



*Application of the Public Buildings for the Korean-style houses in the availability of R&D technologies
- Focused on Drawings of Agricultural Education and Experience Center in Na-Ju, Korea*

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ABSTRACT

Purpose: In this paper, based on the design drawings of Naju Agricultural Technology Learning Center by focusing on features of New-Hanok applied technology in the design and construction process of New-Hanok Type Public buildings by looking at the characteristics of the whole building is planned to be presented in the future development direction and value of public architecture applied to public buildings. **Method:** we first review the Phase I study results of technology development and application technology to look at the type and characteristics of the technologies applied in Naju Hanok Experience Agriculture Learning Center. As construction designs through the consultation suggestions reflect changes were seven times. By analyzing the changes in the basic design and conduct design in the process were organized for the new technologies applied and whether the application of existing technology hanok. **Result:** (1) Complements the shortcomings of technology and R & D to offer an alternative to the reinforcement was omitted modify the construction method or irrational process. (2) Implementation of a technique aiming to apply new-hanok workability and economic efficiency is based on a combination of the modern construction techniques and materials. (3) The use of modern materials to the extent that can assist in the purpose and function of the building are to be accommodated. (4) There is sufficient historical study and design plan for establishing identity is necessary in order to reflect the history and tradition of new-hanok public buildings.

KEYWORD

New-Hanok
New-Hanok type Public Buildings
New-Hanok R&D Technology
Education and Research Facility

Neo-Korean Style Public Building
Applied Techniques by part in Hanok
Agricultural Education and Experience Center

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1. Introduction

1.1. Purpose and meaning of the research

Various researches and architectural attempts on traditional architectural field prior on residential facility have been continued due to the rapid increasing of interest for Hanok. Especially, hanok type public building projects can be expected as cultural industry which can announce Korean architecture to the world with Korean wave as well as social ripple effect. Ministry of Land, Transport and Maritime Affairs has been selected 'Hanok Building Support Project' every year and support the budget as a plan to revitalize hanok type public building since June 2012, and to fulfill it, the revitalization plan of several government institutions are expanding all over the nation. Along with it, the research support and education for hanok preservation and culture support and promotion contents development also expanding the scale.

New-Hanok type public building model development and Implementation project among hanok technology development

research¹⁾ is succeed the brand value of traditional hanok and develop general hanok secures modern residential performance as well as public hanok building, and it is aimed to change the social understanding about hanok and create the foundation for hanok by popularization and generalization of hanok technology.

New-Hanok public buildings grafted advantages of hanok and rationality of modern technology have been built at Eunpyeong-gu, Seoul, Soonjang-gun, and site in Naju Agricultural Technology Learning Center, Jeollanam-do by New-Hanok Type Public Buildings Model Development and Implementation Project, and Naju Agricultural Technology Learning Center among them has been built as a education and research facility related to the agriculture for the lectures related to domestic agricultural technology and international agricultural exhibition. Naju

1) New Hanok Type Public Buildings Optimization Model Development and Implementation Project is the project to create the foundation of hanok building, and hanok technology development R&D project of Korea Agency for Infrastructure Technology Advancement aims to globalize and to be sightseeing culture of hanok through the 'Han brand' development which was generalize and expand high class and eco-friendly house hanok. 1st phase of hanok technology development R&D project had been processed from Dec. 2009 to Sep. 2013, and the 2nd phase was started and will be continued until Oct. 2016. This research is divided as three detailed department, and upgrade and standard development of new hanok core technology aims in 1st detailed dept., new hanok village model development and implementation aims in 2nd detailed dept., and new-hanok type public building model development and implementation aims in 3rd detailed dept.

Agricultural Technology Learning Center is one of the case applied new-hanok type public building concept of hanok technology development 2nd phase demonstration implementation project. It applied the outcome of hanok technology development 1st phase and also greatly significant as new style new-hanok type public building grafts modern architecture technology not usually used in existing hanok such as RC or glass curtain wall system.

In this thesis, the future value and improvement direction of new-hanok type public building applied on public building over the hanok shall be proposed through the check about the features of new-hanok technology applied on the design and construction of new-hanok public building and the planned features of total buildings reflected them based on the design documents of Naju Agricultural Technology Learning Center. Specially, the design change was mainly applied for effective construction of new-hanok type technology application, so to organize and analyze hanok applied technology appeared or disappeared during design change is positively necessary work for future expansion of new-hanok type public buildings and continuous competitiveness securing, and improving workability.

1.2. Method and Range of the Research

In this research, the research result of hanok technology development 1st phase and hanok technology were reviewed preferentially to check the type and features of hanok technology applied on Naju Agricultural Technology Learning Center, and organize and analyze the application or not and applied degree of existing hanok technology as well as newly applied technology based on the trace for changed items on basic design drawings and detailed design drawings modified 9 times to reflect design plan discussion or construction suggestion, etc.

The basic and detailed design drawings of Hanin Architects & Associates elected for design of this project was reviewed for the analysis of hanok technology reflected on Naju Agricultural Technology Learning Center, and the technology suggestion of construction company and design discussion of research group also has been referred.

Object of the research is limited as Naju Agricultural Technology Learning Center. Besides, the definition or concept related to new-hanok in this thesis is following the standard of Hanok Technology Research Group.

2. Present Condition of Hanok Type Cultural Assembly Facility and Outline of Agricultural Technology Learning Center

2.1. Range of Education and Research Facility among New-Hanok Type Public Facilities

The definition of ‘New-Hanok’²⁾ under current law is not established institutionally, but it means the improvement to adapt modern life and environment by adopt advanced wooden architecture technology and system along with traditional value in academic significance.³⁾ Furthermore, new-hanok type public building is the building close to everyday life of the residents, and it includes the facilities to improve welfare, cultural benefit, and exchange of the residents.

Meanwhile, domestic education and research facility based on Building Act and Enforcement Ordinance includes every kinds of school, education center, vocational training center, private training center, laboratory, and library. These facilities are composed with education basic facility and research facility as well as support facility and affiliated facility. Among them, education center and laboratory are the space for main activity with unique independence and overall interconnection is most important. Especially, planned design on education and research facility as a public building is necessary to fulfill publicness and professionalism at the same time.

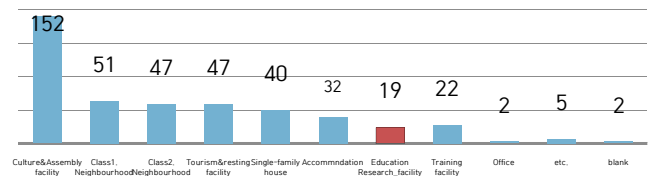


Fig. 1. Distribution of Han-ok Public center

It is 128 sites⁴⁾ of hanok public buildings owned by central government and local government all over the country based on the statistics in 2015, and most of them are concentrated in culture and assembly facility in use (36.3%) (fig.1)⁵⁾.

As shown in fig. 1, the share of education and research facility⁶⁾ among hanok multi purposed facility is very low and more than half of



2) ‘Architectural Property’, ‘Hanok’, and ‘Hanok Architectural Style’ is defined in current law, but ‘Traditional Hanok’, ‘New-Hanok’, ‘Cultural Properties Hanok’, ‘New-Hanok Type Architecture’ are not included in the law.
 3) New-hanok was defined as follows in the research for New-hanok village demonstration project enforcement direction and standard arrangement by Korea Land and Housing Corporation (LH) in 2009. Since then, New-hanok was defined as ‘it means overall hanok designed and built present premised the livability, hanok applied modern hanok new technology and new construction method, hanok applied renovation work’ in ‘study on the policy measures for provision of the han-style public buildings’ by Architectural Institute of Urban Space published in Dec. 2011.
 4) Sin C-H arranged hanok public building list as 128 sites and 419 buildings through the data search process such as satellite photos, roadview readout, government support project, news release, news among national and public property and tiled roof 17,886 buildings in building management register for hanok public building statistics through [A Study on Efficient Operation and Management of Hanok Public Buildings on the Journal of Architectural Institute of Urban Space published in 2014.
 5) Extracted from the body of [Present Operation and Management Condition and Utilization Plan of Hanok Public Building] among hanok policy briefing of June 2015
 6) The list of total 8 sites 19 buildings of education and research facility opened the main participant is public organization are as below table. Detailed type is divided as library, museum, and experience center apart from education center and laboratory. Besides, there are Agricultural Museum (RC + wooden structure) at Yeongam-gun, Jellanam-do built in 2014.

them are located in Jeollanam-do, therefore, the regional deviation is severe and the construction was concentrated during 2008 ~ 2012. Most of them designed as wooden structure, but there are more than a little applied modern architecture technology such as reinforced concrete structure, etc. Also, the share of education center and laboratory including library and experience center is high in the check based on detailed facility type of education and research facility.

2.2. Construction Background and Design Outline of Naju Agricultural Technology Learning Center⁷⁾

The popularity of graft between education and research facility and new-hanok type public building shall be decreased than other use facilities because it has special features that the purpose of construction is clear and specific user range is limited.

Table 1. Architecture and Structural Design Abstract

Title	Naju Agricultural Science and Technology Education Center		
Address	77-1, Deungsu-ri, Sanpo-myeon, Naju-si, Jeollanam-do		
Zoning district	managing production area	Completion	2016. 04.
Site area	6.615m ²	Building area	374.94m ²
Gross floor area	308.34m ²	Building coverage	5.67%
Floor space index	4.66%	Building scale	Two stories above ground
Structure	R/C Structure -basement and foundations/wooden structure -ground floor		
			
Site status around		Panoramic view	

However, the graft of hanok with technology education facility planned based on Korean agriculture can be identity establishing of the facility and promotional alternative, and especially, in the case of Naju Agricultural Technology Learning Center, it is the space to host and progress agricultural exhibition, so the utilization plan before and after the exhibition should be considered separately.

Regarding Naju Agricultural Technology Learning Center, the detailed design was completed reflects the technology suggestion

of construction company and research group on the basic design of elected plan decided by the discussion of professional organization and research group after select inviting organization through public contest of every local government for new-hanok type public building regional substantiation construction project on Dec. 2014. There had been 9 times of design change from elected plan to final detailed design based on the discussion among research group, engineering company, and construction company.

Naju Agricultural Technology Learning Center is a new-hanok type education and research facility located in Jeonnam Agricultural Research & Extension Services sites which is a building with two stories above ground combined RC structure and wooden structure. Building area is 374.94m² and detailed outline is as shown in below table 1. There are a Naju Plain village at northeast and formed continuous reservoirs and hydrologic system, and near waterside park and agricultural theme park.

3. Design Plan Analysis of Naju Agricultural Technology Learning Center

3.1. Design Change Aspect and R&D Technology Application Range

The design plan have changed 9 times from first public contest prize elected plan. The characteristic change on plane plan for 3 times before and after detailed design from the alternation, and it is distinguished as previous plan and after plan by the detailed design reflects technology proposal of construction company after construction. Among them, design change stages are identified as 4th, 6th, and 9th alternation and main contents and plane type are shown as in below Table 4.

A. The Substance of Naju Agricultural Technology Learning Center Design Change

The initial elected plan was designed traditional wooden technology and design method strengthen the symbolization, but modern construction way and the economic feasibility and efficiency expanding the range applying modern material were shown after detailed design.

The building-to-land ratio decreased 1.54% and floor area ratio decreased 0.68% than initial design plan and the mass also supplemented from parallel type to slenderly straight type. The alternatives which delete unnecessary design method and display space, secure convenient space, and fulfill economic requirements were applied.

Building name	City	Facility type	Open	Structure
Gulmaru children's library	Seoul Gurogu	Library	2011	wooden Structure
Gwangheung-dang	Seoul Mapogu	Education Institute	2013	RC+wooden S
hwachun hanok-school (5)	Gangwon Hwacheon	Education Institute	2008	wooden Structure
Livestock Sanitation Office	Jeonnam Gangjin	Laboratory	2010	RC+wooden S
Sanitation Office(2)	Jeonnam Yeonggwang	Laboratory/Storage	2010	wooden Structure
Forest Museum	Jeonnam Wando	Museum	2009	RC+wooden S
Jangsung public library	Jeonnam Jangsung	Octagonal Pavilion	2012	wooden Structure
Pilbong culture hanok village (7)	Jeolbuk Imsil	Experience center	2009	wooden Structure

7) All drawing data in this thesis are the works of Hanin Architects & Associates, and they all included in this thesis through the agreement with Hanin.

Table 2. Details design change in plan

	Plan Overview in Competitions				3rd ~ 4th Details Alteration				6th Details Alteration				Final drawings			
key-note	- Building coverage 5.67% - Floor space index 4.66%				- The overall area reduction - The stereobate and columns sizing - Column' layout changes /realignment				-United mass on the side of the axis changes -Changes Wheelchair Access and Independent configuration of the staircase				-Changing the bathroom layout -Expand the force up front hall of the openness -connected to the storage and office space			
space	lecture room	exhibit hall	main hall	toilet	lecture room	exhibit hall	main hall	toilet	lecture room	exhibit hall	main hall	toilet	lecture room	exhibit hall	main hall	toilet
area	81.9m ²	64m ²	37.8m ²	34.56m ²	66.15m ²	48.6m ²	37.8m ²	41.76m ²	72.9m ²	54m ²	32.4m ²	32.4m ²	72.9m ²	54m ²	43.2m ²	36.9m ²
					▼ 19%	▼ 24%	=	▲ 21%	▲ 10%	▲ 11%	▼ 5%	▼ 14%	=	=	▲ 33%	▲ 14%
content	function space		communal space		Expansion of the convenience and public space ⇒ Accessible space is secured				Remove the front columns ⇒ stereobate area reduction ⇒ reflects the efficiency of the economy and construction				Independence and expand the office ⇒ increase the openness secured convenience.			
R&D	list of Required Application techniques Korean-style house tile roof structure (reflect a part) Wood structure Construction Insulation Materials and Structures (Required) Foam plastic module for dangolmakyee and dangolmakyee using the same (reflect a part)								improvement suggestion on Select techniques ⇒ wall (1), flooring(2) roofing(5), ceiling(1)				Before Working-Design Required Application – 5(45%) of the 11 Select Application – 12(16%) of the 77			
	list of Select Application techniques ⇒ stylobate(1), carpenter(1), wall (2), flooring(1) roofing(5), ceiling(2)								Structural performance improvement Installation cost savings / Improved workability				After Working-Design Select Application – 19(25%) of the 77			

Overall layout change including column lows and reducing mass was achieved until 2~3th alternation, service space (toilet and storage) expansion plan to secure convenient space in 4th alternation looks remarkable. Since then, the storehouse plan using upper part of 1st floor was suggested passing by 6th alternation, and it is considering the traditional proportion and also considering construction workability and economic feasibility at the same time by omitting front column among 1 front column and 5 beams structure of initial design and changed as large arch type and could secure upper space and unified the mass arranged in a row for right and left.

Upper space of 1st floor is connected with 2nd floor and it is used as storehouse. Also, the preparation of frontality and openness assessment reflected after three times of discussion was completed based on higher accessibility by omission of partial front columns and common hall type of front opens to front yard by independent positioning of stair hall at the rear from 6th alternation.

The change of the entrance of the toilet for disabled person is also for the amendment for publicness and convenience. Finally, the readjustment of toilet space, independent positioning of stairs, and improvement of public space shows the direction of the detailed design after selection of construction company.

Totally, maximized the traditional beauty of Korean style wooden structure and attempted the convergence with modern architectural structure adopted economic structure system, and at the same time, space composition of front corridor, exhibition hall at 2nd floor, and terrace which are symbolic element of elevation design also placed emphasis on variable using of multi function space. However, concentrated the public function for the education room for lectures and hall including toilet considering service space and convenience to approach.

B. Range of New-hanok Technology Application Applied on Naju Agricultural Technology Learning Center

5 in 11 of 1st Mandatory R&D technology firstly designated items reflected on the design of Naju Agricultural Technology Learning Center were constructed, but alternative technology 77 items had been amended or excluded after apply elected plan and

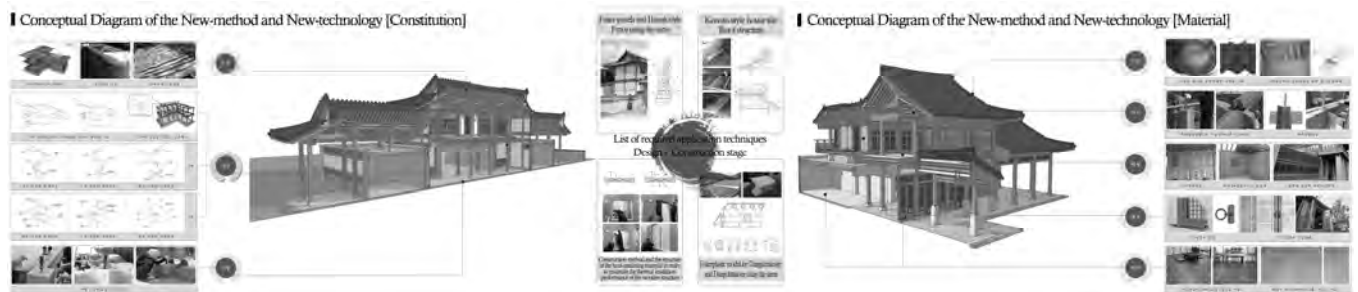


Fig. 2. NaJu Agricultural Education and Experience Center

detailed design. The reflection rate of alternative technology is 25% (19 items) and used at roof construction mostly from 6 construction process, and most of excluded technologies⁸⁾ (53%, 42 items) were mostly excluded because there was no work in this construction or the design condition was different.

Table 3. list of R&D techniques & range of application

No.	Process	Classification			Total	Naju's Agricultural Education and Experience Center		
		required	selection	addition		apply	exclude	hold
01	foundation	-	-	2	2	-	2	-
02	stylobate	-	-	2	2	1	1	-
03	carpenter	-	5	12	17	1	16	-
04	wall	1	1	9	11	5	1	5
05	flooring	-	1	6	7	1	2	4
06	roofing	2	5	11	18	5	2	11
07	ceiling	-	-	5	5	4	-	1
08	joiner's	-	2	7	9	1	5	3
09	landscaping	2	-	4	6	-	6	-
10	other	-	-	3	3	-	3	-
11	monitoring	-	2	-	2	-	2	-
12	computer program	6	-	-	6	4	2	-
total		11	16	61	88	22	42	24

Also, 24 items of technology partially amended the method and applied or postponed to decide to reflect according to the site condition. It is worthy of notice on 9 technology groups applied after supplementation reflecting suggestion of construction company and research group. These improvement plans are the alternatives securing the reinforcement in performance for the defects can be appeared due to the difference of the construction condition (Table 2).

3.2. Focus on Hanok Cultural Assembly Facility Design

When simply imitation traditional design elements in new-hanok type public building, there can be a confusion when mixing other kind of materials or graft with modern architectural technologies. Also, the convenience and publicness of users should be considered when design education and experience center which are public facility though traditional architectural style is base for it.

A. Transmission Process of Traditional Beauty of Naju Traditional Government Office

The design concept of Naju Traditional Government Office is applied on Naju Agricultural Technology Learning Center. Especially, it was reconstituted the central place of Naju⁹⁾ Traditional government Office and hotel, "Geumseongwan", so, it displaced 'space' concept, bilateral symmetry structure, realization

of corridor and servant's rooms in traditional architecture for the symbolization as 'main government office' and fanciness.

Geumseongwan has five rooms by 4 rooms and East-ikheon and west-ikheon¹⁰⁾ were restored during restore project and became current appearance.



Fig. 3. Na-Ju's Traditional Government Office (羅州牧 官衙)



Fig. 4. NaJu Agricultural Education and Experience Center

To approach main office, passing through the main gate, 'Outer three gates' constructed as 3 rooms and 2nd floor gate tower, then passing through 'Center three gates', and also 'Inner three gates' which is only remains as sites, then can arrive front yard of Geumseongwan.

Table 4. Symbolism of design approaches

Naju-mok traditional government office	
outer three-gates	center three-gates
NaJu Agricultural Education and Experience Center	
outer three-gates	Main Entrance

These series of traditional processes had been simplified and reproduced through the 'Outer three gates' at the entrance part of existing construction site and 'Tall three gates' at the front of Agricultural Experience and Education Center'

B. Space Utilization Plan in Corridor as Multipurpose Use

Corridor is a passage installed to divide courtyard with main

8) Excluded technologies due to the design condition difference are 15 items, eliminated items due to the design condition difference are 13 items, and omitted technologies in design plan because of construction cost increasing.

9) Naju was named as 'Ballagun' or 'Geumseonggun' and became current name 'Naju' at 903. Naju became 'Mok' which is current metropolitan council at 998, the time of Seongjong, Goryeo.

10) Dongikheon and Seoikheon had been restored after Naju-gun county office which covered the front of Geumseongwan pulled down at the time of Geumseongwan restoration project. Seoikheon has 4.5 rooms by 3 rooms and located at west of hotel and was for the government official has the grade of Danghagwan (under Jong 3rd grade). Dongikheon has 5 rooms by 3 rooms, and was a working place when the Governor visited Naju and for the government official who is over Jeong 3rd grade.

office as the center or surrounding the inner sanctum. In modern architecture, it is used as service space for events or indoor space meets outside air. Above all, the spatial atmosphere of corridor plays a buffer role for the traditional architecture transition to modern facility.

In Naju Agricultural Technology Learning Center, front of 1st floor composed as corridor, so it strengthen the frontality and reminds open corridor of the main floored room of East-ikheon and west-ikheon, and rises the traditional beauty. Corridor completes three dimensional elevation looks like sticking out of the column of inner wall, and protect direct exposure of the opening connected to inside to outside air and possible to be used as front room.

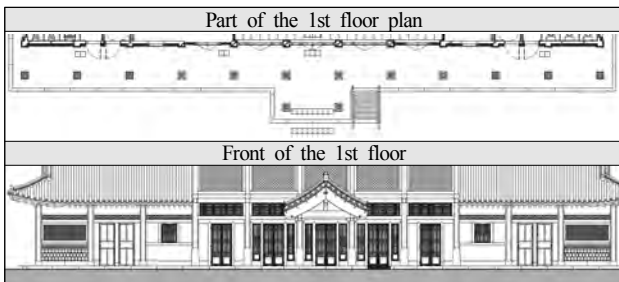


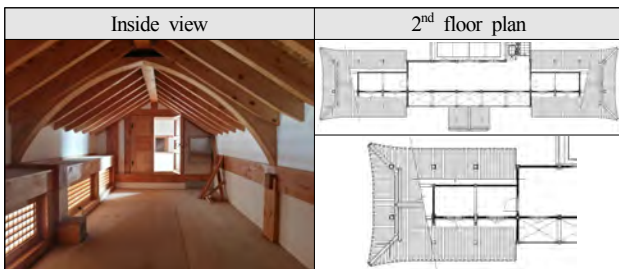
Fig. 5. Details design on corridor

Therefore, it was planned as a reception space for large scale events and lectures by a practical space connected with outside cultural facilities.

C. Storehouse Composition using Roof Upper Space

Use of attic frequently appeared in two storied hanok space have been mentioned several times in already constructed hanok-type public buildings. The attic in hanok library in Guro-gu established in 2009 used as children's space allotting it as sitting reading room, and used as assistant space for education in Geumgua Public Nursery School at Soonchang opened in 2016.

Table 5. Details design in 1st floor on the attic



The plan using roof upper space as room basically a plan to increase the space utilization, but main structure should be come out as it is, so structural effect elements cannot be eliminated including plastering.

The construction method expanding roof space to omit crossbeam for right and left wings and installed hongye truss (arch truss) was applied on the roof space of Naju Agricultural Technology Learning Center.

The securing of storehouse was much needed because of the characteristic feature to perform the events related with agriculture. Insufficient warehouse facility by existing design could be solved by more enough attic space by hongye truss (arch truss) construction as storage and service space assists 2nd floor exhibition hall.

D. Harmony between tradition wooden furniture structure and modern curtain wall

The stair hall installed at the rear of Naju Agricultural Technology Learning Center was constructed with modern structure using steel and glass not with traditional materials. It is interpreted as the plan to secure the safety for the lift for at weak pedestrians and to increase openness and conformability. Also, THK22 the curtain wall at stair hall two storied glass, so it solved visual closure due to the stair hall height.

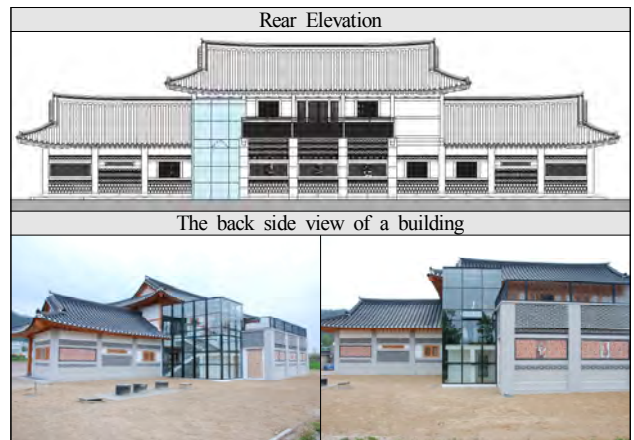


Fig. 6. Rear design

The glass which is modern architectural material is used for stair hall, but it is planned to minimize decoration elements and reducing the sense of difference, and the facility to assist indoor lighting and aims the convenience of the user was applied. It is the convergent of traditional hanok with modern material and construction method, and can be said as an attempt to suggest the development direction and possibility of new-hanok type public building in the future.

E. Reflection of Design Standard for Disabled Person Convenient Facility

Based on social requirement increasing the awareness and expectation for weak pedestrian including disabled person and seniors through advanced research, more detailed and reasonable standard is necessary on the barrier free certification system applied on new-hanok type public buildings.

Table 6. Naju planning regulations pursuant to the Building Act

Section	Act	Application standard	Reflection of content
Type of application - specific building	Act19	Production management area	Education and Research facility
building coverage / Floor area ratio	Act55/ Act59	below 20%/ below 80%	building coverage: 5.67%/below20% Floor area ratio: 4.66%/below80%
Landscape area	Act23	sum total gross floor area under 1000m ² buildings : More than 5 per cent of the land area	gross floor area : 436.50m ² <1,000m ² Landscape area:6.615m ² x0.051 = 340.50m ² >337.37m ²
land in empty lot	Act26	sum total building floor area above 1000m ² below 2000m ² Building alignment and the neighboring property line: above 2m	gross floor area:308.34m ² <1,000m ²
Public Open Space	Act30	sum total building floor area : above 5000m ²	gross floor area : 308.34m ² < 5,000m ²
Installation of Parking Lot	Act18	Area facility 300m ² per parking one	gross floor area: 308.34m ² / 300m ² = 1.027 cars Legal parking:1<parking plan:2

Table 7. Disabled facilities installation plan lists and coverage

Connection Facility	interior facilities			sanitary facilities			guidance facilities		etc facility								
	Disabled parking spaces	Remove entrance stairs	Main entrance	Toilet	Urinal	Washstand	Bathroom	Locker/shower	Braille block	Induction/guidance	Administration facilities	Rooms / Bedroom	Grandstand / central	Front desk / bench	Tricket machine/ drinks	Pregnant rest facilities	
Approach to main entrance	●	●	●	●	●	○	○	○	○	○	○	○	○	○	○	○	○
	★	x	★	★	★	★	★	★	★	-	-	-	-	-	-	-	-

● obligation duty ○ encourage ★ application x does not apply

Table 8. Details of Disabled Accessible Design

Disabled facilities installation plan			
Toilet	Stair hall	Access ramp	Handle a wall
A Bathroom amenities	- Braille signs and Punctiform block installation - Install the sink urinal toilet for the disabled - Infants cradle installed in the disabled toilet cubicle		
B Stair hall amenities	- Braille signs and Punctiform block installation - Beveled lift installation		
C Main Entrance amenities	- Ramp installation (ramp 1/12, Rough floor surface, Both handle, Braille signs installed) - Braille signs and linear block installation		
D Entrance amenities	- Install Braille signs on the wall beside the door height 1.5m		

Jeollanam-do obliged BF certification for overall public buildings and it affected on plane design after detailed design as an important factor.¹¹⁾

11) Convenient facilities for the disabled installation plan is related with Article 3.

The laws related to public building applied on Naju Agricultural Technology Learning Center are as shown in Table 8. Based on the BF design instructions applied by architectural area base according to the Naju-si planning ordinance, considered wheelchair moving line by the reducing the step difference between buildings and installed access ramp at the front of entrance, and expanded stair hall size which was poor due to the toilet arranged as parallel with classroom, and also adopted modern facilities to contribute in safety of elevator operation in Naju Agricultural Technology Learning Center.

Besides, it considered visually handicapped for vertical movement as well as horizontal movement in the space by installing braille signs and punctiform block in overall indoor space.

3.3. Moving Line Establishment focused on Publicness and Assembly

Outer space of government office was planned with gradual space movement and ideal symbolic trees, and the access road of Naju government also shows typical composition passing through outer three gates, middle gate and arrive main office. However, it is concentrated to build service area to prepare as a public facility and intermediate space embracing event yard according to the design direction based on the publicness and rationality than symbolization and traditionality through the modern reinterpretation process of Geumseongwan in Naju government office for Naju Agricultural Technology Learning Center.

Representatively, it reduced the inconvenience in passing through by reducing the column quantities of corridor space which had symbolic design effect in initial design and arranged the service space such as toilet and supply room at front to increase the connectivity with outdoor event yard. Also, allocated the offices which were distributed closely with the classrooms, so improved the moving line of work and lecture related to be concentrated. Different with open type 1st floor, divided the territory of 2nd floor to be used as a complete exhibition space and rooftop terrace to be used as outside exhibition and rest area.

In general, the rooms have been arranged separating the floor according to the purpose and characteristics of space use, but planned design goal is revealed to secure publicness by the effort to reflect the design plan considering safe movement of weak pedestrian including disabled person and the elderly and the infirm and shorten the moving line.

Convenient Facility Installation Object Facility in Enforcement Ordinance of Act on Guarantee of Promotion of Convenience of Persons with Disabilities, the Aged, Pregnant Women, etc. Detailed contents of convenient facility are divided as intermediate facilities, internal facilities, sanitary facilities, information facilities, and other facilities, and intermediate facilities and internal facilities of education and research facility is mandatory.

4. New-hanok Technology applied on Naju Agricultural Technology Learning Center

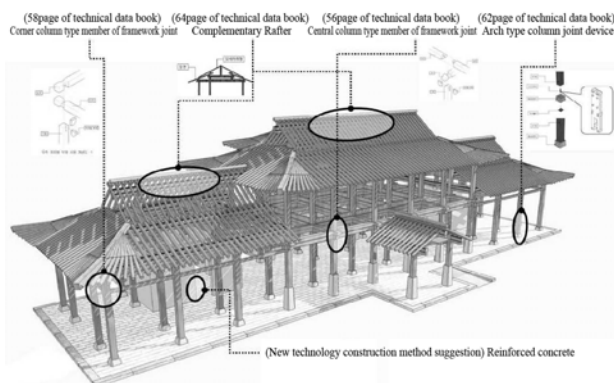
4.1. Range of New-hanok Technology and Construction Suggestion Technology

New-hanok technology reflected at construction phase were applied through the discussion with research group and construction company based on reasonable construction cost and structure system advantageous for construction duration shortening.

The range of applied technology can be divided as construction for each part and maintenance program after completion of construction, and the reflected technologies totally increased after detailed design as shown in Table 5. But, reflected technologies were beyond half of the list research group suggested during design change process, it was largely because of unreasonable process and construction cost increasing, and also it was excluded because the technology was researched for residential architecture, so it was different condition with public buildings.

Table 9. list of required R&D techniques

Before Working-Design			Process	After Working-Design		
Constructor	Architects	Research Team		Research Team	Constructor	
				B.W-D	A.W-D	
-	-	-	foundation	2	-	1
-	-	-	stylobate	2	1	1
5	5	5	carpenter	17	12	2
2	1	2	wall	11	10	3
-	-	1	flooring	7	6	1
2	4	6	roofing	18	13	6
-	-	-	ceiling	5	1	4
-	-	2	joiner's	9	2	2
2	1	2	landscaping	6		-
Working-Design Process		6	other	9	4	4
		2	monitoring	2	-	-
11	11	26	Total	88	49	24



Iron reinforcement R&D application plan in wall construction technology was discussed to reflect it whether it is really necessary or not, but excluded because it was judged as unnecessary during construction, but flooring work which was excluded because it was

different with design condition was managed to reflect partial construction method. Nevertheless, many of the technologies could not applied because they were not correspond with site condition and design condition.

Main new-hanok technologies in Naju Agricultural Technology Learning Center are Corner Column Type and Central Column Type Member of Framework Joint (Technology no. 10-1263628~1263630), Complementary Rafter (Technology no. 10-1374163), and Tubular Column Connector (Application no. 10-2014-0087245).

Among them, Korean style system window composition for openness, use of complementary rafter and light roof tile for lightening, danggolmakyee for insulation and improving air tightness are representative application case of R&D technology improving durability and considering traditional beauty.

Especially, it is necessary to pay attention that the roof upper space was secured on each ikxa applying hongye truss (arch truss) which was suggest technology for construction on Naju Agricultural Technology Learning Center. The upper part structure planned as large scaled arch in initial design plan changed and constructed as hongye truss (arch truss)(Table 6).

Table 10. Details design change in the attic

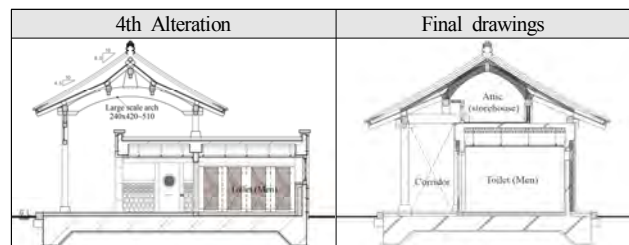
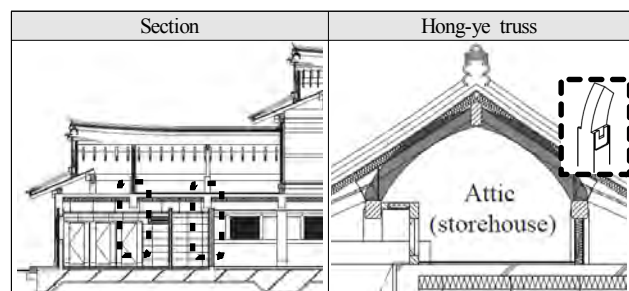


Table 11. Details design on Hong-Ye truss



There are construction process that cut a groove on the purlin and whole setting and put up the ridge beam, then reinforce with metal joint. The roof of hongye truss section used dimension lumber rafters instead of circumference rafters, and OSB plywood for structural use instead of Ceiling Board to finish with exposure.

Hongye truss became direct element to solve the structural problem to secure upper space of roof , and has a meaning as first case constructed with suggested technology method of construction company for new-hanok public building.

4.2. Economic Feasibility and Construct Ability of New-hanok Technology

Based on the research for Korean style public buildings built for last 10 years¹²⁾ new-hanok type has highest rate of 41 in 60 cases.¹³⁾

Table 12. Neo-Korean Style Public Architecture Status of the composition

Structure	Title	unit cost of tube	Gross Floor area (m ²)				
			1000	2000	3000	3500	10000
	Hanok Experience Center		120				
	DooDle village Hanok Experience Center		290				
	Korean traditional food culture center		330				
	O'jin library	≒ 11.1	1193				
	Icheon Ceramics art village		2000				
Tradition	Jukdong 2-ri Village Hall		192				
Tradition	Namak New City Namak maru		264				
Tradition	Gunja Village Hall		288				
Tradition	Official Residence O'jimmuri	≒ 12	419				
Tradition	Gaebong library in Guro-gu	≒ 9.1	441				
Tradition	Kangwon Tourism Information Center	≒ 12.5	500				
Tradition	Tea Experience Center in Seonam Temple "SaRang-chaeh" in National Assembly	≒ 13.6	803				
Tradition	Gimhae Hanok Experience Center	≒ 14.4	817				
Tradition	Street of Intangible Cultural	≒ 16.7	927				
Tradition	Oeam Folk Village's jajat street	≒ 11.5	1119				
Tradition	Hanok village in 2012 Yeosu Expo Town	≒ 10.7	1153				
Tradition	Naju Agricultural Education and Experience Center	≒ 12				3440	
Tradition + RC	Wando Forest Museum	≒ 9.9	263				
Tradition + RC	Namsan Traditional Theater	≒ 14.1	2060				
Tradition + RC	Yeongsanjae hotel	≒ 10.2	2935				
Tradition + RC	Yeongam gimchangjo's memorial hall	≒ 7.9	3231				
Tradition + RC	F1 motordrome 's pedestrian overpass	≒ 8.8	2293				
Tradition + RC	Hanok library in hwanhyong's happy village	≒ 16.9	510				
Wooden Structure	wooden furniture complex in Jangheung-gun	≒ 4	600				
Wooden Structure	Oksan Lecture Hall exhibition		367				
Wooden+RC	Yun Seon-do Relic Museum	≒ 8.8	1831				
Wooden+RC	traditional culture concert hall in Govang	≒ 6.6	2315				

- Unit Cost of m² (x1,000,000 won)

In comparing with expense unit price between architectural area of new-hanok public building and total construction area in the contents of Table 5¹⁴⁾, regular correlation can be identified on design unit price between structure type and architectural area.

12) Based on the research for construction by each period on Korean style public buildings built for last 10 years, the projects started the construction after 2007 announced Korean style promotion policy are 49 in 60, and it is 82% of total projects. In regional distribution, 33 cases (55%) located in Jeolla-do, and overwhelming construction rate (43%) in Jeollanam-do, and Jeollabuk-do (12%), Seoul Gyeonggi-do (12%), and Gyeongsangbuk-do (10%) are following.

13) Lee, G-M divided Korean style public buildings as 4 categories such as traditional hanok/new-hanok/hansil/hanok type architecture through [Study on the policy measures for provision of the han-style public buildings] and mentioned that researched new-hanok as most (41 units), and hanok type architecture is 9 units, traditional hanok and hansil are each 5 units.

14) Below table is reconstituted Table 3-3 of 41 page in [Study on the policy measures for provision of the han-style public buildings] of Lee, G-M.

In case of architectural area, it is surveyed as large in principal for traditional type and wooden furniture structure combined with RC structure, and in case of cost, below 10 million won in unit price per pyeong are far higher in the structure combined with RC structure.

Naju Agricultural Technology Learning Center used combined traditional method and reinforced concrete method and medium range of traditional and modern method mixture group, but the construction cost is lowest in comparison.

Of course, to discuss about the economic feasibility with total construction cost and area without the comparison between the process is not a good comparison element. However, in considering that new-hanok technology is not generalized at this moment, so it can be identified that the construction cost in contrast with area in new-hanok technology secures the economic feasibility.

4.3. Reflecting Construction Company Suggested Technology and Combination with Modern Construction Materials

New-hanok technology divided as 88 detailed items separated as essential skill and optional skills under 12 processes. 22 R&D items were applied and 42 items were eliminated in Naju Agricultural Technology Learning Center.

24 items were partially applied or substituted with improvement suggestion and it can be announced that it got a fruitful outcome in the way that it suggested construction alternative to overcome the limitation of existing technology.

Table 13. list of R&D techniques & range of application

No.	Process	improvement suggestion
04	wall	Improve the crack gap problem by fitting a confidential manner and use joint tape on wood
05	flooring	By mixing the line subtraction and matt subtraction to facilitate the install a hypocast. To improve the structural performance and It is possible to omit the base ends.
		The pillar and wall panel joints detailed construction □ type - Improved insulation performance /Joint prefabricated construction method put into the pre-assembled panel on a pillar groove is improved thermal performance.
		Improve product application difficult to utilize a formal standard
06	roofing	Wood truss roof structure - large space design available. Korean wooden rafters more savings and process that can shorten the construction period.
		applied to improve the performance of the add rafters - structural performance enhancement prevents the deflection of the short and long term
		plain roof-tile construction - Roof insulation, using Moisture transmission protection paper
07	ceiling	korean style built-up tiles or the above tiles are installed roof to reduce the heterogeneity of the material replaced by improved plain roof-tile.
		install a skylight a retaining wall in the basement play room to improve the lighting conditions, and promote ventilation.

Construction suggestion technology were reflected on 9 detailed items in wall, floor, roof, and ceiling process.

Representatively, the process used danggolmakyee in roof was arranged as amendment with partial modification and construction to supplement difficulty in use of standard part in site construction,

especially in end pieces.

In wall construction, insulator construction to maintain insulation performance of wooden structure and used tight tape for joint on the gap created on frame when construct structure and improved by putting trimming timber to improve the durability.

New-hanok technology have been researched to improve existing construction method depend on the experts, and also improve overall materials performance, and the ultimate aim of them are widespread and generalization of hanok by reducing supply unit price and building the distribution structure as a result. However, to overcome the limit of technology group developed and researched based on residential architecture, the construct ability and economic feasibility in various aspects will be very important requirement. In this point of view, the reflection of construction suggestion technology in Naju Agricultural Technology Learning Center can be evaluated as the attempt to prove the improvement direction and development possibility of existing hanok technology.

Meanwhile, securing publicness giving priority as public building should reflect convenience and universality. In this aspect, the plan to increase the satisfaction of modern users will be positive plan to resolve existing inconvenience with most modern and technical equipments than the space stick to the traditional method, and it can be more realistic solution.

Naju Agricultural Technology Learning Center also reflects these social aspect and the stair hall finished with glass curtain wall was came from the safety and practicality not by simple considering of design function.

4.4. Design Plan applied Traditional Architectural Elements

New concept of publicness need to consider¹⁵⁾ history and culture of the region, urban context, or macroscopic frame premising nature, tradition, and long historical frame.

The hanok element of Naju Agricultural Technology Learning Center shows intentional design plan to highlight decorative beauty as well as following traditional method.

Representatively, designed the window type according to the function, latticed rib door for gate, transom window (comb) for dome window (high window), and band rib window for other windows, and constituted the eaves with all exposing rafters for everywhere not constructed boarded ceiling.



Fig. 7. Picture of Traditional design elements

Improved Korean style roof tile increased construction performance through new construction method was used. Also, fire control wall and traditional pattern were used for modern reinterpretation for the harmony with Korean style outer wall in the finishing of outer wall treatment of RC structure.

5. Conclusion

In this research, I would like to consider the possibility to realize new-hanok technology and suggested technologies on construction reflected on Naju Agricultural Technology Learning Center as a public building hosting international agricultural exhibition.

Current definition of public architecture is difference with existing mainly for use. Not the facility constructed mainly by host and ordering organization, it is focused on “publicness¹⁶⁾” strengthen the community function participate and communicate with the users these days. Furthermore, the publicness secured by aesthetic space realized by hanok and modern construction technology shows the possibility to develop future new-hanok.

The features appeared in design change process of Naju Agricultural Technology Learning Center and expected effects on new-hanok technology are as follows.

(1) New-hanok technology reflected on Naju Agricultural Technology Learning Center is settled as 27% and 24% of total technology list. It is decreased than the range planned before detailed design in quantitative aspect. However, it is worthy of notice that there was the consideration of economical performance based on the amendment of the construction method by suggesting the alternatives to supplement and reinforce the disadvantage of

15) Jun I-H pointed out that destructive public design to make leave the residents and remove the place is not desirable and new publicness concept should premise the durability of nature, tradition, and long historical frame, and focusing on what is more realistic development method for citizens deviates from simple logical development method not considering the history and culture of the region, urban context, or macroscopic frame through [Identity Research for Public Design]

16) Jo, M-L defined public architecture means the architecture (building) serve and express collective life's level (public administration, welfare, culture, etc) living together in urban spatial environment, and it is the architecture (building) leads the publicness of urban architecture and in charge of role and function for community communicate individual urban life.

existing R&D technology and eliminated irrational process. The reflection of suggested technology on construction can be judged that it revealed the improvement direction and development possibility of existing hanok technology.

(2) The realization of new-hanok technology aims the increasing of economic feasibility and construction performance is based on the combination with modern construction technology and materials. The economic feasibility of new-hanok technology was partially proved based on the comparison of construction cost per unit area, it is at the time to find out future development possibility and necessary continuous suggestion and development for various attempts.

(3) Combination in construction between traditional hanok and modern materials have been attempted already in many new-hanok buildings. The use of modern material should be accepted partially in the range of supplementation the use and function of the building. Especially, there should be widen the width of engagement on the graft of various materials and construction technology in public buildings because it can be the alternative positively reflects the demand of popularity by securing convenient facilities and safety facilities.

(4) Enough historical consideration and the design plan for establishing identity is necessary to reflect the historicity and traditionality on new-hanok type public buildings. The traditional beauty of Naju government office reflected by Naju Agricultural Technology Learning Center was reconstituted modernly with the harmony with traditional architectural elements. Design composition based on the historicity can be most effective spatial device derive emotional communication with users.

Meanwhile, spatial composition of traditional hanok is completed with the harmony with outer space and surrounding environment. There were many cases losing transitive spatiality only concentrated on the building itself excluding the distribution plan in many preceded researches. It feels lack of spatial continuity continued from three gate in Naju Agricultural Technology Learning Center, but the design based on the publicity main user's moving line should be considered as first due to the feature of large scale exhibition. Furthermore, I expect this research can be the guideline of new-hanok design realized as research and education facility.

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