

Development of Textile Pattern Design and Women's Clothing Design Using the Baekje Munyangjeon Icons and the CLO 3D Program

백제문양전 도상을 활용한 텍스타일 패턴디자인 및 여성복 디자인 개발 : CLO 3D 프로그램의 활용

An, Mihwa*

Department of Fashion & Textiles, Jeju National University*

Abstract

본 연구의 목적은 백제 문양전의 구성적 특성과 상징적 의미를 바탕으로 아르키메데스의 타일링 기법을 적용하여 개발한 텍스타일 패턴 디자인과 이를 삽입하여 개발한 여성복 디자인을 제작하여 제시함으로써, 전통문화원형으로서의 고유성과 우수한 전통적 가치는 물론 일상에서도 쉽게 접근할 수 있는 실용적 상품화에도 활용 가능한 소재임을 확인하는 것이었다.

연구방법으로는 문헌 및 선행연구를 토대로 백제 문양전의 개념과 아르키메데스의 타일링 기법에 관한 이론적인 고찰을 하였고, 백제 문양전의 실물과 사진을 중심으로 도상의 구성적 특성과 상징적 의미를 분석하였다. 그 결과를 바탕으로 연구 목적에 적합한 도상(연화문, 운문, 봉황문)을 발췌하였고, 그 도상에서 추출하여 양식화한 모티브를 아르키메데스 타일링 기법에 따라 정다각형에 배치한 후 다시 정다각형 도형을 추가로 삽입한 기본영역을 설정하였으며, 2024년 트렌드 컬러를 배색하여 재구성한 컬러리피트를 배열방식에 따라 수평이동하여 텍스타일 패턴 6종을 개발하였다.

개발한 6종의 텍스타일 패턴이 과연 실용적으로 활용이 가능한지를 확인하기 위한 도구로 여성복디자인 3점을 개발하였다. 6종의 텍스타일 패턴을 여성복디자인에 삽입한 결과물에 대한 선호도 조사를 실시하기 위해 CLO 3D 가상착의 프로그램을 활용하여 제시하였다. 조사결과, 선호도가 높게 나온 여성복 디자인을 실물 제작하여 제시하였고, 이에 대한 적합성 평가를 위해 패션 관련 전문인 및 대학원생 10인과의 일대일 심층면접조사를 실시하였다. 그 결과 백제 문양전의 전통문화원형으로서의 고유성과 우수한 전통적 가치 그리고 일상에서도 쉽게 접근할 수 있는 실용적인 상품화에도 활용 가능한 소재임을 확인할 수 있었다. 본 연구결과는 MZ세대에게 전통문화원형에 대한 긍정적인 관심과 흥미를 유발시킬 수 있으리라 사료된다.

주제어: 백제 문양전, CLO 3D, 텍스타일 패턴디자인, 여성복 디자인

I. Introduction

As the world enters the era of multiculturalism due to globalization, several countries have recognized the need to develop designs that integrate traditional and modern elements using distinct and traditional cultural archetypes. South Korea has also been making attempts to explore and discover traditional cultural archetypes

to create unique Korean designs with global values (Jang et al., 2014).

In this study, the Baekje Munyangjeon was selected as the traditional cultural archetype. This choice was made because patterns not only include simple graphics or designs but are composed of unique stylistic features that reflect the cultural, religious, and social symbolism of a particular era and region according to the distinct

* Corresponding author: An, Mihwa
Tel: +82-64-754-3530, Fax: +82-64-725-2591
E-mail: hwa8495@jejunu.ac.kr

order of the pattern. As such, pattern designs are valuable pieces of cultural heritage that express the traditional culture and identity of a nation (Moon, 2008). In particular, the eight types of Baekje Munyangjeon excavated from Oe-ri, Buyeo are highly regarded for their excellence among East Asian patterned tiles. The Munyangjeon contains patterns representing belief in divine beings(神仙思想) and Taoist philosophy(道家思想), as well as Buddhist symbolic patterns, making them vital materials for examining the ideas of the Baekje people during the Sabi Period (Lee, 2005; Moon, 2008). Therefore, the Baekje Munyangjeon was selected as the research subject for its distinct quality, excellent traditional values, and versatility as an authentic material.

Recent studies on the Baekje Munyangjeon have mainly focused on its production methods and periods, morphological characteristics, and design motif interpretations (Jo, 2006; Kim, 2002; Lee, 2005; Moon, 2008; Park, 2006; Park, 2008). Other studies have also utilized Baekje patterns, with topics ranging from the development of cultural fashion products using wadang (roofend tile) patterns (Jeong, 2011) and household items using tile and convex roofend tile patterns (Kim, 2010) to cultural fashion product designs based on the shapes of relics (Jeon, 2015). However, research remains limited on the development of modern textile patterns and designs for women's fashion using the Archimedean tiling technique based on motifs derived from the compositional characteristics and symbolic meanings of the Baekje Munyangjeon.

To clarify the distinct quality and excellent traditional values of the Baekje Munyangjeon as a traditional cultural archetype and its potential for modern use, this study aims to develop a textile pattern design by applying the Archimedean tiling technique to motifs derived from the compositional characteristics and symbolic meaning of the Baekje Munyangjeon. It seeks to then develop women's clothing designs incorporating this textile pattern.

II. Literature review

1. Concept and characteristics of Baekje Munyangjeon

The Baekje Munyangjeon are patterned bricks(埴) from the Baekje period and were excavated from an ancient temple site in Oe-ri, Gyuam-myeon, Buyeo-gun, Chungcheongnam-do. These bricks come in eight types. Among the patterned bricks, the Baekje Munyangjeon excavated from the archaeological site in Oe-ri, Buyeo is regarded as a good example of the excellence of Baekje culture and has received attention for its uniqueness and aesthetic value from the perspectives of art and architectural history. As the design motif depicted in the Munyangjeon is rich in content and refined in expression, it is regarded as one of the best works representing ancient Korean art (Lee, 2005).

Baekje Munyangjeon eight pieces that were in the best condition were designated as Treasure No. 343 and stored in the National Museum of Korea, while the other pieces are stored in the National Museum of Korea and the Buyeo National Museum (Lee, 2005; Moon, 2008).

The compositional characteristics of the Baekje Munyangjeon are as follows. First, according to the representative patterns, the bricks are classified as follows: Yeonhwamunjeon (蓮花文埴, brick with a lotus design), Yeonhwawaunmunjeon (蓮花渦雲文埴, brick with a lotus and cloud design), Ballyongmunjeon (蟠龍文埴, brick with a dragon in the design), Bonghwangmunjeon (鳳凰文埴, brick with a phoenix design), Sansusangyeongmunjeon (山水山景文埴, brick with a landscape design), Sansubonghwangmunjeon (山水鳳凰文埴, brick with a landscape and phoenix design), Yeonhwagwihyeongmunjeon (蓮花鬼形文埴, brick with a lotus and monster design), Sangyeonggwihyeongmunjeon (山景鬼形文埴, brick with a landscape and monster design), etc. (Lee, 2005; Park, 2008). Accordingly, representative design motifs can be broadly classified into lotus flower, bead, cloud, dragon, phoenix, landscape, and monster patterns.

Second, the Baekje Munyangjeon generally follows a square shape, measuring approximately 28 - 29.8 cm on each side and 4 cm thick. The four corners of a Munyangjeon piece were said to connect with other pieces in four directions and were used as wall decorations (Lee, 2005; Park, 2008).









Third, the composition of the Baekje Munyangjeon can be largely divided into circular and square layouts. The Yeonhwamunjeon, Yeonhwawaunmunjeon, Ballyongmunjeon, Bonghwangmunjeon all share a common design motif of having their icons expressed within a yeonjumun(連珠, circular bead-patterned frame). In addition, the continuity of the pattern is emphasized by how the flower patterns(花文) are arranged and connected at the four corners to form a cross-shaped flower pattern (Park, 2008). The design motifs of Sansusangyeongmunjeon, Sansubonghwangmunjeon, Yeonhwagwihyeongmunjeon,

and Sangyeonggwihyeongmunjeon depict icons filling the entire square frame. Moreover, the arrangement of the three-peak mountains at the bottom is made by connecting the two types of landscape and monster patterns to make it look like a single pattern. This is summarized in Table 1 below.

2. Symbolic meaning of the icons of Baekje munyangjeon

In this study, the composition and symbolic meaning of the Baekje Munyangjeon on display at the Buyeo National Museum were derived from the analysis of the actual samples and photographs. An examination of the icons on the Baekje Munyangjeon revealed that they consist of Taoist iconography, Buddhist symbolism, and symbols from folk religions. The symbols on the Munyangjeon are thought to represent not only the

〈Table 1〉 Characteristics of Baekje Munyangjeon

Classification	Prototype	Use	Screen composition	Representative icons
Yeonhwamunjeon		Byeokjeon (wall brick)	Circle	Yeonhwamun, Yeonjumun
Yeonhwawaunmunjeon				Yeonhwamun, Unmun, Yeonjumun
Ballyongmunjeon				Yongmun, Unmun, Yeonjumun
Bonghwangmunjeon				Bonghwangmun, Unmun, Yeonjumun
Sansusangyeongmunjeon			Square	Sansumun, Unmun
Sansubonghwangmunjeon				Sansumun, Bonghwangmun, Unmun
Yeonhwagwihyeongmunjeon				Gwihyeongmun, Yeonhwamun
Sangyeonggwihyeongmunjeon				Gwihyeongmun, Sansumun

photograph source : Buyeo national museum's collections, photographed by the author

gentle nature and temperament of the Baekje people but also their wish for longevity, well-being, and national prosperity, as presented in Taoist, Buddhist, and folk religious iconography (Hong, 2001). This study interprets the symbolic meaning of the Munyangjeon motifs from the perspective of Taoist, Buddhist, and folk beliefs.

Therefore, the study aims to examine the design motifs present in each Munyangjeon pattern. The representative design motifs of the Yeonhwamunjeon (brick with a lotus design) are the lotus flower and bead. The representative design motifs of the Yeonhwawaunmunjeon are the lotus flower, cloud, and bead. In the same arrangement as the Yeonhwamunjeon, an eight-petaled lotus flower is in full bloom at the center of the bead pattern, which is surrounded by eight clouds. The representative design motifs of Ballyongmunjeon are the dragon, cloud, and bead. It consists of an S-shaped dragon pattern inside the bead pattern surrounded by the cloud pattern. The representative design motifs of the Bonghwangmunjeon are the phoenix, cloud, and bead. Similar to the layout of the Ballyongmunjeon, the S-shaped phoenix is placed within the bead pattern, depicted as soaring gracefully through the cloud motif. The representative design motifs of the Sansusangyeongmunjeon are the landscape and cloud. Water and rocks are arranged at the bottom, and the mountains, trees, buildings, people,

and cloud patterns are placed in the middle and upper sections, resembling a landscape painting. The representative design motifs of the Sansubonghwangmunjeon are the landscape, phoenix, and cloud. The composition is divided into two sections, with heaven at the top and the earth at the bottom. The landscape pattern is placed at the bottom, and at the top, the cloud pattern, which symbolizes the sky, is arranged in two tiers. Meanwhile, the phoenix, which connects the earth and heaven, is depicted flying amid the clouds near the center, on the mountain peak (Moon, 2008; Park, 2008). The Gwihyeongmunjeon depicts a naked figure(裸身) standing with sharp claws and nails. The figure's face(顔面) resembles that of a goblin with two huge bulging eyes and a mouth agape, revealing fangs (Moon, 2008). The Gwihyeongmunjeon is categorized into Yeonhwagwihyeongmunjeon, where the monster stands on top of the lotus flower pattern, and the Sangyeonggwihyeongmunjeon, where the monster figure is placed against the landscape pattern. The representative design motifs of the Gwihyeongmunjeon consist of the monster, lotus flower, and landscape.

Therefore, the design motifs appearing in the Munyangjeon can be broadly classified as the lotus flower, bead, cloud, dragon, phoenix, landscape, and monster patterns. The symbolic meanings associated with each design motif can be summarized in Table 2 below.

〈Table 2〉 Symbolic metabolic meaning of the icons of Baekje Munyangjeon

Taoist icons	Yeonhwamun	Immortal, Heaven
	Yeonjumun	Natural order, fulfillment of wishes, immortality
	unmun	Longevity, the sky, the mystery of heaven
	Yongmun	Natural phenomena and cosmic changes
	Bonhwangmun	Peace, natural order
	Sansumun	Humanity and the natural order
	Gwihyongmun	Helper who aids people in trouble
Buddhist icons	Yeonhwamun	Buddha, Paradise
Folk religious icons	Yeonhwamun	Prosperity and successful offspring
	unmun	Such as the harmony of nature with rain and wind and agricultural abundance
	Yongmun	Water and sea deities who mediate the balance between the wind and clouds, auspiciousness, protection
	Bonhwangmun	Symbolizes a sacred mythical creature that governs the sky and the sun
	Gwihyongmun	Protection

The lotus flower holds multiple meanings, including the Buddhist symbols of Buddha and paradise, the Taoist symbols of immortals and Heaven, and the folk symbols of prosperity and successful offspring (Lee, 2005; Park, 2006). The bead pattern, which is depicted in the form of beads strung in a row, reflects Taoist values of natural order, fulfillment of wishes, and immortality (Park, 2006). The cloud pattern symbolizes the values of folk religions, such as the harmony of nature with rain and wind and agricultural abundance (Kang, 2012). It also holds Taoist meanings such as longevity, the sky, and the mystery of heaven (Park, 2006). The dragon represents water and sea deities who mediate the balance between the wind and clouds. It also symbolizes auspiciousness and protection from evil in folk beliefs (Kim, 2021; Moon, 2008). In addition, it has Taoist meanings of a supernatural being with immense power, symbolizing natural phenomena and cosmic changes (Park, 2006). The phoenix symbolizes a sacred mythical creature that governs the sky and the sun in folk beliefs. It also represents the emergence of a sage and symbolizes peace and natural order in Taoism (Park, 2006). The harmonious juxtaposition of three-peak mountains, rocks, water, and figures such as immortals represented in the landscape pattern symbolizes the Taoist idea of the fusion between humanity and the natural order (Park, 2006). The monster pattern symbolizes protection against natural disasters and various calamities in folk beliefs. It also represents a helper who aids people in trouble, according to Taoist symbolism (Yim, 1998; Park, 2006).

In conclusion, the symbolic meanings of the icons shown in the Baekje Munyangjeon's design motifs reflect the origin of the Baekje people rooted in an agricultural society. In other words, the religious philosophy of the Baekje people during the Baekje Sabi Period is expressed in the form of relief carvings (浮彫), where Taoist iconography, Buddhist symbolism, and folk symbols intertwine and blend (Moon, 2008).

3. Archimedean tiling technique

Tessellation, also known as “tiling,” refers to a pattern of rectangular tiles that extends indefinitely, filling the space without any gaps or overlaps (Son, 2005). Generally, tessellations are composed of equilateral triangles, squares, and hexagons because the sum of the angles formed by regular polygons at one vertex must be 360° (Mike, 2011/2020). However, the patterns of patchwork quilts or the Alhambra Palace consist of various tessellation patterns using two or more regular polygons based on geometric principles. From this, it can be inferred that they were arranged using the Archimedean tiling technique. Here, the Archimedean tiling technique consists of three platonic tessellations and eight semi-tilings. A platonic tessellation is composed of regular polygons of one shape, such as equilateral triangles, squares, and hexagons. The order and configuration of the regular polygons that meet at each vertex total three types: (3, 3, 3, 3, 3, 3), (4, 4, 4, 4), and (6, 6, 6). Semi-tiling is composed of multiple regular polygons, and the order and configuration of regular polygons that meet at each vertex total eight types, which are as follows: (6,4,3,4), (8,8,4), (3,3,3,3,6), (3,3,3,4,4), (3,3,4,3,4), (3,6,3,6), (3,12,12), and (4,6,12) (Mike, 2011/2020). The Archimedean tiling technique and notation are summarized in Table 3 below.

As seen above, the Archimedean tiling technique can be used to make various patterns with regular polygons. In the arrangement of shapes created according to the Archimedean tiling technique, a continuous permutation is possible in platonic tessellation. However, this is not the case in semi-tiling, as it may result in overlaps or empty spaces. With this, it was confirmed that it is possible to create a nonoverlapping continuous pattern by setting a base area where the smallest possible tiles can form a continuous horizontal pattern without overlapping (Mike, 2011/2020).

In other words, to create a continuous pattern arrangement, additional regular polygonal shapes were inserted into the shapes arranged using the Archimedean tiling technique to establish a base area, which was then continuously arranged by horizontal shifting. This base area is thought to be similar to the basic repeating

unit (one-repeat) that constitutes a textile pattern. Accordingly, in this study, the basic repeating unit set for the patterning process using the Archimedean tiling technique was defined as the basic area. The Archimedean tiling technique is based on mathematical concepts, allowing for the expression of artistic beauty by utilizing the measurement of angles, symmetry, transformation, and congruence of shapes (Jang & Hyun, 2016). Therefore, in this study, a textile pattern was developed using the Archimedean tiling technique, which is one of the construction methods that can expand a planar polygon in all directions without leaving empty spaces through the application of mathematical logic.

III. Method




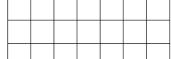



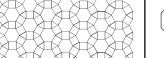



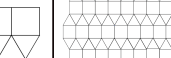





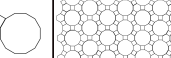
The research was conducted through both theoretical and empirical approaches. The theoretical method involved a review of literature and previous studies to examine the concept of the Baekje Munyangjeon and the Archimedean tiling technique. For the empirical approach, based on the results of the theoretical method, the analysis of the actual samples and photographs of eight types of Baekje Munyangjeon displayed at the Gyeongju National Museum were first analyzed to derive the compositional characteristics and symbolic meanings of the design motifs. Based on the results, the design motifs suitable for this study were then selected. The selected design motifs were stylized and

arranged in regular polygons using the Archimedean tiling technique, and the base area was reset after inserting additional regular polygons. After reconfiguring the color palette by integrating Pantone's trendy colors in 2024 in the set base area, a total of six textile patterns were developed by moving them horizontally according to the arrangement method.

Then, two preference surveys conducted to develop women's clothing designs. The preference survey was conducted among 110 female college students in Jeju from May 30 to June 12, 2024. The first survey was conducted to investigate preferences for SS season clothing items. In the second survey, we conducted a survey on preferences for the developed clothing design. The survey presented six developed textile pattern designs, three women's clothing designs, and 3D simulations of the designs incorporating six textile patterns. The designs selected as the result of the survey were produced using textile patterns printed on fabrics (DTP) and presented in order of preference. To provide more accurate information about the 3D costume, an image on the monitor was presented. Adobe Creative Cloud (Photoshop 2022, Illustrator 2022) and CLO 3D were used as tools for the development of patterns and clothing designs, with colors specified in CMYK values.

Finally, in-depth survey were conducted to reconfirm the suitability (to the combination of textile pattern design inserted into each clothing design, color combination, fabric combination, image, and application target) of

〈Table 3〉 Symbolic metabolic meaning of the icons of Baekje Munyangjeon

Platonic tessellation						
	3,3,3,3,3,3		4,4,4,4		6,6,6	
Semi-tiling						
	6,4,3,4		8,8,4		3,3,3,3,6	
						
	3,3,4,3,4		3,6,3,6		3,12,12	

the actual clothing design and the modern usability of the developed textile pattern. The in-depth interviews were conducted one-to-one with 10 fashion professionals and graduate students from March 25 to 28, 2025.




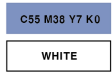



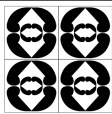







IV. Results and Discussion

1. Development of textile pattern design using Baekje Munyangjeon




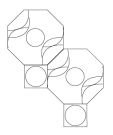




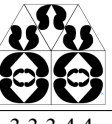
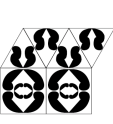





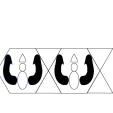

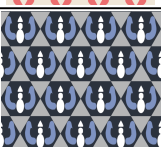
The process of developing textile patterns using the Baekje Munyangjeon design motifs (lotus flower pattern, cloud pattern, and phoenix pattern) was carried out in three stages: motif extraction, repeat configuration (geometric shape arrangement and fundamental region), and textile patterning based on the Archimedean tiling technique, as shown in Tables 4 and 5 below.

Textile pattern design 1 involved a textile pattern development process based on the compositional characteristics and symbolic meanings (heaven, fulfillment

〈Table 4〉 Development process of textile pattern design using Platonic tessellation technique

Number	Prototype	Motif of icon	Geometric shape arrangement in archimedean tiling	Colors repetition	Patterning
1			 6.6.6		
2			 4.4.4.4		
3			 3.3.3.3.3.3		

〈Table 5〉 Development process of textile pattern design using semi-tiling technique

Number	Prototype	Motif of icon	Geometric shape arrangement in archimedean tiling	Fundamental region	Colors repetition	Patterning
4			 8.8.4			
5			 3.3.3.4.4			
6			 3.6.3.6			

of wishes, immortality, etc.) of the lotus flower pattern and bead pattern, the representative design motifs of Yeonhwamunjeon (brick with a lotus design). The lotus flower pattern motif was derived by stylizing the circular petal shape into several curves, while the bead pattern was stylized into two circle shapes. The motif of the bead pattern was arranged in the center of a hexagon. The lotus flower motif in curves was arranged facing each other and then placed in the geometric shape of a hexagon (6.6.6), which follows a platonic tessellation technique. After reconfiguring the color palette in shades of blue (C55·M38·Y7·K0) and white on the arranged geometric shape, the arrangement was shifted horizontally to create the pattern. Textile pattern design 2 involved a textile pattern development process based on the compositional characteristics and symbolic meanings (abundance, longevity, mystery of heaven, etc.) of the cloud motif, the representative design of Sansusangyeongmunjeon. The motifs were derived by simplifying the cloud patterns at the top of the Sansusangyeongmunjeon into straight lines and arranging them symmetrically. After arranging the stylized motifs to face each other up, down, left, and right in the center of the square, they were placed in a square shape (4.4.4.4) using a platonic tessellation technique. The pattern was then created by horizontally moving the arrangement after reconfiguring the color palette in shades of violet (C37·M57·Y14·K0, C70·M94·Y46·K10) and applying it to the arranged geometric shape. Textile pattern design 3 involved a textile pattern development process based on the compositional characteristics and symbolic meanings (sky, sun, harmony of peace and order, etc.) of the phoenix pattern, the representative design motif of the Sansubonghwangmunjeon. The motif was stylized using the shape of the phoenix's head at the top of the Sansubonghwangmun (landscape and phoenix design). After arranging the stylized motifs in an equilateral triangle, they were placed in an equilateral triangle shape (3.3.3.3.3.3) using the platonic tessellation technique. After reconfiguring the color palette in the arranged geometric shapes using different shades of red (C11·M62·Y14·K0, C24·M91·Y30·K0), gray (C0·M0·

Y0·K20), and white, the shapes were horizontally shifted in the arrangement to create the pattern.

Textile pattern design 4 involved a textile pattern development process based on the compositional characteristics and symbolic meanings (heaven, fulfillment of wishes, immortality, etc.) of the lotus flower pattern and bead pattern, the representative design motifs of Yeonhwamunjeon. The lotus flower pattern motif stylized into several curves and the bead pattern motif stylized into a circle were derived. After arranging the bead pattern motif in the center of a regular octagon, the lotus flower pattern motif in the curve was placed to face the bead pattern and then arranged in the 8.8.4 shape, a semi-tiling technique, after inserting the bead pattern motif in the square. Then, after inserting an additional square shape into the arranged shape, the color palette was reconfigured using varying shades of yellow (C0·M35·Y39·K0), red (C29·M84·Y47·K0), and blue (C55·M38·Y7·K0) in the set base area and then horizontally moved using the patterning method to create a pattern. Textile pattern design 5 involved a textile pattern development process based on the compositional characteristics and symbolic meanings (abundance, longevity, mystery of heaven, etc.) of the cloud motif, the representative design motif of Sansusangyeongmunjeon. From the top part of the Sansusangyeongmunjeon, two types of cloud motifs were derived: one was simplified into straight lines and arranged symmetrically, while the other was simplified into curves and arranged symmetrically. The motifs stylized into straight lines were then arranged to face each other in the center of a square, and the motifs stylized in curves were arranged in an equilateral triangle and then placed in a 3.3.3.4.4 geometric shape using the semi-tiling technique. Based on the arranged shape, an additional equilateral triangle shape was inserted, and a color palette was reconfigured using shades of yellow (C7·M10·Y16·K0) and orange (C1·M69·Y46·K10) in the set base area, after which the pattern was created by horizontally shifting the arrangement. Textile pattern design 6 involved a textile pattern development process based on the compositional

characteristics and symbolic meanings (sky, sun, harmony of peace and order, etc.) of the phoenix pattern, the representative design motif of the Sansubonghwangmunjeon. The motifs were derived by simplifying the body and wings of phoenix at the top of the Sansubonghwangmun into triangles and ovals. After arranging the stylized motifs in a hexagon, they were placed in a 3.6.3.6 geometric shape using a semi-tiling technique. Based on the arranged shape, two additional equilateral triangles were inserted, and the color palette, in shades of blue (C55·M38·Y7·K0, C85·M78·Y64·K39, C34·M26·Y25·K20) and white, was reconfigured in a pattern by horizontally shifting the arrangement.

2. 3D Simulation and actual production of women's clothing design using developed textile pattern design

This study was conducted to develop textile patterns and designs for women's fashion, targeting those in their 20s. The characteristics of women in their 20s, the majority of whom belong to the MZ generation, tend to prioritize value-oriented consumption with emphasis on their own tastes and express interest in traditional Korean culture in their unique ways (Kim, 2021; Kim, 2021). Women in their 20s were selected as the subjects of the study because they represent a generation that values individuality and uniqueness while also having interest in the traditional culture. It was deemed that they were suitable to be the target demographic that could confirm whether designs derived from traditional artifacts would be suitable for practical commercialization. Results of the first survey, preference for the top items was in the order of shirt(31, 28.2%)>one-piece dress(29, 26.4%)>hooded t-shirt(23, 20.9%)>blouse(19, 17.3%)>vest(6, 5.4%)>etc.(2, 1.8%). And preference for the bottom items was in the order of miniskirt(28, 25.5%)>short pants(25, 22.7%)>slacks(20, 18.2%)>midiskirt(18, 16.4%)>long skirt(14, 12.7%)>jump suit(4, 3.6%)>etc.(2, 1.8%). Based on this, the design focused on one-piece dress, shirts and short pants, hooded t-shirt and miniskirt. The designs were created by applying the

results of the 2D pattern creation and sewing process using CLO 3D, a virtual fitting program. The pattern was then applied to a virtual avatar and presented as a 3D simulation. The standard measurements were based on the average size of women aged 20 to 29 from the 8th Human Dimension Survey (2020-2021) conducted by Size Korea (2023), applying an approximate height of 162 cm, bust circumference of 89 cm, waist circumference of 70 cm, and hip circumference of 95 cm. The process of developing the final three women's clothing designs using the CLO 3D virtual fitting program is shown in Table 6 below.

One-piece dress is a halter neck dress with an A-line silhouette. It was designed to emphasize a sexy yet romantic image by combining a fitted halter neck top and a dressy full-flare skirt. For the 3D simulation, the linen texture was recreated by applying the fabric properties of "Cotton_40s_Chambray." Shirt and short pants is a set that consists of a cropped shirt and shorts. The design emphasizes a smart yet casual image by combining a cropped shirt with loose set-in sleeves and slim-fit shorts. The shirt features a back yoke and box pleats for ease of movement, as well as a shirt collar for a neat, elegant look. The shorts feature a low-waist H-line silhouette, with a waist belt and pockets for added convenience. For the 3D simulation, the texture of Oxford fabric was recreated by applying the fabric properties of "Cotton_Oxford." Hooded t-shirt and miniskirt is a set consisting of a hooded T-shirt and a pleated miniskirt. The design emphasizes a lively and sporty image by combining an oversized hooded T-shirt with a pleated A-line skirt. The hooded T-shirt was designed with oversized shoulders, as well as ribbed sleeves and hem, to enhance mobility. The pleated miniskirt conveys a playful, lively vibe with 3 cm-spaced pleats on the waist yoke, complete with a side zipper closure. For the 3D simulation, the texture of Daimaru fabric for the hooded t-shirt was recreated by applying the fabric properties of "Knit_Cotton_Jersey," while the sleeves and hem were textured with the fabric properties of "Rib_2X2_468gsm." Furthermore, the Cotton Oxford fabric of the pleated mini skirt was

expressed by applying the fabric properties of “Cotton_Oxford.”

In order to verify the results of combining the developed textile patterns and fashion designs, six textile patterns were applied to three designs and presented through 3D simulations. The six developed textile patterns were added to the CLO 3D texture window, and the sizes of the patterns on the tops and bottoms were adjusted. Different textures were applied to each design so that it could be seen as fabric similar to the actual clothing. The poses of the virtual avatars were rendered by applying KV1_01_A.pos, provided by CLO 3D, and the summary is shown in Table 7 below.

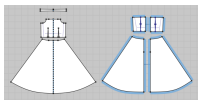



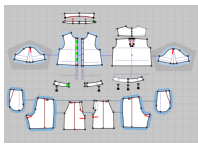



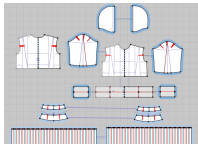



The results of the secondary survey are as follows.

First, the preference for each textile pattern design was measured on a 5-point Likert scale. The results showed that the preference for textile pattern design 1 was as follows: neutral 36(32.7%), like 31(28.2%), dislike 24(21.8%), strongly dislike 13(11.8%), and strongly like 6(5.5%). The preference for textile pattern design 2 was as follows: dislike 41(37.3%), neutral

30(27.3%), strongly dislike 23(20.9%), like 13(11.8%), and strongly like 3(2.7%). The preference for textile pattern design 3 was as follows: dislike 38(34.6%), neutral 30(27.3%), strongly dislike 27(24.5%), like 11(10%), and strongly like 4(3.6%). The preference for textile pattern design 4 was as follows: dislike 40(36.3%), neutral 32(29.1%), strongly dislike 19(17.3%), like 18(16.4%), and strongly like 1(0.9%). The preference for textile pattern design 5 was as follows: dislike 37(33.6%), neutral 32(29.1%), strongly dislike 19(17.3%), like 18(16.4%), and strongly like 4(3.6%). Finally, the preference for textile pattern design 6 was as follows: like 30(27.3%), dislike 30(27.3%), neutral 28(25.4%), strongly dislike 18(16.4%), and strongly like 4(3.6%). In summary, the preference for textile pattern design 1 and 6 was somewhat high, while the preference for textile pattern design 2, 3, 4, and 5 was somewhat low.

Second, the women's clothing were presented as 3D simulation images, and the preference for each item was measured using the Likert scale. The results are as follows. The preference for one-piece dress was as follows: like 46(41.8%), dislike 22(20%), neutral 20

〈Table 6〉 3D simulation of developed women's clothing design

Design	2D pattern	3D clothing simulation		
		Front	Side	Back
One-piece dress				
Shirt and short pants				
Hooded t-shirt and miniskirt				



















(18.2%), strongly like 13(11.8%), and strongly dislike 9(8.2%). The preference for clothing shirt and short pants was as follows: like 32(29.1%), neutral 30(27.3%), dislike 23(20.9%), strongly like 19(17.3%), and strongly dislike 6(5.4%). The preference for hooded t-shirt and miniskirt was as follows: neutral 34(31%), like 28(25.4%), dislike 28(25.4%), strongly like 10(9.1%), and strongly dislike 10(9.1%). In summary, the preference for the clothing design was in the order of one-piece dress>shirt and short pants>hooded t-shirt and miniskirt.

Third, 3D simulations with the six types of textile patterns applied to each item were also presented. The results are as follows. The preference for textile patterns applied to one-piece dress was 3D 1-3(36, 32.7%), 3D 1-6(34, 30.9%), 3D 1-5(21, 19.1%), 3D 1-1(10, 9.1%), 3D 1-2(6, 5.5%), and 3D 1-4(3, 2.7%). The preference for textile patterns applied to shirt and short pants was 3D 2-6(58, 52.7%), 3D 2-1(24, 21.8%),

3D 2-3(12, 10.9%), 3D 2-5(9, 8.2%), 3D 2-2(6, 5.5%), and 3D 2-4(1, 0.9%). The preference for textile patterns applied to hooded t-shirt and miniskirt was 3D 3-6(31, 28.2%), 3D 3-3(26, 23.6%), 3D 3-5(20, 18.2%), 3D 3-1(14, 12.7%), 3D 3-2(14, 12.7%), and 3D 3-4(5, 4.6%). In summary, the preference for one-piece dress was highest when textile pattern design 3(3D 1-3) was applied, while the preference for shirt and short pants was highest with textile pattern design 6(3D 2-6). Moreover, the preference for hooded t-shirt and miniskirt was highest with textile pattern design 6(3D 3-6). As such, it was identified that the preference for textile pattern design and the preference for inserting it into clothing design do not match. This identified that the usability of textile patterns is higher when they are presented by applying them to clothing design rather than as fragmentary images.

Fourth and last, the designs for physical production

〈Table 7〉 3D simulation of fashion design using development textile patterns

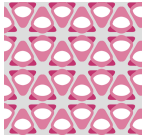



Clothing design	Textile pattern design					
	1	2	3	4	5	6
One-piece dress						
	3D 1-1	3D 1-2	3D 1-3	3D 1-4	3D 1-5	3D 1-6
Shirt and short pants						
	3D 2-1	3D 2-2	3D 2-3	3D 2-4	3D 2-5	3D 2-6
Hooded t-shirt and miniskirt						
	3D 3-1	3D 3-2	3D 3-3	3D 3-4	3D 3-5	3D 3-6

were selected based on the preference survey results. For the various uses of the developed textile pattern design, the selection criteria prioritized the top-ranked textile pattern for each design based on the highest preference. If the top-ranked textile pattern overlapped across designs, the next-ranked pattern was selected. As a result, 3D 1-3 for one-piece dress, 3D 2-6 for shirt and short pants, 3D 3-5 for hooded t-shirt and miniskirt were selected. The model's body measurements are height(167cm), bust circumference(87cm), waist

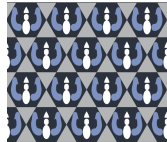



circumference (69cm), hip circumference(92cm), and shoulder width(42cm). The results are summarized in Tables 8, 9 and 10.

Table 8 shows the actual production process of the romantic design of a halter neck one-piece dress (3D 1-3) with the red Textile pattern design 3, featuring a phoenix motif. For the material, the fabric used was 100% cotton linen, with textile pattern design 3 printed using DTP, and the lining was made with plain 100% cotton linen.

〈Table 8〉 Actual production process of one-piece dress

Actual production						
Textile pattern	Material and subsidiary material			Front	Side	Back
 6cm×6cm	Outer fabric		Lining			
	100% cotton linen DTP fabric		100% cotton linen fabric			
			Subsidiary material			
			Conceal zipper			

〈Table 9〉 Actual production process of shirt and short pants

Actual production						
Textile pattern	Material and subsidiary material			Front	Side	Back
 5cm×5cm 2.5cm×2.5cm	Outer fabric		Subsidiary material			
	Top	100% cotton oxford DTP fabric	Button			
	Pants	100% cotton oxford DTP fabric	Button, zipper			

〈Table 10〉 Actual production process of hooded t-shirt and miniskirt





Actual production						
Textile pattern	Material and subsidiary material			Front	Side	Back
 6cm×6cm 4cm×4cm	Outer fabric		Lining			
	Top	Circular knit DTP fabric	.			
	Pants	100% cotton oxford DTP fabric	100% cotton oxford fabric			
			String, rib			
			Zipper			

Table 9 presents the actual production process of a casual cropped shirt and shorts (3D 2-6) with the blue and monotone Textile design 6, inspired by the phoenix motif. For the material, the fabric used was 100% Oxford cotton, with textile design 6 printed using DTP. During the production of the short pants, additional pleats were added to the waistband to reflect feedback from the survey suggesting that the pants' waistline felt a bit tight.

Table 10 depicts the actual production process of a sporty hooded T-shirt and pleated miniskirt (3D 3-5) with the orange Textile design 5, inspired by the cloud motif. The hooded T-shirt was made using knit fabric with the circular knit textile design 5 printed using DTP. Ribbing was also inserted into the sleeves and hem. The pleated miniskirt was made with 100% Oxford cotton with textile design 5 printed using DTP, and the width of the pleats was standardized at 3 cm.

In-depth survey for each actual clothing were measured on a 5-point Likert scale. The results are as follows. Regarding the combination of clothing design and textile pattern design, one-piece dress was very suitable(5, 50%)>suitable(3, 30%)>neutral(2, 20%). Shirt and short pants was very suitable(4, 40%)>suitable(3, 30%)>neutral(2, 20%)>unsuitable(1, 10%), and Hooded t-shirt and miniskirt was very suitable(9, 90%)>suitable(1, 10%). Regarding the combination of clothing design and color, one-piece dress was very suitable(8, 80%)>suitable(1, 10%)>neutral(1, 10%). Shirt and short pants was very suitable(6, 60%)>suitable(4, 40%), and Hooded t-shirt and miniskirt was very suitable(6, 60%)>suitable(4, 40%). Regarding the combination of clothing design and fabric, one-piece dress was very suitable(4, 40%)>suitable(3, 30%)>neutral(3, 30%). Shirt and short pants was very suitable(7, 70%)>suitable(1, 10%)>neutral(2, 20%), and hooded t-shirt and miniskirt was very suitable(4, 40%)>suitable(4, 40%)>neutral(1, 10%)>unsuitable(1, 10%). Regarding the combination of clothing design and design image, one-piece dress was very suitable(4, 40%)>suitable(4, 40%)>neutral(2, 20%). Shirt and short pants was very suitable(4, 40%)>suitable(3, 30%)>

neutral(3, 30%), and hooded t-shirt and miniskirt was very suitable(8, 80%)>suitable(2, 20%). Regarding the combination of clothing design and application target, one-piece dress was very suitable(6, 60%)>suitable(3, 30%)>neutral(1, 10%). Shirt and short pants was very suitable(2, 20%)>suitable(4, 40%)>neutral(3, 30%)>unsuitable(1, 10%), and hooded t-shirt and miniskirt was very suitable(7, 70%)>suitable(3, 30%). It was generally rated as suitable in all items.

This study based on the survey results from the 3D simulation of textile patterns inspired by the Baekje Munyangjeon and their application to women's clothing designs, the actual garments were produced and presented. As shown in the research results, it was reconfirmed that the developed textile pattern can be used in modern women's clothing. This confirms that Baekje Munyangjeon can be reinterpreted in a modern way and utilized as practical products. This study has limitations in that it was limited to the design of 20s women's clothing, but we plan to expand the scope of application and suggest various practical solutions through further research. Based on the results of this study, we expect that content will be built around the developed motifs and that they can be utilized in various fields (cultural tourism products, interior accessories, etc.) as well as fashion design.

V. Conclusion

In response to the demand for innovative designs that combine traditional and modern elements using unique and traditional cultural archetypes as motifs, this study aimed to create textile patterns using the Baekje Munyangjeon and produce and present women's clothing that incorporated these patterns in order to confirm their potential for practical use.

The results are summarized as follows.

First, the textile patterning process extracted the compositional characteristics and symbolic meanings of the design motifs expressed in eight types of Baekje Munyangjeon. From this, motifs such as the lotus

flower, bead, cloud, and phoenix were derived from the original patterns and later stylized. The stylized motifs were juxtaposed within a regular polygon using the Archimedean tiling technique, and a base area was established by inserting additional regular polygons. After reconstructing the color palette by arranging the 2024 trend colors in the set base area, a total of six textile patterns were created by moving them horizontally according to the arrangement method.

Second, in order to confirm the practical applicability of the developed textile pattern, three designs were developed by selecting items women in their 20s prefer and wear casually in spring and summer. These designs were then presented using the CLO 3D virtual fitting program. Design 1 was a halter neck dress that depicts a sexy and romantic image, and Design 2 was a set with a cropped shirt and shorts pants, reflecting a smart yet casual image. Meanwhile, Design 3 featured a lively and sporty hooded T-shirt paired with a pleated miniskirt. Using the CLO 3D virtual fitting program, configured based on the average size of women in their 20s, three designs were developed through simulations of the 2D pattern creation and 3D sewing process on a virtual avatar.

Finally, a preference survey was conducted by presented with 3D simulations of 6 developed textile pattern designs, 3 women's clothing designs, and a total of 18 women's clothing designs with the patterns applied. Based on the preference results, one-piece dress(3D 1-3), shirt and short pants(3D 2-6), and hooded t-shirt and miniskirt(3D 3-5) were selected to utilize a wider variety of textile patterns. This designs were then produced and presented using DTP fabric. In addition, based on the results of the in-depth survey on the actual items, the following results were derived: The overall evaluation was that the suitability to the combination of textile pattern design inserted into each clothing design, color combination, fabric combination, image, and application target was suitable.

In conclusion, through the presentation of the results of the physical production of textile patterns developed based on the compositional characteristics and symbolic

meanings of the Baekje Munyangjeon motifs, as well as the women's clothing designs incorporating these patterns, it was validated that this can generate positive interest in and engagement with traditional cultural archetypes among the MZ generation. In addition, it was confirmed that the distinct quality and other excellent traditional values of the Baekje Munyangjeon can be applied to practical daily items.

This study was limited in that the preference survey was conducted only with female university students in their 20s residing in Jeju and, thus, may be restricted in its generalizability. In the future, this study aims to expand and further explore the practical applications of traditional cultural archetypes through research in a broader range of subjects and cases.

Keywords: Baekje Munyangjeon, CLO 3D, Textile pattern design, Women's clothing

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