A Study on the Changes of Building Uses

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1. Introduction

Under the rapid changes of life-style and cultural environment, many buildings become out of fashioned day by day. Such aging of buildings will affect building values as well as social resources. Therefore, it is beneficial to maintain building quality in a good condition.

Among various methods, a change of building uses is one of the good strategies to maintain building quality due to its easiness and financial saving. In order to change building uses, internal structures and exterior features of buildings are transformed through addition, improvement, or repair of the building parts. Here, an owner of a building should decide whether to change uses of the building or to demolish it on the basis of economic feasibility. Therefore, it is important for an architect, owners of a building, and even public officials to understand methods of changes of building uses in order to achieve best economic rewards and to save social and natural resources by recycling buildings.

Comparing to importance of this subject, there are only a few studies on changes of building uses. Moreover, there are no empirical studies which examine inter-relationship between old uses and new uses of the buildings based on real data such as location, structure, and years of the buildings. Under this circumstance, this study aims to find out co-relationship between old uses and new uses of the buildings and to propose further research direction about building recycling, especially changes of building uses.

This study uses data regarding changes of building uses in two major districts in Taegu, Korea from 1996 to 1998 in order to find out patterns of changes of building uses. The cases of changes of building uses, examined in this study, are 125 and 265 from each Jung-Ku and Suseong-Ku in Taegu, Korea. The study uses number of changes of building uses and analyzes statistical differences due to location, structure, and years of the buildings.

2. Theoretical Review

It has been generally accepted that the changes of built environment reflect social changes. It means that people's preference to the building is not fixed but changed so the value of the building is variable depending on the conditions of the building. In this regard, one can say that a building has a limited life like other living organs and is getting old. However, unlike living organs, living organs buildings

are not aging but becoming obsolete since it is possible for an old building to be useful and it is also possible for a new or recent building to become useless[1] despite of its age. That is, every building becomes obsolete as it is built[2]. However, some buildings become obsolete faster than other buildings due to the changing social and cultural environment of the buildings, or the quality of materials used in the buildings.

According to previous study, a building is functionally obsolete when the building can no longer provide adequate services to the users of the building[3] and factors causing functional obsolescence of a building are demand for new uses for the building, technical changes, and changes in standard.[4] In addition to these factors, current uses, physical structure, location, and years of the building also have some influences on functional obsolescence of a building because these factors are influenced by changing social and cultural environment of the buildings and materials used in the building.

Based on these findings, additional maintenance efforts can enhance value and useful life of the functionally obsolete buildings because these buildings have a great potential to be used effectively when its uses are matched to the demand for the building. In general, these maintenance efforts are called as building recycling in an architectural study and are usually accomplished through repair, improvement, addition, use change, or etc. In this paper the researchers focused on a change of building use as a mean of building recycling method and tries to examine the influence of current uses, physical structure, location, and years of the buildings on the decisions to determine new use of recycled building.

3. Analyses and Results

■ General Descriptions of the Two Districts

Jung-ku is located at the center of Taegu city while Suseong-ku is located at the southern area of the city. These two districts have different functions and then have different land use patterns. First, Jung-ku has been developed as a center of the city and size of its commercial area is about one fourth of the city's total commercial area while its total size is just 7.09㎢ comparing to the city's total area of 458.21㎢. Size of residential area in Jung-ku is only 3.3 percent of the city's total residential area. Second, Suseong-ku is bigger than Jung-ku (76.47㎢) but has recently developed for residential area. Thus, as Figure 1 and 2 show, proportions of residential area and commercial area of Suseong-ku to the city are 20.0 percent and 11.7 percent, respectively. These simple comparisons between the two districts show that they have very different characteristics not only in size but also in major function of the districts within the city.

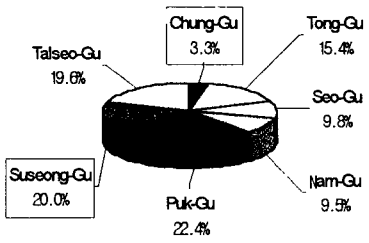

Figure 1. Proportion of Residential Area by Each District of Taegu city (Total Residential Area of the city = 79.95km^2)

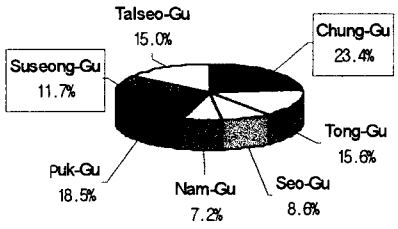

Figure 2. Size of Commercial Area by Each District of the City (Total Commercial Area of the City = 15.36km^2)

■ Analyses of Building Uses

From 1996 to 1998 Jung-ku issued total 570 building permits (including new construction and building recycling such as use change, improvement and addition) and among them 116 permits were for building recycling including 74 permits for the changes of building uses, while during the same period Suseong-ku issued total 2,105 building permits of which 293 permits were for building recycling including 180 permits for changes of building uses(Table 1). In addition, from the comparison of the proportion of the numbers of building recycling to total building permits and the size of area approved by the building permits between the two districts the researchers could find that change of building use was the most frequently adopted method within the two districts and these cases were under growing(Table 2).

Table 1. Approved Building Permits (Units: Cases, %)

district / year	Jung-Ku				Suseong-Ku			
	recycling		recycling sum	new construction	recycling		recycling sum	new construction
	use change	addition improvement			use change	addition improvement		
1996	26	13	39(13.1)	258(86.9)	106	49	155(13.4)	1001(86.6)
1997	36	26	62(25.9)	177(74.1)	52	55	107(15.4)	697(84.6)
1998	12	3	15(44.1)	19(55.9)	22	9	31(27.2)	114(72.8)

Table 2. Size of Areas by Approved Building Permits (Unit: m^2)

district / year	Jung-Ku		Suseong-Ku		Whole Area of Taegu City	
	recycling	construction	recycling	construction	recycling	construction
1996	12.193	347.334	15.524	1.694.444	1.064.680	12.330.066
1997	9.940	113.362	50.426	671.315	936.007	9.646826
1998	21.868	108.179	11.255	826.226	706.868	8.851.499

In Jung-ku of 8.1 percent of the total changes of building uses occurred during the study period were changes of neighborhood facilities to single-family houses while only 1.6 percent of the total changes of building uses were changes of single-family houses to neighborhood facilities. In contrast, 10.7 percent of total changes of buildings were changes of neighborhood facilities to single-family houses while 16.1 percent of the total changes were changes of single-family houses to neighborhood facilities in Suseong-ku(Table 3). The results show that these two districts have different patterns of changes of building uses. When housing supply ratio[5] and building types of these two districts were considered the researchers could find one possible reason for these differences. That is, due to a large amount of residential area Suseong-ku seems to have a great demand for neighborhood facilities rather than additional houses to support dwelling requirements while due to the strong commercial and office activities Jung-ku seems to have a bigger demand for small size of single-family houses to accomodate low income workers, who work in the central area of the city.

Table 3. Types of the changes of building uses

rank	Jung-Ku				Suseong-Ku			
	before use change	after use change	cases	%	before use change	after use change	cases	%
1	accommodations	neighborhood facilities	19	15.4	neighborhood facilities	educational facilities	43	16.5
2	office facilities	educational facilities	11	8.9	single-family houses	neighborhood facilities	42	16.1
3	neighborhood facilities	educational facilities	11	8.9	neighborhood facilities	single-family houses	28	10.7
4	neighborhood facilities	neighborhood facilities	10	8.1	neighborhood facilities	neighborhood facilities	27	10.3
5	neighborhood facilities	single-family houses	10	8.1	neighborhood facilities	recreational facilities	17	6.5
6	neighborhood facilities	office facilities	6	4.9	office facilities	educational facilities	10	3.8

Table 4 supports some of these arguments. Suseong-ku has highest housing supply ratio (85.6%) and largest numbers of single-family house(29,595 of total 15,995 houses as the year of 1996), while Jung-ku has 77.1 percent of housing supply ratio and largest numbers of office and commercial buildings among the 7 districts in the city.

Table 4. Housing Stocks in Taegu City (1996)

district / item	**Jung-Ku**	Tong-Ku	Seo-Ku	Nam-Ku	Puk-Ku	**Suseong-Ku**	Talseo-Ku
housing supply ratio(%)	77.1	72.7	65.2	69.6	77.9	85.6	84.7
single-family houses(호)	17,761	32,424	22,807	28,385	27,265	29,595	15,995

In addition, when previous uses of the buildings in Jung-ku, which have changed to new uses through use changes were examined, the study found that neighborhood facilities were the most frequently changed uses(48 cases) among the total cases of use changes and the next were accommodations, office facilities, commercial facilities, dormitories and educational facilities. Among these previous uses of the buildings in Jung-ku, total 26 accommodations have changed to new uses and of which 19 buildings have changed to neighborhood facilities, 3 buildings changed to office facilities, 2 buildings changed to recreational facilities, and remaining 2 buildings changed to educational facilities (Table 5). In contrast, when new uses of buildings in Jung-ku were examined, the study found that most of new uses were strongly related to commercial or official activities, except for the changes to single-family houses (Table 6). Total 10 buildings have changed to single-family houses through the changes of building uses and the buildings' previous uses were for neighborhood facilities. In addition, 7 buildings were older than 15 years and this result suggests that some of the use changes occurred in Jung-ku was influenced by functional obsolescence caused by the years of buildings.

Table 5. previous uses of buildings (Jung-Ku)

rank	before use change	cases	%
1	neighborhood facilities	48	39.0
2	accommodations	26	21.1
3	office facilities	22	17.9
4	commercial facilities	6	4.9
5	dormitories	5	4.5
6	educational facilities	4	3.3

Table 6. new uses through the changes of building uses(Jung-Ku)

rank	after use change	cases	%
1	neighborhood facilities	45	36.6
2	educational facilities	24	19.5
3	office facilities	18	14.6
4	single-family houses	10	8.1
5	recreational facilities	8	6.5
6	commercial facilities	7	5.7

In Suseong-ku, neighborhood facilities were the most frequently changed uses (138 cases) among the total cases of use changes occurred in this district and the next were single-family houses(49 cases), office facilities (22 cases), educational facilities (13 cases), storage of dangerous materials (8 cases) and accommodations (7 cases)(Table 7). Total 49 single-family houses have changed their original uses to new uses through the use changes and of which 23 buildings (46.9%) were less than 5 years old when they changed to new uses. In contrast with these results, when new uses of buildings in Suseong-ku were examined the study found that most of new uses were strongly related to the supplementary functions to make an ideal dwelling environment(Table 8). In sum, these results show that Suseong-ku has much stronger residential function than those of Jung-ku in the city and these different functions might have some relations to the amount of the changes of building uses and types of new uses. Therefore, it seems reasonable to see the relationship between the year of the buildings and frequency of the changes of building uses.

Table 7. previous uses of buildings (Suseong-Ku)

rank	before use change	case	%
1	neighborhood facilities	138	52.9
2	single-family houses	49	18.8
3	office facilities	22	8.4
4	educational facilities	13	5.0
5	storage of dangerous materials	8	3.1
6	accommodations	7	2.7

Table 8. new uses through the changes of building uses (Suseong-Ku)

rank	after use change	case	%
1	neighborhood facilities	98	37.5
2	educational facilities	53	20.3
3	single-family houses	35	13.4
4	recreational facilities	21	8.0
5	old and child care facilities	17	6.5
6	office facilities	12	4.6

■ Analyses of the Relationship between the Years of Buildings and the Changes of Building Uses

The previous analyses of this study showed that there were some relationships between the number of the changes of building uses and years of the buildings. Numbers of buildings counted for this study were 122 and 263 and average years of these buildings were 12.4 years and 5.8 years in Jung-ku and Suseong-ku, respectively. As shown in Figure 4 and 5, buildings located in Jung-ku were much older than building located in Suseong-ku. However, it is unclear whether the location of the building has any influence over the decision of use changes of functionally obsolete buildings.

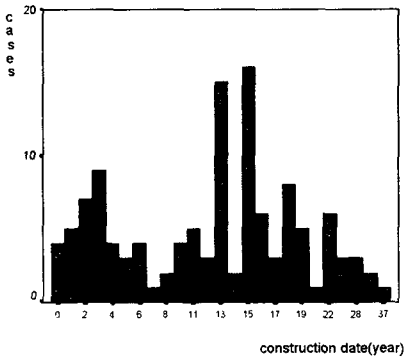

Figure 3. years of the buildings (Jung-Ku)

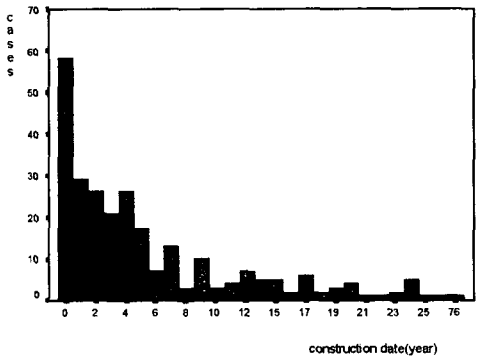

Figure 4. Years of the buildings (Suseong-Ku)

To examine this question t-test was performed for the years of buildings counted in Jung-ku and Suseong-ku. Result of the t-test shows that there is an apparent difference as to the years of buildings between the two districts (Table 9)[6].

Table 9. T-test for years of buildings and numbers of the changes of building uses

t-value	Probability
-7.589	0.000

■ Analyses of the Relationship between the Structure of the Buildings and the Changes of Building Uses

From the analysis of structure of the buildings considered in this study, some interesting differences between Jung-ku and Suseong-ku were found. For instance, only 4 percent of total buildings for changing to new uses through use changes were brick structured buildings in Jung-ku while about 19.3 percent of total buildings were brick structured buildings in Suseong-ku (Table 10).

Table 10. Structure of the Buildings

Structure of Buildings	RC	SRC	RC + STEEL	RC + BRICK	BRICK
Jung-ku	75%	6.5%	6.5%	3.2%	4.0%
Suseong-ku	54.2%	5.3%	2.7%	13.6%	19.3%

Based on the previous analyses results it is could assumed that this difference between the districts might related to the major function of each district. To confirm this assumption t-test was performed for the years of buildings constructed by brick structure within the two districts. Result of the t-test confirms that the numbers of the changes of building uses constructed by brick structure are different between the two districts(Table 11)[7].

Table 11. T-test for years of buildings and structure of the buildings

t-value	Probability
-4.613	0.000

Conclusions

Among the various methods of building recycling, changes of building uses has unique advantages comparing to other methods such as, remodeling, restoration, repair, improvement, and others. in terms of economic efficiency and physical effectiveness. For instance, as discussed in above, since a change of building use usually takes place in minimum transformation of internal structure or alternations of exterior feature of the building it requires only small amount of physical changes of the building and time to be done and generates small amount of waste comparing to the other building recycling methods. Therefore, it is important for an architect, owners of buildings, and even city planners to understand how a change of building use is proceeded.

From the case studies the researchers have found that numbers of buildings provided by building recycling method were under growing within the two major

districts in Taegu City, Korea. And the numbers of buildings provided by building recycling method were strongly influenced by the amount of the changes of building uses took place in the two districts. That is, there were different patterns of the changes of building uses within the two districts. In addition, from the analyses about the relationships between numbers of the changes of building uses and the years of buildings and the structures of the buildings it was found that a change of building use was not only influenced by years and physical structure of the building but also influenced by the surrounding environment determined by the location of the building. These results indicate that in order to extend useful life of a building through a change of its original use one should consider not only the physical adaptabilities of the building, such as years and structure of the building but the functional characteristics of the site within the city.

Based on these findings this study proposes the followings for further study about the use change of buildings;

first, to provide a practical guidance for building recycling, further study should focus on physical designs of the recycled buildings

second, to provide a feasible criterion for evaluation of proposed building recycling strategies, further study should consider financial feasibility of the recycling strategies in terms of savings of natural and social resources

finally, to provide a practical strategy for adopting optimum use change of a building, further study should focus on the benefits of the change of building use comparing to the other building recycling methods, such as repair, improvement, and etc., in terms of functional characteristics of the site within the city.

Notes

1) John Raftery, Principles of Building Economics, BSP Professional Books,
2) John Raftery, Principles of Building Economics, BSP Professional Books,
3) Nutt B. et al, Obsolescence in housing, Saxon House, London, 1976.
4) John Raftery, Principles of Building Economics, BSP Professional Books, p.79, 1976.
5) Housing supply ratio (%) = (Number of houses ÷ Number of households) × 100
6) Spss 8.0 T-test, t value= -7.598 and P= 0.000(<0.05).
7) Spss 8.0 T-test, t value= -4.613 and P= 0.000(<0.05).

References

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