The study of the future verticalization of parallel cities

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Abstract: Sustainability is pivotal for urban evolution. The requirement for functional spatial diversity within a fast-developing city clashes with city land shortage. The novel idea of vertical city can be promising for city evolution in the future. Our team hence finished a report on people's function requirements regarding residential places and their understanding of vertical and parallel cities. Our team finished an indepth investigation via interviewing, using questionnaires and reading literature, for the purpose of drawing associated conclusions more objectively via data harvest and summarization. People's demands for functionality near their residential places are becoming increasingly integrated. Masses of people hold that future cities will reflect the feature of our era and will make our lives more convenient. Moreover, certain people think that conventional parallel cities are better and more comfortable, whereas vertical cities are able to ameliorate land utilization, providing more greenery and residential places while offering various intricate city functions. Although people differ in this regard, supportive viewpoints prevail. Overcoming the problems of parallel cities and innovating new models of urban development, perhaps vertical cities are also a path to sustainable development.

1. Introduction

In Ref. [1], authors showed that the term Vertical City comes from the American female writer Fannie Hurst, but it was later deemed to have nothing to do with the urban solution and was put on hold. The initially ambiguous term “vertical city” becomes clear via the process below: From a vertical city alone as an architecture or a city, it has become an arcology advocating utopia. The second description of vertical cities is that the population density there is moderate, which follows the planned land utilization policies. For that reason, the city-level description of vertical cities is to establish vertical cities with vertical separation based on the rule of high-volume horizontal function zoning.

In spite of the great progress in the past decades, the problem, which is related to ‘Comparison and analysis of vertical cities and parallel cities’ is out of reach yet. In this paper, we investigate to define this topic by some considerate and outbreaking ways.

People are used to defining horizontal cities as a concept contrary to vertical ones, but in fact it is not so. An utterly rigorous parallel city does not exist, nor is there an utterly rigorous vertical one; actually, the two transform mutually and incessantly. Intriguingly, the losses during the transformation from a parallel city to a vertical one can be make up for in a wide range of ways, and vertical urban design can provide massive compensations likewise during the transformation into a parallel one. During the on-going urbanization in Hong Kong, the fast expanding population has urged Hong Kong to transform 8from a comparatively horizontal city into a comparatively vertical one, from originally small bungalows to housing with balconies, to slant-back architectures and block architectures, to podium types, to substantial vertical architectures nowadays, the entire sacrifice from the perspective of a parallel city, like spaces, population density, has been made up for via playgrounds, green spaces and landscaped areas of vertical architectures. Climate change has been one of the primary challenges facing mankind. At the same time, environment problems have been

considered international issues and external challenges for a long time. Similarly, in the context of the continued expansion of a number of social problems such as global housing constraints, environmental pollution, and unmet public needs, the evolution of vertical cities has more flat background and meaning [2].

2. Mechanism And Ways

2.1 Vertical City: Recent Trend and Application

Sustainable development serves as a comprehensive concept, which is evidently all-encompassing even in the first and most broadly adopted definition developed by the UN Brundtland Commission in 1987. It was regarded as "satisfying the current demands without jeopardizing the development of future generations". In short, such definition coincides with the fundamental meaning of "sustain", i.e., "to offer support" or "to be persistent". Vertical city has the large public space, inclining to be self-sufficient and sustainable [3]. As the call for sustainability grows louder, countries around the world are becoming more aware of the links between environmental protection, economic development, artificial intelligence and big data. In short, sustainability on its own is meaningless and must be backed up by corresponding restoration capabilities and corresponding technological developments. Such sustainability can only withstand certain natural disasters, financial crises and regime changes. The most advanced energy and water conservation techniques such as spiral wind turbine technique, solar panels, sun light-sensitive LEDs, rain-harvesting technologies as well as sea water-driven air conditioners. Recently, environment-friendly designs have shown that energy-saving means are capable of producing highly efficient high-rise architectures [3].

2.2 Vertical City: Collecting data and views

In the appendix, we use the questionnaire to make hypothetical reflections on various aspects of the parallel city to the vertical city, in which case we could draw a conclusion from the language alone, which might be really close to the real result, but there are still deviations, so we should analyze the deeper willingness and then we should go back to the questionnaire itself to think about it, that's the point of the questionnaire, we don't need to get a conclusion without deviation from the reality, but to find out why people make such choices.

Appendix: Questionnaire on parallel cities and vertical cities. As cities develop and more and more urban problems slowly emerge, a new theory of urban form is proposed, see Question 1 to Question 7.

Question 1. Have you heard of the concept of "vertical cities", a new form of urban development? [Single-choice Question]

Options	Quantity	Proportion
Yes	51	23.6%
No	165	76.4%
Number of valid completers	216	

Question 2. "Vertical cities" are high-density, mixed-use complexes with a wide range of facilities. What functions do you think your ideal urban form should include? [Multi-select table]

Options	Quantity	Proportion
Convenient transportation	105	48.6%
Complete package of services	163	75.4%
Abundant urban greenery	129	59.7%
High land utilisation	88	40.7%
Number of valid completers	216	

Question 3. Do you prefer the traditional parallel city nowadays or the new form of vertical city? [Single-choice Question]

Options	Quantity	Proportion
Parallel city	122	56.5%
Vertical city	94	43.5%
Number of valid completers	216	

Question 4. What problems have parallel cities encountered now that need to be addressed? [Multi-select Question]

Options	Quantity	Proportion
Land resources are in short supply	182	84.2%
Atmospheric environmental pollution	153	70.8%
Lack of urban green space	114	52.7%
Traffic jams	73	33.7%
Population expansion in developed regions	98	45.3%
Number of valid completers	216	

Question 5. What do you think are the strengths of the parallel cities that can be passed on? [Multi-select Question]

Options	Quantity	Proportion
A strong sense of belonging	151	69.9%
An open community	125	57.8%
Comfortable, intimate living	188	87.0%
Number of valid completers	216	

Question 6. What do you think are the advantages of vertical cities compared to parallel cities? [Multi-select Question]

Options	Quantity	Proportion
Vertical development to ease urban land constraints	178	82.4%
Freeing up more space for vertical greening	142	65.7%
Changing horizontal traffic to vertical flow	93	43.0%
A more integrated and comprehensive supporting services	128	59.2%
Number of valid completers	216	

Question 7. What is your attitude to the future prospects of vertical cities? [Single-choice Question]

Options	Quantity	Proportion
Support	112	51.8%
Against	75	34.7%
Uncertainty	29	13.4%
Number of valid completers	216	

3. Result

3.1 Analysis of the TOD model - the example of Shibuya, Japan

The TOD was realized via the transport integration approach and the establishment of a high-density multi-function region with high-efficiency of spacial exploitation [4]. The concept of Transit-Orient-Development (TOD) was first proposed as a solution to the unrestricted urban sprawl in the United States after World War II, with public transport as the pivot and integrated development of pedestrianized urban areas. A central plaza or city center is then established with a 400–800-meter

(5–10-minute walk) radius around a public transport station and is characterized by a combination of work, commerce, culture, education and housing.

With the development of the times, more and more developed cities have started to build urban center under the TOD model. One of the largest TOD cities in Japan, Shibuya, is used as an example for analysis.

The Shibuya Station building is located above Shibuya Station, with a large interchange plaza conveniently located underneath the building. It is a large-scale integrated facility consisting of an observation facility, office space, industrial exchange facilities and commercial facilities. The lower floors have direct access to the various lines of Shibuya Station. The natural location of the project integrated with the station brings huge traffic to its businesses.

And later, a series of complexes such as Shibuya Hikarie and Mark City have formed a vast ecological network of buildings in their vicinity. Non-profit spaces such as theatres, galleries and exhibition centers, as well as green landscaping, are located on the middle and upper levels to increase the diversity of public spaces and to serve to reinforce vertical movement. The externalization and publicization of vertical traffic nodes drive internal commercial vitality. Transport, commercial, living, working and green spaces overlap each other vertically, which already reveals the beginnings of a vertical city.

According to Professor Zhou Li'an of Peking University Guanghua, when a city has undergone rapid expansion and reached the geographical limit of flat urban space development, it becomes an inevitable stage of urban development to make the urban space three-dimensional and change the line of people's life activities from horizontal to vertical.

3.2 Analysis of questionnaire results

Less than 1/4 of the participants were familiar with the term vertical city, the majority of whom expressed that idealized cities would combine technologies and ecosystems and future cities would have substantial multifunction and green spaces. Masses of people aren't fond of overcrowded cities due to various uncomfortableness brought by the decreasing spaces.

For that reason, vertical cities have progressively become the optimal method to validly tackle the clashes between architectures and residents, cities and architectures, as well as residents and lands. As per Maslow's five needs theory, the development of high-rise architectures has to reach people's fundamental living standards. Nevertheless, owing to the fast socioeconomic progress, the financial status of most of the high-rise architecture residents has been ameliorated. Hence, people start to seek better lives for themselves, both spiritually and materially [5].

Posterior to a basic introduction of the term 'vertical cities', more participants prefer conventional parallel cities in contrast to vertical ones. People have already been used to the urban life nowadays, and they need more time to embrace the novel life mode. In people's city lives, particularly in certain wealthy and overcrowded cities, numerous challenges have occurred and are getting more and more severe. Most of the participants expressed major problems like insufficient lands, environment contamination, as well as inadequate green spaces in cities.

Shanghai and Beijing in PRC, as centers of economy and politics, encounter a remarkable net population influx each year. The population densities there might have already surpassed their upper limitations. The most evident phenomenon reflecting land shortage is the soaring house price which keeps youngsters from entering these cities and makes it a burden for local residents to purchase new houses. The fast city development unavoidably brings environmental clashes. The expanding land exploitation will decrease the space for greenery as well, hence the equilibrium in this regard is constantly highlighted. The daily production activities cast a remarkable influence on the urban atmospheric status as well, apart from light contamination and noisy environment, creating daunting challenges in urban areas nowadays.

Indeed, conventional horizontal cities have a lot of benefits, which have to be copied by vertical ones. For floating population, urban areas can offer a comfortable environment and even create a sense of belonging.

When we further elaborated on the benefits of vertical cities, the majority of the participants realized that this new urban form would somehow mitigate the challenges such as land shortage, inadequate greenery, as well as homogenized urban function structures. This new urban form will bring more spaces, which can be utilized for residential places, commercial activities, or green spaces, creating more diversified cities.

Evidently, we could come to the conclusion that the parallel design is near the ground and closer to nature as well, which are more suitable for mankind. Consequently, people are able to build their personal areas via courtyards easily, whereas a parallel city requires more lands in the end. For densely populated urban areas, it's pivotal to adopt vertical designs, which enable us to discard vehicles and public transportations as well as commuting towns, as the entire functional areas, such as greenery, residential areas, and sports fields, are extremely adjacent and continuous. It's not necessary to discard parallel cities, whereas for densely populated urban areas, the benefits of vertical design are evident [6].

At the end of the research, over 50% of the participants accepted vertical cities, which helped come to the conclusion that despite the fact that vertical cities remain in the embryonic stage, this new type of urban design is feasible. Such vertical arrangement can become a strategy to tackle current city issues and facilitate sustainability within cities.

3.3 Analysis of the problems of parallel cities:

The current status quo of the city's main architectural development continues to be a horizontal extension, with different functional spaces distributed in points or strips to form complexes. Some of the buildings in the urban complex are no longer able to meet the needs of contemporary residents and have been abandoned by the times. This is the problem of renewal and replacement brought about by rapid urbanization. In this context, new forms of mixed-use buildings need to be more highly three-dimensional, composite and intensive, with forward-looking design thinking and design methods.

Through practice and survey analysis, parallel urban complex buildings are prone to cause some urban problems, summarized in the following points.

1) Waste of urban space and land resources

At present, the common form of urban complex buildings in the main land China is mainly in the form of "podium + tower", but also simply for the large volume, horizontal building form. These urban complexes have an exaggerated plan scale, low building heights and a huge overall scale.

The commercial value of a mixed-use building needs to be considered in relation to the volume of visitors. If the volume of the building and the capital investment do not match the value it brings, it will result in a waste of space and economy. At present, the problem of wasted space and inefficient use of building functions is becoming apparent due to the imperfect compounding of the functions of urban complex buildings and their excessive size.

2) Lack of public space and serious environmental pollution.

The podium itself is huge in volume and takes up a large amount of land area. Apart from parking and necessary greenery, it leads to a lack of urban public space around the area that can be used by urban residents. This is not only detrimental to the ecologically sustainable development of the city, but also affects the overall appearance of the city and the living environment of its residents. Sound and air pollution from the noise and exhaust of the traffic and light pollution from the reflection of large glass curtain walls affecting the view are also issues that need to be considered for the environment.

3) The function arrangement is unreasonable, causing traffic congestion.

Nowadays, most of the complexes are located along the traffic arteries, with a privileged location and a large passenger flow. The complex flow, with people and vehicles crossing each other, is likely to cause traffic congestion. Commercial and office-oriented building complexes also need to add the traffic load of the commuting population. The difference in pedestrian flow between day and night is too great, creating morning and evening peaks. This flood-like convergence and evacuation of crowd leads to spatial congestion in the morning and evening. This is often a problem brought about by the unbalanced variety of functional complexes. In addition, due to the long urban construction cycle, the

original urban complex building interior and exterior environment is unable to accommodate the rapid growth in the number of people using it. Older auxiliary spaces and guidance systems inside and outside the building, which are not updated and replaced in a timely manner, can also lead to confusion and blockage of the flow.

4. Conclusion

Sustainablity is a pivotal aspect for urban evolution. The requirements for function diversities spatially within fast developing cities conflict with insufficient city lands. The novel idea of vertical cities can be promising for city evolution. For that reason, our team finished a study pertaining to people's function requirements in terms of residential places and their understanding of horizontal and vertical cities. Our team completed an indepth investigation via interviewing, using questionnaires and reading literature, with the aim to drawing associated conclusions more objectively via data harvest and summarization. People require more integration of functional facilities around their residential places. Masses of people hold that future cities will reflect the features of our times and prevail eventually and will make our lives more convenient, whereas certain individuals think that conventional horizontal cities are more comfortable. A vertical urban design can ameliorate urban land utilization, yielding more spaces for greenery and residence and integrating various intricate city functions. Although people differ on this point, supportive viewpoints prevail. The idea of vertical city might serve as a novel direction for city evolution in densely populated regions.

Compared with the polarization of horizontal cities, vertical ones have evident benefits, with the majority believing that they have intact service systems and sufficient green spaces, and that vertical urban design is able to mitigate land shortage and bring more greenery. Nevertheless, it's hard to define diverse city functions and the associations between public and personal activities are somehow elusive. Insufficient privacy is usually deemed as one of the flaws of vertical urban design [7].

For that reason, although some individuals prefer horizontal cities, most of the participants support idea of vertical urban design in the future. Despite the fact that this new city mode is at its embryonic stage, it's evidently promising owing to the fact that vertical urban design is much more advanced in contrast to horizontal cities when it comes to their deficiencies. People might not want to accept vertical cities as they are concerned about a variety challenge accompanied by high density of population, whereas abundant lands along with substantial greenery provided by vertical urban design will surely enrich urban residents’ lives. The needs of residential spaces and agricultural lands are persistently on the rise and we are obliged to develop our urban areas vertically instead of horizontally [8].

People express that they think horizontal cities are more comfortable in contrast to vertical ones, whereas we ought to pay more attention to the fact that comfort isn't the equivalent to superiority, and that both the world and people with it are ever developing, his is a growing trend in skyscraper design during the present energy-conscious era[9, 10].Vertical urban design may be can tackle over-population and environmental challenges to really achieve a harmonious and equal status between mankind and nature. Real vertical cities ought to be comparative: the vertical urban mode as the primary structure, and the individuals having the preference for living in suburban areas can reside in parallel countryside. Such integrated design caters to different needs and offers a brilliant way to solve environment issues and associated challenges. Hence, we come to the conclusion that the conversion from horizontal cities to vertical ones will prevail due to the elevated sustainability that comes with it.

The challenges and outlook are as follows. Yet we still face many difficult aspects of this transition, such as the level of policy support: to what extent can we achieve such a shift? And how fast can we make the transition? With regard to the general public, will people be able to accept the range of lifestyle and behavioral changes that vertical cities will bring? Are people used to the new public transport network when it comes to getting around? But we have reason to believe that the creation of vertical cities is unstoppable, and that the decline of parallel cities is also a trend of the

times. People have always taken in more and more amounts of information with the development of technology, but for vertical cities, the integration of information and the transfer of information happen within the same area, and interconnection is a trend in the world and a trendsetter in terms of urban development.

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