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Research Paper

Urban Design of the Dashu Hill Area in Hefei Based on the Protection of the View Corridor

X. Zhang [1] and J. Yang [2]

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ABSTRACT

Dashu Hill is the only mountain in Hefei. The paper analyses the relevant methods of the protection of mountain view corridor and expatiates on the evolution of methods and ideas for the protection of the view corridor within all previous Dashu Hill area urban design. Based on the new problems and technical methods, the design has made some research innovation in the protection of mountain view corridor.

1. Introduction

As the only mountain in Hefei, Dashu Hill locates in the west of Hefei, with a height of 284metres. Since 2000, with the rapid development of social economy and urban construction, the Dashu Hill has gradually merged into the main urban area and become an urban mountain park. The increasing development and construction activities in the surrounding area have caused certain threats and damage to the landscape and environment of the Dashu Hill. Therefore, it is crucial to restrict the height and volume of development and protect the mountain view corridor in the Dashu Hill area. Since 2006, the government has successively broadened the Huangshan Road, partitioned the height of surrounding buildings, renovated and improved the Half-side streets, and ecologically restored the South Lake of Shufeng Bay in Dashu Hill area. These acts help protect the mountain landscape environment of Dashu Hill. The Dashu Hill area has entered a new stage of quantitative and qualitative development after the Hefei Comprehensive National Science Center was settled in the area in 2017 and a new round of urban design process has started.

2. Relevant Methods of the Protection of Mountain View Corridor

Mountains or hills are often seen as a symbolic important symbolic urban landscape or urban skyline. The protection of mountain view corridors areas of great significance either in domestic or foreign cities. They hope to highlight the city's symbolic image through mountain view corridor protection. At present, the relevant methods include zoning control method and viewing control method.

The zoning control method is aimed at protecting the mountain landscape environment from being damaged and controlling the surrounding landscape. The mountain is protected by delineating protection lines for different control requirements around the mountain and controlling the height of buildings in each area. For instance, Wuhan

[1] Lecturer, Anhui Jianzhu University, Hefei 230022, CHINA, hongqixu2018@163.com
[2] Engineer, Anhui Provincial Architectural Design and Research Institute Co., Ltd., Hefei 230601, CHINA, aadri1237@163.com
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has published Mountain Protection Measures of Wuhan City, which protects the landscape environment around the mountain by delineating the body line and the protection line. Fuzhou Mountain Protection Plan proposes a method for hierarchical protection of mountain areas. According to the role of mountains in landscape features, history and culture, urban spatial patterns, etc., the mountain protected areas are divided into three levels, and different levels of mountain protected areas are further divided into key control areas and general coordination areas to control the building height of each zone (Yang, 2008).

The viewing control method is to ensure that the overall appearance of a landmark or a mountain is not blocked by urban architecture. It can be traced back to the practices of protecting the city's iconic viewing landscape in the UK and France in the 1990s (Chen, 2008). St. Paul's Cathedral strategic viewing landscape control takes the famous landmark St. Paul's Cathedral and the Houses of Parliament as the viewing objects, and selects 10 public places with good public accessibility as strategic viewing points. There are three types of sight control zones: landscape view corridor, wide-angle view of the surrounding landscape agreement area, and background agreement area. Different height control managements are implemented in each area to ensure that citizens can enjoy urban landmarks with an open and comfortable vision at a long distance. The urban design guidelines formulated by the Hong Kong Planning Department stipulate the elements of line of sight to protect the landscape, namely the protection of ridgeline, protection of cultural heritage buildings, and the shaping and protection of view corridors. It mainly uses the line-of-sight analysis method to select important viewpoints, control the building height and density between the viewpoint and the scenery, form a certain view corridor, and then perform protection control. Among them, eight viewpoints have been set up in order to ensure the view of the ridgeline on both sides of Victoria Harbour. Based on the analysis of the sight of each viewpoint, the observation corridor coverage area is established, and corresponding measures are proposed to protect the ridgeline landscape (Hong Kong Planning Department, 2006). In the control of the building height of the surrounding area of Yuelu Mountain, Changsha selected Tianxin Pavilion, Orange Island and other important tourist attractions as the viewing points, with an angle of 45 degrees as the control range, and the building height in the view corridor is no more than 1 / 3 or 2 / 3 of the overall mountain height as the principle to control the building height (Wu, 2011).

Comparing to the relevant methods of protecting the mountain view corridor in these cities, it can be found that in the early days, the protection of the mountain body and the surrounding environment was mainly used, and then it was extended to the protection of the mountain view corridor. They have many similarities in the controlling method system. Most of them adopted the “view” (line of sight up to about 6 km away) line of sight control method, namely, to select a number of viewpoints in the city, and it is required to look out the landmark or mountain landscape under the viewpoint, without any building shelter. At the same time, the surrounding buildings will not have a negative impact on the overall landscape environment. The overall building volume and style are unified and it is the core method of viewing control.

3. The Practice of Urban Design in Dashu Hill Area

Dashu Hill is one of the most important urban landmarks in Hefei. Hefei has always attached great importance to the urban design work in the Dashu Hill area. Since 2008, it has basically maintained the frequency of modification and improvement once every 3-5 years. It can be divided into three stages: local control, overall control and fine control.

3.1 Urban Design in Local Control Stage

When the roads in Hefei were unblocked and widened in 2006, Huangshan Road is the main target. It happens that Huangshan Road goes west to the foot of Dashu Hill. Therefore, Huangshan Road was regarded as one of the important view corridors on the east side of Dashu Hill. Initially, the total length of Huangshan Road was only 1671.6 meters and the width of the road was 7 meters. At present, the total length is about 9 kilometres, reaching the foot of Dashu Hill in the west and Ningguo Road in the east. The road is 55 meters wide and has 4 lanes in both directions. The widening of the road and the control of the building height on both sides of the road have played a key role in the mountain view corridor on the east side of Dashu Hill, and also made Huangshan Road a “Symbolic Avenue in Hefei”.

After the Huangshan Road was unimpeded, real estate development on the east side of Dashu Hill rose rapidly. Considering the long-term planning of urban development and shaping the characteristic image of urban space, Hefei conducted a study on urban space control on the east side of Dashu Hill, mainly making sure the building height within 1,000 meters shall not exceed 33m in order to protect the Dashu Hill itself and the surrounding environment. According to the implementation of the plan, the mountain view corridor of Huangshan Road and the environment on the east side of Dashu Hill have been well protected (Fig. 1). However, the building height control on both sides of Huangshan Road has not been included in

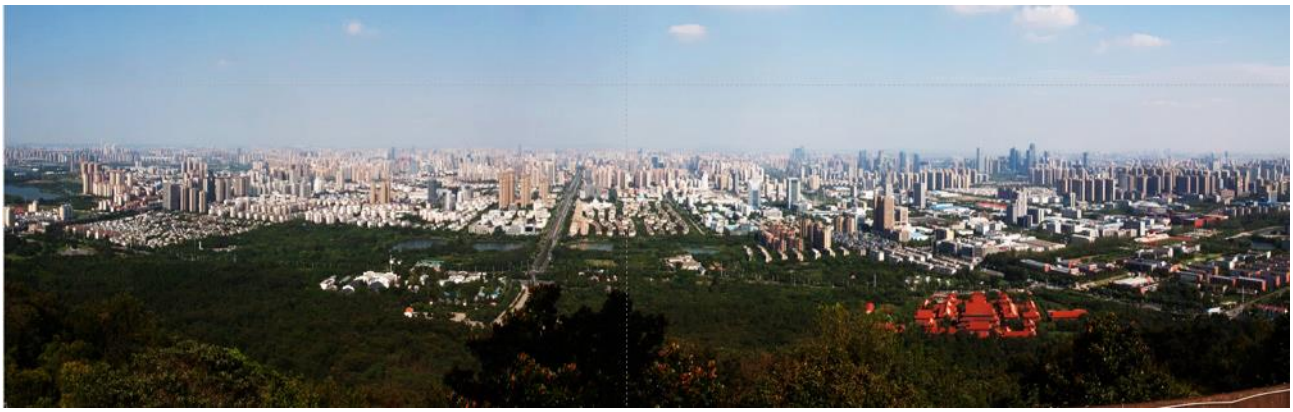


Fig. 1 Control Effect of the View corridor on the Eastern Side of Dashu Hill and Huangshan Road

the statutory documents, so the high-rise buildings in local plots have some interference with the view corridor. Because of the relatively cheap land price, the low-intensity development, Good controlling achievements have been made.

3.2 Urban Design in Overall Control Stage

After 2008, the Dashu Hill area has entered the stage of comprehensive development and construction. There are Hefei Hi-tech Industrial Development Zone, Baiyan Industrial Park, the central core area of Hefei National Science and Technology Innovation Pilot Demonstration Zone, and Shushan industrial park respectively on the east, south, west, and north. At that time, Dashu Hill was the only mountain landscape and provincial tourist attraction in Hefei, and it was a precious natural landscape resource in Hefei. It should fully reflect its scarcity, publicity and ecology in urban planning and control. Based on the successful experience of regional control on the east side, Hefei has further carried out the urban space control plan of the entire Dashu Hill area.

The plan adopts a circle-type zoning control method. Drawing a circle with centre of plane geometry of Dashu Hill (opposite the centreline of Huangshan Road) as the centre and the distance to the Second Ring Road as the radius. In the planned control area, space control is performed according to the area and corridor (Fig. 2).

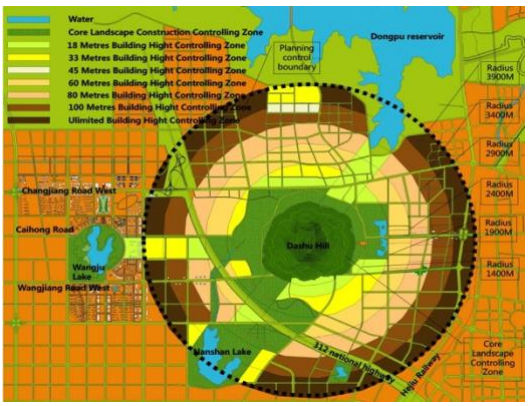


Fig. 2 Circumferential Zoning Control in 2008

1) the planning takes the green space protection in and around the Dashu Hill ring road as the core landscape control area. Any development in this area is forbidden and all construction activities shall strictly abide by the scenic area construction standards.
2) Take Dashu Hill as the centre (opposite the centreline of Huangshan Road), draw circles with radiuses of 1400 meters, 1900 meters, 2400 meters, 2900 meters, 3400 meters, and 3900 meters respectively and divide them into seven types of construction control areas by building height: 18m, 33m, 45m, 60m, 80m, 100m and unlimited.
3) Ecological landscape corridor control mainly includes four ecological landscape corridors: Dashu Hill-Dongpu Reservoir (approximately 560 meters wide), Dashu Hill-Baiyan Lake (approximately 560 meters wide), Dashu Hill-Wangzui Lake (approximately 500 meters wide), Dashu Hill-Swan Lake (approximately 800 meters wide). The maximum height of the building in the ecological landscape corridor is restricted to 60 meters to ensure the line of sight between the mountains and waters, the connection of biological communication and the connection of urban air ducts.

In general, due to the increasing attention of the protection of Dashu Hill in Heifei, the protection of the view corridor of Dashu Hill in this stage has been greatly strengthened either in depth or breadth. it not only emphasises the stepwise control of the building height around Dashu Hill, but also establishes the basic structure of the relationship among mountains, lakes and cities. Comprehensive and rigorous management and control have achieved good implementation results, the Dashu Hill-Wangzui Lake Mountain view corridor has been especially well controlled during the implementation process.

3.3 Urban Design in Fine Control Stage

In recent years, the Dashu Hill area has entered the development stage of “Retreating from Two to Three” industrial transformation. The inefficient industrial land has gradually been replaced by residential, commercial, and office land. Driven by the benefits of economic balance, the high-intensity urban development and construction and the control of the view corridor of the Dashu Hill have a great conflict. Again, the protection of the view corridor of the Dashu Hill is particularly necessary. Based on this necessity, the planning department organized a new round of compilation of Urban Design of the Dashu Hill Area, focusing on controlling content in the view corridor of the Dashu Hill.

Although the work of the previous view corridor protection has achieved considerable success, there is still the need to further optimization while rethinking the actual achievements of the previous acts. Firstly, the environmental quality of the Dashu Hill area is considerably high. The opening of the underground line 2 cause the high-intensity development of land. A large number of tall buildings raised after that. It has a great impact on the overall layout of the mountain, lake and the city. The view corridor protection of the Dashu Hill needs to take full account of the changes in the economic value of the land. Secondly, from the survey feedback of citizens and tourists, people wish Dashu Hill could appear in more sights of public area. This brings questions such as “where should people be able to see the Dashu Hill?”, “How is the scenery when overlook the city from the top of the Dashu Hill?”. Thirdly, there are still some blind spots in the existing mountain view corridor protection. At present, the main focus is the height control of the buildings around the Dashu Hill to avoid obstructing the view. However, the control of the shape of the building group, especially the density of the buildings, is still insufficient. There are large-scale and high-rise buildings in the north of the Dashu Hill, blocking the depth effect of the view corridor. At the same time, due to the low-level of detail of the overall control, some high-rise buildings have had a greater impact on the existing mountain view corridor image.

Aiming at the problems mentioned above, based on the ring-type partition control and overlooking control methods, the urban design has fully taken the advantages of the spatial analysis of ArcGIS, the simulation of three-dimensional buildings, and the shape design of buildings to carry out the study and judgment of the view corridor pattern, multi-view superimposed control, and the comparative analysis of multiple schemes. research innovations have been realised in urban design guidelines to provide a scientific basis for promoting fine control of the view corridor. Sufficient investigation of the residents' travel activities and viewing requirements is an important basis for selecting the position of the viewpoints; in terms of the control of the view corridor, superposition analyses of multiple viewpoints are made to obtain the most ideal building height control system; in terms of the controlling level of detail, multi-plan architectural form design for key sections will be done. The pros and cons of each scheme can be identified by comparing and analysing in the 3d architectural simulation system; In terms of the fine management, the best building shape plan is finally fed back to the land development through design guidelines. In addition to the basic control rules, the design guidelines increase the control of aspects including but not limited to open space, location of high-rises, building face width, visibility, and line sticking rate.

3.3.1 Research and Judgment of the View corridor Pattern

In the region of the visibility distance (take the top of the Dashu Hill as the centre and 6 km as the radius), the landscape pattern of “One Hill and Four Lakes” establishes the view corridor structure of the Dashu Hill area (Fig. 3). One Hill (Dashu Hill) and Four Lakes (Dongpu Reservoir, Swan Lake, Baiyan Lake, Wangzui Lake) are important public activity areas in Hefei, and the space landscape relationship between them will be the leading factor to determine the control content of the view corridor protection. With the construction of key functional areas brought by the Comprehensive National Science Center, the spatial form centred on “One Hill and Four Lakes” will gradually become clear and stable. Based on this, Considering the layout optimization of urban functions, the overall view corridor pattern is sorted out and predicted, so as to determine the existing and future potential landscape value areas and carry out comprehensive and detailed protection control. It will make the design more forward-looking and targeted and can be used to strengthen urban characteristics and promote regional socio-economic value.

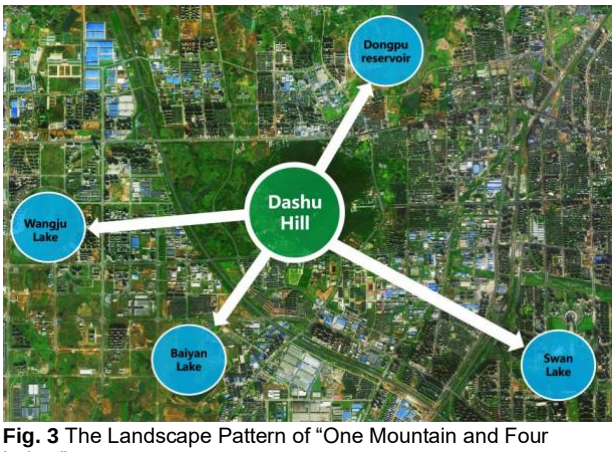


Fig. 3 The Landscape Pattern of “One Mountain and Four Lakes”

3.3.2 Multi-view Overlook Control

The method can superimpose the building height control requirements of important viewing corridors from multiple viewpoints and improve the rationality and comprehensiveness of height control. The viewpoint are selected according to the residents' viewing needs and the actual viewing situation. The view control of exceptional viewpoints will have a greater impact on the development of land in the view corridor. Socio-economic benefits must be considered comprehensively to determine whether this viewpoint is adopted. According to the actual mountain view conditions and the economic demands of land development, the view control method is used to control the building height in the mountain view corridor under the principle of ensuring more than 20% of the mountain view is not blocked by the buildings. The GIS skyline analysis function can be used (in ArcGIS, the “Skyline” and “Skyline Obstacle” functions under the 3DAnalyst toolbox can generate a skyline silhouette and a skyline obstacle surface in a three-dimensional environment based on the viewpoint, so as to calculate the precise height control value of each viewpoint), and then the height control maps determined by multiple view corridors are obtained based on the comprehensive superposition calculation (Fig. 4).

A variety of building height control requirements are superimposed, and the minimum value is taken in the overlapping area to determine the comprehensive height control requirements for mountain protection. The application of ArcGIS technology means that the accuracy of the calculation process can be controlled (it depends on the accuracy of the grid). By controlling the size of the grid analysed by ArcGIS and taking the minimum value within the plot, the height control value of each plot is determined.

3.3.3 Multi-scheme Comparison Analysis

The architectural form of the plot is designed according to the height control value of the plot. In the three-dimensional building simulation system, the height control value can be directly calibrated. After a control demonstration of different building heights, it is proved that the height control obtained by ArcGIS analysis is reasonable (Figure 5). In addition to the control of the mountain view corridor, there is also a “green seam” between the buildings and the Hill. Under the same building height control, different architectural form designs have a great influence on the size of the “green seam”. In the three-dimensional building simulation system, important open spaces are selected for observation around the “green seam” of the mountain view, and the multi-project comparative analysis of the architectural form of the key plots is conducted. Economic indicators can be used for demonstration if necessary (Figure 6). There are many influencing factors considered in the scheme comparison process, and opinions can be widely consulted, so that more reasonable and effective control requirements can be derived.

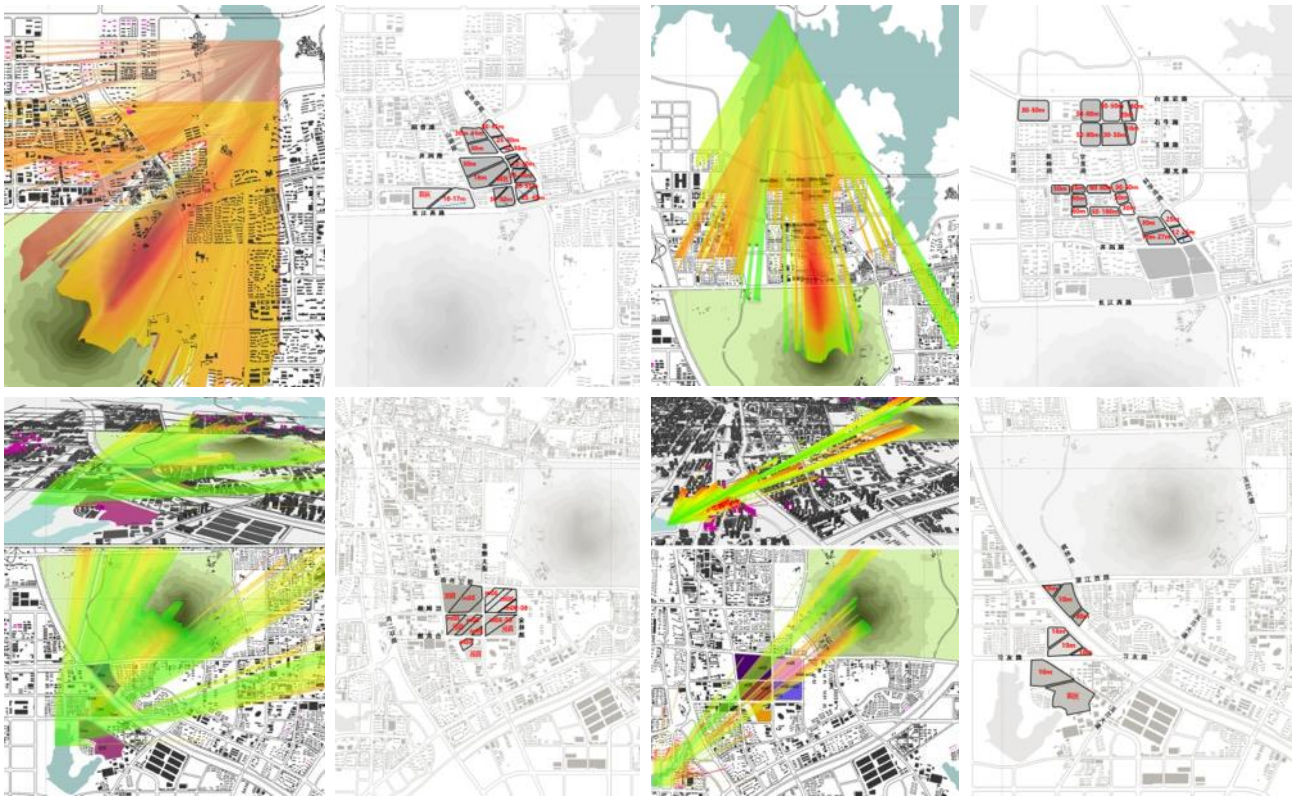


Fig. 4 Height Control Chart for Multiple View corridors

Fig. 5 Comparative Analysis of Multi-scheme

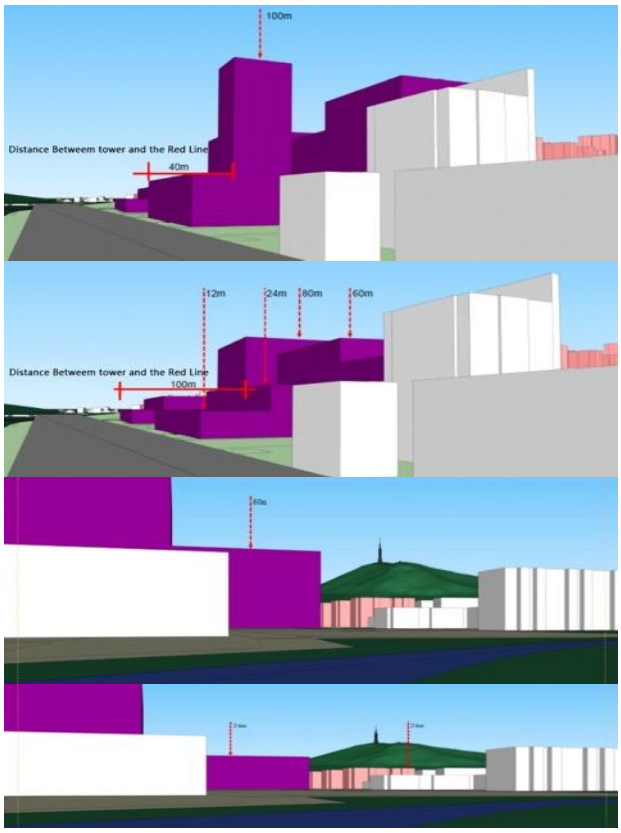


Fig. 6 Comparative Analysis of Key Plot Schemes

3.3.4 Site + Architectural Design Guideline

Merely controlling the height of the plot is far from enough for the current urban design intention. and refined architectural form control is essential to the expression and implementation of urban design. In this case, the design guidelines are divided into site design guidelines and architectural design guidelines (Figure 7). The site design guidelines have added environmental design requirements based on the requirements for land development control and municipal roads and public supporting facilities, including but not limited to requirements for open space range, open line of sight control, canopy line control, and plot wall control. In addition to the building height, colour and style, the architectural design guidelines restrict the location and width of high-rises, the visibility and line rate of buildings, and the control lines of the street wall. The purpose is to increase the openness of the site, reduce the number of obstructed objects in the sight of the mountain view, and improve the visualization of the “green seam”.

4. The Overall Evaluation of the Urban Design of the Dashu Hill Area

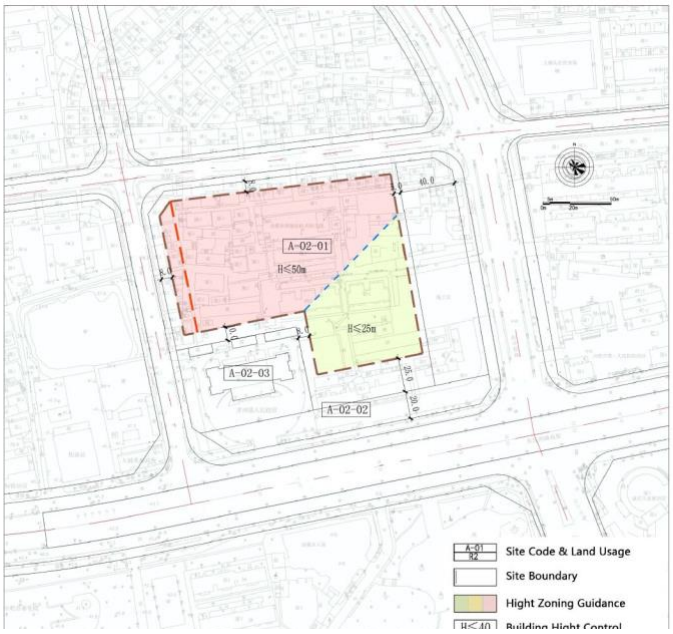
From the compilation process of the urban design of the Dashu Hill Area shows that Hefei has achieved rich results in the method and implementation of the protection of the mountain view corridor. Based on the research of mountain view corridor protection and control, it has formed a distinctive, detailed and complete, highly operable urban design system.

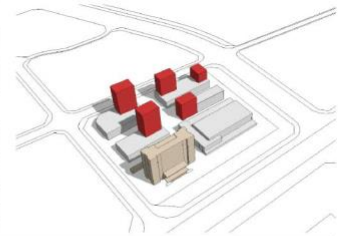
1. Pay attention to public participation in viewpoint selection and scheme comparison. The ultimate purpose of the view corridor protection is to provide the public with the best way to experience the mountain landscape, so that the public can further understand the social connotation carried by the city. From how the public see the mountain landscape to how they want to perceive the city image contained in the mountain landscape are all the most significant factors in this urban design and they directly determine the final result of the protection and control of the view corridor. It is also an important way to involve more people in urban construction and realise open planning.
2. The controlling objective is more scientific, precise and effective. By using ArcGIS technology and comparative analysis of multiple sschemes, a more detailed and comprehensive control requirement is put forward through the site + architectural design guidelines.Compared with the design drawings based on land transfer conditions, it is helpful to achieve the ultimate intention of control. Some of the control elements in the guidelines are set according to specific requirements such as the protection of mountain view

corridor and “green seam”. They eliminate the failure of traditional two-dimensional planar element control, add element control in three-dimensional space, and show the special significance of urban design.

3. Focusing on the continuation of urban design. In previous urban designs, before the large-scale development and construction of the area, prospective design management was carried out and good implementation results were obtained. Each round of urban design has continued the key control content of the previous one, combined with new problems and needs, and carried out targeted research and innovation to form a unique and ordered urban space environment. It also reflects the continuity of urban design compilation and implementation, which is also one of the few in the current urban design.
4. Paying more attention to the application of digital 3D technology. At present, many cities in China have started the construction of three-dimensional urban platforms. Hefei has basically built a visual three-dimensional digital urban real-time platform which can fully simulate the specific form of buildings in the urban space environment with full perspective and dynamics and provide a direct and effective basis for scheme optimization and planning approval management. The entire process of the 2018 Dashu Hill urban design used the technology to conduct a comparative analysis of the architectural form scheme in a three-dimensional urban environment. It carefully elaborated the key

	Controlling Factors	Site Code		
		A-02-01	A-02-02	A-02-03
Land Development Control	Site Area	2.6ha.	1.1ha.	0.6ha.
	Land Usage	Business(B1)	Green Space(G1)	Administrative (A1)
	Plot Ratio	2.5	——	——
	Greening Rate	≥25%	75%	≥35%
	Building Density	≤50%	——	——
	Building Line	See control plan for details	——	——
Environmental Design Request	Request of Opening Line of Site	——	——	——
	Width of the Section of Line of Sight	——	——	——
	Open Space	≥2000㎡	——	≥2000㎡
	Site Enclosure	Transparent Grenn Belt Is Applied	——	——
	Woodline Control	——	——	——
Municipal Roads and Public Facilities Request	Car Entrance	N、W、E	——	W
	Pedestrian Entrance	N、S、W、E	——	S、W
	Parking Lot	Parking spaces will be equal or greater than 1 park space per 100 ㎡. Ground parking rate will be equal or lower than 30%.	——	——
	Pedestrians	There is at least one pedestrian run through the site	——	——
	Public facilities	See control plan for details	——	——
	municipal pipeline requests	Connecting the municipal facilities in surrounding roads	——	——





	Controlling Factors	Site Code		
		A-02-02		
Architectural Design	Maximum face width (L) of the tower along the roads	Along Tianpudong Road L≤45m		
		Along Yantanchong Road L≤45m		
		Along Changjiangxi Road L≤45m		
		Along Kexuedao Road L≤45m		
	Intervisibility Rate		Building Hight lower than 24m	Building Hight Higher than 24m
		Along Tianpudong Road	≥30%	≥40%
		Along Yantanchong Road	≥30%	≥60%
		Along Changjiangxi Road	≥40%	——
		Along Kexuedao Road	≥30%	≥60%
	Building Hight	≤50m		
		See control plan for details		
	Street Wall Line	Elevation should follow the street wall line		
	Close to Line Rate	Along Tianpudong Road ≥85%		
		Along Yantanchong Road ≥70%		
		Along Changjiangxi Road ≥70%		
		Along Kexuedao Road ≥70%		
	Architectural Colour	The main color of high-rise buildings should be cool gray neutral gray, reflecting a low-key and noble temperament; The skirt room of commercial part can use brunet appropriately.		

Fig. 7 Site+Architectural Design Guidelines

elements such as the open space, tower location, building width, line sticking rate that should be controlled by the mountain corridor and the “green seam”, greatly reduced the difficulty of predicting the architectural control effect, and made the urban design control closer to the reality.

5. Conclusion

The Zhengzhou International Urban Design Conference held in September, 2018 proposed to strengthen the planning and control of urban spatial dimensionality, style integrity and context continuity, and to retain the city's genes such as the unique regional environment, cultural characteristics, and architectural style. Dashu Hill is one of the most important urban landmarks in Hefei. The urban design involves the construction and protection of the city's important mountain corridors in key areas of urban construction. The protection ideas, control content and technical means of the mountain corridors have made in-depth research and innovation, which has certain universality at home and abroad. In line with the principle of striving to promote the refinement and scientific management and control of urban design, the problem of "making up but not using, controlling but not being true" is solved. the results are expected to provide references for related designs in other cities. It is worth mentioning that the consistent design and management of the urban design work in the Dashu Hill Area since its inception has been the key to ensuring the continuity of the Dashu Hill view corridor space.

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