Study on Conservation and Reuse Planning of Tianjin Airport Historic Buildings

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Abstract—With the continuous development of Chinese civil aviation industry, the airport construction facilities built in different periods of time have suffered from the dilemma of idle, abandoned or even demolished, so it needs to be protected and utilized from the perspective of industry. Taking the historical buildings of Tianjin Airport as an example, this paper first expounds the development course of Tianjin Airport construction, and then delimits the protection scope and functional partition of the airport historical buildings by means of field survey and textual research, and then the AHP and Delphi method are used to evaluate the comprehensive value of the historic buildings of Tianjin Airport. Finally, according to the evaluation results, it is proposed to apply to the overall protection planning of the historic buildings of Tianjin Airport.

1. Development of Tianjin Airport
Tianjin Binhai International Airport, formerly known as "Zhang Guizhuang Airport ", is located in the area of Zhang Guizhuang Village, 13.3 km from Tianjin Station in the city center. Zhang Guizhuang Airport plays an important role in the development history of New China Civil Aviation and is the witness and place of many important historical events. At the same time, Tianjin Airport has complete aviation functions, with air transport, aviation education and other comprehensive functions, is the most complete existing airport buildings in China's inner city airport.

The construction process of Tianjin Zhang Guizhuang Airport is mainly divided into four stages: the period of Japanese puppet, the period of national government, the period of planned economy, and after the reform and opening up. Tianjin Airport was built in 1939, when the Japanese invasion of China in Tianjin County Zhang Guizhuang Village northeast, west of Daxinzhuang, Zhujiazhuang (now Dongli District Zhujiangzi) south of the Dawa built a large military airport with a circular scene as the main body. During the period of the National Government, Tianjin Airlines Station compiled the "Plan for the Enhancement of Zhang Guizhuang Airport" in 1948. The first phase of the project is to extend the runway to 2150 meters long and 75 meters wide according to the international B grade runway standard, and to build the Tianjin Airlines Station (demolished after the founding of the people's Republic of China because of the expansion of the airport)[1].

During the planned economic period, Zhang Guizhuang Airport has carried out three large-scale reconstruction and expansion successively : (1) the first expansion project started the emergency supporting construction of the locomotive maintenance area including two aircraft repair plants and one Aircraft hangar in 1950 by the Tianjin Airport Construction Agency; and another 640 m² of terminal and boiler rooms were completed in 1953[2]. (2) The second expansion project began in 1955, when
civil aviation began to build Zhang Guizhuang Airport as a flight training base, and on December 15, 1958, a two-and-a-half-year "reconstruction project of the High Aviation School Airport" was launched again. (3) The third expansion project is the largest project since the establishment of Zhang Guizhuang Airport. The "7402" project is the completion of the runway, taxiway, liaison road and passenger plane by the 54th Division 101 and 125th and 125th Regiment respectively, and then in 1980, the terminal, restaurants and hotels and other supporting projects all put into use [3]. After the reform and opening up, in order to serve the needs of the rapid development of local social economy and civil aviation, Tianjin Binhai Airport has undergone several reconstruction and extension, and has now become a four-level airport with "double-floor double runway" E.

2. Present Situation of Spatial Distribution and Evolution Buildings in Tianjin Airport

2.1. Spatial Distribution

The historical buildings of Tianjin Airport mainly refer to the historical buildings from the beginning of the establishment of the airport in 1939 to the early 1990s. After the construction process of different periods, apart from the national government period of architectural remains have not been left, so far the remains of each characteristic complex have been formed at all stages. According to the course of airport construction and its functional zoning, Tianjin airport area mainly includes seven historical buildings: the bunker group left by the Japanese invading China in the 1940s, the maintenance area built in 1950, the teaching area of the advanced aviation school opened in 1958, the new China first-generation terminal area built in 1953, the second-generation terminal area built in the 1970s, the production support area and the living service area, etc. These functional areas with civil aviation characteristics are mainly distributed in the land and air border areas of the airport, as shown in Figure 1.

![Figure 1](image-url)

2.2. Evolution of major functional areas

The main terminal area and flight area of Tianjin Airport have formed close interaction with the main entry road, and they are distributed from east to west at the junction of air side and land side. The approach road of Tianjin Airport in modern times was introduced from Zhang Guizhuang Road to the airport scene, runway and aerodrome. In 1948, the Civil Aviation Administration of the National Government built Tianjin Air Station and partially expanded the airport runway. The construction of these airports is mainly concentrated in the southeast of the airport. The maintenance area and terminal area built by Tianjin Airport in 1950s still follow the development path of modern airport. In 1953, a new approach road, No. 1, connecting Xunhai Road and Zhang Guizhuang Road, was built to serve the terminal area and the teaching area. In 1974, the layout of the new terminal area and the approach road changed the layout of the buildings in the north-south direction of the former functional areas, and then the parallel runway was used to carry out the layout of the buildings, and a new passenger approach...
road was introduced from the outer ring line of Tianjin. In 1989, the construction of a new 20,000-square-meter terminal was launched on the west side. Finally, the airport area forms a pattern of interlacing between the north-south and the northeast-southwest regions [4], as shown in Fig. 1.

3. Comprehensive Value Assessment of Historic Buildings of Tianjin Airport

3.1. Evaluation indicators
According to the actual situation of historical building protection in China, combined with the common characteristics of cultural relic buildings and historic buildings, and referring to the value evaluation system of Nanjing architectural heritage, industrial architectural heritage and modern architectural heritage, a comprehensive value evaluation index system suitable for the protection of historical building heritage in airports in China is put forward [5-8]. The whole index system is divided into three levels: the four primary indicators are historical value, social and cultural value, science and technology value, protection and reuse value, and 18 items in the secondary index are historical age, historical figures and events, historical information, historical background; social contribution, urban development, cultural characteristics, civil aviation value, public participation; technical level, scientific value, historical style, design level, artistic style; landscape environmental value, spatial use function, urban resources, economic value, basic index 35 items.

3.2. Weight setting

3.2.1. According to the actual situation, the weight vectors of the first-level index calculated by AHP and Delphi method are as follows:

\[
W = (0.3407, 0.1703, 0.2026, 0.2865). \quad (1)
\]

3.2.2 Weight vector of secondary indicators:
- Historical value weight vectors are:
  \[
  w_1 = (0.4774, 0.1283, 0.1378, 0.2565). \quad (2)
  \]
- Social and cultural value weight vectors are:
  \[
  w_2 = (0.4621, 0.1732, 0.0828, 0.1879, 0.0939). \quad (3)
  \]
- Scientific and artistic value weight vectors are:
  \[
  w_3 = (0.1536, 0.1417, 0.3332, 0.2901, 0.0814). \quad (4)
  \]
- Protection reuse value weight vectors are:
  \[
  w_4 = (0.0882, 0.1569, 0.2717, 0.4832). \quad (5)
  \]

3.3. Statistics on evaluation results
The comprehensive value fuzzy evaluation of 60 airport historical buildings in Tianjin airport is carried out by AHP. Finally, the evaluation results are sorted out. Among them, there are 1" excellent grade "with comprehensive value ,5" good grade" with high protection value ;14" general grade "with good protective reuse value ;22" poor grade" with comprehensive value, and neither protection nor reuse value is very prominent; and the comprehensive value is "poor grade" without protection value, which is not marked in figure 2. The historical buildings of Tianjin Airport are plotted according to the above five grades, and their distribution is shown in Fig. 2.

3.4. Hierarchical Protection Planning Strategy
The evaluation results of the comprehensive value evaluation system are mainly to provide the selection and reference for the value subject (users, owners, managers, estate owners, etc). After fuzzy evaluation
of historical buildings, they are classified and classified by comprehensive value grade. According to the existing historical building types in China, different levels of protection measures and specific ways of development and utilization are put forward [5-8]. This paper mainly divides Tianjin airport historical buildings into four types of protection levels: special protection level, key protection level, general protection level and pending protection level. The evaluation grades, protection principles and specific protection measures of the four types of protection levels are shown in Table 1[6].

![Figure2. Construction classification protection of Tianjin Airport](image)

| Grade            | Protection principles                          | Specific protection measures                  |
|------------------|-----------------------------------------------|-----------------------------------------------|
| Special protection | Protection of identity                        | 1) Maintain the appearance and interior of the building.  
                                 |                                                | 2) To repair, severely damaged structures or components need to be strengthened or replaced.  
                                 |                                                | 3) Any man-made changes need to be recorded. |
| Focus on protection | Protection first, moderate development secondary | 1) Maintain the integrity of architectural appearance and maintain architectural features  
                                 |                                                | 2) Restorative local repair of structures and details  
                                 |                                                | 3) Important changes in the protection process need to be identified and documented  
                                 |                                                | 4) It is advisable to restore the original function or select the appropriate use function |
| General protection | The main structure and features of the building remain unchanged, and the internal functional adaptability changes | 1) Maintaining architectural features and integrity of the main structure  
                                 |                                                | 2) Local restoration of appearance and local reconstruction and extension of buildings  
                                 |                                                | 3) Internal space can be functionally adapted to usage requirements |
4. Design of General Protection and Reuse Planning of Historic Buildings of Tianjin Airport

The effective protection of historical buildings should not be stored as collectibles, but should be reused by reasonable and appropriate means. Therefore, this paper takes the concept of protective reuse of architecture as the core idea. Secondly, the protection of the historic single building from the surrounding environment will make the building lack of humanistic and historical environment and lose its own characteristics and significance. Historic buildings and the surrounding buildings and environment are a unified whole, if the lack of overall awareness of the protection of the historic buildings of Tianjin Airport, it will destroy the historical and cultural environment of the western region of Tianjin Airport, and at the same time, it is an irreversible damage to the historical and cultural value of the building itself.

The overall structure of the historical building protection plan of Tianjin Airport is "one piece and four districts ", in which "one piece "refers to the historical and cultural style building area formed by the historical buildings in the part of Tianjin Airport, and" four districts "refer to the maintenance area arranged along the perimeter of the western part of Tianjin Airport, the terminal area of the 1950s, the terminal area of the eighth and 1990s and the teaching area located in the Civil Aviation University of China. The overall planning scheme is "one move, one guarantee, two reforms ", and the specific transformation scheme is as follows [9].

4.1 Maintenance area

Mainly adopt the renewal strategy and method of relocation or reconstruction. According to the planning document of Tianjin Airport, the red dotted line frame in Fig .3 will be converted into apron, and the historical buildings in the protection and maintenance area which fully consider the feasibility and economy of the renovation scheme have been maximized. It is suggested that the head bank should be transferred to the terminal area of 1950s (Fig .4) and applied to the building unit of Tianjin cultural relic protection. The workshop proposes to retain one of them, which can be relocated to the North Gate of the North Campus of CAAC near the existing maintenance base laboratory and continue its existing laboratory functions. China Eastern Airlines general aviation office building proposed to move to the 1950s terminal area, can continue to be used as office building or with the 1950s terminal area after the transformation of the new functional positioning re-development of new functions, maintenance area other buildings suggested demolition.

4.2 Terminal area, 1950s

Adopt the renewal strategy and method of protective modification. The buildings in the area are relatively concentrated, well-preserved and have a wide field of vision, and occupy the position of the apron. In the 1950s, the terminal was proposed to be changed to the airport aerodrome command building, the west side of the supporting building and the south side of the chimney building to retain and repair the original appearance, the north side of the fire garage demolition reconstruction or partial renovation and ensure the unity of the whole building style, the front of the terminal car park, central garden in and out of the old terminal area road and surrounding environment moderate renovation, other buildings proposed demolition.
4.3 Terminal area, 1980-1990s
Adopt the renewal strategy and method of transformability protection. It is suggested that the idle part of the terminal in the 1990s should be transformed into a low-cost terminal, and that the symmetrical building on the north and south sides of the terminal in the 1980s, the central ring garden on the west side and the garden should be preserved and extended. The proper repair and adjustment of the front square, parking lot and access road of the terminal is shown in Figure 4.

4.4 Teaching area
Using the original appearance protection update strategy and method. The buildings in the teaching area are well preserved and the original planning and construction pattern is completely preserved. It is suggested that, on the basis that the north 2 and north 3 teaching buildings of CAUC have been included in the fourth batch of protective building lists in Tianjin, the relatively concentrated administrative buildings, the No .8 building of the hospital, the teaching staff restaurant, the north 1 apartment and the head bank buildings proposed to be relocated should be protected together, thus forming the "historical style and features building group of the senior aviation school teaching area" in the planned economic period and granting them the key protection units in Tianjin. It is suggested that the existing flat roof of the administrative building be converted into a sloping roof in order to unify the roof style of the building in the style area.

5. Summary
Tianjin ZhangGuiZhuang airport is one of the only airports with a long history in use in China. It is a museum of modern airport architecture in China. Under the background of continuous and rapid development of Tianjin Airport and limited land use, this paper puts forward the overall structure orientation of "one piece and four districts" and the overall protection plan of "one move, one guarantee,
two reforms” in order to find a balance between the needs of airport development and the protection of historical buildings. There are few people involved in the field of this paper. I hope this paper will give readers more inspiration, so that more researchers will be involved in the protection of airport historical buildings in the future.

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