

A Study on the Design Elements of Sidewalk in Urban Commercial District

Ji Hyun Kang, Hwan Su Seo, Hong-Kyu Kim, Hong Sok Kim

Abstract—This study was to search for the desirable direction of the sidewalk planning in Korea by establishing the concepts of walking and pedestrian space, and analyzing the advanced precedents in and out of country. Also, based on the precedent studies and relevant laws, regulations, and systems, it aimed for the following sequential process: firstly, to derive design elements from the functions and characteristics of sidewalk and cluster the similar elements by each characteristics, sampling representative characteristics and making them hierarchical; then, to analyze their significances via the first questionnaire survey, and the relative weights and priorities of each elements via the Analytic Hierarchy Process(AHP); finally, based on the analysis result, to establish the frame of suggesting the direction of policy to improve the pedestrian environment of sidewalk in urban commercial district for the future planning and design of pedestrian space.

Keywords—Sidewalk, Pedestrian, AHP, Indicator.

I. INTRODUCTION

BASED on previous studies, and related laws and institutions, also for walking and pedestrian space, and define the concept of a research and analysis of the literature review and the domestic and foreign advanced case to explore the future direction of the pedestrian road plan. Pedestrian layered design elements derived based on the features and characteristics of the road for pedestrians on the road, by the extraction of characteristics that are representative of similar design elements to the specific characteristics of each, and clustering, and then, through a primary survey to analyze the importance.

Through the Analytic Hierarchy Process (AHP: Analytic Hierarchy Process) based on the analysis of the importance of the priority weights for each design element and analysis in the future, based on the results of the analysis in the planning and design for pedestrian space to the city center, commercial is to lay the foundation for environmental improvements that can provide the policy direction of the local pedestrian road walking.

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II. RESEARCH DESIGN

The spatial extent of this study did not specify the special designation. Pedestrian roads are installed, or you need to install the whole area were included in the study.

Established walking and basic concepts of theoretical concepts and attributes of pedestrian space and pedestrian routes, advanced overseas practices applicable to our country by examining the implications are identified, and related laws and institutions, and through the literature review, the central business district pedestrian street derive indicators on the design elements, and then, through a primary survey indicators are identified, the specific importance analysis based on the results of the hierarchical AHP model through the analysis of indicators specific weights and priorities to derive the rank range of contents and was set up.

This study through the central business district pedestrian road design elements for the analysis, design and develop indicators for each indicator-specific rank appointed to the actual pedestrian road design as indicators of universal design to utilize. Therefore, the present study in order to perform the following step was conducted.

The first-hierarchy indexes were mobility, placeness, safety, amenity, sociality, and their relative significances were shown as descending in the sequence of safety, mobility, amenity, placeness, and sociality.

The second-hierarchy indexes of mobility were continuity, functionality, accessibility, efficiency, and there lative significances were shown as descending in the sequence of accessibility, functionality, continuity, and efficiency.

The second-hierarchy indexes of placeness were symbolicity, variety, culturality, and the relative significances were shown as descending in the sequence of symbolicity, culturality, and variety.

The second-hierarchy indexes of safety were borderness, security/crime prevention, identifiability, and the relative significances were shown as descending in the sequence of borderness, identifiability, security/crime prevention.

The second-hierarchy indexes of amenity were scenic quality, convenience, openness, and the relative significances were shown as descending in the sequence of convenience, openness, and scenic quality.

The second-hierarchy indexes of sociality were publicity, equity, restfulness, and the relative significances were shown as descending in sequence of publicity, restfulness, and equity.

III. METHOD

The pedestrian area, a summary of research papers, books, and related rules, such as journals and derived features and characteristics of the total to 53.

Indicators of these characteristics and the nature and meaning and integrated with each other, similar ones, the meaning or nature of the separation of the different indicators for each previous studies, different definitions, the meaning is ambiguous, and reconstruct things term unsuitable ones with a more appropriate term applicable for pedestrian features and characteristics based on the selection and sort through the results of the primary processing of the attributes that can be defined as the means of processing and integration similar 37 pedestrian road design metrics as indicators summarized.

TABLE I

TYPE THE FEATURES AND CHARACTERISTICS OF THE CITY'S PEDESTRIAN ROAD

Division	Contents
Mobility	Continuity, Functionality, Efficiency, Accessibility, Affordability, Consistency, Connectivity
Location	Symbolism, Independence, Diversity, Ministry of Culture, Identity, Unity, Wholeness, Individuality, Tradition, Spirit of the times, Elements of art
Stability	Buffer, Boundary, Security / Crime prevention, Distinction
Amenity	Landscape, Convenience, Sense of openness, Aesthetic forms, Natural Elements
Sociability	Publicity, Share, Relax, Play, Equity

Hierarchy analysis and indicators defined in the previous study and to provide the convenience of importance for the analysis of questionnaire answers by the respondents considering the implications and pre-defined specific term to make it easier to understand some indicators were reconstructed to be a more appropriate term.

TABLE II

MOBILITY SECTOR, THE DEFINITION OF THE SPECIFIC TERM INDICATORS

Division	Contents
Mobility	From any place pedestrian street of the underlying properties that can be moved quickly to another place
Continuity	Pedestrian space activities or copper in the last unbroken nature
Functionality	For the degree of adequacy of Explosives gait according to the density of pedestrian road so fully the role and function of the original tread, tread obstacles being · non-being
Efficiency	Pedestrian facilities in terms of the efficient use of urban space in the restoration of the unique features of pedestrian facilities maintenance, preservation, and enable or original
Accessibility	Passage occurs from the area or reach a particular place or facility that is easily accessible properties
Affordability	Well formed walking environment pleasant area with the activation of the surrounding commercial area, facilitating new investment, such as the economic value of the surrounding area and the city characteristics that increases
Consistency	Pedestrians to tread the direction of the destination, consistency in space through composition, color, light, smell, and the slope of the ground, Texture features which naturally perceived characteristics
Connectivity	Pedestrians to move to the destination interconnected walking and public transport, car and bicycle parking, and properties that can be connected efficiently

TABLE III

LOCATION SECTOR INDICATORS SPECIFIC DEFINITIONS OF TERMS

Division	Contents
Location	To recognize pedestrians and remember that features that distinguishes a particular space and other space properties
Symbolism	Landmark Features itself has symbolic significance as an important recognition of the target pedestrian this corresponds
Independence	Subjective space whose position in urban space, and move away from the physical location different parts of the space properties
Diversity	Pedestrians can enjoy a variety of experience and of the space through the physical and non-physical environmental factors that energizes the nature
Ministry of Culture	Acts of culture and art exhibitions, concerts, exhibitions, parade, festival, and direct contact with the culture in the same city as the space characteristics
Identity	Unchanging despite various changes and pedestrian streets of the components that have unique characteristics
Unity	To configure a pedestrian street full of various components is identified as one that causes the nature
Wholeness	Pedestrians and road configuration of multiple elements properly integrated into one organic system to accommodate the diversity in terms of location and nature
Individuality	Unique, but wonderful as attention-catching stand out prominently from the surrounding environment, adjacent properties or those
Tradition	Handed down from the past, the area or footpath on Features
Spirit of the times	To characterize the dominated that era, or one of the configuration space pedestrian elements of intangible cultural prevalent in the era of social mental
Elements of art	Collectively, the artistic elements of the stylistic elements of the elements that make up the pedestrian space as an artistic activity, and the accompanying

TABLE IV

STABILITY SECTOR, THE DEFINITION OF THE SPECIFIC TERM INDICATORS

Division	Contents
Stability	Elements that minimizes the possibility of occurrence of the risk arising from the occurrence of a traffic accident or a society, crime, natural disasters, etc., while walking
Buffer	Buffer and avoid a direct conflict between transportation and living space of the quantum interference mitigation function
Boundary	Physical, temporal separation of the driveway and the sidewalk through the ability to minimize friction between the amount of transportation
Security / Crime prevention	Facilities and plans to install easy to show in a public place or pedestrian space to prevent criminal activity, preferably a heightened degree of light or clock to prevent accidents by allowing
Distinction	Protons, whether it has been separated from each other by giving motorists and pedestrians to motorists for pedestrians to make it easier to identify safety measures to help

TABLE V

AMENITY SECTOR, THE DEFINITION OF THE SPECIFIC TERM INDICATORS

Division	Contents
Amenity	To pedestrians, pedestrians walking to affluence and refreshing, and depending on the composition of a good pedestrian environment, the provision of convenience, comfort the mind and body feel good
Landscape	Tangible elements and intangible factors can be divided into pedestrians when placed in the horizontal space is formed, but in this study is limited to the tangible elements such as buildings, billboards, bottom, skylines
Convenience	The presence of the various facilities required for long tread convenient to use the facilities and facilitate the flow of pedestrians walking around without discomfort
Sense of openness	Visual corridor of the building setback, the horizontal configuration of the pattern depending on the extent to which visual open to pedestrians or such feelings
Aesthetic forms	Colors shown in the pedestrian street, aging, horizontal shape, street furniture and signage design, such as aesthetic forms
Natural Elements	Elements of the natural state of the surrounding mountains, rivers, street trees and flower beds and is seen as the visible

TABLE VI

AMENITY SECTOR, THE DEFINITION OF THE SPECIFIC TERM INDICATORS

Division	Contents
Sociability	To allow people to meet each other to share the areas of social interaction, pedestrian consciousness, a sense of community, such as social functioning or personality
Publicity	Composition of all the space that can be done with much help about whether long move certain sections pedestrian experience in a variety of acts for observation or participation in community improvement or interaction through tangible and intangible factors
Share	The duality of the internal space and external space area and remove externalize the internal space of the attempt to internalize the external space form a complementary relationship to nature
Relax	Spatial role of the bench, resting in the shade of the trees, and met a man in the street, the pedestrian area of the dialog
Play	Playing with the sand, slide, trapeze, play, play pieces from big role of the pedestrian area of the spatial
Equity	Characteristics that need to be planned pedestrian routes as well as the firsts by automobile traffic, pedestrians should not sacrifice to use for people with disabilities, children, the elderly, and stands for the same gait designed to be used equitably

IV. ANALYSIS RESULTS

A. The Primary Survey

AHP weights for the analysis were used to analyze the primary survey target group of experts, through the analysis of each of the indicators and analysis of specific importance, so the indicators of high importance only.

TABLE VII

SURVEY RESPONDENTS DISTRIBUTION

Respondent major	Number of respondent	Ratio (%)
Urban Planning	20	46.51
Architecture	10	23.26
Environment, landscaping	7	16.28
transportation	9	13.95

TABLE VII
IMPORTANCE ANALYSIS

Division	Indicators	Importance
Mobility	Continuity	180
	Functionality	175
	Efficiency	166
	Accessibility	179
	Affordability	155
	Consistency	143
	Connectivity	172
Location	Symbolism	154
	Independence	131
	Diversity	153
	Ministry of Culture	156
	Identity	133
	Unity	141
	Wholeness	141
	Individuality	131
	Tradition	137
	Spirit of the times	120
Stability	Elements of art	137
	Buffer	165
	Boundary	170
	Security / Crime prevention	169
Amenity	Distinction	172
	Landscape	160
	Convenience	166
	Sense of openness	173
	Aesthetic forms	154
	Natural Elements	144
	Publicity	168
Sociability	Share	145
	Relax	164
	Play	117
	Equity	179

B. AHP Model of the Set

Expert advisory results in accordance with the opinion of connectivity and continuity of the seven indicators of mobility means that cross-duplicates included in the survey and this continuity only with higher scores, the linkages were excluded from this survey.

Indicators of place identity hypothesis statement results unity, the entire castle its meaning is ambiguous, and the superficial opinion that was place identity of the sub-indicators, the overall importance scores were lower compared to other indicators, diversity (153 points) and unity, unity and totality stars (141) the importance of the score gap between the cursor except the Ministry of Culture, symbolism, the diversity of the three indicators used in the analytic hierarchy.

TABLE IX
PEDESTRIAN ROAD DESIGN ELEMENTS OF THE MODEL THROUGH A
PRIMARY SURVEY

Division	Contents
Mobility	Continuity
	Functionality
	Accessibility
	Efficiency
Location	Symbolism
	Diversity
	Ministry of Culture
Stability	Boundary
	Security / Crime prevention
	Distinction
Amenity	Landscape
	Convenience
	Sense of openness
Sociability	Publicity
	Equity
	Relax

C. Indicator-specific weights analysis

To verify the consistency of the answers were collected questionnaires. Inconsistency ratio (CR) in this study appeared to be less than 0.1 to be consistent with the results of the Analytic Hierarchy Process was verified.

TABLE X
CONSISTENCY VERIFICATION RESULTS

Level	N	C.I	C.R	
Level 1	5	0.015	0.013	
Level 2	Mobility	4	0.008	0.009
	Location	3	0.000	0.000
	Stability	3	0.002	0.004
	Amenity	3	0.000	0.000
	Sociability	3	0.000	0.001

TABLE XI
TOTAL WEIGHTS AND THE PRIORITY SUMMARY ANALYSIS

Main Category	Weight	Rank	Sub Category	Weight	Rank
Mobility	0.229	2	Continuity	0.215	3
			Functionality	0.222	2
			Accessibility	0.364	1
			Efficiency	0.199	4
Location	0.140	4	Symbolism	0.387	1
			Diversity	0.283	3
			Ministry of Culture	0.330	2
Stability	0.298	1	Boundary	0.346	1
			Security / Crime prevention	0.310	3
			Distinction	0.344	2
Amenity	0.196	3	Landscape	0.244	3
			Convenience	0.477	1
			Sense of openness	0.279	2
Sociability	0.137	5	Publicity	0.400	1
			Equity	0.277	3
			Relax	0.323	2

Table V is combination of priority weights and the overall rating of the elements as a whole, by Step 1, the upper layer and sub-divided into a hierarchy of two-phase evaluation area and the evaluation factors to be considered as a priority of the central business district pedestrian road design elements are analyzed.

V. CONCLUSION

A. Conclusion

This study due to the nation's growth-oriented economic policy, the roads when planning for pedestrians rather than from reality for a serious infringement on gait caused by automobile-oriented planning began last for many social movements and citizens of gait, the consciousness of the citizens of such as improvements, research and drafting prepare plans due to the problems and guesswork revealed several pedestrian road planning and design phase, many changes have occurred, but the effect on the improvement of the still insufficient reality is, especially in the commercial area of the city center tread infringement can be about the problems more

serious than in other regions.

Extracted by pedestrian road design elements related to previous research and related institutions on the basis of the present study, comprehensive and relevant indicators of reclassification after analyzing the importance of each of the indicators, the indicators of high importance by the Analytic Hierarchy Process (AHP) to extract weighted analysis priorities were selected through the central business district pedestrian road design elements of it through for pedestrian planning and design-related professionals in the future, more pleasant and be able to provide the basic data for the planning and design of effective pedestrian road judgment.

Pedestrian road design indicators presented in this study, for the first ranking measure called the high-priority indicators necessarily reflect the indicators that you need to plan, and the first low-priority indicators means that the plan does not need to be considered when is not considering all indicators reflect the best place, but if many are faced with the problem realistically have a limited budget, you need to select the priority of enforcement of the decision-making if the designation that is consistent with the characteristics of each element of the priority indicators of high priority consideration shall be deemed to be able to provide the basic data for this study.

Given the sense of separation due to the car, the loss of humanity can solve one of the important ways that of human gait the most primitive means of transportation, at the same time, enhancing the level of quality is so bad in the city center pedestrian area of walking you will need to enable of premodern institutions also need maintenance and, fundamentally, the gait of the car rather than the flow of people should be a priority of values that change will be based.

In addition, Korea's Korea policy of gait relative stands to be a pedestrian-oriented policy, but the policy gait is still a lot of policy, the center of the communication vehicle and recently tried switching to the distance you want to walk on the streets have no composition or compositions, such as pedestrian-friendly car, but still the safety of pedestrians on the road is threatened, and the analysis of the results in this study appeared as top priority for pedestrian safety has been regarded as the challenges.

Hasty pedestrians on the road, pedestrians owner thinks that the performance-based policy or institutional improvements rather than long-term perspective and consciousness of citizens to improve road traffic laws and pedestrian road system, specific design guidelines or codes of conduct, such as design standards should be prepared.

B. Limitations of the Study

First, the priority of the indicators presented, nor the absolute priority designation on the characteristics of each design and planning of pedestrian road priorities differently is to be determined. Universally valid logic and the indicators presented in this study by a comprehensive be applied first to apply to the individual characteristics of the site, as suggested, but item is flexible, can be called.

Second, it did not conduct a weighted analysis presented in the analysis of the importance of this study, all of the 37 indicators through the AHP analysis. 37 analysis yielded a total of 21 indicators selected indicators of the ground, there are too many limitations due to the difficulty getting the questionnaire responses of the survey respondents, difficult to answer the questionnaire consistent, which determine priorities through the analytic hierarchy, but the importance all pedestrian road design and planning indicators to indicators that cannot be overlooked that in mind, when applied to the actual designation will require a comprehensive consideration on all indicators.

Third, the present study, we surveyed a group of experts, but the target sample group of experts, urban planning, design and engineering, and career biased for short people tend to be accurate and objective analysis of the results in order to derive allocated to the appropriate proportion of various groups, the research will be carried out.

C. Future Research

First, this study therefore need to consider the characteristics of each of the land-use such as residential, commercial, and industrial areas for pedestrian design elements under different assumptions for pedestrian walking relatively serious violations that are deemed as the center of the commercial area of research was the most used in everyday life, residential areas and other uses in the area of design elements for further study will be needed.

Second, the step 1 of the two-phase design metrics and indicators designed this study, conducted by a two-step analysis of the layered design indicators only indicators that correspond to the three-stage design, streetlights, landscaping trees, the setback of the building, the disconnection interval for pedestrian, such as the actual working through the layered design elements can be applied for analysis of the weighted indicators for a specific design, were excluded. Study will be needed for the development of a three-phase design metrics.

REFERENCES

- [1] A.K. Jang, "For small to improve the urban environment the Cheongju existing downtown walking Landscape Study: pedestrian-oriented on the horizontal plan centered" , Seowon Univ. Graduate School of Industry, 2008.
- [2] H. M. Yang, "Research on pedestrian space in the city", Seoul National University, Graduate School of Environmental Studies, 1981.
- [3] G. J. Lee, "Study of pedestrian space on the Revitalization of city doing", Chung-Ang University, 1982.
- [4] Y. H. Yoo, "Study of Landscape of the city center pedestrian space characteristics and the improvement in the direction the district of Myeong-dong, Seoul", Seoul National University, Graduate School of Environmental Studies, 1987.
- [5] E. S. Kang, "Pedestrian road in the form of landscape preference analysis", Yonsei University, 2000.
- [6] S. P. Kim, "Pedestrian area of Myeong-dong, Seoul Space Research", University of Seoul, Graduate School of Industry, 1998.
- [7] J. E. Kim, "Gait is dedicated to the commercial development of the horizontal and Utilization Study", Seoul National University, Graduate School of Environmental Studies, 2002.
- [8] Y. S. Lee, "The center of horizontal space and Utilization Study", Inha University Graduate School, 1985.

- [9] Y. J. Lee, "Study on the spatial characteristics of the horizontal space: horizontal space components of Apgujeong and Daehangno by comparing proposals", Dankook University Graduate School, 1991.
- [10] C. H. Park, "Composition for pedestrian space the front bulletin Utilization", Yonsei University Graduate School of Industry, 1992.
- [11] M. A. Park, "Research-dong, Gangdong-gu, Seoul godeokdong Jugong wave art, with a focus on residential landscape management plan, through openness and affinity analysis", Kyungwon University, 2005.
- [12] W. S. Jung, "Urban street research on the analysis of the physical elements of the pedestrian environment", Hongik University, 2007.
- [13] H. J. Yang, "Specialized specify the city center, on the direction of the horizontal space exterior remodeling", Chungnam National University, 2006.
- [14] S. H. Kim, "Streetscape characterization by a horizontal image of pedestrians walking dong, pedestrian environment, basic horizontal business plan targets", Hanyang University, 2007.
- [15] J. H. Kim, "Plan on the day-to-day use of the Urban Residential Landscape Research", Ajou University, 2006.
- [16] S. S. Park, "Study to improve the pedestrian walking environment: in Seoul", Yonsei University of Seoul, 2005.
- [17] K. M. Park, "Study: gait according to the type of horizontal planting landscape, Gangnam-gu, Streetscape", Kyung Hee University, 2006.
- [18] H. R. Seo, "Pedestrian Environment Improvement Study", Sun Moon University, 2006.
- [19] J. H. Choi, "Ecological environment applicable to private urban development project research, planning indicators", Daejin University, 2007.
- [20] S. M. Yeo, "Study on the continuity of the road for the activation of the pedestrian space", Hongik University, 1989.
- [21] T. H. Kim, "Apartment complex on my configuration of the road and pedestrian system improvements research", Hongik University, 1985.
- [22] G. I. Lee, "Residential complexes Study on the Evaluation of Side Walk separated by type of residents' perception and use of space", the Society of Construction and Transportation, 1996.
- [23] H. S. Lee, "Study on the Revitalization of pedestrian road in town", the Architectural Institute of Korea, 2000.