Exploration on the selection of Engineering Project coordinate system based on "Integration of multiple regulations"

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Abstract: In order to avoid the problem that the side length projection deformation value is too large in the process of "multi-gauge in one" coordinate system selection, different coordinate system methods are adopted for planning drawings and engineering construction respectively. In the process of planning, CGCS2000, is comprehensively adopted in the project construction, and the independent coordinate system of the central city of Bijie City is comprehensively adopted. By means of surveying and mapping technology, the connection between the two coordinate systems is established to meet the different needs of the natural resources system and the engineering construction department on a small scale. Under the premise of ensuring the quality and safety of the project construction, it meets the requirements of the Ministry of Natural Resources, and lays a solid surveying and mapping foundation for "multi-regulation integration".

1. Introduction

With the integration of state ministries and commissions, urban and rural planning management functions have been merged into natural resources departments, creating favorable conditions for the full development of "multi-regulation in one". According to the requirements of the Ministry of Natural Resources, since July 1, 2018[1], the full adoption of CGCS2000, in the natural resources system has established a surveying and mapping benchmark for the "multi-regulation in one" project, which determines that "multi-regulation in one" can only be carried out on the basis of CGCS2000.

2. The limitation of CGCS2000 in engineering project.

CGCS2000 is the national coordinate system, which is the latest coordinate system of the country. The selection of ellipsoid parameters is very reasonable, very consistent with the reality of China, and has a strong application value. But CGCS2000 is still a geocentric coordinate system based on the national situation, which is a national coordinate system. China has a large national territory, and it is impossible to find a coordinate system that meets the limitation of side length projection deformation within the range of 9.6 million km2. Therefore, there is still a problem in CGCS2000 that the undeformed value of edge length projection does not meet the requirements of "Engineering Survey Code" and "Urban Survey Code"[2].
3. The establishment of urban independent coordinate system in the central urban area of Bijie City.
In 2014, Bijie City Planning Bureau built the basic surveying and mapping project in the central urban area of Bijie City, and established an independent urban coordinate system in the central urban area of Bijie City to meet the needs of side length projection deformation. Guizhou Institute of Engineering Applied Technology is located in Qixingguan District of Bijie City, so it is completely included in the central urban area of Bijie City. According to the DEM analysis of the central urban area of Bijie City, Guizhou Institute of Engineering Applied Technology adopts the independent coordinate system of the central urban area of Bijie City to fully meet the needs of side length projection deformation\[3-4\].

4. The emergence of contradictions
According to the requirements of the Ministry of Natural Resources, the natural resources system must fully adopt CGCS2000, urban and rural construction planning, land use norms, etc. all belong to the natural resources system, and CGCS2000, must be adopted. therefore, based on urban and rural construction planning, land use planning and other planning "multi-planning in one" is bound to adopt CGCS2000. However, the design of the engineering construction project is designed on the topographic map, and the various parameters of the building are calculated on the basis of the edge length on the map. Due to the influence of the side length projection deformation, the actual edge length does not match the edge length on the graph, and the actual edge length will be larger than the edge length on the graph, which poses a certain threat to the safety of the building. In order to ensure the safety of engineering construction, according to the Code for Urban Survey, the projection deformation value of side length must meet the requirement of less than 25mm/km, which inevitably requires the independent coordinate system of the central city of Bijie City, which accords with the deformation value of side length projection. This gives rise to the contradiction between the state ministries and commissions that do not meet the requirements.

5. The solution to the basis of "multi-regulation in one" surveying and mapping.
"Integration of multiple regulations" is the basis for avoiding contradictions in various plans, putting an end to the situation of "Kowloon water control", and ensuring "a blueprint to the end". It is the inevitable demand of social and economic development. CGCS2000 is the most reasonable coordinate system established at the national level in line with China's national conditions, and it is an inevitable trend to adopt it in an all-round way, and it is an irresistible historical trend. At the same time, the side length of the building in the process of project construction is related to the quality and safety of the project. In order to ensure the safety of the project construction, the relevant requirements of the housing and construction department must be met. In order to ensure the quality and safety of the project construction and to meet the needs of "multi-planning in one", when formulating urban and rural construction planning and land use planning, CGCS2000, is uniformly used in surveying and mapping topographic maps in the planning area on the basis of CGCS2000 for all kinds of planning. Making use of the strong surveying and mapping technical force of the natural resources department, the topographic map is transformed into the independent coordinate system of the central city of Bijie City, which can be used in the design and construction of specific construction projects to ensure the quality and safety of buildings. Various planning indicators are seamlessly transplanted to specific construction projects to guide the design and construction of the project, in order to meet the planning requirements, achieve the purpose of planning supervision, and realize the planning intention.

5.1. Surveying and Mapping of Planning Topographic Map
The area of planned topographic map is relatively large, and its surveying and mapping is generally undertaken by surveying and mapping units with corresponding qualifications. The planning topographic map is surveying and mapping by CGCS2000, and the control survey is established by CGCS2000 and the independent coordinate system of the central city of Bijie City, and a strict transformation relationship is established.
5.2. Planning formulation

All kinds of planning are carried out by the competent planning departments on the CGCS2000 topographic map in order to achieve the goal of "multi-planning in one".

5.3. Information provided by the natural resources department

After the sale of the land and before the design of the project, the planning management department shall strictly convert the coordinates under the independent coordinate system of the central city of Bijie city by the planning management department according to the red line coordinates of the land under CGCS2000, and the natural resources department will provide the coordinates of the red line of land under the independent coordinate system of the central city of Bijie City, the control points under the two sets of coordinate systems and various planning indicators.

5.4. Planning and design of the construction unit

The project construction unit obtains the topographic map under the independent coordinate system of the central city of Bijie City, on the basis of which the construction control network is established and the project construction is carried out.

5.5. Planning verification measurement

The construction unit carries on the planning verification survey under the independent coordinate system of the central city of Bijie City, and converts the final result into CGCS2000.

6. Feasibility analysis

6.1. CGCS2000 topographic map surveying and mapping

Although the natural resources department is the department in charge of surveying and mapping, with rich theoretical knowledge of surveying and mapping and strong technical force of surveying and mapping, the number of surveying and mapping professionals is insufficient and cannot map large-scale topographic maps on their own. Therefore, the large area planning topographic map under CGCS2000 can be entrusted to surveying and mapping units with corresponding qualifications.

6.2. Establishment of high-level control network

The establishment of GNSS control network is the foundation of topographic mapping and engineering construction, and the corresponding grade control must be established. When the natural resources department entrusts the corresponding units to carry out the surveying and mapping of the planned topographic map, it is necessary to establish a high-level control network covering the whole planning area at the same time. Because the selection of coordinate system of GNSS control network is only different in indoor calculation, such as constraint adjustment and parameter selection, the difference of field work mainly lies in the joint survey of known points, so the workload does not increase much, so it is possible to provide the coordinates of the independent coordinate system of Bijie city while providing CGCS2000 coordinates. The urban independent coordinate system of Bijie central district is based on CGCS2000 ellipsoid and the ellipsoidal expansion method is used to establish the urban independent coordinate system, so it is feasible to establish a strict transformation relationship between the two. At the same time, the unit that can carry out large area topographic map survey should be qualified as Grade An and should have the corresponding technical ability to establish a strict conversion relationship between the two sets of coordinate systems.

6.3. Coordinate transformation of land red line

After the transformation relationship between the coordinate systems is determined, the natural resources department only needs to collect the red line point coordinates under the CGCS2000, and use the transformation relationship to carry out strict transformation, which can meet the accuracy
requirements of the Bijie city center city independent coordinate system under the red line point coordinates.

6.4. Control data provision
Since the corresponding control network has been built when the high-level control network is established, the natural resources department only needs to select the attachment control points in the project area to provide.

6.5. Topographic map surveying and mapping of the project area
The area of the construction project is generally small, so the construction unit can entrust the corresponding surveying and mapping qualification unit to survey and map, or it can be obtained by the surveying and mapping unit under the natural resources department by using the CGCS2000 topographic map through the seven-parameter conversion method, and the specific acquisition method can be decided by the construction unit itself.

6.6. Planning verification measurement
The purpose of planning verification survey is to implement the plan and supervise the planning of project construction, which does not involve the quality and safety of project construction. Therefore, the independent coordinate system of the central city of Bijie City is used in the process of project construction to ensure the quality and safety of the project construction. Because the area of the project is small, the ratio of the projection deformation of the whole project area to that of the specific building area changes little, which does not affect the implementation of planning supervision and planning, so it can be carried out by surveying and mapping in the independent coordinate system of the central city of Bijie City, and then converted to CGCS2000.

7. Application examples
Bijie Electronic Information Industrial Park Phase I project is located in HaoGou village, Xiaoba Town, Bijie Economic Development Zone, adjacent to Ciwu road in the East, Xiaoba Avenue in the north, and main 2nd Road in the West. The plot number is bsghjsjk2014-26, covering an area of 152723.7 square meters. It is block b08-1 / 01 in the regulatory detailed planning of Bijie Economic Development Zone, Guizhou. The central meridian (105 °) of the 35 belt with 3 °belt is closer but the elevation is higher, resulting in a larger projection deformation of the side length, about 19.6 mm / km, which is far beyond the provisions of the relevant national norms, so it is necessary to establish an independent coordinate system in engineering construction. In 2014, the basic surveying and Mapping Project of Bijie City Central District hosted by Bijie Urban and Rural Planning Bureau mapped a topographic map of 200km ~ 2 based on CGCS2000, and established the conversion relationship between CGCS2000 and the independent coordinate system of Bijie City.

7.1. property lines are available
The red line of the building uses the planning drawings to measure the red line coordinates under the CGCS2000, and through the coordinate conversion software (figure 1), it is transformed into the independent coordinate system of the central city of Bijie City. The coordinates of the specific boundary points are shown in Table 1.
Figure 1 Software for coordinate transformation of urban independent coordinate system of Bijie central area

Table 1 Result table of boundary point coordinates

| The number of the point | ordinate (m) | Abscissa (m) | Remarks |
|------------------------|--------------|--------------|---------|
| JZ01                   | ***34.510    | ***99.507    |         |
| JZ02                   | ***28.724    | ***02.405    |         |
| JZ03                   | ***16.375    | ***78.111    |         |
| JZ04                   | ***22.161    | ***75.214    |         |

7.2 Control point coordinates and planning coordinates are provided
The coordinates of the control points provide the coordinates under two sets of coordinate systems (see Table 2), and the planning indicators are shown in Table 3.

Table 2 Coordinate results table of control points

| CGCS2000 coordinate | Urban independent coordinate system of Bijie central area | Altitude |
|----------------------|--------------------------------------------------------|----------|
| Ordinate (m)         | Abscissa (m)                                          |          |
| GZBJ                 | **2.911 **3.845 **8.543 **4.830 1534.029              |
| GZDF                 | **4.191 **6.411 **4.935 **6.498 1745.075              |

Table 3 Planning indicator

| Project               | Index      | Project           | Index      | Project               | Index      |
|-----------------------|------------|-------------------|------------|-----------------------|------------|
| Total building area   | 305447 m²  | Construction land area | *23.7 m² | Capacity area         | *30.8 m² |
| Area not included     | 0 m²       | Floor area        | *** m²    | Plot ratio            | 1-2        |
| Building density      | 30—60%     | Green rate        | 30%        | Green area            | *** m²    |

7.3 Index conversion of planning verification survey topographic map
Use the independent coordinate system of the central city of Bijie to carry on the planning verification survey, and calculate the planning index; according to the control points of the construction control network, carry on the topographic map conversion, complete the planning under the CGCS2000 to verify the survey results.

8 Conclusion
In order to meet the requirements of the Ministry of Natural Resources, the CGCS2000 coordinate system must be used in "multi-regulation in one".
In order to ensure the quality and safety of the project construction, the independent coordinate system which meets the requirements of the side length projection deformation should be adopted in the project construction.

the natural resources department provides the coordinates of the boundary point of the land red line under the independent coordinate system according to the planning;

the construction unit carries out the project construction in the independent coordinate system;

Planning verification survey is carried out by independent coordinate system, but the results must be converted to CGCS2000, and the surveying and mapping data under two sets of coordinate systems can be obtained.

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REFERENCES

[1] Website of National Bureau of Surveying and mapping. China launched CGCS2000 on July 1[J]. Land & Resources, 2008(7):48-49.

[2] Anonymous. Profession Standard Of The People's Republic Of China:Code for urban surveyCJJ 8-99[M].2011.

[3] Yong Lei, Lihui Wang, Zecheng Wang. on the establishment of urban independent coordinate system in Bijie City Center[J]. Journal of Liupanshui Normal University, 2014(6):13-16.

[4] Lei Qiu, Yuanhong Chen, Zhimin Yang. Change of The Cadastral Parcel Area Caused by CGCS2000 coordinate system Conversion [J]. Urban Geotechnical Investigation & Surveying, 2016(5):123-125.