

Cloud-based Virtual Reality Technology for Representing Design Guideline of Urban Residential Environment

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Dissertation

**Cloud-based Virtual Reality Technology for
Representing Design Guideline of Urban Residential
Environment**

Graduate School of
Natural Science and Technology
Kanazawa University

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Course: Environment Planning

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Chapter 1 : Introduction

1.1 Background

Modern society has been overwhelmed by the increasingly information of geospatial data year by year. Users of virtual globe can easily zoom the point of view from the globe level, country level down to a specific street, recognizing their own houses. Web-based virtual globe has generated huge number of digital content including maps, satellite photos and countless users' comments and text. Besides, those geospatial information connecting with environment, architectures, climate and so on, can have a lot to do in solving the practical problem of the world.

However, to derive such knowledge it need more than the automatic system or human manipulator alone in an effective way. Thus the computational 3D modeling techniques need to link with the cartographic method and interactive pictures together to favor the voluminous analysis with interaction and communication within multi-users, only in which way the operators may get a smooth visualized sense of the practical project and have a decision making support platform.

And Virtual Reality environment have the experiential features oriented from the following aspects: immersion, interactivity and sensorial feedback. Immersion can be summarized as that surrounded by the simulated environment the user has the sense of feeling or consciousness of what presences in the depicted world ([Schuemie, 2001](#)). Interactivity, is the ability to control (make & receive) the responses reflected in the simulation environment as a result of human initiative thinking or body movements ([Achten, Roelen, 1999](#)), which no doubt deepen the impression of the environment to the actor.

The most common utilization of Virtual Reality in urban planning or design project is to experience around the simulated 3D environment. Researchers have been working on developing virtual reality as a tool for design & planning exploration and evaluation. Because creating virtual model is much easier and cheaper than building a physical model, virtual reality techniques have been widely employed in visualizing the design results. In other words, virtual reality can be used as a tool to design and build up the target model including the surroundings. Now Virtual Reality on the design concept creation has been adapted by designers and architects, so as for

representing to the customers. By exhibit the design concept, virtual reality system favors the communication during the designing process, and also for the public the understanding, which provides full images of spatial relationships of the design to the audience instead of the conventional raw and text imagining. In this way, VR has this characteristic advantages to help the audience to get a complete image of the spatial relationships towards a particular design work. Thus, virtual reality system, especially for the nonprofessionals, can be employed in learning processes, helps the public to get a better understanding of the planning and design policy or regulation.

The subject focus on looking for Virtual Communication (towards teachers & students, or designers & public) in the mode of city design and planning new analysis model and way of presentation, by the virtual reality system, which includes UC win-road, Google Earth and other tools might partly involve augmented reality, which may increase effectively the efficiency of the stakeholders' understanding the urban planning operation process and the design results.

1.2 Objectives

Based on the condition mentioned above, there are still deficiencies need to make steps forward. This PhD research targets on how cloud-based virtual reality technology representing design guideline of urban residential environment. We attempted to employ cloud-based virtual reality technology to support stakeholders' comprehension of urban design guidelines, compared with conventional planning documents and drawings

This dissertation has some objectives to try to give the solution:

1. 3D modeling is not only for presenting the design work, and also how to helps to express the design guideline to the first party (non-professionals), proving the design effectiveness.
2. Virtual global widely support other plug-in, which shows diverse flexibility, but undoubtedly separates the functions to users, especially for the nonprofessional background users, lowering the ability of controlling the process. How to connect the nonprofessional background users with the virtual reality system for their comprehension.
3. Public get better comprehension with the synchronized 3d environment and the alternative choices, however still not easy to make alternative themselves

but only to give the suggestions in text. Because of the large amount of 3d modeling, it is not smoothly for the public to experience the virtual environment in end servers, at least which are limited. The alternatives of platform for the end users need to analyze and towards which target group people each platform has a better performance.

1.3 Brief Literature Review

In the recent decades, urban planning processes has been improved by the fast developing field of the geospatial information in modern society ([Huang, 2003](#)). Online GIS system can be employed to generate urban design & planning visualized concept and also assemble data, which makes the general public with no professional skills could involve in urban planning procedures as well ([Drummond, 2008](#)).

In the beginning, web-based GIS can only provide the function of image exhibition including the simple sketch and maps onto the internet. To meet the increasing demand of the public's expectation of design visualization, it has been considered more and more about the 3D visualization technology.

Comprehensive spatial media have been used in researches such as photography, video, text and GIS data in the process of urban planning and design to try to involve more public participation and let the public have a better understanding. ([Matsubara,1991](#); [Michael, 2001](#)).

Alternatives in design tools are provided also for the general participants to experience a virtual world, which helps the stakeholders to get a better concept and involved during planning process.

For some specific design project, visualization of planning and design alternatives are proposed to encourage public involvement during decision-making process (Pettit, Nelson, 2004). In order to collect comment and suggestion through the Internet, a public outdoor space visualization tool is developed as a collaboration system of online design ([Shen, 2003](#)).

But most of the 3D visualization project results were specifically towards to the individual projects at the same time isolated from the real environment of the existing site or the region. If the end users want to visualize those 3D concepts, they have to download all the model as a whole package firstly. The process may be finished in a hidden thread so that the users might not aware, but it still takes quite a long time.

Never the less those results only provide a channel visualizing design project, but do not provide the possibilities for interaction with the visualized environment, thus the impact of public participation is limited.

During the last few years, 3D virtual reality technology in cloud-based system has become matured and public have get more used to the virtual globe technologies. This online globe-based visualization tool has changed the way the stakeholders understand, interact and control the geo-information data ([Butler, 2006](#)). This virtual globe-based visualization technology use Web Services to support 3D model sharing and modification in urban planning, developing the framework for the public comprehending the urban and architecture information. ([Huayi Wu, 2010](#))

So far, present computer technologies of VR on the internet can be employed by users across locations to come together and create a virtual world by presenting, sharing and selecting different design elements. A visualization tool is developed ([Shen, Kawakami, 2008](#)) to achieve consensus within the local committee on townscape planning design. Stakeholders could use different visualize alternatives of design elements in synchronization, and experience the scenes of the generated virtual world, with multiple functions combined in the townscapes.

The service oriented architecture system provides geospatial information of planning and design to expand as one or many servers, including the personal laptop of individual end user. With the service oriented system's capacity of distributed complex information and resources, other conventional methods can also be integrated into the system to involve more friendly user experience for the end users. In this way the spatial information tool is merged to help the general public to perform tasks such as seismic resistance, solar power calculation and performance analysis, as the professional designers do.

1.4 Research Method and Thesis Organization

This PhD research targets to the communication between the designers and the stakeholders during the process of urban planning, by using cloud-based virtual reality technology for representing design guideline especially for urban residential environment.

The research starts from using 3d model to present the guideline. In this research we attempt to achieve new design method of the residential environment of low-rent

Housing, we attempted to employ a practical project to present the concept. Firstly we investigate the low-rent housing residential area in Tianjin, China. With the interview of the local, the characteristics of the residential towards to the environment are analyzed. We think the outdoor open space of the low-rent housing residential environment could be diversified to partly fulfil the interior functions, by which way the cost of the low-rent housing is reduced to a certain extent. Then the detailed design work with some data is given necessarily.

Then we targeted representative urban design guidelines to enhance public understanding. In particular, we concentrated on developing a tool for stakeholders to improve their understanding of urban design guidelines determined by related laws and regulations. We suggest that Cloud-based virtual reality technology (Google Earth) not only can display a detailed district plan of the urban design guidelines or related documents but can also offer a possible method for stakeholders to experience the planning site from anywhere via the Internet. Stakeholders can refer to other planning projects on Google Earth at the same time. Thus, urban design guidelines can be more intuitive and dramatic to both professional planners and stakeholders.

After that, we use the example of Shibuya bridge concept design to summarize the advantages how the virtual reality technology do favors to represent urban design guideline. We used SAAS(Software as a Service) to facilitate the procedure of the pedestrian bridge design in Shibuya, Japan, also in communication on design evaluation, sharing design concept to each other designers and reached a consensus. Then public participation through cloud computing is discussed.

We compare cloud computing SAAS with the different platform of VR cloud tools to present in which parts and how the cloud computing could enhance during the design process. We made the comprehensive evaluation of the features of the three platforms. In the aspect of planning support using virtual reality, 3DVIA is one kind of platform that is based on http-based cloud server, while Google Earth and VR-Cloud are specified platforms for users to share the digital virtual globe or virtual reality.

The whole research is organized in to 5 Chapters. We started from Chapter 1 for Introduction and following it we will introduce the subject focusing on looking for virtual communication in the mode of city design and planning new analysis model and way of presentation; Chapter 2 about using 3d model to present the guideline to solve a practical problem in Chinese low-renting house ; Chapter 3 targeted repre-

sentative urban design guidelines to enhance public understanding; Chapter 4 about with the different platform of VR cloud tools to present in which parts and how the cloud computing could enhance during the design process. We made the comprehensive evaluation of the features of the three platforms. Last, we make a conclusion on this PhD research in Chapter 5.

Chapter 2 : Planning Review of the Residential Environment of the Low-rent Housing: A Method to Solve Low-rent Housing Space Insufficiency

2.1 Introduction

In this work we attempt to find out how the planning regulations can provide public space as a solution for housing space insufficiency in order to improve residential environment in China, in which the Chinese Green Construction Standard as a fundamental standard for exploring the environment design guideline of low-rent housing Residential Area in China has been reviewed. As a result, design guideline of low-rent housing environment balances public space and housing space for community communication in residential environment from the viewpoint of indoor and outdoor.

Regarding housing policy measures, the definition of housing affordability was used to summarize the difficulties that individual household confronts with descent or adequate housing ([Hulchanski, 1995](#)). The rising need calls for construction quality and housing cost, and is also a reflection of the difficulties accessing acquisition of the new housing building authority. ([Edward, Joseph, et al, 2005](#)).

The current city form, high density urbanization mode, often lacks of green space ([Jim, 2002a](#)), which is shown extremely in the low-rent housing area. Similar to the compact of European cities, most Chinese low-rent residential areas are developed with an intensive urban plan. The planners have tried to create sustainable low-rent housing to confront the fast increasing urbanization and population since the 1980s. While during the 1990s, quite amount cities conducted augmented greening space programs, which made the confliction between the greening durability, urbanization and the financial cost. Recently, the compact city has been given definition as a term for sustainable urban form to have the control of urbanization at the same time controlling the natural areas ([Beatley, 2000](#)). The natural areas especially in the edge of the countryside are to be minimized and need to enlarge in cooperation with human activity ([Swenson, Franklin, 2000](#)).

Environment ecology provides suggestions on an optimization of environmental space utilization within conservation, consumption and improvement ([Forman, Godron, 1986](#); [Dramstad, Olson, et al, 1996](#)). Such design concepts of spatial arrangement have been conducted effectively in environment landscape projects and urban planning designs ([Goldstein, Gross, et al, 1982](#)). Many different researches have proposed some landscape design concept which are composed of linear mosaic elements to enlarge the possibilities of the connection within the land, the green plants, the urban habitant, and small living creatures, to create a harmonious natural living environment ([Ahern, 1991](#); [Walmsley, 1995](#); [Mazzotti, Morgenstern, 1997](#); [Quayle, Lieck, 1997](#); [Flores, Pickett, et al, 1998](#); [Schrijnen, 2000](#)). However, few research reports focus on the functions of green space for improving housing space insufficiency with a viewpoint of indoor and outdoor community communication in low-rent residential area.

So far insufficient researches have been conducted on comprehensive low-rent housing design and planning in the environment of high density urban development ([Jim, 2002b](#)). . In the European and American developed country, and no such as China, such a large number of residents crowd, therefore in the economic input and policy system on the content does not have the typical reference meaning, need not give necessary details. Because of housing morphology of low density or scattered layout, the residential area landscape research mostly focus on residential garden type, does not directly applied for low-rent housing in the high density integrated uptown specific environment. Although the landscape design is not specifically for low-rent housing environment design, its application in low-rent housing in residential environment construction and landscape design is possible to find out some solution for housing space insufficiency.

Recent years in China, there is not any official national regulation of low-rent housing environment. Although the establishment of the system of low-rent housing in China has been more than ten years, during the implementation process and various economic reasons, most researches are about policy, management, operations, and the other parts of the researches are from the angle of site location, building, facilities, energy-conserving. The reports on low-rent housing landscape design are not few. Related literatures are only about low-rent housing planning and design guideline on environment and there is a minority literature discussing the green building and the low-rent housing together, with a small amount of landscape design content. All the

papers in Chinese National Knowledge Infrastructure (CNKI) database are retrieval include "low-rent housing" and "design" literature number for 18, but is all about policy, planning, architecture.

Low-rent Housing has been discussed recent years in developing countries ([Bajunid, Ghazalib, 2009](#)), addresses the problem through a sociological standpoint by first reviewing the crisis of poor families. Meanwhile, the public identification of poor people concentrated in one location in a city. For finding a possible solution of residential environment in low-rent housing areas, the objective of this paper is to review how landscape design can be the new method to balance the housing space insufficiency due to the limited cost with the performance of low-rent housing, to improved the living quality of the residents.

2.2 Research Approach

For achieving new design solution of residential environment in low-rent housing areas for housing space insufficiency, we investigate the low-rent housing residential area in Tianjin, China. We think the outdoor space of the low-rent housing could be diversified to partly fulfil the interior functions, by which way the cost of the Low-rent housing is reduced to a certain extent.

In this paper, we attempt to review a design guideline of environment design in low-rent housing areas based on the Green Construction Standard. With the interview of the local residents, the characteristics of the residences towards to the environment are analyzed. A couple of design solutions are given respectively for each problem in the existing low-rent housing environment and the detailed design work with some data is given necessarily.

The remainder of this paper is organized as follows. Section 3 describes the research area and investigation information details. Section 4 discusses living needs analysis of the residential environment in low-rent housing area based on interview investigation to residents. In Section 5 and 6, design concepts and solutions are reviewed according to the national Green Construction Standard. Finally in Section 7, a brief conclusion is given and future work is discussed.

2.3 Investigation and Study Area

For understanding what kinds of design guidelines on landscape design and public space are necessary for solving the problem of housing space insufficiency, a field survey and interview have been conducted in Tianjin.

Tianjin is a city which is the fourth largest in China. Tianjin's GDP reached 1.12 trillion Yuan in 2011, an increase of 16.4 percent over 2010. The city of Tianjin recorded China's highest per-capita GDP with \$13,393, followed by Shanghai with \$12,784 and Beijing with \$12,447, levels on par with some developed countries.

For this investigation, the current conditions of the study area related to location, traffic, landscape, space intensity, disable facility and sense of belonging have been summarized for residential environment improvement as shown in Table 1 and Figure 1. As summarized in Figure 1, RuiXian Yuan and RuiXiu Yuan are typical projects of low-rent housing built in 2005, 2006 in Tianjin, China, which locates in the suburb of HongQiao district of Tianjin. The Buildings are six-storey with each apartment 40~50 square meters. Most of the apartments are low rent housing, mainly allocated by the department of housing management of local government to accord with a condition for low-income groups. Since most apartments are constructed by the local government for low-income groups, the budget is so limited for the maintenance of the building management.

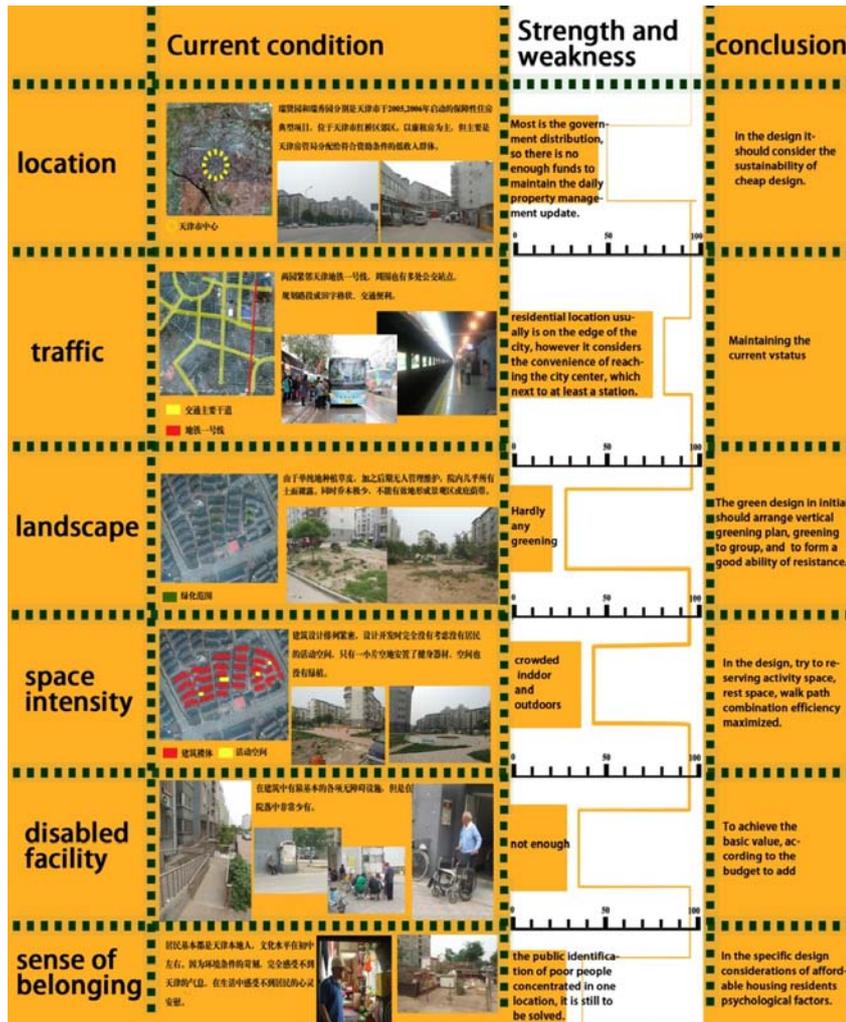


Figure 2-1 Low-rent Housing Existing Conditions Summary、

Table 2-1 Existing Paradigms Summary

Field investigation	Current conditions	solutions
Location	Most of the apartments are built by the local government distribution, there is no enough funds to maintain the building.	In the design it should consider the sustainability of construction budget and the sustainability of low-cost.
Traffic	The residential location is on the edge of the city, however it considers the convenience of reaching the city centre, which next to at least a station.	Maintaining the current status
Landscape	Not enough green plant in the environment	Considering vertical and group greening plan to form a good performance of damage resistance
Space Features	Outdoor space is crowded, while space of inside houses is narrow, too.	Maximize the efficiency of the space, interlace the activity space, resting space, walking path together.
Disabled facilities	Most facilities in the park for the disabled and the elderly	According to the budget, at least achieve the basic standard for the special group

Sense of belonging	The public identification of poor people concentrated in one location, it is still to be solved.	Beside the design, also consider housing residents psychological factors
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2.4 Living needs Analysis in Low-rent Housing Residents

2.4.1 *The Indoor and Outdoor Factors from the Questionnaire Survey and Interview*

We made field survey towards this residential area, which mainly focus on the different aspects of the living needs of their low-rent housing environment. The questionnaire follows Maslow's hierarchy of needs ([Maslow, 1943](#)) to exam different needs of the residents, which are physiological needs, social communication needs, aesthetic needs and sense of self-worth. The majority of the residents are old or disabled population (figure 2, 3), limiting to their educational level and the health condition of ageing (bad hearing, weak eyesight), they cannot not understand the questions properly. Thus, interview is chosen as a method to investigate residents' opinions in the study area. In this survey, we have chosen 26 residents, however, the effective answers received from the residents are 11 healthy residents, containing 7 old persons and 4 youth. We try to figure out the living needs in indoor and outdoor housing space of residential environment.



Figure 2-2. (Left) The majority of the residents is old or disable

Figure 2-3. (Right) Ruixiu Yuan age structure percentage (from the service center)

Based on the investigation, most of the problems from the responder points to the insufficient indoor space and lack of outdoor space. Environmental virescence and management problems are mentioned though, they are not as strong as this issue. In conclusion, for all the users of the residential, strengthen the communication for public space is very necessary. The inconvenience of indoor function could be fulfilled by the outdoor space. In responding the calls for the communication demand, the different functional space need to be planned in the following design work.

As to the other responds related with aesthetic demand and sense of self-worth, which provides directions towards other aspects of the future design results (vertical greening, etc), we do not take it as core in this paper.

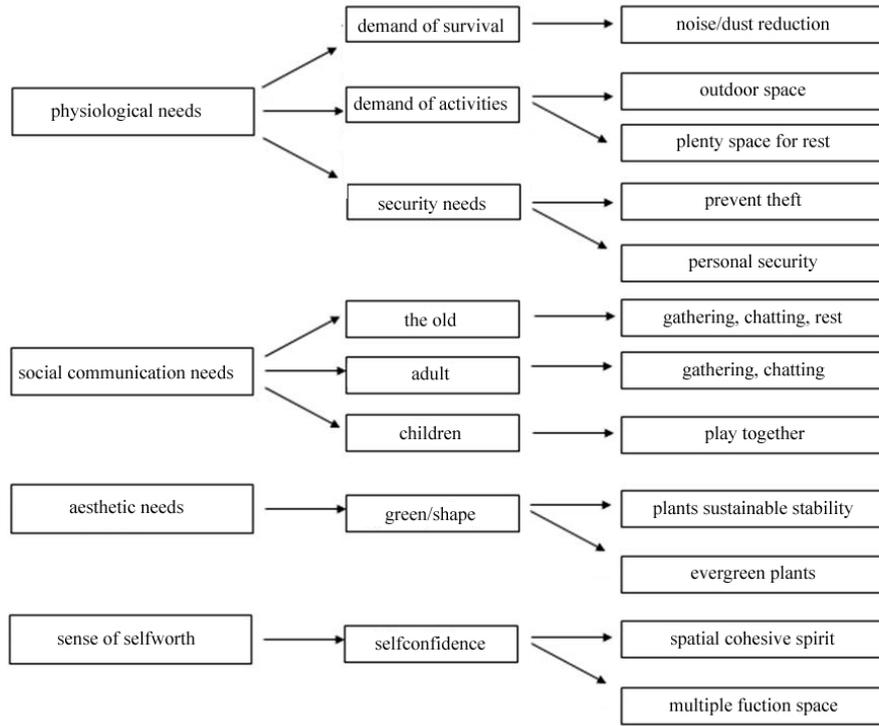


Figure 2-3. Living needs and residential environment between Indoor and outdoor

2.4.2 The Physiological Needs

Physiological demand is the physical priority demand of human being, which is also the basic requirement for a living environment. Including the fresh air, good ventilation, plenty of sunshine, suitable climate, no interference noise and so on.

The Survival Needs

First of all, the residents do have many dissatisfaction against the environment. Besides the questionnaire, 10 of the 11 interview responders from residents think the problems currently concern are from the indoor.

The core problem in the local concentrates on the indoor space insufficiency, for the indoor space is where the residents actually live. In the small room fulfilled by all kinds of stuff (figure 4), the residents feel depressed for the space is barely for sitting. And this issue influence on their communication activity of entertaining guests because of the physical impossible space, which is mentioned by more than half of the responders. The residents have no alternative towards this situation.



Figure 2-4. The insufficiency of the indoor space

There is no good corresponding building management, so indoor water leakage, water plugging and other problems are more highlighted. According to the interview, some of the first floors of the building always have water on the floor.



Figure 2-5. Some residents have to install another drainpipe from the second or third floor.

The Activities Needs

Activities demand stands for all kinds of outdoor activities in residential environment. In the daily life of the residents, outdoor activities may species widely, including rest, sports, recreation, fitness and targeted travel and a series of activities are required with the corresponding space environment.

In the low-rent residential house, the majority of the users are the old and the child, therefore more space for staying and activity is needed. In the interview, 7 aged people suggest that there should be more space for staying and activity. If possible, they would like to spend the day time in outdoor instead of at home watching TV.

At the same time aged persons were asked about the state of fatigue when they go out in the yard for activities. Due to personal activity preferences from different aged persons, the existing residential area has no reasonable activities for rest space,

according to the response to this question. They are not sure after how far or how long they may fatigue. But one thing is almost the same, if they go out for purposeful activities (chat, play chess, etc.), usually they will have to bring their own small stool. They can't stay long at standing position.



Figure2-6. (left) The residents play chess at the curbside

Figure2-7. (right) The residents need to prepare small chair to go out for rest

2.4.3 The Social Communication Demand

Whether low-rent housing settlements or ordinary residential area, the social communication demand of human activities is essential. "We believe that the residents interaction and communication is the basic foundation of city existence (John, 2007)". In Low-rent housing, the proportion of aged people is higher than ordinary residential community, the outdoor environment can be the most important communication place for aged population since normally they will not travel long distance, so that the elderly will not be segregated from the current society. However, low-rent housing every interior space is limited, thus limiting the residents indoor communication the possibility of communication. In the design of the communication activities it should have a strong sense to encourage and strengthen the communication behavior.

In addition, the need of visiting space for adults cannot be ignored. As the main group of economic source of low-rent housing families, they call for the talks with colleagues, friends, neighbors. For less than fifty square meters of low-rent residential interior space, receiving a visitor in the home is very tight. the residents would like to have some conversation place outdoor.



Figure2-8, 2-9. There is no space to meet residents' strong demand of communication

2.5 Reviewing Outdoor Design Guideline for Low-rent Housing Environment Improvement

2.5.1 Design Guideline for the Low-rent Housing Project

After analyzing the current condition of the low-rent housing residential area, we would try to redesign the environment of this area to solve the problems which are brought up by the space insufficiency. At present, the reasonable housing proportioning of this site is as following, which came from the calculation data of construction department:

Low-rent housing: 100,000 square meters, 2222 sets; interior space less than 50 square meters, 1 or 2 living space models; plot ratio: 3.0; greening rate: 30%; bicycle rate: 3 bicycles/apartment, and so on.

Following the indicators of outdoor space, the design and planning in study area towards the residential environment fits the requirement of the facilities, and to maximum extent shares the responsibility of interior space.

This project is subject to a high-rise residential building, tie-in part of commercial facilities and public facilities. According to the housing condition, we employed the evaluation standard in China namely Evaluation Standard for Green Building, GB/T 50378-2006. We made the examination of the outdoor space design implementation. We employed six aspects of the standard to review this design work, which are: Land-saving and outdoor environment, Energy saving and energy utilization, Water saving and water resource utilization, Material Saving and resource utilization, Indoor environment quality, Operation management.

Preliminary judge method towards the Standard: initial determination of qualified tick “√” ; the unqualified option with "X" said; the Standard provisions temporarily unable to judge a related to "?"; the Standard provisions temporary non-evaluated related with "-".

Preliminary assessment table shows as the follow tables. The standard of regulations down here are for the indoor and outdoor indicators, to review if the design work is qualified enough. Some of the six contents of the standard are not related to the topic of this paper, so we partly selected the relevant options from all the related standards, which are two of the six aspects.

Table 2. Land-Saving and outdoor environment

Category	Standard Provision	Result
----------	--------------------	--------

Control opinion	4.1.1 Site construction does not destroy the local cultural relics, natural drainage, wetland, basic farmland, forest and other reserves.	√
	4.1.4 Residential building layout ensuring indoor and outdoor sunshine environment, daylight and ventilated requirements, meet the national standard "urban residential district planning and design specification of GB 50180 in the residential building sunshine standard requirements.	√
	4.1.6 The rate of the residential not less than 30%, the per capita public green area of not less than 1 m ²	√
general opinion	4.1.9 Residential public service facilities according to plan, reasonable using comprehensive building and sharing and its surrounding areas.	√
	4.1.10 Make full use of old buildings. (such as the purpose of building site location in the desert, such as refuse site without old buildings open area, or old buildings in the area in 200 m ²	—
	4.1.11 Residential environment noise conform to the national standard "urban regional environmental noise standard of GB 3096 regulations.	?
	4.1.12 Residential outdoor daily average heat island intensity is not higher than 1.5 °C.	√
	4.1.13 Residential wind environment conducive to winter outdoor walk comfortable and transition season, summer natural ventilation.	√
	4.1.14 According to the local climate conditions and plant natural distribution characteristics, planting a variety of types of plants, constructed by combining multi-level plant, every 100 m ² green space on not less than 3 plant trees.	√
	4.1.15 Location and residential gateway setting the convenience of residents to make full use of public transport network. Residential gateway to public transportation sites walking distance less than 500 m.	√
4.1.16 Residential non road motor vehicle, the ground parking lot and other hard floor using permeable ground, and the landscape to provide shade. Outdoor permeable surface area ratio is not less than 45%.	√	

Table 3. Indoor environment quality

Category	Standard provision	Result
Control opinion	4.5.1 Each house has at least one living space to meet the requirements of the sunlight. When there are four and four more living space, there are at least two living space to meet the requirements of the sunlight.	√
	4.5.2 Bedroom, living room (hall), study, kitchen set up outside the window, the daylighting of the room coefficient is not lower than the national standard "architectural lighting design standard of GB 50033 regulations.	√
	4.5.4 Living space can natural ventilation, ventilation openings in hot summer and warm winter area of hot summer and cold winter area is not less than 8% of the area of the room floor, in other areas is not less than 5%.	√
	4.5.5 Indoor free formaldehyde, benzene, ammonia, radon and TVOC and air pollutant concentration accord with the national standard "civil building indoor environment pollution control norm" GB 50325 regulations.	—
	4.5.10 By the adjustable outer shading device, prevent summer the sun radiation through the window glass directly into indoor.	?
Optimization	4.5.12 Bedroom, living room (hall) use energy storage, humidity or improve indoor air quality functional material. (design stage this not eligible)	—

After reviewing the standard, we have a clear idea towards which parts of the low-rent housing problems the design may cover and towards which parts may be hard to

improve by only redesign the environment. In next section, we will present the detail methods of this environment design.

2.6 Low-Rent Housing Environment Improvement For Indoor Space Insufficiency

In this section we try to redesign the environment to solve the main problems of space insufficiency of the low-rent housing to lower the cost of the reconstruction. Low cost and high performance as far as possible is the key task of this project. Some of the design guideline related to indoor and outdoor environments are as follow.

Considering community supporting commercial facilities construction, increasing the proportion of business and other service facilities. Arranging more residents' employment in this area, to improve the low-income people living and working condition.

Considering the service facilities of the community, focus on convenience of the public service. While meeting the requirements of planning and design, the health services, public security, education and other functional service facilities may moderately increase. Make full use of the first floor space of the building, combining with the landscape design and public service.

The needs of different age class should be taken into consideration carefully in landscape design. The open space of public activities should be combined with relatively independent group greening, such as: the children activity space, the fitness equipment playground. Differ from commercial residential design, the design concept should aim to sustainable development and low maintenance.

2.6.1 *The Interlaced Functional Outdoor in Guideline*

Based on the discussion in the last session, low-rent housing, with the major group of the old and disabled people, should provide sufficient stay space, activity space for the incontinent people, to meet their demand of living and communication.

Therefore, in the environmental planning, the landscape design should not have large distance non-staying green belts. First, in order to ensure the old people's rest. Second, avoid large area of green plant of high maintenance. Third, avoid the "enclosure behavior" which mentioned in the previous section. These thinking about

indoor and outdoor has been put into the design principle and shown as Figure 2-11, 2-12.

Besides the aged people, the youth is at the second place of the priority. Although children activity facilities are differ from the old, however the safety precautions of the activity space are similar. Thus, in the design, we can combine the activity/stay space and children activity space together, scattering as different space in the area.

This kind of layout scheme shown in Figure 4 sacrifices large area of landscape view. But from the residents' psychological need, the actual maintenance costs, and the convenience of functional space, it has the high cost performance.

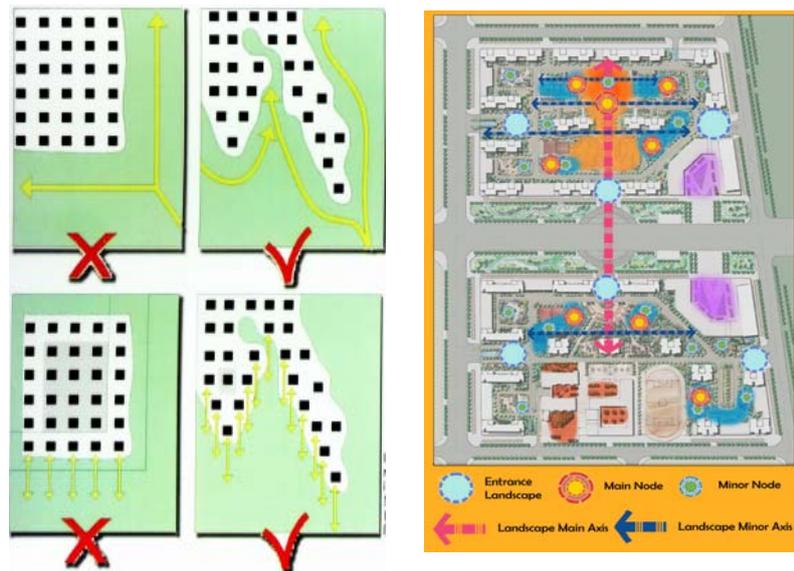


Figure 2-11.(left)The interlaced pattern of functional outdoor

Figure 2-12. (right)The planning ichnography of different space functions



Figure 2-13. The example of interlaced functional outdoor

2.6.2 The Establishment of the “Private” Yard in Guideline

In order to make up for the space deficiency of the function of sitting room indoor, some half-closed private space is necessarily established in the residential district, which is equivalent to transferring the indoor function to a courtyard space for receiving visitors.

The spatial arrangement of the private yard is next to each entry of the residential area for convenience, which are several half-closed places for conversation and

discussion. It avoids the main road , as well not be interfered by the traffic. In the space division, trees and shrubs are the soft isolation belt, which are 0.8m to 1.3m height, to provide the conversation privacy relying on the environment. In this way the sitting room function is moved to the outdoor environment, letting the individual communication happen in a big environment, promoted the neighborhood relationship.

At the same time the space also as one of scatter space, achieves a variety of functions for old peoples' rest.



Figure 2-14. The example of the “private” yard

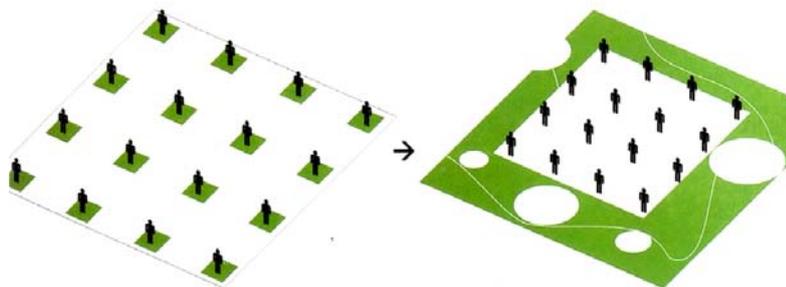


Figure 2-15. The pattern of space formation

2.6.3 Public Space Design for Indoor Insufficiency

We try to provide a comprehensive consideration of the public activity space and walking system Settings. Public space environment design should pay attention to the resident age characteristics and behavior pattern. Outdoor fitness equipments are necessary for residents to exercise and children to play. Service facilities, including but not limit to public gathering place, the elderly and children activities places and community health, are of the importance. And disabled moped, small tricycle parking Spaces and accessible elevators should be set.

The square of the central area or the main entrance can be planted around shade trees, and set rest seat, provides the rest, activities, communication facilities for the residents, partly equivalent to transferring the indoor function outdoor. Hard pavement with permeable material is given priority to, and it should take anti-sliding measures.

In the design of landscape full consideration should be taken for the needs of every age class. The activities of the public open space group combination of greening plant should be designed together.

2.6.4 The Outdoor Environment Design Review Summary

Table 4. The environment design review result

Evaluation Standard for Green Building Star Level	Options of the standard (in total 31)					
	Land-saving and outdoor environment (7)	Energy saving and energy utilization (6)	Water saving and water resource utilization (7)	Material Saving and resource utilization (7)	Indoor environment quality (7)	Operation management (7)
★	3	2	3	1	2	1
★★	4	3	4	2	3	1
★★★	5	4	5	2	4	1
<i>The numbers of the result of the design project which meet the standard</i>						
Eliminate the dubious options	4	3	6	4	4	2
Including the dubious options	6	5	6	4	6	2

The upper part of Table 4 is the judgment criterion of *Evaluation Standard for Green Building*. The number under each category of the six aspects of the standard shows the options considered in total (e.g., *Land-saving and outdoor environment*, 7), and the number met the individual regulation can be evaluated as different star levels from one star (★) to three star (★★★).

The lower half of Table 4 is the examining result of the design work according to the original scale adjustment. According to the GBT50378-2006 clauses 3.2 regulation: when a standard provision does not adapt to the construction area, climate, building types or conditions, which doesn't participate in review. At this time, the total number of a contestant will be reduced correspondingly. In the table of evaluation summary, eliminate the dubious options, the result of the design matches the two stars standard; including the dubious options, the design matches three stars standard.

Especially, In the evaluation of *Land-saving and outdoor environment* and *Indoor environment quality*, including the uncertain options, the environment outdoor design of the low-rent housing environment get the 3 stars standard, which provides the

convincing evidence the outdoor space is improved and the design methods we used in the paper is a positive alternative.

2.7 3D model Helps Representing the Guideline

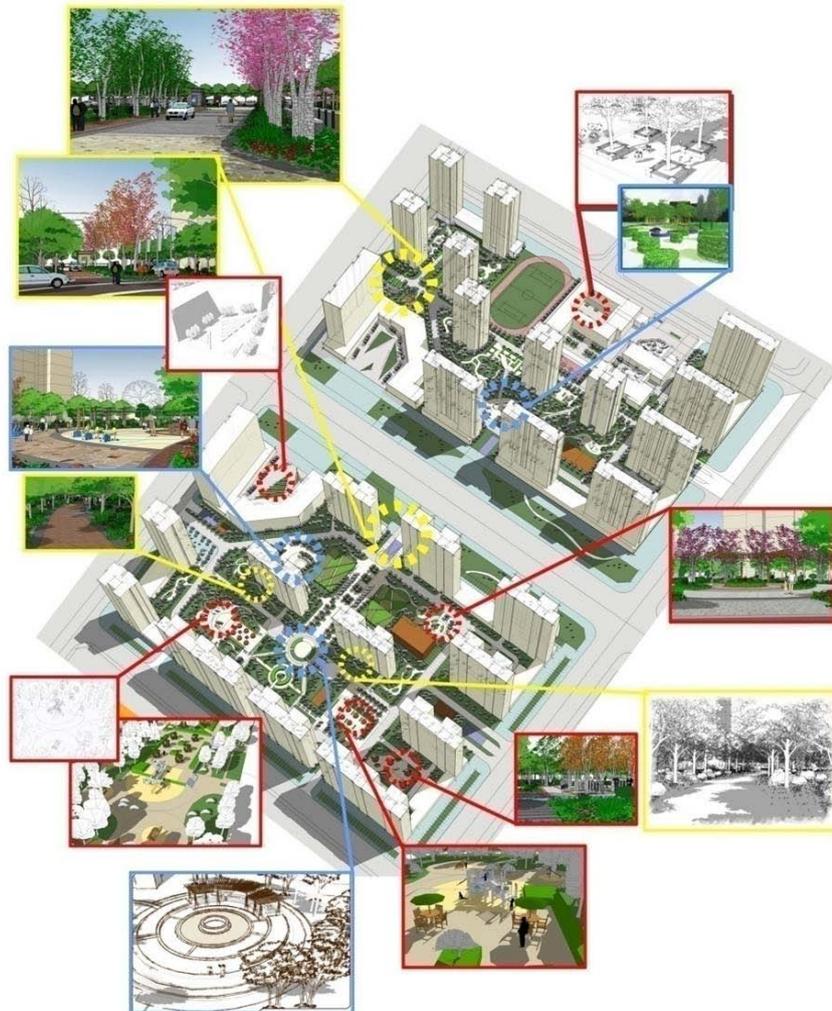


Figure 2-16. The 3D environment of the design concept of the area

With the help of 3D model technology, it is much easier to review the indicators of a design project, as well as the comprehension to the project for the first party. In this section we use the regulations of *Land-saving and outdoor environment* as example to explain how the 3D models facilitate representing the design guideline.



Figure 2-17. The sunshine shade simulation

In the option 4.1.4 of the previous form, the standard has the requirement of the necessary hour of sun light. Use the 3d model of the design project and the relevant software, it can bring the daylight levels of the whole area clearly to the stakeholders.

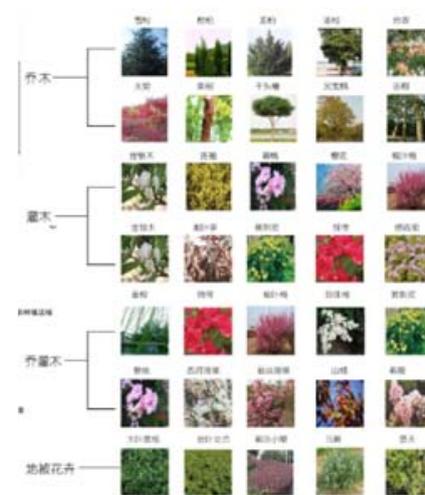


Figure 2-17. 3D vertical greening group of plant configuration

For the option 4.1.14, the requirement of planting a variety of types of plants, 3d model shows a intuitionistic virtual presentation. In this shoot, the audience can view the plants configuration and greening method of the design document straightly.

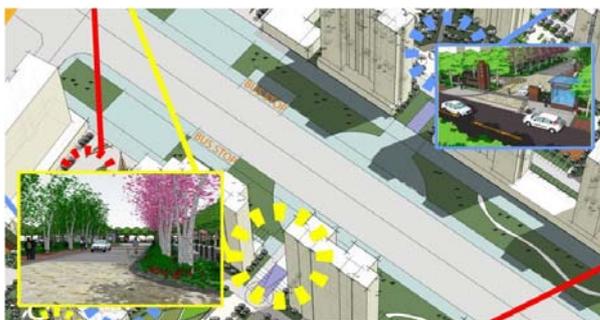


Figure 2-18(left). 3D environment of the entrances of the residence area



Figure 2-19(right). The 3D rest yard model

Without doubt, 3D model also has its natural attribute that this technology is advantageous in representing architecture environment with a virtual image, which shows in the figure 18 and 19, towards the option 4.1.15 and 4.1.16.

2.8 Conclusions in this Chapter

The contribution of this research is to explore an alternative to solve the indoor space insufficiency of low-rent housing for developing sustainable housing scheme at low cost. This research may help the housing department of the government consider which elements of the environment may have a high performance meanwhile keeping an acceptable quality for the residents.

Instead of designing the building, this thesis addresses the point that by reorganizing the residential environment to shift some insufficient indoor function to the outdoor space, achieving the improvement for the low-rent housing. On the one hand it lower the pressure of the high density of the buildings, on the other hand it is easier to implement than rebuilding the whole area for the residential improvement. We hoped that from the result of this research a noticeable low-rent sustainable house design scheme could be taken into consideration and maybe implemented for the increasing needs of the households in the country.

With the using of 3d model to present the guideline to the first party, the concern of Chapter 2 is to design towards the development of critical construction processes in residential environmental design for developing affordable and sustainable housing scheme.

Additionally, if greening consciousness being involved in the implementation, it may cause positive effect in keeping life cycle of the sustainability and stability of the environment. We will try to explore other alternatives with acceptable financial budget in order to help low group income to own the durable housing as well as the environment. The work done so far was the preliminary attempt, and the future work shall be focus on the specifying the detailed design standards for affordable housing, if possible.

Chapter 3 : Using virtual global for Representing Design Guideline of Urban Environment

3.1 Introduction

In this work, we employed Google Earth as a web-based visualization tool to represent planning and design guidelines of an urban planning site to improve the presentation of planning alternatives for the nonprofessional public understanding and design coordination with stakeholders. Public participation is very significant through the design coordination process of any urban planning or design project, for all the projects are finally to become part of the public's daily lives ([Kingston, 2000](#); [Tiedtke, 2005](#)). It has been proven that one urban planning project is more likely to succeed if the public have more opportunities to get involved. Some public participation in the planning process is a political goal in European countries ([Hetherington, 2007](#)).

In European countries, local governments are more and more required to make the data of urban planning available digital over the Internet ([Märker, Pipek, 2000](#)). Soon It has been proven that to promote public involvement during the urban planning procedure using the computer science by conducting the interactions with planners and the public ([Lai, 2010](#)). Undoubtedly the internet become a great platform to share the information and assemble the comments. Traditionally, the communication of planning proposals between the planners and public was in the help of the drawings, sketches, text and other methods during the planning meeting. Some urban planning tools such as computer design and geographic information systems have provided the function of planning designs to export as searchable maps, digital drawings, label and other supplement files. The conventional methods above cannot offer sufficient ways for users to experience all of the aspects of the planning sites. Virtual reality (VR) can also be used to represent planning sites on the Internet as reference material for stakeholders. Now as the developing of virtual globe technology, a multi-function 3D visualization platform is capable to be created for sharing the urban panning data with the general public. Not only the professional designers but also the nonprofessional stakeholders can operate the proposed project of the site ([Wu, 2010](#))

Many studies are currently researching applications of VR systems using Web technology for planning support. In the past ten years, although designers mostly used drawings and planning sketches in business, some of them have gradually adopted virtual reality technology to facilitate citizen understanding of the content of urban design guidelines, visualize more design concepts and better design details, and provide greater fun in this field ([Shen, 2003](#)). Shen et al. ([2010](#)) also completed a WEB VR system simulating the district landscape of Nanao City. The Urban Planning Exhibition Hall in Expo' 2010 in China represented the significant simulated system of VR to exhibit the urban design guidelines of Shanghai to the public and citizens so that the people can interact with each other in it, share their experiences, and leave their feedback ([Gao, 2010](#); [Styliani, 2009](#)). In addition, stakeholders can discuss among themselves or with the designers about the virtual world of the city provided by the VR system ([Masatoshi, Takafumi, 2008](#)) through the Internet.

In the planning process, designers can attempt their thoughts more accurately and specifically using a VR system on the internet. It is possible to enhance public participation through the effective communication processes as well. As discussed above, the virtual model is effective at improving the information flow and knowledge to the public ([Jiang, 2003](#)). On the one hand, stakeholders without a professional background in planning or design can also learn the content of the urban planning and post opinions. On the other hand, designers and planners can improve their design works based on feedback from the stakeholders.

During the last few years, 3D virtual reality technology in cloud-based system has become matured and public have get more used to the virtual globe technologies. The public can use their home computers and access the virtual globe through the Internet, which provides the public a new communication platform and allows public participation in planning process, from brainstorming of the idea to the final completed project ([Drummond, 2008](#)). Virtual globe system has become popular with the general nonprofessionals. It is predictable to use virtual globe technology for urban planning information sharing in the future.

Google Earth is virtual globe software and a new potential system with some functions similar to a VR system. As a three-dimensional globe, Google Earth includes all the cities of the world. It is difficult for a conventional VR system to share VR datasets of different cities in the same virtual world ([Meguro, 2003](#); [Hamilton, 2001](#)). Google Earth, which was released in 2005, is now widely used by the general public

and researchers. ([Wu, 2010](#)) discussed the technical issues of programming a virtual globe-based system framework for promoting GIS information and data using web services, or service-oriented architecture to facilitate the 3D model visualization and sharing with Google Earth. Although Google Earth has potential with regard to planning practices ([Lee, 2007](#)), so far there have been only a few reports on the improvement of public participation during planning process using Google Earth. Thus, we address utilizing the functions of Google Earth for public participation in planning practice by illustrating more planning and design guidelines.

In this work, we employed Google Earth as a visualization tool to represent planning and design guidelines of an urban planning site in order to improve the presentation of planning alternatives for public understanding and design coordination with stakeholders. We attempted to employ Google Earth to improve stakeholders' understanding of urban design guidelines compared with conventional planning documents and drawings. Section 2 describes the research approach details. Section 3 discusses how to represent design guidelines using Google Earth. In Section 4, we give conclusion of this chapter.

3.2 Research Approach

The present work examined Datong Newtown, China, as an example of typical planning guidelines for the Newtown development project in China. Our study did not consider details on developing the urban design guidelines; we used the proposed guidelines to visualize the planning concept in this area.

The urban design guideline concept in China originates from detailed urban planning and design in the 1980s. In order to solve problems with rapid urban expansion and construction during this time, some regions in China began to emulate foreign city designs to produce the roots of the guidelines ([Gao, 2007](#)). Nowadays, the content of the guidelines is relatively complete and contains the following main 11 aspects: building style and special features, urban land use, urban integral space pattern, public green space system, urban landscape system, historical culture protection and utilization, urban road space, urban activities and support, architectural and environmental space, key area, and incentives ([Kong, 2007](#)). All 11 aspects are part of the comprehensive urban design guidelines in China.

In contrast to a VR system, the Google Earth platform shares a database of information from around the world; we can visualize an urban project over the entire globe and not just within the limited project area. This feature makes Google Earth inherently superior at expressing and sharing urban design guidelines of the world, which aid stakeholders' understanding by comparing different projects in the virtual world. We utilized Google Earth to represent some urban design guidelines in the Datong region to reveal how efficient it can be to visualize the documents. The whole work comprised three components. First, we proposed urban design guidelines that were developed for the Datong region and discussed the flexible application of Google Earth. In this step, we examined existing urban design guidelines to determine the content for visualization. Second, we discussed how to use Google Series software to visualize the design guideline. Third, we used Google Earth to test our dataset. In the future, it will be necessary to open up the dataset to stakeholders and collect their feedback on the effectiveness of representing urban design guidelines using Google Earth. We did not discuss user feedback at this stage.

The guidelines for Datong Newtown chosen in this research focus on natural environment protection for sustainable development. Therefore, our work on visualizing this urban design guideline involved environmental design guidelines and conventional urban design guidelines, including those for construction, road networks, and land utilization. In order to utilize the multiple functions of Google Earth, we tried to fully utilize the superiority of multimedia to express the urban design guidelines and replace vague parts with our new explanations.

Using Google Earth to download 3D GIS topography

Google Earth is 3D GIS software; it is rich in geographic information presented in map formats, and its virtual three-dimensional version was originally called Earth Viewer 3D. It maps Earth by overlaying images from the satellite imagery, aerial photos, and three dimensional global ([Phan, 2010](#)). Fetching 3D GIS topography is as well possible as a basement to create a virtual city model using Google SketchUp.

Using Google SketchUp to produce a 3D model

Many city models already exist in Google Earth. After editing these models on downloaded topography, we can use Google SketchUp to upload them onto Google Earth ([Lee, 2007](#)).

Adding conventional multimedia such as text, images, and links of cities in Google Earth as references

For some guidelines that are hard to express with a 3D model, we can use texts and charts to add them directly to Google Earth. We can then add conventional multimedia such as outdoor scene photos, audio files, and movie clips along with other information to present the design guidelines in Google Earth.

Using this method, we can have all kinds of multimedia, such as text, images, and photos, to support 3D models that represent urban design guidelines in Google Earth. We can involve all of the previous media in the platform for Google Earth. The completed Keyhole Markup Language, Zipped (KMZ) file format can be used for browsing, watching, commentary, and modification as long as users have a computer with Google Earth software and are connected to the Internet.

Testing and application of urban design guidelines

There are two conventional methods to show urban design guidelines using this system: showing them to the stakeholders with a projector or touch screen and publishing them through the Internet.

Google Earth has a 3D model database called the Google 3D Warehouse platform. There are many models and information in it about all of the cities' architecture and scenery. Although it has not been verified, it might be one of the biggest free building 3D model databases in the world. Architects and planners update the models and related information in the database every day. The completed Google Earth database can be shared with users around the world on this platform.

3.3 Using Google Earth to Express Urban Design Guidelines in DaTong Region

For Datong Newtown, we reveal three detailed guidelines using Google Earth: traffic, architecture, and environment guidelines. By combining the three guidelines in Google Earth, the space appears more realistic and is easier to understand than reading documents and drawings on each guideline independently. This effect is discussed in the following subsections. The guidelines presented in our work are not the proposed planning guidelines by the campaign planning teams in the local design

competition organized by the local government. In the local design competition, most design guidelines come from Western countries; thus, the guidelines utilized in this work are not based on the Chinese planning system.

3.3.1 Traffic Guidelines

Topography map for site layout and traffic network

All of the content for our design guidelines comes from New Design Guidelines—A Step towards Self-Explaining Roads (German Federal Transportation Research Institute), in which urban roads are divided into 21 different types according to cross-sectional constitution, intersection form, road corner radius, largest cubes, and special use form. In this study, we divided all of the main roads in the Datong region into five types and visualized them in Google Earth. The overall topography map and traffic network map are shown in Fig. 1. To present the planning document of road types, a picture in the 3D world of Google Earth is embedded in the bottom left corner of Fig. 3-1.

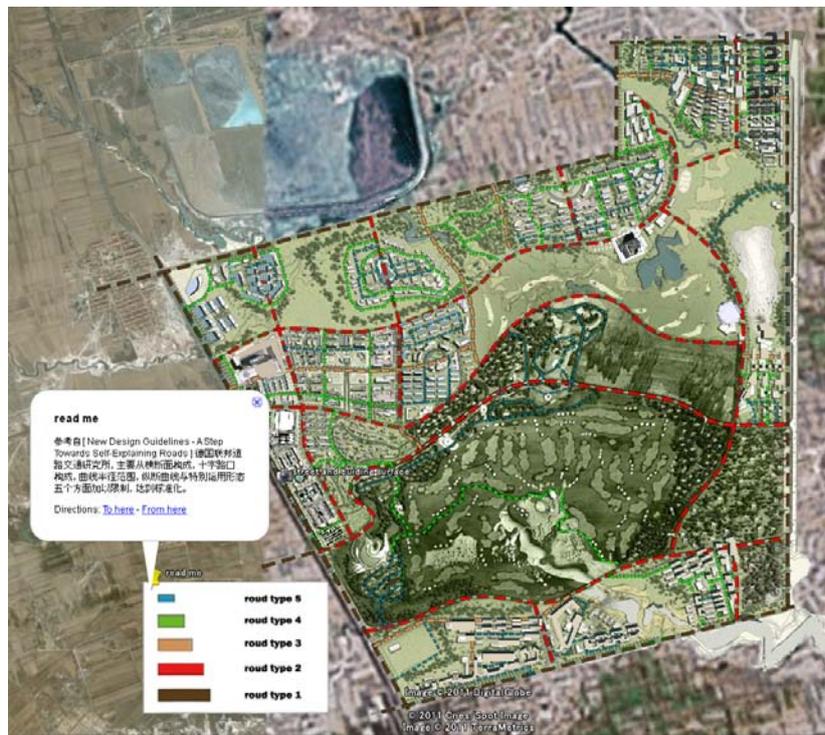


Figure 3-1. Traffic guidelines for urban traffic network in Google Earth

The urban design guidelines were developed based on a site plan using topography maps, which is intuitive for illustrating the design requirements of the entire site layout. Thus, we need to add the site planning as an overlay to the topography map in

Google Earth. Topography maps are characterized by being always extremely close to the ground and undulating. We used the image overlay adding pattern from Google Earth to directly overlap fabricated images onto available topography conditions in Google Earth; this is easier than the expression in a VR system.

Details of all types of urban roads—3D model and combination of texts and charts

In the previous VR system, the 3D model can be shown with related papers and html links. However, Google Earth can use its connecting mechanism to place the 3D model and related materials together and promote stakeholders’ understanding through reading and listening.

Table 3-1 presents the 3D models of sample roads and detailed illustrations with texts and charts. The 3D models in Google Earth are easier and more straightforward to be understood than is the traditional combination of texts and charts when designers explain the planning materials of traffic networks. More pictures of the road section and plane can be added as auxiliary information, as shown in Table 3-1.

Google Earth uses real-time rendering technology, so the datasets of the 3D model can be changed instantly. Either VR or virtual globe changes the vision angle freely, and the 3D model’s datasets can be changed conveniently. Designers can change the vision angles freely during the model-making stage, and animation and rendering can be done after the designer fixes the vision location or vision route. Google Earth can display any angle from the model-making stage to the final exhibition stage. Although it is not easy for the stakeholders themselves to create the models, designers can now import enough sets of 3D data into Google Earth according to current regulations for urban design guidelines. As the [Road type 1 3D model in summer/autumn in Tab.3-1], users can exchange datasets and show the urban image for different road types; this allows stakeholders convenient access to the correct information on different road types in the design guidelines.

Table 3-2. Traffic guidelines in Google Earth

<i>Road types</i>	<i>The road types of Traffic Guideline in Google Earth</i>
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Road type 1
3D model
in Summer
/autumn

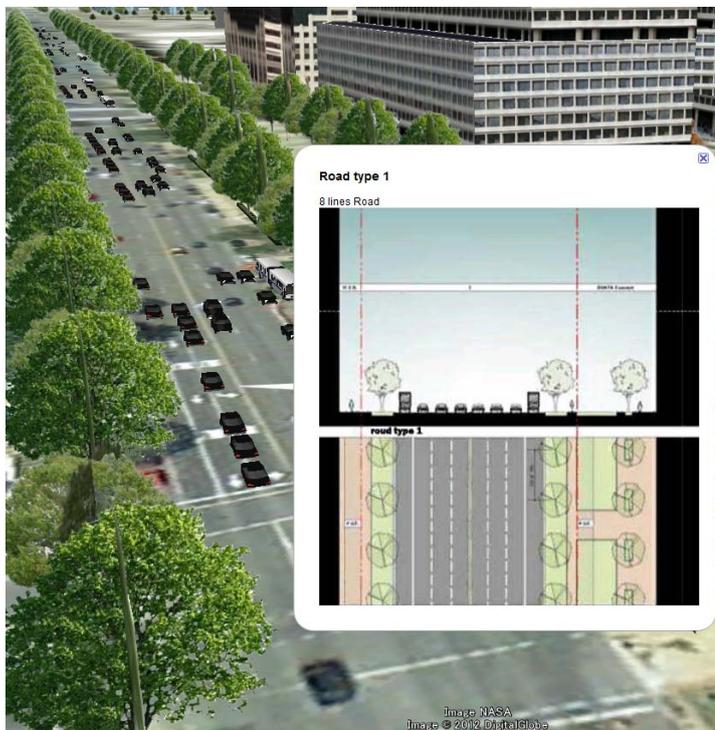


Road type 2
3D model



Explanation for
Road types
Road type
with planar
graph and
section
drawing

Planning documents for road design embedded in the 3D world of Google Earth



The traffic guidelines reveal a completely new exhibition effect embedded in the 3D world of Google Earth. An analysis table is presented on the effectiveness of Google Earth at representing traffic guidelines. As shown in Table 3-2, traffic guidelines received an “effective” result. This means that more than half of the guidelines

can be understood effectively with Google Earth. However, when more and more images are added, a problem of locating the guideline illustration images emerges; the images frequently overlap with the 3D models. In particular, when people are viewing the model from a certain distance, most of the 3D models on the ground overlap and cannot be seen. Thus, we need to locate the images for architecture and environment guidelines properly: the former has few pictures, but the latter has many.

Table 3-3. Results of displaying traffic guidelines in Google Earth

Guideline Name	Word	Figure	3D Model	Detailed 3D Model	Advance for Understanding
Traffic network	●	●	○	○	effective
Road type	●	●	○	●	very effective
Roadway dimensions	●	●	○	●	very effective
Vehicle	●	○	○	●	limited
Crossing and Overpass	●	●	○	○	good
Street signs	●	●	◎	●	very effective
Total:					effective

Not to be used or Poor results: ○ Normal results: ◎ Good results: ●

3.3.2 Architecture Guidelines

The architecture guidelines used for Datong Newtown are mainly from the urban design guidelines from the White Flint master plan and downtown design guide in Los Angeles. It focuses on regulations for massing, surface, base wall height, step-back or podium setback, and other architecture issues. We already discussed the topography and 2D maps previously; extra 3D datasets to represent buildings are necessary for the architecture guidelines. Fig.3-2 shows the architecture guidelines in detail.

Building type and massing—images and 3D model

The building type and massing and building facade image are discussed here. Building massing restricts the construction density, building plot ratio, etc. Building facade images refer to outside colors, shapes, and neighboring facilities of the building.

First, we employed pictures to present documents for architecture guidelines on building type and massing. For the traffic guidelines, we embed the guidelines in the 3D world of Google Earth; a different presentation method is used for the architecture

guidelines. Fig. 2 shows a “My Places” icon on the left side of the Google Earth main window. Users need to find the architecture guideline sub-item in the “My Places” icon and find the “building introduction.png” file. They double-click this file to see the content of the picture in the right window of Google Earth. The background 3D model can serve as an additional illustration for the picture. For traffic guidelines, we embedded pictures in the 3D world of Google Earth; here, it is difficult to control the direction and position to read the content of the guidelines. Thus, this method resolves the previous issue with traffic guidelines. When a user exits the photo mode, he/she can still freely browse in the space. This is a VR-style illustration of a street-view 3D model with a PowerPoint presentation. This method combines the advantages of the two techniques to make understanding of the urban design guidelines intuitive for stakeholders. If the user would like to know more, relevant links are available for further experience. In short, double-clicking the photo on the left side and controlling the window on the right side make it easier for stakeholders to check the content of the guidelines in planning documents. As shown in Fig. 3, we can express the guidelines for four types of buildings in terms of names, sizes, building plot ratios, construction density, functional regions, and rough effect simulation pictures.

When users exit the photo mode in Google Earth, they can see the locations of different types of buildings in the 3D models by using the transparent squares with the same color as the building types. This is convenient for users in finding the locations of the four types of buildings. Fig. 3-4 shows the architecture 3D model for the four types of building samples and the combination effects with the surrounding environment.



Figure 3-2. Overall image of the city in Google Earth



Figure 3-3. Building massing picture in Google Earth



Figure 3-4. Building type samples in Google Earth

Building facade image and street furniture—3D model

As shown in Fig. 3-5, the urban building style is more intuitively visualized using images and 3D models. With delicate and accurate models in very realistic environment scenery, a high-quality visualization effect can be achieved.

Street furniture is mainly rendered from figures and photos using a simple 3D model. We do not necessarily create each complex 3D model for non-critical areas, and there is not enough memory to display so many 3D models in a common personal computer.

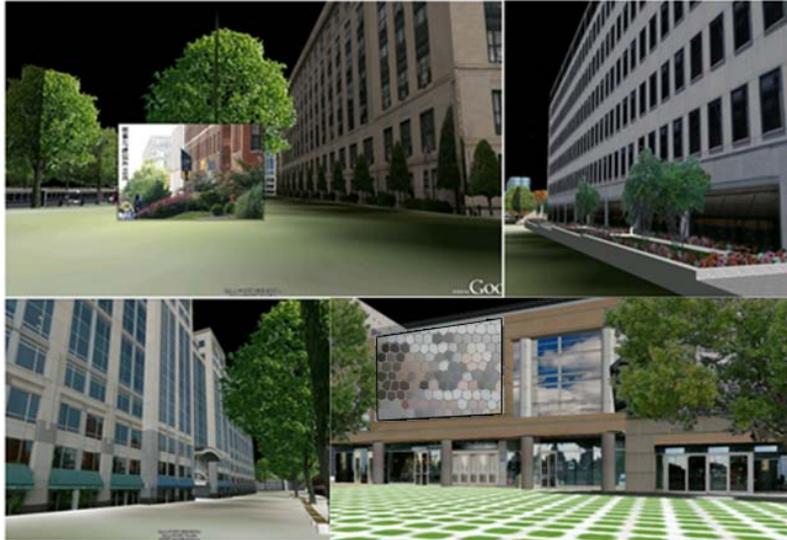


Figure 3-5. Building facade image in Google Earth

From all the works introduced above, the use of Google Earth to express architecture Guidelines is more intuitive than the use of previous formats because it is more suitable to use the 3D model to illustrate architecture. A questionnaire on the architecture guidelines received positive responses from the respondents, as shown in Table 3. The 3D model effect is more vivid than common VR systems because of the correct coordination information and surrounding urban and nature environment of the virtual globe around the planning site, but it is not as realistic as high-quality renderings done using Autodesk 3ds Max software. By using Google Earth, designers can also see whether a building can coordinate well with the city landscape from a wide view instead of considering the building alone.

Table 4-3.Result of Architecture Guideline

Guideline Name	Word	Figure	3D Model	Detailed 3D Model	Advance for Understanding
Building height	●	●	●	◎	very effective
Plot ratio and building coverage	●	●	○	○	very effective
Setback/ property line	◎	●	○	◎	effective
City General impression	○	◎	●	●	very effective
Sky line	◎	◎	●	○	good
Building Types	◎	○	○	●	effective
Architectural style	●	○	○	●	very effective
Public space	◎	●	○	●	effective

Building appendages	●	○	◎	●	very effective
Main section	◎	◎	●	●	very effective

Not be used or Poor results: ○ Normal results: ◎ Good results: ●

3.4 Environment Guidelines

Environment guidelines focus more on regulation details than do the previous two guidelines; the focus is partly on the environmental effects of building material and thermal environmental changes, the wind corridor map, and so on; this makes them complicated to illustrate. The environment guidelines in this study were obtained from the heat island plans from the Japanese Ministry of Environment. In total, 19 heat island technologies that use low-cost technology to effectively reduce the temperature of the urban environment are described. We used 14, which are presented in Table 3-4.

Partial items of environmental effect—3D model, multimedia, and topography map

Used alone, 3D models are not enough for stakeholders to understand all the content of environmental guidelines. Thus, we try to represent them using not only 3D models but also multimedia expression, including cross-section pictures and other illustrations. The complete data are presented in Table 3-5.

As shown in Table 3-4, *green coverage*—the region covered by different colors—has strict restrictions on vegetation coverage. The blue region is 90%, the cyan blue one is 75%, and the green one is 40%. This is an approach to showing the geographic division using a topography map, which is similar to the work we did for traffic guidelines.

As shown in Table 3-4, the flexible application of pictures and 3D models for *river wind/breeze* can help visualize the environmental effect on the planning site. When users double-click the items in the sidebar “My Places” on the left side of Google Earth, Google Earth will skip to its location; users can then read all the detailed information in the photo model with the detailed 3D model. This is the same method we used for the architecture design guidelines. It is also possible to link more pictures to the buildings, street furniture, and ground surface as auxiliary information, as shown in Table 4. This method was used to present the traffic guidelines.

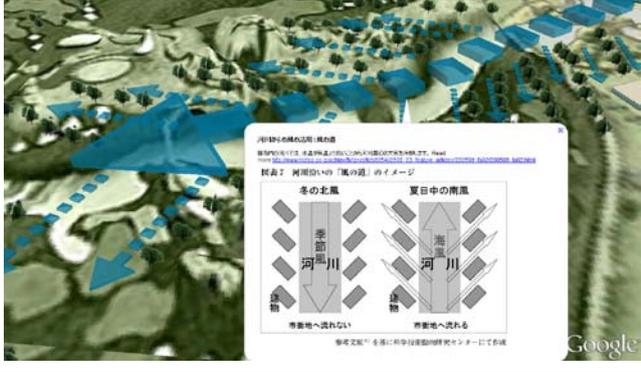
Table3- 5. Environment guidelines in Google Earth

Name	Environment Guideline date efface in Google Earth
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green coverage



River wind/breeze

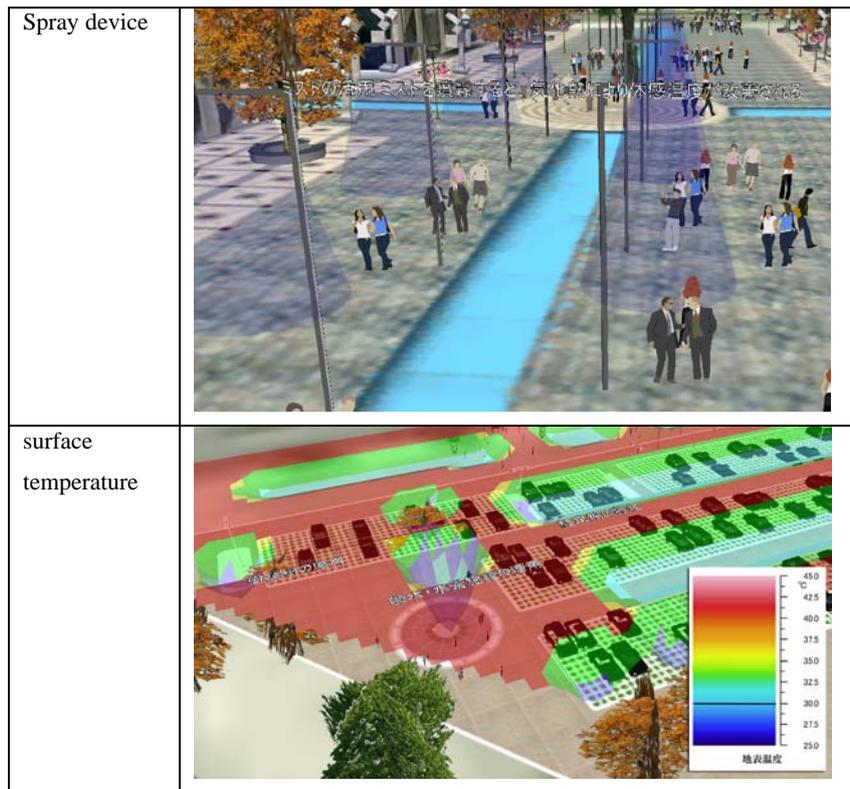


Roof greening



Avoid thermal paving and water retention of Paving





In Table 3-4, *roof greening* is easily visualized by the 3D model and pictures to show the effect of roof plants and solar disruption. It is possible to link the shape of the roof greening and picture of the guideline to explain the roof greening effect. Accordingly, Guideline Nos. 2, 3, 5, and 6 in Table 3-5 are easy to understand and are used in the same way in Google Earth.

However, there are still parts that are difficult to present in a 3D model, such as *avoid thermal paving and water retention of paving* in Table 3-5. For pedestrian streets, designers consider water retention, surface water channels, and *spray devices* for paving in the central part in the street that cannot be covered by trees in order to control the surface temperature to be comfortable for the human body. We created a 3D model of the cross section to show the structure of the pavement, but this alone cannot show people how it works. We think that this is one of the difficult aspects of the guidelines to illustrate in Google Earth. Guideline Nos. 9–14 in Table 3-5 also have similar problems. We added the construction materials in the 3D models of Google Earth to improve user understanding. Although it is technically possible, it is still difficult to locate those 3D models in Google Earth; this will be one of our future study topics.

Thermal environmental change—sandbox

We employed the “sandbox” plug-in to illustrate the less intuitive elements numbers. As shown for the *surface temperature* of the ground in Table 5, different translucent colors were used to display the uneven ground. In this case, the surface temperature was reduced by three countermeasures: grass-planting bricks in the parking lot, spraying water, and tress on the street. The reduction in temperature can be displayed by different colors; meanwhile, the translucent shapes accurately show the positions of different surface temperatures.

From the items in the heat island guidelines, not all of the environment guidelines are suitable for visualization in a 3D model. The results of the questionnaire regarding environment guideline results had quite a few responses of “hardly” effective, as shown in Table 5. However, since all of the text and graphs can be imported into Google Earth, it is possible to integrate all multimedia materials to present the guideline. Compared with conventional formats, Google Earth is more effective at helping stakeholders learn about the environment guidelines by illustrating the planning information in 3D models.

Table3-6. Results of environment guidelines

No.	Guideline name	Word	Figure	3D Model	Detailed 3D Model	Advance for Understanding
1	River wind/breeze	●	●	◎	○	effective
2	Park and garden	●	◎	○	●	very effective
3	Roadside tree	●	◎	○	●	very effective
4	Parking place greening	●	○	○	◎	good
5	Residential Area greening	●	●	◎	●	good
6	roof greening	●	●	○	●	very effective
7	wall greening	●	●	○	●	very effective
8	water spray / waterscape	●	◎	○	●	effective
9	water retention of Paving	●	◎	○	◎	limited
10	water retention of	●	◎	○	○	limited

	Architecture surface					
11	watering	●	●	○	◎	good
12	mist spray	●	○	○	◎	limited
13	Avoid thermal paving	●	◎	○	○	limited
14	High-reflection roof	●	○	○	◎	limited

Not be used or Poor results: ○ Normal results: ◎ Good results: ●

3.5 Conclusions in this Chapter

In this work, we employed Google Earth as a visualization tool to represent planning and design guidelines of an urban planning site in order to improve the presentation of planning alternatives for public understanding and design coordination with stakeholders. This virtual globe-based system favors public understanding through the visualized 3D environment of specific planning projects from any viewpoint, thus facilitate the participation of the planning process. Each individual can zoom in and out freely from the large scale vision to the accurate detail of the modeling at any point of view on his end computer.

In this research, a set of completed urban design guidelines imported most of the data, such as topography, texts, charts, images, and 3D models, into Google Earth. The topographic map, photo mode, and plug-in sandbox functions in Google Earth were utilized to develop the visualization tools for presenting the guidelines. According to our present work, most of the content of urban design guidelines can be imported into Google Earth. Google Earth has extraordinary exhibition capabilities in comparison to previous traditional formats. Using Google Earth to visualize urban design guidelines can surely improve the stakeholders' understanding of this part.

There are additional advantages to using this tool. First, the information can be shown locally by projectors or a touch screen to stakeholders. This method reveals the value of a common VR system. Second, the dataset of urban design guidelines can be uploaded into Google 3D Warehouse so that distant stakeholders can download it anytime and anywhere on the Internet and give feedback or chat by using communication software such as Skype. Third, people around the world can access the guidelines through the Internet as reference materials for urban design in local cities. Although we did not complete the study on a multi-user Web environment, we will focus on Google Earth application programming interface (API) technology in the future. We

hope that in the near future, this completed dataset can be multi-user, interactive, shared, and recorded according to the regulations of WEB 2.0 using the globe background of Google Earth.

Chapter 4 : Cloud-based Virtual Reality

Technology for Design Review in Different Platforms

4.1 Introduction

4.1.1 *Current issues in public comprehension and participation*

Improving the living environment of the city is the main objective of urban planning. Thus all the city planning projects eventually serves the citizens, who are the ones “using” the city, public participation matters significantly to the urban planning, which will become part of the public lives. ([Barton, Plume, 2005](#); [Counsell, 2006](#); [Kingston, Carver, et al, 2000](#)). It has been proven that computer science technology helps to improve the efficiency of public participation since last century. ([Armstrong, 2000](#)). Comprehensive spatial media have been used in researches such as photography, video, text and GIS data in the process of urban planning and design to try to involve more public participation and let the public have a better understanding. ([Matsubara, 1991](#); [Michael, 2001](#)).

In a general way, three major issues were noticed in the procedure of public participation ([Lai, 2011](#)):

Lack of comprehension:

The result of one planning project is normally represented on the paper of two dimensional sketches and pictures. In this way of demonstration the public usually find it difficult to understand the design work for they are not in the environment of the reality. It hard for the non professionals to imagine the concept.

Lack of interactivity:

The design concept or architecture information is usually delivered via the paper material files, which has no interactive participation with the participants. Because of the lack of integrated interaction of corporation, the audience are not understand the plan and the details correctly. They cannot sense themselves inside the environment and view the design or have any to perform towards the design.

Lack of communication:

Large projects of planning have comprehensive analysis and terminology which make the public confused. The stakeholders, especially the first party, may need explanation by professionals from the objective to the detail of the specific design. Even with the help of the 3D presentation software, the public may still do not understand part of the design content. There is the need that put the general public on the same level with the designers to view the design project, or in other words, to develop a better tool for the public to perform the professional tasks.

These three issues always cause communication gaps within the designers, the decision makers, and the public ([Araby, 2004](#)).

4.1.2 *Communication in public participation*

The design concept or architecture information is usually delivered via the paper material files, which usually results in the lack of integration towards necessary information.

Stakeholders from first party ought to review the planning and design work and make the decision, and Stakeholders from the government need to make the policy. It definitely not easy for them to get the big image of the professional information. It takes time and efforts which may delay the planning project or do harm to the final results.

As for the general public, the professionals have to explain to them about the policy and details so that the public participation can start. After all, the designers or policy department of the government requires suggestion and evaluation from the people to improve the future work.

Unfortunately, the traditional communication channel usually costs a lot time with low efficiency because the public do not have the professional knowledge, which leads them misunderstanding the project, in concept or in detail. At the same time, the designers also find it difficult to collect the constructive feedbacks from the general public throughout the process.

To cause less communication gaps, designers need to find out a method to let the public understand the design detail more easily. One of the challenges focuses on how to make a better performance of the visual presentation for the audience ([Kodmany, 1999](#)). With advanced technology representing the necessary information, a simulated three dimensional environment is considered as an perfect solution so far ([Howard, 2007](#)).

With the help of virtual environment, the decision makers can have more specific suggestions from the survey or interactivity in public participation. On the other hand, after the immersive experience in the simulated environment, the public can response their comments more effectively and accurately.

In this channel, the communication towards planning projects between designers and the public is improved significantly. With the visual presentation method of 3D environment, the public have a more precisely understand of the design work and also have a more precisely description of their experiences towards the design details

4.1.3 About cloud computing

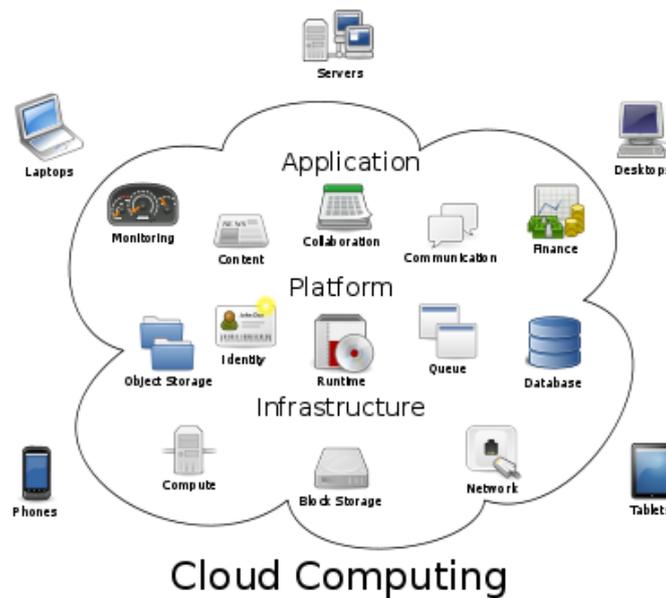


Figure 4-1. The concept of Cloud Computing.

Cloud computing is a definition of expression used by IT Services companies for the delivery of computing requirements as a service to a homogeneous community of end-recipients. Cloud computing also focuses on maximizing the effectiveness of the shared resources. Cloud resources are usually not only shared by multiple users but are also dynamically reallocated per demand. This can work for allocating resources to users.

Cloud based applications could be used by the end-recipients when the data and files are uploaded on the web servers in the independent geographical isolation through a web browser or just the mobile apps. The application developers of cloud computing try to provide the same performance and right of control wherever the installation happens even if it on the personal local computer.

There are three main types of cloud computing services normally, as following:

Infrastructure as a Service (IaaS): thought out this mode, a computer infrastructure can be fully controlled within long distance. Pools of hypervisors within the cloud operational support-system can support large numbers of virtual machines and the ability to scale services up and down according to customers' varying requirements.; IaaS clouds often offer additional resources such as a virtual-machine disk image library, raw block storage, and file or object storage, firewalls, load balancers, IP addresses, virtual local area networks (VLANs), and software bundles.

Platform as a Service (PaaS): In the PaaS models, cloud providers deliver a computing platform, typically including operating system, programming language execution environment, database, and web server. Application developers can develop and run their software solutions on a cloud platform without the cost and complexity of buying and managing the underlying hardware and software layers. With some PaaS offers like Microsoft Azure and Google App Engine, the underlying computer and storage resources scale automatically to match application demand so that the cloud user does not have to allocate resources manually.

Software as a Service (SaaS): In the business model using software as a service (SaaS), users are provided access to application software and databases. Cloud providers manage the infrastructure and platforms that run the applications. SaaS is sometimes referred to as "on-demand software" and is usually priced on a pay-per-use basis. SaaS providers generally price applications using a subscription fee. This type provides multi-functional application including productivity applications and programs, software.

Here is a hypothetical example in illustrating the types of clouding computing and how they are utilized. A university with IT infrastructures serves the different groups of people: students, teachers, and management/research staff and software developers. The requirement for the IT infrastructures from the IT Services Department must fulfill the following job descriptions:

- a. Supply the students and the staffs software (e.g., operating systems, applications of different majors, email accounts, etc.) and hardware (e.g., computers, hard disc, etc.).
- b. Supply the required relevant software& hardware for researchers and postgraduate students to do experiments which may including the processing, calculation and computation.

3. Supply software developers with the tools needed to frame and set up web servers of applications.



Figure 4-2. Explanation of the users of IT services

Within this situation, many pattern related to cloud technical can be described as follows. For instance, students, staffs can be addressed to operate the services of SaaS and IaaS. The two types of servers are well performed via the independent users.

All the software once used on the servers of the SaaS by these people simultaneously accessed on the internet. Tasks or requirements for the hardware or a virtual Server is operated and monitored by the IaaS cloud provider online.

The same pattern attributes the developers' scenario in this similar condition. All the developers have the right to operate the needed software for the online development and maintenance. At the same time, the hardware for maintain their applications of development go through a PaaS cloud controller.

Eventually, once the big project calls for the additional server capacity in a great amount, the researchers who use it can through an IaaS cloud controller to obtain the resources of processing meanwhile do not need to take the others online operational internal memory.

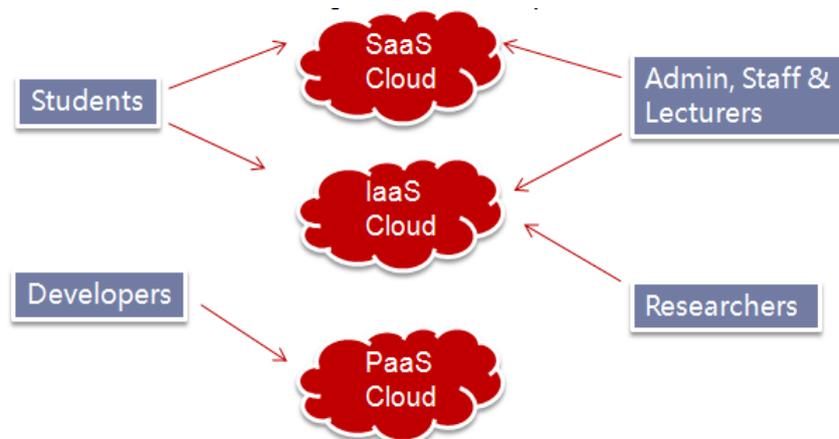


Figure 4-3. Explanation of the users of IT services with cloud computing

The simplification and convenience of the services computers has brought to the world are nowadays more related to the high efficacy of cloud computing ([Erdogmus, 2009](#)). Free the IT services organization from the high cost of maintenance and install

the applications locally to the end user personal computer instead seems a potential economic solution ([Leavitt, 2009](#)). The thought of the methods that lower the pressure of the mother server and separate the resources can surely be employed in other research field.

Back to the urban planning process, if clouding computing can be involved as tools for public participation, it could largely enhance the capacity of the online servers' information, as well as the end users uploaded data, if possible. Web-based visualization tools has matured however the cloud computing served as a tool in planning process for public participation is not so common, there are several attempts of researches and we believe it will have great influence on this field.

4.1.4 *Review of Cloud computing for Design Coordination and communication*

There are still deficiencies need to make steps forward:

Although the web-based software provides users a synchronized 3d environment, but the complex integration of functions require users download pieces of components (eg, modeling) to have the more concrete visualization effect, making them need even more time to get familiar with the interface or individual function, which have hardly been changed by the insufficient bandwidth.

Also, virtual global widely support other plug-in, which shows diverse flexibility, but undoubtedly separates the functions to users, specially for the nonprofessional background users, lowering the ability of controlling the process.

Public get better comprehension with the synchronized 3d environment and the alternative choices, however still not easy to make alternative themselves but to give the suggestions in text. Thanks to the large amount of 3d modeling, it is not smoothly for the public to experience the virtual environment in end servers, at least which are limited. Thus it limits the other methods of possibilities in simulations, presentations and experience.

4.2 Research Approach

We used SAAS (Software as a Service) to facilitate the procedure of the pedestrian bridge design in Shibuya, Japan, also in communication on design evaluation, sharing design concept to each other designers and reached a consensus.

We compare cloud computing SAAS with the different platform of VR cloud tools to present in which parts and how the cloud computing could enhance during the design process.

In our study, we made the comprehensive evaluation of the features of the three platforms. In the aspect of planning support using virtual reality, 3DVIA is one kind of platform that is based on http-based cloud server, while Google Earth and VR-Cloud are specified platforms for users to share the digital virtual globe or virtual reality.

4.3 A Case study: Concept design of Pedestrian Bridge "The OASIS-symbol of Shibuya in 2012"

The location of the design on the roads around Miya Masuzaka intersection of Shibuya Station, Tokyo, to plan at the center a pedestrian bridge that was called OASIS. The name of the plan is "The OASIS-symbol of Shibuya in 2012" (hereinafter referred to simply as pedestrian bridge OASIS). This concept design, on the basis of the "Shibuya city planning master plan 2000(渋谷区都市計画マスタープラン 2000)", shows the master plan contents to achieve in the field of urban development in the future city image of Shibuya basic concept, completes the plan of 2012 foot-bridge road environment plan that exhibit urban road environment. The proposed plan OASIS, I suggest to improve the environment and transportation of the Masuzaka intersection. So, to organize the contents under the basic plan and town planning policy goal that was filled out in the master plan.

Development goal	Basic policy	The contents of the draft plan
Development of sub-center vibrant originating the living culture	enhance transport node functions and to form a space for communication and gathering	General road design
		People/car flow separation
		Doorway of the adjacent building
	a region full of character and charm	Appearance of the pedestrian bridge
		The material of the bridge
Development of close living space	make a place for public communication	Exchange space as a set point
		Installed in front of the station park
Formation of environment-friendly people	The elder people and people with disabilities	Installation of an elevator
		Ramp with stairs
	Community development in harmony with the environment	Utilization of wood
		Use of new materials
		solar power

Development of rich green space	make use of the resources of water and green, to promote the networking	Greening the park, the roadside tree
		Greening of flower beds
		Use of fountain water
Formation of a strong Disaster prevention	the beautiful scenery and the town that considers the characteristics of the city terrain	Slope of the pedestrian bridge that combined the terrain
		The view around bridge construction
		General pedestrian bridge
	fix the roads and transportation network with the foundation of disaster prevention	3D Bar arrangement
		Seismic simulation

Table4-1. The content table of plan OASIS

The challenge of the pedestrian bridge three functions: *the concept of pedestrian bridge, the road, the roadside environment*. Here shows in the following table visualization content by functions of OASIS.

Functions	Visualization content of pedestrian bridge environment
The concept of pedestrian bridge	
The road	

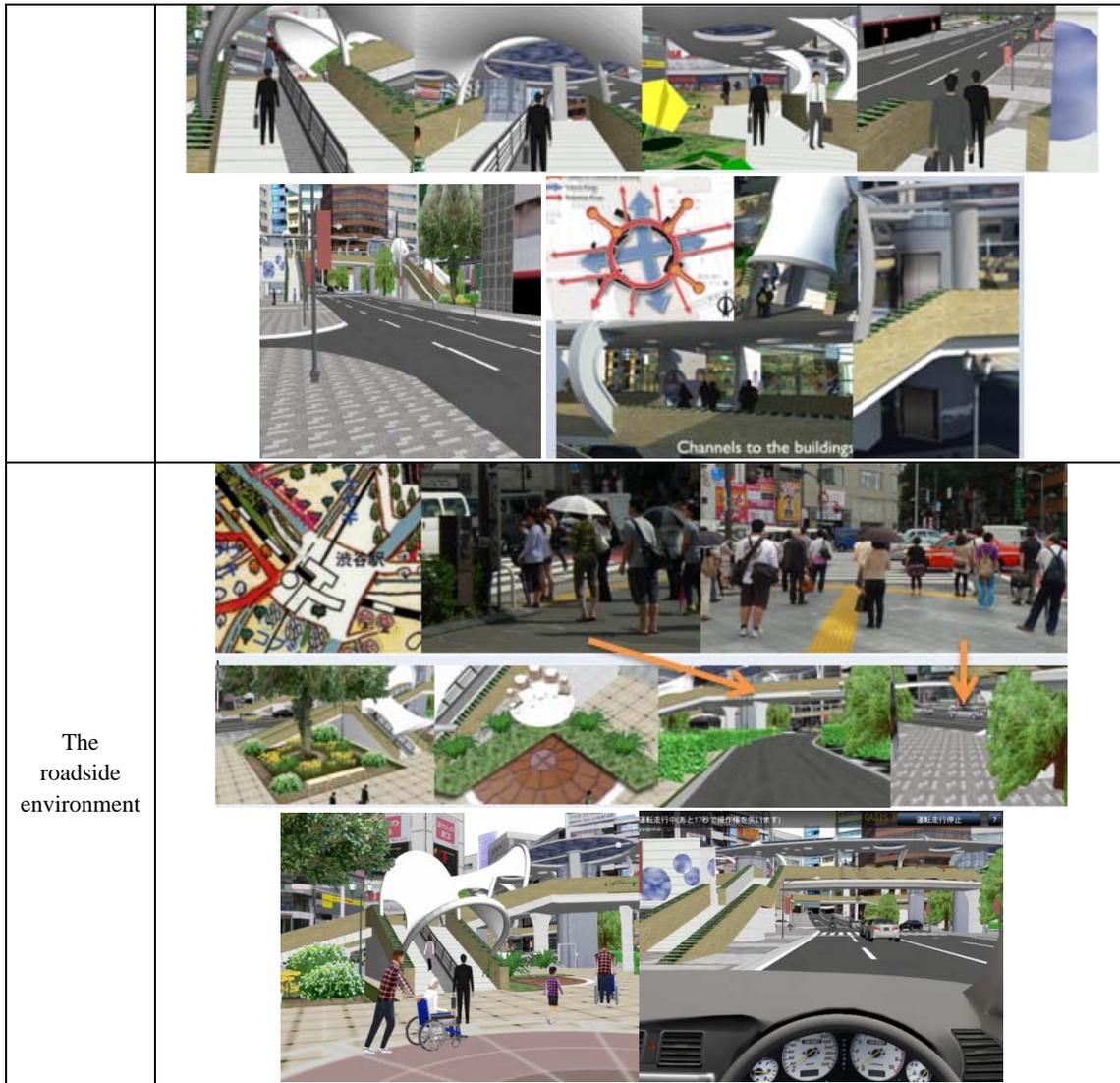


Table4-2. The content of the system

From the citizen participation process, opinion exchanges in the following five aspects: "operability of the system to the citizen", "available space of the system", "the use of time period of the system", "use of low-performance client of the system", "citizen opinions communication".



Figure4-4. Walking experience and traveling experience of navigating

It was set up as shown in the figure below the root of the perspective. Or in places that reflect the concept of the draft plan, and at the plan selection reason, by the special point. When introducing the plan, the guide of the view stops at important points. It is possible to see the contents in detail. Is set as shown in the following route camera.

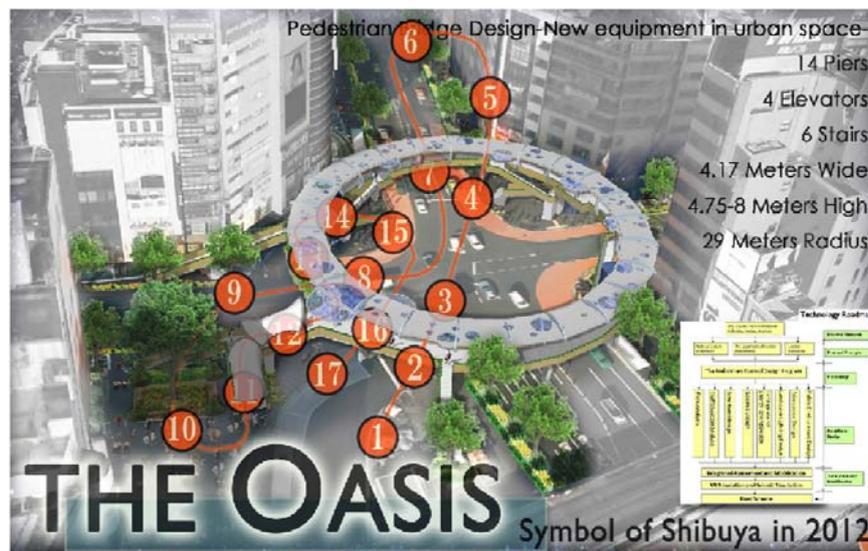


Figure4-5. the order of the fully automatic experience

Numbers 1-17 in the diagram 4-3-4-2 above is referred to as the automatic guidance point of 17 pieces. As shown in the following figure, we set respond to the contents of the plan OASIS specific contents of automatic guidance point of these.

- Comprehensive background of plan OASIS
- ①General Information of the entire design proposal
- ②Siting Study

- ③ Around Building Introduction
- ④ Basic Introduction of the Entire Bridge
- ⑤ Road Surface Gradient
- Environment
- ⑥ Installation of Station park
- ⑦ Placement of Street Trees
- ⑧ Use of Material for the Environment
- Structure
- ⑨ Crossing Time Simulation
- ⑩ Structure of the General
- ⑪ Special Facility
- ⑫ Special Facility II
- Eco-design
- ⑬ A comfortable Seating
- ⑭ Use of Wood
- ⑮ Use of Tension Membrane and ETFE
- ⑯ Solar Power and Lighting
- ⑰ Simulation of Shadow

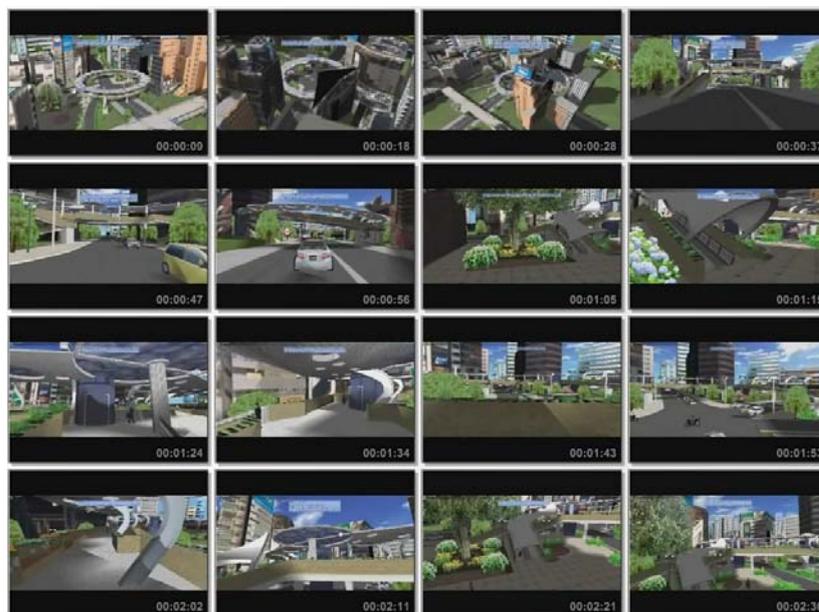


Figure4-6. Snapshot of a fully automatic experience

The fully automatic experience function, it is possible to guide the plan all automatically, the system can perform description more effective. After the "auto experience"

complete, it is also "free experience" as in the prior art in the virtual space, where there is interest was seen to jump into the place and there is a problem, it can be submitted within the OASIS specific problems. Also, get a waiver of the operation right is freedom, toggle between "free experience" and "Auto experience" is simple, it is possible to stop any automatic experience in the back of the building, it seems that even jump inside.

4.4 Coordination and Communication Using Cloud-Based Virtual Reality System

4.4.1 *Design Coordination Using Cloud-Based Virtual Reality System*

First we employed a file sharing platform and data display platform using VR Cloud, Google Earth and the matched software, which let the designers' concept can rapidly show to other designers;

Second coordinate each other designers by cloud communication software. multiuser video chat tool and Remote control tool by MSN,QQ to be used in same time and different place condition; voice chatting app with photo and video sharing by micro BBS tool in message group could be used in different time and different place condition. So that the detail of the Pedestrian Bridge Design would Combining the Design concept of several people. Therefore, this method may achieve consensus on pedestrian bridge design or another architecture design and aid the design review process.

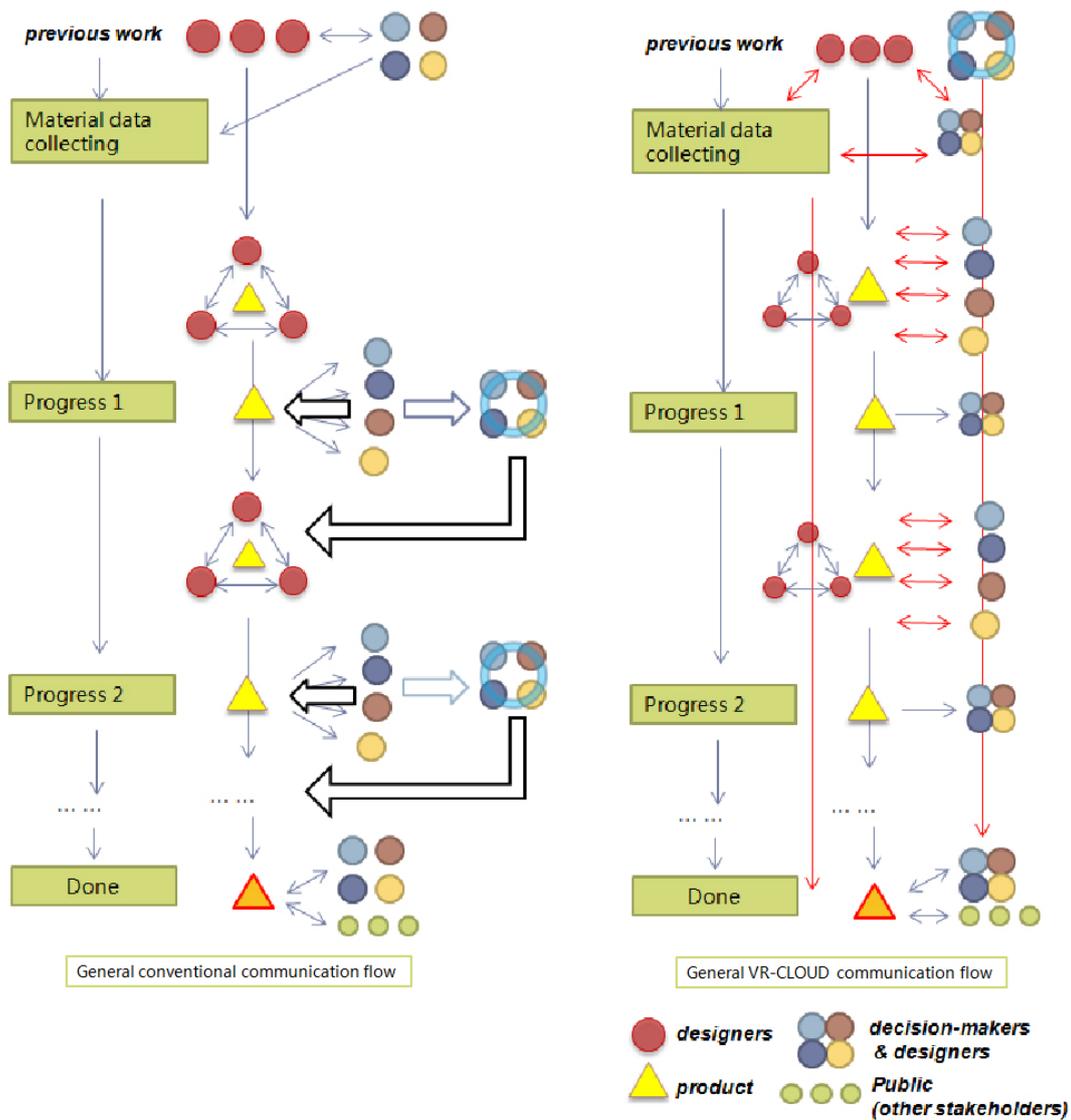


Figure4-7. Comparison conventional communication flow and VR-CLOUD communication flow

4.4.2 Public participation Using Cloud-Based Virtual Reality System

Except the virtual reality experience we mentioned in chapter3, we summarized the advantages of Cloud-Based Virtual Reality System for understanding and evaluation with non-professionals as following:

1. Friendly user interface
2. View the animation scheduled by designers on VR-cloud
3. Get the authority of ways to zoom & view around
4. Various interactive VR space, such as a riding or driving simulation, is offered.
5. Synchronusness of modifying for everyone



Figure4-8.4-9. VR-CLOUD friendly interface



Figure4-10. VR-CLOUD driving simulation



Figure4-11. VR-CLOUD traffic volume simulation

4.5 Comparison on Three SAAS Platforms

We use 3 tools on Communicating and evaluating. In each tool, One cloud communication software would be used in contacting designers and target users; one cloud VR or 3D GIS software respectively to the target users to show our design concepts, which named:

1. VR-Cloud v2.0, the matched software are UC-win Road Ver.5.02.03 and BIM software Allplan 2011.

2. Google Earth Version 6, the matched software are Google Sketch Up 8 and Google 3Dwarehouse.

3. 3DVIA, the matched software is 3DVIA player.

Then we put production completed Pedestrian Bridge Design into the three software. We compared the advantages and also the disadvantages of the three platforms, and analysis what kind of people they suitable, for decision maker, or professor, or general public.

VR-Cloud



Figure4-12. Bridge Design in VR Cloud v2.0

VR-Cloud v2.0 is Using Cloud servers provide VR Cloud clients. In the authenticity and navigation of the two indexes, VR-cloud got high score, and enough represent pedestrian bridge details in moldering and structure simulation. Because of Due to the charge for production, and not a very good support avatar tool, We outline VR-Cloud cannot do better than others in the general public.

Google Earth



Figure4-13. Bridge Design in Google Earth V6

Free 3D GIS software, have Virtual Global data base and supporting by Sketch Up. Lack of supporting in action, movement and environment change than VR Cloud. And only supporting in representing existing or past model in Google Earth. We outline VR-Cloud cannot do better than others in the general public.

3DVIA



Figure4-14. Interior Design Interface In 3DVIA

Free web VR data website. Have their own avatar system and own BBS or chat tool. And can easily gather general public because it has a very good relationship with social networks as Facebook. However, 3DVIA was a web site features. It weak in large date representation and navigation function needs to be developed.

Table4-3. Detailed Comparison Results between three SAAS platforms

	VR Cloud (In KU)	Google Earth	3DVIA
<i>Sever side</i>			
VR Sever	Application server	Application	Http-based application server
Server management	Standalone (Specified IP address)	Cloud server	Cloud server
<i>VR Database</i>			
Dataset	KMZ created in SketchUp	KMZ created in SketchUp	KMZ created in SketchUp
VR objects	Prepared and imported	Prepared and imported Possible to use online data warehouse	Composed on-line using 3DVIA tool and possible to use online data warehouse
VR data editing	Impossible	Impossible	Direction, position and scale
Design alternatives	Prepared	Prepared	Possible for user to adjust
Data range	Planning site only	Global	Planning site only
Surrounding data	No	3D warehouse	3D warehouse
<i>Functions of the VR server</i>			
VR Navigation	Predefined and freely walkthrough	Freely walkthrough	Predefined and freely walkthrough
Communication	No (QQ)	No (QQ)	Chat
Avatars	Car and person can move based on predefined scenarios	No	Avatars on behalf of real users
Sound Environ.	Car noise	No	No
<i>Total evaluation</i>			
SaaS	VR representation and simulation.	VR representation	VR representation and communication with avatars
System Developer	Difficult	Easy	Easy
Planer	Comprehensive	Simple	Middle

4.6 Conclusion in this Chapter

In our study We consider the comprehensive evaluation of the feature of the three software, We can know that in the present by the technical support of Cloud Computing, a whole set of pedestrian bridge design can be completed by several designers in different time and different place condition.

Compare those 3 SAAS, we can know that VR Cloud can make much better coordination between designers, and also can make much better communication between designer and administrative staff. Using Google Earth, the communication between designers in more convenient change the design data as well as which has worldwide Virtual Global date. 3Dvia make the communication between ordinary people become more real and make the gathering of information become simpler. The contact

with social networks can make which has more advantage on gathering of ordinary people.

Finally we conclude results obtained so far, that during making the valuate of decision maker(DM) ,the advantage of software is VR Cloud > Google Earth > 3Dvia,while Google Earth > VR Cloud > 3Dvia during the professor(P), and 3Dvia > VR Cloud > Google Earth during the general public(GP).

Table4-4. Evaluation Result

Evaluation result				1	Outstanding
	DM	P	GP	2	Definitely effective
VR Cloud	2	3	3	3	Probably effective
Google Earth	3	2	3	4	Marginally effective
3DVIA	4	3	1	5	ineffectiveness

By much simplifying the operation of processes, Cloud computing lower the threshold for public comprehension and participation in urban planning. The components are scheduled on PaaS and SaaS so that the user interface and functions could be much friendly and less complicated.

With sufficient bandwidth and capacity of Cloud computing in virtual reality system, there is a leap in the following aspects: On the one hand, the high efficiency of operation and communication without any delay, makes Instant design coordination possible, also more accurately with highly display models. On the other hand, with the smoothly Presentation of the project, many different way of design performances and public participation which could not manage to employ before, now are available.

Chapter 5 : Conclusion

This PhD research targets to the communication between the designers and the stakeholders during the process of urban planning, by using cloud-based virtual reality technology for representing design guideline especially for urban residential environment.

With the using of 3d model to present the guideline, the concern of Chapter 2 is to design towards the development of critical construction processes in residential environmental design for developing affordable and sustainable housing scheme. It is well known in China the difficulty in ownership of housing especially for middle-low income category. Thus, this research is useful to help government housing department in determining which element that can help in reducing the price of new houses meanwhile keeping an acceptable quality for the stakeholders. Furthermore, green element if being introduced, may give significant effect in long run of life span and life cycle of the environment.

Then we targeted representative urban design guidelines to enhance public understanding. In Chapter 3 we employed Google Earth as a visualization tool to represent planning and design guidelines of an urban planning site in order to improve the presentation of planning alternatives for public understanding and design coordination with stakeholders. This virtual globe-based system favors public understanding through the visualized 3D environment of specific planning projects from any viewpoint, thus facilitate the participation of the planning process. We summarized different results of the performance of representing different design guides and the advantages.

In this research, a set of completed urban design guidelines imported most of the data, such as topography, texts, charts, images, and 3D models, into Google Earth. The topographic map, photo mode, and plug-in sandbox functions in Google Earth were utilized to develop the visualization tools for presenting the guidelines. According to our present work, most of the content of urban design guidelines can be imported into Google Earth. Google Earth has extraordinary exhibition capabilities in comparison to previous traditional formats. Using Google Earth to visualize urban design guidelines can surely improve the stakeholders' understanding of this part.

After that, we use the example of Shibuya bridge concept design to summarize the advantages how the virtual reality technology do favors to represent urban design guideline. By much simplifying the operation of processes, Cloud computing lower the threshold for public comprehension and participation in urban planning. The components are scheduled on PaaS and SaaS so that the user interface and functions could be much friendly and less complicated.

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We compare cloud computing SAAS with the different platform of VR cloud tools to present in which parts and how the cloud computing could enhance during the design process. We made the comprehensive evaluation of the features of the three platforms. In the aspect of planning support using virtual reality, 3DVIA is one kind of platform that is based on http-based cloud server, while Google Earth and VR-Cloud are specified platforms for users to share the digital virtual globe or virtual reality.

This paper using Cloud computing technology to design coordination method are gradually replacing the workshop design work. However, we use existing software (SAAS) complete cloud design coordination. In further work, we would complete a platform using programming. To realize a more effective communication and evaluation, we try to use game engine Unity to build Cloud architecture. In further work, we would try more methods and discuss those possibilities in evaluation.

Publications:

Zhenjiang, S. and Xuefei, L. (2013). “Cloud Computing in Virtual Reality System as a Tool Enhancing Design Coordination and Public Participation in Urban Design: a case study of the concept design of pedestrian bridge in Shibuya”, *The Proceeding of Workshop on Urban Planning and Management; “Low Carbon City in Chinese Cities”*, Spatial Planning and Sustainable Development, Kanazawa, pp. 173-197, Feb.18-20, 2013, ISSN: 2013.2.18-20.

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Appendix:

A. Low-renting House Environment Design Concept (in Chinese)

極簡主義下的舒適空間架構研究

——保障型佳房屋住區景觀環境構建研究

中國城市住房現狀

我國當前正處於經濟飛速發展的時期，經濟的騰飛帶動了房地產業的高速增長。同時，住房問題卻越來越成為了每個城鎮居民最關切的問題之一。飛速攀升的房價，大量的向居住宅與無償提供公共工作無助的窮人形成了鮮明的對比。

“居者有其屋”的古訓提出了對社會公平性的要求，而且房屋不僅是一個居所的消費品，也是每個人生活所必須依賴的必需品。因此每個城鎮居民的住房問題是政府必須面對的重要問題——保障型住房就是從這樣的背景產生的。

然而無論是國家綠色建築標識還是各省市的保障型住房條例，都沒有對環境設計提出高規格的要求。因此本論文就是從建築以外的環境構建和環境設計入手，配合國家政策，研究保障型住房居住區的景觀設計，旨在為社會的每個保障型居民的居住環境提升提供一定的參考。

MINIMALISM 極簡主義的詮釋

極簡主義是一種設計風格，適宜上與的裝飾，品味和思想上更為簡樸。這並不僅僅是對於極簡主義含義的延伸，最後還于文字上的極簡主義，主要表現為（文字）的簡約性，以平鋪直敘的方式，減少華麗的詞藻，讓讀者主動參與內容成為文本角色，避免作者的主導對讀者閱讀時出現的阻礙。

保障型住房因其經濟成本極為有限，因此在極簡的設計手段中尋求豐富而舒適的功能空間，以期從生理和心理兩方面來提高保障型住房居住區的居住體驗。

保障型住房簡介

保障型住房，是與商品性住房（商業商品）相對應的一個概念。保障型住房是指政府為中低收入住房困難家庭所提供的限定標準、限定價格或租金的住房。在中國，“保障型住房”包含多種住房類型，它是提供給符合地方政府所制定標準（收入、總資產、婚姻狀況和目前生活條件等）的居民的一種社會保障形式。全國各地市政府目前所擁有的對象收入與支付水平，設立了公共租賃房、廉租房、經濟適用房和兩限商品房的保障型住房，各城市自行制定保障型住房標準。

保障型佳房屋住區調研分析

區域分析	現狀	優劣分析	結論
佳區簡介	<p>選址位於天津市中心區天津中心區，交通便利，生活便利，位於天津市中心區，交通便利，生活便利。</p>	<p>佔地太多，交通不便，因此沒有更好的發展前景。</p>	<p>選址位於天津市中心區，交通便利，生活便利。</p>
道路交通	<p>兩環線天津路第一、二、三、四、五、六、七、八、九、十、十一、十二、十三、十四、十五、十六、十七、十八、十九、二十、二十一、二十二、二十三、二十四、二十五、二十六、二十七、二十八、二十九、三十、三十一、三十二、三十三、三十四、三十五、三十六、三十七、三十八、三十九、四十、四十一、四十二、四十三、四十四、四十五、四十六、四十七、四十八、四十九、五十、五十一、五十二、五十三、五十四、五十五、五十六、五十七、五十八、五十九、六十、六十一、六十二、六十三、六十四、六十五、六十六、六十七、六十八、六十九、七十、七十一、七十二、七十三、七十四、七十五、七十六、七十七、七十八、七十九、八十、八十一、八十二、八十三、八十四、八十五、八十六、八十七、八十八、八十九、九十、九十一、九十二、九十三、九十四、九十五、九十六、九十七、九十八、九十九、一百。</p>	<p>保障型住房由於其低價廉售的目的，多集中在城市邊緣，因此多不會設有一個相對交通樞紐的車站。</p>	<p>應加強交通。</p>
綠化景觀	<p>由於市區地勢平坦，加之人口密度大，因此市內綠化率較低，綠化率較低，綠化率較低。</p>	<p>綠化率低，綠化率較低。</p>	<p>在綠化設計中應加強綠化率，加強綠化率，加強綠化率。</p>
空間特性	<p>選址位於天津市中心區，交通便利，生活便利。</p>	<p>大尺度的開發，大尺度的開發。</p>	<p>在設計規劃中應加強空間利用，加強空間利用，加強空間利用。</p>
殘障設施	<p>在選址中應加強殘障設施，加強殘障設施。</p>	<p>殘障設施不完善。</p>	<p>在設計規劃中應加強殘障設施，加強殘障設施。</p>
文化歸屬	<p>選址位於天津市中心區，交通便利，生活便利。</p>	<p>缺乏文化歸屬感。</p>	<p>在具體設計中應加強文化歸屬感，加強文化歸屬感。</p>

保障型住房問題解析

年齡結構

以老齡（或高齡）等行動能力的群體為主要對象，同時以健康成年人占的比重要超過45%，則由於工作在外，對居住環境的使用率會比較低，因此設計中必須對此類群體予以照顧。

維護管理

即使不考慮以老齡者，由於保障型住房大多沒有完善的物業，因此很多小問題日積月累，居住環境變差導致發展。

交通工具

由於社區內居民收入較低，因此機動車的投資與成本都不考慮，加之社區內老人孩子的行走穩定性和行動力都較弱，因此必須通過道路建設保障安全。

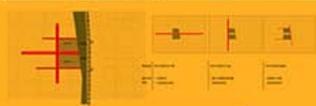
鄰裡交流

所有居住區建造都要關注的重點，如何關注此類群體的心理感受，創造人與人和諧的居住環境。

Affordable Housing Residential Environment Design

設計項目背景

项目的地址位于北京市朝阳区，项目总用地面积为168877平方米，项目的定位为保障性住房，包括普通、公寓、经济、限价四种类型，并争创绿色建筑三星标识项目定位为保障房项目标杆项目，要求打造高品质的保障性小区。



景觀構思生成

MAKE A CHANGE

景观策略

策略名称	策略内容
生态策略	生态基底+优质环境
人文策略	人文关怀+社区生活

MAKE A CHANGE

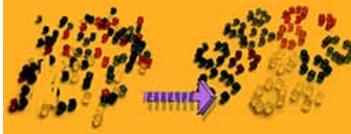
景观策略

- “生态策略” 生态基底+优质环境
- “人文策略” 人文关怀+社区生活

客厅里的大花园

景观策略

基础设计要素	MAKE A CHANGE	创新设计要素
绿化种植		生态基底
道路交通		复合街区
空间组织		建筑肌理
基础设施		人文关怀
防护绿带		周边森林



設計總平面圖



地块东侧即地铁与铁路之间为一直城市绿化带，在设计中考虑了本项目景观设计与城市绿化带之间的互相影响及利用，设置社区活动广场，扩大活动空间，为居民平时休闲、健身活动提供便利条件。充分考虑各个年龄阶段的需要，公共开放的活动空间与相对独立的私密绿化相结合。设计中结合绿色评估标准对景观设计的要求，加速水网，人行道路网等。

本项目为保障性住房，按照建设单位及规划院的要求，按照小区规划为功能充分利用周边可利用的自然环境，又能减少周边不利因素（如地铁铁路的噪音）对住宅小区环境的影响，不仅要满足居民平时的活动休闲还要通过景观设计来提升整个小区的品质。

住区景观节点分析



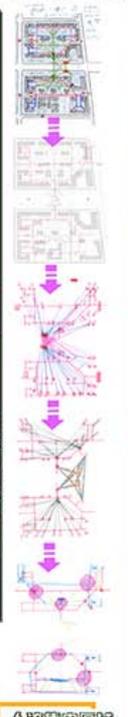
- 入口景观
- 景观主轴
- 景观中心
- 主要节点
- 次要节点
- 景观组团
- 商业景观
- 景观小化

景观功能区域分析



- 可游憩区域
- 观赏景观带
- 步行道景观
- 游憩景观
- 玩耍区域
- 健身区域

住区交通结构



人流组织图



鳥瞰效果



路网分析



功能分区



- 小学幼儿园
- 住区内部
- 景观绿地
- 外围商业街
- 商业广场
- 防护绿带



HELP!

Affordable Housing Residential Environment Design

2

● 停留空间
● 游赏空间
● 道路系统

首功能功能空间有秩序地设计并组合，一次实现多功能，低成本，高质量。

景观构成说明

由上到下的道路系统优化

HELP!

Affordable Housing Residential Environment Design

3

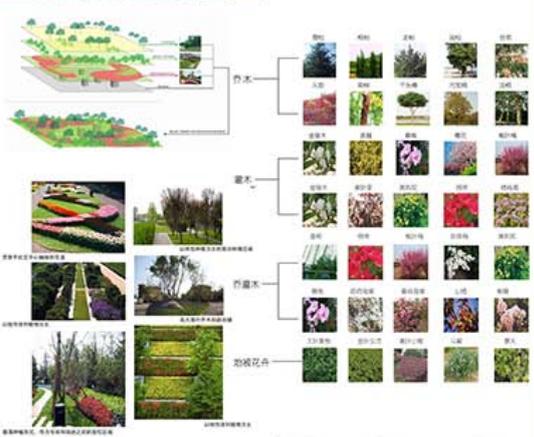
節點細化設計



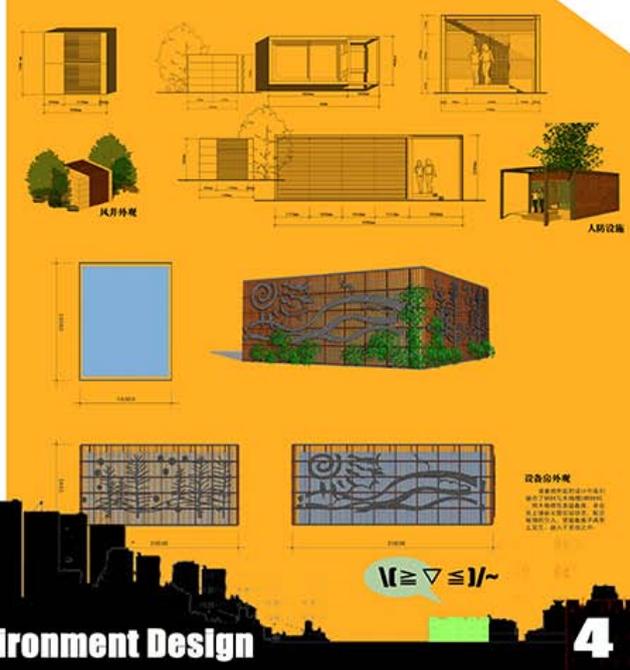
場景效果表現



植物造景配置



功能用房外形設計



B. The Concept Design of OASIS

Virtual Design World Cup THE 1ST STUDENT BIM & VR DESIGN CONTEST Theme2011 "SHIBUYA Bridge"

Pedestrian Bridge Design-New equipment in urban space

14 Piers
4 Elevators
6 Stairs
4.17 Meters Wide
4.75-8 Meters High
29 Meters Radius

THE OASIS

Symbol of Shibuya in 2012

Location Decision Area B (Miyamasuzakashita Crossroads)

- The build-up of the Hikaria high-rise building will effect the volume of visitors flow of Shibuya moving towards to the east, which has a direct impact to Miyamasuzaka, besides the East Entrance of Shibuya Station has had a pedestrian overpassing already.
- So for the differential of the amount of traffic from downtown and north-south to Miyamasuzaka is about 3 times, and traffic jams are easily caused. If the vehicles and pedestrians can be mutually independent, the pressure of traffic could be dramatically eased.
- Miyamasuzaka, which has plenty of young sunlight with no high-rise building in the south and very limited amount of trees, is very appropriate to operate ecological and environmental improvement or reconstruction, and realize the energy conservation and reduce the heat island effect.

Design Concept

- The consummate shape "O", which does not include sharp edges, has the intimacy to natural environment and flexible use of space. Also, "O" stands for "OASIS".
- The intersection of this area B is irregular crossroads without vertical crossing. The pedestrian crossing in the south is 22 meters long while the three other pedestrian crossings are only 8 to 12 meters long. There is also an additional path in the southwest.
- The ring shape could provide a better connection towards to the irregular surroundings.
- The Miyamasuzaka area is crowded and narrow, the ring shape has a good approach to the surrounding buildings. Several channels could be designed, accessing to the interior of commercial building directly.

Traffic Division

1 Traffic volume data in OASIS (Timing)
From 6:30 to 7:00am (working hour), from 8:45 to 10:00am (working hour)

2 The prediction of traffic volume can be calculated basally as 600hr (E & W) and 1500hr (N & S). And traffic jams occur frequently from about 10 o'clock, some of the vehicles have to wait 2 turns to drive through. The delay gets much worse when the pedestrian involved occupies the green-light time for vehicles.

3 For the pedestrian, from Shibuya Station to another side, the OASIS provides a half-meter distance on floor, which simulated in the UC-WinRoad, reducing about 50% time compared with before.

Sectorization

- The 4 channels on the bridge connect the bridge to the interior of the 2nd floor of commercial buildings, which provide people more convenience to the stores of individual destination, also could distribute the pedestrian flow dramatically.
- balconies set upon the bridge are especially designed without seats in order to let the pedestrians not to stay for long, or they could choose to rest on the green bench seats. The balconies have several functions: 1. waiting & gathering; 2. relieve the pedestrian flow pressure of other areas; 3. Sightseeing.

Functional Area

- 4 individual elevators to cases in 4 directions to facilitate the old and the inconvenient people.
- There is a height difference of 2.18 meters in this intersection from East to West. A guide slope is designed to cushion it, and facilitates the pedestrian route.

Eco-design

Wooden Parapet & Green Bench Seat

- Low carbon and ecological materials are widely used to make people feel closed to nature. Wooden grids which appears in outer green wall could increase the permeability to sunshine, also increase the stability of rattan plants. The wood materials in use is installed between the deck and the roof of the bridge in case of fire.
- Comfortable seats are provided just next to the parapet. The scale of seat and parapet listed on the right strictly complies with ergonomics.
- Three kinds of behaviour systems as walk, short-time stay, long-time rest are coordinated on this passerage foot-bridge.

Tensioned Membrane

- ETFE (ethylene-tetrafluoroethylene), a lightweight new material with effective thermal properties and transmission of light, is used as the outer roof of the bridge. ETFE can adjust the closed or half-closed environment with winter heat preservation and summer heat dissipation.
- ETFE has the features of high resistance to stain and fire. Usually the membrane can eliminate the main dirt with rainfall, which almost needs' daily maintenance.
- The characteristics of lightweight and fire resistance make it a considerable advantage even in the situation of earthquake in Shibuya.

Environmental Design

- Shibuya, especially the JR Station, is lack of green area as the aerial view shows(right). Surrounded by intensive commercial buildings, this place calls for more fresh air and leisure space. The OASIS could be an essential acupuncture needle healing this area.
- Side road trees are set to absorb carbon dioxide and ease the visual pressure of tall buildings. More plants are provided in this scheme.
- A garden is created here to make people passing by pleasant and staying comfortable, increasing the intimacy to natural environment and flexible use of public space.

Seismic Design & Simulation

The piers is designed in UC-1 Series Pier Design (data files submitted), then import to Alipais to check up if any distributed steel error. After being the distributed steel (data files submitted), the corresponding structure of the bridge body was imported in UC-frame 3D for the earthquake simulation, whose data was the Great Houshin Earthquake in 1995. The Simulation results is shown as lower right corner, with 4 components only slightly damaged and 4 microcracks.

Seismic Simulation Result in UC-win/Frame 3D

Solar Power Illumination Simulation

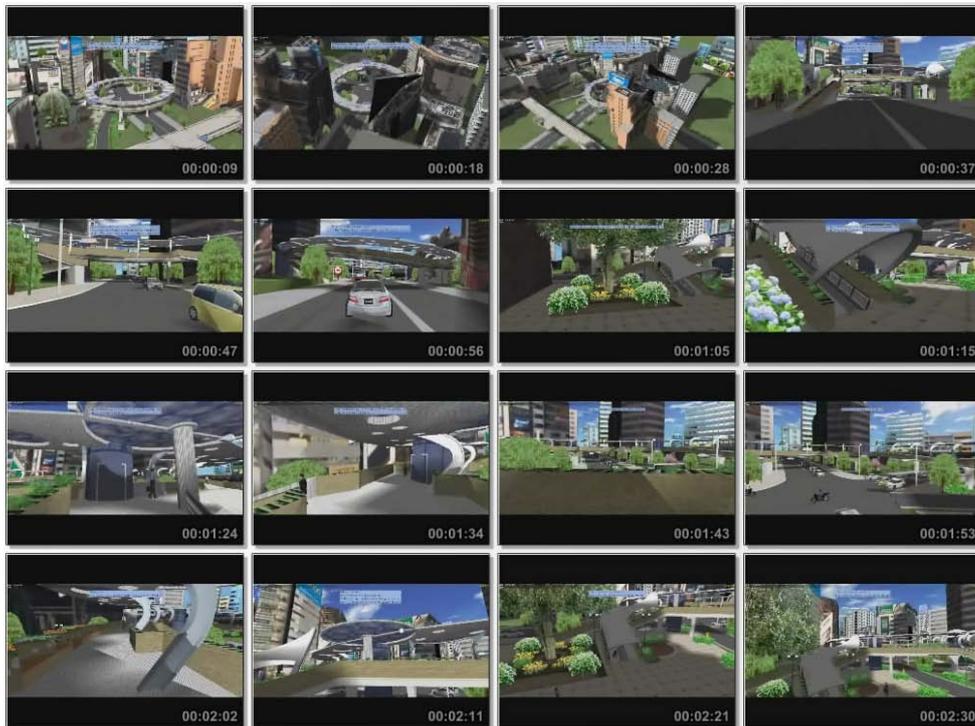
2011.10.30 Simulation Result

Solar Panel Position

- In order to reduce carbon dioxide produced, the cost of electricity is reduced in the design. Low carbon and ecological materials are used such as LED lighting and solar battery which set on the roof providing electric power for the lighting.
- On Currently Existing Data of the Tokyo daily light quantity, we choose the period from 7:00 to 16:00 as the effective collection period, then simulate the average daily sunlight in the specific environment by UC-WinRoad. The space where could receive most sunlight energy on the roof might be used for solar power generation by Solar battery panels.
- The Reduced Power Output (due kWh/h) = The amount of solar radiation (W/m²/day) × (photovoltaic lightness) × LCD capacity (kW) × (1 - Temperature loss) × (1 - Power Conditioner loss) × (1 - Other losses)

Losses of Temperature:
in spring (March to May): 15% in summer (June-August): 20%
in autumn (September-November): 15% in winter (December to February): 10%
Powerloss (power conditioner) Loss: typically about 5-6% Other losses: typically about 5-7%

C. Snapshot of Automatic Experience of the Guide of the Concept Design of OASIS (.avi file attached in the Appendix folder)



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