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Policy Innovation Paths in Conservation Measures for Historic Buildings in Cities and Towns and the Promotion of Sustainable Development

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Abstract Historical buildings are areas in a city with rich preservation of cultural relics and concentration of historical buildings, which can reflect the local traditional characteristics and historical features in a more complete and authentic way, and have high cultural and economic values. This study collects ground and aerial image data of historical buildings in towns and cities. After the two kinds of data are aligned and filtered, a 3D point cloud model of the historic buildings is constructed in Context Capture software, and the point cloud model is used as a platform to simulate and analyze the effect of the implementation of conservation measures. It is verified that the point cloud data model constructed has a high applicability with a maximum error of only 2.54cm and -2.98cm in plane accuracy and height. The simulation analysis reveals that the increased measures on the exterior walls and roofs of the selected historic buildings can ensure that the indoor temperatures of the historic buildings can maintain the appropriate temperatures in both cold and hot temperatures. Based on the research and analysis, this paper proposes a policy innovation path in the conservation measures of historic buildings in towns that can improve the efficiency and scientificity of historic building conservation and promote the sustainable development of historic building conservation.

Index Terms point cloud data, Cloud Compare, conservation measures, urban historical buildings, sustainable development

I. Introduction

Urban renewal is one of the important issues in contemporary urban development. With the continuous advancement of urbanization, the appearance of cities has changed dramatically, and many traditional historical buildings have been destroyed or neglected because of the need for renewal. How to protect historical buildings in the process of urban renewal has become a common concern of the community [1]-[4]. As the treasure of a country's cultural heritage, historical buildings carry rich historical information and unique artistic value. However, with the passage of time and the influence of natural disasters, many historic buildings are facing increasingly severe conservation challenges [5]-[8]. In order to protect these valuable heritages and ensure that future generations can appreciate the charm of historic buildings, we need to adopt a series of scientific and effective measures [9], [10].

As an important part of the world's cultural heritage, the conservation of historic buildings is not only related to the safety of a single building, but also to the cultural heritage and the dissemination of the national image [11], [12]. Through a series of measures such as the establishment of specialized institutions, the formulation of laws and regulations, the provision of adequate financial support, scientific restoration techniques, the improvement of monitoring systems, the enhancement of safety and fire prevention facilities, the prevention of natural disasters, safety education and awareness-raising activities, rational use and management mechanisms, and the promotion of relevant research and the application of innovative technologies, historic buildings can be better protected for their continuity and inheritance [13]-[16]. Such protection measures can not only guarantee the safety of historic buildings, but also help to enhance people's sense of identity and cultural self-esteem of historic buildings [17].

Zhu,X. et al. affirmed the important value of historical buildings, and based on the protection of historical buildings and human settlements to Wuhan Tanhualin Street as a research object, the local culture into the architecture and environment, to create a street full of local characteristics [18]. Vicente, R. et al. emphasized the importance of historic buildings, outlined the methods of diagnosis and seismic evaluation of historic buildings through case studies, and discussed the design of retrofit and strengthening works [19]. Fung, I.W. et al. aimed to understand the differences between Hong Kong and Macao in terms of history, policies, etc., so as to propose strategies to improve the protection system of historic buildings. It was found that there are major differences between Hong Kong and

Macau in terms of legislative development and scope of protection [20]. Bertolin, C. et al. aim to integrate a life cycle approach within a framework based on the principles of architectural conservation to assist in dealing with "green" maintenance and adaptation interventions for historic buildings. It facilitates the selection of the right time of intervention, reduces the decay rate of the building and helps to reduce the carbon footprint, supporting the preservation needs of the building through a minimal intervention approach [21]. Yuk, H. et al. examined the indoor environmental conditions of Stimson Hall. The effects of variables such as use plan and occupant type on indoor climate were emphasized, as well as the potential advantages and disadvantages of retrofit strategies on energy consumption and thermal comfort [22]. Gupta, A. et al. emphasized that the primary motivation for historic restoration is education. It was also pointed out that by concentrating on the preservation of historic buildings, the preservation of cultural and traditional values is thus achieved and the building techniques and materials best suited for their survival are identified [23].

This paper relies on point cloud technology to realize the construction of point cloud models of urban historical buildings and the simulation analysis of the effect of the implementation of conservation measures, and proposes a policy innovation path for the conservation of urban historical buildings based on this technology. In this paper, drones and scanners are used to collect low-altitude photogrammetric information and near-ground photogrammetric point cloud data of historical buildings in towns and cities, and the alignment of the two kinds of point cloud data is realized in Cloud Compare processing software, which lays the foundation for the construction of the subsequent point cloud model. Subsequently, the point cloud data are enhanced by filtering algorithm, and the processed data are imported into Context Capture software to reconstruct the point cloud 3D model of the historical buildings in the town. In this study, the accuracy of the point cloud model is determined by experiments, and then the simulation analysis of the implementation of the conservation measures of historic buildings is carried out by combining with the point cloud model of historic buildings in order to seek for the best conservation and repair measures. Finally, based on this technique, we propose policy innovation paths in the conservation measures of historic buildings to promote the sustainable value of historic buildings.

II. Point cloud modeling of historic buildings in towns and cities

II. A. Historical Building Point Cloud Data Acquisition and Processing

In order to complete the mapping and archiving of the town's historical buildings and to ensure that the point cloud information of the town's historical buildings obtained at a later stage meets the requirements, under the premise of meeting the various parameters, the camera and drone equipment are used to collect the point cloud data of the town's historical buildings in the field. After using the scanning equipment to carry out field data acquisition of historical buildings, the point cloud data obtained is saved in the SD card built-in the scanning equipment. After the end of the fieldwork, the SD card is used to quickly transfer the collected point cloud data to the computer, and at the same time, the point cloud data processing software is used to carry out point cloud data related processing operations on the acquired point cloud data of the ground historical buildings, so as to preliminarily complete the processing of the point cloud data.

II. A. 1) Low-altitude photogrammetric information acquisition

The low-altitude photogrammetric information acquisition work is realized based on the gimbal camera mounted on the UAV equipment, which has a swivel range of -90 degrees to 35 degrees, and is capable of acquiring the multi-angle image data required for point cloud model reconstruction. The information acquisition work requires to improve the shooting quality and reconstruction accuracy as much as possible under the premise of controlling the working cost. The DJI Mavic 2 pro selected for the low-altitude photogrammetric information acquisition equipment in this paper is equipped with advanced dual inertial measurement units (IMUs) [24] and a global navigation satellite system (GNSS) [25], so that the acquired image data have more accurate attitude and position information, and also provide accurate external orientation elements for the later model reconstruction work.

The UAV information acquisition work is under the pre-set flight altitude, using the gimbal camera and the camera attitude conversion, to shoot multi-view images with high overlap rate, including vertical, front-back-left-right five tilted views. Among them, the appropriate flight altitude is one of the control parameters for the clarity of image detail expression and the accuracy of matching with ground image details in the later stage.

II. A. 2) Near-surface photogrammetric information acquisition

The near-ground photogrammetry work is based on the digital camera equipment to capture the elevation image of the target building at a close distance. In this paper, the near-ground photogrammetry uses Nikon D750 camera, which has about 24.32 million effective pixels FX-format CMOS, EXPEED 4 image processor, 51-point focusing system, and about 91,000 pixels RGB sensor, which is very balanced in all aspects of performance, and is more lightweight, which is of great advantage in the large range of information collection work. The near-ground camera shooting work is synchronized with the drone shooting work. It should be noted that, in order to ensure that the matching accuracy of aerial images and ground images in the later data processing work meets the reconstruction requirements, the near-ground photography and low-altitude photography should have similar shooting frequency, the acquisition path and the building elevation are set in parallel to each other, and the overlap rate of each photo is maintained at about 80%. Taking the barracks of the road guard as an example, the image acquisition points of the building are set in two rows of 5m and 10m away from the front façade of the building, and 2-3 pictures are collected at each point, which facilitates the image orientation and model connection during the processing steps and ensures the success rate of façade matching. In order to ensure that the image acquisition of the two data sources is under the same conditions of light intensity, and the shadows of the surrounding objects are minimally mapped on the target, the windless weather is the first choice, and it is completed at one time between 10:00 and 15:00. In addition, too much difference between the two shooting angles can cause the problem of post reconstruction failure, and the camera lens of the near-ground photogrammetry needs to be facing the building façade or lowering the shooting angle.

Compared with aerial photogrammetry, the advantage of near-ground photogrammetry is that it can supplement aerial photogrammetry to obtain clear images of areas in traditional villages that are covered by obstacles such as trees and fences, as well as complex decorative details that are difficult to obtain, which guarantees the accuracy of the reconstruction of the model at a later stage.

II. A. 3) Multidimensional data alignment methods

In this paper, the two mapping techniques of air and land are combined with each other to map historical buildings in towns and cities, so that the information of historical buildings can be obtained in a more complete way. The image data obtained by using UAV inclined photogrammetry and the laser point cloud data obtained by using terrestrial 3D laser scanning belong to both different sources and different types of data, and due to the difference in the location of the data acquisition instruments, one is in the air and the other is on the ground, and the common area between these two types of data is very small in comparison with the two types of data, so it is the key point of utilizing multi-source data to survey and map historical buildings by combining the two types of data with each other. The combination of these two heterogeneous data is the key point of utilizing multi-source data for mapping historical buildings.

When aligning multi-source data, firstly, the aerial image data are converted into aerial point cloud data, and then the coordinate systems of the converted aerial point cloud data and ground point cloud data are unified into the same coordinate system, and then the coarse alignment of the two sets of point cloud data can be carried out. Because the overlap between the UAV point cloud data and the ground point cloud data is very low, the position of the aerial point cloud and the ground point cloud is adjusted by selecting similar data points in the common area of the two groups of point clouds, and the data are initially adjusted to roughly match. Finally, the two groups of point clouds are finely aligned. When aligning, the UAV point cloud data can be used as the base, and the ground point cloud can be shifted to complete the alignment of the UAV and ground point cloud data. After the alignment is completed, view the alignment results, if the error does not meet the accuracy requirements, the point cloud fine alignment work can be repeated several times. The specific operation process is as follows.

(1) Post 4 or more pieces of target paper in different directions of the building, and use the total station and 3D laser scanner to measure the target paper respectively.

(2) The point coordinates of the center point of the target paper measured by the total station are exported and converted into a format that can be recognized by the point cloud post-processing software.

(3) Align the point cloud data with the target paper acquired by the 3D laser scanner to the ground 3D laser point cloud data of the courtyard at No. 44 South Market Street.

(4) Import the coordinates of the center point of the target paper into the newly obtained point cloud data in the previous step, and align the point cloud data to the geodetic coordinate system.

(5) Convert the point cloud data with attached coordinates to xyz format and import them into CloudCompare together with the aerial point cloud data for alignment.

II. B.Historical building point cloud modeling methods

The reconstruction effect of the point cloud model for the protection of urban historical buildings [26] is determined by the color uniformity, brightness, and sharpness of the input image data. Although the low-altitude and near-surface photography work in this paper was completed in the same time period, it is still difficult to avoid the differences in color, brightness, and other parameters between images. Therefore, before the image data fusion work, the exposure degree, color difference and blurring degree of the image of the group of acquired images. The images with large differences in exposure and blurring are eliminated to ensure that a 3D model with better texture and color mapping is obtained later.

In this paper, the filtering algorithm of multi-scale retinex (MSR) is applied to the enhancement of two data source images to obtain image data with uniform color, brightness and exposure approximation. Its formula is:

$$m_{in}(x,y)=\sum_{i=1}^{n}w_n r_{in}(x,y) \tag{1}$$

where m is the output image of the i st band of MSR, n is the n rd scale, w_n is the weight of the enhancement result of the n th scale corresponding to the single scale retinex filtering algorithm (SSR), and $\sum_{i=1}^{n}w_n=1$. In this paper, $n=3$, $w_1=w_2=w_3=1/3$, the algorithm has significant results in the processing of color images for enhancement, defogging, and color recovery.

The pre-processed image data are imported into Context Capture software for 3D reconstruction, the principle of Context Capture software model reconstruction is to obtain the out-of-camera orientation element (EO) of each image through the aerial triangulation (AT) function on the basis of accurate attitude parameters and camera attributes of each data set, i.e., to clarify the projection of the same feature positions in the real scene by pixel points in each image. corresponding to the projection of the position of the same feature point in the real scene. Since the digital camera used in this paper does not have GPS function, the image data obtained lacks positioning information and cannot be given enough out-of-camera orientation elements to recover the image position and reconstruct the 3D model. Therefore, the matching of feature points is accomplished by the following steps: first, the Block1 block containing digital camera images and the Block2 block containing UAV images are created in the ConextCapture software, and the disordered images are arranged according to the real spatial location to obtain block1-AT and block2-AT, respectively; once again, in the block2-AT, the images are arranged according to the real spatial location to obtain the Block1-AT and Block2-AT. block2-AT, six connection points will be set on the same feature points as in the ground photographic images, and the number of images set on each connection point is 10-15 images is preferred. Next, it is imported into block1-AT as a control point for data matching, and matching and checking are performed. Finally, aerial triangulation of block1-AT was done again to obtain block1-AT-AT and merged with block2-AT.

Due to the large differences in computer performance, in order to ensure that the computer's processor can meet the computational requirements of model reconstruction, the overall model needs to be divided into a certain number of model tiles according to the computer's memory size through the adaptive block slicing function of the CC software. Next, the 3D reconstruction of each tile is carried out separately, and the specific steps include dense point cloud generation, TIN triangular mesh establishment and texture mapping, and finally the 3D point cloud model of the target area is obtained and exported to the las point cloud format. During the process of data fusion, the inaccurate setting of connection points and the lack of image information can easily cause the problem of 3D reconstruction failure, which can be corrected by resetting another feature point with obvious characteristics, and then repeat the reconstruction step.

III. Analysis of the simulation effect of historic building preservation under point cloud technology

III. A. Accuracy Analysis of Point Cloud Models of Historic Buildings

III. A. 1) Overview of the experiment

In this paper, we rely on a historical building mapping and archiving project in a town of M city as a simulation application project to explore the accuracy of the multi-source data point cloud model, and lay down the data support for its implementation in the innovative path of urban historical building preservation policy. The point cloud data model simulation test practice selected project involves a total of five town historical buildings need to carry out the measurement of historical buildings, the main unit of these five historical buildings contains a total of 96 historical buildings. Most of the historical buildings for the mapping and archiving work in the experiment are the first batch of key protection buildings designated in M city, and their locations are mainly distributed in the old neighborhoods of five districts and counties in M city, which have a strong historical heritage, are the birthplace of M city's culture, and carry the historical memories of the city's development.

(1) Ground Data

The ground measurement project is fine and comprehensive to collect and record detailed data on the current situation of each district and county where the historical buildings are located, and the specific work is shown in

Table 1. The survey photos of the selected historical buildings in the towns totaled 605, and the size of the point cloud data and the three-dimensional real view model were 476.2GB and 26.13GB respectively.

Table 1: M city historical building surveying and mapping construction project overview

Zoning	A	B	C	D	E	Total
Building number	36	48	5	2	6	97
Figure point control point	29	31	5	3	7	75
Dot cloud data size (GB)	226.35	214.52	16.84	5.23	13.26	476.2
Three-dimensional concrete model (GB)	15.26	8.52	0.65	0.78	0.92	26.13
Floor plan	89	115	6	4	8	222
elevation	56	84	7	2	6	155
Sectional view	45	49	3	3	10	110
Sample diagram	49	60	2	2	5	118
Survey photograph	239	308	18	11	29	605

(2) Aerial survey data

The UAV aerial photography line was designed using the Trail Master software in accordance with the requirements of 80% overlap in the side direction and 80% overlap in the heading direction. The experiment actually completed 13 flights of aerial workload, multiple historical buildings are located in centralized and contiguous, then combined with a flight to perform aerial aerial survey work, aerial aerial survey workload, each flight of aerial aerial survey calculated measurement of the ground resolution as shown in Table 2. 5 towns and cities of historical buildings of the route length of 2.37km, 2.23km, 2.78km, 2.59km, and 2.01km, respectively. The aerial survey route of the historical buildings is laid around the route according to the aerial photography sub-area. After the ground station software check and UAV self-check are completed to ensure that there are no abnormalities, the UAV will be cut into the auto-pilot state and take off automatically, and the UAV will start to fly according to the designed route, while the ground supervisory staff monitors the UAV flight attitude through the ground station. When the route shooting is finished, the UAV will automatically return to the takeoff location. After the flight, download the POS data and image data, and organize the POS data, image data, route file and aerial photography parameter file.

Table 2: Navigational parameters

Historic building code	Relative altitude (m)	Flight area (m^2)	Route number	Number of photos	Course length (km)	Ground resolution (cm/ pixels)
A	67.19	27440.09	8	172	2.37	0.48
B	107.85	24664.72	10	102	2.23	0.5
C	70.72	21697.34	6	127	2.78	0.53
D	105.65	16271.72	7	127	2.59	0.49
E	109.74	25077.77	6	245	2.01	0.6

III. A. 2) Point cloud model accuracy analysis

After the fusion of ground and airborne multi-source data is completed, the external work uses a total station set up on the known control points to carry out repetitive measurement of the feature points of each historical building for pointing check. The internal work selects the feature points checked by the external work from the 3D point cloud model entity after data fusion to obtain the coordinate information. The position and elevation accuracy of the fused point cloud model is counted by calculating the positional difference between the plane position and elevation of the above checked points, and the plane position and elevation accuracy of each historical building is counted separately. The calculation and analysis results of the plan position and elevation components of the point cloud model, taking some point cloud data in the historic preservation building A of the town as an example, are shown in Table 3. The plane measurement errors and elevation measurement errors of the 20 selected point cloud data points are between 0.5m~2.0m and 0m~2.0m, respectively, and the point cloud data measurement errors are small.

Table 3: Analysis of the precision of cloud model of a point in historic building A

Dot	Three-dimensional point cloud (m)			Actual value (m)			ΔS	ΔH
	X	Y	H	X	Y	H		
S1	2700003.03	510015.70	1863.18	2700003.14	510015.53	1863.98	0.8	0.8
S2	2700008.09	510010.93	1851.22	2700008.27	510011.11	1849.62	1.9	-1.6
S3	2700000.55	510016.19	1854.93	2700000.38	510016.39	1854.03	0.9	-0.9
S4	2700008.40	510006.28	1866.53	2700008.28	510006.22	1864.83	0.7	-1.7
S5	2700006.62	510014.80	1852.73	2700006.53	510014.91	1854.73	1.3	2
S6	2700009.03	510006.87	1863.91	2700008.90	510006.86	1865.51	0.8	1.6
S7	2700006.84	510010.09	1852.58	2700006.83	510010.10	1853.58	1.2	1
S8	2700003.58	510001.70	1866.62	2700003.50	510001.72	1866.22	0.7	-0.4
S9	2700000.22	510015.18	1862.62	2700000.32	510015.24	1864.02	1.1	1.4
S10	2700001.97	510016.21	1854.33	2700002.01	510016.33	1852.63	1.5	-1.7
S11	2700008.80	510010.52	1852.21	2700008.98	510010.70	1852.81	2	0.6
S12	2700008.62	510014.86	1858.14	2700008.58	510014.80	1858.94	0.8	0.8
S13	2700000.69	510001.59	1859.27	2700000.61	510001.79	1857.87	1.5	-1.4
S14	2700008.41	510012.47	1852.07	2700008.33	510012.63	1854.07	1.8	2
S15	2700008.77	510005.29	1863.19	2700008.86	510005.28	1861.69	0.5	-1.5
S16	2700007.93	510004.21	1859.6	2700007.95	510004.21	1860.6	1.8	1
S17	2700002.41	510005.03	1853.97	2700002.36	510004.98	1853.97	1.8	0
S18	2700007.47	510015.75	1858.7	2700007.60	510015.87	1858.4	1.5	-0.3
S19	2700007.07	510004.59	1864.41	2700007.15	510004.54	1864.01	1.2	-0.4
S20	2700002.92	510005.89	1854.64	2700002.80	510005.74	1856.24	1.6	1.6

After the completion of the point cloud model planar position and elevation accuracy statistics of each historical building, the overall accuracy of the point cloud model of historical buildings in each district and county is combined.The results of the analysis of the planar position and elevation accuracy of the point cloud model of the historical buildings in five cities and towns are shown in Table 4. The maximum errors in the planar absolute accuracy detection and elevation accuracy detection are 2.54cm and -2.98cm respectively, which indicates that the accuracy of the 3D point cloud model results after the experimental multi-source data fusion meets the point cloud scanning accuracy of CH/Z 3017-2015 “Ground-based 3D Laser Scanning Technical Regulations”, which stipulates that the accuracy of point cloud scanning accuracy of ground-based 3D laser scanning and the technical indexes as follows The point cloud precision requirement of “third class” is met. It meets the requirements for the detection error in the digitization grade of historical buildings “Grade I” in the Technical Standards for Digitization of Historical Buildings.

Table 4: Point cloud model plane position and height accuracy analysis

Project		Historic building				
		A	B	C	D	E
Plane absolute accuracy (cm)	Permissible error	10	10	10	10	10
	Maximum error	2.15	2.36	2.54	2.09	1.94
	Middle error	1.23	1.25	1.42	1.03	0.96
	Check total points	85	69	57	52	63
Elevation accuracy (cm)	Permissible error	10	10	10	10	10
	Maximum error	-2.62	-2.54	-2.98	-2.51	-2.31
	Middle error	1.36	1.52	1.24	1.62	1.32
	Check total points	85	69	57	52	63

III. B. Simulation analysis of historic building preservation in towns and cities

III. B. 1) Simulation results of historic building wall preservation

M city is located in the cold region of China, so the thermal insulation of historic buildings should be taken into account in the implementation of conservation measures and policy making. In this paper, the historical building A in the above analysis is selected as the case study object, and based on the point cloud model of the historical building, the physical properties of the materials of the historical building structure and the thickness of the combination of thermal insulation materials are quickly optimized in DeST-h software to achieve the protection and sustainable development of the historical building. Through analysis and comparison, we can optimize the selection of exterior wall insulation materials and thickness. The results of the temperature simulation analysis of the external wall of the historical buildings with and without thermal insulation materials are shown in Figure 1. In the simulation results, it can be found more intuitively that the average temperature inside the external wall before and after adding thermal insulation in the external wall enclosure of the town historical building is -7.23℃ and -8.74℃, respectively. It shows that the measure of adding thermal insulation material can make the heat transfer coefficient of the town historical building reduce, and ensure that the temperature of the internal wall of the building is kept at a relatively high level. And it can provide data basis for energy saving and thermal insulation. In addition, the visualization of the performance analysis can ensure the intuition of the results, which is easier to understand for the main body of the conservation work of the historical buildings. The performance simulation analysis based on the point cloud model of urban historical buildings can effectively simulate the conservation effect of urban historical buildings. It is no longer necessary to re-input information and build models repeatedly, which reduces the time of the analysis cycle, achieves the professional service quality expected by the conservation work, and ensures the accuracy and efficiency of the decision-making in the urban historical building conservation project.

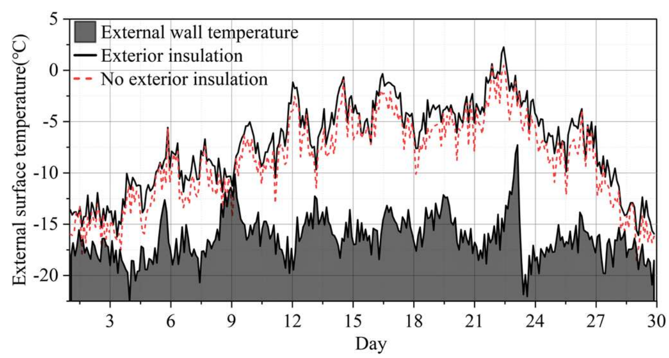


Figure 1: Simulation and analysis of the insulation effect of the building wall

III. B. 2) Simulation results of roof protection repair

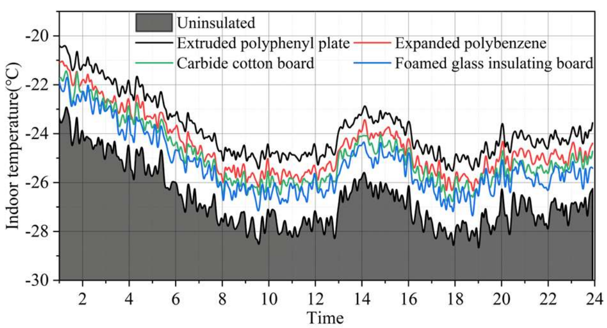
In the case study, the roof of the upper envelope of the historic town building is composed of purlin supports, trusses and small tiles, which work together with the floor and walls to form the interior space. The roof structure of the historic building opens up the interior to the outside world, and there is a constant 'communication' between the two. The form of the structure is very suitable for the former temperature, shielding the sunlight in summer and cooling the interior by circulating the wind in and out of the roof. In winter, the sunlight was taken in by the patio, and when the fire was warmed indoors, the smoke floated upward and seeped out of the roof. However, in terms of modern climate and living comfort requirements, there is no large temperature gradient between indoor and outdoor at high temperatures, resulting in a small difference between indoor and outdoor temperatures, and the roof of the building plays a lower role in the effectiveness of airflow circulation and exchange. At low temperatures, the cold winds from the outside world invade the roof and rapidly lower the indoor temperature. For the protection and repair of the roof of this historical building, the existing structure of the roof, whether in size or style, cannot be changed, and the same attempt is made to add thermal insulation materials to it. Historical building roof load-bearing is very limited, can be added to the size of the insulation material has limitations, need to select the appropriate size and insulation material types for roof repair and protection, insulation material parameters as shown in Table 5. The thermal conductivity of the foam glass insulation board is the largest, 0.074 $W/m \cdot K$. The thermal storage coefficient of rigid mineral wool board is the highest, 1.526 $W/m^2 \cdot K$.

Table 5: Insulation material parameter table

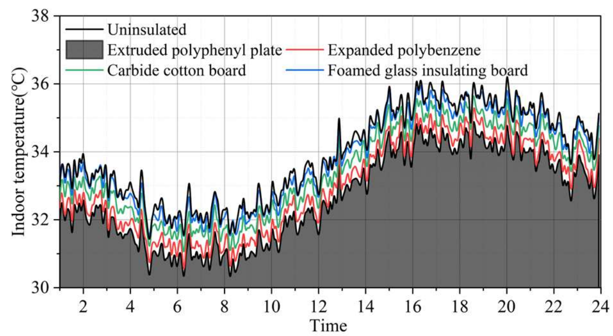
Name	Heat conductivity factor ($W/m \cdot K$)	Density (kg/m^3)	Constant pressure specific heat ($J/kg \cdot K$)	Steam permeability coefficient ($g/m \cdot h \cdot mmHg$)	Heat accumulation coefficient ($W/m^2 \cdot K$)
Extruded polyphenyl plate	0.036	28.5	1785.26	0.001	0.365
Expanded polybenzene	0.041	17.4	2451.63	0.001	0.412
Carbide cotton board	0.065	302.6	1365.26	0.001	1.526

Foamed glass insulating board	0.074	169.5	906.25	0.001	0.902

The results of the simulated implementation of the insulation roof protection measures for the historic buildings in the town are shown in Fig. 2, with (a) and (b) representing the results of the time-by-time room temperature analysis on the coldest and hottest days of the insulated roofs, respectively. The overall analysis results all show that the thermal insulation performance of the insulated roof is significantly better than that of the uninsulated roof. The indoor temperature is relatively high at low temperatures and relatively low at hot temperatures. On the coldest day, the average interior temperature of the historic building without roof insulation was -26.71°C, which was much lower than the average temperature with roof insulation (-25.31°C to -23.80°C). The average interior temperature of the historic buildings with roof insulation measures during the hottest day is between 32.65°C and 33.75°C. Meanwhile, it can be found that extruded polystyrene board performs the best among the insulation materials in the simulation calculation, and extruded polystyrene board is selected as the roof insulation material of the General Mansion in the materials of this study.



(a) Coldest day



(b) Hottest day

Figure 2: The temperature simulation analysis of roof insulation measures

IV. Innovative paths for architectural conservation policy based on point cloud technology

Assisting relevant organizations, coordinators and managers to clarify the significance of the protection of sites, and to break the dilemma of permanent neglect and architectural protection of historic buildings in towns and cities is the basis for the formulation and implementation of policies in the protection measures for historic buildings in towns and cities. The above analysis shows that the simulation protection method of urban historical buildings designed based on the point cloud model in this paper has strong application value, so this paper proposes the innovative realization path of policies in urban historical building protection measures based on this technology, and the specific path implementation process is shown in Figure 3. First of all, from the perspective of cognition of the value of urban historic buildings, an explanatory framework is provided for the rational protection and sustainable utilization of urban historic buildings. The policy formulation in the protection of historical buildings is based on the importance of historical buildings in the town to clarify the value of protection and sustainable development, and then value-oriented historical building protection measures are formulated. At the same time, the goal of value-oriented conservation measures is to maintain the diverse values of historic buildings in towns and cities, and to achieve sustainability through their revitalization and restoration, which effectively guide the effective conservation of historic buildings in towns and cities. Secondly, the point cloud technology proposed in this paper forms a guideline for the formulation of conservation measures for urban historic buildings. In the specific dimension of the conservation objectives, the conservation effect of urban historic buildings can be analyzed through simulation, the specific measures of conservation and repair can be clarified, and the relevant conservation policies can be formulated. Finally, the effective protection and sustainable development value of urban historical buildings can be realized through management implementation and monitoring.

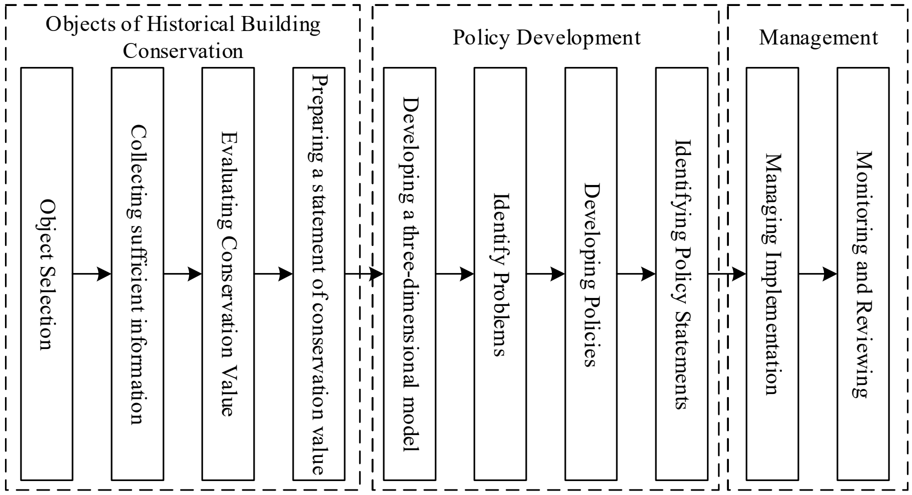


Figure 3: Historical and architectural protection measures policy innovation path

V. Conclusion

This paper constructs a 3D model of urban historical buildings based on point cloud technology, and verifies the accuracy of the point cloud model, and finds that the maximum errors of the planar position and elevation accuracy of the point cloud model of the five urban historical buildings are 2.54cm and -2.98cm, respectively, which are in line with the requirements of the error in the digitization of historical buildings. Combined with the model simulation to analyze the effectiveness of different measures in the protection of historic buildings in towns, it is found that before and after the addition of thermal insulation in the external wall enclosure of the historic buildings in towns, the average temperatures inside the external walls are -7.23℃ and -8.74℃ respectively, which indicates that the protective measure of adding wall thermal insulation can ensure that the temperature of the internal walls of the historic buildings can be maintained at a relatively high level. It is also found that the implementation of roof insulation measures in hot weather makes the average indoor temperature of historical buildings between 32.65℃ and 33.75℃, which is much lower than the temperature value without protection measures. Finally, through the confirmation and discussion of specific cases and practices, this paper puts forward policy innovation paths in the protection measures of urban historic buildings to help realize the effective protection of urban historic buildings, and at the same time, provides certain reference significance for the protection of historic buildings in Chinese cities and towns.

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