mock-up

Source: Kanlayanee Phueaknamphol, 2024

4.1.1.6 Set Yam Rung – Design Set 6 (Prototype Development)

Building on previous mock-up explorations, one design (set 2) was chosen for prototype development to assess its viability with real materials and production methods. This phase moves beyond conceptual visualizations, directly evaluating how fretwork motifs translate into tangible modular products. The goal is to ensure alignment with the five dimensions of the Pattern Development Matrix.

The chosen design incorporated symmetrical floral and vine motifs adapted from Chanthaboon fretwork, assembled into modular units that emphasized openness and rhythmic balance. Translated into perforated structures, these motifs interacted with light and shadow to evoke the freshness and clarity of dawn. Unlike mock-ups, which used digital simulations and recycled samples, the prototype was physically

fabricated with eco-conscious materials to assess structural integrity, usability, and material expression.

The prototype was produced using recycled plastic sheets derived from melted HDPE bottle caps, chosen for their durability, light weight, and compatibility with CNC cutting. This use of upcycled materials is a deliberate sustainability measure, allowing intricate patterns to be precisely cut while ensuring the material remains stable and eco-friendly.

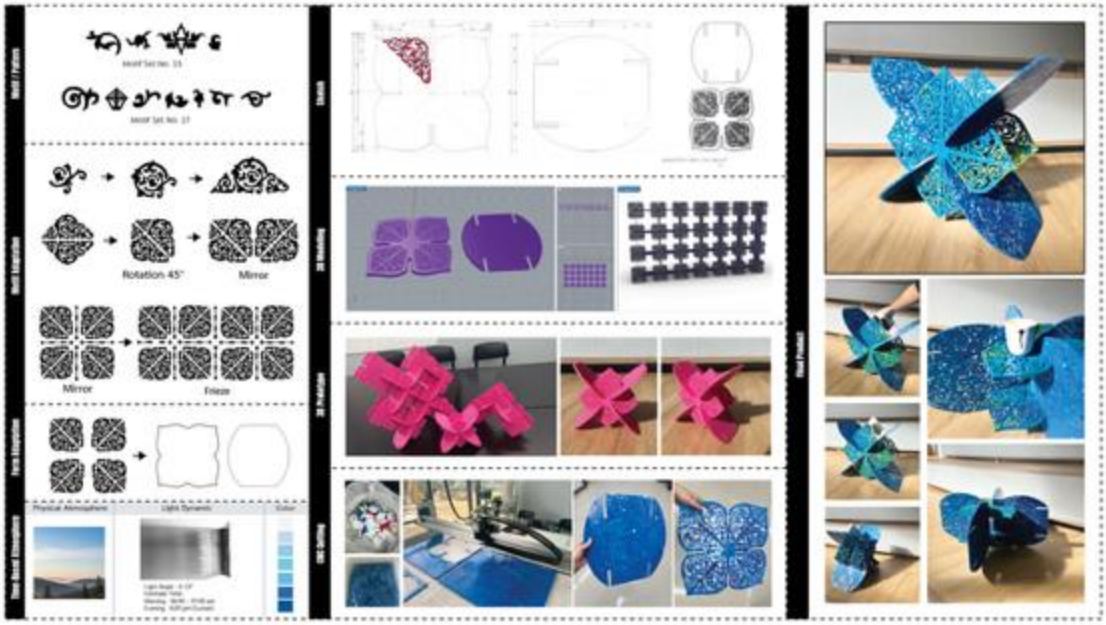

Figure 65 Set 6 : Yam Rung (Dawn) – Design and Prototype Development

Source: Kanlayanee Phueaknamphol, 2024

4.1.1.7 Set Yam Rung – Design Set 7 (Prototype Development)

This prototype facilitated mock-up explorations in ceramics, testing fretwork motifs through craft and sustainable glazing techniques. Using the Pattern

Development Matrix, floral clusters and geometric diamonds were scaled, mirrored, and arranged radially to create rhythmic perforated patterns. Designs applied to vessel forms highlight openness, balance, and light–shadow interplay found at dawn.

The production process followed three sustainable stages: forming clay bodies, carving fretwork-inspired perforations, and preparing a mussel-shell glaze. Crushed, locally sourced shells were processed into glaze, underscoring sustainable intent and direct ecological connection. The glaze partially filled the carved perforations, allowing light to filter through the motifs and heightening translucency and definition. Glaze tests confirmed a suitable surface texture and durability, ensuring both functional and aesthetic quality in the final results.

These prototypes for breakfast tableware comprise bowls, milk jugs, coffee cups, drip-brewing sets, and soft-boiled egg holders, each designed with perforated patterns that let light pass through, casting dynamic shadows. Crafted from locally sourced waste, these environmentally responsible pieces reflect both the project's visual and ecological aims. When illuminated, the vessels project clarity and freshness, evoking dawn's renewal and reinforcing the design's sustainable, community-focused mission.

Advancing traditional ceramics with contemporary gingerbread fretwork, this prototype demonstrates how cultural motifs can be transformed into functional products that reflect heritage and sustainable innovation. The outcomes validate the framework's ability to guide design from motifs to tangible, environmentally responsible prototypes resonating aesthetically, symbolically, and ecologically.

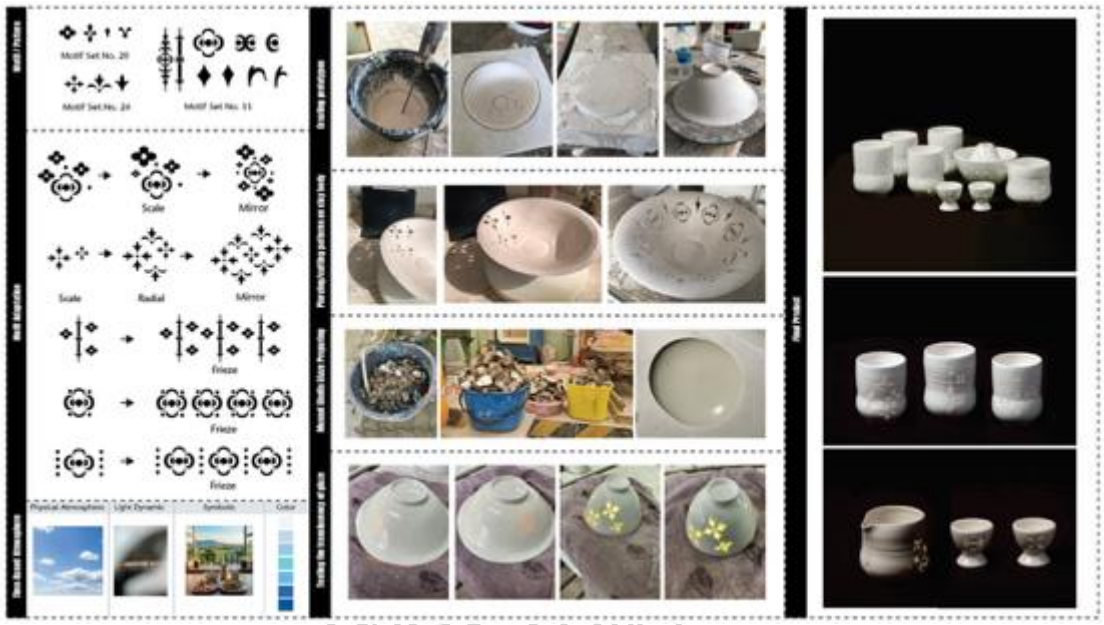

Figure 66 Set 7 : Yam Rung (Dawn) – Design and Prototype Development

Source: Kanlayanee Phueaknamphol, 2024

Across seven design sets, Yam Rung (Dawn) was articulated through gingerbread fretwork, atmospheric gradients, and the interplay of light and shadow. Each set emphasized distinct aspects of morning—clarity, freshness, vitality, radiance, and elongated diagonal shadows. Advancing from mock-ups to prototypes showed how heritage motifs can be reinterpreted using eco-friendly materials such as recycled fabrics, mussel-shell glazes, and recycled plastic sheets. These sustainable choices validate both cultural resonance and ecological responsibility. Collectively, these outcomes illustrate dawn as a symbol of renewal and optimism, bridging traditional craftsmanship with contemporary, sustainability-driven design.

4.1.2 Yam Kum (Dusk)

4.1.2.1 Set Yam Kum – Design Set 1 (Mock-up)

This design set applied the Pattern Development Matrix to interpret the contemplative and nostalgic atmosphere of dusk. Motifs derived from Chanthaboon fretwork were recomposed into modular patterns and combined with lilies, butterflies, and moths—symbols of transition, reflection, and closure. The palette of deep reds, warm oranges, and purples was selected to echo the intensity and warmth of twilight skies.

The primary design features layered motifs with floral accents set against dusk-inspired backgrounds, creating a rhythm, depth, and a sense of gradually fading light. Secondary designs extend this approach by experimenting with repetition, rotation, and layering, generating diverse textile and surface applications. Mock-ups feature recycled-fabric apparel, cushions, and mixed-material textiles, underscoring the project's commitment to sustainability.

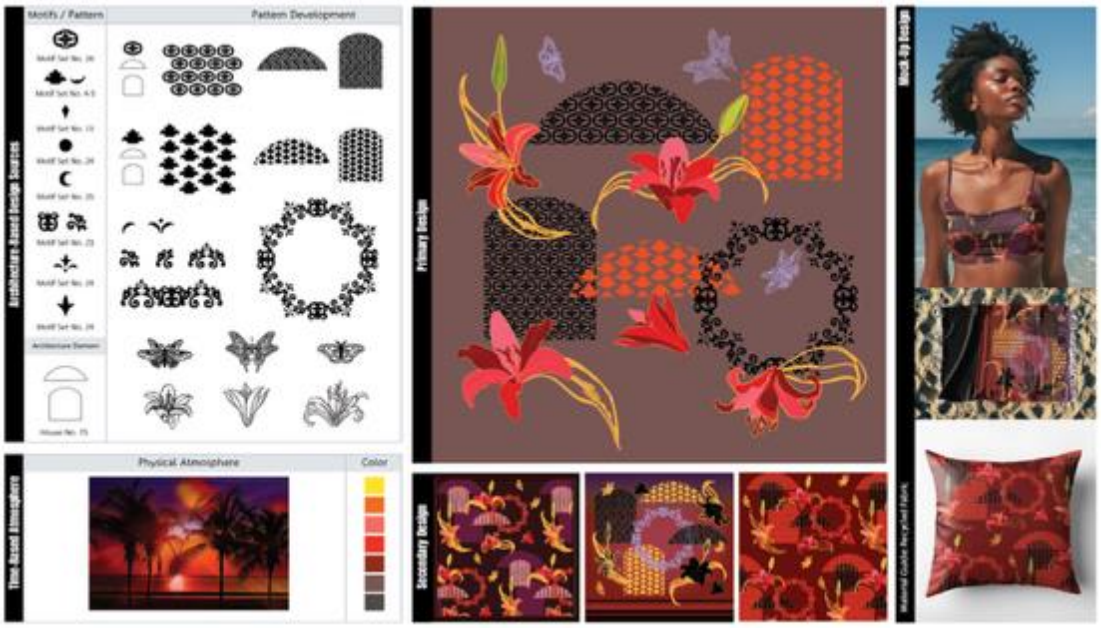

Figure 67 Set 1 : Yam Kum (Dawn) – Design and Mock-up

Source: Kanlayanee Phueaknamphol, 2024

4.1.2.2 Set Yam Kum – Design Set 2 (Mock-up)

This design set applied the Pattern Development Matrix to reinterpret fretwork motifs into rhythmic, modular arrangements that evoke the layered glow of twilight. The motifs were abstracted into geometric units—dots, lines, and crosses—and recomposed into structured grids, friezes, and diagonal sequences. These modular systems were paired with gradient palettes inspired by the sunset sky, shifting from deep reds and oranges to violets and blues, capturing the gradual transition from day to night.

The primary design features a large-scale composition where modular motifs overlay dusk-inspired gradients, simulating the fading interplay of light and shadow at twilight. Secondary designs expand this modular approach into dense dot grids, layered bands, and diagonal variations, demonstrating adaptability across surface

applications and reinforcing a sense of order and progression. Mock-ups include recycled-fabric tote bags, backpacks, and drawstring pouches, highlighting the potential for fretwork-inspired patterns to enrich contemporary fashion and accessories.

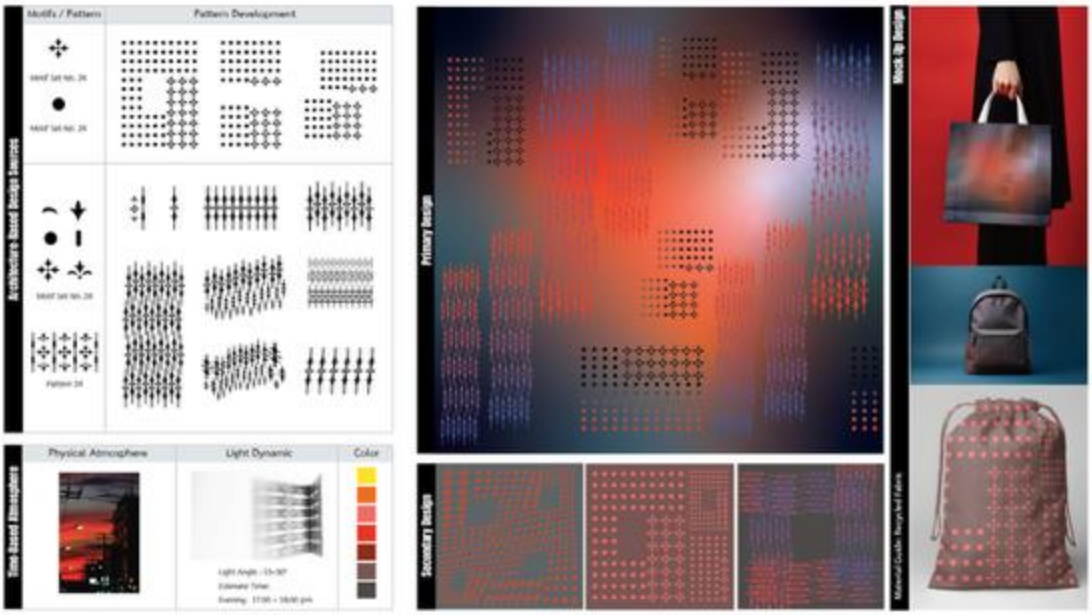

Figure 68 Set 2 : Yam Kum (Dawn) – Design and Mock-up

Source: Kanlayanee Phueaknamphol, 2024

4.1.2.3 Set Yam Kum – Design Set 3 (Mock-up)

This design set applied the Pattern Development Matrix to interpret the twilight atmosphere, when the sky shifts into deep crimson and burnt orange. Floral and cross-shaped fretwork motifs were reorganized into modular compositions through layering, rotation, and scaling, creating rhythmic patterns that reflect the gradual dimming of daylight and the intimate mood of dusk.

The primary design features overlapping floral clusters rendered in warm reds and golden linear tracery, radiating outward from a central gradient reminiscent of

the fading sun. This interplay of color and motif emphasizes both symmetry and atmospheric depth, evoking the contemplative transition from light to darkness.

Secondary designs expand on these strategies by employing frieze borders, grid repetitions, and delicate golden tracery. Dusk-inspired palettes of red, orange, purple, and dark grey were applied to reinforce the emotional qualities of warmth, nostalgia, and reflection. Mock-ups include recycled-fabric apparel, ceramic tableware with mussel-shell glaze, and lifestyle accessories, demonstrating the adaptability of the design system across material platforms.

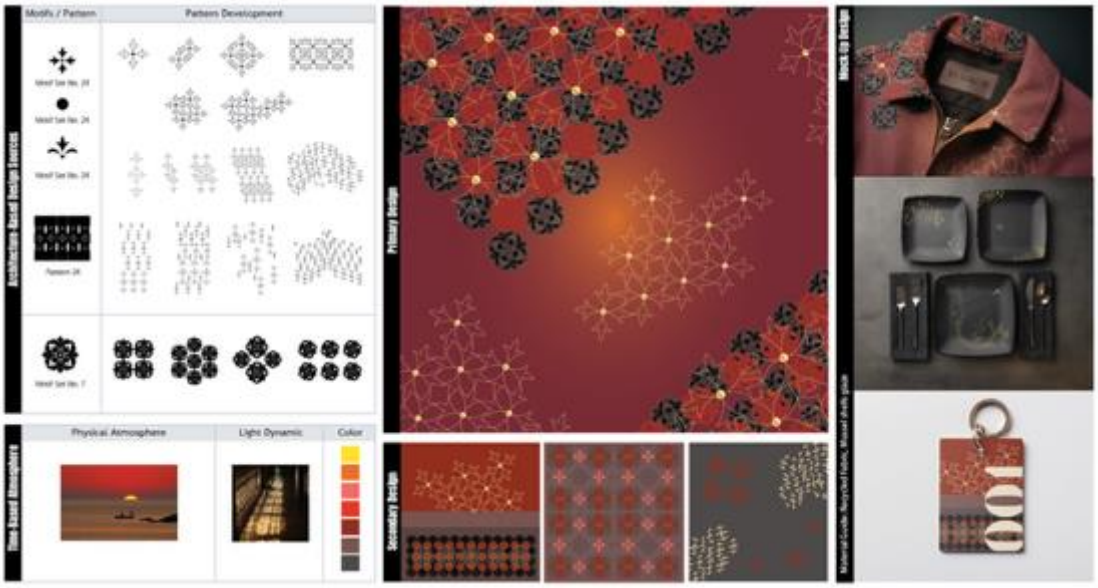

Figure 69 Set 3 : Yam Kum (Dawn) – Design and Mock-up

Source: Kanlayanee Phueaknamphol, 2024

4.1.2.4 Set Yam Kum – Design Set 4 (Mock-up)

This design set applied the Pattern Development Matrix to emphasize the symbolic and atmospheric qualities of the evening sun. Motifs derived from fretwork—particularly floral details, diamond forms, and ornamental curves—were

reorganized into symmetrical and modular compositions that highlight radiance, rhythm, and balance.

The primary design employs gradients of deep red, burnt orange, and dark brown, reflecting the intensity of twilight skies as daylight fades into night. Layered motifs in contrasting black and crimson create depth and visual resonance, suggesting both warmth and solemnity.

Secondary designs expand this approach through grid repetitions, circular tiling, and border sequences, reinforcing adaptability across textiles and surface applications. Mock-ups include recycled-fabric tote bags, coffee cup sleeves, and patterned textiles, demonstrating how fretwork-inspired motifs can be seamlessly translated into everyday lifestyle products.

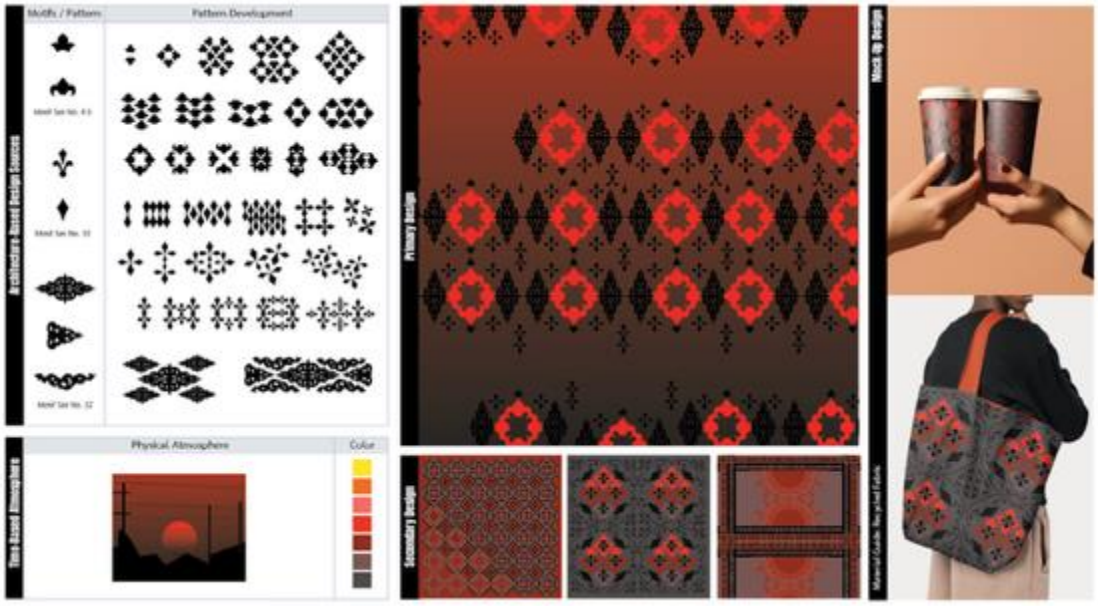

Figure 70 Set 4 : Yam Kum (Dawn) – Design and Mock-up

Source: Kanlayanee Phueaknamphol, 2024

4.1.2.5 Set Yam Kum – Design Set 5 (Mock-up)

This design set applied the Pattern Development Matrix to capture the twilight palette of purple and pink hues as the last traces of sunlight fade. Floral, vine, and geometric fretwork motifs were adapted through repetition, mirroring, and layering, producing rhythmic compositions that reflect the gradual transition from evening light to night.

The primary design situates these motifs against gradient backgrounds of violet, rose, and muted orange, simulating the dynamic interplay of light and shadow at dusk. The layering effect creates depth and visual movement, enhancing the atmospheric quality of twilight.

Secondary designs extend these principles into vertical alignments, radial clusters, and overlays, further exploring the richness of sunset tones. Mock-ups incorporate these motifs into home décor and textile products, including lampshades, curtains, and cushions, made from recycled fabrics. These outcomes reinforce the sustainable ethos of the framework while emphasizing the emotive resonance of light fading into darkness.

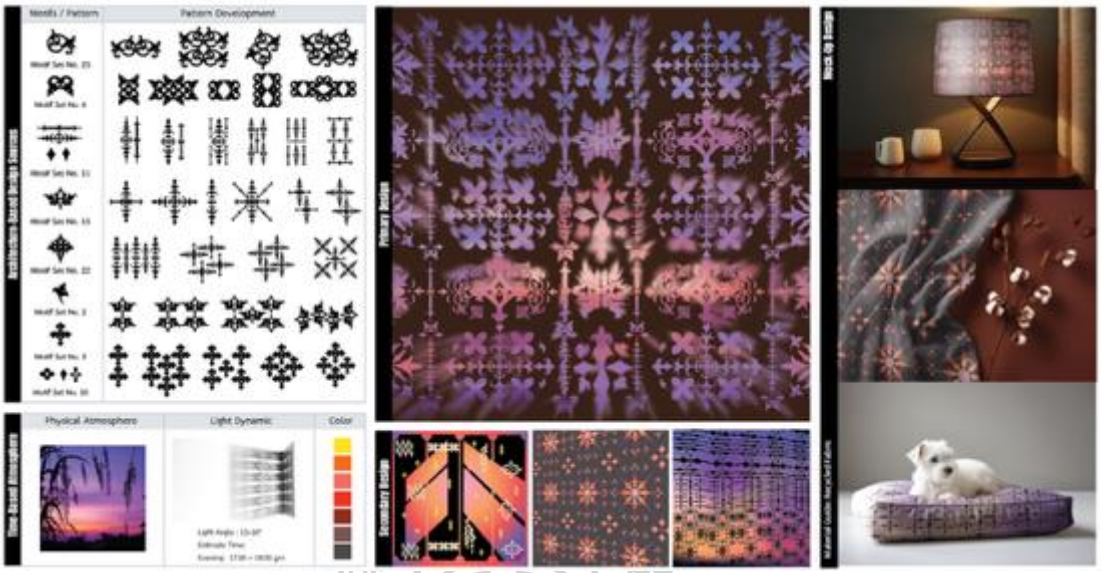

Figure 71 Set 5 : Yam Kum (Dawn) – Design and Mock-up

Source: Kanlayanee Phueaknamphol, 2024

4.1.2.6 Set Yam Kum – Design Set 6 (Prototype Development)

Guided by the Pattern Development Matrix, floral and linear motifs were adapted into frieze and radial compositions, arranged within an octagonal lamp form to emphasize rhythm, symmetry, and balanced shadow projection. The design process began with digital sketches and 3D modeling to refine proportions and pattern placement, followed by ceramic fabrication through slab construction, hand-carved perforations, and the assembly of structural elements.

An experimental mussel-shell glaze, made from locally sourced waste shells, was applied to reinforce sustainability and community connection. During glazing, selected perforations were partially filled with glaze to enhance translucency, allowing light to pass through with greater clarity and definition.

When illuminated, the lamp projects intricate shadows across its surroundings, simulating the layered ambience of dusk. The interplay of warm light with patterned

apertures evokes a sense of cultural nostalgia, recalling the experience of twilight in traditional houses where interior light escapes through fretwork to the outside world.

This prototype demonstrates how heritage-inspired motifs can be reinterpreted into contemporary design practice. By combining cultural symbolism, atmospheric qualities of light and shadow, and sustainable materials, the work validates the Matrix as both a generative and evaluative framework for design exploration.

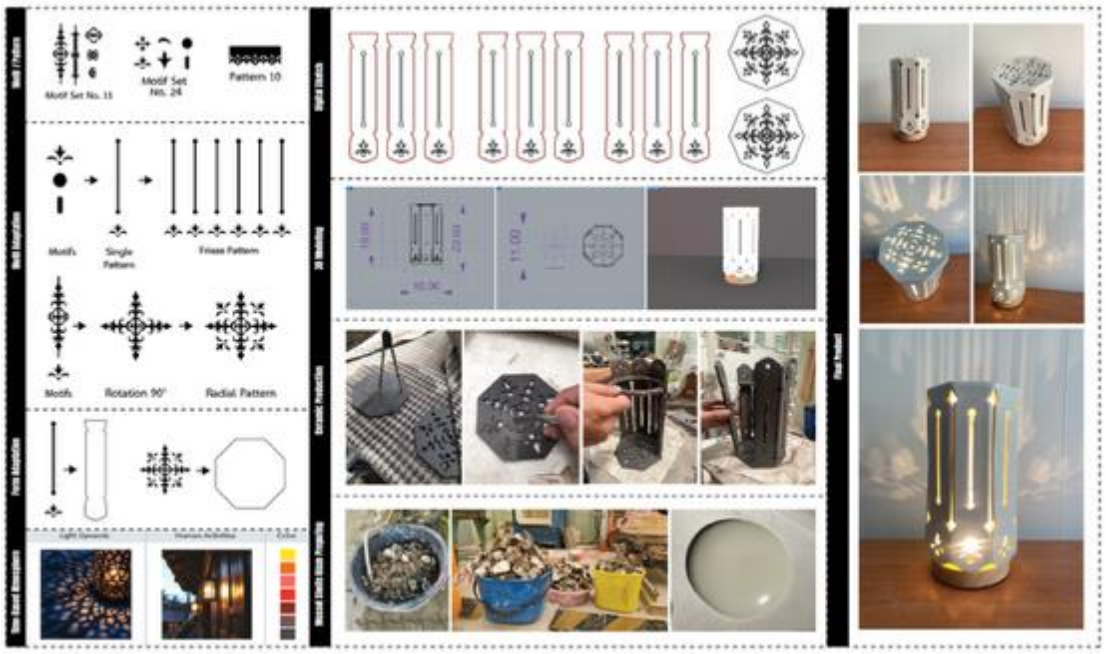

Figure 72 Set 6 : Yam Kum (Dawn) – Design and Prototype Development

Source: Kanlayanee Phueaknamphol, 2024

4.1.2.7 Set Yam Kum – Design Set 7 (Prototype Development)

This prototype explored the application of fretwork-inspired motifs onto recycled PET fabric. The pillowcases are designed to connect with the human activity of

sleeping at night. Guided by the Pattern Development Matrix, motifs drawn from Chanthaboon fretwork were reorganized into grid, frieze, and radial arrangements. These arrangements combine with twilight-inspired palettes of crimson, purple, and orange to evoke the warmth and intimacy of dusk.

The production process began with the development of digital patterns and 3D mock-ups. Sublimation printing followed, using recycled PET textile made from post-consumer water bottles. This material was chosen for its durability, vivid color rendering, and alignment with sustainability objectives. The printed fabrics were cut and sewn into pillowcases, allowing the patterns to be experienced in daily life.

Placed in the bedroom, the pillow prototypes evoke the quiet atmosphere of nightfall. At this time, people retreat to rest, and illumination softens. Cultural motifs, atmospheric palettes, and sustainable fabric reinforce both the symbolic and functional role of design. The result merges heritage aesthetics with daily life.

Through this prototype, the project demonstrates how the emotion of dusk can be incorporated into products that fit into ordinary routines. This ensures that cultural heritage continues to shape contemporary lifestyles, both in symbolic and practical ways.

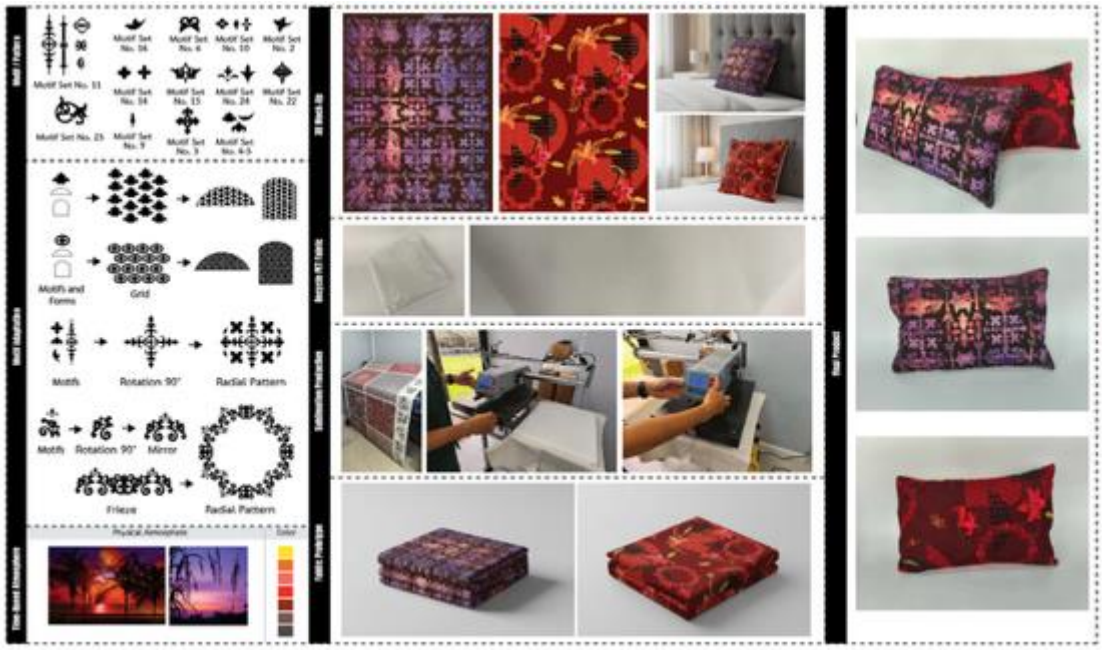

Figure 73 Set 7 : Yam Kum (Dawn) – Design and Prototype Development

Source: Kanlayanee Phueaknamphol, 2024

The Yam Kum (Dusk) series applied the Pattern Development Matrix across seven design sets, ranging from mock-ups to prototypes, to explore how fretwork motifs can embody the atmosphere of twilight. Mock-up designs translated motifs into textiles, fashion, accessories, and surface applications using dusk-inspired palettes of deep red, orange, purple, and pink, emphasizing transition, reflection, and cultural resonance. Prototype developments extended these concepts into tangible objects: a ceramic lamp projecting perforated shadows reminiscent of traditional houses at night, and recycled PET pillowcases linking cultural motifs to the human activity of resting. Together, these outcomes integrate cultural authenticity, atmospheric qualities of dusk, and sustainable material practices, demonstrating the adaptability of fretwork heritage in contemporary design.

4.2 Evaluation of Design Outcomes

The fourteen design sets—seven Yam Rung (Dawn) and seven Yam Kum (Dusk)—were evaluated to confirm alignment with research objectives. A rubric-based framework assessed quantitative and qualitative outcomes, addressing Research Objective 3: developing contemporary designs grounded in the Pattern Development Matrix, which integrates cultural integrity, formal harmony, adaptability, semantic–emotive relevance, and sustainability/technical feasibility.

The evaluation involved five potential users representing general consumers of lifestyle and home-related products, together with two design experts specializing in product and surface design. All fourteen design sets were presented through mock-ups, prototypes, and digital visualizations, and assessed using a rubric-based 5-point Likert scale (1 = very low, 5 = very high). In addition to quantitative scoring, participants provided open-ended qualitative feedback to identify strengths, weaknesses, and suggestions for improvement.

The rubric comprised five key criteria, each directly linked to the research framework:

Criterion	Description	Likert Scale (1–5)
Cultural Integrity	Degree to which fretwork motifs are authentically adapted and maintain symbolic meanings (e.g., floral = prosperity, vine = continuity), while still fitting contemporary contexts.	1 = Very low cultural relevance 2 = Weak preservation of meaning 3 = Moderate adaptation, partial authenticity 4 = Strong cultural reflection 5 = Excellent authenticity with meaningful adaptation
Formal Harmony	Visual balance, proportion, rhythm, and compositional clarity of the design, ensuring aesthetic coherence between motifs, structure, and overall form.	1 = Very poor harmony 2 = Weak balance 3 = Moderate but inconsistent harmony 4 = Strong formal coherence 5 = Excellent harmony and rhythm
Variation & Adaptability	Flexibility of motifs across different applications (ceramics, textiles, recycled materials) and ability to adapt while retaining identity.	1 = Not adaptable 2 = Limited adaptability 3 = Moderate adaptability 4 = Highly adaptable 5 = Versatile and scalable
Semantic & Emotive Relevance	Capacity of the design to evoke intended atmospheres (dawn freshness, dusk nostalgia), and communicate symbolic/emotional depth to users.	1 = No emotive impact 2 = Weak resonance 3 = Moderate emotional relevance 4 = Strong resonance 5 = Excellent symbolic and emotive expression
Sustainability & Technical Feasibility	Effective use of eco-materials (PET textiles, mussel-shell glaze, recycled plastic) and demonstration of technical feasibility in design production.	1 = No sustainability / infeasible 2 = Weak sustainable focus 3 = Moderate use of sustainable methods 4 = Strong sustainable integration 5 = Excellent eco-practice and feasibility

Table 12 Rubric for Evaluation of Design Outcomes (Pattern Development Matrix 5 Criteria)

Some sets were selected for community-based evaluation. In particular, Yam Rung – Set 6 was tested in real use with he community enterprise group "Transforming Waste into Value, Save the Sea, Charm of Ban Amphoe" in Chonburi Province. The exhibition took place at the Ban Suan Municipal Public Hall in Chonburi City on June 10, 2025, as part of the Marine Waste Management exhibition.

Figure 74 The work was displayed and tested at the Marine Waste Management exhibition at Ban Suan Municipal Public Hall in Chonburi City.

Design Set	Cultural Integrity	Formal Harmony	Variation & Adaptability	Semantic & Emotive Relevance	Sustainability & Technical Feasibility	Overall (Mean)	SD (±)
Yam Rung 1 (Mock-up)	4.5	4.4	3.8	4.6	4.0	4.26	±0.30
Yam Rung 2 (Mock-up)	4.3	4.1	4.0	4.2	4.1	4.14	±0.12
Yam Rung 3 (Mock-up)	4.6	4.4	4.0	4.5	4.2	4.34	±0.22
Yam Rung 4 (Mock-up)	4.2	4.0	3.9	4.3	4.1	4.10	±0.15
Yam Rung 5 (Mock-up)	4.4	4.2	3.8	4.5	4.0	4.18	±0.27
Yam Rung 6 (Prototype: Recycled Plastic Modular)	4.7	4.6	4.5	4.6	4.8	4.64	±0.11
Yam Rung 7 (Prototype: Ceramic Breakfast Set)	4.8	4.5	4.4	4.6	4.7	4.60	±0.14
Yam Kum 1 (Mock-up)	4.5	4.3	3.9	4.6	4.1	4.28	±0.25
Yam Kum 2 (Mock-up)	4.3	4.2	4.1	4.4	4.0	4.20	±0.15
Yam Kum 3 (Mock-up)	4.6	4.4	4.0	4.6	4.2	4.36	±0.22
Yam Kum 4 (Mock-up)	4.4	4.3	3.9	4.5	4.1	4.24	±0.21
Yam Kum 5 (Mock-up)	4.5	4.4	3.8	4.7	4.0	4.28	±0.30
Yam Kum 6 (Prototype: Ceramic Lamp)	4.8	4.7	4.7	4.8	4.8	4.72	±0.12
Yam Kum 7 (Prototype: PET Pillowcases)	4.6	4.4	4.4	4.5	4.5	4.50	±0.15

Table 13 Evaluation Results of 14 Design Sets

Across all fourteen design sets, overall evaluation scores ranged from 4.10 to 4.72, with standard deviations ranging from ±0.11 to ±0.30. The prototypes (Sets 6–7 in both Yam Rung and Yam Kum) consistently achieved higher overall ratings (>4.5) with lower deviations, indicating greater stability and quality across all five criteria. By

contrast, the mock-ups averaged 4.1–4.3 with slightly higher variability, reflecting strong conceptual direction but uneven performance, particularly in adaptability and technical feasibility. Specifically, mock-ups showed inconsistent results when scaled or translated to different materials, and some failed to meet technical requirements. When analyzed by dimension, Cultural Integrity (avg. 4.50) and Semantic–Emotive Relevance (avg. 4.52) emerged as clear strengths, while Variation & Adaptability (avg. 3.9) was the weakest dimension, highlighting the need for refinement in both scaling and multi-material applications, as multiple mock-ups demonstrated challenges in these areas.

Building on these findings, prototypes (Sets 6–7 of Yam Rung and Yam Kum) consistently scored high, with overall averages above 4.5 and low deviations (e.g., Yam Kum 6, Ceramic Lamp: 4.72 ± 0.12), demonstrating both aesthetic resonance and technical feasibility. In comparison, mock-ups generally performed well in Cultural Integrity and Emotive Expression, but were less effective and showed variability in functional adaptability, with scores often below 4.0. For example, Yam Rung 1 (Mock-up: Dawn curtain design) was praised for its symbolic freshness (Cultural: 4.5, Emotive: 4.6), but scored lower in adaptability (3.8), indicating challenges in translating conceptual strengths into practical applications.

Further distinguishing the series, Yam Rung (Dawn) emphasized freshness and clarity, strongly linking Cultural Integrity with Semantic–Emotive qualities (e.g., Yam Rung 3 scored 4.6 in Cultural Integrity and 4.5 in Emotive Relevance). In contrast, the Yam Kum series (Dusk) conveyed nostalgia and atmospheric depth, with particularly strong emotive resonance (e.g., Yam Kum 5 scored 4.7 in Emotive Relevance), though some sets reflected lower functionality.

The five dimensions of the Pattern Development Matrix can be mapped onto three broader evaluation domains. Cultural Integrity and semantic–emotive relevance together reflect cultural value, as they ensure that symbolic meanings are preserved while also evoking atmosphere and emotional resonance. Formal Harmony

corresponds directly to Aesthetics, emphasizing balance, rhythm, and compositional clarity in design. Variation & Adaptability, as well as Sustainability & Technical Feasibility, primarily address Functionality, as they evaluate usability, scalability, material feasibility, and ecological responsibility. This alignment demonstrates how the Matrix bridges detailed cultural and design considerations with conventional evaluation categories.

4.3 Feedback and Refinements

The design development of both the Yam Rung (Dawn) and Yam Kum (Dusk) series moved past conceptual mock-ups. This next stage focused on gathering feedback and refining the designs. The primary objective was to assess the effectiveness of reimagining Thai gingerbread fretwork motifs for contemporary contexts. The process also prioritized cultural authenticity, functional feasibility, and emotive resonance.

Feedback was collected from five potential users and two design experts. Their insights spanned functionality, aesthetics, and cultural value. Functionally, participants praised the lamps' and curtains' light–shadow effects. However, they identified technical issues. Acrylic sheets produced precise motifs but failed to diffuse light. Recycled fabrics were valued for their sustainability but needed adjustments in translucency to achieve clearer shadow projection.

For aesthetics, evaluators appreciated the blend of traditional fret work motifs and modern design principles. They highlighted features like modularity and repetition. The Yam Rung series conveyed freshness and optimism through blue and yellow gradients. The Yam Kum series used red, orange, and purple to evoke warmth, intimacy, and nostalgia. Some motifs, however, were considered too intricate. Suggestions included simplifying these while keeping their cultural identity.

Culturally, participants agreed that the new fretwork patterns reflected Thai heritage. Symbolic elements, such as flowers, vines, and shields, were seen as meaningful. These motifs carried the most emotive power when combined with the atmospheres of dawn and dusk. This feedback reinforced the need to align symbolic expression, atmosphere, and technical feasibility.

Based on these findings, three refinements were prioritized:

1. Pattern simplification – making motifs easier to manufacture.

2. Material adaptation – enhancing translucency and shadow effects in recycled and ceramic materials.

3. Cultural-emotive alignment – linking motifs more closely with the sensory effects of light and shadow.

In conclusion, the feedback showed that successfully reinterpreting Thai gingerbread fretwork demands a careful balance. Designers must weigh heritage preservation, innovation, and usability. The identified refinements enhanced the feasibility and sustainability of the prototype. These improvements also validated the Pattern Development Matrix as a useful tool for iterative design.

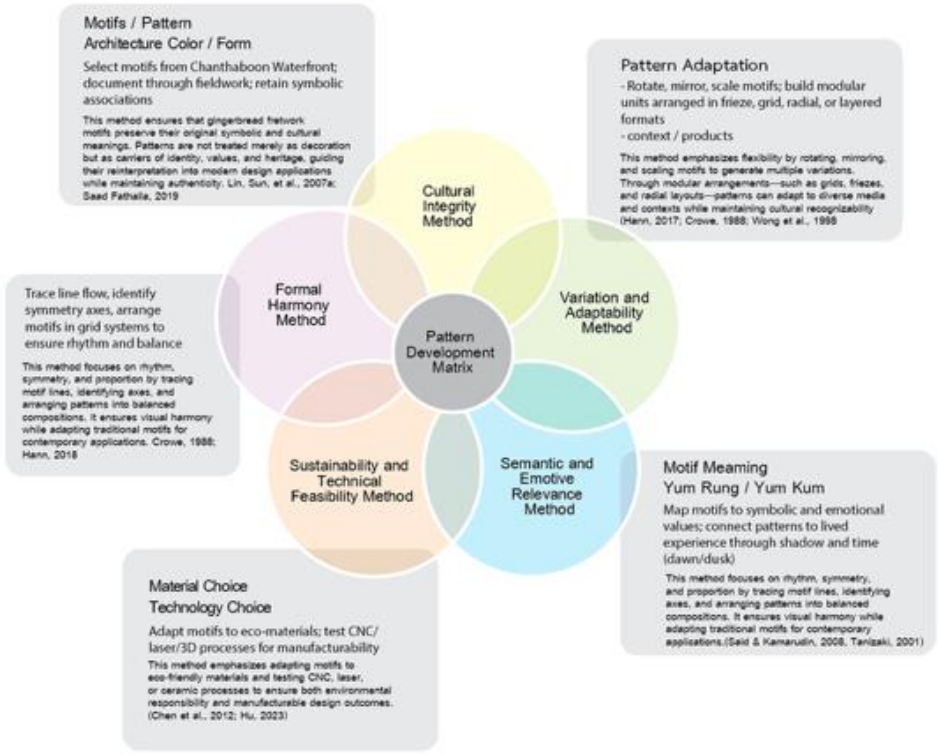

Figure 75 Diagram of the Pattern Development Matrix

Source: Kanlayanee Phueaknamphol, 2024

This synthesis provided a coherent framework that directly informed material experiments and the development of prototypes. The framework was tested through design applications, including ceramic lamps, acrylic fretwork lamps, and modular panels made from recycled plastic, demonstrating how cultural heritage can be preserved and revitalized through systematic reinterpretation. This stage bridged the methodological framework with practical experimentation, laying the foundation for the design outcomes presented in **Chapter 4.**

CHAPTER 5 CONCLUSION

5.1.1 Response to Objective 1

To systematically analyze and document Thai gingerbread fretwork motifs, highlighting their diversity of forms, techniques, and symbolic meanings.

The documentation and analysis of Thai gingerbread fretwork patterns revealed their dual role as both decorative and functional elements in vernacular architecture from the late nineteenth to early twentieth centuries. Patterns were recorded through fieldwork in the Chanthaboon Waterfront Community. Here, motifs were photographed, traced into vector forms, and grouped for comparative study.

The analysis identified a wide variety of motifs reflecting both natural and cultural inspirations. Floral and vegetal motifs—including lotus, vines, and coiled stems (*Kan Khod*)—emerged as dominant themes. These symbolized fertility, abundance, and continuity. Geometric motifs, such as diamonds, crosses, and lattices, conveyed a sense of order and balance. Emblematic motifs, such as shields, suns, and swans, represented protection, vitality, and unity. The Fleur-de-Lis motif, introduced through Western influence, was particularly prominent in Chanthaboon fretwork and signified purity, prosperity, and power.

Most patterns showed a strong emphasis on symmetry and formal harmony, with balanced compositions radiating from central motifs. This structural order enhanced their visual appeal and reflected broader Thai cultural values of balance, rhythm, and proportion. The patterns also embodied a hybrid aesthetic, blending Thai craftsmanship with Western Gothic and Victorian influences. This hybridity positioned gingerbread fretwork as a marker of both modernity and cultural adaptation during Siam's period of increased international contact.

Regionally, differences in style were also evident. Northern fretwork blended Lanna and Chinese floral symbolism. Southern designs drew from Islamic geometry. Chanthaboon patterns, by contrast, were marked by their simplified botanical motifs and emblematic symbols. They reflected the identity of a merchant community shaped by cultural exchange and economic prosperity.

Beyond aesthetics, gingerbread fretwork also served practical purposes in Thailand's tropical climate. The perforated panels facilitated natural ventilation and filtered sunlight. They cast intricate shadow patterns that animated architectural façades throughout the day. This functional dimension reinforced the cultural resonance of fretwork as both a craft tradition and an environmental adaptation.

In sum, Thai gingerbread fretwork patterns represent a convergence of artistry, symbolism, and utility. They embody cultural memory, social aspiration, and technical ingenuity. These patterns also demonstrate how local artisans adapted foreign influences to create a distinctly Thai expression of architectural ornament.

5.1.2 Response to Objective 2

To identify and emphasize the unique characteristics and cultural significance of gingerbread fretwork from the Chanthaboon Waterfront Community as a representative case study.

The Chanthaboon Waterfront Community in Chanthaburi Province presents a distinctive expression of gingerbread fretwork, which reflects its role as a multicultural trading hub during the late nineteenth and early twentieth centuries. Unlike fretwork in other regions, Chanthaburi's patterns uniquely blend traditional Thai craftsmanship with influences from China, Vietnam, and France. This distinct

hybridity makes Chanthaboon fretwork a compelling case for studying the interactions among cultural exchange, architecture, and identity.

Field documentation revealed that Chanthaboon fretwork is characterized by simplified botanical motifs, such as leaves, flowers, and coiled stems (kan khot). These motifs contrast with the highly elaborate, Victorian-inspired designs of Bangkok or Phrae, which tend to favor ornate complexity and historical Western influences. In Chanthaboon, motifs emphasize clarity and balance, often arranged in symmetrical compositions that highlight rhythm and order. Unlike in Northern regions, where symbolic carvings such as zodiac animals predominate, or in Southern regions, where Islamic geometry is prevalent, Chanthaboon's motifs focus on natural and ornamental forms with understated elegance.

Another defining feature lies in the strategic placement of fretwork within the built environment. Due to the community's narrow streets and closely aligned houses, fretwork was concentrated on areas most visible to passersby—such as eaves, doorways, and above windows—rather than on gables, which were less noticeable. This practice showcases the community's commitment to maximizing aesthetic impact and visual presence in prominent architectural settings.

The patterns also reveal cultural blending in both motif and form. Chinese influences are evident in certain floral arrangements and symbolic patterns, while the Fleur-de-Lis, introduced through French colonial and Western Victorian design, was adapted into local fretwork as a symbol of prosperity and refinement. These influences were not directly copied but reinterpreted through the skills of local artisans, resulting in a style that is recognizably local while still reflecting international exchanges.

Collectively, the gingerbread fretwork of the Chanthaboon Waterfront Community reflects a unique synthesis of aesthetic restraint, cultural hybridity, and environmental adaptation. Its simplified botanical focus, strategic architectural placement, and blended cultural references distinguish it from fretwork traditions in

other parts of Thailand. By identifying these unique characteristics, this research lays the groundwork for reinterpreting Chanthaboon motifs in contemporary design applications, while preserving their cultural authenticity and resonance.

5.1.3 Response to Objective 3

To develop contemporary design applications by transforming fretwork motifs into adaptable patterns that integrate functionality, aesthetics, and cultural value.

The third research objective was achieved through the creation of contemporary design applications that reinterpret Thai gingerbread fretwork motifs for modern creative settings. Instead of mass production or an expansive product range, the study focused on select application textiles and ceramics—as demonstrative prototypes that illustrate how traditional motifs can be reimagined.

Motifs documented from the Chanthaboon Waterfront Community were transformed into modular patterns. These patterns emphasized symmetry, rhythm, and balance for cultural recognizability. They were applied in two key directions:

Textiles: Motifs were adapted into mock-ups, including curtains, scarves, and accessories, through digital printing and laser-cut simulations. Their perforated or translucent qualities highlighted the interplay of light and shadow, echoing the atmospheric role of fretwork in architecture.

Ceramics: Motifs were incorporated into tableware and lamps, where perforated surfaces cast shadows inspired by dawn and dusk. Experimental glazes using mussel shells reinforced the project's commitment to sustainability and material innovation.

These applications were created as conceptual prototypes. They were intended to demonstrate the potential of fretwork motifs as a dynamic design language. By

placing motifs in textiles and ceramics, the research highlighted their adaptability and relevance. This approach bridged heritage preservation, usability, and contemporary aesthetics.

5.2 Discussion

The findings of this research reaffirm the potential of Thai gingerbread fretwork as a cultural and design resource that bridges heritage and contemporary practice. Unlike previous studies that primarily emphasized descriptive or preservation aspects (Kuamsub, 2017b), this study proposed a systematic Pattern Development Matrix to guide the transformation of fretwork motifs into adaptable design languages. Motifs documented from the Chanthaboon Waterfront Community were analyzed and reorganized into modular, geometric, and symbolic structures, illustrating how traditional forms can be adapted for modern applications. In doing so, the research extends prior scholarship on pattern design as both ornament and cultural language (Crowe, 1988; Hann, 2018).

This transformation was systematically guided by the Pattern Development Matrix (see Chapter 3). It linked motifs to principles of cultural integrity, formal harmony, variation and adaptability, semantic-emotive relevance, and sustainability. The matrix provided a structured tool for mapping motifs—such as floral, vine, and geometric forms—to specific design strategies and applications. This ensured that reinterpretations remained both culturally authentic and technically feasible.

A key contribution of this study is the preservation of cultural integrity, ensuring that symbolic meanings are maintained in reinterpretation. For example, motifs such as floral patterns (representing fertility), swans (symbolizing unity), and shields (signifying protection) were retained to support cultural resonance. This demonstrates continuity with earlier research on Southeast Asian woodcarving and textiles, which

shows that such patterns express collective identity and spiritual values (Kunkhet & Chudasri, 2022; Said & Kamarudin, 2008). Additionally, this study highlights the importance of formal harmony—through rhythm, symmetry, and proportion—reaffirming established design theories that position order and balance as universal principles of ornament (Chen et al., 2012; Hann, 2018).

The exploration of semantic and emotive relevance further contributes to design knowledge. Observations revealed that fretwork motifs gain atmospheric significance when interacting with light and shadow, especially at dawn and dusk. This resonates with Tanizaki's (Tanizaki, 1933/2001) reflections in In Praise of Shadows, where shifting light creates aesthetic depth and cultural significance. Similarly, studies on Islamic and Malay woodcarving patterns highlight how perforated designs mediate space through shadow, atmosphere, and symbolism (Said & Kamarudin, 2008). By translating these qualities into mock-ups—such as recycled-fabric curtains and ceramic lamps, the study demonstrated how emotional resonance can be embedded in contemporary design through atmospheric storytelling.

The research also advances the discourse on sustainability and material innovation. By experimenting with mussel-shell glazes as substitutes for limestone-derived calcium oxide, the study aligned with broader movements in sustainable ceramics and resource efficiency (Chen et al., 2012). Recycled fabrics and plastic sheets were also explored as alternatives, reflecting global trends in design for circular economies (Hu, 2023). These material trials confirmed that cultural motifs can be revitalized in ways that balance heritage preservation with ecological responsibility. However, limitations were also identified: acrylic provided precision but failed to diffuse light effectively, recycled fabrics required refinements in translucency, and perforated ceramics demanded careful adjustments to maintain structural integrity. These findings align with challenges noted in other studies, where traditional patterns were integrated into fragile or modern materials (Silah et al., 2013).

Overall, the discussion highlights a recurring tension between cultural preservation and design innovation. Simplifying motifs for functionality without losing their symbolic depth proved to be a delicate process, consistent with previous research that stresses cultural sensitivity in design adaptation (Lin, Sun, et al., 2007a). At the same time, iterative prototyping and user feedback underscored the importance of balancing aesthetics with usability, echoing findings in pattern design research across craft and product contexts (Crowe, 1988; Hann, 2018).

Importantly, the Pattern Development Matrix (Chapter 3) served as the operational framework for this study. It connected analytical insights with design outcomes. By aligning motifs with reinterpretation principles and potential applications, the matrix ensured that the textile and ceramic mock-ups were developed through a consistent and replicable methodology.

In summary, this research demonstrates that Thai gingerbread fretwork can be repositioned as a living design language. This is possible when approached through a structured development framework. The successful adaptation of motifs into textiles and ceramics shows how cultural authenticity, atmospheric experience, and sustainable practices can intersect to inform contemporary creative fields. These findings not only contribute to heritage studies but also provide a methodological model. The model helps reinterpret intangible cultural heritage into design practices that resonate with modern lifestyles.

5.2.1 Pattern Development Matrix

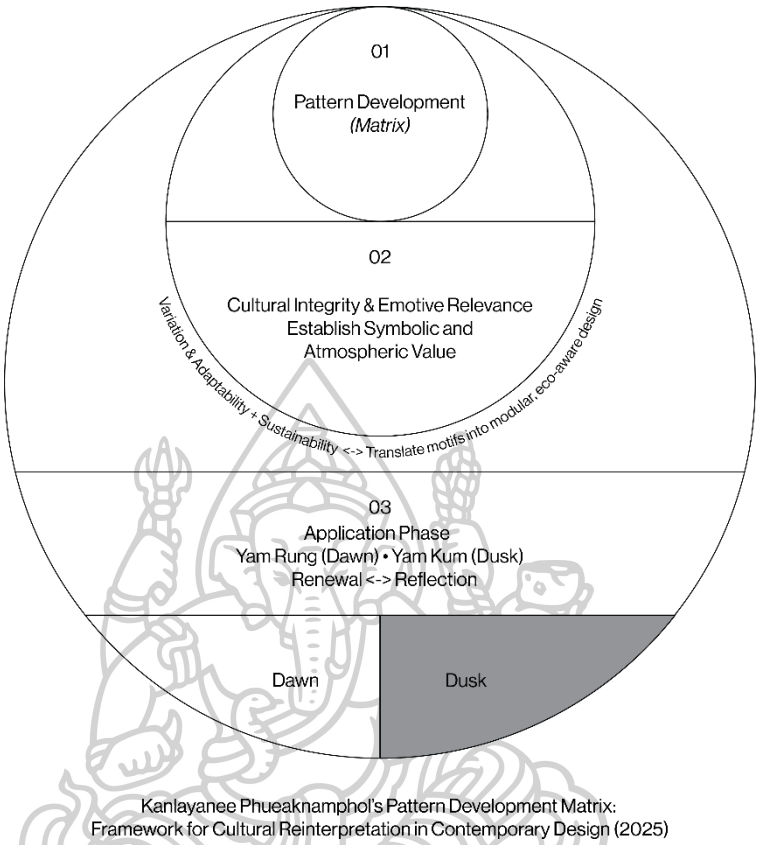

Figure 76 Kanlayanee Phueaknamphol's Pattern Development Matrix: Framework for Cultural Reinterpretation in Contemporary Design

Following from the discussion, The Pattern Development Matrix represents my framework for transforming Thai gingerbread fretwork patterns into contemporary design applications. I developed this model to bridge traditional craftsmanship and modern design thinking through a structured yet reflective process that values both cultural depth and aesthetic innovation.

At the core, The Pattern Development (Matrix) establishes the conceptual foundation for my design process. It serves as a methodological guide for analyzing Thai fretwork motifs, identifying their symbolic meanings, and reinterpreting them in new creative contexts.

The second layer, Cultural Integrity and Emotive Relevance, expresses my intention to maintain authenticity and emotional connection within the reinterpretation process. Here, I focus on translating symbolic and spiritual qualities of traditional motifs into designs that evoke contemporary resonance while preserving their cultural essence.

Along the outer arc, I emphasize Variation, Adaptability, and Sustainability as guiding principles. These qualities allow the motifs to evolve across materials and scales, ensuring that each reinterpretation responds to environmental and technological concerns while remaining faithful to its origin.

The lower section, labelled Application Phase, demonstrates how the theoretical framework materialized in two design collections — Yam Rung (Dawn) and Yam Kum (Dusk). *Yam Rung* represents freshness, light, and renewal, while *Yam Kum* conveys reflection, depth, and atmosphere. Together, they symbolize the cyclical nature of Thai culture — the transition between light and darkness, day and night, renewal and introspection.

Through this model, I aim to illustrate how Thai cultural heritage can be revitalized within contemporary design practice. The Pattern Development Matrix not only guided my creative experimentation but also serves as a methodological contribution that others may apply to reinterpret cultural artefacts in modern contexts — balancing tradition, innovation, and sustainability.

5.3 Suggestions and Recommendations

5.3.1 Suggestions

Based on the findings, the study offers the following suggestions for applying Thai gingerbread fretwork motifs in contemporary design:

Designers should integrate fretwork-inspired motifs into selected products, particularly textiles and ceramics, where curtains, lamps, and tableware effectively highlight the light-shadow qualities central to fretwork aesthetics. (Semantic-Emotive Relevance)

Symbolic meanings and historical associations must be preserved during reinterpretation. Floral motifs, signifying abundance, and shields, representing protection, should continue to convey cultural value rather than being reduced to surface ornament. (Cultural Integrity)

Fretwork motifs should be developed into modular systems adaptable across scales, from household products to architectural panels, ensuring both design coherence and flexibility. (Variation & Adaptability)

The use of waste-based materials, such as mussel shells and recycled plastics, demonstrates how cultural heritage can be aligned with sustainability, adding both ecological and cultural value. (Sustainability & Technical Feasibility)

5.3.2 Recommendations

Building on the findings and limitations, the following directions are recommended for future research and development:

Apply digital technologies such as parametric modeling, symmetry analysis, and computational design to generate systematic variations of fretwork while maintaining structural harmony.

Explore sustainable and innovative materials, including bio-based composites, bamboo laminates, and recycled glass, alongside advanced fabrication methods such as 3D printing of ceramics or CNC milling of textiles, to enhance feasibility and broaden applications.

Conduct broader user testing with larger and more diverse demographic groups to evaluate aesthetic perception, cultural resonance, and functional usability across markets.

Foster collaborations with local artisans, design industries, and cultural institutions to translate fretwork-inspired patterns into viable products and exhibitions, sustaining intangible heritage while creating cultural and economic value for communities.

5.4 Research Contribution

This study makes a significant contribution to design, cultural heritage, and creative practice by identifying how Thai gingerbread fretwork motifs can be adapted for contemporary settings. The research expands existing scholarships by offering a systematic framework for design innovation and demonstrates that traditional motifs can be reinterpreted to suit modern creative practice.

Theoretical Contribution

The study advances design knowledge by introducing the Pattern Development Matrix, which integrates five dimensions: cultural integrity, formal harmony, variation and adaptability, semantic–emotive relevance, and sustainability. This framework shifts patterns from mere descriptions to dynamic cultural languages that can be systematically analyzed, generated, and evaluated. It offers a replicable model for linking traditional motifs with modern applications.

Methodological Contribution

The research combines field documentation, motif classification, and design reinterpretation into a coherent process. Motifs from the Chanthaboon Waterfront Community were systematically traced, categorized, and analyzed before being reconfigured using the Matrix. This approach bridges the gap between intangible cultural heritage and experimental practice, offering a transferable model for other craft traditions and regional studies.

Practical / Design Contribution

Practically, the study produced mock-ups and prototypes that illustrate how fretwork motifs can be integrated into products, striking a balance between aesthetic quality, functional usability, and cultural resonance. Applications in textiles (such as

curtains, scarves, and pillows) and ceramics (including lamps and tableware) demonstrate the feasibility of adapting heritage motifs through sustainable materials, such as mussel-shell glazes and recycled fabrics. These prototypes validate the operational value of the Pattern Development Matrix as a tool for guiding contemporary design practice.

Socio-Cultural Contribution

Socio-culturally, the research emphasizes the role of design in sustaining and revitalizing intangible cultural heritage. By grounding the study in the Chanthaboon Waterfront Community, it highlights how fretwork embodies local identity and cross-cultural exchange. Reinterpreting these motifs for contemporary contexts reinforces their symbolic and emotional value while offering pathways for the development of a creative economy and alignment with global sustainability agendas. In this sense, the study affirms that design operates not only as a vehicle for aesthetic innovation but also as a medium of cultural preservation and community empowerment.

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AWARD RECEIVED

Outstanding Invention Award for Fiscal Year 2025 (B.E. 2568), Excellent Level, from the National Research Council of Thailand (NRCT), for the project titled ‘Creative Ceramic Product Innovation from the Unique Characteristics of Mussel Shell Waste. (Co-Researcher)

Excellence Award, The 7th International Arts & Designs Collaborative Exhibition 2025 (IADCE2025), Burapha University, Thailand — Received in recognition of the artwork “Dawnlight”, which was selected for excellence during the international exhibition held from July 1–17, 2025.