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Urban Voids: As a Chance for Sustainable Urban Design

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Abstract: Future cities will have to confront limited urban spaces and resources, undertake the preservation or conservation of sense of place, and continuously improve the existing urban environment. Accordingly, urban void spaces are likely to become key strategic places for ‘Green Urban Development’. Urban voids are spaces that are useless, underused, abandoned, or in-between spaces among public and private realms. This research looks into urban voids that can be found especially within the residential environment in Seoul, as a chance for sustainable urban design. Dispersed urban voids have been generated due to various reasons, such as intrinsic to policy and planning system, changing economic, social and functional aspect and further on. The study briefly evaluates the existing built environment especially the quality of urban spatial structure and public spaces in the residential area, which is made up of individual buildings. Existing urban voids are extracted, identified and then classified into three major categories- street, block and edge condition. A crucial aspect would be showing how these urban voids could be used or reused in terms of ‘green urban development’. Conventional low-level technology which involves planting and greening and environmental high technology which includes fuel cell, electric car station, and rainwater storage and so on can be potentially applied and integrated into these urban voids. Consequently this research paper will suggest that each improvement measure should be considered as a piecemeal ‘act’ of an integrated urban regeneration and transformation of a whole city with adequate development guidelines.

Keywords: urban voids; sustainable development; keyword

1. Introduction

Contemporary cities are confronting environmental challenges, such as global warming, climate change and energy shortage. Urban areas are becoming both the causes and solutions of the current environmental crisis and future cities will also have to deal with limited urban spaces and resources, undertake the preservation or conservation of sense of place, and continuously improve the existing urban environment. In order to cope with these environmental and urban crises, a paradigm shift in conventional urban regeneration is essential along with orienting toward green urban development through sustainable urban planning and design strategies in conjunction with application of green technologies. In this respect, underused, misused or abandoned leftover spaces within the city, especially among residential neighborhoods possesses potential opportunities to recycle (re-utilize), re-densify, reform and integrate green technologies into everyday urban life. In this paper, the authors will define these leftover spaces as ‘urban voids’ and explore the ways of combining high- and low-tech in regard to generate more sustainable communities in ecological, environmental and socio-cultural terms.

The paper briefly overviews related literature denoting definition and concept of urban void, its emerging background and intrinsic nature. Urban voids are rediscovered in a case study of Dohwa-dong in metropolitan Seoul that represents an extremely dense residential area with various housing types that have been built over several urban development periods. The study evaluates the existing built environment especially the quality of urban spatial structure and public spaces in the residential area, which is made up of individual buildings. Existing urban voids are extracted, identified and then classified into three major categories- plot, block, and street condition. A crucial aspect would be showing how these urban voids could be used or reused in terms of ‘green urban development’, which should consider not only the importance of preservation, but also balancing with new developments. Conventional low-level technology which involves planting and greening and environmental high technology which includes fuel cell, electric car station, and rainwater storage and so on can be potentially applied and integrated into these urban voids. Simulation of implementing high and low technologies on urban voids at the block condition will be exemplified leading to final results and discussions.

2. Literature review

Theoretical research on urban voids was first initiated approximately 30 years ago in Western countries. In the book ‘Finding Lost Space’, Roger Trancik brings up inquiries on undesirable urban area that makes no positive contribution to the surroundings and which is ill-defined, without measurable boundaries and fail to connect elements in a coherent way, by calling them ‘lost space’ (Trancik, 1986)¹. Since the 1990s, as the land value soared in the city center, scattered unused parcels of land varying in size and shape located on valuable inner-city land increased. Michael Greenberg and other scholars have defined those abandoned lands as ‘Temporarily Obsolete Abandoned Derelict Sites (TOADS)’ (Greenberg et al., 1990²; Perera & Amin, 1996³; Greenberg et al., 2000⁴). On the other hand in declining industrial cities, due to suburbanization and decrease in population various ‘vacant land’ has emerged (Accordino & Johnson, 2000⁵). Vacant land refers to many different types of unutilized and underutilized parcels with abandoned buildings and structures (Pagano & Bowman, 2000⁶). Criticisms on the trend to

create large landscaped open areas near new development projects that few people use, according to excessive planning has led to producing terminologies such as ‘planned wasteland’ or ‘new urban desert’ (Cybriwsky, 1999⁷). ‘Fortuitous urban void’ indicates spaces beyond the conventional mainstream planned space which are more likely to be in marginal and residual condition (Groth & Corjin, 2005⁸; Akkerman & Cornfield, 2010⁹). Other relevant concepts include ‘Terra Incognita’, ‘urban ruins’, ‘brownfield’ and so on. However, consensus has still not been reached on terminology definitions and concepts, which are used extensively in diverse areas. Multiple criteria and factors for defining urban voids can be considered such as formation background, scale and shape, regional context, planning influence, dispersion pattern and ownership.

Cause of occurrence for these urban voids can be found in transforming political, economic and social structure. As the world entered the post-industrial age, decline of manufacturing industry, suburbanization, changing urban policy and planning system has resulted in producing diverse spectrums of urban voids (Cybriwsky, 1999; Accordino & Johnson, 2000¹⁰; Pagano & Bowman, 2000). Ariya Aruninta has pointed out radical restructuring of global economy in recent decades has resulted in an explosion in the number of urban voids and inefficient decision making, poor land management, poor co-ordination among decision makers as the main policy problems that created urban voids (Aruninta, 2004). Bowman and Pagano insisted different reasons for each expanding cities that contains issues such as growing local economy, in-migration, city policy to encourage land reuse (infill) and shrinking cities that possess situations such as disinvestment, suburbanization, deindustrialization, out-migration and so on (Bowman & Pagano, 2000). Overall, there has been an influence of global phenomenon related to post-industrial modern society that has been producing various spaces losing its original purpose as well as regional and local issues regarding negligence or conflict in planning system and sociocultural changes.

In order to utilize urban voids as strategic places, it is imperative to understand the intrinsic problems and potentials they possess. As noted earlier, lack of planning guideline and policy for appropriate implementation is critical as the urban voids are overlooked and depicted yet negative from the realms of planning, architecture, design and urban theory (Hudson & Shaw, 2011¹¹). Also long period of abandonment increase social and economic expense and causes further deterioration. However positive interpretation is increasing as vacant primarily means empty, but also free and therefore full of opportunity and can be constantly reshaped and redefined as users reorganize and reinterpret them (Cupers & Miessen, 2002; Hudson & Shaw, 2011). Terry Schwarz listed potential strategies such as infill development, application of low-cost and low-maintenance greening technologies (Schwarz, 2011). Alan Mallach presented realized projects in Cleveland and Philadelphia which uses urban voids to restore city’s ecosystem through storm water mitigation system and generating alternative energy (Mallach, 2012¹²).

In this study, urban void is defined as unused, underused or currently used but can be in better usable conditioned spaces. The scope of the research focuses on urban void dispersed among urban residential neighborhoods. Most previous studies have focused on public urban voids, however urban residential area takes up a major proportion, therefore including semi-private and private urban voids is becoming necessary particularly those in communities and neighborhoods. The ownership belongs to both public and private; edge or corner condition of roads, retaining wall or public facility spaces are under public ownership whereas private ownership includes area within apartment complexes, residual spaces within

individual plots. The scale of the urban void can be found from building scale, plot scale, and block scale to neighborhood community scale. The following research investigates urban void in terms of plot, block and street condition with test-bed simulation and seeks for possibilities of innovative recycle energy technology application.

3. Urban voids on Korean cities

Dohwa-dong is a small district in Seoul however meaningful district in terms of urban design of Seoul. It is a typical Korean middle-class residential area, however partly it has low-income class's housing where not had been developed as apartment complexes. It means this district is mixed with high-rise apartment complex and low-rise housing. In the middle of low-rise housing, they don't have same character, otherwise they have different history, form and details chronologically. Dohwa-dong has a heterogeneous character and is a microcosm of Seoul even in a small district in terms of urban form, production of development, etc. Therefore it is regarded as proper site to research urban voids on Korean city.

3.1 Introduction of research site; Dohwa-dong

Dohwa-dong was developed on 1930's when Seoul is expanded because of rapid urbanization in city wall, it was kind of a new town. It consists of many small plots before developing as apartment complexes.(Figure 1) There are lots of housing types for examples detached housing, attached housing and apartment complex, therefore size of plots are so variety from small plot for one detached houses to large plot for huge apartment complex. Moreover street type is also various, from 2m width narrow alley to 18m width street inner district.(Figure 2) This district is divided into two wide streets, Han River and hill side. Hill side was developed from 1930's as small plots but there was redeveloped in 1990's as apartment complex. Other urban forms with small plots are candidates for the next redevelopment.

3.2 Urban voids at Dohwa-dong discussing with simulation

Two methods is conducted to find and analyze void spaces on Dohwa-dong, First, field trip was conducted several times to check present situation and then a block near apartment complex was chosen to simulate. This block closes to apartment complex and enough old because it developed from 1930's and gradually modified when residents want to repair with weak regulation. Even long history and gradual development, this block is now under pressure to renewal as high-rise buildings.

Simulation indicates that how dense this district and how much void space are. This district have 113.52% FAR(Floor Area Ratio) and 56.77% BCR(Building Coverage Ratio)¹³. These ratios is relatively low, this block have a permission to build maximum 200% FAR and 60% BCR according to zoning ordinance. However this district doesn't have enough amenity like open spaces and parking lots though it has low density. It is occurred with lots of buildings built with each regulation not considering other plot and block. Figure 4 indicates situations and Figure 5 shows situation photo.

Figure 1. District map of Dohwa-dong



Figure 2. Street network.

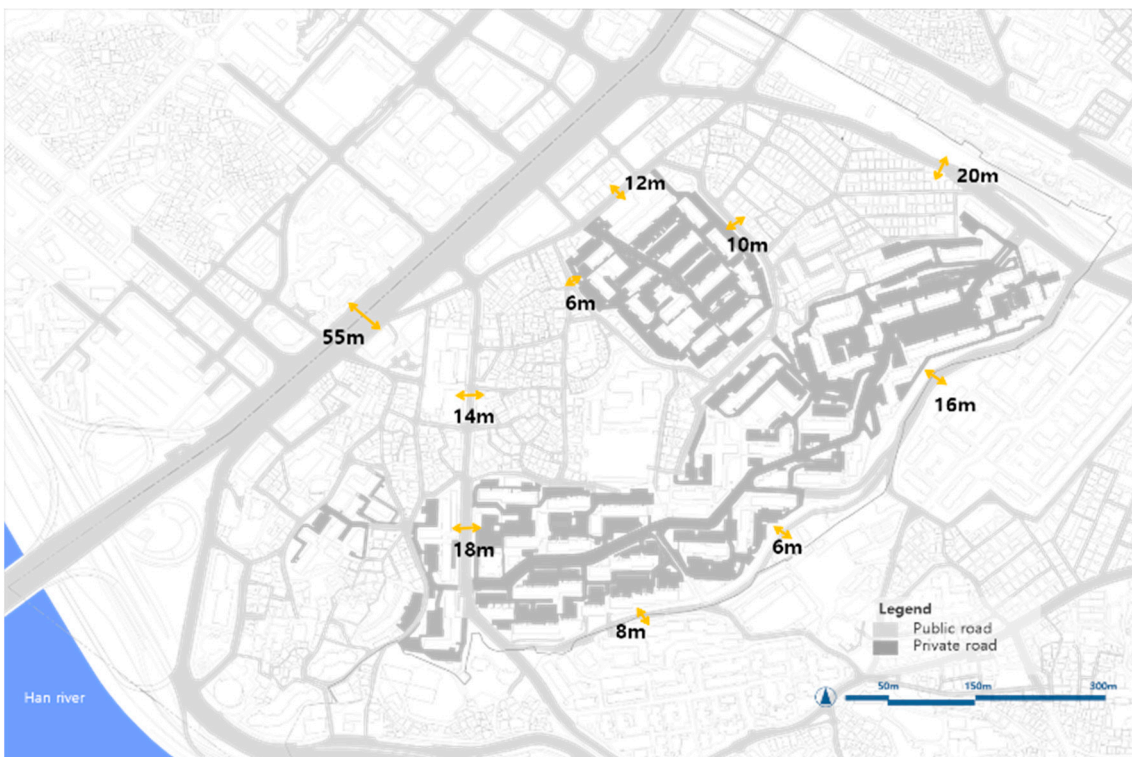


Figure 3. Present picture of Dohwadong.



Table 1. Information of simulation blocks.

Net area	27,882.2m ²
Number of plots	282
Number of buildings	236
FAR	113.52%
BCR	56.77%

Figure 4. Map of simulation boundary.

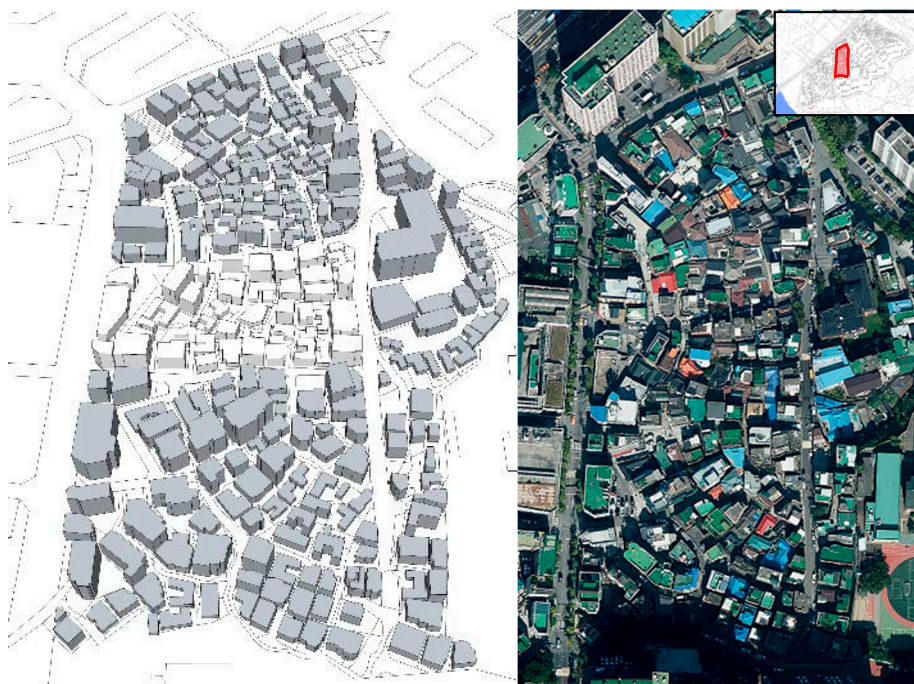


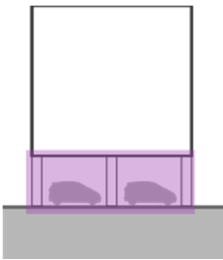

Figure 5. Present picture of simulation blocks.



3.2. Categorizing urban voids

Urban voids could be categorized as three categories. It is comparted as place where voids placed for example plot, block, and community. Plot is a basic units of urban space, and this unit can be dealt with easily when landholder want to develop or modify. Block is lager unit which gather plots, it can be regarded as basic unit of development so this unit is important in the future to prevent from making urban voids again. Lastly community is a largest unit, it can be involved plot, block, street and vague spaces between apartment complexes and low-rise housing at edge.

Table 2. Urban voids on plot.

Type	Explanation	Examples
Pilotis	First floor of the building where commonly used for parking spaces	
Rooftop space	Top floor of the building especially constructed flat.	

3.2.1. Urban voids on plot

Pilotis, rooftop space are urban voids on plot. Pilotis are result of making a parking spaces in limited conditions. It provides parking space for residents, but since most residential building has pilotis because of parking act, street is getting more dangerous and monotonous.

Rooftop space have unique characters of Korean residential building, because many Korean residential building has almost or full flat rooftop. Generally some residents are abandoned or using it small garden, outer storage but it's not used actively.

3.2.2. Urban voids on block

Space between buildings and set-backed space is common urban voids type in Korean city. It is commonly small and placed sporadically in low-rise residential area therefore it regarded as vague space to utilize. This kind of space mainly used as parking spaces, small garden, or even nothing.

This sporadic void space make some problems like ventilation and lighting. Moreover this inefficient space using leads them lack of open spaces and parking lots.

Table 3. Urban voids on block.

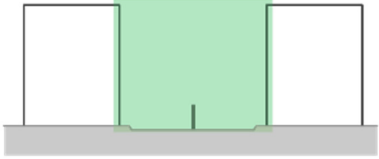
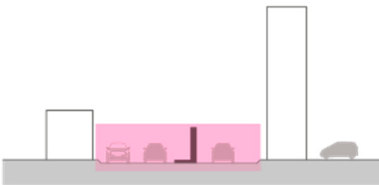
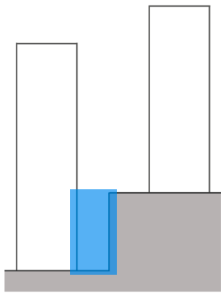
Type	Explanation	Examples
Set-backed or between space	Vague spaces caused by act.	

3.2.3. Urban voids on community

Urban voids on community make urban problem. It means community involves street, so community urban voids also involve street problem like less hierarchy and vague street network. Therefore people suffered from flood of car on street and lack of public space, also it can be occur lose sense of direction easily and it makes to decline quality of life. Moreover chaotic urban landscape and image can be produced based on this urban voids.

Oversized street promotes cars are getting rapid, and pedestrians are threatened by car. Over-supplied street is similar with above but it means repeated street caused by poor design and acts.

Table 4. Urban voids on community.

Type	Explanation	Examples
Oversized street	The streets that supplied more than needs.	
Over supplied street	It is caused by poor urban planning instrument. Each apartment complex should be considered as a ,perfect unit' offering its own infrastructure independent from the existing infrastructure of surrounding areas.	
Steep land slope	It is produced by developing a huge building masses on the foot of hills. The topography was deformed.	

3.3. Cause of Urban voids

3.3.1. Erroneous act

Some acts related with urban and architects help to make urban voids. Architects should obey many acts to get to construction consent from public like other country, however these acts lead urban block to strange direction.

3.3.1.1. Building act

This act defines where and how built a building on site and originally intend to make a space between near building because of sunlight and hygiene when this act established. Nowadays it makes vague spaces like between spaces, front or rear spaces of buildings and prohibit to build a joint wall building which can remove between spaces as occasion demands. (Table 5, 6, 7 and Figure 6, 7)

Table 5, 6, 7 indicates that building should space out from road boundary (Figure 6(a)), property line (Figure 6(b)). Table 8 indicates similar kinds of spaces, it forces to make a space from the property line at north (Figure 8(d)). This fact is identified in other research that lack of planning guideline and policy occurs urban voids problem (Hudson & Shaw, 2011).

Table 5. Distance from the boundary line of road (a).

Housing	Distance
Apartment	3m
Row house	2m
Multi-family house	1m

Table 6. Distance from the property line (b).

Housing	Distance
Apartment	3m
Row house	2m </td
Multi-family house	1m

Table 7. Distance from the center line of road (c).

Area	Distance
Residential area	1/2 of b/d Height
Quasi-Residential area Neighboring- Commercial area	1/4 of b/d Height

Table 8. Distance from the property line at north (d).

Height	Distance
Under 9m	1.5m
Over 9m	1/2 of b/d Height

Figure 6. Each spaces occurred by building act.

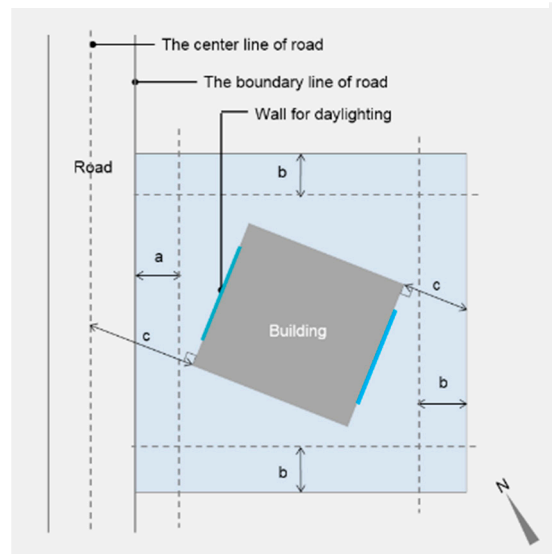


Figure 7. Distance from the property line at north.

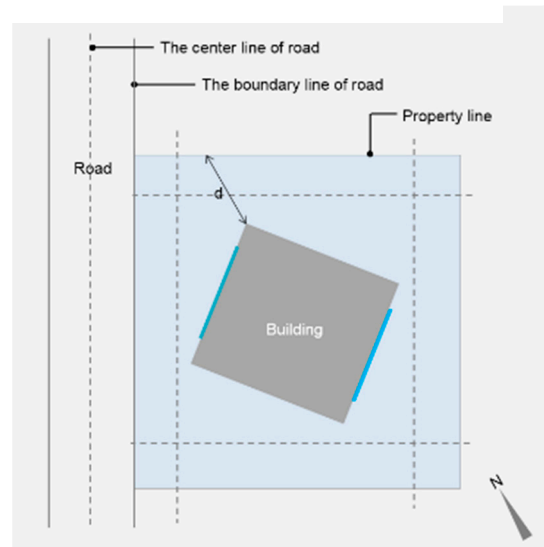
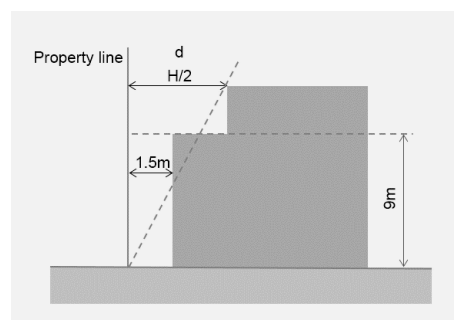


Figure 8. Detail description of figure 5.



4. Urban voids as a chance for sustainable urban design

4.1. Possibilities of applying high-technologies on urban voids

Between spaces have much potential that possibilities of conversion to green space. This space is usually paved and non-permeable urban voids however it can be converted as permeable space which helps to decline heat island effect and enrich underground water. People can enjoy gardening as planting and growing, so it can be good opportunity to the step for sustainable city. Additionally piecemeal development which involves repair and modify exist condition can be an alternative. For example wall which indicates property line would be collapsed and build a storage, bench, and table then it can offer opportunities communication between neighbors (Figure 9).

Pilotis have important space to provide parking lots, however it also contributes to make sustainable urban space with fundamental transition of parking policy. If parking space could be built out of the residential area, pilotis can be converted as many ways. First it can be changed as planting space for example garden and kitchen garden also. Second it can be converted as mutual space for house chores. So it can accepts washing machine room, small storage room and so on. Last it can be accepted also hi-technology facilities like electric car charging station, fuel cell room. Supplying a charging station is important factor of vitalizing electric car. Charging station doesn't need to large space, needs only 0.25 m² in case of small one. Moreover pilotis can be converted as car sharing space. It can offer good connectivity to customers who want to drive shared car (Figure 10).

Figure 10. Ideas for between spaces.

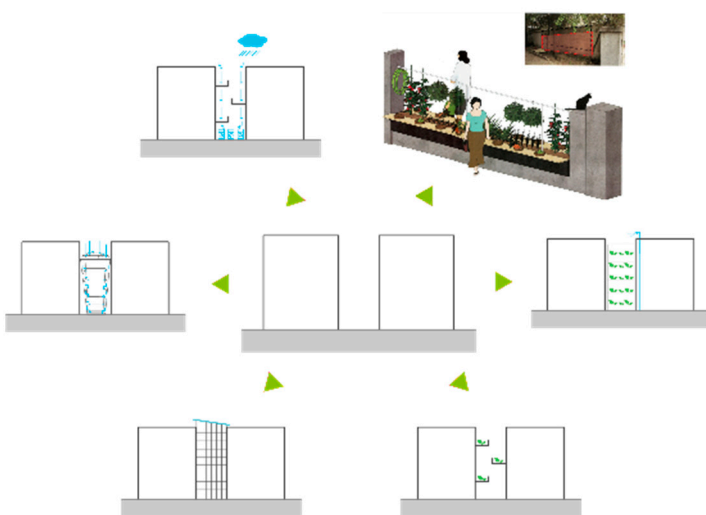
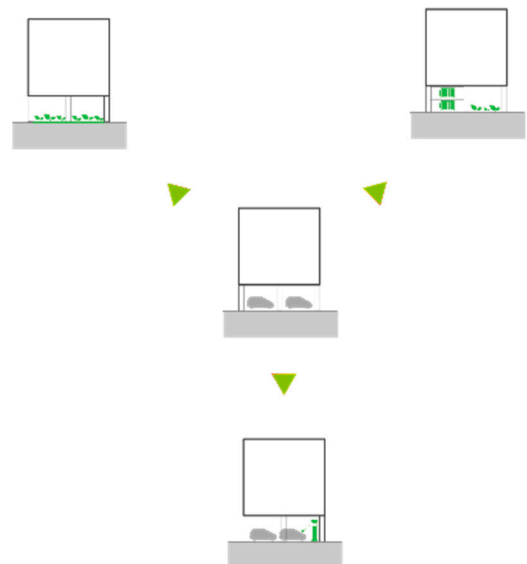
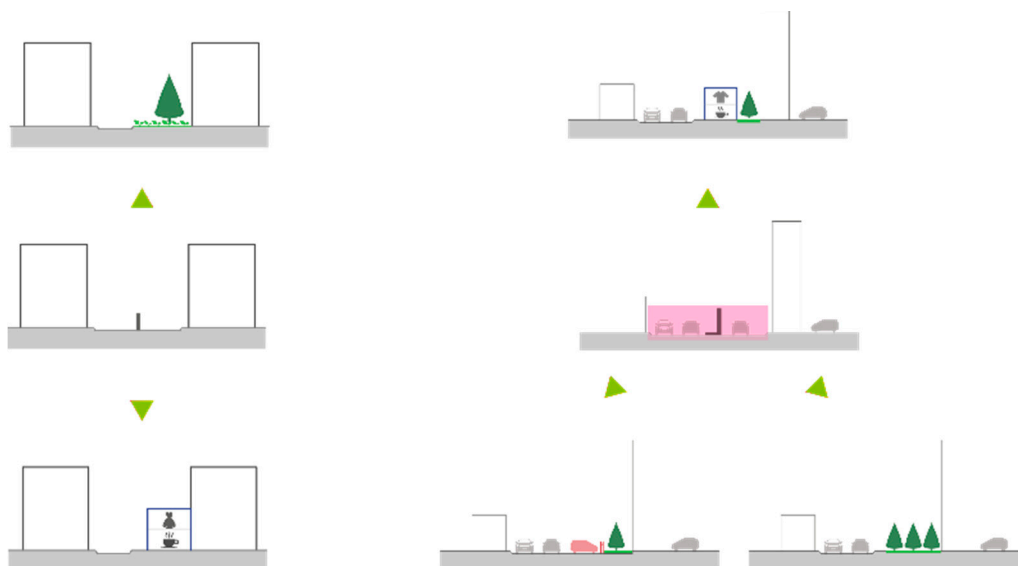


Figure 9. Ideas for pilotis.



Over spaced or over supplied roads can narrow considering its hierarchy. This road can be converted as green space or space for adhesive extension of building and it is utilized as commercial facilities where helps to make street flourished. Some wide roads can be comparted as using for example car way, parking lots, planting, walking and so on (Figure 11).

Figure 11. Ideas for over spaced, over supplied road.



4.2. Opportunity of integrated urban renewal

4.2.1. Necessity of block unit urban renewal

As this research refers to above, this research figured that most of urban voids are produced with unreasonable act. It is important to accept new technology on urban voids however it is also important to prevent from building new urban voids in long term access. Therefore this research suggest that block unit development would be an alternative to maximize efficiency of land use and supply pleasant quality space for them in green development dimension.

4.2.2. Simulation of block unit urban renewal

Figure 13. Present simulation.



Figure 12. Satellite map.



Simulation block has a 120.7% FAR and 58.15% BCR. According to building act, this district is allowed to build until 200% of FAR and 60% of BCR. BCR of this block is almost maximized although FAR is less than limit, therefore they have huge potential to develop. This block has 31 plots and 28 buildings and net area is 5,412.6 m².(Figure. 12, 13)

Figure 14 simulated as present density condition 120.7% FAR and 58.15% BCR and without any modifying property lines. Figure 15 simulated developed condition maximized FAR and BCR. It also minimize modifying property lines. Lastly Figure 16 has same density condition but it modified property line to get right and get larger.

Figure 14. Simulation alternative 1.

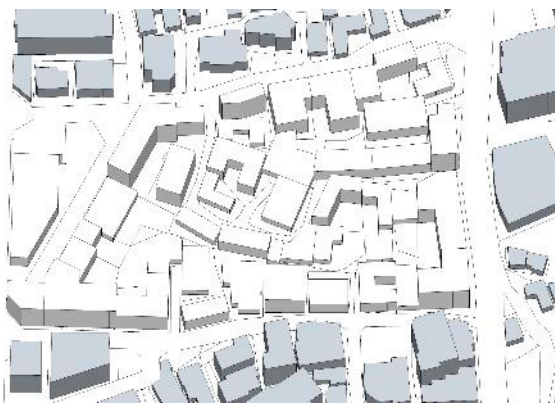


Figure 15. Simulation alternative 2.



Figure 16. Simulation alternative 3.



Differences between each simulation is related with how plot is modified and how dense. Figure 14 has same density as present, and it tried to remove between spaces. However it has limitations to make no between space because erratically shaped plots and alleys. Figure 15 has getting more density until limitation on act and it modified some plots. Many between spaces are removed and some building can gather their backyard but there are still some difficulties to maximize land use efficiency. Figure 16 is most changeeful development scenario, because it accompanies with combination of lots. Development can have several phases because it's difficult to develop simultaneously. Small combination of lots is proceed in long term phase with specific guide line (Figure 17, 18).

Courtyard is developed about 1,847.3 m² for various uses for example high-technological equipment, green space or parking space. (Figure 17) As this study mentioned, this alternative is accompanied with proper guide line for achieving specific goals. Courtyard and other amenities should be considered before developing with guide line. It also controlled landscape, facade, and any other green facilities or spaces.

Figure 18. Change phase of plots.

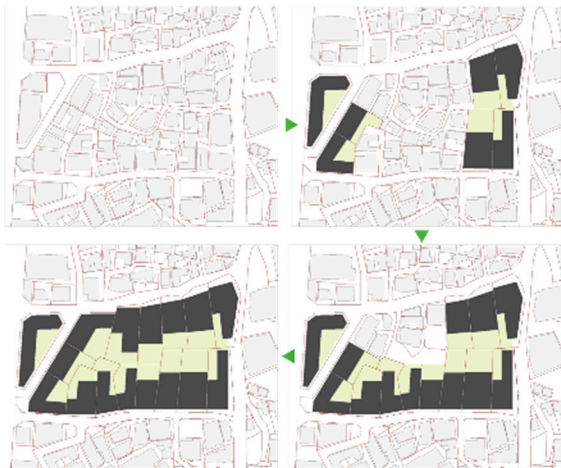
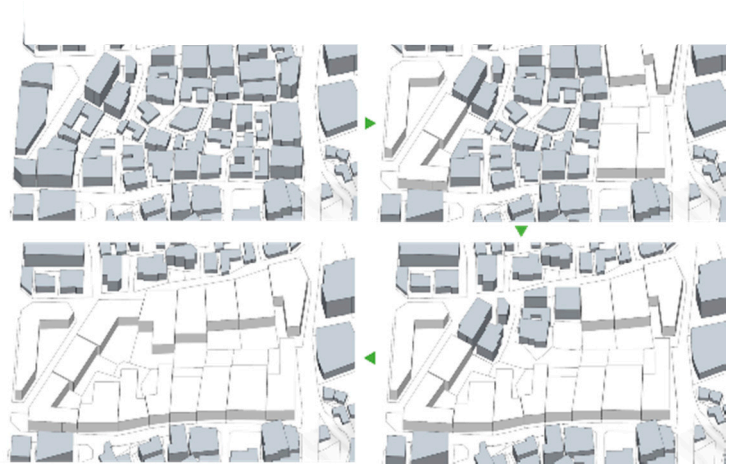


Figure 18. Development phase of Alternative 3.



5. Conclusions

5.1. Value of urban voids for building sustainable residential area

This study defined that urban void is unused, underused or better usable conditioned spaces in the future. In terms of this dimension urban voids have huge potential to convert or change their using for sustainable urban development. So this research analyses and suggest a new way to utilize urban voids. Finding urban voids was conducted on specific district Dohwa-dong of Seoul because this district has heterogeneous character even in small area. Urban void can be categorized as their existing places and scale like plot, block, or communities.

Rooftop space and pilotis would be found on plot, this space is small but many residential building have it and it has huge potential according to parking and development policy. Between, front, rear space of buildings would be found on block, but scale is small and distribution is sporadic. This space is caused by unreasonable act to force to space out from property line or street. It was considered to get sun lights or for hygiene originally otherwise nowadays act makes useless and vague space. Oversized street, over supplied street and steep land slope can be found on community where related to structure of urban space. It is made with wrong prediction or huge development but it can be converted as useful space if it is comparted or infilled.

This space has a potential because many small ideas can be applied without huge budget. Korea government is trying to apply green energy technology to residential building so they have made subsidy to promote to supply it. It means condition is almost made preparations, guide line will be needed to control it properly. This strategy can be used as without huge development also and promoted as a short-term alternatives.

5.2. Integrated urban renewal and urban voids

It is important to provide pleasant environment, maximize efficiency of land use, so urban renewal should carry this goal and be continued. However change will not come if there is no forward-looking policy so innovative alternative could be suggested for the future. Urban development and renewal has been conducted several years in Korea however result is almost same and produce many defects. Moreover urban voids is produced now at this very moment, because act or regulation can't control it.

Therefore alternative development model could be suggested and simulated specific block. It has more useful space to utilize many ways even it is increased density before. Increasing their density is also acceptable like near apartment block and but it can consider near condition and urban fabric unlike apartment complex. Their useful space is also utilized as space for hi-technological equipment or green space.

Urban renewal in Korea now at the crossroads, because people are getting diversified according to their housing demand. Typical urban renewal method faced with economical problem, and its result is also criticized because of their monotonous landscape, land use efficiency, etc. Besides green technology should be considered when they develop to prepare our future. Thus it is important to research and find new alternative ways to develop new types of housing considering our present and future condition. In a sense, this research has meaningful result as a first step of this direction.

Conflict of Interest

The authors declare no conflict of interest.

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- 13 Actual density especially BCR is estimated relatively higher than density on building register because most of building have extended their space illegally and some buildings built before made ordinance.

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