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A Characteristics through the Exterior Space of Mixed-Use Residential Tall Buildings

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Abstract
The exterior space characteristics of mixed-use residential tall buildings from a three-dimensional viewpoint were divided into space above ground, ground space, and underground space. A total of 12 Exterior Space types were drawn and became the analysis criteria for this study. Following such analysis criteria, 16 domestic cases satisfied the following conditions; more than 500 households, with a height of 200m or more and above 50 floors were analyzed, and followed by exterior space characteristic drawings

Keywords: Mixed-Use residential, Exterior Space, Space above Ground, Ground Space, Under Ground Space

Introduction

Background of the Study

Modern societies seem to be getting a lot of attention for their cities rather than for their country. Meaning, a city's branding has been deepening. Currently, many cities in Asia are more interest in constructing high-rise buildings[1] and compete with each other in trying to build the tallest one[2]. There are some advantages of high-rise buildings. First of all, high-rise buildings often become a city's landmark and are a very important element in the formation of the city's image. They also bring residents, traffical and environmental and economic benefits based on high land utilization, so as a result area residents have the opportunity to use a wide range of facilities and public open space. In addition, the close proximity of housing and office space often reduces heavy traffic problems. From among these advantages obtaining more exterior space means city residents have more area for enjoying the city life on the view of city planning. For example, compared to other countries, many characteristics of high-rise buildings in Korea can be used as a residential facility or office space. <table2 >

[1] High-rise building is defined as 'buildings with more than 50 floors or above 200m in height' based on 2jo1hang 15ho in Specifies Building Codes of Korea.

[2] According to Data of CTBUH, the tallest building in the world is 'Burj Khalifa'(163stories, 828m) at Dubai in UAE, 'Royal Clock Tower hotel' at meca in Saudi arabia (120stories, 601m) is ranked in second place and Third place is 'Taipei 101' in Taiwan(101stories, 508m). The only building in top 10 outside Asia is 'Willis Tower in USA'(108stories, 442m) ranked in ninth. Buildings ranked in 4^{th}~10^{th} position are located in Shanghai, Hongkong, ShenZhen, Nanking and Kuala Lumpur.(based on data at 20^{th} Jan, 2014)

A residential facility has to provide exterior spaces for the inhabitants to residents. The exterior space of mixed-use residential tall building has to give some diversity and energy to city in the context of urban life. It also has to provide some public space to inhabitants, so city residents can receive some benefits such as the feeling of being connected with other city residents and the city. Generally mixed-use residential tall buildings are located in the heart of the city, often without being able to secure a lot of space. Therefore, building plans often use a stacking method through three-dimensional thought. Consequentially, exterior space of mixed-use residential tall buildings is also planned using three-dimensional stacking.

So the purpose of this research is to analyze the spatial characteristics of three-dimensional stacked exterior space of high-rise commercial complex buildings through the cases. These types of buildings are to be used to provide a better exterior space condition as a base material in expected planning

The subject and method of the study

The analyzed cases of three-dimensional stacked exterior space from a spatial scope are limited in Korea, but since 2014 that have been more time-based scopes. Additional conditions are suggested among these cases, and are limited in some cases; buildings with more than 50 floors or is above 200m in height and have more than 500 households units.

The methods of research are as follows. First, we draw some differentiation with preceding researches and then analyze the space function of the exterior space of mixed-use residential tall buildings through studying the current materials of literature. Second, we analyze drawings, homepages, and promotional materials for sales and real estate websites about the 48 exterior spaces of 16 mixed-use residential tall building cases. Next, we classify the 48 exterior space cases using three-dimensional stacking. As a result of classifying, exterior spaces of mixed-use residential tall buildings are divided into 3 types: space above ground, ground space, and underground space. These 3 types will be used as criteria for the analysis. Third, we draw the characteristics by type and plan of exterior space of mixed-use residential tall buildings through the presented criteria for analysis.

Study on the preceding materials and basic researches

Study on preceding materials of Mixed-use residential tall buildings.

There are 32 target preceding studies in total, and are divided

into 3 parts by their approaching point. 9 materials are approached from a viewpoint of urban planning, 14 are approached from a viewpoint of architecture planning, and the remaining 9 materials are approached from a viewpoint of condition analysis. For these discriminative viewpoints, the definition of a 'tall building' is confusing. According to preceding studies, if a building is higher than 30 floors it is called 'tall building', but after 2012 it is only considered a 'tall building' if it is higher than 50 floors. In addition, most of studies focus their information on the housing units; only one of studies refers to environment-friendly exterior space. So this study will analyze space planning using three-dimensional stacking with discrimination and originality.

Preceding studies about exterior space planning using three-dimensional stacking

Currently, studies of exterior three-dimensional stacked spaces are ongoing in the area of mixed-used development. Through 14 preceding studies about the exterior space of mixed-used development, we can analyze each case and divide into them into 3 types: space above ground, ground space, and underground space. In addition, depending on the capabilities of the horizontal space, it can be divided into two functions: a walking path for pedestrians and resting area. The analysis contents of the preceding research centered on the exterior space built using three-dimensional stacking are as follows table 1.

Table 1: The exterior space planning using three-dimensional stacking

Space above Ground		Ground Space		Underground Space	
Walking	Resting	Walking	Resting	Walking	Resting
Bridge Space above Streets	Rooftop garden Space above decks	Streets Arcade	Square Park Playground Piloti	Underground Streets	Sunken

The current status and analysis of mixed-used complex development

The distribution of whole mixed-use complex development in each the metropolitan cities and province are as follows table 2.

Table 2: The distribution of whole mixed-use complex development

Area	Building Numbers	Area	Building Numbers	Area	Building Numbers
Seoul	712	Gwangju	8	Chungcheongnam-do	15
Incheon	143	Sejong	1	Jeollabuk-do	3
Busan	307	Jeju	12	Jeollanam-do	2
Daegu	78	Gyeonggi-do	292	Gyeongsangbuk-do	21
Daejeon	97	Gangwon-do	2	Gyeongsangnam-do	32
Ulsan	31	Chungcheongbuk-do	172		

The analysis of the mixed-use development which has more than 500 households

Before analyzing the current situation of mixed-use residential tall buildings based on the cases of Table 2; Cases of mixed-use development having more than 500 households in Korea are shown in Table 3.

Table 3. the mixed-use development which has more than 500 households ( ) : households

Area	Case Study
Seoul	Tower Palace1 (1,297), Tower Palace2(813), Yongsan The Prime (559), Park Tower1(597), Hyundai Supervill(645), Acrovista(757), Galleria Place(741), The Sharp Star city(1,177), Mok-Dong Hyundai Hyperion2 (576), mecenapolis(617), Mapo Hanwha Obelisk(662), Lotte Castle Venice(1,870), DaeSung D cube city(524), Yeoui-do xi(580), Hanil Summit Ville(504), Gwanghwamun poonglim spacebon(657), Dongjak SsangtteVill (545)
Incheon	The Sharp central park1(729), The Sharp central park2(632), The Sharp First world(1,596), Global Campus Prugio (1,703), Exllu Tower(616), Cheongna Lynnstraus(590), Yonghyeon Exllu Tower (630), Eco Metro 3rd The Tower(644)
Busan	Haeundae Doosan Weve The Jenis(1,788), Haeundae IPark(1,631), The Sharp Centum Star(629), Trump World Centum1(564), The Sharp central Star(1,360), Daewoo The-Oville Seomyun2(751), Tower Vervill(566), Seomyun Vervill2(606), Seomyun Yulim Norway(512), Neospot(782), Doosan Weve Poseidon2(690), Hanseong Girin(547), Bando Bora Sky view(1149), Bukok Prugio(540), Daelim City Plaza(521)
Daegu	Daewoo WorldMark West End(994), Samjeong British Yongsan (767), Chimsan Prugio 1(1,149), Myeongseong Purigio(746), Doosan Weve The Jenis(1,494), SK Leaders view(788), Suseong Daewoo Trump World(967), Centro Palace(843)

Gyeonggi-do	Park View(1,829), I'Park (540), Bundang Doosan Weve(656), Michelan Chereville(803), Royal Palace(566), Metapolis(1,266), Ilsan Doosan Weve The Jenis(2,700), Richensia Joongdong (527), Royal Palace(614)
Chungcheongbuk-do	Sinyeong Gwellcity(2,164), Doosan Weve The Jenis(576)
Chungcheongnam-do	Yojin Y City(1,479), Pentaport(793)
Jeollabuk-do	Hyudai Metro Tower(614)

The analysis of cases

The general details of mixed-use residential tall buildings as the subject of study

The general details of selected cases satisfied with 2 conditions are in Table 4. One condition applies Korea and the number of mixed-use developments having more than 500 households and the other applies to the definition of 'tall building', in this study.

Table 4: The general details of mixed-use residential tall buildings as the subject of study

Area	Case Study Name	Local and district	Year of completion	Maximum Height	Building numbers	the number of household	lot area	building area	building to land ratio	floor area ratio
Seoul	Tower Palace1	General commercial and central commercial area	2002	66	4	1,361	33,696.10㎡	16,376.90㎡	48.60%	909.96%
	Tower Palace2		2003	55	2	813	20,704.13㎡	8113.26㎡	39.32%	923.11%
	The Sharp Star city		2006	58	4	1,177	60,235.40㎡	16,867.73㎡	28.00%	414.90%
	D cube city		2011	51	2	524	25,756.80㎡	2,901.92㎡	11.27%	302.52%
Busan	The Sharp Centum Star		2008	60	3	629	205,704.13㎡	74,157.48㎡	36.00%	936.00%
	Haeundae Doosan Weve The Jenis		2011	80	7	1,788	42,500.00㎡	14,875.00㎡	39.00%	899.00%
	Haeundae I'Park		2011	72	3	1,631	511,805.50㎡	13,668.95㎡	37.00%	898.00%
	The Sharp central park		2011	58	5	1,360	433,834.00㎡	238,608.70㎡	55.00%	998.00%
Incheon	The Sharp First world		2009	64	6	1,596	103,154.00㎡	27,851.58㎡	27.00%	358.00%
	Exllu Tower		2011	55	2	616	52,525.00㎡	28,888.75㎡	45.00%	312.00%
	Yonghyeon Exllu Tower		2011	54	4	630	20,815.98㎡	3,746.87㎡	18.00%	501.00%
	Eco Metro 3rd		2013	51	3	644	18,939.04㎡	10.279.64㎡	54.00%	699.00%
Daegu	Doosan Weve The Jenis		2009	54	9	1,494	39,905.00㎡	31,330.00㎡	78.00%	777.00%
	SK Leaders view		2010	57	7	788	21,408.23㎡	16,823.00㎡	79.04%	716.00%
Gyeonggi-	Metapolis		2010	66	4	1,266	50,948.00㎡	34,900.13㎡	68.50%	908.40%

do	Richensia Joongdong		2012	66	2	572	11,289.04 ㎡	5,562.11㎡	49.27 %	996.69 %

The analysis of three-dimensional stacked exterior space

In this study, we draw 12 exterior space types which are drawn through classifying 3 types along with3 types of three-dimensional stacking: space above ground, ground space, and underground space, by function for pedestrian to walk and rest. The contents of the analysis of the 12 exterior space types are as follows table 5.

Table 5: The analysis of tree-dimensional stacked exterior space.

Case Study Name	Space above Ground				Ground Space						Underground Space	
	Walking		Resting		Walking		Resting				Walking	Resting
	A1	A2	A3	A4	B1	B2	B3	B4	B5	B6	C1	C2
Tower Palace1	○	X	X	○	○	X	X	○	○	X	X	X
Tower Palace2	X	○	X	○	○	X	○	○	○	○	X	○
The Sharp Star city	X	X	○	X	○	X	○	○	○	X	X	○
D cube city	○	X	X	X	○	X	○	X	○	○	X	○
The Sharp Centum Star	○	○	○	○	○	X	○	○	○	X	X	X
Haeundae Doosan Weve The Jenis	○	X	○	X	○	X	○	○	○	X	X	X
Haeundae I'Park	○	○	X	X	○	X	○	○	○	X	X	X
The Sharp central park	○	X	○	○	○	○	○	○	○	X	X	○
The Sharp First world	X	X	○	X	○	X	X	○	○	○	X	○
Exllu Tower	X	X	○	○	○	X	○	○	○	X	X	X
Yonghyeon Exllu Tower	X	X	X	X	○	X	○	○	○	X	X	X
Eco Metro 3rd	○	X	○	X	○	X	X	○	○	○	X	X
Doosan Weve The Jenis	X	X	○	X	○	X	○	○	○	○	X	X
SK Leaders view	X	X	○	X	○	○	○	○	X	○	X	X
Metapolis	○	X	○	○	○	X	○	○	○	○	X	X
Richensia Joongdong	○	X	○	○	○	X	○	○	○	X	X	X

※ A1: Bridge, A2: Space above Streets, A3: Rooftop garden, A4: Space above decks, B1: Streets, B2: Arcade, B3: Square, B4: Park, B5: Playground, B6: Piloti, C1: Underground Streets, C2: Sunke

Conclusions

Through this study, the characteristics of mixed-use residential tall buildings built using three-dimensional stacking are as follows. First, functional space used by pedestrians for walking in the exterior space above ground is divided to bridge and street above ground. A bridge is located contingent upon the complexed or separated form of the housing and commercial facilities layout. The street above ground is just located when mixed-use development has exterior space in the center of the whole facility. For example, a roof garden, which is associated with a space user's resting area would prefer to have a deck.

Among the exterior space of ground space, which would be used as a pedestrian's walkway, streets are always nearby and while other spaces, such as an arcade is almost never found in a layout where there are housing and commercial facilities. Rest areas like a square, or Park and playground, are found in almost all cases. The number of space varies with the size of the mixed-use development. However, Pilotis are placed in the case of grand scaled mixed-use development having a separated form of residential facilities and commercial facilities.

Finally, under ground space would not be an area for pedestrians to walk, and a sunken space for resting could be possible in the case of mixed-use development having a complex form of residential facilities and commercial facilities with ground space.

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