

Analysis of Isolation, Connection and Circulation with the Neighborhood park in Daegu

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Abstract

Major and reckless development which have been continued during the last half century, have caused decrease and damage of urban green spaces in the point of qualitative and quantitative view. Particularly, it brought about reduction to urban neighborhood park which has taken the main role for landscape ecological value. Recently, neighborhood park planning based on the landscape ecological results has been increasing gradually. Most of all, diverse attempts such as the application of shape character analysis and the step of landscape ecological planning in urban park planning have been proposed. Today, we recognize the importance of comprehensive approach in urban green planning and neighborhood park planning, but landscape ecological approach which is analyzing character and making proposal with isolation, connection and circulation is still insufficient. Most of neighborhood parks in Korea are surrounded by buildings and isolated from adjacent green spaces. Besides, these parks have landscape ecological problems such as reduction of size, isolation from adjacent green spaces, decline of nature, and excessive pavement which we ignored during urban development process. We have sympathy for understanding landscape ecological characters and considering improvement proposals for neighborhood parks. Therefore, the purpose of this study was to 1) select five neighborhood parks in Daegu, 2) analyze landscape ecological characters with isolation, connection and circulation, and 3) compare data. It is certain that these results should be the main data for the arrangement of improvement proposals which landscape ecological characters were applied to.

Key words : circulation, connection, green spaces, isolation, landscape ecological character, urban neighborhood park

Introduction

Urban green spaces, which have been confronted with the major or reckless development during the last half century, have various problems in point of qualitative and quantitative view. In particular, the value of neighborhood parks, which take the main role in terms

of landscape ecological value in urban areas, declined(Naveh and Libeman, 1994; Ra, 2005). Recently, neighborhood park planning based on the landscape ecological results has been increasing gradually. Above all, diverse attempts such as the application of shape character analysis and landscape ecological planning step in urban park planning have

been proposed(Sukopp and Weiler, 1988; Ahern, 2005; Murphy, 2005, Ryu, 2005; Cho, 2007). The necessity of urban green spaces and neighborhood park planning was recognized in the comprehensive view. However, landscape ecological approaches based on indicators such as isolation, connection and circulation are still insufficient for the neighborhood park planning. Most of neighborhood parks in Korea were surrounded by building and isolated from adjacent green spaces. In addition, these have landscape ecological problems such as reduction of size, isolation from adjacent green spaces, decline of nature, and excessive pavement which we ignored during urban development process. Finally, we need to understand the landscape ecological character and consider the improvement proposal for neighborhood park. Therefore, we selected five neighborhood parks in Daegu, conducted especially landscape ecological character analysis with isolation, connection and circulation, and compared data. It is certain that these results can be main data for the arrangement of improvement proposal which landscape ecological characters were applied to.

Contents and Methods

Condition

We selected five neighborhood parks such as Beommul Park, Chimsan Park, Dalseong Park, Ehyeun Park, and Kyukchaebosang park in Daegu and the general characters including location, size, land use and so on of the study site were as follows(Table 1).

Table 1. Study site

section	site	location	size	land use
artificial park	Kyukchaebosang park	Jung-gu Dongen2	42,509m ²	main-commercial district
	Beommul Park	Suseong-gu Beommul-dong	7,158m ²	residential district(high-rise apartment building)
semi-natural park	Dalseong Park	Jung-gu Dalseong-dong	126,576m ²	commercial district
	Chimsan Park	Buk-gu Chimsan-dong	291,080m ²	residential&industrial district
	Ehyeun Park	Seo-gu Ehyeun-dong	110,920m ²	industrial district

Scope

This study was carried out by the two survey steps. The first survey was focused on the general survey in the landscape ecological character view and the condition checking for the selection of study site. The period of survey was four months from June to September in 2001, five months from June to October in 2002. The second survey performed detail site survey for landscape ecological character analysis during five months, from June to October in 2003 and four months, from March to June in 2004.

The spatial scope was limited to five neighborhood parks in Daegu and the method for selection was applied by the stratified sample and the purposive sample. The contents scope was based on landscape ecological concept with P-C-M model of Forman and in particular defined as isolation, connection and circulation in landscape ecological characters.

Method

Isolation with nearby green areas

We used formula for isolation-estimation and especially measured and compared with the mutual distance of main green spaces. Above all, green spaces of the minimum size 7,000m² (Forman, 1995) which can maintain as an ecological island were categorized and surveyed. First, we understood isolation with the fact that the higher isolation is, the lower ecological value is and we applied the score 500 m between green spaces as the isolation standard by Wolfgang and Robert(1985).

Connection and circulation by permitted limits

In order to measure connection, we made use of gamma index which divides real links into practicable maximum links and alpha index which divides real circulation loop with practicable maximum circulation loop. Alpha index range is from 0 to 1, score 0 implies no circulation loop and score 1 means maximum circulation loop.

However, this study performed the measure of connection and circulation with neighborhood parks in urban areas and nearby green spaces and so alpha and gamma index could be minus score or over score 1 since urban street system was interrupted and changed rapidly. It has been attributed to urban structure. Besides, permitted limits with nearby green spaces, standard and method for selection of nodes and links are as follows.

Application standard by permitted limits

Permitted limits applied to this study were focused on the connection with green spaces in neighborhood district and block unit. Particularly, we applied neighborhood district size as the attraction distance 500m of neighborhood park which was regulated by

urban park legislation, and block size as average radius 500m which was utilized for biotope type classification in seoul to set permitted limits 500m neighborhood district(Seoul, 2000). In addition, we compared with the value of connection and circulation within permitted limit 500m and over permitted limit 500m.

Selection of nodes and links

We classified nodes into 1) playground for children which is under 75 m²×75 m² and over green ratio 10%, 2) elementary school which is under 150 m²×150 m² and over green ratio 30%, 3) middle-high school which is between 150 m²×150 m² and 300 m²×300 m² and over green ratio 30%, 4) university which over 300 m²×300 m² and over green ratio 30%, 5) government office, neighborhood park, extant plant and so on which is over 300 m²×300 m² and under green ratio 30%.

In particular, the standard size of green space type was fixed between minimum size and maximum size in permitted limit 700m and the standard of green ratio was applied to green evaluation standard with related research(Seoul, 2000). We set links to roads planted with trees and sidewalk to analyze connection and circulation(Table 2).

Table 2. Landscape ecological character analysis

Indicator	Analysis method
Isolation	comparison of isolation with the distance of nearby green areas i) isolation with nearby green areas ii) isolation with over nearby green 7,000m ² which is minimum size for self-maintenance by ecological island green isolation $r_i = \frac{1}{n} \sum_{j=1}^{i=n} d_{ij}$ (n = number of nearby greens, d_{ij} = the distance between green I and nearby green j)
Connection and Circulation	<ul style="list-style-type: none"> gamma index of networking connection $\frac{\text{number of links}}{\text{maximum number of practicable links}} = \frac{L}{3(V-2)}$: networking connection means rate of knot connection. value is between 0 and 1. alpha index of networking circulation $\frac{\text{number of circulation or loop}}{\text{maximum number of practicable circulation}} = \frac{L-V+1}{2V-5}$ (L=number of links ; V=number of nodes)

Table 3. Isolation by criteria

park	criteria	value
Beommul Park	isolation with nearby green areas	case1> playground $ri=(150+270+424+390)/4=308.5m$
		case2> school $ri=(374+298+412+790)/4=468.5m$
		case3> playground+school $ri=(150+270+424+390+374+298+412+790)/8=388.5m$
		case4> playground+school+neighborhood park $ri=(150+270+424+390+374+298+412+790+596)/9=411.5m$
		case5> playground+school+neighborhood park+nearby forest $ri=(150+270+424+390+374+298+412+790+596+412+520+530+420)/13=429.7m$
	isolation with over 7,000m ² green areas	case1> $ri=(596+412+520+530+420)/5=495.6m$
Chimsan Park	isolation with nearby green areas	case1> school $ri=(350+436+578+630+644+812+1080)/7=647.1m$
		case2> government office $ri=(880+928)/2=904m$
		case3> school+government office $ri=(350+436+578+630+644+812+1080+880+928)/9=704.2m$
		case4> school+government office+neighborhood park $ri=(350+436+578+630+644+812+1080+880+928+928)/10=726.6m$
		case5> school+government office+neighborhood park+nearby river1 (sincheon) $ri=(350+436+578+630+644+812+1080+880+928+928+482)/11=493m$
		case6> school+government office+neighborhood park+nearby river2 (geumho ⁷) $ri=(350+436+578+630+644+812+1080+880+928+928+870)/11=739.6m$
		case7> school+government office+neighborhood park+nearby river1+nearby river2 $ri=(350+436+578+630+644+812+1080+880+928+928+482+870)/12=718.2m$
isolation with over 7,000m ² green areas	case1> $ri=(350+578+630+644+812+928+1080)/7=717.4m$	
	case2> $ri=(350+578+630+644+812+928+1080+482)/8=681.3m$	
	case3> $ri=(350+578+630+644+812+928+1080+870)/8=736.5m$	
	case4> $ri=(350+578+630+644+812+928+1080+482+870)/9=708.2m$	
Dalseong Park	isolation with nearby green areas	case1> school $ri=(275+294+400+462+646+654+684+762+790+918)/10=588.5m$
		case2> government office(university hospital) $ri=552m$
		case3> school+government office(university hospital) $ri=(275+294+400+462+646+654+684+762+790+918+552)/11=585.2m$
		case4> school+government office(university hospital)+neighborhood park $ri=(275+294+400+462+646+654+684+762+790+918+552+638)/12=589.6m$
isolation with over 7,000m ² green areas	case1> $ri=(294+400+462+646+654+762+790+918+552+638)/12=509.7m$	
Ehyeun Park	isolation with nearby green areas	case1> school1 $ri=(358+506+602+704+790)/5=592m$
		case2> school2 (university) $ri=(480+704)/2=468.5m$
		case3> school1+school2 (university) $ri=(358+506+602+704+790+480+704)/7=592m$
		case4> school1+school2+nearby forest1 $ri=(358+506+602+704+790+480+704+860)/8=625.5m$
		case5> school1+school2+nearby forest2 $ri=(358+506+602+704+790+480+704+934)/8=634.8m$
	isolation with over 7,000m ² green areas	case1> $ri=(506+704+790+480+704+860)/6=674m$
case2> $ri=(506+704+790+480+704+934)/6=686.3m$		
Kyukchae-bosang park	isolation with nearby green areas	case1> school $ri=(375+550+575+590+720+832)/6=607m$
		case2> government office(university hospital, library) $ri=(145+150+268)/3=187.7m$
		case3> school+government office(university hospital, library) $ri=(375+550+575+590+720+832+145+150+268)/9=497.2m$
		case4> school+government office(university hospital, library)+neighborhood park $ri=(375+550+575+590+720+832+145+150+268+420+875)/11=500m$
		case5> school+government office(university hospital, library)+neighborhood park+nearbyriver(sincheon) $ri=(375+550+575+590+720+832+145+150+268+420+875+742)/12=520.2m$
	isolation with over 7,000m ² green areas	case1> school+government office(university hospital, library)+neighborhood park $ri=(550+575+590+720+832+145+150+268+420+875)/10=512.5m$
		case2> school+government office(university hospital, library)+neighborhood park+nearbyriver(sincheon) $ri=(550+575+590+720+832+145+150+268+420+875+742)/11=533.4m$

Results

Isolation with nearby green areas

Isolation analysis

In the case of Beommul Park, we classified green spaces into five cases by selected green types to measure isolation with nearby green spaces. First, case 1 showed the lowest isolation, 308.5m, between Beommul Park and playground for children. On the other hand, we found that isolation between Beommul Park and school green spaces including Beomeel elementary school is highest, 468.5 m. It is the cause that school green spaces around Beommul Park have bigger size than playgrounds for children but are further away from Beommul Park than playgrounds for children.

In addition to, the isolation between Beommul Park and green spaces over 7,000 m² showed 495.6 m and isolation is the highest than other cases. It is why there are high-rise apartment building, residential or commercial district around Beommul Park and appearance rate of over 7,000 m² green spaces is very low.

In Chimsan Park case, the isolation of case 5 was the lowest, 493 m and case 2 was the highest, 904 m. In particular, case 5 which showed the lowest isolation results from adjacency with school green spaces, government office, neighborhood park and river. Regarding isolation with over 7,000 m² green spaces, case 2 has the lowest isolation, 681.3 m and case 3 has the highest isolation, 736.5 m. Above all, this is why over 7,000 m² green spaces appeared in residential district which has low density.

Consideration

According to the isolation with school green sites which

commonly appeared in five study sites, Beommul Park was 468.5 m, Chimsan Park, 647.1 m, Dalseong Park, 588.5 m, Ehyeun Park, 592 m, and Kyukchaebosang park, 607 m. Chimsan Park has the highest isolation and Beommul Park has the lowest isolation on the part of distance with nearby school green spaces. It resulted from the urban planning on the parks particularly located at the industrial district and having distance from schools(Table 4).

As a result of the isolation with nearby schools, government office, neighborhood park, river and forest, Beommul Park was 429.7 m, Chimsan Park, 718.2 m, Dalseong Park, 589.6 m, Ehyeun Park, 634.8 m, and Kyukchaebosang park, 520.2 m. Most of all, we found that Chimsan Park had the highest isolation and Beommul Park, the lowest isolation in the comparison to isolation with school green type. It was caused by method such as not size of study site but mutual distances between nearby green spaces. Finally, the isolation with school green type generally appeared low even though the size of the school green spaces was small.

Connection and circulation by permitted limits

Connection and circulation in permitted limit 500m

In the case of Dalseong Park, it was found that connection of case 1 was 0.67 and circulation of case 1 was 0.33, highly. On the other hand, in case 3, connection showed 0.44 and circulation, 0, lowly. As a result of nodes selection in case 3 such as 1) elementary school which is under 150m²×150m² and over green ratio 30%, 2) middle-high school which is between 150m²×150m² and 300m²×300m² and over green ratio 30%, connection with nearby green spaces was

Table 4. Isolation by green types

criteria		study area	Beommul Park	Chimsan Park	Dalseong Park	Ehyeun Park	Kyukchaebosang park
isolation with nearby green areas	elementary · middle · high school green areas		468.5m	647.1m	588.5m	592m	607m
	all green types(school+government office+neighborhood park+river+forest)		429.7m	718.2m	589.6m	634.8m	520.2m
isolation with over 7,000m ² green areas			495.6m	736.5m	509.7m	686.3m	533.4m

0.44 and circulation, 0. It is why permitted limit 500m district around Dalseong Park consists of residential and commercial district which has few green types except elementary, middle, and high school green types. Moreover, there are old residential complexes around Dalseong Park, and so it lacks function of connection with nearby green spaces. Therefore, it is found that circulation of Dalseong Park was low since types and number of nodes is insufficient and links around residential district is absent(Table 5).

Ehyeun Park showed very high connection and circulation value of over 1 in case 1 which has nodes such as elementary school which is under 150 m²×150 m² and over green ratio 30%. In the case 4 adding university green type of over 300 m²×300 m² and green ratio 30%, the connection value was 0.67 and the circulation value was 0.33. Finally, green types which play a role of node, caused cutting between green spaces around Ehyeun Park and it was a negative influence in the ecological view(Table 6).

Table 5. Connection in permitted limit 500m

park	criteria	value
Beommul Park	case1> under 75m ² ×75m ² and over green ratio 10% (playground for children, total 5 nodes)	(over) 1
	case2> under 150m ² ×150m ² and over green ratio 30% (elementary school, total 3 nodes)	(over) 1
	case3> between 150m ² ×150m ² and 300m ² ×300m ² and over green ratio 30% (middle-high school, total 3 nodes)	(over) 1
	case4> case2+case3-total 5 nodes	(over) 1
	case5> case1+case2+case3-total 9 nodes	0.48
	case6> existing forest-total 6 nodes	0.83
	case7> case5+case6-total 14 nodes	0.28
Chimsan Park	case1> under 75m ² ×75m ² and over green ratio 10%(playground for children, total 2 nodes)	×
	case2> between 150m ² ×150m ² and 300m ² ×300m ² and over green ratio 30% (middle-high school, total 2 nodes)	×
	case3> case1+case2-total 3 nodes	1
Dalseong Park	case1> under 75m ² ×75m ² and over green ratio 10%(playground for children, total 4 nodes)	0.67
	case2> between 150m ² ×150m ² and 300m ² ×300m ² and over green ratio 30% (middle-high school, total 2 nodes)	×
	case3> case1+case2-total 5 nodes	0.44
Ehyeun Park	case1> under 75m ² ×75m ² and over green ratio 10%(playground for children, total 3 nodes)	(over) 1
	case2> over 300m ² ×300m ² and over green ratio 30% (university, total 2 nodes)	×
	case3> green zone①-total 2 nodes , green zone②-total 3 nodes	× (over)1
	case4> case1+case2-total 4 nodes	0.67
	case5> case1+case2+case3①-total 5 nodes, case1+case2+case3②-total 6 nodes	0.44 0.33
Kyukchaebosang park	case1> under 75m ² ×75m ² and over green ratio 10%(playground for children, total 3 nodes)	(over) 1
	case2> over 300m ² ×300m ² and over green ratio 30% (university, total 2 nodes)	×
	case3> over 300m ² ×300m ² and under green ratio 30% (government office, library, university hospital, total 3 nodes)	(over) 1
	case4> case1+case2-total 4 nodes	0.67
	case5> case1+case2+case3-total 6 nodes	0.33
	case6> case1+case2+case3+neighborhood park-total 7 nodes	0.27

- : no appearance of green types, × : no measure

Table 6. Circulation in permitted limit 500m

park	criteria	value
Beommul Park	case1> under 75m ² ×75m ² and over green ratio 10%(playground for children, total 5 nodes)	(over) 1
	case2> under 150m ² ×150m ² and over green ratio 30%(elementary school, total 3 nodes)	(over) 1
	case3> between 150m ² ×150m ² and 300m ² ×300m ² and over green ratio 30% (middle-high school, total 3 nodes)	(over) 1
	case4> case2+case3-total 5 nodes	(over) 1
	case5> case1+case2+case3-total 9 nodes	0.15
	case6> existing forest-total 6 nodes	0.71
	case7> case5+case6-total 14 nodes	(-)
Chimsan Park	case1> under 150m ² ×150m ² and over green ratio 30%(elementary school, total 2 nodes)	×
	case2> between 150m ² ×150m ² and 300m ² ×300m ² and over green ratio 30% (middle-high school, total 2 nodes)	×
	case3> case1+case2-total 3 nodes	1
Dalseong Park	case1> under 150m ² ×150m ² and over green ratio 30%(elementary school, total 4 nodes)	0.33
	case2> between 150m ² ×150m ² and 300m ² ×300m ² and over green ratio 30% (middle-high school, total 2 nodes)	×
	case3> case1+case2-total 5 nodes	0
Ehyeun Park	case1> under 150m ² ×150m ² and over green ratio 30%(elementary school, total 3 nodes)	(over) 1
	case2> over 300m ² ×300m ² and over green ratio 30% (university, total 2 nodes)	×
	case3> green zone①-total 2 nodes , green zone②-total 3 nodes	× (over)1
	case4> case1+case2-total 4 nodes	0.33
	case5> case1+case2+case3①-total 5 nodes, case1+case2+case3②-total 6 nodes	0 (-)
Kyukchaebosang park	case1> under 150m ² ×150m ² and over green ratio 30%(elementary school, total 3 nodes)	(over) 1
	case2> over 300m ² ×300m ² and over green ratio 30% (university, total 2 nodes)	×
	case3> over 300m ² ×300m ² and under green ratio 30% (government office, library, university hospital, total 3 nodes)	(over) 1
	case4> case1+case2-total 4 nodes	0.33
	case5> case1+case2+case3-total 6 nodes	(-)
	case6> case1+case2+case3+neighborhood park-total 7 nodes	(-)

- : no appearance of green types, × : no measure

Connection and circulation in permitted limit 700m

According to the analysis of Beommul Park, case 2 and case 3 which selected elementary, middle and high school green spaces as nodes, showed the connection and the circulation of over 1 value. It was found that this result is same with value of permitted limit 500 m. Besides, the case 5 adding playground green spaces for children as node had 0.48 value, 0.15 value as connection, circulation, respectively. It is why the distribution and the appearance of playground green spaces for children, elementary, middle and high school

green spaces between permitted limit 500 m and permitted limit 700 m are almost similar(Table 7).

Chimsan Park had 0.58 value, 0.29 value as connection, circulation, respectively in case 3 which selected Chimsan, Daesan, Dalsan elementary school and Chimsan high school green spaces as nodes. In addition, the case 4 including Sincheon river was analyzed as connection 0.47 value and 0.11 circulation value and it showed lower value than case 3. The connection and circulation with Sincheon river became all low since the district around Chimsan Park was composed of industrial complex which had few green spaces.

Table 7. Connection in permitted limit 700m

park	criteria	value
Beommul Park	case1> under 75m ² ×75m ² and over green ratio 10%(playground for children, total 5 nodes)	(over) 1
	case2> under 150m ² ×150m ² and over green ratio 30%(elementary school, total 3 nodes)	(over) 1
	case3> between 150m ² ×150m ² and 300m ² ×300m ² and over green ratio 30% (middle-high school, total 3 nodes)	(over) 1
	case4> case2+case3-total 5 nodes	(over) 1
	case5> case1+case2+case3-total 9 nodes	0.48
	case6> neighborhood park-total 2 nodes	×
	case7> existing forest-total 5 nodes	(over) 1
	case8> case5+case6-total 10 nodes	0.63
	case9> case5+case6+case7-total 14 nodes	0.28
Chimsan Park	case1> under 150m ² ×150m ² and over green ratio 30%(elementary school, total 4 nodes)	(over) 1
	case2> between 150m ² ×150m ² and 300m ² ×300m ² and over green ratio 30% (middle-high school, total 3 nodes)	(over) 1
	case3> case1+case2-total 6 nodes	0.58
	case4> case1+case2+water-total 7 nodes	0.47
Dalseong Park	case1> under 150m ² ×150m ² and over green ratio 30%(elementary school, total 4 nodes)	(over) 1
	case2> between 150m ² ×150m ² and 300m ² ×300m ² and over green ratio 30% (middle-high school, total 5 nodes)	0.78
	case3> over 300m ² ×300m ² and under green ratio 30% (government office, university hospital, total 2 nodes)	×
	case4> case1+case2-total 8 nodes	0.58
	case5> case1+case2+case3-total 9 nodes	0.33
Ehyeun Park	case1> under 150m ² ×150m ² and over green ratio 30%(elementary school, total 4 nodes)	0.83
	case2> between 150m ² ×150m ² and 300m ² ×300m ² and over green ratio 30% (middle-high school, total 2 nodes)	×
	case3> over 300m ² ×300m ² and over green ratio 30% (university, total 3 nodes)	(over) 1
	case4> green zone①-total 2 nodes, green zone②-total 3 nodes	× (over)1
	case5> existing forest-total 2 nodes	×
	case6> case1+case2-total 5 nodes	0.56
	case7> case1+case3-total 6 nodes	0.42
	case8> case1+case2+case3-total 7 nodes	0.33
	case9> case1+case2+case3+case4①-total 8 nodes case1+case2+case3+case4②-total 9 nodes	0.28 0.24
	case10> case1+case2+case3+case4+case5①-total 9 nodes case1+case2+case3+case4+case5②-total 10 nodes	0.24 0.21
Kyukchaebosang park	case1> under 150m ² ×150m ² and over green ratio 30%(elementary school, total 6 nodes)	0.5
	case2> between 150m ² ×150m ² and 300m ² ×300m ² and over green ratio 30% (middle-high school, total 2 nodes)	×
	case3> over 300m ² ×300m ² and over green ratio 30% (university, total 2 nodes)	×
	case4> over 300m ² ×300m ² and under green ratio 30% (government office, library, university hospital, total 3 nodes)	(over) 1
	case5> case1+case2-total 7 nodes	0.4
	case6> case1+case3-total 7 nodes	0.4
	case7> case1+case2+case3-total 8 nodes	0.33
	case8> case1+case2+case3+case4-total 10 nodes	0.25
	case9> case1+case2+case3+case4+neighborhood park-total 11 nodes	0.22

- : no appearance of green types, × : no measure

Table 8. Connection in permitted limit 700m

park	criteria	value
Beommul Park	case1> under 75m ² ×75m ² and over green ratio 10%(playground for children, total 5 nodes)	(over) 1
	case2> under 150m ² ×150m ² and over green ratio 30%(elementary school, total 3 nodes)	(over) 1
	case3> between 150m ² ×150m ² and 300m ² ×300m ² and over green ratio 30% (middle-high school, total 3 nodes)	(over) 1
	case4> case2+case3-total 5 nodes	(over) 1
	case5> case1+case2+case3-total 9 nodes	0.15
	case6> neighborhood park-total 2 nodes	×
	case7> existing forest-total 5 nodes	(over) 1
	case8> case5+case6-total 10 nodes	0.07
	case9> case5+case6+case7-total 14 nodes	(-)
Chimsan Park	case1> under 150m ² ×150m ² and over green ratio 30%(elementary school, total 4 nodes)	(over) 1
	case2> between 150m ² ×150m ² and 300m ² ×300m ² and over green ratio 30% (middle-high school, total 3 nodes)	(over) 1
	case3> case1+case2-total 6 nodes	0.29
	case4> case1+case2+water-total 7 nodes	0.11
Dalseong Park	case1> under 150m ² ×150m ² and over green ratio 30%(elementary school, total 4 nodes)	(over) 1
	case2> between 150m ² ×150m ² and 300m ² ×300m ² and over green ratio 30% (middle-high school, total 5 nodes)	0.6
	case3> over 300m ² ×300m ² and under green ratio 30% (government office, university hospital, total 2 nodes)	×
	case4> case1+case2-total 8 nodes	0
	case5> case1+case2+case3-total 9 nodes	(-)
Ehyeun Park	case1> under 150m ² ×150m ² and over green ratio 30%(elementary school, total 4 nodes)	0.67
	case2> between 150m ² ×150m ² and 300m ² ×300m ² and over green ratio 30% (middle-high school, total 2 nodes)	×
	case3> over 300m ² ×300m ² and over green ratio 30% (university, total 3 nodes)	(over) 1
	case4> green zone①-total 2 nodes, green zone②-total 3 nodes	× (over)1
	case5> existing forest-total 2 nodes	×
	case6> case1+case2-total 5 nodes	0.2
	case7> case1+case3-total 6 nodes	0
	case8> case1+case2+case3-total 7 nodes	(-)
	case9> case1+case2+case3+case4①-total 8 nodes case1+case2+case3+case4②-total 9 nodes	(-) (-)
	case10> case1+case2+case3+case4+case5①-total 9 nodes case1+case2+case3+case4+case5②-total 10 nodes	(-) (-)
Kyukchaebosang park	case1> under 150m ² ×150m ² and over green ratio 30%(elementary school, total 6 nodes)	0.14
	case2> between 150m ² ×150m ² and 300m ² ×300m ² and over green ratio 30% (middle-high school, total 2 nodes)	×
	case3> over 300m ² ×300m ² and over green ratio 30% (university, total 2 nodes)	×
	case4> over 300m ² ×300m ² and under green ratio 30% (government office, library, university hospital, total 3 nodes)	(over) 1
	case5> case1+case2-total 7 nodes	0
	case6> case1+case3-total 7 nodes	0
	case7> case1+case2+case3-total 8 nodes	(-)
	case8> case1+case2+case3+case4-total 10 nodes	(-)
	case9> case1+case2+case3+case4+neighborhood park-total 11 nodes	(-)

- : no appearance of green types, × : no measure

In the point of ecological view, the low value of connection and circulation implicates the interruption of green spaces. Therefore, connection of green spaces should be improved by adding green spaces to around Chimsan Park(Table 8).

Consideration

As a result of connection analysis, the value of Beommul Park was 0.28, Chimsan Park, 1, Dalseong Park, 0.44, Ehyeun Park, 0.33 and Kyukchaebosang park, 0.27 within permitted limit 500m. Specifically,

Chimsan Park had the highest connection value but it was caused by the number of nodes around Chimsan Park. Within permitted limit 700m, Beommul Park showed 0.28, Chimsan Park, 0.47, Dalseong Park, 0.33, Ehyeun Park, 0.21 and Kyukchaebosang park, 0.22 as connection value with all nodes. It appeared that the value of the connection within permitted limit 700 m was lower than within permitted limit 500 m. It is caused why increase the rate of increase in nodes' number is higher than increase rate of links' number(Figure 1, Table 9).

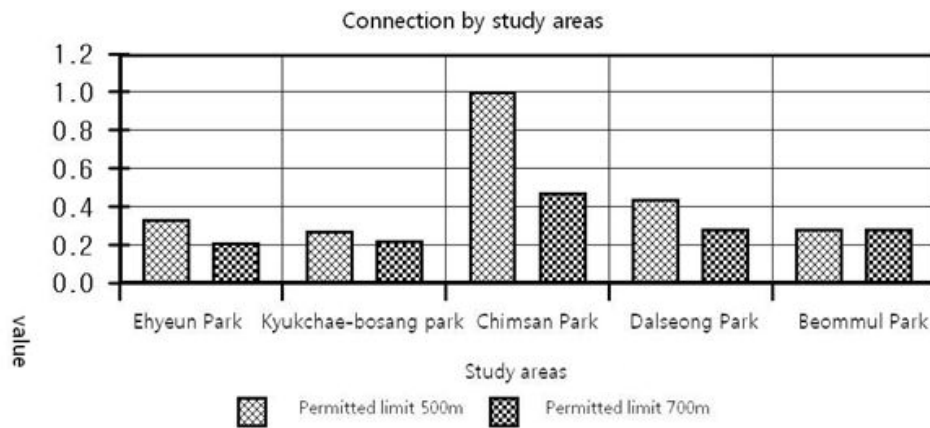


Fig. 1. Connection of study areas

Table 9. Connection by nodes' criteria

permitted limit criteria	Ehyeun Park		Kyukchaebosang park		Chimsan Park		Dalseong Park		Beommul Park	
	500m	700m	500m	700m	500m	700m	500m	700m	500m	700m
① under 150m ² ×150m ² and over green ratio 30%(elementary school)	over1	0.83	over1	0.5	×	over1	0.67	over1	over1	over1
② between 150m ² ×150m ² and 300m ² ×300m ² and over green ratio 30% (middle-high school)	-	×	-	×	×	over1	×	0.78	over1	over1
③ ①+②	-	0.56	-	0.4	1	0.58	0.44	0.58	over1	over1
④ over 300m ² ×300m ² and over green ratio 30% (university)	×	over1	×	×	-	-	-	-	-	-
⑤ ③+④	0.67	0.42	0.67	0.33	-	-	-	-	-	-
⑥ over 300m ² ×300m ² and under green ratio 30% (government office, library, university hospital)	-	-	over1	over1	-	-	-	×	-	-
⑦ ⑤+⑥	-	-	0.33	0.25	-	-	-	0.33	-	-
⑧ all Nodes	0.33	0.21	0.27	0.22	1	0.47	0.44	0.33	0.28	0.28

- : no appearance of green types, × : no measure

According to the circulation by study sites, the value of Beommul Park, Ehyeun Park, and Kyukchaebosang park, which were shown as over all 1 in the permitted limit 500m. Above all, the circulation value of Dalseong Park was seen as 0.33 and it showed the very lower circulation than other study sites. Chimsan Park had no measurement of the circulation within the permitted limit 500 m.

In the circulation case of within the permitted limit 700 m, the value of Beommul Park, Chimsan Park, Dalseong Park had over 1 and Ehyeun Park, 0.67, and Kyukchaebosang park, 0.14. respectively(Table 10).

Beommul Park had higher value than γ index 0.27 in Seoul and Ehyeun Park and Kyukchaebosang park had lower value within the permitted limit 700 m than Seoul. According to the circulation result, Chimsan Park appeared higher than -0.12, α index in Seoul and other study sites were analyzed as minus value such as Seoul. Seoul made some differences with this study in the point of green space types which were selected by not only parks and green spaces but also all types which became habitats. However, if we compared the connection and the circulation between this study sites and Seoul, it was known that this study areas had higher value of

Table 10. Circulation by nodes' criteria

criteria	Ehyeun Park		Kyukchaebosang park		Chimsan Park		Dalseong Park		Beommul Park	
	500m	700m	500m	700m	500m	700m	500m	700m	500m	700m
① under 150m ² ×150m ² and over green ratio 30%(elementary school)	over1	0.67	over1	0.14	×	over1	0.33	over1	over1	over1
② between 150m ² ×150m ² and 300m ² ×300m ² and over green ratio 30% (middle-high school)	-	×	-	×	×	over1	×	0.6	over1	over1
③ ①+②	-	0.2	-	0	1	0.29	0	0	over1	over1
④ over 300m ² ×300m ² and over green ratio 30% (university)	×	over1	×	×	-	-	-	-	-	-
⑤ ③+④	0.33	(-)	0.33	(-)	-	-	-	-	-	-
⑥ over 300m ² ×300m ² and under green ratio 30% (government office, library, university hospital)	-	-	over1	over1	-	-	-	×	-	-
⑦ ⑤+⑥	-	-	(-)	(-)	-	-	-	(-)	-	-
⑧ all Nodes	(-)	(-)	(-)	(-)	1	0.11	0	(-)	(-)	(-)

- : no appearance of green types, × : no measure

Consequentially, it was found that the value of not only connection but also circulation was lower within permitted limit 700 m than within permitted limit 500 m. However, Dalseong Park had the opposite results because of the arrangement of sidewalks planted with trees and it was seem to be a special result with positive effect. In accordance with the research which evaluated urban neighborhood parks in Seoul with the connection concept to quantify move difficulty by habitate fragment(Ahn and Kim, 2003), connectiIn comparison with the connection value in this study, Chimsan Park,

connection and circulation than Seoul.

Finally, it was found that the connection and the circulation of this study sites were insufficient as below the average and that interruption with nearby green spaces was excessive in the point of mutual relation view. Therefore, it is expected that the result of this study will be very important basic data to select and find improvement proposals for the connection and the circulation in neighborhood park planning.

Conclusion

The purpose of this study was to select five neighborhood parks such as Beommul Park, Chimsan Park, Dalseong Park, Ehyeun Park, and Kyukchaebosang park in Daegu and to analyze isolation, connection, and circulation among landscape ecological characters with P-C-M model by Forman. The result are as follows.

First of all, in the point of the isolation view with school green spaces, Beommul Park showed 468.5 m, Chimsan Park, 647.1 m, Dalseong Park, 588.5 m, Ehyeun Park, 592 m, and Kyukchaebosang park, 607 m, respectively. It was found that Chimsan Park had the highest isolation and on the other hand Beommul Park had the lowest isolation. It was regarded as long distance with school green spaces from Chimsan Park, frequent distribution of school green spaces around Beommul Park.

As a result of the connection and the circulation by the permitted limits, the connection value of Beommul Park had 0.28, Chimsan Park, 1, Dalseong Park, 0.44, Ehyeun Park, 0.33, and Kyukchaebosang park, 0.27, respectively within the permitted limit 500 m. In the case of the circulation with elementary school node, Beommul Park, Ehyeun Park, and Kyukchaebosang park was analyzed as over 1 and specifically, Dalseong Park was analyzed as 0.33.

According to the connection with all nodes within the permitted limit 700 m, the value of Beommul Park was 0.28, Chimsan Park, 0.47, Dalseong Park, 0.33, Ehyeun Park, 0.21, and Kyukchaebosang park, 0.22, respectively. In the circulation case, the value of Beommul Park, Chimsan Park, and Dalseong Park appeared as over 1 very high and Ehyeun Park and Kyukchaebosang park showed 0.67 and 0.14. In particular, Chimsan Park had the highest connection value but it was regarded as numerical value since the number of nodes around study sites is small relatively.

The result of isolation, connection, and circulation between urban parks and nearby green spaces shows difficulty, which was confronted by urban parks and nearby green spaces in point of landscape ecological

view, as numerical value. Above all, it is expected that green isolation index for isolation check and gamma index and alpha index for connection and circulation measure will be objective data to understand problems of urban parks and nearby green spaces and relation with green spaces within permitted limits.

However, the scope of this study was limited to Daegu and so it is certain that we need to analyze and compare with the result of urban parks and green spaces in other cities for the future. It is expected that this result will be objective indicators not only to accumulate data base but also to propose improvement plans for urban parks and green space planning based on sustainable relation process in the landscape ecological view.

REFERENCES

1. Ahern, J., 2005, Integration of landscape ecology and landscape architecture: an evolutionary and reciprocal process, *Issues and Perspectives in Landscape Ecology*, Cambridge University Press.
2. Ahn, D. M., and M. S. Kim, 2003, Environmental-friendly urban park green planning research -in the green establishment view for connection of habitats in Seoul-, *Journal of the Korean Institute of Landscape Architecture* 31(1): 34-41.
3. Cho, H. J., 2007, The establishment of model and application standard for landscape ecological planning, Daegu: Kyungpook National University.
4. Forman, R. T. T., 1995, *Land Mosaics: The Ecology of Landscapes and Regions*, Cambridge University Press.
5. Murphy, M., 2005, *Landscape Architecture Theory*, Waveland Pr Inc.
6. Naveh, Z. and A. Lieberman, 1994, *Landscape ecology: Theory and application*, New York: Springer-Verlag.
7. Seoul, 2000, *Field survey of Biotope and planning for eco-friendly urban establishment in Seoul*. Seoul: Seoul Development Institute.
8. Ra, J. H., 2005, *The development of method*,

- possibility, and limit in the landscape ecological research, *Journal of the Korean Institute of Landscape Architecture* 33(4): 45-70.
9. Ryu, Y. S., 2005, A Character Analysis of the Neighborhood park in point of Landscape Ecology, Daegu: Kyungpook National University.
 10. Sukopp, H. and S. Weiler, 1988, Biotop mapping and Nature Conservation Strategies in Urban Areas of Federal Republic of Germany, *Landscape and Urban Planning* 15: 39-58.
 11. Wolfgang, S., and M. Robert, 1985, Die Biooekologische Bewertung innerstaedt-ischer Gruenflaechen als Begrueundung fuer ein naturnah gestaltetes Gruenflaechen Schtzgebietssystem, *Natur and Landschaft*, 60. jg.