

QUALITY ASSESSMENT AND ANALYSIS FOR THE ONE STATUS MAP (CORE AREA) OF HOUSING THEMATIC DATA

Su Yin, Hai Li *, Chunxi Chen, Jin Zhou, Bingquan Yao

National Quality Inspection and Testing Center for Surveying and Mapping Products, Beijing, 100830, P.R.China –
29292638@qq.com

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ABSTRACT:

A systematic solution to the one status map (core area) of Beijing - housing thematic data (hereinafter referred to as "the one status map (core area) of housing thematic data") aims to provide housing thematic data with full coverage, high precision, dynamic update and attribute integration, and has the characteristics of "accurate data, fast update, complete attributes and multiple classifications". This paper makes full use of relevant standards and specifications, combined with internal specifications related to data processing and quality evaluation. Based on the analysis of the characteristics and technical requirements of the data, this paper puts forward a quality evaluation system suitable for the data, including quality elements, quality measurement and quality evaluation, so as to provide technical guarantee for ensuring the quality of achievements.

1. INTRODUCTION

A systematic solution for the one status map (core area) - housing thematic data aims to meet the demand for comprehensive geographic information analysis and decision-making services. It is produced by integrating data such as housing census, geographic national survey and monitoring, topographic map, place name census and internet on the basis of overall consideration of various data relations and inheriting the advantages of existing data (Duan et al., 2020).

Starting from the needs of users, based on the analysis of the achievement quality characteristics of housing thematic data in the one status map (core area), a complete achievement quality evaluation system is formed. First, considering different quality evaluation indicators, quality elements and quality sub elements are proposed to describe the quality composition of housing thematic data in the one status map (core area); second, based on the study of production processing flow, quality evaluation method and other relevant contents, form a method suitable for evaluating the quality.

2. ACHIEVEMENT CHARACTERISTICS

2.1 Scope

The housing thematic data in the one status map (core area) covers the core area of Beijing, i.e. The east and west city, with a total area of 92 square kilometers, including 42 square kilometers of the east city and 50 square kilometers of the west city. With reference to the 1:500 topographic map grid (about 40 pieces/block), the operation blocks are divided according to the principle of dividing along the road, with a total of 60 blocks, including 26 blocks of the east city and 34 blocks of the west city.

2.2 Composition

The housing thematic data in the one status map (core area) mainly include four layers, as shown in table 1.

Name	Remarks
Rejected Construction Area	Calibration rejection area in 3d mesh model
Occupied House	Integration of topographic map, housing and general registration, housing and general unregistered, national and general formation
Room On Room	Fusion building upstairs of housing census
Ancillary Buildings	Formation of house ancillary facilities and road ancillary facilities integrated with topographic map

Table 1. Composition of housing thematic data in the one status map (core area).

3. QUALITY COMPOSITION

3.1 Quality Elements

The quality elements and inspection contents of housing thematic data in the one status map (core area) are shown in table 2 (General Administration of Quality Supervision, Inspection and Quarantine of P.R.China, Standardization Administration, 2008).

* Corresponding author

Serial number	Mass element	Mass sub element	Check item	Inspection content
1	Spatial reference system	Geodetic datum	Coordinate system	Check whether the coordinate system meets the requirements
		Map projection	Projection parameters	Check whether the parameters of map projection meet the requirements
2	Position accuracy	Plane accuracy	Geometric displacement	Check the number of feature geometric position offset overruns
			Vector edge	Check the number of edge errors in the geometric position of features
3	Attribute precision	Attribute correctness	Attribute value	Check the number of attribute value errors and omissions. Include errors where attribute values do not meet edges
4	Integrity	Surplus	Redundant elements	Check the number of redundant elements. Including non-current layer elements, that is, elements are misplaced
		Omission	Element omission	Check the number of missing elements
5	Logical consistency	Conceptual consistency	Attribute item	Check whether the attribute item definition meets the requirements (such as name, type, length, order, etc.)
			Dataset	Check whether the data set (layer) definition meets the requirements
		Format consistency	Data organization	Check whether the data file storage organization meets the requirements
			Data format	Check whether the data file format meets the requirements
			Data file	Check whether the data file is missing, redundant and unreadable
			File naming	Check whether the data file name meets the requirements
		Topological consistency	Coincidence	Check the number of non-coincident errors
			Repeat	Check the number of duplicate features
			Connect	Check the number of errors that elements are not connected
			Continuity	Check the number of errors of discontinuous elements (such as false nodes, etc.)
			Interrupt	Check the number of unbroken errors of features (such as intersection should be broken but not broken, etc.)
6	Time accuracy	Current situation	Source	Check the current status of the original data
			Outcome data	Check the current situation of achievement data
7	Characterization quality	Geometric expression	Geometric anomaly	Check the number of feature geometry exceptions. Such as extremely small unreasonable surface or extremely short unreasonable line, broken thorn, back line, adhesion, self intersection, jitter, etc
		Geographical expression	Element relationship	Check the number of errors in the feature relationship. Such as room to room
8	Accessory quality	Metadata	Item error and omission	Check the number of errors and omissions of metadata items
			Content error and omission	Check the number of errors and omissions in each content of metadata
		Attached documents	Integrity	Check the completeness of the attached data of the unit's achievements
			Correctness	Check the correctness of the attached data of the unit's achievements

Table 2. Inspection contents of housing thematic data in the one status map (core area).

3.2 Inspection Contents and Methods

3.2.1 Spatial Reference System: The inspection of spatial reference system includes geodetic datum and map projection. The spatial reference system of data is checked by manual inspection to verify whether the quality of results meets the requirements of technical design.

3.2.2 Position Accuracy: The inspection of position accuracy mainly adopts the method of man-machine mutual inspection, combines and compares the data with satellite photos and 3d mesh model results, and checks the number of house geometric position offset exceeding the limit; check the number of errors in the geometric position of the house. The plane accuracy index requirements are shown in table 3.

Data Sources	Plane Accuracy	
3d Mesh Model	1m	50% relaxation in difficult areas (bungalow areas)
Satellite Image	5m	
Topographic Map Rejection and Uncovered Area	5m	

Table 3. Quality requirements for plane accuracy.

3.2.3 Attribute Precision: The inspection of attribute accuracy mainly adopts the methods of man-machine mutual inspection and reference comparison, which is compared with the results of 3D mesh model, housing general data and 1:500 topographic map data to check the number of errors and omissions of house attribute values, including the error that the attribute values are not connected. Focus on the following aspects:

(1) The correctness of the number of floors and the requirements of stratification accuracy index are shown in table 4.

Data Sources	Layering Accuracy	
3d Mesh Model	Obvious judgment	Ensure consistency
	Difficult to judge (such as villa thermocline, large gymnasium, exhibition hall, etc.)	Number of floors inheriting topographic map, house census and other data
	Complex and special-shaped buildings	The stratification error of the main body of the house shall not be greater than 2 floors, which can be relaxed under special circumstances
Satellite Image	Relevant information available	Number of floors inheriting topographic map, house census and other data
	No relevant information	Field verification

Table 4. Quality requirements for layering accuracy.

(2) Correctness of feature element classification.
(3) Rationality of building structure and use type classification.

(4) Inherit the correctness of some authoritative attributes of the housing management department, such as the place name, address, use type, construction age, etc.

3.2.4 Integrity: The integrity inspection includes redundancy and omission, mainly by means of man-machine mutual inspection and reference comparison to check whether there are missing houses; check whether there are redundant houses, including houses not on this floor, that is, the houses are placed on the wrong floor. Focus on the following aspects:

(1) Collection integrity, such as ground buildings and temporary buildings on the roof (simple houses on the house), building top structures belonging to the main body of the building (permanent houses on the house), etc;
(2) Layered integrity, the correctness of the division of parts belonging to different heights of the same building.

3.2.5 Logical Consistency: Logical consistency check includes concept consistency, format consistency and topology consistency.

(1) Conceptual Consistency: Concept consistency check is to check whether the definition of data set meets the requirements by means of man-machine mutual check; Check whether the attribute item definition of each layer (such as number, name, type, length, etc.) Meets the requirements.
(2) Format Consistency: Format consistency check is to check whether the data file storage organization, data format, file name, etc. Meet the requirements by means of man-machine mutual check; Check whether the data file is missing, redundant, and the data cannot be read out.
(3) Topological Consistency: Topology consistency check is to check whether the coincidence, repetition, connection, continuity, interruption and closure of data are correct by means of man-machine mutual check and software automatic check.

3.2.6 Time Accuracy: The inspection of time accuracy includes two aspects: the current situation of original data and the current situation of achievement data. Manual inspection is mainly used to check whether the time identification of original data meets the requirements; check whether the result data are produced according to various reference materials that meet the requirements.

3.2.7 Characterization Quality: The inspection of characterization quality includes two aspects: geometric expression and geographical expression. It mainly adopts the methods of man-machine mutual inspection and software automatic inspection to check the number of abnormal geometric figures of houses; check the number of errors in the house relationship (such as room on room).

3.2.8 Accessory Quality: The inspection of attachment quality includes metadata and attached documents. It mainly adopts the method of man-machine mutual inspection to check whether the metadata items and contents are wrong or missing; check whether the attached documents (including professional technical design, inspection report, technical summary, etc.) Are complete and correct.

3.3 Quality Evaluation

3.3.1 Evaluation Process

(1) Sampling: The method of stratified and proportional random sampling is adopted, and the samples are randomly selected in

each floor according to the urban distribution (Dongcheng District and Xicheng District), regional type (bungalow district and non bungalow District), complexity, house density and other factors in the batch results.

(2) Comprehensive Overview: The overview inspection focuses on the spatial reference system, logical consistency, time accuracy and accessory quality. The overall inspection of 60 operation block units is mainly carried out by means of automatic software inspection, means of production verification and internal inspection.

(3) Detailed Sampling Survey: The detailed survey focuses on location accuracy, attribute accuracy, integrity and characterization quality, and mainly uses the methods of human-computer interaction inspection and reference comparison to check all inspection items of the sample one by one.

Adopt the method of combining internal and external work, arrange tasks according to the principle of "focusing on internal work and supplemented by external work", and supplement field work verification for areas where there is lack of relevant data in internal work and the data on the map is difficult to identify or in doubt, so as to ensure the accuracy of housing thematic data in the one status map (core area).

3.3.2 Quality Evaluation Method

(1) Quality Sub Element Scoring Method: Each quality sub element sets the error rate limit r_0 according to its importance and quality requirements. When the error rate r exceeds its error rate limit r_0 , the quality sub element is directly determined as unqualified; When the error rate r is less than the tolerance r_0 , the quality sub element scoring method shall be carried out according to formula (1) (General Administration of Quality Supervision, Inspection and Quarantine of P.R.China, Standardization Administration, 2008).

$$S = 60 + 40/r_0 \times (r_0 - r) \quad (1)$$

where S = quality sub element score value
 r_0 = error rate limit
 r = error rate

(2) Quality Element Scoring Method: The scoring method of quality elements shall be carried out according to formula (2) (General Administration of Quality Supervision, Inspection and Quarantine of P.R.China, Standardization Administration, 2008).

$$S_1 = \min(S_{2i}) \quad (i = 1, 2, \dots, n) \quad (2)$$

where S_i = quality element score value
 S_{2i} = score value of the i -quality sub element
min = minimum value
 n = number of quality sub element

(3) Unit Achievement Quality Score: The weighted average method is used to calculate the quality score of unit achievement. The unit achievement quality score shall be carried out according to formula (3) (General Administration of Quality Supervision, Inspection and Quarantine of P.R.China, Standardization Administration, 2009).

$$S = \sum_{i=1}^n (S_{1i} \times P_i) \quad (3)$$

where S = score value of unit achievement
 S_{1i} = score value of the i -quality element
 P_i = the weight of the i -quality element
 n = number of quality element

4. PROBLEMS AND ANALYSIS

Sampling inspection was conducted according to *GBT 18316—2008* (General Administration of Quality Supervision, Inspection and Quarantine of P.R.China, Standardization Administration, 2008), and a total of 7 operation blocks were selected. The scores of main quality elements are shown in figure 1.

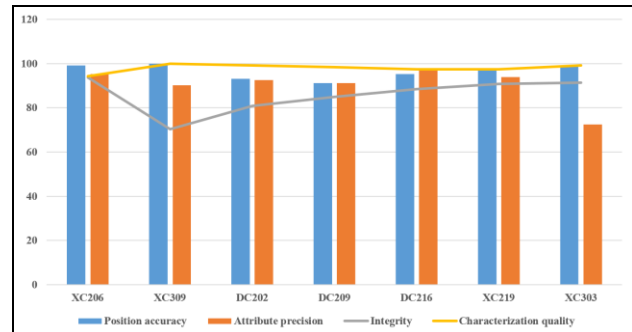


Figure 1. Scoring statistics of main quality elements.

If the score of the inspection item is lower than 60, the weighted solution will not be carried out, and the unit result is unqualified; On the contrary, the weighted average method is used to calculate the quality score of unit achievements as shown in figure 2.

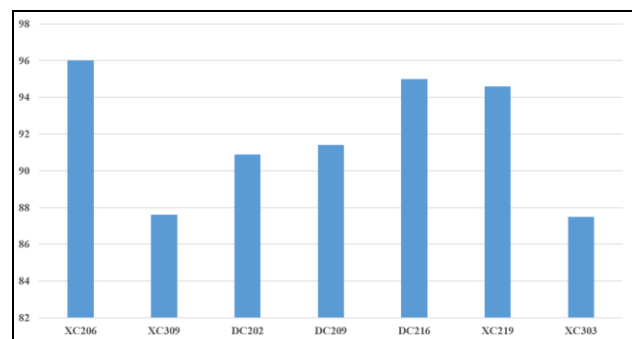


Figure 2. Statistics of unit achievement quality score.

For the inspection of the results of housing thematic data in the current picture (core area), it is necessary to grasp "two emphases, one difficulty and one update": the two emphases are to focus on the integrity of the collection of ground feature elements in the housing data in the core area, the correctness of single measurement stratification, the correctness of the classification of ground feature elements, and the correctness and rationality of the representation of main collection attributes (such as floor number and building structure); One difficulty is that there are still some problems to be improved, such as the corner of the house in the courtyard in the bungalow area, tree occlusion, the shadow area or tree occlusion of large ground objects in the non bungalow area, and the change of small

ground objects can not be found; One update is based on the current situation of satellite image update.

4.1 Position Accuracy Problem

The acquisition accuracy exceeds the limit, such as permanent houses with more than 5 floors and general houses in bungalow area; the collection methods and standards of location boundary line are not unified, such as the permanent upper room with imitation of ancient eaves. As shown in figure 3.



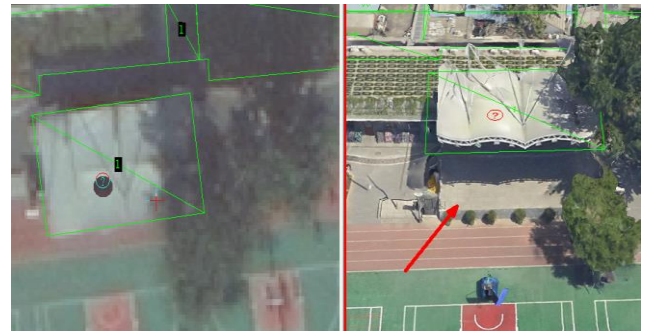
Figure 3. Position acquisition accuracy of permanent house exceeds the limit.

4.2 Attribute Precision Problem

The number of floors is obviously wrong, some exceed 2 floors, mainly including the number of floors of permanent houses and rooms above the house, which is inconsistent with the mesh model; the house type is wrongly divided, such as the playground podium is wrongly divided into ordinary houses; the termination floor and building structure are incorrect, such as the termination floor of suspended walkway is unreasonable, and the floating building structure is inconsistent with the main body. As shown in figure 4.



(a) The number of floors is wrong, and the fourth floor is wrongly filled as the fifth floor.



(b) The house type is wrong, and the playground podium is wrongly divided into ordinary houses.

Figure 4. Attribute accuracy.

4.3 Integrity Issues

Missing houses, such as permanent houses and large-scale simple houses on the roof of multi-storey houses; general houses for missing or surplus collection; omit to collect the shed and corridor that meet the index; the selection criteria of individual acquisition objects are inconsistent, such as redundant acquisition door top. As shown in figure 5.



Figure 5. Missing permanent room.

4.4 Other Issues

There are a few minimal planes and lines self intersecting; the above ground start and end floor marks of the house on the roof of the permanent house are unreasonable; there are repeated collection of individual houses in the border area. As shown in figure 6.

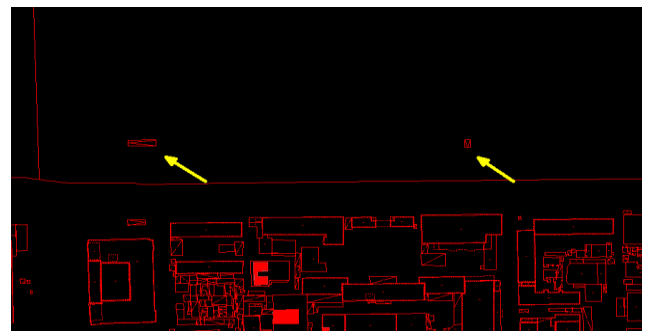


Figure 6. Repeated collection of houses connected to the border block.

5. CONCLUSION

This paper analyzes and determines the quality evaluation system for the result inspection of housing special data according to the characteristics of the result project of housing special data (core area), a systematic solution to the one status map of Beijing, and according to the production technical documents and the use of results, and comprehensively uses the methods of production material verification, internal inspection of results and reference data comparison (core area) check and accept the achievements and determine the quality of the achievements.

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