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A QUANTITATIVE ANALYSIS OF THE APARTMENT UNIT TYPES IN SOUTH KOREA

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ABSTRACT

The history of modern apartments began in 1962 in South Korea. Since then, the number of apartment units constructed every year has been increasing. According to the 2005 Population and Housing Census, the proportion of apartment units in the total housing units approached 53%. Apartments became the major housing type in South Korea. Such changes had a great influence on the changes in residential culture and the life styles of the population. There have been many studies on qualitatively analyzing the changes of apartment unit types and the influence on residential culture. However, there has been little study on a quantitative analysis of the changes. In order to examine the reflection of the changes in apartment unit types on the residential culture, we quantitatively analyzed apartment space configurations. In this analysis, we limited the analysis target to the apartment units with a net usable space of 85m^2. They are called “National Housing Type” or “People’s Housing Type” by the Housing Construction Promotion Act. Since apartment units with a net usable space of 85m^2 are so small that they do not give architects many choices for design .Architects have to choose a design option that may satisfy most of potential residents of the time. In this process, A-Space, an analysis software program, was developed by Yonsei University in Seoul Korea. A-Space can analyze the characteristics of individual units and the similarity between the flat units in addition to the the integration analysis in Space Syntax. We expect that, by analyzing the representative unit types of Korean apartments, we can get a better understanding on the

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characteristics of Korea apartment housing, the impact of culture on apartment space configurations, and cross-cultural links between Korean apartment units and other types of housing in other countries.

Key words: Apartment Space Analysis, Apartment Type, ASpace.

Introduction

This study is to analyze the area of unit space, construction of space and route between unit spaces according to the LDK, bay, access type and each type and to find out the element that influences each space for the planes of 1,547 apartments in Seoul, which have been built after 1978 when the apartment increased and boomed in Korea. A-Space, a space analysis program was used to sample data established with CAD automatically for such a plan data analysis.

And it was analyzed and verified whether the factors of plane construction relate to each other and whether these factors influence each unit space by using a statistical methodology.

Analysis

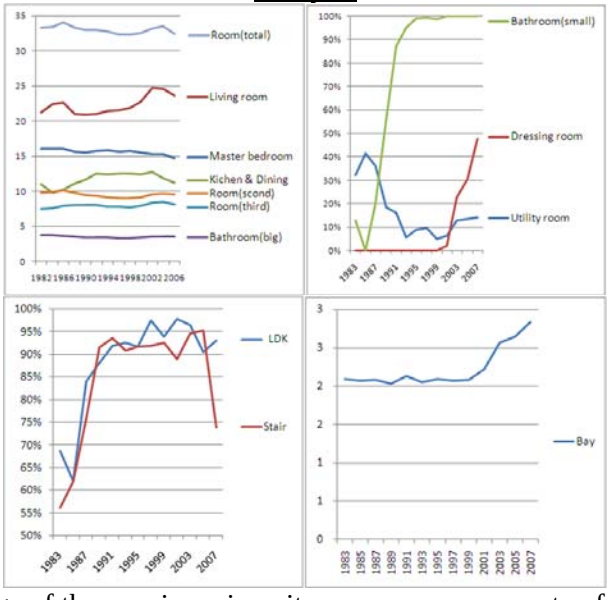

Figure 1 : Change of the area in main unit space, appearance rate of a dressing room, utility room and 2 bathrooms, LDK, occurrence rate of the stair-case type and change of the mean bay

Table 1 : Component ratio of apartment types

	Access type		Bedroom		LDK		Bay		Bathroom		* Dressing room		Organization	
2000 | 2008 N 746	Stair-case type	663 88.9%	3R	742 99.5%	LDK	706 94.6%	3 Bay	391 52.4%	2B	746 100%	1DR	564 75.6%	1L3R2B1DK	519
	Single-loaded corridor type	42 5.6%	4R	3 0.4%	L-DK	40 5.4%	2 Bay	340 25.6%	1B		0DR	182 24.4%	1L3R2B1DK1DR	161
	Concentrated type	37 5.0%	2R	1 0.1%	LD-K	0	4 Bay	13 1.7%	3B				1L3R2B1dK	21
	Double-loaded corridor type	4 0.5%	1R	0	LK-D	0	1Bay	2 0.3%					1L3R2B1DK1H	16
1970 | 2000 N 801	Stair-case type	705 88.0%	3R	791 98.8%	LDK	723 90.%	2BAY	730 91.1%	2B	667 83.3%	0DR	709 88.5%	1L3R2B1DK	596
	Single-loaded corridor type	94 11.7%	4R	9 1.1%	L-DK	64 8.0%	3BAY	69 8.6%	1B	133 16.6%	1DR	92 11.5%	1L3R1B1DK	104
	Concentrated type	2 0.3%	2R	1 0.1%	LD-K	13 1.6%	4BAY	1 0.1%	3B	1 0.1%			1L3R2B1DK1H	25
	Double-loaded corridor type	0 0%	1R	0 0%	LK-D	1 0.1%	1BAY	1 0.1%					1L3R2B1dK	17

(구성에서 창고,다용도실,복도 생략)

(L: Living room, R : Room, B : Bathroom, DK : Dining & Kitchen, dK : small Dining & Kitchen, DR : Dressing room, H: Hall)

If looking into the area of each space according to a time, it is noticed that the areas of a living room and a kitchen, which are used in common have increased while the area of a bedroom has gradually decreased. And the area of a master bedroom has decreased somewhat and the areas of other bedrooms have increased. This means that the function of a master bedroom is shared by a living room in the meaning of common space and the master bedroom has been stressed as private space which is a bedroom for husband and wife. And a bathroom added to a master bedroom means that the master bedroom is stressed for the function of a bedroom for husband and wife.

The general increase in space's area after 2000 was due to a change in calculating the exclusive area and the increase of an utility room and a dressing room caused a little decrease in the areas of all spaces relatively again.

For the access type, stair-case type has increased from the Single-loaded corridor type of the early days and its reason is that it is advantageous to design the back side of an apartment freely and to install a balcony with the function of a utility room close to a kitchen. And the decrease of the stair-case type is due to the increase of the concentrated type as residential land commercial buildings increase.

The cause of the increased bay is due to the thoughts to attach importance to open indoor space and to Koreans' traditionally-preferred southern exposure. And the 3 bay method has been frequently used, which places 2 rooms with a living room in the center and especially, it has been increased to arrange 3 rooms in the front side in 4 bays recently. And the increase of the LDK type also relates to the arrangement of open indoor space by combining a living room, kitchen and dining room into a single one.

From Fig. 1 and Table 1, it is shown that many changes have occurred after 2000 due to the liberalization of a selling price of 1998 after Korea's IMF crisis. And although most of apartments built after 2000 are of the stair-case type, LDK and 3 bay and most of plane constructions consist of 1L3R2B1DK, the types of apartment floor plans were analyzed on the basis of 1L3R2B1DK1DR in this study by considering the fact that the ratio of a dressing room has increased abruptly since 2000 to be 42% after 2005.

Statistical Verification

Before examining the characteristic of an apartment's unit space, it is necessary to verify statistically whether the standards of analysis influences actual space. Analysis was conducted on the influences to each of main spaces and the area of each space through the verification of independence and the ANOVA analysis among the LDK, bay and Access type by cross-tabulation analysis.

Verification of independence among the bay, LDK and the access type

Table 2 : Cross-tabulation analysis among the LDK, bay and access type

Bay					LDK						Bay				
1B	2B	3B	4B	Access Type	L-DK	LD-K	LDK	LK-D	합계	LDK	1B	2B	3B	4B	합계
2	954	401	11	Stair-case Type	65	9	1294	0	1368	L-DK	0	73	31	2	106
0	2	0	2	double-loaded corridor type	1	0	3	0	4	LD-K	0	7	4	0	11
0	5	33	1	Concentrated type	2	0	37	0	39	LDK	3	990	424	12	1429
1	109	26	0	Single-loaded corridor type	38	2	95	1	136	LK-D	0	0	1	0	1
3	1070	460	14	전체	106	11	1429	1	1547	전체	3	1070	460	14	1547
p = 0.0 < 0.05					p =0.90 >0.05					p = 0.0 < 0.05					

The result of Table 2 means that the access type-bay and bay-LDK interrelate with each other and that the stair-case type is of the 3 bay type more than other types and the 3 bay has more LDKs. On the other hand, the access type-LDK was shown to be independent from each other.

Verification of the Difference in the Room Areas According to the Bay, LDK and Access Type

Table 3 : ANOVA analysis between the bay, access type and LDK and the area of each room - analysis of 746 floor data after 2000

	Master Room	**Living room**	**Kitchen & Dining**	**Bathroom (big)**
Bay	0.072	*0.015	0.707	*0.024
Access type	*0.025	0.145	0.411	0.062
LDK	*0.034	*0.05	0.442	0
Bay & Access type	0.404	0.274	0.248	**0.007
Bay & LDK	0.804	**0	0.073	0
Access type & LDK	0.33	0.587	0.776	**0.007
Bay & Access type & LDK	**0.032	0.685	* 0.041	0.036

Table 4 : Meaning of ANOVA analysis result

Master bedroom	The P-values of an access type and LDK are 0.025 and 0.034 respectively to be significant at the level of .05 so that it shows a difference of the area by an Access type and LDK. The P-value of the bay & an access type & LDK is .0032 to be significant at the level of .05 so that it means an interaction effect.
Living room	The P-values of a bay and LDK are 0.015 and 0.050 respectively to be significant at the level of .05 so that it shows a difference of the area by a bay and LDK. For the interaction effect, The P-value of the bay & LDK is .000 to be significant at the level of .01 so that it means an interaction effect.
Kitchen& dining room	The P-value of the bay & access type & LDK is .0041 to be significant at the level of .05 so that it means only an interaction effect.
Bathroom	A bay is 0.024 to be significant at the level of .05 so that it shows a difference in the areas by a bay. The P-value of the bay & access type and the bay & access type & LDK is .0007 to be significant at the level of .05 so that it means an effect.

The result of Table 3 shows that there is a difference in the areas of a living room and a bathroom by a bay, a difference in the area of master rooms by an access type and a difference in the areas of a mater room and a living room by the LDK and that there is an interaction effect.

Table 5 : Verification of a difference in the area by the presence of a dressing room in the arrangement of the 3 Bay, LDK and access type - analysis of 746 floor data after 2000

	Master bedroom	Bedroom (second)	Bedroom (third)	Living room	Kitchen & Dining	Bathroom (big)	Bathroom (small)
1L3R2B1DK	15.21	9.80	8.54	25.32	11.69	3.57	2.78
1L3R2B1DK1DR	14.17	9.52	8.10	25.28	11.37	3.60	3.10
P Value	**0.00	*0.02	**0.00	0.88	0.13	0.50	**0.00

As both means, they are smaller than the significant level of $P < 0.1$ from a result of the verification of the mean values by the presence of a dressing room, there is a difference in both means. And there are differences in the mean areas of other spaces except a living room, a kitchen and dining room and a bathroom.

Result of the Settings of Standards

In conclusion, there is a difference in the areas of an apartment's unit spaces by the presence of a bay, LDK, access type and dressing room as hypothesized before and it proves that these standards influence the dimensions of space. Therefore, it is required to analyze according to each condition in order to examine the characteristic of an apartment's unit space. So, analysis was conducted on the mean values about the space property of an apartment's unit space based on the arrangement of the **3 Bay, LDK, Access type** and **1L3R2B1DK1DR**.

Analysis Result

Table 6 : Property of an apartment's unit space N 108

Property	Master bedroom	Bedroom (second)	Bedroom (third)	Living Room	Kitchen & Dining	Bathroom (big)	Bathroom (small)	Dressing room
CONNECTION (N) (including porch)	2.03	1.01	1.01	5.73	1.00	1.00	1.00	1.98
DEPTH (N)	1.04	1.12	1.06	0.00	1.00	1.70	2.28	1.98
RR(including porch)	0.23	0.38	0.37	0.12	0.38	0.46	0.54	0.40
RRA(including porch)	0.72	1.22	1.17	0.37	1.22	1.47	1.72	1.26
INTEGRATION (including porch)	1.41	0.84	0.87	2.77	0.94	0.74	0.63	0.80
AREA(m2)	14.18	9.52	8.10	25.29	11.34	3.60	3.10	2.91
Length(m)	15.18	12.49	11.52	25.05	13.89	7.84	7.43	7.17
Width(m)	3.96	2.97	2.80	7.22	3.61	1.65	1.60	2.02
Height(m)	3.62	3.27	2.96	5.20	3.34	2.27	2.11	1.57
Degree of Concavity	16.27	16.44	16.42	24.87	17.13	17.14	17.91	18.02
Convex Deficiency	0.01	0.01	0.01	0.19	0.03	0.01	0.03	0.03
Radial Mean(m)	2.56	2.13	1.97	3.14	2.17	1.35	1.22	1.09
Radial Max(m)	2.80	2.28	2.11	4.52	2.70	1.46	1.40	1.42
Radial Min(m)	2.38	1.95	1.84	1.57	1.61	1.18	0.96	0.73
Variance Complexity	0.46	0.46	0.46	0.86	0.70	0.46	0.57	0.65

Autocorrelation	0.06	0.06	0.04	0.08	0.18	0.07	0.07	0.20
From ratio	0.89	0.87	0.87	0.47	0.80	0.67	0.64	0.66
Grain Shape Index	3.80	3.77	3.77	3.40	3.69	3.36	3.35	3.42
Compactness	0.88	0.88	0.88	0.71	0.86	0.86	0.84	0.84
Thinness Ratio	0.77	0.77	0.77	0.51	0.74	0.74	0.71	0.70
Circularity1	0.76	0.77	0.77	0.63	0.71	0.74	0.72	0.68
Circularity2	0.76	0.77	0.77	0.63	0.71	0.74	0.72	0.68
Circularity3	0.76	0.77	0.77	0.63	0.71	0.74	0.72	0.68
Normalized Dispersion	1.48	1.52	1.56	1.30	1.31	1.70	1.60	1.42
Simplicity	0.88	0.89	0.92	0.20	0.61	0.91	0.82	0.65
Shoreline Development	1.14	1.14	1.14	1.41	1.17	1.17	1.19	1.20
Correlation	-0.13	-0.16	-0.15	-0.01	-0.07	-0.15	-0.12	-0.10
Orientation	97.58	99.23	98.71	90.78	93.86	98.39	96.75	95.59
Elongation	0.90	0.88	0.88	0.69	0.84	0.68	0.67	0.71
Vertex	4.69	4.62	4.51	11.65	6.25	4.55	5.17	6.17

Table 7 : Shortest distance(m) of a route between an apartment's unit spaces – from door to door

	Master bedroom	**Bedroom (second)**	**Bedroom (third)**	**Living room**	**Kitchen & Dining**	**Bathroom (big)**	**Bathroom (small)**	**Dressing room**
Master bedroom	-	3.03	5.12	0.24	2.89	3.98	3.07	0.13
Bedroom (second)	3.03	-	5.41	0.36	2.76	4.49	5.78	4.94
Bedroom (third)	5.12	5.41	-	0.49	3.20	5.14	5.98	7.04
Living room	0.24	0.36	0.49	-	0.00	1.27	2.50	4.79
Kitchen & Dining	2.89	2.76	3.20	0.00	-	4.35	5.52	6.27
Bathroom (big)	3.98	4.49	5.14	1.27	4.35	-	9.20	5.31
Bathroom (small)	3.07	5.78	5.98	2.50	5.52	9.20	-	3.01
Dressing room	0.13	4.94	7.04	4.79	6.27	5.33	3.01	-

As the areas of bedrooms are 14.17, 9.52, 8.10m2 respectively and for the ratio of each room, a medium-sized room is 67% and a small room is 57% based on a master room, it shows the relative difference in sizes due to the importance of a master room in Korea's patriarchal system.

If examining the arrangement and relations of rooms according to the length, connection and depth of a route, the connect value of a living room is 5.73(including porch), the distances of routes are very similar except a bathroom(small one) and dressing room and routes function as main space that connects almost all of 6 spaces. As the connect value is 1 and the depth is 1 for a kitchen and dining room, it is connected directly to a living room. The connect value of a mater room is 2.03 because the room is connected to a living room and dressing room. And as a dressing room is 1.98 for the connection and depth respectively, it is not connected directly to a living room and it functions to connect a bathroom to a bedroom not as an independent room. The depth of one bathroom is 1 and that of another bathroom is 3

if considering that the mean of the depths of large and small bathrooms is 2 and it is due to the arrangement of a living room-bathroom or living room-bedroom-dressing room-bathroom. As the integration of a living room is 2.81 and a master bedroom is 1.41 if examining the integration of space syntax, these rooms are more space-oriented than other ones.

For elongation and form ratio, each bedroom, kitchen and bathroom (large one) have the approximate value of 0.9 to be in an almost proportional shape. A bathroom (small one) and a dressing room have the approximate value of 0.7 so that it is noticed that these 2 rooms consist of a same module.

Conclusion

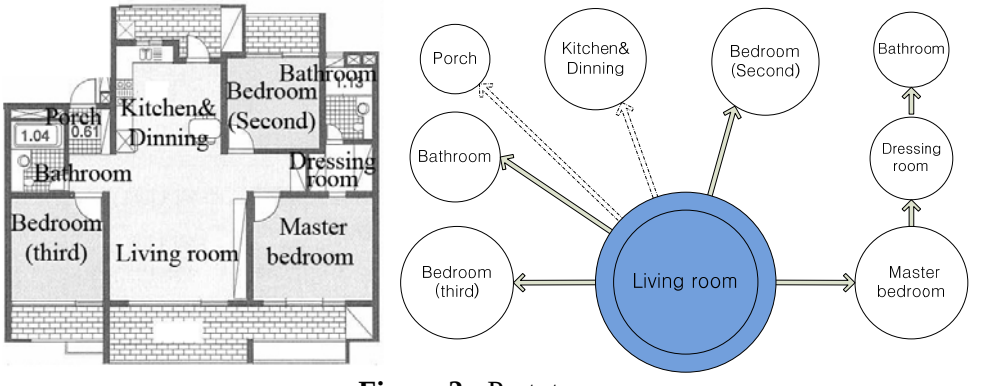

Figure 2 : Prototype

Table 8 : Shortest distance (m) of a route between an apartment's unit spaces – from door to door

	Master bedroom	**Bedroom (second)**	**Bedroom (third)**	**Living Room**	**Kitchen & Dining**	**Bathroom (near living room)**	**Bathroom (near dressing room)**	**Dressing room**
Connection(N)	2	1	1	6	1	1	1	2
Depth(N)	11	1	1	0.00	1.00	2	2	2
Area(M2) (95% confidence interval)	13.9~14.4	9.4~9.7	8.0~8.3	24.9~25.7	11.0~11.7	3.5~3.7	3.0~3.2	2.8~3.1

It was possible to find out the type of a plane like Fig. 2 above by using the connection and depth between spaces that show the area and spatial structure, which

are the important elements of space. This study shows that the type of a Korean apartment of 85 m^2 has the plane of the 3 bay which consists of a master bedroom and a medium-sized room at both sides of a living room in the center and the structure that the master bedroom is connected to a bathroom through a dressing room.

Such a structure is a case to show a characteristic different from the apartments in other countries due to Koreans' preference for residence that prefers an open plane oriented for a southern exposure as explained before. And it is considered that we can analyze more spatial elements through other spatial properties not explained and these data would be necessary for the analysis on spatial elements.

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