



## Needs-Response-type Affordable Design Method for Public Hanok Buildings

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### ABSTRACT

**Purpose:** This study highlights the eco-friendly elements of a hanok and the advantages of expressing Korea's unique identity. Further, there is need for a reasonable design or construction technique to simultaneously meet today's daily life requirements such as low material and construction costs and high insulation performance. **Method:** Based on a previously researched thesis, the meaning or possibility of the visually perceived parts is examined with focus on a hanok and public buildings. The study does not provide a discussion on the interior space or living aspects of public buildings or a hanok, religion, and philosophy. Further, the external space is limited to visually or formally perceptible components. **Result:** While maintaining a large framework of modern interpretation and application of a hanok, the study attempts to combine modern public buildings with hanok elements. It is thus necessary to develop design techniques that can respond to modern requirements through in-depth discussions and research on Hanok or Korean traditional architecture in the future.

### KEYWORD

Public hanok building  
Needs-response-type  
Affordable

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## 1. Introduction

### 1.1. Background and Purpose

Although the application of hanok elements to public buildings satisfies the aesthetic and environmental requirements to some extent; however, it cannot satisfy the diverse requirements of today's architecture such as safety and economic efficiency[1]. Thus, it is necessary to apply hanok elements continuously and systematically and to combine hanok and modern architecture through design strategies such as replacement, transformation, and fusion, beyond simple adoption[1]. This implies that the active acceptance of the advantages and the proper supplementation of the disadvantages of a hanok should be achieved before new concepts involving hanok fusion buildings that can respond to the diverse needs of today's architecture can be presented. Therefore, in the future, there is a need for the development of proper and rational design and construction techniques to satisfy today's living and performance requirements such as insulation and to solve economic problems such as expensive materials and construction costs, while building on the strengths of the hanok such as eco-friendliness and the expression of unique identity of Korea.

In this study, we define this as a needs-response-type affordable design method of hanok, and we examine the sustainability and utilization value of hanok elements. To that

end, this study targets public buildings that have distinct general types and attributes, and it can be easily used by citizens and express local symbolism, rather than residential buildings that reflect individual differences and various tastes. Further, we define public buildings where hanok elements are applied or applicable as public hanok buildings and propose a needs-response-type affordable design method of hanok elements for public buildings.

Further, this study is a follow-up study of "Correlation and Strategy of Tangible Attributes of Public Buildings and Elements of Hanok"[1] and aims to derive a concrete, practical, and affordable design method for the Hanok elements application methodology proposed in the previous study.

### 1.2. Research Method and Scope

The objective of this study is to propose a new unique building type for Korea via the combination or application of hanok elements and public buildings. To that end, we propose a needs-response-type affordable design method for applying hanok elements to public buildings. The major research method for this study was identifying problems in the application of hanok elements by investigating previous studies[2, 3], field surveys based on actual cases, and literature review. In addition, to examine an affordable design method, we referred to research projects such as the development of a hanok village and the new hanok-style public building optimization model to complement the disadvantages of hanok (Ministry of Land, Transport and

Maritime Affairs, 2013–2016) and the publications and research results of the Auri National Hanok Center. This paper is a result of the research project “Affordable Design Method of Needs-Response-type Public Hanok Building”, and it summarizes the following studies: “Typification and Models Related to Type and Attributes of Public Buildings”[2], “Survey Analysis of Hanok Element Application Status in Gyeongju Public Buildings”[3], “Survey of Actual Situation on Application of Han-ok Components of Public Buildings”[4], “Classification and Characteristics of Han-ok Based on Public Building Planning Standards”[5] and “Correlation and Strategy of Tangible Attributes of Public Buildings and Elements of Hanok”[1].

Since this study aims to investigate the combination and application of public buildings and hanok elements, the scope of the present study is limited to the form elements of hanok and public buildings as with the previous study[1], and research on natural philosophy, religion, and interior space are excluded. This is because applying hanok elements to public buildings is still optional, rather than essential, for the attachment to and realization of our tradition, and it is reasonable to examine the meaning or possibility first based on visually perceived parts. Therefore, internal spaces, living spaces, and the religious and philosophical aspects of public buildings and hanok are not discussed; external spaces are also limited to visually or formally perceivable parts.

## 2. Theoretical Considerations

### 2.1. Definition of public hanok building and similar concepts

#### 1) Definition of public hanok building

A public hanok building is a term that literally combines hanok and public building. To understand this term accurately, we should first understand the conceptual definitions of hanok and public buildings.

According to the Act on Value Enhancement of Hanok and Other Architectural Assets<sup>1)</sup>, Article 2 of the Enforcement Decree of the Building Act<sup>2)</sup>, and the local government ordinances of Jongno-gu, Seoul and Suwon, Gyeonggi-do<sup>3)</sup>, a hanok is commonly defined as “a building, the main structure of which consists of wooden columns, beams, and Korean style roof frames, and which reflects the traditional style of Korea, and any building annexed thereto,” contributing to the promotion of historical and cultural values and the national architectural culture, and the formation of regional identity as its attributes<sup>4)</sup> [5].

As shown in Kim[2] and other studies that classified public

buildings based on legal criteria (Kim, 2004) and publicness (Cho, 2007), public buildings can be classified as facilities related to public works and government agencies, local government buildings, and other public buildings that promote public interests and values even if they are not directly related to public works (culture and services)<sup>5)</sup>[6].

Therefore, a public hanok building is a public building to which hanok elements and techniques have been applied “to promote the historical and cultural values or the national architectural culture of Korea and to form a local identity by inheriting and developing the advantages of hanok design and structures of a hanok.” Since public hanok buildings refer to all buildings that basically maintain the functions of public buildings, buildings with little or no publicness such as residential buildings are naturally excluded.

#### 2) Similar concepts of public hanok building

Similar concepts of public hanok buildings that appeared in existing studies and reports include hanok-style public buildings, Han-style public buildings, and new hanok-style public buildings. These similar concepts of hanok focus on the modern application of traditional hanok and the expansion of its boundaries. Further, these concepts emphasize the possibility of the transformation of a hanok to respond to modern requirements rather than being used as a cultural heritage or a traditional building with a high preservation value.

Hanok-style public buildings and Han-style public buildings emphasize the spatial or aesthetic aspects besides the traditional structures or structural methods of hanok as stated in the Building Act. In particular, the Han-style building is a broad concept different from a traditional hanok and its application encompasses Korean style interior and external spaces as well as buildings[7]. In contrast, the new hanok-style public buildings pursue complex structures that combine modern structural beauty such as reinforced concrete (RC), steel, and glass while accepting the definition of hanok as stated in the Building Act, according to which a hanok is a building that applies wooden structures as its main structural parts. They are aiming for active fusion and convergence of hanok and modern buildings by prescribing hanok as a building that reflects the inherited and reinterpreted design elements of Korean traditional beauty and future-oriented designs. This concept considers the advantages and disadvantages of the traditional hanok and attempts to direct the hanok, which has not been done owing to the requirements of modern life, to the stage of everyday life by application to public buildings that conform to modern conveniences through the conversion and dissemination of the hanok.<sup>6)</sup>

These concepts regard a hanok as an active object or means

that can be applied to meet various modern requirements and secure the identity of Korea beyond the traditional preservation or maintenance of hanok. As such, they can be considered to have the same trend as the present study in that they apply to public buildings used by many people for the distribution and spread of hanok.

### 3) Classification and characteristics of public hanok building types

The above-mentioned hanok classification is applied to the hanok public buildings. However, owing to the nature of public buildings, the distinction is made according to the structural style, aesthetic aspects of the traditional hanok, and the degree of reproduction or application of traditional attributes.

First, Park (2015) classified hanok public buildings into wooden and complex structures based on the structural style and attempted to establish the status of a new hanok-style public buildings by using the complex structure. The wooden structure type can be considered a passive concept as it leaves room for combining it with modern techniques while being faithful to the definition of a hanok as in the Building Act. Complex structures are reclassified into strong connection between hanok and modern architecture (fused type), and mutually independent connections (juxtaposition type), thereby expressing the combination of hanok and modern architecture more actively. Similarly, Chun[9] classified them into New-Hanok 1 and 2 and Eclectic (Korean) types. New-Hanok 1 is a concept that is relatively close to the traditional hanok that involves the use of pine wood and traditional seams and fittings, whereas New-Hanok 2 is a more active concept that allows the use of imported and laminated timbers, bonding with metals, and free story height. Furthermore, the eclectic (Korean) type is defined as a style that combines traditional and improved types such as traditional Korean roof styles and red clay while applying an integrated structural method centered on cast-in-place using modern structure techniques such as RC, steel framed RC (SRC), and steel framework.<sup>7)</sup>[9] By synthesizing previous studies, Kim and Lee classified the types of hanok-style public buildings into authentic hanok, hanok-style, new hanok, and new hanok-style public buildings[5].

Some researchers classified hanok-style public buildings around the aesthetic aspects or traditional attributes of hanok. Jo et al. classified the types of hanok-style public buildings into authentic hanok, transformed hanok, and applied hanok. They defined the transformed hanok as a hanok with some modified parts while maintaining the appearance of a traditional hanok and an applied hanok as a hanok that is a traditional hanok transformed by introducing modern materials and other

Table 1. Classification of types of public Hanok buildings.

Researcher	Classification format		Classification criteria
Jo, Sung-ho (2014)	Authentic hanok		Visual / design elements (based on traditional hanok)
	Transformed hanok		
	Applied hanok		
Jo, Sung-ho (2015)	Traditional representation		Design elements
	Partial deformation		
	Abstract application		
Shim, Kwan-Su (2015)	Imitation		Morphological type
	Eclectic		
	Abstract		
Park, Jun-Young (2015)	Wood structure		Structure combination
	Complex structure	Fused	
		Juxtaposition	
Chun, Kuk-Chun (2017)	New-Hanok 1		Wooden and complex structures
	New-Hanok 2		
	Eclectic (Korean)		
Kim, Young-Hoon (2018)	Authentic hanok		Form and structural combination method
	Hanok-style architecture		
	New-hanok		
	New-hanok-style public buildings		

elements.<sup>8)</sup>[6] Another study by Jo classified RC hanok-style public buildings into three types: traditional representation, partial deformation, and abstract application<sup>9)</sup>. This classification emphasizes the aesthetic and design aspects rather than the structural aspects of hanok and modern architecture. Furthermore, Shim classified the traditional architectural elements in Korean modern public buildings into morphological, spatial, ideological, and material elements; the morphological elements were further classified into three types: imitation, eclectic, and abstract<sup>10)</sup>. The above classifications are outlined in Table 1.

In terms of the morphological aspects, it can be seen that they are classified largely into three categories: (i) inheriting and developing Hanok architecture and applying it to public buildings (centered on traditional hanok); (ii) partially transforming elements or parts of traditional hanok (centered on partial deformation); and (iii) applying and abstracting elements or features of hanok (reference and application of hanok)[6, 9].

## 2.2. Definition of affordable and affordable design method

The dictionary definitions of affordable can be summarized as “that can be acquired” and “(price is) reasonable.” The concept of “affordable things or costs” is often used, such as affordable housing, which refers to a housing for low and middle income earners, and it is generally supplied in the downtown area in line

with the development of office buildings<sup>10</sup>). However, this concept emphasizes the cost and economic aspects and is likely to highlight negative connotations such as cheap housing. Thus, a broader concept is required.

In the architecture field, Cinn defines an affordable house as a proper house or a house of a reasonable scale for the middle class, expanding the concept of affordable to “proper” or “rational (scale)”<sup>11</sup>). To examine the concept of affordable in the non-architecture field, Yang et al. interpreted affordable as “entry-level”<sup>12</sup>), and Yang et al. defined affordable as reasonable<sup>13</sup>). Meanwhile, Oh defined affordable luxury as “semi-luxury, high-quality, and high-priced products that can be mass-produced with excellent technology”<sup>14</sup>). Further, Oh interpreted the affordable attribute as a product that can be mass-produced with excellent technology in terms of quality or technology, rather than a concept that only emphasizes inexpensiveness or economic efficiency.

To summarize the above definitions, the concept of affordable can be broadly defined as proper, reasonable, and mass-distributable while considering economic aspects such as relatively low price. This paper adopts this definition of affordable, and commonly designates the design method or result applying this concept as the affordable design method.

### 3. Application Scope and Strategy of Affordable Design Method for Application of Hanok Elements to Public Buildings

#### 3.1. Application scope of affordable design method applying hanok elements

##### 1) Application scope of affordable design by representative attribute of public buildings

As defined in the Building Act, public buildings have unique attributes and requirements based on their use, and new requirements may be generated depending on the location or local requirements and the number of users or the target. Furthermore, new trends may be created as they react to the trends of the times or cultural trends. These can be classified as unique, optional, and sociocultural requirements, respectively. Since this study requires the establishment of a generalized logic—the development of hanok elements applicable to public buildings—optional requirements expressed in a variety of ways in their mode or degree of demand are excluded from this study. Furthermore, sociocultural requirements are not separately discussed because they can be regarded to be partially inherent in each type or use of public buildings and applying hanok elements to public buildings

itself can be regraded as one of the current requirements.

Therefore, this study only examines the unique requirements for each use of public buildings. Since this is similar to the unique attributes according to the trends of public buildings, we adopted the tangible attribute model theory of public buildings proposed by Kim [1, 2]. As suggested in the above-mentioned study[1], the application of hanok elements focused on the aesthetic features until recently, and it is understood that hanok elements can be used to some extent in some attributes such as environment and accessibility because of the eco-friendliness and openness of the hanok. Therefore, for continuous and systematic application of hanok elements, we need to identify the challenges behind why certain elements and attributes have not been applied thus far, and we need to establish design strategies based on these challenges.

An examination of the correlation between the representative attributes of public buildings and hanok elements reveals that hanok elements are applied smoothly to aesthetic attributes, accessibility, and environmental aspects. This suggests that existing research on the utilization of the hanok elements consider aesthetic and eco-friendly aspects except for in the reinforcement research that focuses on the sustainability or openness of the hanok. However, in terms of safety, convenience, and economic efficiency, the application frequency of hanok elements is still low and there are many obstacles in terms of easy use or application. Therefore, for smooth application of hanok elements in the future, reinforcement strategies around economics, safety, and convenience are required. The application scope of the affordable design method can thus be established, i.e., the development of hanok elements that are economical as well as suitable, reasonable, and widely available(Fig. 1.).

##### 2) Setting the scope of affordable design method based on the public building type and size

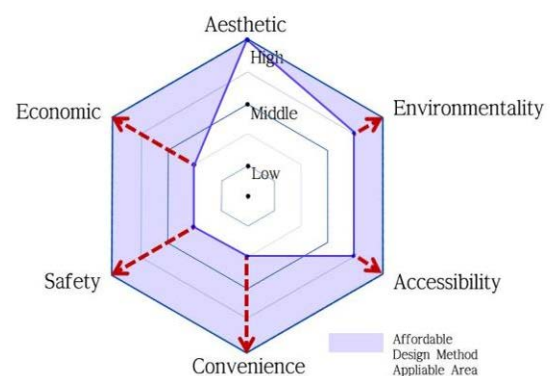


Fig. 1. Scope of application of possible design techniques according to public building type attributes  
Source; Re-quoted and partially revised by Kim[1]

The general types of buildings for difference uses or the public buildings defined in the Building Act can be classified into public offices, welfare facilities, educational research facilities, culture/meeting/sports facilities, environmental sanitation facilities, medical facilities, transportation and other facilities[2]. Each of these public buildings have different needs and application mode of hanok according to their unique attributes[1]. According to a previous study[1], public buildings can be divided into multiple frequent use and multiple low-frequency facilities depending on the frequency of use by the public. In the case of multiple frequent-use facilities, functional aspects such as accessibility, convenience, safety, and environmental and economic aspects are emphasized. In contrast, aesthetics is a major consideration in cases where aesthetic aspects need to be emphasized such as culture/meeting/sports facilities, and partially necessary for symbolic aspects in other cases. However, the major attributes of low-frequency facilities are safety, environmental, and economics, which are faithful to the inherent function of the facilities[1].

Furthermore, considering that the main reason for applying hanok elements to public buildings is associated with symbolic aspects rather than functional aspects such as traditional expressions or emphasis of local identity, the introduction or application of hanok elements to all public buildings remains unnecessary and not urgent. Since there is no legal coercion to enforce the application of hanok elements, the introduction or application of hanok elements must be timely and reasonable. In this respect, it is necessary to first limit the application scope to public buildings that have strong symbolic meaning and high possibility of diffusion when hanok elements are applied, instead of applying them to all public buildings. Hence, multiple frequent use facilities are more appropriate for this purpose than multiple low-frequency facilities. It is thus appropriate to apply them to public facilities which are easily accessible to the public, the demand is high, and they universally exist regardless of region.

Therefore, the application targets of the affordable design method based on the public building type are public offices, welfare facilities, culture/meeting/sports facilities, etc., which have a premise of universal use, can be set as representative priority targets. In addition, educational research facilities, medical facilities, and transportation facilities can be set as optional application targets according to special purposes<sup>15)</sup>. Multiple low-frequency facilities such as other environmental facilities and special facilities are excluded from the hanok application targets because the need or ripple effect of application of hanok elements is not large. When necessary, they can refer to the examples and results of previous public buildings. This is because public buildings of the same type share the same needs

Table 2. Summary of representative attributes by public building type

Classification	Representative attributes						Design application target	Multiple exposure accuracy
	Function			Environmental	Aesthetic	Economics		
	Accessibility	Convenience	Safety					
Public office	⊙	⊙	⊙	⊙	⊙	⊙	Priority target facilities	
Welfare facilities	⊙	⊙	⊙	○	○	○		
Culture / meeting / sports facilities	⊙	⊙	⊙	○	○	○		
Educational research facility	⊙	⊙	⊙	⊙	○	○	Selective facility	
Medical facilities	⊙	⊙	⊙	⊙	△	⊙		
Transportation and other facilities	⊙	⊙	⊙	○	○	⊙		
Environmental sanitation facility	△	○	⊙	⊙	△	⊙	Excluded	
Special facilities	△	△	⊙	⊙	△	⊙		

and attributes with each other, and the results of the affordable design method for representative attributes can be borrowed or shared if necessary(Table 2.).

The application scope and targets of the affordable design method according to the public building size also need to be examined. According to a study that examined the application status of hanok elements to 47 public buildings[4], the most frequent uses of public buildings are culture and meeting[19], education and research (9), elderly and children[3], business[9], and type 1 & 2 neighborhood living facilities[7], and the sizes are mostly small and medium with 1 or 2 stories and a total floor area of approximately 500–1,000 m<sup>2</sup>[4]. Thus, it can be seen that according to the use of public buildings, public buildings to which hanok elements are actively applied, such as culture and meeting facilities, the existing application patterns should be reinforced and an additional discovery of or attempts for other uses should be implemented. Further, for public buildings to which hanok elements are not applied sufficiently, a strategy to develop and apply hanok elements suitable for the purpose or size of the public buildings is required. However, according to the Survey Analysis of Hanok Element Application Status in Gyeongju Public Buildings(3), hanok elements are being applied to medium and large buildings such as Seorabeol Culture Center (2,230 m<sup>2</sup>) and Gyeongju City Library (3,673.5m<sup>2</sup>). This reflects

the special situation of Gyeongju City that has ordinances to actively support hanok styles and hanok special district.

The fact that the existing applications of hanok elements are limited to relatively small and medium-sized buildings indicates that application to large-sized public buildings has limitations because in general, hanok elements or structural styles are not large in size and are composed of spaces between columns. Further, it indicates that it is necessary to discover hanok elements that can be applied to large-scale public buildings as shown in the case of Gyeongju City. In this respect, it can be inferred from the classification system presented above that the hanok central type is applicable to small public buildings due to the structural limitations of the hanok itself. However, partially transformed and abstract application types are applicable to small and medium-sized public buildings.

### 3.2. Application strategy of affordable design method applying hanok elements

#### 1) Correlation between application strategies of the affordable design method and focused strategy

To apply hanok elements to public buildings, we need to analyze the existing applied hanok elements and carefully examine future possibilities, in addition to discovering applicable hanok elements.

As mentioned in Kim's study[1], the application strategy for hanok elements to public buildings emerges as one of four stages of adoption, replacement, transformation, and fusion, or a combination of these[1]. This division of stages is meaningful to infer the degree of application of hanok elements to public buildings or the parts required for future application, and it can also be applied to the development of an affordable design method applicable to public buildings.

However, this strategy may be useful as an index of the stage or degree of application of hanok elements; however, it has vague aspects in its scope and degree for composing the hanok elements application strategy optimized for the type or attributes of every public building. Therefore, it needs to be reorganized by considering the correlations between strategies according to the degree of application in general. When we examine the correlations between strategies in the above discussion or that mentioned in Kim[1], the strategies suggested for the application of hanok elements are based on adoption, and strategies such as replacement, transformation, and fusion are added, or substitution and transformation are mixed. Furthermore, the adoption and replacement strategies can be classified as passive strategies because they are faithful to the existing structural system of the hanok. The hanok elements are applied without

transforming or distorting hanok elements, whereas the deformation and fusion strategies can be classified as active strategies that apply hanok elements through morphological and functional transformation or abstract application of existing hanok elements. To compare the correlations matrices, we use the results as summarized in Table 3.

Table 3. indicates that the application strategies of hanok elements to public building are passive strategies such as adoption and replacement. The active strategies are mostly centered on transformation, and there are few cases where the application strategies are actively involved. In particular, the fact that the fusion strategy, which is an advanced design behavior, is rarely applied indicates that there is room for expanding the application of hanok elements to public buildings through the active analysis of tradition or additional design research in the future. Furthermore, a passive strategy can be considered an element-centered strategy in that the basic forms of hanok elements are maintained, whereas the active strategy is a design strategy in that it emphasizes the morphological transformation or abstract utilization of existing hanok elements.

This fact suggests that, when considering the tangible attributes of public buildings, it is desirable to set the minimum application scope of the strategy such as consideration of the aesthetic strengths or functional and economical aspects of the hanok elements. In contrast, advanced design strategies such as fusion can be defined as an optional application strategy although as it is unnecessary and not urgent, considering the general attributes of

Table 3. Correlation chart between each strategy

		Passive		Active	
		A	R	T	F
Passive	A (Adoption)	-	○(AR)	○(AT)	△
	R (Replacement)	△	-	○(RT)	-
Active	T (Transformation)	○(TA)	○(TR)	-	-
	F (Fusion)	-	-	-	-

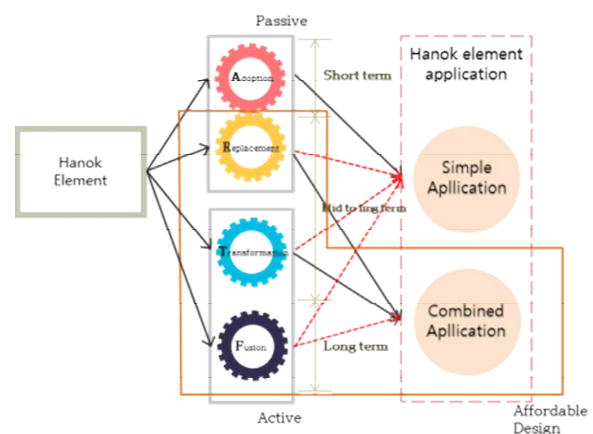


Fig. 2. Correlation between Hanok element application and application strategy

public buildings (Table 4.). This is graphically represented as Fig. 2.

2) Affordable design strategy based on the representative attributes of public buildings

Since each type of public buildings has different values and frequency of use, an affordable design method appropriate for a corresponding building needs to be applied. In this regard, Kim[1] proposed a hanok elements application strategy that is based on the representative tangible attributes of each public building. This is consistent with the meaning of the economic, appropriate, and reasonable affordable design method for hanok

elements[1]. Based on the content of the above study, the sequence of the hanok elements application scope, the main considerations of hanok elements application, and the corresponding application strategies in the above section are summarized in Table 5.[1]. This table outlines the main considerations as per accessibility, convenience, safety, environmental, aesthetics and economics, which are the representative attributes of public buildings. This suggests that the adoption strategy is frequently used in the application of hanok elements and replacement or transformation strategies are used together as needed.

The adoption strategy has a strong tendency of emphasizing the aesthetic aspects such as the maintenance and discovery of the basic morphological elements of a hanok or harmony with modern buildings. A replacement strategy can be used when economic aspects such as the development of substitutes are emphasized, and it is useful when reinforcing the advantages of hanok elements together with the adoption strategy. The transformation strategy can be used when a functional aspect such as improvement of safety or convenience are emphasized. In contrast, fusion is used to emphasize a specific attribute such as aesthetics together with other strategies rather than being used primarily when hanok elements are applied (Table 5.).

To examine strategies based on the attributes of public buildings, the application strategy of hanok elements works primarily on the aesthetics, accessibility, and environmental attributes, while the replacement or fusion strategies are used together additionally. Furthermore, the transformation strategy is set as the primary strategy for safety and convenience, and the

Table 4. Strategic Matrix for Hanok Element Application

Division	Active (Future)		
	Transformation	Fusion	
Passive (Current)	Adoption	AT (TR); Centralization - Utilization of the advantages of Hanok elements - Deformation according to needs	AF; Traditional abstraction - Utilization of Hanok element advantages - Seek design application
	Replacement	RT; Economic practical use - Maintaining hanok - Alternative and partial transformation	RF; Traditional practical abstraction - Maintaining hanok - Abstract design
		TR; Practicalization + abstraction - For optimal transformation - Complementing the disadvantages of the hanok element	FR; Abstraction / new genre - Hanok traditional beauty / abstractness - High-level design behavior

Table 5. Correlation chart of public building attributes and hanok application strategy

○; Leading strategy, △; Ancillary strategies

Representative properties	Major considerations when applying hanok elements	First strategy for applying Hanok elements				Final application strategy	General features	Characteristics of affordable design techniques
		Adoption	Replacement	Transformation	Fusion			
Aesthetic	- Additional discovery and application of design elements of hanok - Attempts to harmonize with modern architecture	◎	○	○	○	A	Aesthetic	Short-term / passive Affordable design technique
Accessibility	- Maintain basic form of hanok / hanok components - Develop and discover existing unapplied hanok elements - Deformation and fusion as needed	◎	○	○	-			
Environmental	- Use of natural materials / sustainable old method, use of modern materials - Deformation and fusion as needed	◎	○	○	-			
Safety	- Compensation for fire shortcomings - Develop seismic reinforcement by utilizing wood structure features	-	○	◎	-	T	Functional	Mid / long term / active Affordable design technique
Convenience	- Introduction of design for convenience / convenience such as universal / BF	-	○	◎	-			
Economics	- Development of economic alternatives such as materials and old methods	-	◎	○	-	R	T	Economical

replacement strategy for economics, while the replacement or transformation strategies can be used together. This fact suggests that, to express aesthetics, accessibility and environmental aspects, the application strategy of hanok elements from the aesthetic aspect, such as the original application of hanok elements or the discovery and application of additional design elements, is effective. Further, it means that, to emphasize safety or convenience, the transformation (T) strategy that emphasizes the functional aspects such as the compensation of fire or earthquake or the adoption of BF and universal design, and in terms of economics, the replacement (R) strategy such as the development of substitutes for the existing expensive hanok materials or structural methods, are key strategies. This implies that fusion, deformation, and replacement are the main strategies to be considered when applying hanok elements, and the development of an affordable design method is necessary in terms of aesthetic, functional, and economic aspects[1].

Furthermore, when these strategies are considered in association with the application scope of the affordable design for public buildings discussed above, the attribute that requires the introduction of the affordable design method are safety, convenience, and economics. Thus, it is necessary to actively attempt the universal application of hanok elements to public buildings using the transformation or replacement strategy (mid-term/active affordable design method). For aesthetics, accessibility, and environmental attributes, an affordable design can be achieved by maintaining the simple adoption (A) strategy of hanok elements, which is applied even now, and by using the replacement, transformation, and fusion strategies in parallel as needed (short-term/passive affordable design method).

### 3.3. Subconclusion

We presented the scope and main strategic directions for the smooth application of hanok elements to public buildings in the future as well as the characteristics of the application of hanok elements through the correlation between the application strategy and public building attributes for applying hanok elements to public buildings. This can be identified as applying hanok elements to public building more smoothly and actively by additionally improving or generating new applicable items among the various attributes that need to be considered. This analysis suggests that each application strategy can be selectively applied depending on the attributes of public buildings and additionally required strategic direction, and it distinguishes the types of public buildings to which each strategy is applied. Furthermore, the strategies for public building types for application of hanok elements can be distinguished between

strategies applicable to all types and strategies that can only be applied to multiple frequent use public buildings.

The affordable design method for the application of hanok elements requires mid- to long-term research for active application or utilization compared to short-term research with a limited scope. Therefore, existing cases where hanok elements have been applied to public buildings or the cases where the hanok elements can be used immediately to express aesthetics, environment, and friendliness through additional discovery or development of hanok elements, can be set as a short-term strategy. In addition, economics, safety, and convenience, which are currently obstacles to application, can be set as mid- to long-term strategies because various studies and experiments must be conducted through replacement or transformation. Furthermore, a fusion strategy that creates new domains based on the hanok and traditions through the application of hanok elements and abstract design can be classified as a long-term strategy that requires continuous research and experimentation (Fig. 2).

The affordable design method applicable to the public buildings based on the correlations between the above application scopes and strategies of the affordable design method outlined in Table 6.

## 4. Needs-Response-type Affordable Design Method for Public Buildings

Two methods can be suggested to apply hanok elements to public buildings. First, we need to identify existing problems based on past application cases of hanok elements and then to apply and discover hanok elements that can respond to the unique attributes and needs of each public building. Next, to expand the application of hanok elements to public buildings, we need to suggest methods to improve and complement the disadvantages of hanok elements in correspondence with modern needs.

The former can be considered a short-term strategy due to its strong objective of immediate application of hanok elements to each type of public buildings. The latter can be considered a mid- and long-term strategy in that it sets forth the applicability of hanok elements to various modern buildings including public buildings.

### 4.1. Short-term strategy: Needs-response-type hanok elements affordable design method based on the tangible attributes of public buildings

To introduce and apply hanok elements to public buildings



Table 6. Comprehensive strategy of applying Hanok elements to public buildings

Strategy	Characteristics	Application properties	Target public buildings	Strategic use of direction	Strategies and characteristics of affordable design technique
Adoption	A strategy that adopts and applies the unique eco-friendly attributes and symbolism or identity of hanok	Aesthetic Friendliness Environmental	Multiple frequency public building	<ul style="list-style-type: none"> <li>- In order to express openness or harmony with existing buildings, it is necessary to introduce aggressive methods such as replacement, transformation, and fusion of hanok elements (A-T / F).</li> <li>- For openness, an alternative space or design method that complements the closure of hanok while using the existing hanok elements needs to be replaced (AR), and in some cases, it is necessary to transform and fuse as necessary to present new hanok elements or space ( AT / F)</li> </ul>	Short term strategy ; Partial / passive possible design technique applied emphasis on aesthetics
			Hanok central type		
Replacement	As a passive strategy to respond to today's needs while maintaining the advantages or unique form of the hanok, a strategy that needs to be introduced to express the functionality of economics and safety of public buildings	Economics safety	All public buildings	<ul style="list-style-type: none"> <li>By replacing (R) relatively inexpensive materials among the elements of hanok with inexpensive and functional modern materials, it secures economics without modification to the existing style.</li> <li>- To reinforce topical vulnerabilities, it is possible to replace (T-R) through the development of new materials, such as CRT and non-wood materials.</li> <li>- For public buildings where economic efficiency is not greatly emphasized, proper adoption or replacement of hanok elements can be performed (AR), and when openness of public buildings is required, design techniques (RT, RF) through transformation and fusion of existing materials or elements and so on.</li> </ul>	Mid- to long-term strategy ; Application of active possible design technique ; Economic / functional Side emphasis
			Partial transformation		
Transformation	The limitations or problems of the hanok element strategies that can respond to modern requirements and to transform existing elements using materials and methods	Safety Convenience Economics	All public buildings	<ul style="list-style-type: none"> <li>- It is necessary to develop a modified design technique in consideration of universal design or BF.</li> <li>- Interworking with the replacement (R) is also possible</li> <li>- It is also possible to use it by transforming it appropriately for modern needs, or to carry out a combination of transformation and replacement while maintaining the shape (T-R).</li> </ul>	
			Partial transformation		
Fusion	Applicable in cases where traditional hanok elements are reflected without morphological characteristics or materials	(Aesthetic)	Multi-frequency public buildings	<ul style="list-style-type: none"> <li>- Rarely used directly for expressing the properties of each public building</li> <li>- Applicable for the purpose of hiring Hanok elements (symbolism, etc.) (A-T / F, A-R / F)</li> </ul>	Long-term strategy ; Applying optional possible design techniques ; Abstract beauty emphasis
			Abstract application		

immediately and easily, we need to develop a design method that can individually respond to the attributes or unique needs of each public building. To that end, we need to establish the priorities of application strategies such as adoption, replacement, transformation, and fusion according to the response strategy of hanok elements to each attribute of public buildings. This is a primary method for complementing the insufficient parts of the application of hanok elements to public buildings, and it can be

considered a short-term strategy because the hanok elements can be directly and immediately applied to public buildings.

The short-term strategy is to maintain the current application frame of hanok elements in which the application of hanok elements to existing public buildings focuses on the aesthetics, friendliness, and symbolism aspects(1). It can be separated into a method of inheriting the original form such as the traditional beauty of the hanok and a method of additional discovery, and

the introduction of the general aesthetic aspects of a hanok. In both cases, the application strategy of the hanok elements is centered on adoption (A).

Further, to introduce and apply hanok elements to modern public buildings while maintaining the original form of the hanok or hanok elements, it is important to discover hanok elements that are applicable even today through research or past examples of existing traditional hanok apart from the representative elements of hanok that are applied such as windows and columns. As shown in prior studies, the hanok elements adopted in today's public buildings are mostly roofs, tiles, columns, cornerstones, foundation, and windows(10), and unfamiliar elements such as somaetdol and baluster are rarely or passively applied. Furthermore, if it is difficult to adopt the original elements of a hanok because of material characteristics and economic aspects such as price; however, if they need to be applied, the replacement (R) strategy can be introduced in parallel. When relatively expensive members such as tiles, columns, and windows are replaced with other members that are economically feasible while maintaining the original forms of hanok elements, they can be applied at no cost. This strategy may be necessary for the universal supply or expansion of the application of hanok elements in the future.

Next, when applying hanok elements to emphasize the aesthetic aspects of hanok, not only the simple adoption (A) strategy through the application or discovery of hanok elements but also the discovery and application of more diverse hanok elements is required. This is possible through the simple transformation of the members. The aesthetic selection range of hanok elements can be expanded through the partial transformation (T) strategy of hanok elements. Furthermore, increasing the degree of transformation or the abstract fusion (F) strategy using the motive of traditional hanok architecture can be applied to emphasize the aesthetic aspects of hanok elements or to expand their application scope.

Although this short-term strategy has the advantages of the possibility of immediately using the hanok elements that have been newly discovered and those verified until now, some trial and errors in discovering new elements through replacement, transformation, and fusion are expected. Therefore, to practically apply the short-term strategy, it is necessary to apply it to small-scale hanok-style public buildings where aesthetics, environment, and friendliness are emphasized.

#### 4.2. Mid-to long-term strategy: Needs-response-type affordable design method based on complementing hanok elements

As suggested by previous studies such as Kim and Baek, hanok

and hanok elements are being recognized for their effectiveness in various aspects such as the maintenance of tradition, harmony with nature, and the use of eco-friendly materials. However, they expose functional problems such as long moving line, equipment, noise, and lack of storage spaces[10]. This implies that although there is no problem in terms of aesthetics, they have difficulties in responding to today's functional or structural needs. Furthermore, based on Kim[1] and the discussion in 3.3[2], economics, safety, and convenience play a role in the application of hanok elements to public buildings. However, there are no specific problems in the application related to accessibility, environment, and aesthetics aspects. Therefore, to easily apply hanok elements to public buildings in the future, the current unreasonable parts need to be corrected, which is a prerequisite for the affordable design of public hanok buildings.

To apply more hanok elements to public buildings in the future, we need to examine the economics, safety, and convenience aspects of hanok elements and to provide room for utilizing them in other buildings as well as public buildings in the future. This work is required for the proper and continuous applications of hanok elements in the future, rather than for immediate and direct application of hanok elements. In this respect, it can be considered a mid- to long-term application strategy. Since the improvement effects of hanok elements are expected through the above mid- to long-term strategies, they can be used in partially transformed public buildings as well as the hanok-centered public buildings.

The main considerations regarding the economics, convenience, and safety for mid- to long-term strategy and the affordable design method are summarized as follows.

##### 1) Affordable design method considering improvement of economics

This design method can be applied even when it is difficult to introduce and apply hanok elements to public buildings because of the economic disadvantages of the hanok. For example, this strategy presents a method that can be used to replace expensive hanok elements such as Douglas fir and other wooden materials and traditional tiles. To understand the economic aspects of hanok elements, active complementation and modification of all hanok elements are required. Thus, it is necessary to promote the replacement (R) strategy rather than simple adoption. Depending on the case, a passive replacement (R) strategy for expensive materials and elements can be used in parallel.

Since various national policy projects such as research and development and hanok technology development at the National Hanok Center, which attempts to expand its boundaries by

developing relatively inexpensive hanok elements for the diffusion of hanok architecture, are producing results, these research results can be referenced. In particular, the National Hanok Center and other institutions have already presented various replacement technologies considering the economics of hanok[11].

Furthermore, as shown in the case of Gyeongju City, simple replacement (R) strategies such as replacing wood with concrete or traditional tiles with plastics while maintaining the shapes of the hanok elements can be also introduced. Furthermore, the replacement and transformation (T) of hanok elements appropriate for the characteristics of large-scale public buildings such as the Gyeongsangbuk-do Provincial Office can consider the economic aspects.

## 2) Affordable design method for improving convenience

The hanok shows good eco-friendly properties such as moisture prevention and ventilation because its foundation is above the surface; however, this may interfere with convenient entry or approach. In particular, for public use facilities that are used by all age groups, universal design or barrier-free design need to be introduced to prevent interference with entry or use because of the nature of public buildings that should satisfy all users. In particular, many local governments including Naju City are necessitating BF certification for all buildings in the area, thereby enforcing the legal coercion of securing convenience of public buildings.

As reported by Kim(4), the foundation for social welfare facilities or senior and children facilities and the hanok elements that can be used aesthetically such as stepping stones and somaetdol are omitted to secure safety. Therefore, the application of hanok elements to public buildings must be preceded by a review of the general elements specified in the existing universal design or BF certification, and it should be followed by the application and modification of hanok elements that will be useful for securing convenience in public buildings as well as for expanding the scope of the application of hanok elements. Among the certification items, the hanok elements addressed in this study are mediating facilities (access road, parking lot for the disabled, and main entrance), and it is critical to discover, replace, and transform hanok elements to prevent interference with the entrance and the exit. When the application of hanok elements is expanded to the internal space in the future, the items required by the BF certification such as sanitation, guidance, and other facilities need to be examined individually.

The active replacement or transformation of hanok elements that lack convenience is also possible. One possible example is to adopt a modern engineering method such as the direct

installation of columns or walls from the surface by reducing or discarding the foundation that interferes with the entry and the exit to secure the aesthetic aspects of the hanok elements.

## 3) Affordable design method for improving safety

When we exclude convenience and certain overlapping parts such as removing the step or installing a ramp as mentioned above, the main topics of the affordable design method for safety are safety against fires and earthquakes. Hanok elements are inevitably vulnerable to fire because wood is used by default. There is no exception when hanok elements are used as exterior materials. Thus, it is necessary to perform flame retardant treatment for the wood and to replace them with flame retardant and thermal insulation materials. In particular, the active introduction of new materials using wood, such as cross-laminated timber (CLT), can provide structural stability as well as safety against fire. Lamination or industrial wood can be used if the economics aspect needs to be considered. Since this strategy of applying replacement timbers has a considerable amount of data owing to the extensive research performed by forest research institutes, previous studies, and overseas cases, these data need to be used in the future.

Protection against earthquake is also a critical part of the affordable design for safety. Although hanok wooden structures are relatively stable against earthquakes, it is necessary to utilize hanok elements through the inspection or certification of earthquake resistance because these public buildings will be used by many people; thus, it is necessary to ensure safety, as can be seen from lessons of the earthquake in Gyeongju, which damaged tiles. In particular, the affordable design method for hanok elements requires intensive replacement and transformation of elements that can introduce risks in the event of an earthquake such as columns and roof tiles. To that end, as with the convenience item mentioned above, we should search for a method to secure earthquake resistance or seismic safety for hanok elements when necessary using certification systems such as an earthquake safety labeling system applied to public buildings (Ministry of the Interior and Safety)<sup>16)</sup>. Further, it is advisable to devise earthquake measures for individual hanok elements such as drying tiles and assembling them using bolts or nuts, and complementing and developing traditional structural methods that are relatively robust to earthquakes such as the foundation soil layer method<sup>17)</sup> and sidelobe method.

These are protection techniques of existing hanok elements have a poor performance against fire and earthquakes. Therefore, a strategy to transform (T) the hanok elements by actively using substitutes, modern materials, and new methods should be adopted.

### 4.3. Long-term strategy: Affordable design method for hanok public buildings based on fusion strategy

The long-term strategy can be considered an omnidirectional interpretation of the hanok that considers the mental aspects as well as the hanok elements and traditional building of hanok. It is also a developmental behavior to promote coexistence with modern architecture and the expansion of boundaries of our traditional architecture through the restoration of the traditionality and peculiarity of our country. Therefore, in principle, it is desirable to start with a discussion on the restoration of our tradition or traditionality, and the actual premise is high-level design behaviors such as reinterpretation of the hanok itself, which is beyond the simple application of hanok elements. Thus, the long-term strategy is considered to have experimental applicability of new genres such as abstract application time to public buildings.

This movement appeared intermittently around experimental buildings including houses as a result of the theories and disputes regarding the implementation of traditionality or methodologies that have been continued since the 1960s. However, it was not applied as actively to public buildings as it was to housing. Therefore, to apply the fusion results of hanok elements to public buildings in the future, various experimental processes regarding hanok, hanok elements, and traditionality are required.

The discussion of the fusion strategy of hanok elements—a long-term strategy—is omitted here because this paper deals with the application of hanok elements to public buildings. Public buildings are not objects of experiments for discussions on traditional housing, and it is desirable to immediately and objectively apply the verified results in terms of the publicness of public buildings.

Based on the above discussion, the strategies of each hanok element and the expected application results and cases are summarized in Fig. 3. and Table 7.

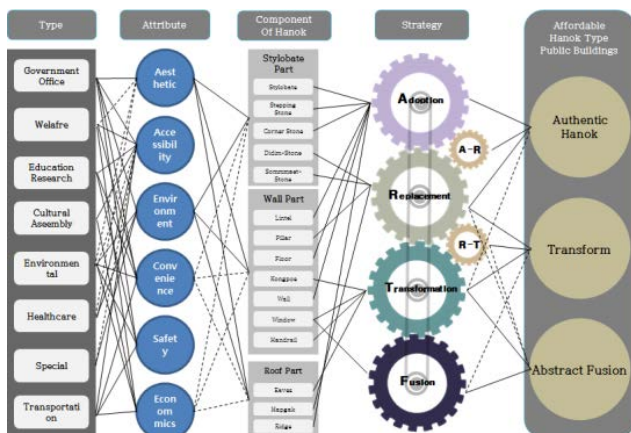


Fig. 3 Strategic planning according to the hanok area

Table 7. Strategy and application results and examples for each hanok element

	Part	Adoption	Replacement	Transformation	Fusion
F o u n d a t i o n	Foundation				-
	Stepping stone			-	-
	Somaetdol			-	-
	Cornerstone			-	-
W a l l	Wall				
	Lintel				-
	Pillar			-	-
	Window				-
	Kongpoe				-
	Floor				-
	Handrail				-
R o o f	Eaves				
	Hapgak			-	-
	Crest			-	-
	Shape			-	

## 5. Conclusions

This paper described the considerations and application strategies for applying hanok elements to public buildings and the affordable design method for public hanok buildings wherein hanok elements are applied. The results of this study can be summarized as follows.

1. A hanok design method to respond to the needs of each public building is required to apply hanok elements to public buildings and to supply and diffuse them smoothly in the future. As shown in previous studies, the application of hanok elements to public buildings should meet the economic, safety, and convenience requirements. There is a concern in that the application of hanok elements would remain partial and limited to specific elements unless further research on this subject is conducted. Therefore, we need a design method for economic and acceptable hanok elements that can respond to the needs of today's public buildings for active and sustainable applications of hanok elements.

The present study established an affordable design method and defined its application scope by presenting it as a methodology to complement and develop the insufficient parts in the application of hanok elements to the current public buildings such as economics, safety, and convenience. Furthermore, we noted that the aesthetic and symbolic aspects are more emphasized for hanok elements applied to public buildings compared to the functional aspects. Thus, we suggested multiple frequent use facilities often exposed to the public as an application target of the affordable design method, considering the diffusion and promotion of the public hanok buildings in the future.

2. To introduce and apply the affordable design method, the correlations with the hanok element application strategies suggested by a previous study(1) were examined. The strategies for introducing hanok elements to public buildings were classified into passive and active strategies based on whether the hanok shape is maintained and the degree of maintenance using a correlation chart between application strategies and the strategy matrix. Consequently, the hanok element introduction strategies of replacement (R) and transformation (T) were derived as appropriate strategies for applying the affordable design method. Based on this, the hanok element application strategies of simple application were classified as short-term strategies, and strategies such as replacement (R) and transformation (T) as mid- to long-term strategies. The fusion strategy was classified as a long-term strategy because it involves advanced design behaviors as well as being associated with additional traditionality research or experiments on hanok in the future.

3. It is advisable that short-term strategies of the affordable design method should be centered on the adoption (A) strategy because it emphasizes the unique morphological aspects of hanok elements and can be used immediately. We suggested that it was necessary to discover various hanok elements that can be applied aesthetically in the future, in addition to applying the current

paradigm of hanok elements or specific multiple frequent use elements such as roofs and roof tiles.

Mid- to long-term strategies are strategies that encourage active utilization or application of hanok elements in the future by improving the current disadvantages. We proposed an affordable design method using the replacement (R) strategy for improving economics, the replacement (R) or transformation (T) strategy through universal design or BF for securing convenience, and the active transformation (T) strategy considering fire resistance or earthquake resistance for improving safety.

4. Finally, the applicable design patterns and actual applicability were presented using the above application strategies for correlations between the types and attributes of public buildings and the hanok elements. However, this study only outlined the representative utilization cases of each application strategy, and the individual designs and products are expected to be concretized through follow-up research in the future. When these design methods and products are organized, they can be used as archives for affordable design elements of the needs-response-type hanok elements applicable to public buildings.

This study is different from existing studies on hanok that focus on the quality improvement or modern utilization of traditional hanok buildings because it attempts to experiment on the possibility of implementing a new genre of public hanok building by actively applying hanok or hanok elements to public buildings. However, this study is limited in the comprehensive discussion on the interior and exterior space compositions of the hanok and the mental aspects of the furniture and hanok architecture because the discussion only focuses on the visual and morphological aspects of hanok elements. However, it is meaningful that this study attempted to combine modern public buildings and hanok elements while maintaining a large framework of the modern interpretation and application of hanok.

Based on this study, we should further develop the affordable design method of hanok elements that can respond to modern needs through in-depth discussions and research on hanok or traditional Korean architecture.

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- 12) Yang et al, defines affordable LED as an entry-level LED. J.G. Yang, B.C. Lee, Y.S. Oh, S.K. Park, Development of affordable LED headlamp with two 4-chip LED. *Spring Conference of the Korean Society of Automotive Engineers*, 2014, p. 1032.
- 13) Yang et al, interprets affordable method as a reasonable method. Source: E. Yang, K. Lee, J.M. Ha, W. Kim, H.K. Song, I. Hwang, P.G. Jablonski, Affordable method of video recording for ecologists and citizen-science participants. *Journal of Ecology and Environment*, 42(1), 2018, p.11.
- 14) Quoted from D. Oh, The marketing strategy study on affordable luxury in China: The example of MCM, VOL.- NO.- (2017)
- 15) Shim (2015) also presents similar research results. He examined the application cases of hanok elements and found that there are many cases of applying traditional architectural elements to cultural and meeting, residential, business, and educational facilities. K.S. Shim, A Study on the traditional architectural elements and changing patterns of preference in contemporary architectural works of South Korea, *Chonbuk National University Doctoral Dissertation*, 2015, p. 104.
- 16) The subjects of the issuance of the certifications for earthquake safety labeling system are the public buildings among the buildings listed in Article 14 (1)–1 of the Act on the Preparation for Earthquakes and Volcanic Eruptions. Public buildings are buildings that are maintained and managed by the following organizations: central administrative agencies, local governments, the institutions corresponding to Article 4 (1) of the Act on the Management of Public Institutions, public enterprises and industrial complexes established based on the Local Public Enterprises Act, and buildings that are specially recognized by the Minister of Public Administration and Security. Relevant Law: Act on the Preparation for Earthquakes and Volcanic Eruptions, Article 14 (Establishment of Standards of Earthquake-Proof Design)
- 17) Foundation soil layer refers to a method of accumulating layers of fine stones, soil, and sand. It is a construction technique that can sufficiently withstand differential settlement or earthquakes. Ancient buildings in Korea were generally built using the foundation soil layer method. The foundation soil method or sidolobe method was applied to the Cheomseongdae and Pungnap-toseong Fortress as well. Partially quoted from the Pyeongchang Occupational Hanok School blog ([https://blog.naver.com/ix\\_1004/220013362738](https://blog.naver.com/ix_1004/220013362738)).
- 1) The Act on Value Enhancement of Hanok and Other Architectural Assets defines hanok as a building, spatial environment, and infrastructure with social, economic, or scenic value valid in the present and future, which either has unique historical or cultural value, such as a hanok, or contributes to promoting architectural culture of the State or to the formation of the identity of any local region.
- 2) Article 2 of the Enforcement Decree of the Building Act defines hanok as a building, the main structure of which consists of wooden columns, beams, and Korean style roof frames, and which reflects the traditional style of Korea, and any building annexed thereto.
- 3) The definitions of hanok in the ordinances of local government follow the definition of the Building Act, but also uses the definition of “buildings and attached facilities that retain traditional beauty” (Jongno-gu, Seoul and Suwon-si, Gyeonggi-do)
- 4) Apart from the above-mentioned architectural assets and hanok, many studies have suggested various similar concepts considering the expansion of the boundaries and application scopes of hanok such as the hanok building style, traditional hanok, cultural heritage hanok, Han style, and new hanok. However, we do not discuss them here because they are not closely related to the intention of this study. For details on these concepts, please see the following research report and paper: Ministry of Land, Infrastructure and Transport, Hanok Technology Development Stage 2, First Year Research Report on New Hanok-style Public Building Model Development, 2014, Chun (2017), p.5
- 5) Re-quoted from Cho, *ibid.*, p.4
- 6) Re-quoted from Hanok Technology Development Stage 2/ First Year Research Report on New Hanok-style Public Building Model Development (2014) and Cho (2015), p.4
- 7) Chun (2017), *ibid.*, pp. 41–42
- 8) Re-quoted from Chun (2017), p. 20. See the following paper for the original text: S.H. Cho, Building type classification and architectural characteristics of public buildings of the Korean traditional styles,