Full Length Research Paper

A study on the physical characteristics of the visual environment factors based on dynamic characteristics: A focus on six major traditional villages in Gyungbuk regions of Korea

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This study focuses on the visual experience of human beings, and the objective of this study is to perform the investigation and comparison of the circulation systems, which affect the study on the investigation of sequential visual characteristics related to pedestrian movement. Also, based on continuous comparative studies on the visual characteristics of traditional villages in other neighboring nations, a coherent index in the method of the study that has the ability to respond to environment conditions for subjective regions through the site investigation and data analysis for various variables and factors, which affect the attainment of data related to the subjective regions, was achieved. In the first step of this study, the physical characteristics and aspects of the major circulation systems in six major traditional villages in Gyungbuk regions, Korea, were investigated. Regarding future studies, it is considered that this study will be used as useful basic data for analyzing the circulation systems and visual environment factors of the traditional villages in East Asian regions.

Key words: Sequential visual experience, visual environment, traditional village, circulation systems.

INTRODUCTION

Human beings can recognize surroundings using various sensing organs in the body and response to their environments. Most of the space experiences in human beings are based on a three dimensional environment (Shin, 2001) influenced by time, speed, and direction caused by the unfixed human body with respect to various movements in such space experiences. The sequential space experiences related to the concepts of speed and direction represent a linear path movement in recognition subjects (human beings). Also, in the case of the outdoor space, which becomes the major field of the work related to such movements or actions in human beings, various user movement paths are created according to the situation and condition of such space in which lots of actions are created and completed in that space (Kwon, 2001; Arslan et al., 2011). In this study,

physical environment conditions that play important variables in experiencing visual experiences for the traditional villages, which are determined in a basic administrative unit in group life spaces, are to be clearly investigated to perform a study on the investigation of the visual characteristics in historic spaces. In particular, the objective of this study is to consider the circulation system and its characteristics in traditional villages that largely affect the sequential visual experience based on the aspect in which the main subject of the visual experience is pedestrians and to prepare a basic index for the methods of study for the comparison and investigation of neighboring countries. Therefore, in this study, it is expected that this study will be a case of a new study method for visual experiences as a dynamic concept for some future important regions in human beings and applied as a basic material for establishing national identity by comparing their own regions with other similar regions in neighboring countries.

Subsequently, the major six traditional villages located in

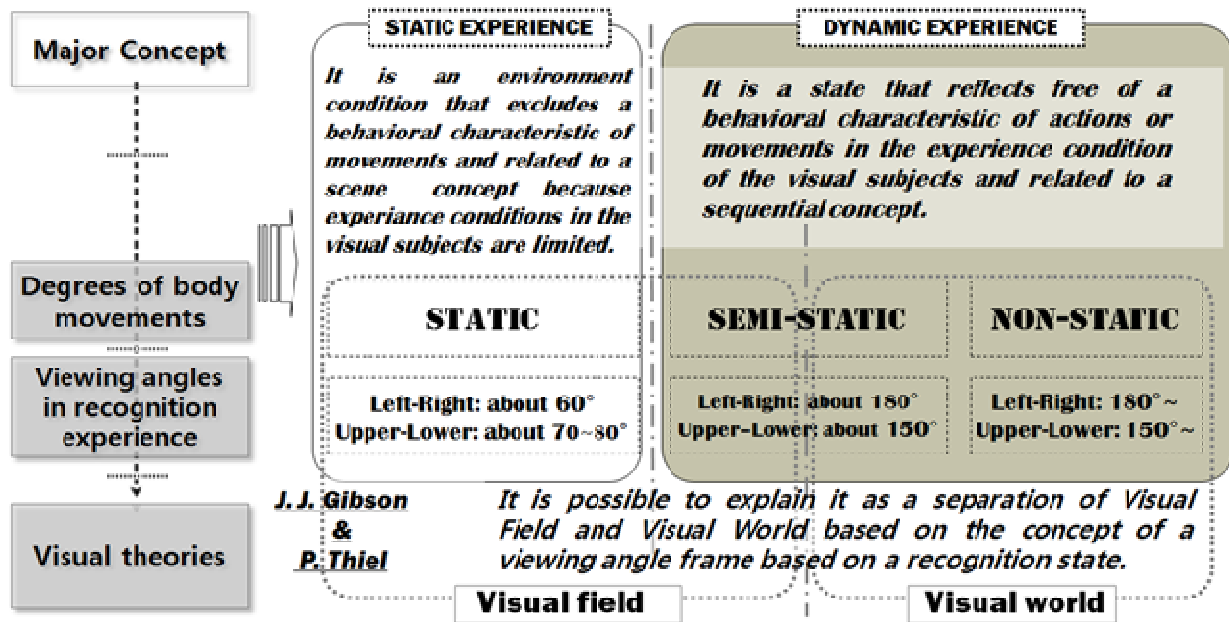*Corresponding author. E-mail: samlih@pnu.ac.kr.

Figure 1. Diagram for the concept of the experience type in the subjects of the visual experience (Kim et al., 2008a).

the Daegu/Gyungbuk region in Korea, which include Hahoe and Yangdong traditional villages as UNESCO registered cultural heritages, were determined as the main subjects in this study because lots of traditional architectures and materials have been well preserved in this region as compared to other regions (2011 Korea regional cultural assets distribution data; Appendix Table 1). In addition, it is considered that this region will present abundant data and generalized values in the data collection and analysis for comparing this region with other traditional villages in foreign countries.

PREPARATION OF STUDY

Study area and methods

The visual experience in human beings can be classified as static and dynamic states according to the experience conditions in the subjects of the visual experience and are summarized as some theories and objects according to the movement or viewing angle of the subjects of the visual experience (Figure 1). In the objective of this study, performed as one of the studies, which are to be performed for the next several years under the subject of the sequential visual researches for village spaces that play roles in a basic administrative unit as a settlement space in human beings, the major subject and scope of this study are to investigate the circulation system and its characteristics that largely affect the movements of pedestrians directly and indirectly in the examination of the sequential visual characteristics. Figure 2 shows the major subject and its stream based on the mentioned concept.

Site descriptions

In Korea, administrative regions are divided into eight regions, such as: 1) Seoul/Gyeonggi, 2) Gangwon, 3) Chungbuk, 4) Chungnam,

5) Daegu/Gyungbuk, 6) Busan/Gyungnam, 7) Jeonbuk and 8) Jeonnam, except for island regions. Regarding the subject region in this study, the six traditional villages are located in the Daegu/Gyungbuk region, which include Hahoe and Yangdong traditional villages as UNESCO registered cultural heritages or government protected cultural heritages. Figure 3 illustrates these six traditional villages in this region.

History and scale

The six traditional villages consisted of the nobility and their relatives, which were the ruling class in the Lee Dynasty (1392~1897), and were formed by about 20 to 140 families. These villages have been considered as a representative of traditional villages by adapting them to the nature of over 300 years in spite of various difficulties in conserving their villages for a long time from their historical and cultural backgrounds, which include frequent invasions from neighbor countries and physical properties such as wooden architecture. Table 1 shows the summary of these six subject villages (target research region status data suggested in Appendix Table 2).

SPACE CONFIGURATION AND CIRCULATION SYSTEM

The space types of the subject region according to the land use plan and application purpose can be determined as residential and non-residential spaces (agricultural fields including paddy fields, upland fields and forest lands). Also, such spaces can be recognized as not only the spaces in the areal concept for residential and non-residential spaces, but also paths for pedestrians and certain linear ones such as rivers and waterways (the Factor Status Examination, Appendix Figure 1). In these spaces, the vector diagrams for 16 compass directions
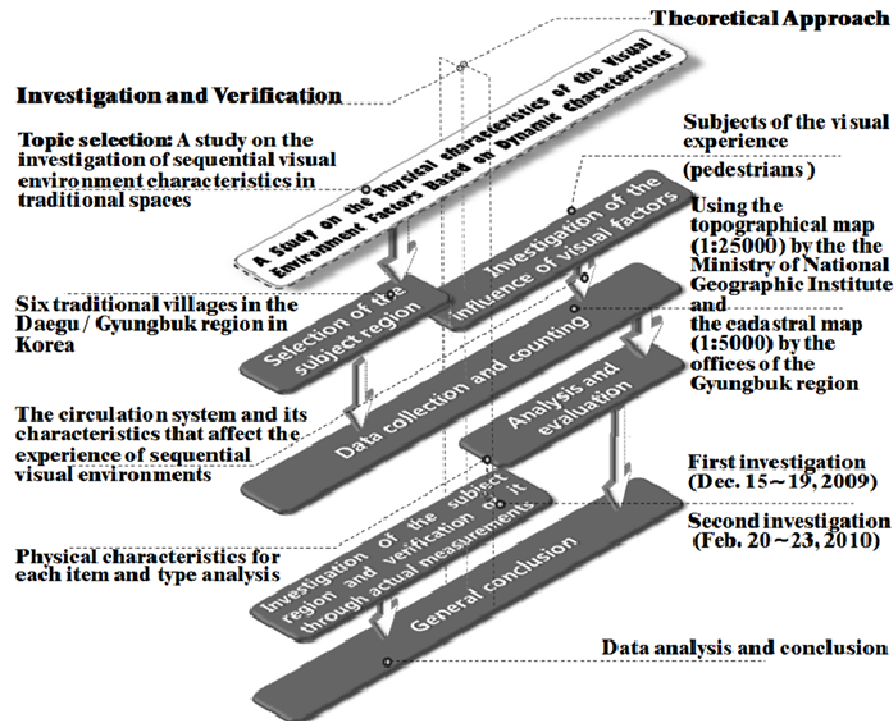
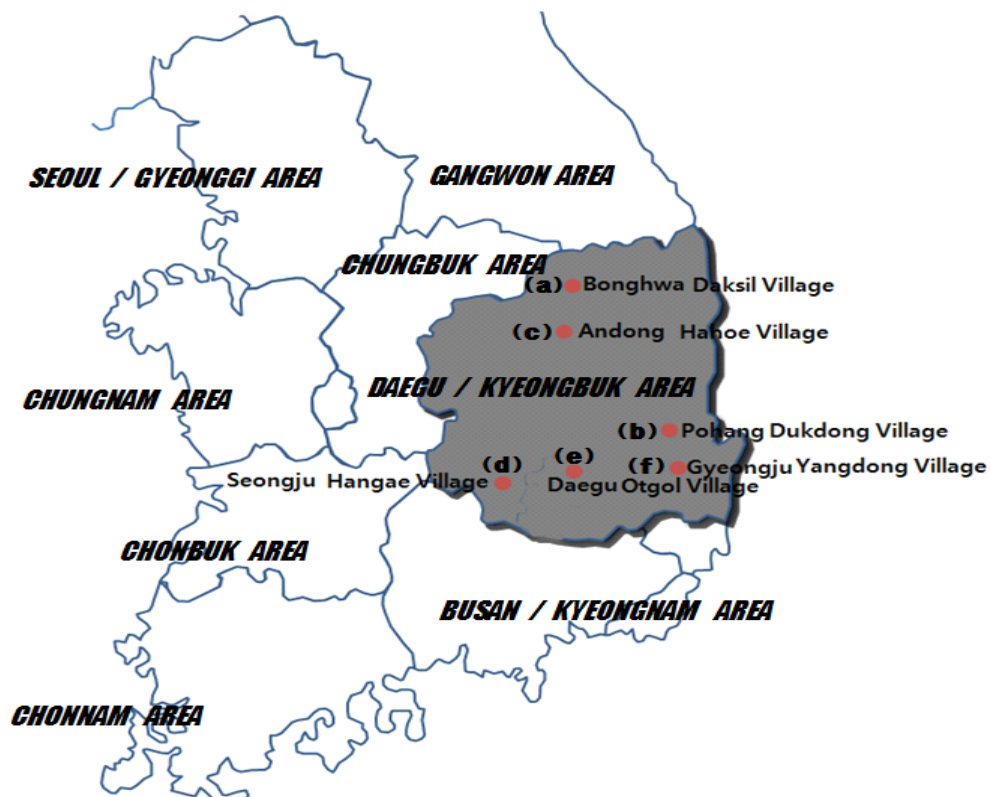**Figure 2.** Study process and conceptual diagram (local investigation table suggested in Appendi[2)].

Figure 3. Site location.

Table 1. Summary of the subject villages.

		Index			
Village name	Location	Number of households	Estimated foundation year	Village founder	Major family in the village
Daksil	Yugok-ri, Bonghwa-eup, Bonghwa-gun Kyeongbuk	20	Around 1521	Gwonbul	Andong Kim's clan village
Dukdong	Odaek-ri, Gibuk-myeon,buk-gu Pohang-si, Kyeongbuk	29	Late 1640s	Leegang	Yeogang Lee's clan village
Hahoe	Hahoe-ri, Pungcheon-myeoan, Andong-si, Kyeongbuk	127	Around 1390	Ryujonghae	Pungsan Ryu's clan village
Hangae	Daesan-ri, Wolhang-myeaon, seongju-gun, Kyeongbuk	47	Around 1445	Leeu	Sungsan Lee's clan village
Otgol	Dunsan-dong Dong-gu, Daegu	20	Around 1616	Choi dong-jip	Gyungju Choi's clan village
Yangdong	Yangdong-ri Gangdong-myeon Gyeongju-si, Kyeongbuk	133	Around 1457	Sonso	Gyungju Son's and Yeogang Lee's clan villages

Reproduced by the reference of Jeoan, 1992; Lee, 1995; Park et al., 2002; Shin, 2008; Yang et al., 2005.

Table 2. Distribution of primary class circulations for each subject region.

Name	Daksil	Dukdong	Hahoe	Hangae	Otgol	Yangdong
Main	○	○	○	○	○	○
Sub-1	—	—	○	○	—	○
Sub-2	—	—	○	—	—	○
Sub-3	—	—	○	—	—	—

that correspond to the village spaces based on the distribution types of each resident as the individual spaces, which strongly reflect the concept of private spaces, are presented in Figure 4 and Appendix Figure 2). Then, the space types according to the residential allocation for each subject region can be classified as a prolate type that shows a long shape and a radial type that represents certain left and right stretches like a tree branch. Also, these are specifically divided into a simple structure that has prolate vector shape axes, such as Daksil (NW-SE), Hahoe (NNE-SSW) and Otgol (NNE-SSW) villages and a complex structure that has several radial vector shape axes such as Dukdong, Hangae and Yangdong villages. In these types, in the case of the pedestrian paths that directly affect the movement and action of pedestrians, which are the subjects in visual experiences, the characteristics of such pedestrian paths can be determined according to its scale, function and type. It can be classified as a 'primary' circulation class that shows public dispositions due to the fact that it can be used as a major movement route from specific sections to specific sections according to the scale and type of users in the pedestrian paths employed in the subject region and a 'secondary' circulation class that represents semi-public or private dispositions that play

roles in a medium between pedestrian paths and a penetrative function to final destinations. Circulation structure type, confirmable by the existing research data as the pre-mentioned concept, is shown in the suggestion of Appendix Table 3, while circulation type classification-applied cases as simpler or more unified type for further studies are shown in Figure 5.

LIMITATION OF THE VIEWING DISTANCE ACCORDING TO THE CHANGE IN CIRCULATION AXES

In visual recognition, the circulation structure that is a major factor in affecting the sequential experience in pedestrians can be influenced by certain surroundings and conditions in which the change in physical conditions, such as a limitation in viewing distances, directly affect the change in experience environments. Regarding some factors that affect the movement of the subjects of such visual recognition, the change in planar environments determines what types of basic visual environments are provided to pedestrians (Higuchi, 1975) through analyzing the angles of circulation axes and the changes in such types. Based on the results of this
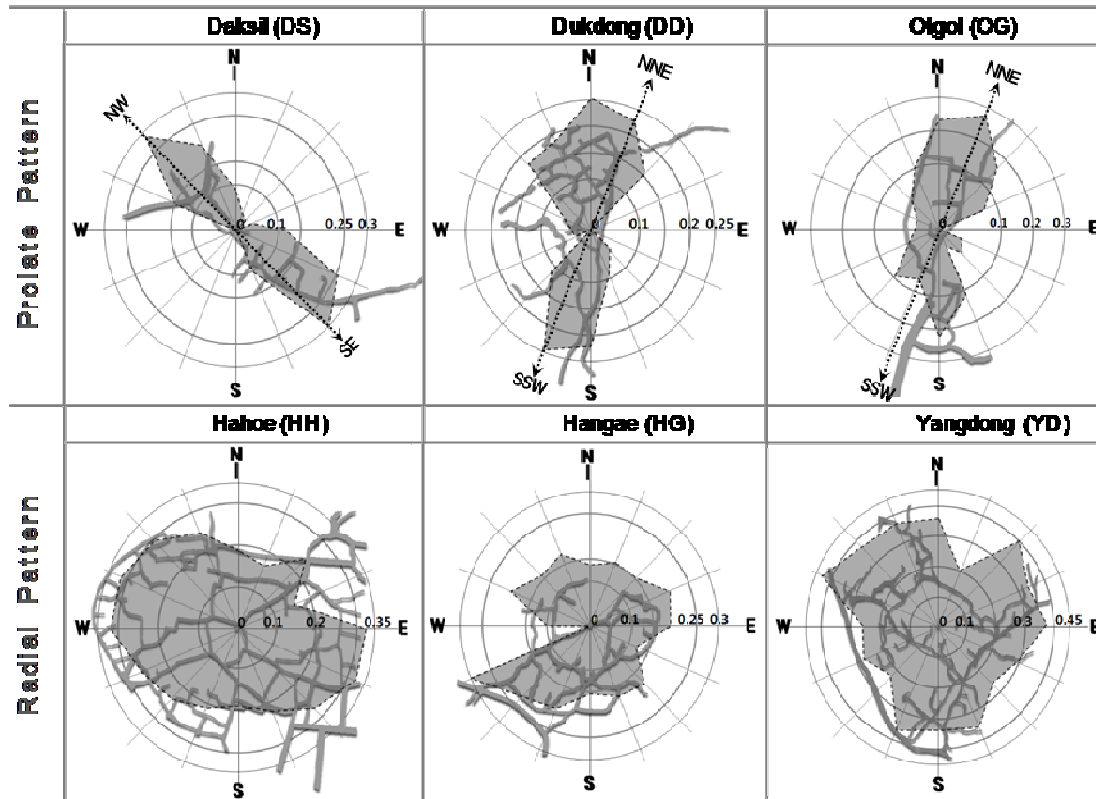
Figure 4. Vector diagrams for the circulation structure and resident distribution for each region.

Table 3. Lengths and sections in secondary class circulations.

Name	Class		Distance (m)	Number of sections
Daksil	Link	DSL	380.96	4
	Terminal	DST	463.62	9 — 13
Dukdong	Link	DDL	738.54	15
	Terminal	DDT	1199.25	15 — 30
Hahoe	Link	HHL	3801.55	45
	Terminal	HHT	682.10	21 — 66
Hangae	Link	HGL	1260.89	16
	Terminal	HGT	333.09	11 — 27
Otgol	Link	OGL	611.26	10
	Terminal	OGT	348.84	7 — 17
Yangdong	Link	YDL	1733.88	23
	Terminal	YDT	2200.46	28 — 51
Total	Link = 8527.08 m, Terminal = 5227.36 m			
Average	Link = 1421.28 m, Terminal = 8717.22 m			

Reproduced by the reference of Jeoan, 1992; Lee, 1995; Park et al., 2002; Shin, 2008; Yang et al., 2005.
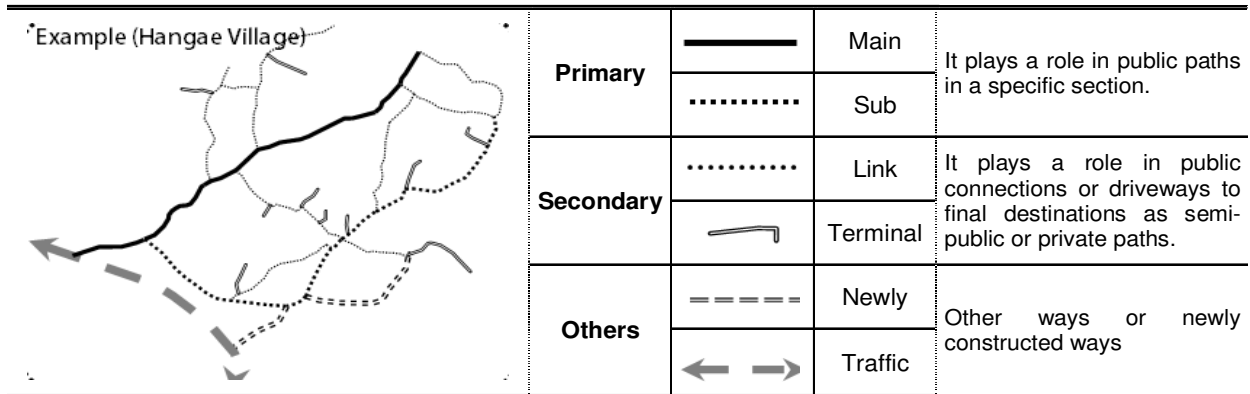
Figure 5. Circulation environments in the subject region provided to pedestrians. Data by target region contained in Appendix Figure 1).
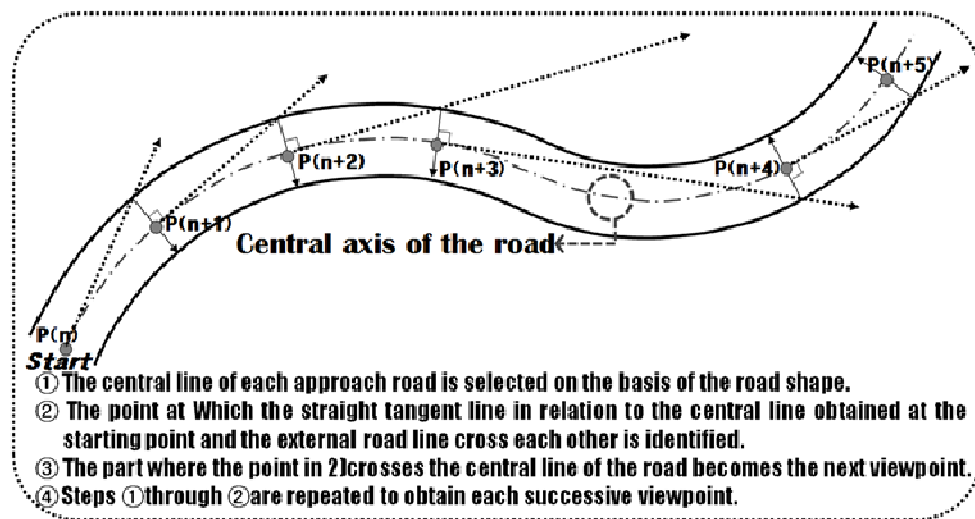

Figure 6. Basic model for extracting sequential viewpoints according to pedestrian movements (Kim et al., 2008b; 2009).

analysis, it was verified that the circulation axes can be influenced by two conditions: 1) the curvature or bending of paths and 2) the node space due to the cross. In particular, such conditions are to be investigated by determining the terms (progressive type and divergent type) and considering the progressive structure and characteristic of circulation structures. In the case of the divergent type, it represents a circulation structure that determines the visual transition effect to the next image according to the selection of the progress direction. However, in the case of the progressive type, it shows a circulation structure in which the viewing distance is influenced by the curvature or bending of paths and that represents changes in the transition effect or space image that occurred with the movement to the next space on the basis of certain physical conditions, such as the

degrees of curvature, depth and width of paths (Shinohara, 1982). Based on these planar movements in pedestrians, the basic concept for extracting the sequential viewpoints in this study is based on the model presented in Figure 6 and Appendix Table 3 In the consideration of the sequential viewpoints, which can be corresponded to the change in physical conditions and the limitation in viewing distances, based on the mentioned method, it was verified that the occurrence rate of viewpoints (77~82%) due to the limitation in viewing distances by the curvature or bending of paths in the progressive type affected the results more than that of the divergent type (17.5~24.4%).

In addition, in the viewpoints, the Hahoe village showed the largest number of viewpoints in both the divergent and progressive types as 320 points, and the Yangdong
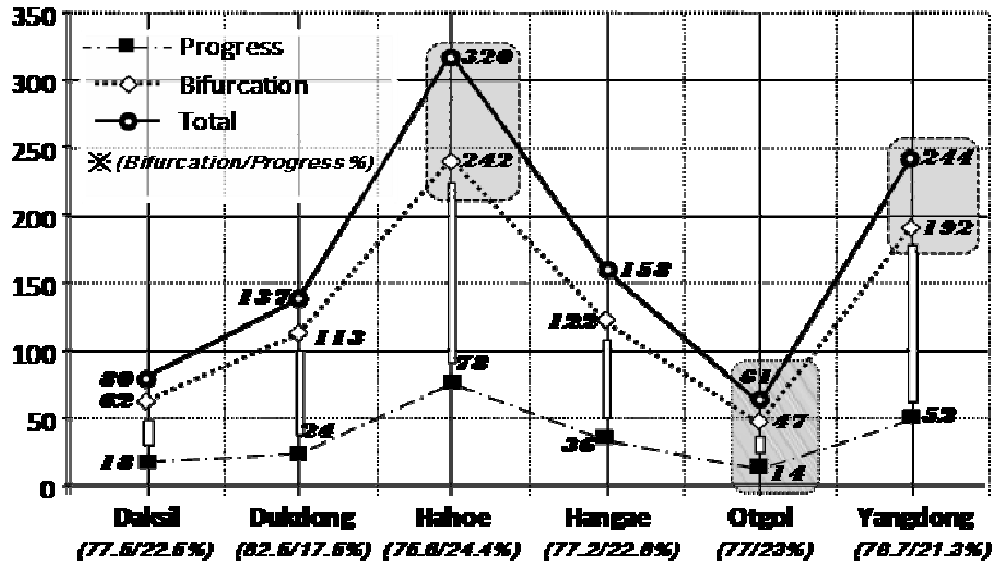
Figure 7. Data of the sequential viewpoints for each condition and subject region.

village showed 244 points in both types as a large level. Then, Hangae, Dukdong, Daksil and Otgol showed 158, 137, 80 and 61 points relatively in which the Otgol village that showed 14 viewpoints in the divergent type and 47 viewpoints in the progressive type represented the simplest circulation system (Figure 7).

CIRCULATION CHARACTERISTICS IN PUBLIC PATHS: PRIMARY CLASS

Based on the characteristics of the circulation for each compass direction mentioned above, the circulation structure can be divided into primary and secondary classes according to the scale, type and usage frequency of paths. The primary class paths that show a characteristic of public paths can be divided into the way that has only a main path (DS, DD and OG), which plays a role in the base path of the village space, and the way that has sub paths (HH, HG and YD), which support the area that cannot be influenced by the main path as a sub path of the main path, even though it has a similar scale and function to that of the main path (Figure 8 and Table 2). The viewpoints extracted by the sequential concept in the primary class paths as a function of public paths were presented by the smallest value (17 points) in Otgol village (Otgol: Main) and the largest value (35 points) in Yangdong village (Yangdong: Sub-2).

CIRCULATION CHARACTERISTICS FOR CONNEC-TIONS OR DRIVEWAYS IN FINAL DESTINATIONS: SECONDARY CLASS

By differing the primary class paths, in the case of the

secondary class paths that show the characteristics of semi-public paths or private paths for the driveways in final destinations, the average distribution of the paths (871.22: Terminal ~ 1421.28 m: Link) was 2~3 times longer than the primary class paths [Sub (411.32 m) ~ Main (546.24m): average) (Appendix Table 4). In addition, it was verified that the distribution widely ranged from 13 sections (Daksil) minimally to 66 sections (Hahoe) maximally (Table 3). In such a distribution, Hahoe village showed the longest ways in the secondary circulation as 4480 m, and Yangdong, Duckdong, Hangae, Otgol and Dasil were presented by 3930, 1920, 1590, 950 and 840 m, respectively (Figure 9). Thus, it was investigated that Hahoe and Yangdong villages showed longer circulations than other four villages relatively. However, in the secondary class circulation, Yangdong village (total distributions: 2200 m, sections: 28) represented longer distributions and more sections than Hahoe village (total distributions: 682 m, sections: 21) in the terminal type of circulation, which plays a role in the final driveway, in which Yangdong village represents a pattern of tree branch in its circulation structure, whereas Hahoe village that shows higher rates in closed line type paths (1.33) and terminal type paths (1.10) represented a mesh type pattern in its circulation structure.

CONCLUSIONS

Based on the results of the investigation of the spaces and circulation systems for the traditional villages in Korea, the study can be summarized as follows: The residential type formed along the main path can be divided into the prolate type (P-Pattern) and radial type
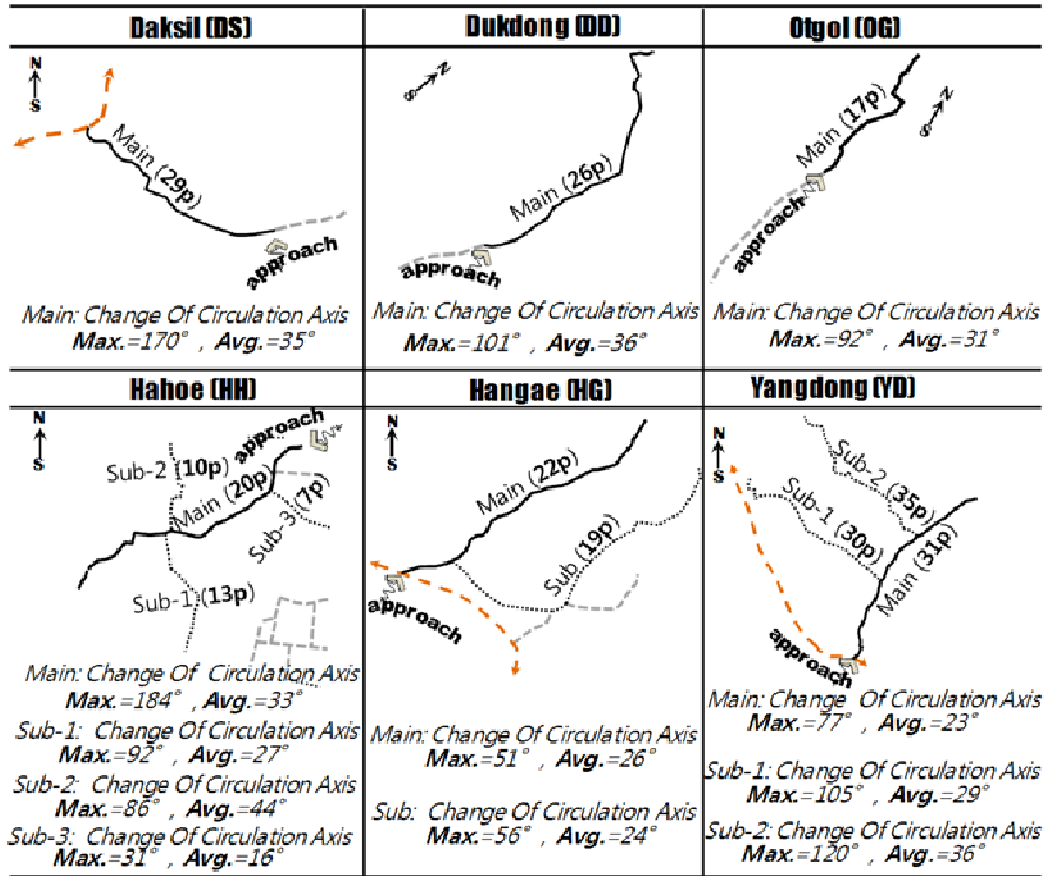
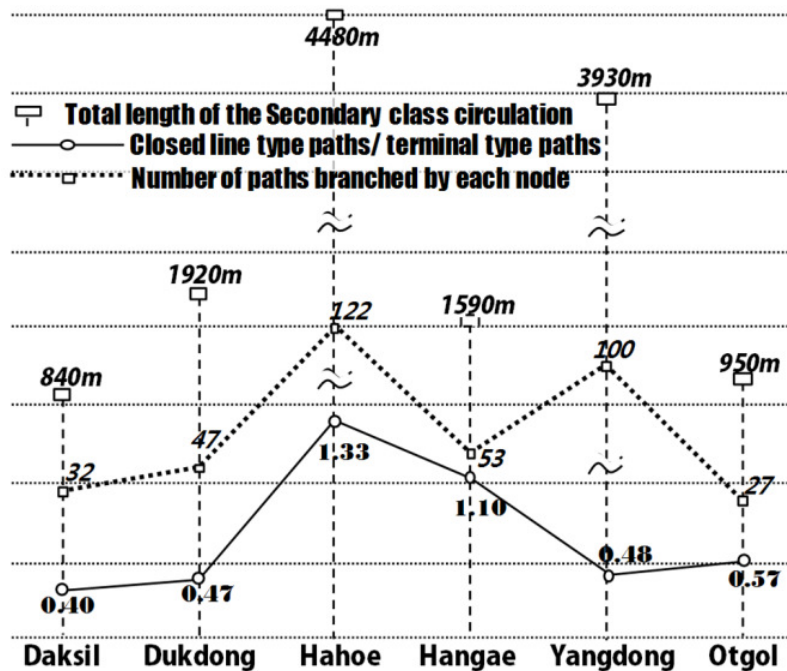**Figure 8.** Circulation distribution and its locations in the primary class.

Figure 9. Distribution of secondary class circulations for each subject region.

(R-Pattern) where the directions for Daksil: NW-SE, Dukdong: NNE-SSW and Otgol: NNE-SSW formed the main paths and residential areas, while Hahoe, Hangae and Yangdong villages were formed by the whole directions as radial paths. In addition, the circulation system and type in the six major tradition villages that play roles in the variables for the visual experience in its dynamic characteristics can be divided into two different classes according to its scales and functions and can then be divided into four different types on the basis of their characteristics. Thus, a total of 24 paths were classified according to their classes (12 types for the primary and secondary classes, respectively). Moreover, the transition type that affects the extraction of viewpoints based on the sequential concept was influenced by the progressive and divergent types, which are classified according to the limitation in viewing distances and the circulation axis transition type. The distribution of the divergent type was about 17.5~24.4%, but the progressive type was about 75.6~82.5%, which largely and clearly affected its distribution. It can be considered that the results were obtained on the basis of an organic concept in constructing traditional spaces for using the given environments instead of developing such spaces and villages. In addition, the circulation structure in the secondary class played a role in the link (medium and network) to main paths and the driveway for final destinations and showed a large distribution in subject regions. In the case of Yangdong village, the total length of the terminal type circulation was 2.2 km and that showed 28 sections distinctively. In the case of Hahoe village, however, the link type circulation was largely presented by the total length of 3.8 km and 45 sections. In the results of the comparison of the closed type paths and the terminal type paths, it was verified that Hahoe and Hangae villages showed a mesh type circulation system that differed from other four villages, which represented simple and complicated branch type circulation structures.

As mentioned in the foregoing, the characteristics of the circulation system affect the sequential visual experience of the six traditional villages in Daegu/Gyungbuk region of Korea according to their locations and types. In future studies, it is expected that the results of this study will be used as basic materials for verifying the peculiarity and identity of the sequential visual characteristics and space structures for certain similar spaces presented in other nations.

ACKNOWLEDGEMENTS

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APPENDIX

Table 1. Reconfiguration of the regional cultural data in Korea.

Region	Seoul/Gyeonggi	Gangwon	Busan/Gyungnam	Daegu/Gyungbuk	Jeonnam	Jeonbuk	Chungbuk	Chungnam
Major cultural data	62	12	77	38	22	11	19	13
City and regional cultural data	29	26	123	48	19	4	26	34

Cultural heritage administration of Korea, February 28, 2011.

Table 2. Investigation summary.

	First investigation	Second investigation
Objective	Investigation of the physical environment condition for each subjective region.	Complement and additional investigation for the first investigation.
Date	Dec. 15~19, 2009 (Dec. 15: Yangdong, Dec. 16: Dukdong and Daksil, Dec. 17: Hahoe, Dec. 18: Hangae, Dec. 19: Otgol).	Feb. 20~23, 2010 (Feb. 20: Yangdong, Feb. 21: Dukdong and Daksil, Feb. 22: Hahoe, Feb. 23: Hangae and Otgol).
Content	Verification of the basic materials and physical conditions based on drawings and references (investigation of some physical conditions including curvatures in a circulation system, bending, altitude, distance, width, and node generation).	Supplement investigation for the first investigation, survey for the recognition of the major circulation system for each section, and obtaining of visual images for each drawn point.
Researcher	One researcher, three assistants.	One researcher, two assistants.
Equipment	Camera (one DSLR with an 18 mm lens, one regular compact camera), distance and slope meter, drawings, tape measure, pencils and recording devices.	Camera (one DSLR with an 18 mm lens, two regular compact camera), distance and slope meter, drawings, tape measure, pencils and recording devices.

Reproduced by the reference of "http://yangdong.invil.org, http://www.hahoe.or.kr, http://www.seongju.go.kr, http://www.bonghwa.go.kr, http://www.dong.daegu.kr, http://bukgu.ipohang.org and Shin JD (2008)"

Table 3. Road types verified in the existing studies and used in this study.

	Name	Characteristics	Road types in this study
Road types presented in the existing studies.	Keon road	A road that connects villages and strongly represents a passing way. However, it has a little connection to the lard structure system in internal villages directly.	External roads in villages were not considered in this study.
	Eogui road	A road that connects villages and strongly represents an entrance road.	
	An road	A road that is the biggest road used by all village residents and plays a role in the framework in the entire village roads.	Main road Primary class
	Saet road	A road that represents semi-public roads used by some resident groups.	Sub road
	Golmok road	A road that is a type of internal road in villages used by 2~3 households.	Secondary class
	Teot road	A road that plays a role in a guide road to rice and upland fields connected to An and Golmok roads.	
	New road		Others

Based on the existing studies performed by Kim (1985), Park (2008), Lee (2006), Sin (2008) and Park et al. (2002), although the types of roads in the village structure in Korea were determined as 5~6 different roads, such as 'Keon' road, 'Eogui' road, 'An' road, 'Saet' road, 'Golmok' road, and 'Teot' road, it was pointed that there exist some obscurities (Lee, 2006; Park et al., 2002) in determining the boundary and section in roads according to practical characteristics and propensities in roads. Thus, it was considered that such roads are to be classified as more clear and simple types for comparing its circulation systems with other neighbor countries and then the road types employed in this study are classified as major and minor road groups, which have been recognized and used by local residents. Also, their characteristics were also examined.

※Reproduced by Kim (1985), Park (2008), Lee (2006), Shin (2008) and Park et al. (2002). Kim (2008), recitation of characteristics of landscape elements appearance and the view-point of approach road on three treasures buddhist temples in korea -the characteristics of sequence in historical spaces (I), p. 365.

Table 4. Circulation distances of the primary class for each location.

Name	Class		Distance(m)
Daksil	Main	DSM	488.59
Dukdong	Main	DDM	486.12
	Main	HHM	761.95
Hahoe	Sub-1	HHS-1	318.60
	Sub-2	HHS-2	257.84
	Sub-3	HHS-3	173.05
Hangae	Main	HGM	433.10
	Sub	HGS	480.24
Otgol	Main	OGM	473.59
	Main	YDM	634.11
Yangdong	Sub-1	YDS-1	587.57
	Sub-2	YDS-2	650.62
Total	Main = 3277.46 m, Sub = 2467.92 m		
Average	Main = 546.24 m, Sub = 411.32 m		

a) 圖谷村: Daksil Village (http://www.bonghwa.go.kr)
b) 德洞村: Dukdong Village (http://blog.daum.net/inpohrung)
c) 河回村: Hahoe Village (http://www.unesco.or.kr)
d) Hangae Village (http://gimalon.go.kr/tour/)
e) 澤澳村: Otgol Village (http://blog.naver.com/fungeu99)
f) 良洞村: Yangdong Village (http://blog.naver.com/dommon128)
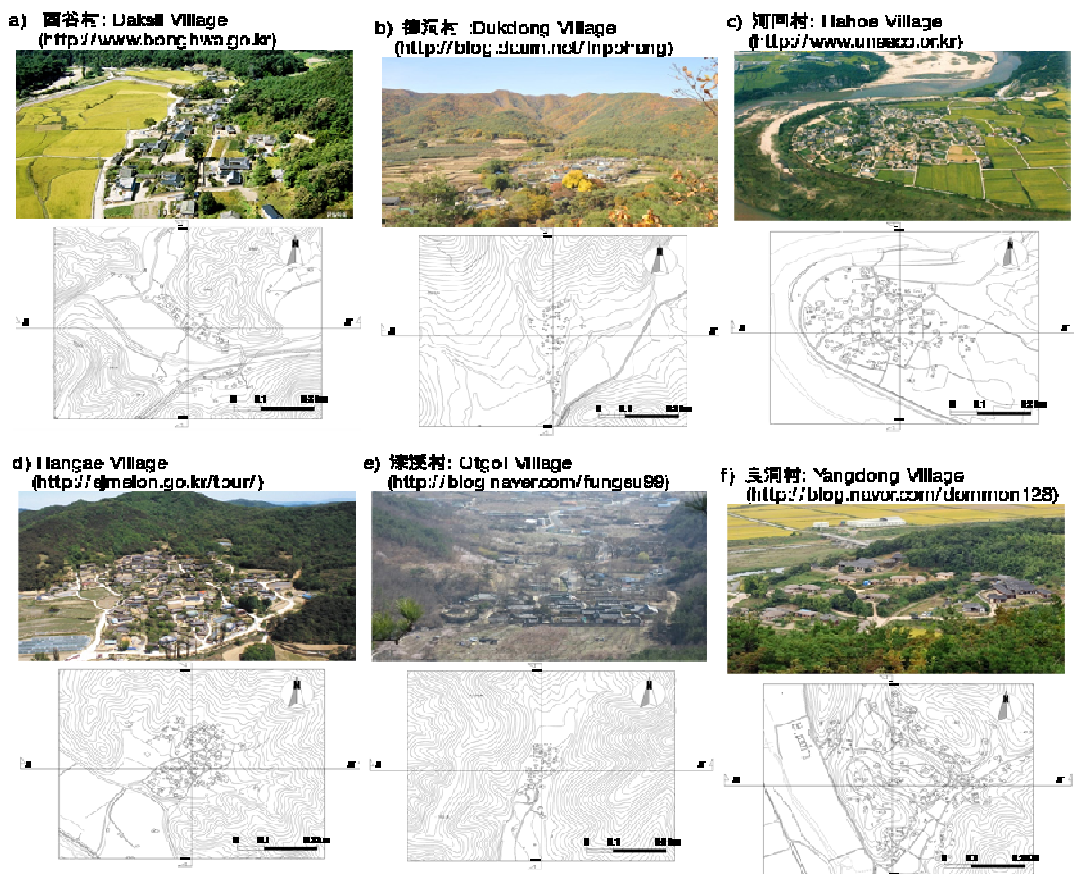
Figure 1. The space types of the subject region according to the land use plan and application purpose.

	Planar Elements		Linear Elements	
	Resident space	Nonresident space	Path Element	River Element
Dasil (DS)		woodland		
Dukdong (DD)		woodland		
Hahoe (HH)				
Hangae (HG)		woodland woodland woodland		
Otgol (OG)		woodland woodland		
Yangdong (YD)		woodland woodland woodland woodland		

Figure 2. The unit of the distance in the vector diagram is km, and the limitation in the resident for each compass direction is presented by the absolute distance as an index from the center of the village to the boundary of the village except for non-residential buildings.