Research on Vertical Planning of Urban Land Based on Rigid and Elastic Control Points

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Abstract: This paper explores a vertical planning method of urban land use based on element analysis of control points. The rigid and elastic control point system is established, the terrain and related control points are analyzed with GIS technology, and the data output is used to formulate technical measures. The results show that the establishment of control point system is closely related to the rationality of urban vertical planning, and both rigid and elastic control points have important influence on urban vertical planning.

1. Introduction

With the continuous expansion of urban scale demand, urban planning to fine development, urban construction to intensive development, vertical planning of an important role in urban construction is increasingly prominent, by more and more attention. Scholars at home and abroad have made extensive research on the vertical planning method, and the currently recognized methods include contour method, elevation arrow method, vertical and horizontal section method, etc. Its main content is to use and transform the natural terrain, determine the slope, control the elevation and balance earthwork and so on. However, at the present stage, the urban topography and landform in southwest China are quite different, various planning technical standards are not unified, and the scope of various urban planning areas are not the same, which leads to a large number of earthwork and rockfill yards in the implementation of urban vertical engineering, and the regional earthwork balance is not well handled, and flood control and drainage engineering investment is large, etc. In view of this, this paper, taking the centralized development area of Mianyang science and technology city as an example, tries to explore a vertical planning method of urban land based on rigid and elastic control points, and provides certain reference value for solving problems in urban construction and management through vertical planning in the future.

2. Research Ideas And Technical Routes

2.1 Research Ideas

The vertical planning of the land within the scope of Fucheng District of Mianyang science and technology city is based on reality, multi-argumentations, multi-perspectives, keeping pace with The Times, and striving to create a vertical control network for sustainable development. Based on the statutory control detailed planning, the elevation of the road system in the area is systematically

sorted out. From different perspectives, such as macro and micro, I conceived the solution to the vertical urban land use, the connection of important trunk roads, and the micro control of three large areas, emphasizing the sustainable vertical control of land use, and taking planning as a long-term management process to achieve the goal.

2.2 Research Technology Route

In terms of research methods, the paper starts from the actual application needs, collects and analyzes the centralized development area (Fucheng District) of Mianyang science and technology city, and explores the control method with certain operability in each stage, which is suitable for the vertical planning of urban construction and development in the study area. The technical route of the study is shown as follows:

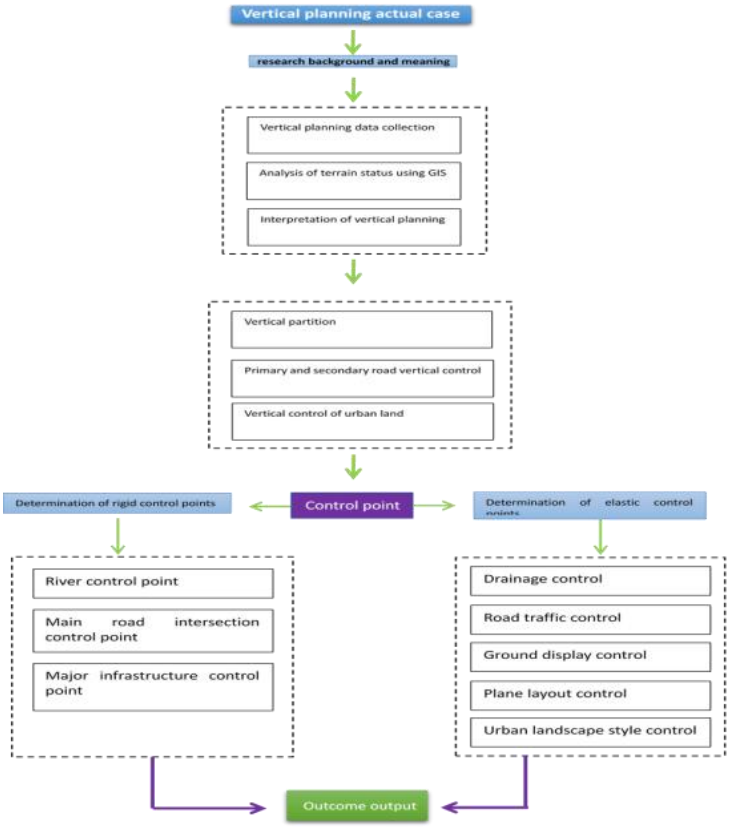

Figure 1: Research technology roadmap.

3. Practice of Vertical Planning Method for Urban Land Use

3.1 GIS Terrain Analysis

The terrain is analyzed in detail through GIS technology, and vertical zoning, vertical control of main and secondary roads and vertical control of urban land use are conducted according to the principles and purposes of vertical planning of the study area. The determination of control point system is very important, which provides a basis for further work of vertical planning.

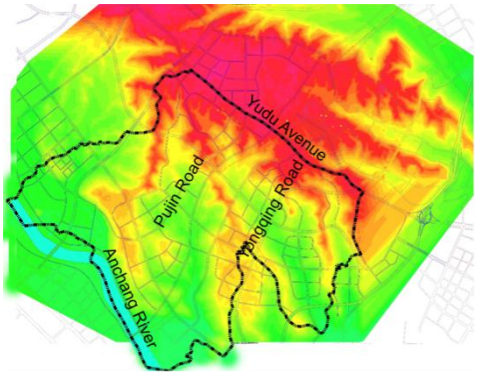

Figure 2: Terrain analysis.

3.2 The Vertical Partition

According to the current situation of land discharge in the area, the area is divided by considering relevant factors such as roads, rivers and terrain. The purpose of dividing the central city into several small vertical partitions is to organize small vertical partitions to discharge rainwater in the most reasonable way, such as the schematic diagram of Jinjialin area.

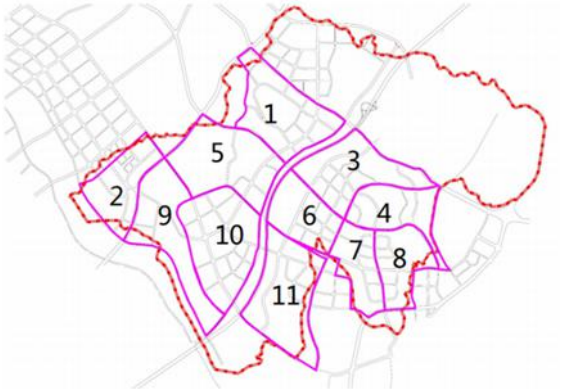

Figure 3: Schematic diagram of Jinjialin area.

3.3 Vertical Control of Main and Secondary Roads

By collecting, sorting and analyzing the vertical design data of existing roads and planned roads, as well as the control elevation data of urban planning land, the elevation of road intersections to be planned is determined. Compared with the surrounding topography and road elevation, 50cm is selected as the standard, which can be divided into four situations: depressions within 50cm, depressions above 50cm, elevations within 50cm and elevations above 50cm. Different methods can be adopted to adjust these four conditions: within 50cm, the current road of the depression can be appropriately adjusted to solve the terrain, and the planning road can be appropriately reduced to solve the design elevation; In principle, no major adjustment will be made to the existing road and planned road within 50cm height, and the design is basically reasonable. Elevation and depression above 50cm. The existing road can be solved by the combination of terrain adjustment and road reconstruction. Planning road g requires adjusting the design elevation.

3.4 Control Point Design

According to road grade, major infrastructure layout and drainage control requirements, were identified as rigid, flexible control point, the rigid and flexible control point of organic combine, vertical design can both guarantee system integrity, and can more adapt to the requirement of the change of market and planning implement ation management, but alsobenefit to the next step to build constructive-detailed plan and design work.

3.4.1 Rigid Control Point

The control point of the river course should study the flood control and drainage function of the main river course in the region, determine the flood control standard, and ensure that the elevation of the road around the river course is higher than the designed flood level of the river course when conditions permit. Combined with the control detailed planning of the research area, the current situation and the level of the planned key infrastructure in the region were calculated according to the corresponding flood control standard safety height control. Important medical facilities, education facilities, transportation hub stations, parks and squares and other infrastructure are also major infrastructure control points.

3.4.2 Elastic Control Point

Drainage, flood control, prevent water logging drainage control point reference research area planning of river location, water surface line and rain partitions, combined with drainage flow and slope, river control points (design flood level) as control conditions calculated elastic rigidity control points, drainage area elasticity level should be higher than the corresponding channel control point elevation.

For the vertical design of roads of all levels, while meeting the relevant control factors, it is necessary to plan and design in strict accordance with the index value under different design speeds of the code, so as to ensure traffic safety.

Table 1: Motor Vehicle Maximum Longitudinal Slope.

Design speed（km/h）		100	80	60	50	40	30	20
Maximum longitudinal slope(%)	General value	3	4	5	5.5	6	7	8
	Limit value	4	5	6		7	8	

Table 2: Minimum Slope Length.

Design speed（km/h）	100	80	60	50	40	30	20
Minimum slope length	250	200	150	130	110	85	60

Table 3: Three Scheme Comparing.

Design speed（km/h）	100	80	60			50			40		
Longitudinal slope	4	5	6	6.5	7	6	6.5	7	6.5	7	8
Minimum slope length	700	600	400	350	300	350	300	250	300	250	200

Combined with GIS analysis, form planning map was drawn, and ground form and slope were determined according to different land types and road elevation around the land. When the natural slope of land is less than 5%, the plan adopts flat slope type; when the natural slope of land is more than 8%, the plan is stepped type; when the natural slope of land is between 5% and 8%, the plan is mixed type. When the natural slope of the land is more than 30%, it is not suitable for construction. Most of the construction land should not be planned as ecological green space in the regulation.

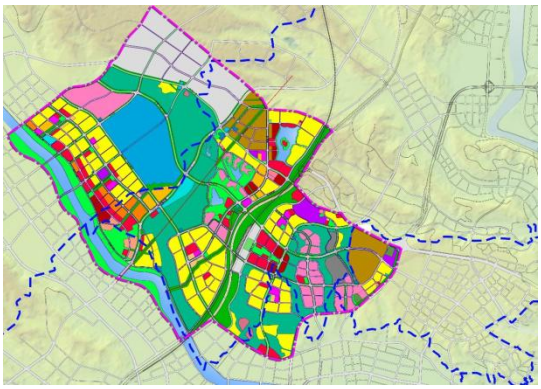

Figure 4: Land use planning map.

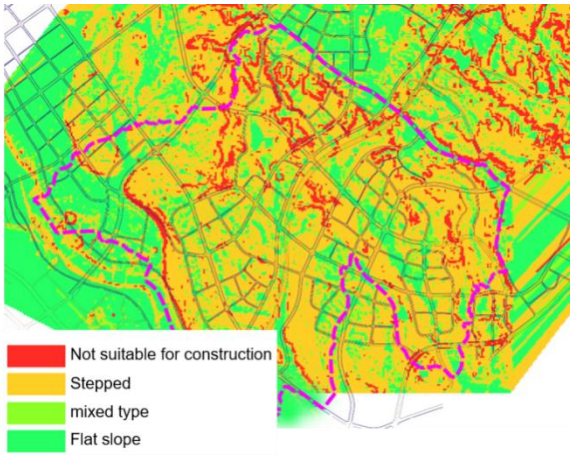

Figure 5: Ground form planning map.

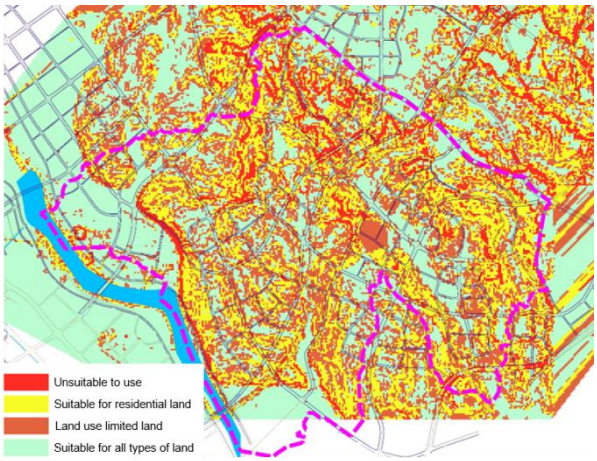

Figure 6: Plane layout control chart.

3.5 Vertical Partition Design

The control points determined according to the road grade, major infrastructure layout and drainage control requirements provide the basis for the vertical partition design, and the reasonable division of the vertical partition can provide the basis for the estimation of earthwork. For example, the general plan of vertical elevation of Jinjialin area (50-meters grid)

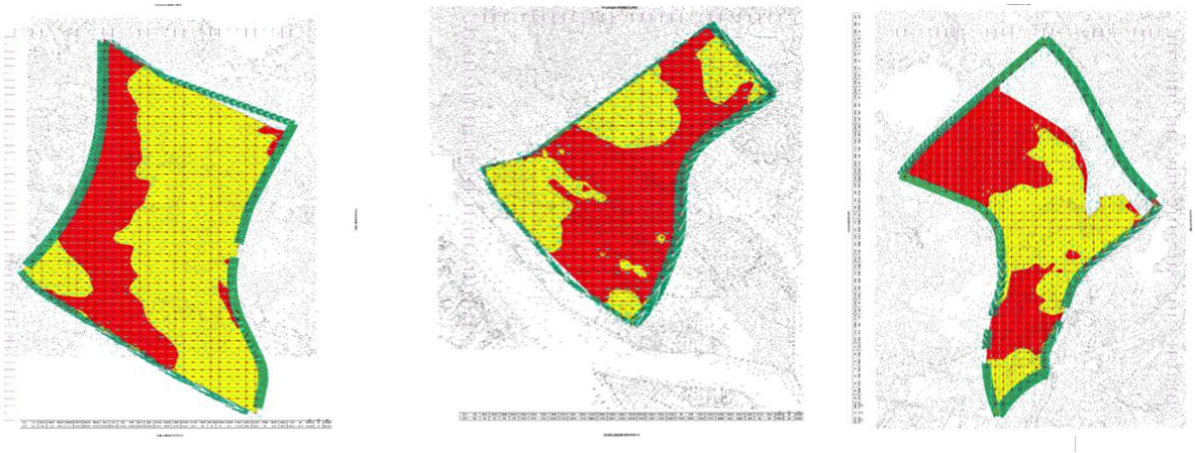

Figure 7: General map of vertical elevation point in Jinjialin area.

3.6 Earthwork Calculation

The effective estimation of earthwork has a great influence on the plane layout of the study area. The earthwork grid calculation according to the vertical partition can roughly estimate the amount of excavation and fill. In addition to the concentrated green space, the excavation amount of the whole research area is 100.6 million square meters, the filling amount is 63.74 million square meters, the loose soil amount is 5 million square meters, and the overall excavation amount is 41.32 million square meters more than the filling amount. The estimated amount of excavation and filling in each area is shown in the figure below:

Table 4: Jinjialin Core area.

	Digging (10,000 square meters)	Filling (10,000 square meters)
core area1	501.2411	180.7093
core area2	23.79706	219.1208
core area3	245.5466	334.1739
core area4	771.7933	674.3484
core area5	486.9877	453.5847
core area6	493.7954	401.0107
core area7	476.7378	94.99077
core area8	47.16764	127.1034
core area9	164.7794	192.4401
Subtotal	3211.846	2677.482

Table 5: Qingyi Town Area.

	Digging(10,000squaremeters)	Filling(10,000squaremeters)
Qingyi 1	115.631	209.2904
Qingyi 2	474.9361	529.6496
Qingyi 3	392.0229	465.7099
Qingyi 4	460.8174	245.9016
Qingyi 5	187.9441	230.5998
Qingyi 6	560.0404	670.8291
Subtotal	2191.392	2351.98

Table 6: Longmen Town Area.

	Digging (10,000 square meters)	Filling(10,000squaremeters)
Longmen1	160.6727	179.3405
Longmen2	---	---
Longmen3	222.7176	148.1614
Longmen4	383.3903	327.5019

According to the estimation of excavation and filling amount, the earthwork balance calculation is controlled in the small plots related to the construction scope, and then the regional plane layout can reduce the earthwork waste in the construction.

4. Conclusions

Taking the vertical planning of the centralized development area of Mianyang city science and technology city as an example, the rigid and elastic control point system is established in this paper. GIS technology is applied to analyze topography and related control points, which provides necessary data support for further vertical planning. The results show that the establishment of the control point system is closely related to the rationality of the vertical planning of the city， both rigid and elastic control points are of great significance to urban vertical planning.

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