



# Conservation and Valorisation of Zhaohua Temple

Management of Built Environment

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VALORISATION OF HISTORICAL BUILDINGS AND CULTURAL HERITAGE  
PROF: BONIOTTI CRISTINA & RONCHI ALFREDO

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## 1. Overview

Temples are one of the important forms witnessed the development of Chinese ancient architecture, usually with a north-south longitudinal axis to organize space and symmetrical layout. In ancient China, temples were the central place for people's activities and occupied a very important and significance position in both political and traditional culture.

Located in the north of West Street Road, Huai'an County, Zhangjiakou City, Hubei Province, China, Zhaohua Temple was built in 1436 AD, taking eight years to build into a spectacular Buddhist shrine. After the completion of the temple, the emperor gave the name "Zhaohua Temple", meaning that expressing the emperor's benevolence to sensitize the people. In 2001, it was announced as the fifth batch of national key cultural relics protection units by the State Council of China.



Fig 1: Zhaohua Temple

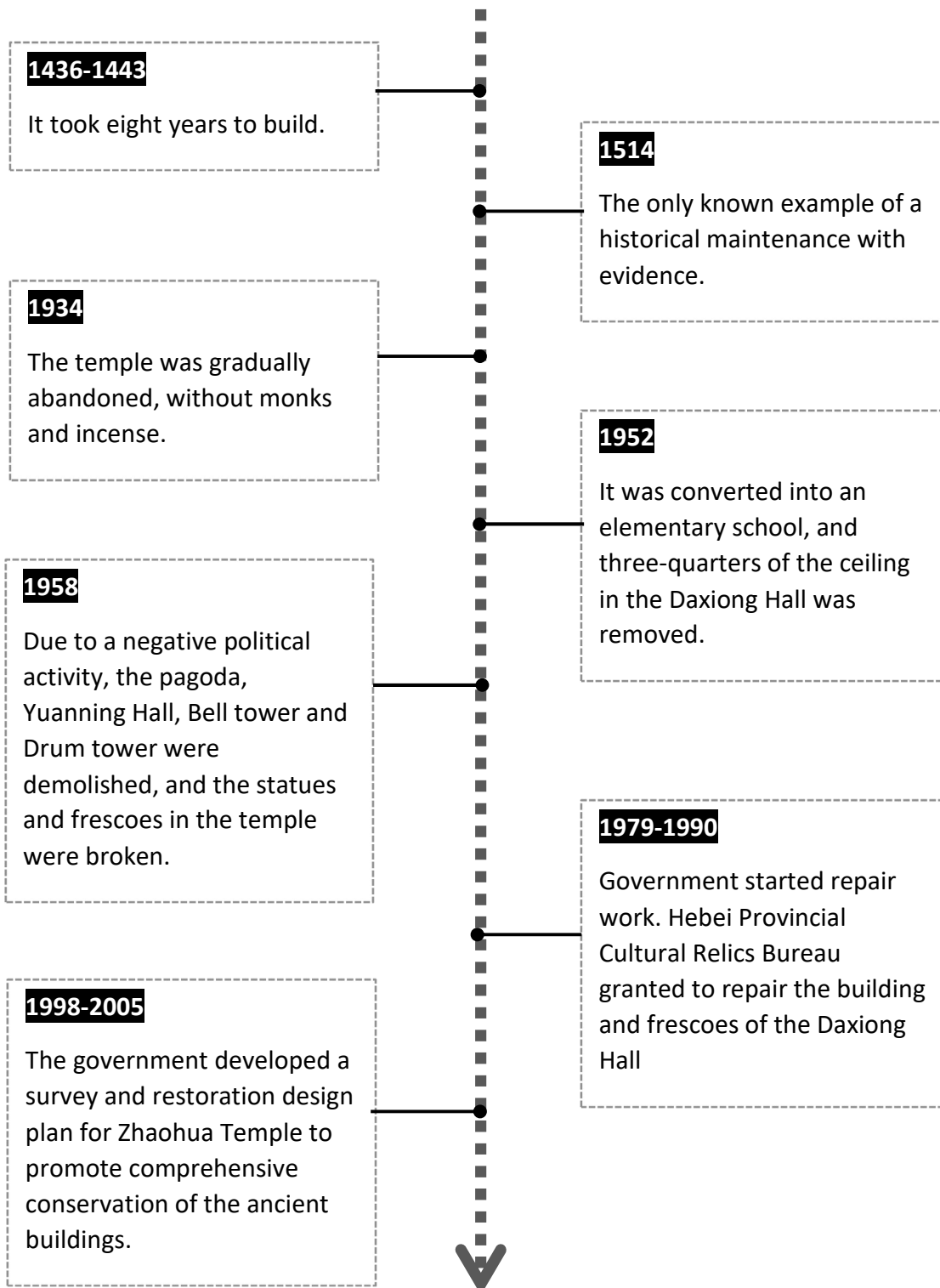
As a cultural heritage, Zhaohua Temple is precious, not only in its architectural structure, but also in the exquisite fresco painted in the Ming Dynasty on the inner walls of all the buildings. However, the degree of its protection and usage is far from matching its own value. In this case project, we want to deal with such a situation through conservation and reuse.



Fig 2: Zhaohua Temple

## 1.1 Development of Zhaohua Temple

Due to its age and lack of historical information, the development of Zhaohua Temple cannot be accurately deduced from the available evidence. The only thing we can be sure of is that the temple must have been restored several times during the Ming and Qing dynasties, otherwise the buildings would not be able to retain their distinctive chronological features until now.



## 1.2 Characteristics of the fresco

The frescoes of Zhaohua Temple are a kind of religious paintings hung in monasteries or private pujas, called "water-land paintings", which originated in the Three Kingdoms period. The paintings both depict the religious world and reflect the secular social life, which is a relatively special style in the history of Chinese painting.

Daxiong Hall, the main building of the temple, according to the statistics, the four walls of the temple now exist 93.13 square meters of frescoes completed in 1562, 2 on each of the north and south walls, 22 on the east wall and 21 on the west wall, painted with a total of 47 (groups) paintings of various stories, more than 500 characters. Although the content of the picture was damaged, the main part has been preserved, and with the precipitation of history, it shows a kind of incomplete beauty. The scale of the mural is magnificent, extremely rich in content, and the painting time and author are clear, providing valuable information for us to study the religious appearance of the Ming Dynasty, the art of painting, folk customs and the development of water-land painting evolution, etc.

It is outstanding from frescoes of the same type elsewhere for the following factors:

- 1) The large size of the painting and the variety of contents are rare in other places of water-land painting.
- 2) The contents of paintings are usually combined, for example of the 43 frescoes on the east and west walls, at least 21 have content that combines two or more pieces in one painting: similar elements or figures from different religions are combined in one painting.



Fig 3: Five gods are contained in one painting.

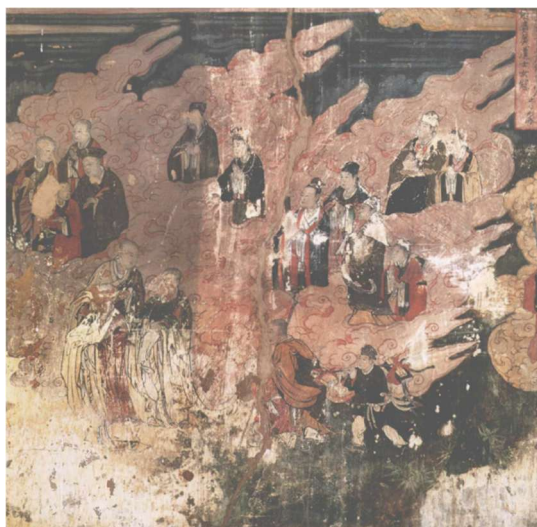


Fig 4: Buddhist and Taoist figures in one painting

Water-land painting is a precious cultural heritage, mainly using the traditional Chinese brush painting with heavy colors of figures. In terms of production, the style of fresco painting since the Tang and Song dynasties was inherited, starting with light ink, outlining, and then colored. The figures are accurately shaped, with different physical appearance, and the use of vignetting shows a sense of three-dimensionality.

The water-land paintings of Zhaohua Temple, which were completed by folk painters, are an excellent cultural heritage created by the ancient laboring people of China.

## 2. Context Analysis

### 2.1 Location

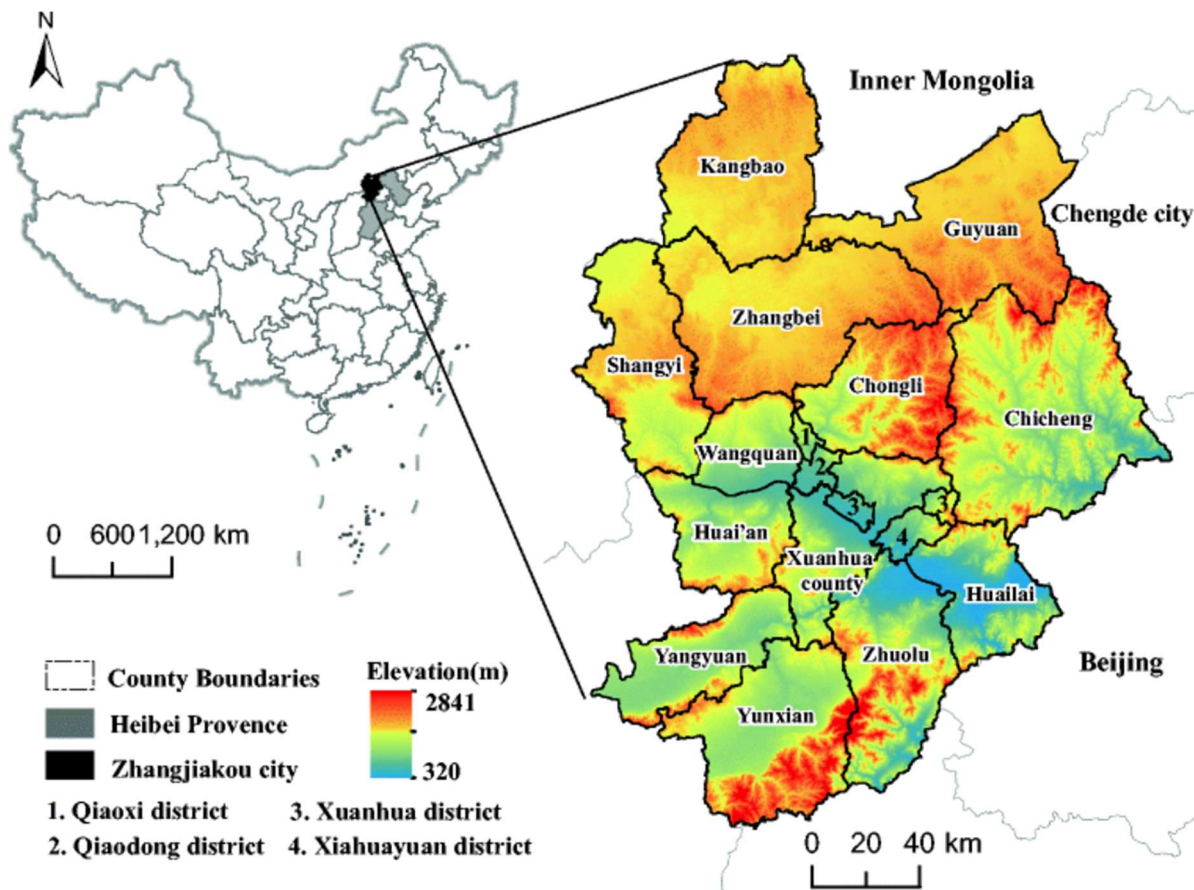
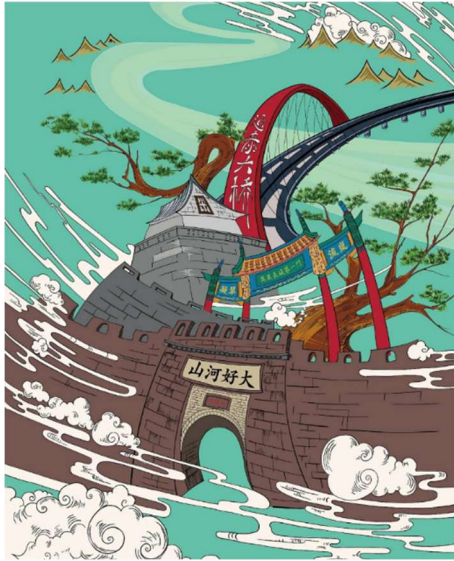
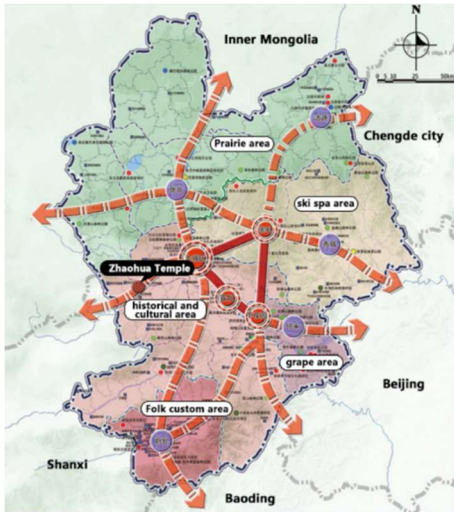


Fig 5 Location of Zhangjiakou

Zhangjiakou City is a prefecture-level city under the jurisdiction of Hebei Province, the People's Republic of China, located in the northwest of Hebei Province. Located between 113°50' and 116°30' east longitude and between 39°30' and 42°10' north latitude, it enjoys a unique geographical location, bordering Beijing, Shanxi Province and Inner Mongolia. The terrain is high in the northwest and low in the southeast.



The Yinshan Mountains run across the central part of the city and divide it into two areas: the upper part of the dam and the lower part of the dam, with Yanshan Mountain in the east and Taihang Mountain in the south. Sanggan River and Yanghe River traverse the city and flow into Guanting Reservoir, and the latter section is called Yongding River. Zhangjiakou is an important channel, a cargo distribution center, a military base and a land commercial port connecting Northwest China, Mongolia and Beijing. The famous Dajingmen is the main pass of the Great Wall.



## 2.2 Urban Planning

Zhangjiakou City governs 6 districts (Qiaodong, Qiaoxi, Xuanhua, Xiahuayuan, Chongli, Wanquan) and 10 counties (Zhangbei, Kangbao, Guyuan, Shangyi, Weixian, Yangyuan, Huailai, Huai An, Zhulu, Chicheng). According to the municipal planning, before 2030, Zhangjiakou's urban tourism will be divided into five areas: Prairie, ski and spa, grape, folk custom, historical and cultural area. The Zhaohua Temple, the project we analyzed this time, is located in the historical and cultural area within the area.

## 2.3 Accessibility and Facilities



Fig 6 Beijing-Zhangjiakou High Speed Railway Map

The urban area of Zhangjiakou is only 180 kilometers away from the capital Beijing, and it only takes one hour by high-speed rail. 340 kilometers away from Tianjin Port. It is the intersection of the Beijing-Tianjin-Hebei (Bohai Rim) economic circle and the Hebei-Shanxi-Mongolian (Outer Great Wall) economic circle. The mileage of expressways in Zhangjiakou City is 808 kilometers, and the mileage of railways is 623 kilometers. The expressway network is developed and the traffic is extremely convenient. The Beijing-Baotou Railway has Zhangjiakou Station and Zhangjiakou South Station here. The aviation center facing Zhangjiakou City, Hebei Province is in its southeast, 9 kilometers away from the urban area, 30 minutes by bus, and 15 minutes by taxi.

## 2.4 Population

Zhangjiakou has a total territory of 36,766 km<sup>2</sup> and a total population of 4,118,908 by 2020, with a population density of 112.0/km<sup>2</sup>. The total population growth rate is -0.53% compared to 2010. In 2020, the male to female ratio in Nanjing was 50.5% and 49.5% respectively, with men outnumbering women by 1.0% and the overall male to female ratio being balanced. (Chart 1)

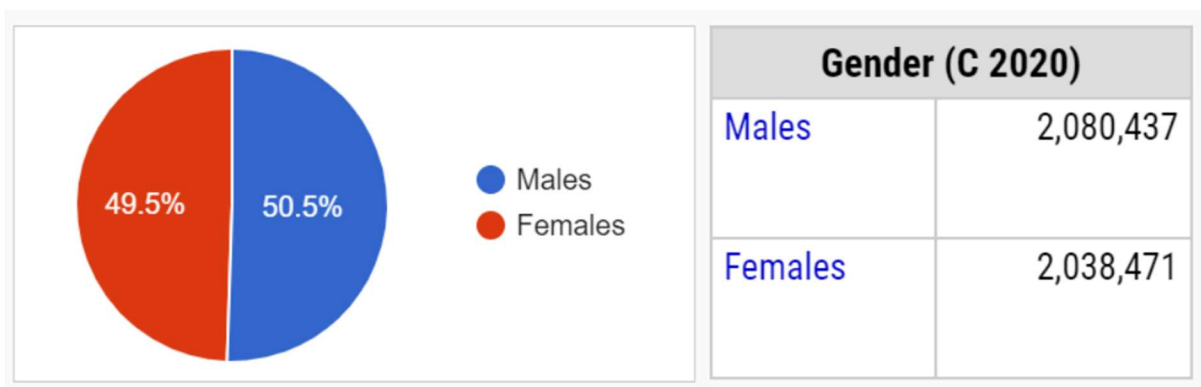


Chart 1: gender composition of Zhangjiakou in 2020.

As of 2020, 30% of Zhangjiakou's resident population was urban and 70% rural, with the urban population almost twice as large as the rural population (Chart 2).

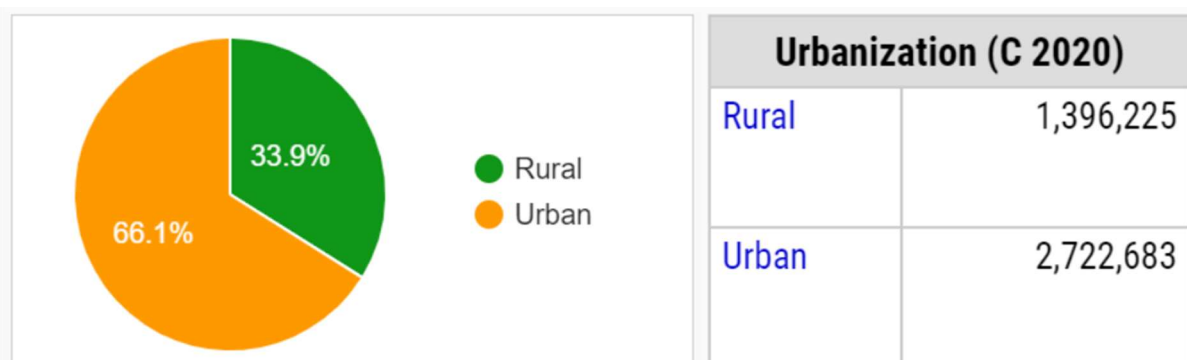


Chart 2: Urbanization of Zhangjiakou in 2020.

More than 2.76 million people in Zhangjiakou were aged 15-64, accounting for 61.1% of the total population, the proportion aged 0-14 was 15.2% and 65+ was 17.6% (Chart 3). As can be seen in Chart 4, the largest share of the 15-64 age group is in the 20-49 age group, which is a very young and creative age group. In terms of the age composition of the population, Zhangjiakou is a predominantly young adult city with a large labor force and a dynamic city.

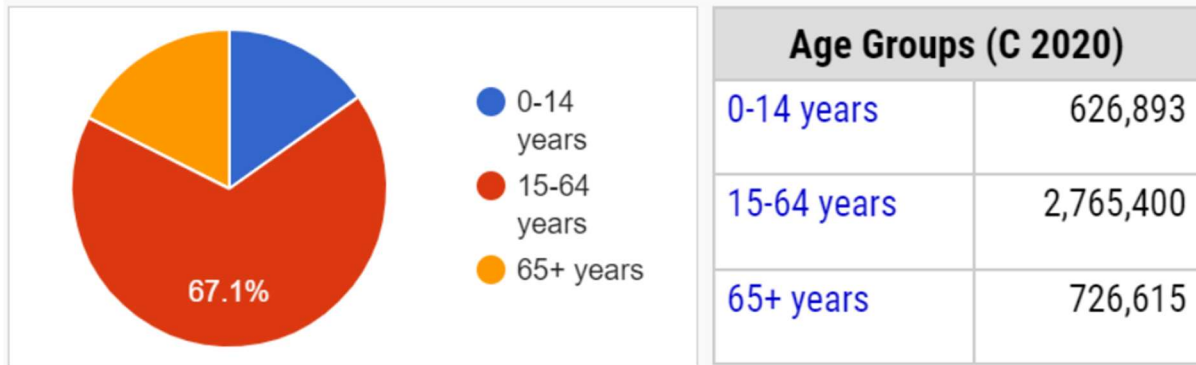


Chart 3: Age Groups

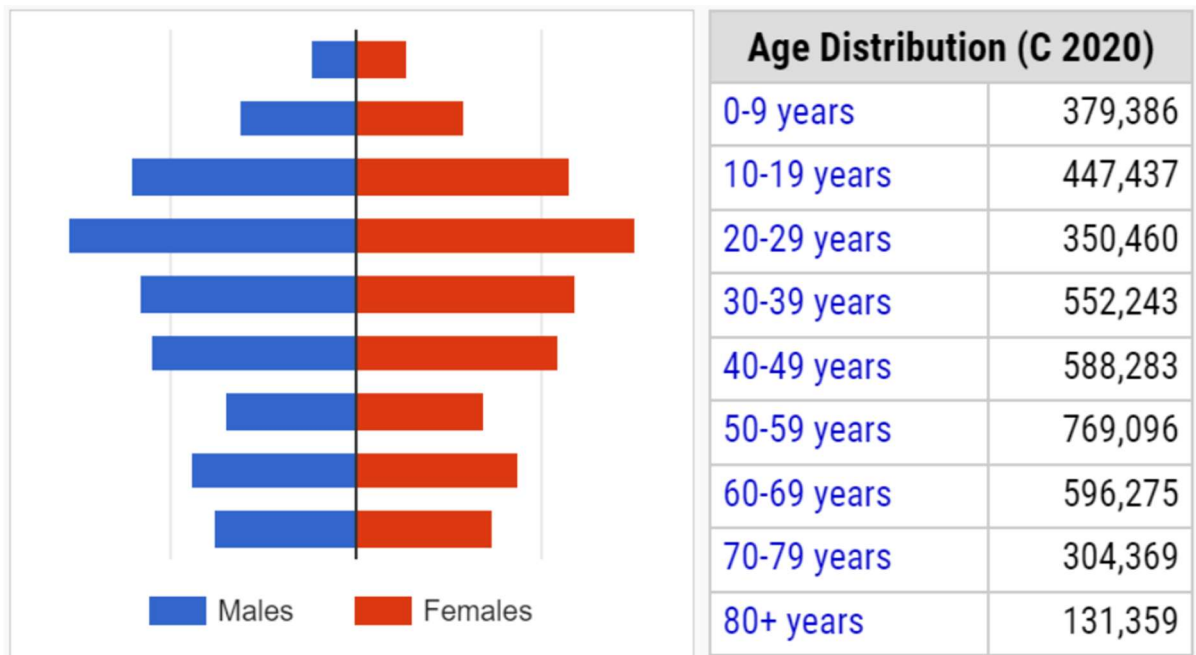


Chart 4: Age Distribution

## 2.5 Economic

The vicinity of Zhangjiakou is rich in coal and iron ore, making it an ideal place to develop the iron and steel industry. Besides metallurgy, the city is also home to one of the most important wine industries in China. At present, about 130 foreign-funded enterprises have settled in Zhangjiakou, with an investment of US\$820 million. The largest is Zhangjiakou Volvo Car Company, with an investment of 3.1 billion yuan and an output value of more than 1 billion yuan.

## Zhangjiakou GDP and Growth Rate, 2018–2022



Chart 5: Zhangjiakou GDP and Growth Rate, 2018–2022

## Industrial Structure of Zhangjiakou, 2018–2022

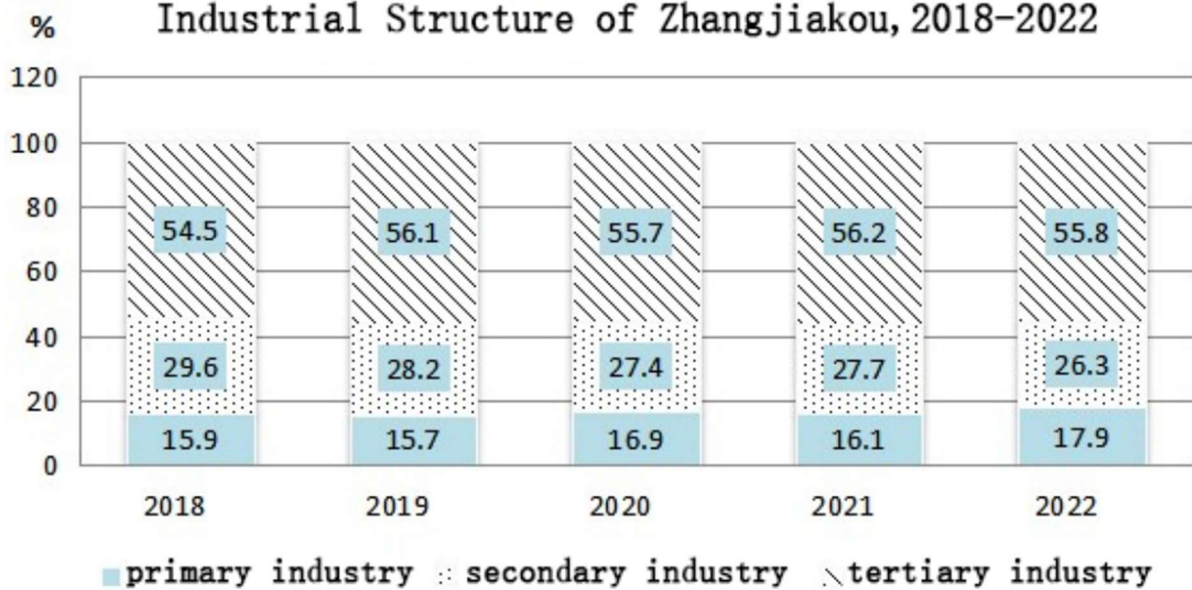


Chart 6: Industrial Structure of Zhangjiakou, 2018–2022

In 2022, Zhangjiakou City will achieve a regional GDP of 177.52 billion yuan, an increase of 1.5% over the previous year. Among them, the added value of the primary industry was 31.74 billion yuan, an increase of 2.2%; the added value of the secondary industry was 46.68 billion yuan, a decrease of 1.2%; the added value of the tertiary industry was 99.10 billion yuan, an increase of 2.4%. The three industrial structures are 17.9:26.3:55.8.

## Income of Urban and Rural Residents in Zhangjiakou, 2018–2022

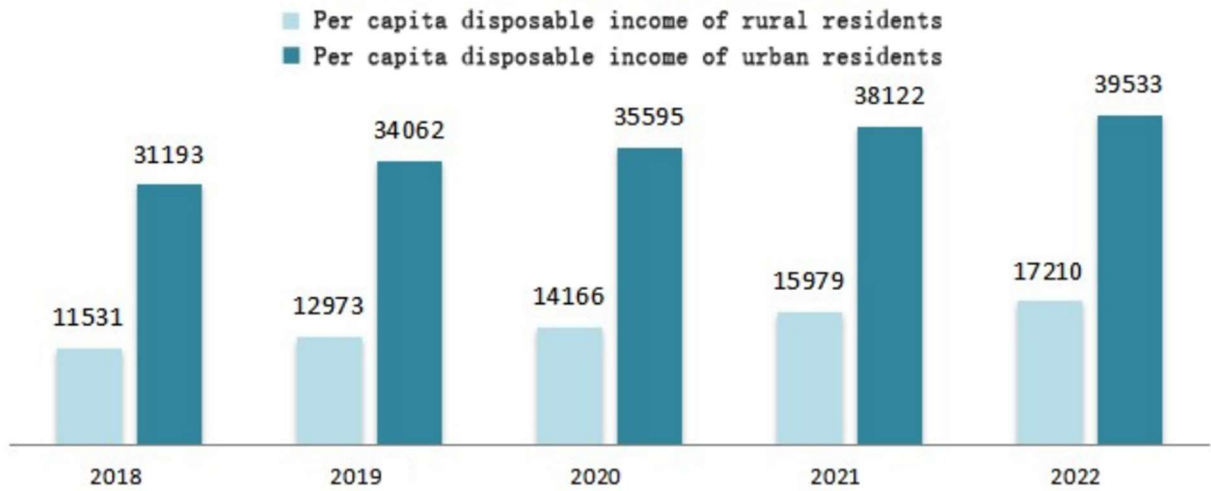
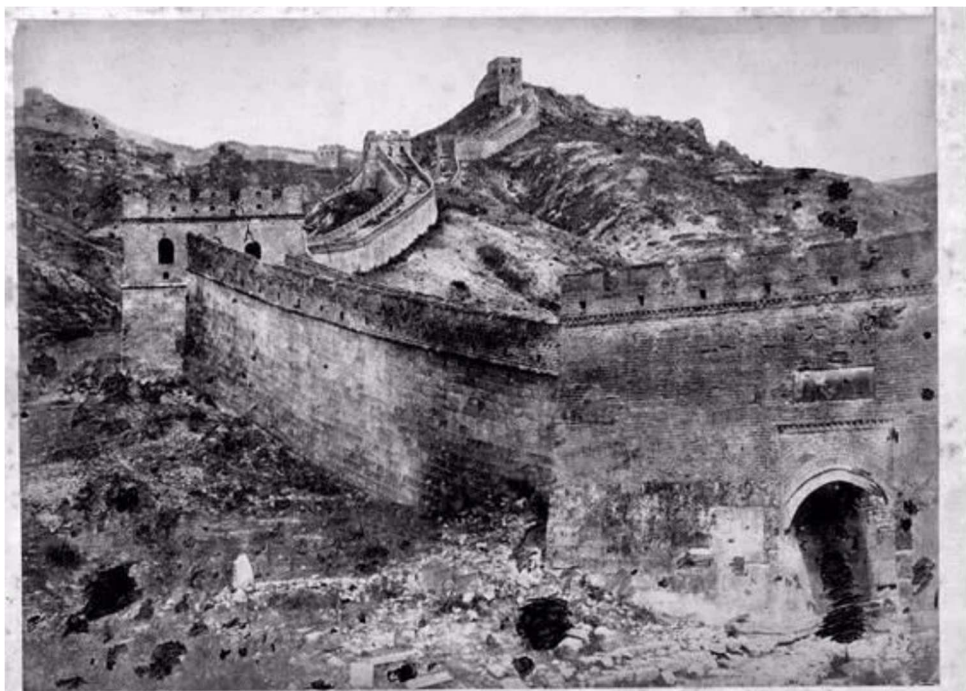


Chart 7: Income of Urban and Rural Residents in Zhangjiakou, 2018-2022

The annual per capita disposable income of the city's residents was 29,452 yuan, an increase of 5.3% over the previous year. In terms of permanent residence, the per capita disposable income of urban residents was 39,533 yuan, an increase of 3.7%; the per capita disposable income of rural residents was 17,210 yuan, an increase of 7.7%.

### 2.6 History

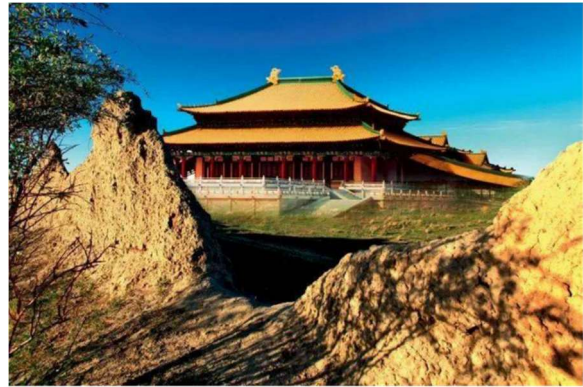
"The history of Zhangjiakou can be traced back to ancient times." The sites of prehistoric human activities found in the territory prove that this place was one of the earliest places where humans set foot in the Paleolithic Age. About five thousand years ago, Emperor Huang and Emperor Yan jointly defeated Chi You in the Battle of Zhuolu in Zhangjiakou. Then the



Yellow Emperor called together the tribal alliances, held the first political conference in ancient China, and built the capital.

Zhangjiakou is located at the junction of farming civilization and nomadic civilization in the Central Plains and has been a battleground for military strategists since ancient times. In the chaotic chaos of dynasties, the administrative settings changed frequently, and the administrative ownership was changed several times.

The emperors of the Jin Dynasty built a summer palace in Zhangjiakou - the Taihe Palace, which was also destroyed in the war. The existing site is only the building foundation.



About 700 years ago, a resplendent and resplendent capital—Yuanzhong Capital—was built on the Bashang Grassland in Zhangjiakou. This is the fourth capital since the founding of Mongolia. It was later reduced to a royal "palace" and was completely burned down in the war.

After the founding of New China, Zhangjiakou City was divided into Hebei Province. Today's Zhangjiakou is not only an ancient city of Chinese history and culture, but also an important



city for economic and cultural exchanges between Han and Mongolia. It is also one of the important business cards connecting China with the world.

## 2.7 Heritage and Tourism

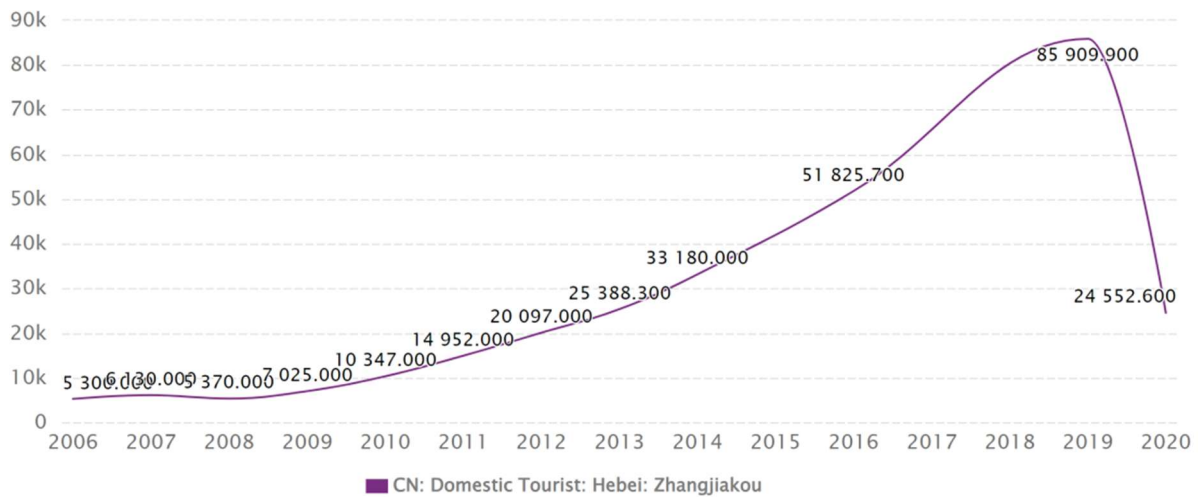


Chart 8: Zhangjiakou Domestic Tourist,2006-2020

From 2009 to 2019, domestic tourism to Zhangjiakou shows an upward trend year on year, with a total of 85 million visitors in 2019. In 2020, there is a sharp drop in the number of visitors due to the covid-19 epidemic, with a 71.4% decrease compared to the previous year (Chart 8)

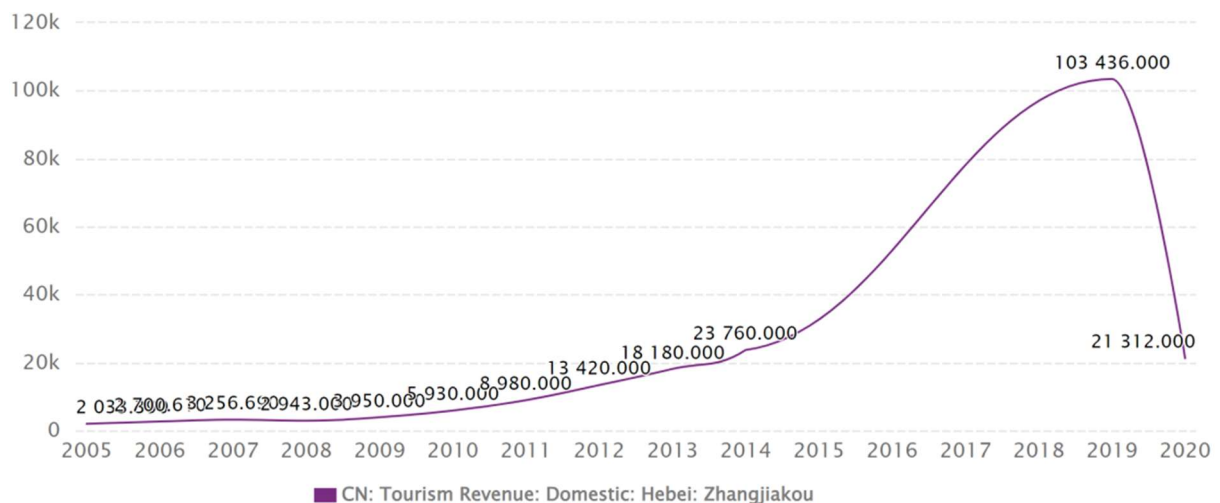


Chart 9: Zhangjiakou Tourism Revenue,2005-2020

Separate domestic visitor data from 2009 to 2019 shows an upward trend in tourism revenue in Zhangjiaku each year, with total tourism revenue reaching RMB 103 million (€13.79 million) in 2019.

2020 tourism revenue decreases to RMB 21 million (€2.84 million) due to the covid-19 outbreak (Chart 9). Zhangjiakou City is a modern city with perfect infrastructure. Its snow-

capped mountains, picturesque grasslands, ancient historical sites, ski resorts, and proximity to major air traffic lines make it one of the most popular tourist destinations in China.

As of the end of 2019, there were 60 A-level scenic spots in the city, including 11 4A-level scenic spots, 30 3A-level scenic spots, 19 2A-level scenic spots, 74-star hotels (22 four-star and above hotels), and 98 travel agencies. Zhangjiakou City has 3 national nature reserves, 1 national forest park, 16 provincial forest parks, and 1 provincial scenic spot. In 2022, Zhangjiakou City will receive 30.6873 million domestic tourists, with a total tourism revenue of 25.174 billion yuan.



The city of Zhangjiakou is famous for the ancient minority settlements around the section of the Great Wall in the area. On the north side of the Great Wall are the historical relics occupied by the Huns, and on the south side are the relics of the Yan Kingdom.

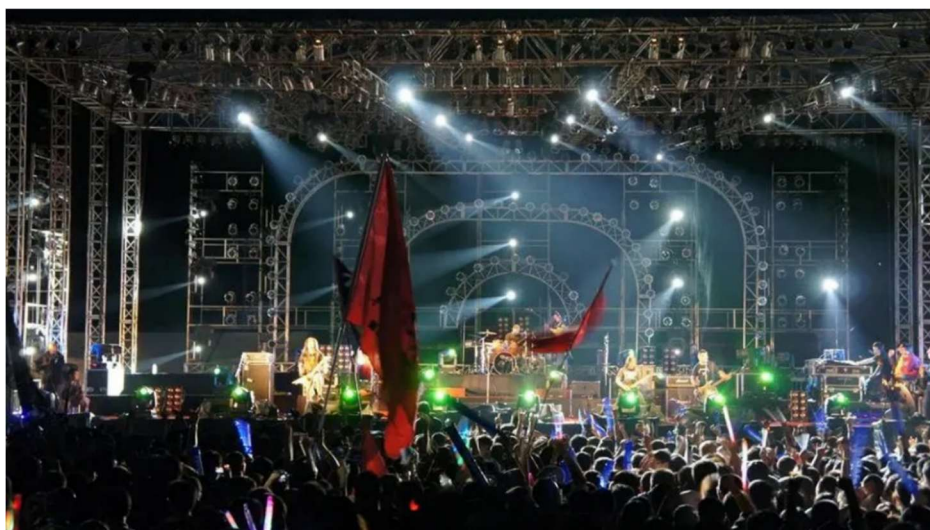
In 2022, Beijing and Zhangjiakou will jointly host the 24th Winter Olympic Games, and the best ski resorts, resorts and ski facilities are all in the city.

Zhangbei Grassland is a grassland located in Zhangbei County, 70 kilometers northwest of Zhangjiakou. It consists of two major grasslands, Zhongdu and Anguli. In the Zhangbei Grassland, you can ride horses and shoot arrows; you can also watch traditional grassland entertainment such as equestrianism, wrestling, and grassland singing and dancing. Every year from June to September is the golden season for tourism in the Zhangjiakou Grassland Customs Region. The scenery here is beautiful and the climate is pleasant. Thousands of acres of meadows are blooming with colorful flowers, forming extremely beautiful pictures.



The annual "Grassland Music Festival" and "Miss World Tourism Beauty Contest" have pushed the tourism in the grassland style region to a new artistic conception and climax. The Zhangjiakou government will further innovate the grassland music model and extend the three-day grassland music festival to a 2–3-month grassland music season, allowing more tourists to experience the infinite charm of the music grassland.

During the 2023 Zhangbei Grassland Music Carnival, there will be a large-scale indoor live-action drama with nearly a thousand people at the same time. In the battle of the battle, the historical imprints are presented one by one rapidly, making people immerse themselves in it.



In this region, there are significant differences between seasons. In winter, tourists can go skiing in Chongli Mountain; in spring, they can visit historical sites and museums. In summer, tourists can sleep in yurts in the Zhangbei Grassland, where concerts are held every year and fresh lamb is tasted.

### 3. Property Analysis

#### 3.1 Architectural property

Zhaohua Temple is facing south, the courtyard is rectangular, north-south length (from the front of the mountain gate platform to the back edge of the platform of the Three Great Houses) is 105 meters, east-west width is 40 meters. Zhaohua Temple's main buildings are distributed on the north-south axis, from south to north in order is: Mountain Gate, Tianwang Hall, Daxiong Hall, Temple of the Three Great Masters. Most of these supporting halls have clay statues of Buddha.

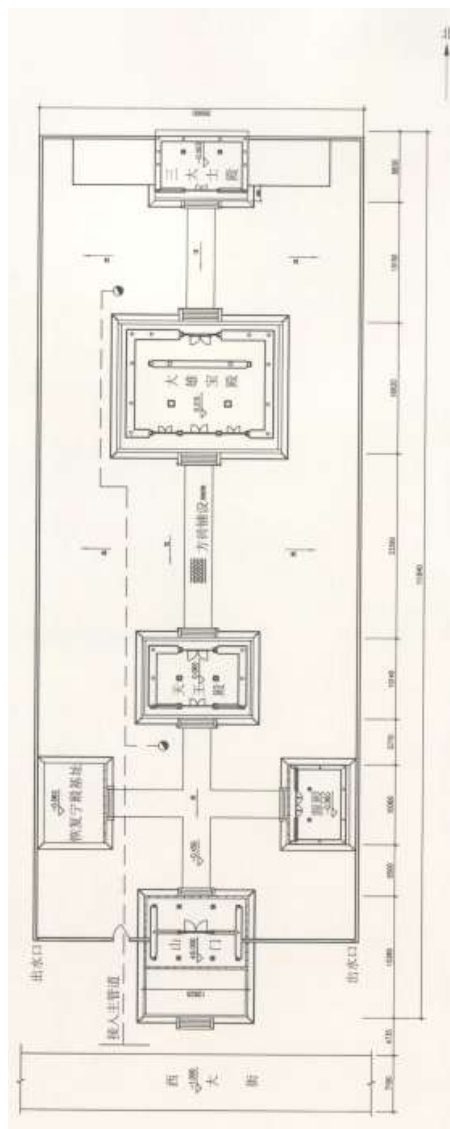


Fig: Masterplan of Zhaohua Temple

Overall, it seems that the architectural layout of Zhaohua Temple is neat and sparse in accordance with the standard Han-style "Jalan seven hall type" arrangement, the axis of the building volume gradually increased, arch painting and other decorations are becoming more and more elaborate.

### 3.1.1 Mountain Gate

Single eaves pang hall cloth tile roof, the height is 5.7 meters, the width of three rooms is 10.37 meters, the depth of two rooms is 6.64 meters. A total of 12 columns are used. The base of the platform is 66 cm high, and the upper perimeter of the platform is covered with 36 x 18 x 62 cm bricks, and the corners are set with corner stones.

The steps on the south side are no longer visible, while the north side has a three-stage step, but the stone is no longer the original, and is now made up with a green stone table base. The two walls are 74 cm thick, the upper is made up with masonry, the outside is white plaster, decorated with red. Because of the rain leakage in the eaves, the outer wall is washed away.

It was changed to a new type of doors and windows or walls, the two secondary rooms are solid walls, and the interior floor has been changed to cement floor in early years.

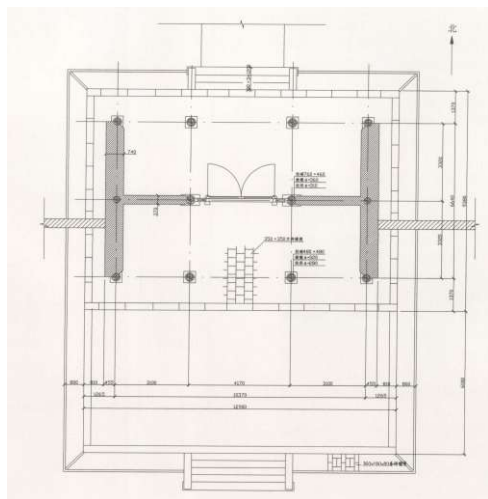


Fig: Site plan of Mountain Gate

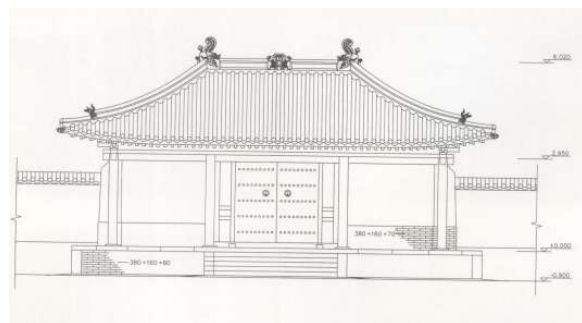


Fig: elevation of Mountain Gate

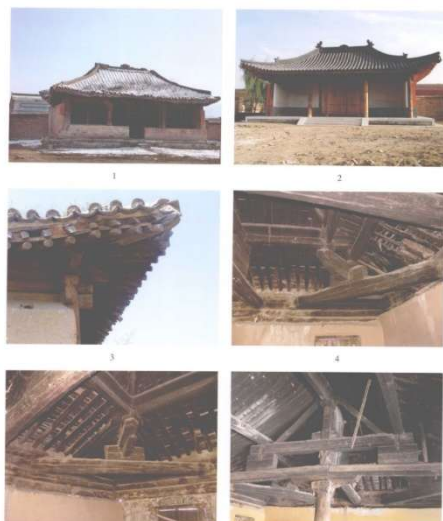


Fig: pictures of Mountain Gate

### 3.1.2 Tianwang Hall

Tianwang Hall is 22.4 meters from the mountain gate. It has a single eave hibiscus tile roof, with a width of 10.9 meters and a depth of 7.2 meters. It has four rafters and three columns. The pillar has side foot without rising, and the corner pillar has side foot along the depth and face width in two directions, 8cm each, and the pillar in the bright room has side foot along the depth direction.

The building is built on a 13.6m\*10.14m\*0.7m platform. The upper part of the building is covered with white sandstone bricks, with corner pillars at the corners. The back eaves bright room is now blocked with wall, the original should be set plate door decoration, the front eaves from the existing traces, bright room should be four partition doors. The inner floor has been changed to concrete floor, and the exposed pillar capstone is of small overlapping basin type.

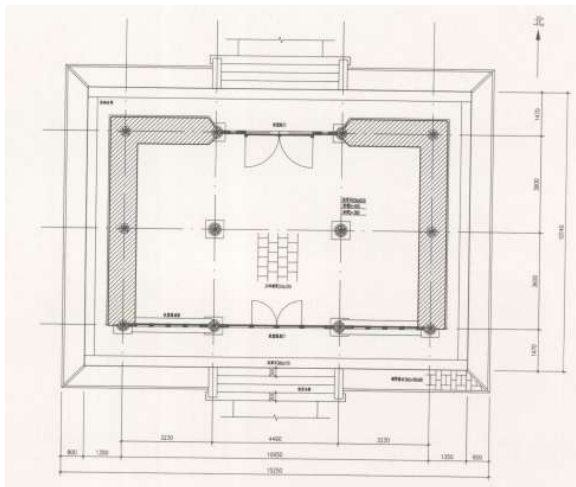


Fig: Site plan of Tianwang Hall

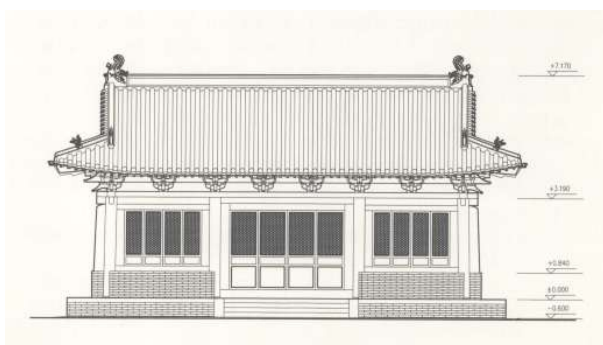


Fig: elevation of Tianwang Hall



Fig: elevation of Tianwang Hall

### 3.1.3 Daxiong Hall

There is Daxiong Hall behind Tianwang Hall, the single eave green glazed tile roof with a wide face of five rooms of 16.8 meters and a depth of three rooms of 12.44 meters. Due to the use of reduction method, the temple has a total of twenty-two columns. Column has at least four specifications, with column scale and the weight of the column is consistent. The back eaves of the bright room should be decorated with wood panel doors, and now the decoration components are missing and blocked with adobe walls.

Under the pillar with a square column base of lapis lazuli, slightly basin type, basin height of 6 cm. The base of the stone platform is 42 cm high, and the platform is surrounded by white sandstone stones. The original ceiling and algae well in the main hall were removed in 1952, 1968 and 1969 when the elementary school was occupied. Therefore, the part above the forehead of the large inner skin is a grass frame, not painted.

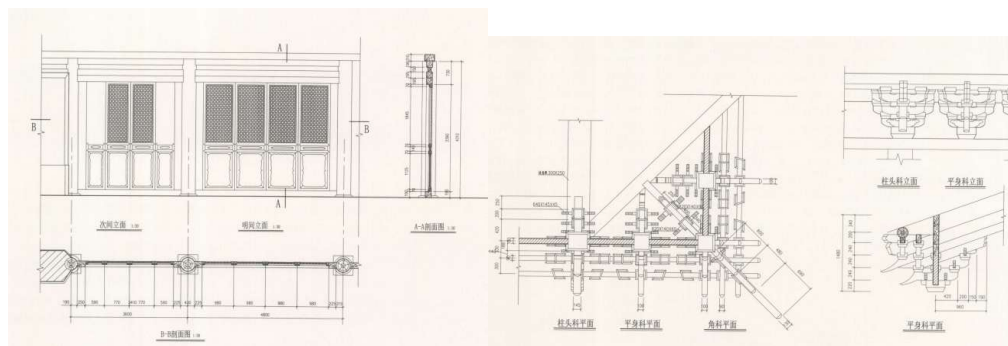


Fig: Site plan of Daxiong Hall

Fig: elevation of Daxiong Hall

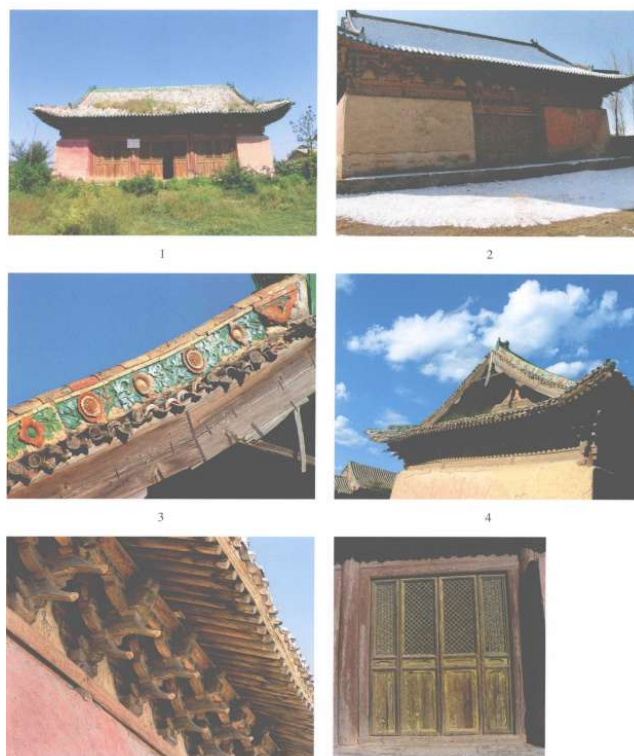


Fig: elevation of Daxiong Hall

### 3.1.4 Temple of the Three Great Masters

It is located behind the Daxiong Hall, with a tiled overhanging roof, three rooms of 10.64 meters wide and two rooms of 6.44 meters deep. The building area is 92 square meters. On each side, there are three ear rooms, hard mountain cloth tile roof. The front and rear platform of the temple is 0.47 meters high, green brick wrapped, on the stone pressure surface.

Back eaves wall sealing to the appendix under the skin, the two walls are 74 cm thick, wide on the narrow, the original decoration of the front eaves, now with brick walls all blocked. The temple has traces of Buddhist platform along the back wall. According to the recollection of local elders, the three bodhisattvas in the temple at that time were destroyed during the "Cultural Revolution".

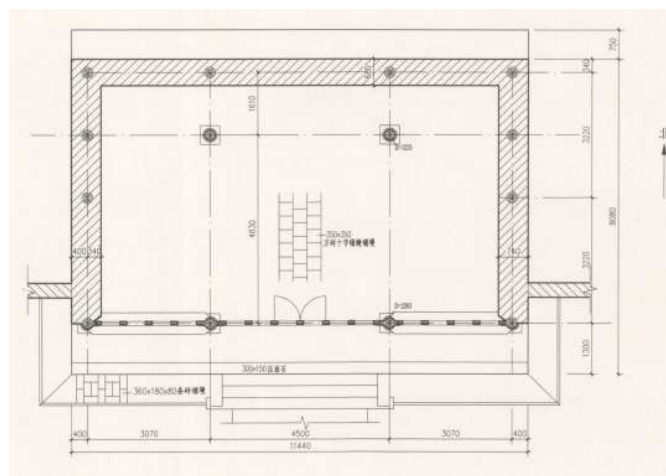


Fig: Site plan of Temple of the Three Great Masters

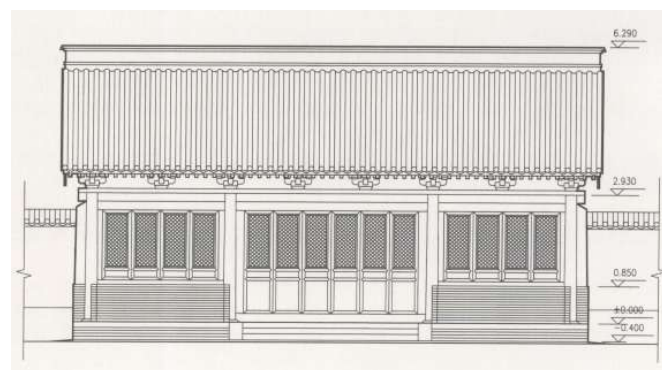


Fig: elevation of Temple of the Three Great Masters

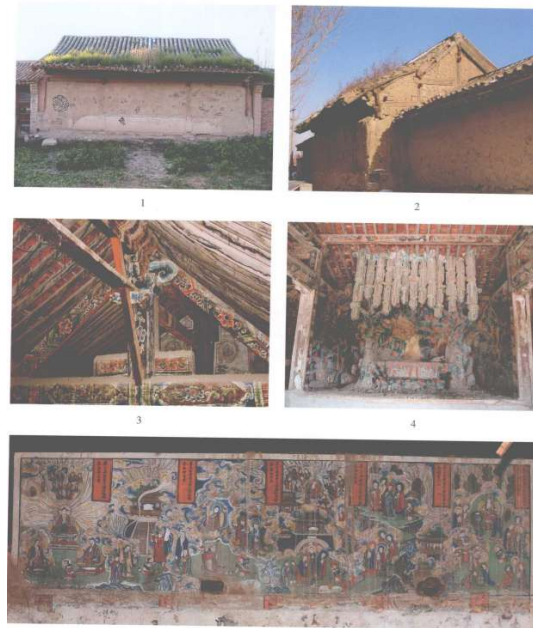


Fig: pictures of Temple of the Three Great Masters

### 3.1.5 Conclusion

Zhaohua Temple is one of the more complete ancient architectural complexes in Hebei Province, built in the first year of the Ming Dynasty or slightly earlier, and completed in the eighth year of the Ming Dynasty, as a relic of the early Ming Dynasty. Through the ground building survey and archaeological excavation, especially through the development of scientific maintenance program and the preparation of conservation planning, we have a deeper understanding of Zhaohua Temple. The architectural characteristics of Zhaohua Temple is summarized as follows:

- a) Zhaohua Temple overall layout in strict accordance with the traditional Chinese style "Jalan seven hall type" construction. According to the book, the data of archaeological survey and the existing main building, the overall layout of Zhaohua Temple is neat, sparse, reflecting the traditional features that building volume increase gradually and the decorative painting gradually become red and gorgeous along the central axis.
- b) The column network of Daxiong temple is along with the prevailing Yuan dynasty pillar with reduction, the use of column reduction method is to eliminate the front eaves and move the pillar to make the front eaves two gold pillars along the longitudinal to the secondary 1.075 meters, the back eaves gold pillars with move the pillar to make the two gold pillars along the longitudinal to the secondary 1.35 meters, so that the space in the temple increased.
- c) Each building is on the central axis, the eaves columns have side feet and no rise. After the Ming and Qing dynasties, the side foot of the building column is smaller.
- d) The flat hang and the front hang is "T" shape, flat hang to the corner column out of the head carved Haitang line.
- e) The ridge of the existing buildings in the temple are using forked hand, between the beam frame without Shu column, to gun pier support pad, retaining the characteristics of the building before the Ming Dynasty.

### **3.2 Frescoes property**

The water-land painting is a group painting of religious figures dedicated to Buddhism when holding water-land pujas, which began at the end of Tang Dynasty and flourished in Song, Yuan and Ming Dynasty. Zhaohua Temple Mahamudra painting, painted in Ming Jiajing 41 (year of 1562), contains Confucianism, Buddhism and Taoism.

It is precious evidence of the mutual integration of Confucianism, Buddhism and Taoism in the history of China. It reflects the religious landscape of the Ming Dynasty, and is a manifestation of the further secularization of Chinese Buddhism, which is turning into folklore, and is a valuable source for us to study the social life, religious culture, painting art, and folklore of the Ming Dynasty today.

#### **3.2.1 The layout of frescoes**

The existing fresco in Daxiongbao Hall take up with 93.566 square meters, which are mainly distributed in the north wall, east wall, west wall and south wall. North wall has four existing frescoes, each 2.6 meters high, 5.18 meters wide. East wall painting is 2.7 meters high, 11.05 meters wide, totaling 29.835 square meters. The picture is divided into two rows, each row of 11.

The west wall painting is 2.7 meters high, 10.85 meters wide, 29.295 square meters. The picture is also divided into two rows, the upper row of 11, the lower row of 10. The south frescoes are located in the east and west, each painted a Vajrayogini, each picture is 2.5 meters high and 1.5 meters wide.

#### **3.2.2 Preservation status**

The frescoes of the Daxiongbao Hall were painted in the 41st year of the Jiajing dynasty, when the temple had been built for 120 to 30 years, and have lasted for 444 years, so if we consider the issue historically, we can give the evaluation that the state of preservation is still good. However, due to the different locations of the murals and the different preservation environments they face, there are significant differences in the state of preservation of the murals on each wall. Overall, it seems that the frescoes in the east and west wall were preserved the best, the south wall next, the north wall worst.

Frescos in the north wall suffered the most serious damage, were the worst state of preservation. Among them, some have been difficult to identify the content. The eastern part of the picture is slightly better. From the observation of surface, water leakage and shortening alkali is the root cause of their poor state of preservation.

Zhaohua Temple frescoes are extensive, with many subjects, exquisite painting work, and high scientific and artistic value. Given the current state of preservation, it has reached the point of non-rescue. Therefore, we agree with the State Administration of Cultural Heritage "Huaian Zhaohua Temple repair project design approval" in the "deepen the current state of fresco protection design" requirements. We should develop a scientific and feasible rescue, protection, research programs, and put efforts on the implementation of the Zhaohua Temple frescoes protection work as soon as possible.

### 3.2.3 Description of frescoes

#### 1) Painting in the north wall

It includes one Buddha, four guardian Bodhisattvas, eight Vajra, six Ming King, and thirty-four small sitting Buddha. The layout is that the Buddha is sitting in the center, and the four Bodhisattvas sit symmetrically on both sides of the Buddha, but in a lower position than the Buddha. The two bodhisattvas on the same side are also high inside and low outside. On both sides of the Buddha's head and on the auspicious clouds above the two inner Bodhisattvas, there are seventeen small seated Buddhas. On the outside of the statue of the guardian Bodhisattva, there are three Ming Kings and four Vajras painted on each side. The whole painting is centered on the Buddha, and the figures are tall and plump, filling the whole picture.

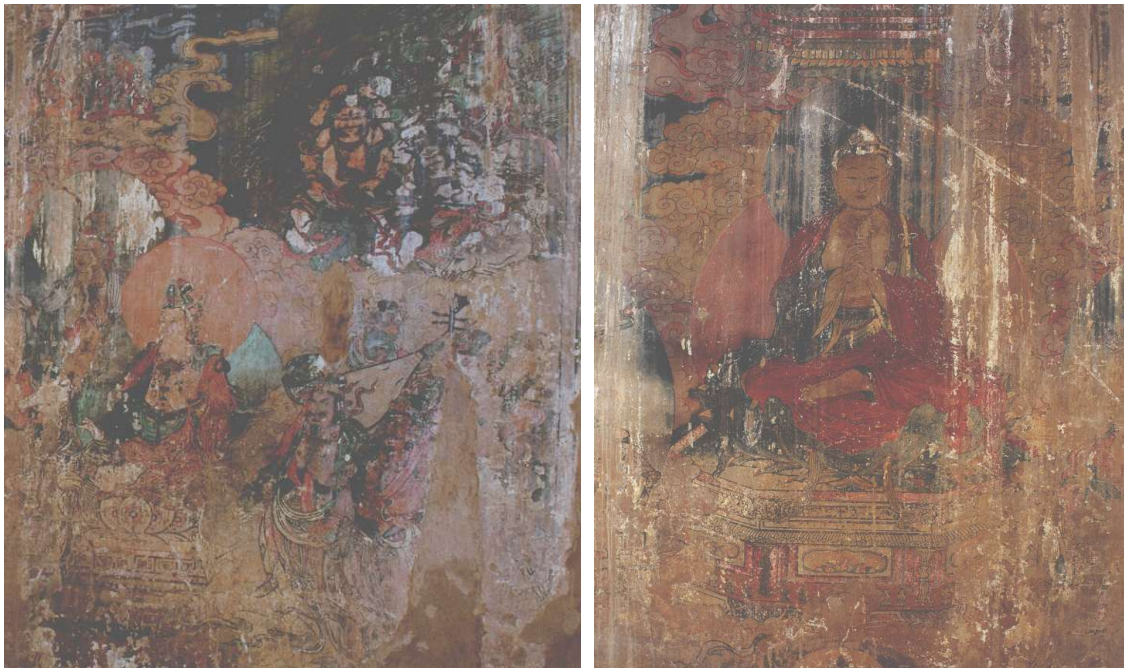


Fig: pictures of Frescoes

#### 2) Painting in the east wall

The name of this painting is holy monks and congregation. This painting, together with the 23rd painting on the west wall, forms the picture of Lohan. The picture is painted with nine people, all figures are arranged outside the open space, showing pine, stone cave, falling wood, mountain beam.

All the holy monks are sitting or standing, meditating or watching, leisurely and freely, vividly. At the uppermost part is an old monk with a hooded head, wearing a blue crane police and a yellow robe, with his hands together in front, meditating on the scriptures. In front of him is a lotus seat platform, and under the platform is a piece of flat ground, standing an old monk, supported by a young child in red, whose face and clothes are blurred.

Another dark-faced Lohan sat cross-legged on a high seat, red surplice, left wild yellow robe, holding a vase in his left hand and a lotus flower in his right hand, with a thin and emaciated

face and strange appearance. The other five monks were side by side, facing the left mountain, either sitting or standing, with a lamp post in the distance in front of them, all gazing.

One of them was dressed in red surplice and green robe, with his hands on the stone beam, looking at it from across the beam, with a puzzled face. Another monk, in green robe and pink robe, with a scarf on his shoulders, was sitting on a cloth cushion, with his hands together on his lap, his eyebrows slightly raised and his face happy.

Below, an old monk, dressed in a red surplice, is sitting on a mountain rock with a cloth sheet padded on the rock, his left hand hanging down, his face seemingly with sadness, and insects flying among the scrub grasses vaguely visible in front. This circular arrangement of figures is a clever way to deal with the end of the picture



Fig: pictures of Frescoes

### 3.2.4 Conclusion

The layout of the water-land paintings is basically the same, with Buddhism as the main focus, supplemented by Confucianism and Taoism. Zhaohua Temple water and land mural painting inherited the axis of the water and land painting to the composition of the unit form, although the mural did not draw out the boundary frame, but the width and width of the interval between the larger, not connected to each other, to the width of the unit composition is clear.

Zhaohua Temple Mahamudra painting, contains a variety of historical information, it graphically shows a large number of ancient figures and costumes, weapons and household utensils, flowers and trees, religious culture and folk customs, etc., has a high historical and artistic value, is known as a continuation of the Dunhuang fresco its rich connotations to be further revealed.

## 4. Strategy

### 4.1 SWOT analysis

As a well-known method of situational analysis, SWOT analysis was originally proposed in the early 1980s by Professor Wyrick of management at the University of San Francisco. These four letters refer to strengths, weaknesses, opportunities and threats, weaknesses, opportunities, and threats. threats.). Strengths and weaknesses are the analysis of the internal characteristics of a company or industry. Opportunities and threats are the exploration of the external environment faced by a company or industry. Through systematic analysis and discussion, it is possible to formulate the analysis and discussion, which can provide a reasonable basis for formulating the future development strategy of the enterprise or industry.

#### 4.1.1 Strength analysis

- a) History: Zhangjiakou has a long history and many ancient human cultural sites. The geological relics of Neihewan, which is classified as a national nature reserve, is considered one of the birthplaces of Chinese civilization and has rich and diverse local cultural tourism resources.
- b) Food: Zhangjiakou's local food culture is unique compared to other cities in Hebei Province, with a fusion of Shanxi and Inner Mongolia food styles, and traditional foods such as oat noodles and yellow rice cake are relatively new to visitors from other regions and worth a taste.
- c) Culture: Zhangjiakou has also developed a rich variety of snow and ice sports and cultural programs in recent years, as well as grassland music festival activities, making Zhangjiakou the first choice for ski tourism for tourists from Beijing, Tianjin and Hebei, and also popular with tourists from other regions and even overseas, thus bringing a lot of people to Zhaohua Temple.
- d) Architecture: Zhaohua Temple is one of the more complete ancient architectural complexes preserved in Hebei Province, the whole building was constructed in the first year of the Ming Dynasty or slightly earlier and completed in the eighth year of the Ming Dynasty. With its unique architectural style and complete preservation, Zhaohua Temple has a high tourism and ornamental value.
- e) Painting: The most striking feature of Zhaohua Temple is the fresco painting of the Daxiong Hall, painted with 47 murals of the Water Land Dojo, covering an area of 93.566 square meters, with more than 610 painted figures, which reflect the period characteristics of Ming Dynasty folk painting, in terms of subject matter showing the unification of Buddhism, Taoism and Confucianism, the further secularization of Buddhism, and the diversified worship of various gods and goddesses, the main content of the Water Land Dojo painting.

Overall, the city has unique location advantages, rich tourism resources, rich historical and folk culture heritage, unique local cuisine, and simple folk customs.

#### 4.1.2 Weakness analysis

- a) Guidance and planning are not enough. The districts and counties within Zhangjiakou City have not formed their own clear development plans for the whole area tourism economy, and each region has not formed its own characteristic positioning, unified standards for the construction of each scenic spot, and diversified publicity methods. Each region has problems such as unspecific tourism images, serious homogenization of scenic spots, uneven quality of scenic spots, and low visibility.
- b) The depth and breadth of industrial integration is not enough. Most of the "tourism +" is still in the conceptualization stage, the big framework is basically built up, but there is still a need to further explore the characteristics and in-depth implementation. The archaeological maintenance work of Zhaohua Temple has developed to a certain extent, but there is still much room for progress, and the popularity is still limited.
- c) Service quality needs to be further improved. At this stage, the tourism service elements such as accommodation, catering, shopping and tour guide have not formed a good system, with a single type and indistinct level, which needs to be improved in all aspects. At the same time, the public service system is not yet complete or standardization, information technology level to be further improved.
- d) There are still many problems in the process of promoting and developing the local cultural resources in Zhaohua Temple. The cultural tourism resources are scattered and the promotion strategies are not uniform in Zhangjiakou, so it is more difficult for visitors to get a convenient form of to get a rich experience in a short period of time
- e) Cultural tourism products have low technological content and lack of creativity. At present, the local cultural tourism products creativity is lacking. There is a more serious homogenization tendency, the modern technology content is low. Historical cultural resources are mainly for sightseeing and viewing, folk art cultural resources are mainly for selling related traditional products or watching performances.
- f) The promotional materials of cultural tourism involve too much human cultural allusions, which is relatively difficult to translate, so the quantity and quality of translation are not satisfactory. This not only affects the promotion of Zhaohua Temple's local cultural and tourism resources, but also the experience of tourists and their impression. It is not conducive to the shaping of Zhaohua Temple's image and hinders the promotion of the city to the outside world.

#### 4.1.3 Opportunity analysis

- f) The 2022 Winter Olympics will bring new life to Zhangjiakou's tourism industry. It will increase the popularity of Zhangjiakou city and raise the number of tourists for Zhaohua Temple.
- g) With the hosting of the Winter Olympics as an opportunity, Zhangjiakou's urban infrastructure construction has been improved, with the passage of high-speed railways such as Beijing-Zhang and Zhang-Da in 2019.
- h) Under the leadership of the local government, the ecological appearance of "green mountains and water" is increasingly prominent, the quality of residents in the area is constantly improving, and the tourism service industry is gradually standardized, which also provides convenient conditions for the rapid development of the tourism industry.

- i) The background of Beijing-Tianjin-Hebei cooperative development is also an important boost for the further development of Zhangjiakou cultural tourism industry. Zhangjiakou, because of its special geographical location, is vigorously developing ecological recreation projects and building an international tourism city, which brings opportunities for Zhaohua Temple's tourism promotion.
- j) With the end of the epidemic that swept the world, people's enthusiasm for travel has risen and brought opportunities for Zhaohua Temple's cultural tourism.
- k) The number of orders for temple-related tickets has recently increased year-on-year, with the post-90s and post-00s accounting for nearly 50% of those booking temple tickets in China. The young people who are wrapped up in impatience and powerless to reality are seeking psychological comfort and adjusting the rhythm of life by worshipping Buddha. The objects printed with auspicious words and seemingly bringing good luck, the objects that are fashionable to wear, comfortable to use and easy to share are the spiritual support that young people have placed in real life. Everyone wants to create a "paradise" like relaxation space for themselves.
- l) Going to temple has become the new "social currency": sharing the experience, precautions, taboos of going to the temple on Xiaohongshu (Chinese famous social media), and even the encounter after worship, the flow and interaction is quite high, greatly satisfying the social sharing desire of young people.

#### **4.1.4 Threats analysis**

- m) Zhangjiakou's local cultural tourism industry is facing challenges from the surrounding big cities. Zhangjiakou is adjacent to Beijing and Datong, and close to Tianjin and other major cities, which have formed a more mature and complete system in terms of cultural tourism. To get a long development, Zhangjiakou's cultural tourism industry must be precisely positioned, digging its own characteristics different from the surrounding cities, giving tourists from other countries and regions a good reason to choose Zhangjiakou, and devote itself to building a local cultural tourism industry that is well-known in the province, the country and the world.
- n) Zhaohua Temple was used as a classroom during the Cultural Revolution, during which there was considerable damage to its architectural structure and frescoes. Although there is now a new step of archaeological excavation and repair, many frescoes have been destroyed due to humidity and other reasons, and the preservation of the existing frescoes is still insufficient.
- o) People know very little about the frescoes, so far only a few experts and scholars have studied them, and the public is not interested in them. If there is no further publicity, people will not come to Zhaohua Temple specifically for tourism if they do not understand the value of these frescoes.
- p) At present, there are no supporting facilities for Zhaohua Temple and the surrounding landscape, such as a special bus line, which is not conducive to the attraction of Zhaohua Temple

## **4.2 PESTEL analysis**

A PESTLE analysis studies the key external factors (Political, Economic, Sociological, Technological, Legal and Environmental) that influence an organization. It can be used in a range of different scenarios, and can guide people professionals and senior managers in strategic decision-making.

### **4.2.1 Political Aspect**

China has left many historical relics to this day, but political turmoil and insufficient attention to ancient architecture have led to the disappearance of many ancient buildings. However, ancient cultural relics represent the productivity and spiritual world of a culture, and they are the root of modern life and thought. Preserving ancient cultural relics and promoting them is greatly conducive to improving cultural self-confidence and allows us to better understand our culture, our country, and ourselves at the same time.

The study and exploration of frescoes, which is the only surviving work of art that combines Confucianism, Taoism and Buddhism, can help us understand the spiritual world of the ancients and thus find a place for the spirit of modern people to reside, and the foundation of a nation.

### **4.2.2 Economic Aspect**

Huai'an County has a rich cultural history, but it was only in 2018 that it was lifted out of poverty list. In addition to traditional agriculture, it has also begun to focus on the development of industries such as photovoltaics, automobiles, and the tourism industry. As a local ancient building in Huai'an, Zhaohua Temple contains rich fresco culture. If it is properly maintained and promoted, Zhaohua Temple has the potential to become a major signboard for local tourism, bringing development to Huai'an's tourism industry and supporting local service industry.

### **4.2.3 Sociological Aspect**

Frescoes left the opportunity for folk painters to give full play to their individual talents, and they were not bound by the program, and they freely presented the images of beings in society from different perspectives according to the life scenes they saw, which became the most social-historical value and artistic charm of the Ming Dynasty water-land dojo paintings.

The paintings in the Daxiong Hall of Zhaohua Temple contain a variety of historical information, and they show a large number of ancient figures and costumes, weapons and household utensils, flowers and trees, religious culture and folk customs, etc. They have high historical and artistic values and are regarded as a continuation of the Dunhuang murals.

#### **4.2.4 Technological Aspect**

For the maintenance work of Zhaohua Temple, including the maintenance of wooden structures, the maintenance of frescoes, and possibly the use of emerging technologies such as VR, it can bring inspiration for other similar maintenance work.

#### **4.2.5 Legal Aspect**

In the protection of ancient buildings, in addition to the protection and maintenance of ancient buildings, we should also pay attention to the overall preservation of ancient buildings. The existing monolithic ancient buildings are part of a temple, government offices, residences, etc., to protect the ground monolithic buildings, it is necessary to understand its location in the establishment as a whole, as well as the relationship with other neighboring buildings, especially in the national key cultural relic protection lists, must include these elements, in order to more accurately delineate its scope of protection.

In the past, not enough attention was paid to this aspect when developing conservation programs. The protection of Zhaohua Temple not only includes the maintenance of existing buildings, but also the exploration of the original scope of the temple which has been destroyed and excavation of the monument and bell tower site, for the comprehensive protection of Zhaohua Temple for the preparatory work.

This shows that China's heritage conservation business to the protection of ancient cultural heritage has paid attention to the integrity and authenticity, the heritage conservation work to a higher level of promotion is a very good development trend, worth promoting. It is possible to display the excavated building sites in their original state, but it is prudent to carry out the restoration of the monument tower, bell tower and drum tower, and to fulfill the procedures of reporting and approval.

#### **4.2.6 Environmental Aspect**

Since this year, Huai'an County insists on pollution prevention and ecological restoration, collaborates to promote pollution reduction, grasps chemical pollution land treatment and restoration, and ensures soil environmental safety.

At the same time, Huai'an County fully explores and protects ancient villages and houses on the basis of optimizing the village habitat, highlighting the characteristic appearance of the integration of farming culture and swan kiln culture, and strengthening the protection of traditional villages. Zhaohua Temple can strengthen the local habitat characteristics and add a different landscape to the local environment.

### 4.3 Strategies for future development

Based on the SWOT analysis and PESTEL analysis of Zhaohua Temple, it should do the following three things to vigorously develop the cultural tourism industry in the future.

First, the integration of cultural tourism resources. Resource integration can be centered on immovable resources such as building complexes to form special blocks of ancient buildings and ruins, and integrating movable cultural tourism resources in the block to establish cultural experience pavilions or experience sites to facilitate tourists' choices, enrich their perceptions and experiences, and give them a "one-stop" access to the temple.

Second, highlight the characteristics and themes. The promotion of Zhaohua Temple must dig deeper into the characteristics of the resources, and the tourism park and tourism products should be built around a certain theme, linking the various local cultural resources. In addition, to deepen visitors' experience and feeling of cultural themes, visitors can be guided to active participation in the experience; at the same time, the introduction of modern technology, such as VR virtual simulation technology, etc., so that visitors can be immersed in it, providing visitors with a fresh immersive interactive experience.

Third, we should pay attention to the creation of local cultural tourism brand, give full play to the publicity effect brought by the brand, and enhance the competitiveness of Zhaohua Temple's cultural tourism industry. Relevant departments can use the strong factors in Zhaohua Temple 's local characteristics of cultural tourism resources as a grasp, such as local characteristics of food as an entry point for branding, encourage enterprises to create local cultural brands, and then drive the promotion of other cultural resources.

## 5. Business Plan

### 5.1 Value propositions and Key activities



The murals in Zhaohua Temple have the most historical and cultural value and should be protected as key objects. Carry out a series of activities around the murals to achieve the purpose of adding value.

As for the building itself, it is necessary to restore the original appearance as much as possible, repair the existing Shanmen, Tianwang Hall, Daxiong Hall, Three Confucian Halls, and Yuan Hall, and rebuild Ning Hall,

Dizang Hall, Guanyin Hall, East and West Halls, Bell and Drum Towers, Stele Towers, and Brick Towers. Build new souvenir shops and visitor centers (including changing rooms and locker rooms), improve the temple landscape, add green plants and wishing trees, dig artificial ponds, breed temple koi, etc. Above is a map diagram of our site. The red dashed box shows the area occupied by Zhaohua Temple. We can clearly see the surroundings of the main building; the

temple is surrounded by higher density residential areas, but there is still enough open space around for us to consider using.

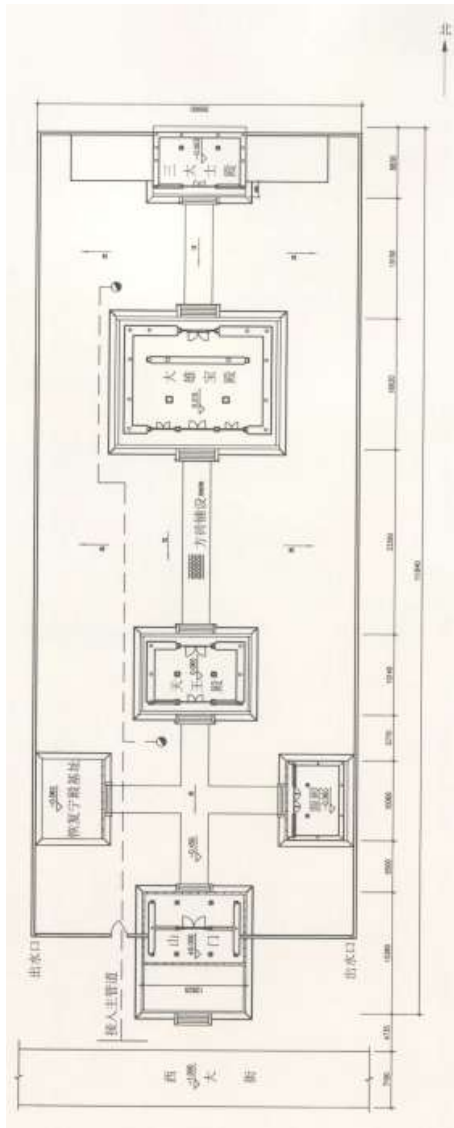


Fig: Masterplan of Zhaohua Temple

Entering the gate from West Street is the reception hall and then the first courtyard, where the two small halls to the left and right can be converted into a souvenir store and restaurant.

Crossing the courtyard, we come to the Tianwang Hall, where a VR exhibition hall will be set up. After experiencing the different experiences using the new technology, we will continue into the Daxiong Hall, which is the space with the most preserved fresco remains. So, this will be a pure exhibition hall to let people appreciate the art of frescoes.

After the fresco exhibition, the last hall is the Sandashi Hall, which can be converted into a meditation room because of the quiet environment and the design of the courtyard landscape and greenery, creating a calm atmosphere. The two courtyards in front sometimes hold outdoor exhibitions or performances and other events.

In addition to the reuse of the building itself, we are considering new complementary spaces in the surrounding open space to expand the venue and enrich the visitor experience here.

We have three strategic goals that combine to transform Zhaohua Temple into a fresco art-centered tourist attraction, trying to stimulate the interest of different people and simultaneously drive and enhance the attractiveness and competitiveness of the place. By incorporating current popular forms, we can better show the public the charm of fresco art and ancient architecture, strengthen links with existing scenic spots in the surrounding area, and activate the reuse value of historic buildings. These three strategic goals are:

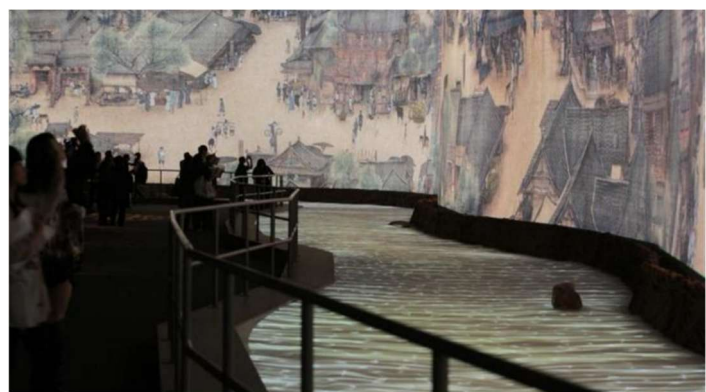
## 1) Visitor Targeting

For believers and meditation experiencers, we plan to provide meditation rooms, fasting rooms and lecture halls. They can live in the temple for a period, meditate and chant scriptures every day, learn murals and Buddhist teachings, stay away from the hustle and bustle of the mundane world, and gain inner peace.



For ordinary tourists, we plan to use a relatively new mural display method and use digital technology to create an immersive experience space. Every visitor could become a character in the mural, and they will wear corresponding costumes to enter the temple. The visitor center at the entrance rents or purchases costumes, and the temple will also provide online purchase channels and deliver them to your home through express delivery.

The temple will also provide outdoor venues for communal dining for visitors, where guests sit around a table and discuss scriptures as people in ancient China did.



## 2) Diversity of Visiting Experience

First, the exhibition hall has its own online network, where people can learn about the murals and their related information online before they visit the site. When people arrive at Zhaohua Temple, the online platform also provides guided tours for visitors and a written visitor guide once they are inside. The interpretation of the murals, as well as the visitor experience, is enhanced by the introduction of new technologies, such as digitization, that connect visitors to our fresco experts. The exhibition will also include a presentation of science and related conservation knowledge about ancient architecture. In addition, we are providing a better visitor experience by updating the building components and optimizing the interior environment.

We also plan to set up a few temple night tours, such as nightly traditional cultural performances, catwalk mural performances, live sutra band performances, and light art exhibitions.



## 3) Adding supporting facilities

The streets around the temple will also be repaired, the infrastructure will be improved, and the number of shops, restaurants and hotels will be increased to form a traditional Chinese cultural street.

In addition, we will set up a dedicated tourist bus line to connect other scenic spots in Zhangjiakou, such as the Grassland Music Festival, the ski resort, and the Yuanzhongdu site, to shorten travel time and improve travel convenience and comfort.

In terms of publicity, we will not only use classic advertisements and email promotions, but we will also actively put advertisements (Search engine optimization) about us on search engines and social media. In addition, we will cooperate with online celebrities, invite them to visit in person and shoot short videos to promote Zhaohua Temple and other tourist attractions in Zhangjiakou, and promote the city through the media. The above measures are to cater to the information receiving habits of the new generation of young people.

We will also try to build social groups online and in reality and invite visitors who have visited the Zhaohua Temple, try to build stronger bonds with visitors through various promotions and special events for fans, attract repeat customers and increase user stickiness.

It will also be useful to encourage tourists to publish their travel experiences in Zhaohua Temple through ticket discounts and gift giving on social platforms.



## 5.2 Key partners

State Administration of Cultural Heritage

Hebei Provincial Bureau of Cultural Relics

People's Government of Zhangjiakou City

Hebei Provincial People's Government

Zhangjiakou Natural Resources and Planning Bureau

Hebei Cultural Relics Protection Center

Hebei Bureau of Cultural Relics

Hebei Provincial Institute of Cultural Relics and Archeology

Hebei Provincial Department of Culture and Tourism

Zhangjiakou Culture, Radio, Television and Tourism Bureau

Hebei Architectural Design and Research Institute Co., Ltd.

Hebei Construction Group Co., Ltd

Zhangjiakou Public Transportation Group Co., Ltd.

Hebei Radio and Television Station

Zhangjiakou Radio and Television Station

Huayi Brothers Media Co., Ltd.

Sun Media Group

China Cultural Heritage Conservation Foundation Co., Ltd.

Zhangjiakou Wanlong Sports Tourism Co., Ltd.

## 5.3 Cost structure and revenue streams

### 5.3.1 Cost structure

The main costs of the Zhaohua Temple Renewal Project are divided into hard costs and soft costs incurred during the construction process and costs incurred during the annual operation process.

Renovation cost of Zhaohua Temple				
Renewal Program	Renovation buildings	Construction area	Construction unit price	Construction cost
Repair	Mountain gate	68.87	¥ 500.00	¥ 34,435.00
	Palace of Heavenly Kings	86.11		¥ 43,055.00
	Daxiong Palace	209		¥ 104,500.00
	Hall of Three Scholars	68.52		¥ 34,260.00
	Yuandian	53.94		¥ 26,970.00
	Subtotal	<b>486.44</b>		<b>¥ 243,220.00</b>
Rebuild	Ning Dian	77	¥ 8,300.00	¥ 639,100.00
	Ksitigarbha	103.6		¥ 859,880.00
	Guanyin Hall	122.12		¥ 1,013,596.00
	East side hall	56.84		¥ 471,772.00
	West Palace	57.42		¥ 476,586.00
	Bell tower	69.92		¥ 580,336.00
	Drum tower	30		¥ 249,000.00
	Monument	56.25		¥ 466,875.00
	Brick tower	157		¥ 1,303,100.00
	Subtotal	<b>730.15</b>		<b>¥ 6,060,245.00</b>
Build	Visitor Center	86.11		¥ 714,713.00
	Gift Shop	56.84		¥ 471,772.00
	Fasting room	68.52		¥ 568,716.00
	Buddhist temple	168.2		¥ 1,396,060.00
	Digital Exhibition Hall	2000		¥ 16,600,000.00
	Subtotal	<b>2379.67</b>		<b>¥ 19,751,261.00</b>
<b>Building Renovation subtotal</b>		<b>3596.26</b>		<b>¥ 26,054,726.00</b>
<b>Landscape Renovation</b>		<b>37227.74</b>	<b>¥ 180.00</b>	<b>¥ 6,700,993.20</b>
<b>Total</b>		<b>40824</b>		<b>¥ 32,755,719.20</b>

Hard costs refer to the construction costs of repairing existing buildings, restoring original buildings, and building new buildings. Assuming that the renovation time is two years, the cost in the first year is 60% of the construction cost of the assembly, and the cost in the second year is 40% of the total construction cost, and it will be open for operation immediately after the renovation.

Soft costs include planning and design fees, engineering supervision fees, project management fees, other unpredictable expenses, management fees, engineering insurance fees, secondary decoration fees and exhibition display fees, calculated according to the total decoration cost, and refer to the Chinese market rate.

The costs incurred during the operation process include staff salaries and administrative costs, costs for research and development of related cultural relics, media promotion costs, and temple building maintenance costs.

### 5.3.2 Revenue streams

Zhaohua Temple's sources of income include operating income, social donations, and government funding.

Temple operating income, including special tickets, transportation, exhibitions, restaurants, accommodation, souvenir shops, parking lot income, etc.

Social donations mainly come from charitable enterprises and individuals. Financial support from the government and foundations is also an important source of financial revenue for temples.

### 5.4 Discount Cash Flow

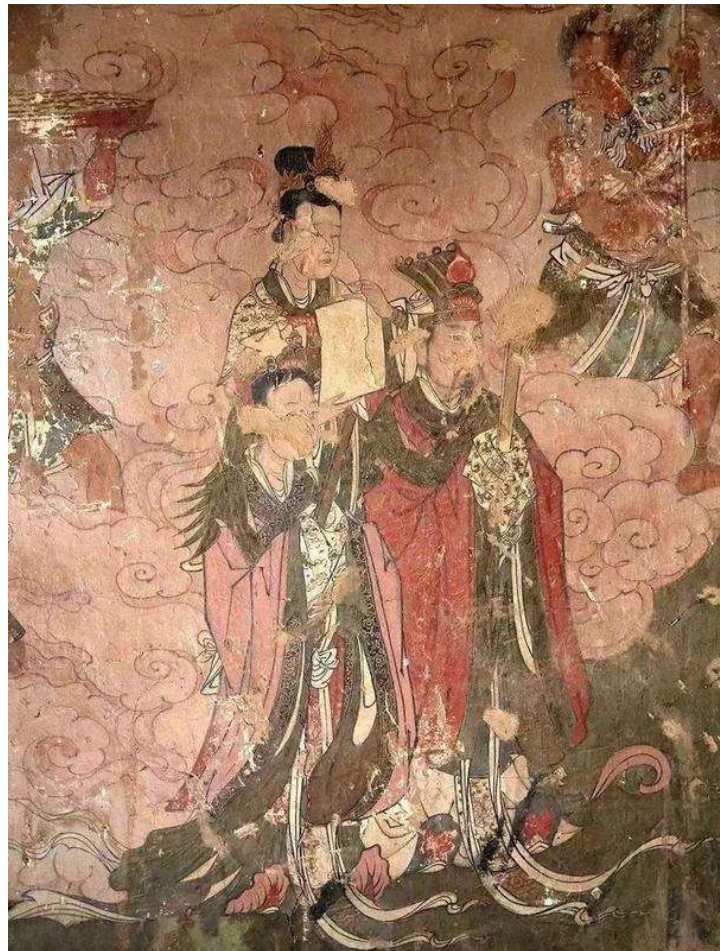
Valorisation case study of Zhaohua Temple										
Years			2023	2024	2025	2026	2027	2028	2029	
Cash Flow	Income	Yearly income(RMB)-ticket etc.			¥13,383,609.45	¥13,383,609.45	¥13,383,609.45	¥13,383,609.45	¥13,383,609.45	¥13,383,609.45
		Funding(RMB)-public funding		¥10,000,000.00		¥2,500,000.00	¥2,500,000.00	¥2,500,000.00	¥2,500,000.00	¥2,500,000.00
		Donation		¥5,000,000.00		¥2,000,000.00	¥2,000,000.00	¥2,000,000.00	¥2,000,000.00	¥2,000,000.00
		Final incomes		¥15,000,000.00		¥17,883,609.45	¥17,883,609.45	¥17,883,609.45	¥17,883,609.45	¥17,883,609.45
		Total renovation cost(RMB)	¥32,755,719.20							
	Cost	Renovation cost(60% in the first year and 40% in the second year)		¥19,653,431.52	¥13,102,287.68					
		Planning and design fee	3%	¥589,602.95	¥589,602.95					
		Works supervision	1.65%	¥324,281.62	¥216,187.75					
		Project management	1.00%	¥196,534.32	¥131,022.88					
		Other unpredictable costs	3%	¥589,602.95	¥393,068.63					
Administration costs		0.84%	¥165,088.82	¥110,059.22						
Engineering insurance fee		0.10%	¥19,653.43	¥13,102.29						
Secondary decoration and exhibition display		20%	¥3,930,686.30	¥2,620,457.54						
Research and Development cost					¥30,000.00	¥30,000.00	¥30,000.00	¥30,000.00	¥30,000.00	
Media promotion costs					¥2,140,000.00	¥2,140,000.00	¥2,140,000.00	¥2,140,000.00	¥2,140,000.00	
Discount cash flow	Operating costs				¥5,320,000.00	¥5,320,000.00	¥5,320,000.00	¥5,320,000.00	¥5,320,000.00	
	Yearly costs		¥25,468,881.91	¥17,175,788.92	¥7,490,000.00	¥7,490,000.00	¥7,490,000.00	¥7,490,000.00	¥7,490,000.00	
Discount cash flow	Yearly net cash flow		¥-10,468,881.91	¥-27,644,670.83	¥-17,251,061.38	¥-6,857,451.93	¥3,536,157.52	¥13,929,766.97	¥24,323,376.42	
	Year(n)		0	1	2	3	4	5	6	
	Discount rate WACC(t)	6.6%								
	Discount Cash Flow= $T \cdot (1/(1+t)^n)$		¥25,468,881.91	¥-25,933,087.08	¥-15,181,036.03	¥-5,660,973.97	¥2,738,437.19	¥10,119,471.41	¥16,576,034.14	
	Current market Value (RMB)								¥8,127,727.57	
	Current market Value (EURO)								1,047,387.57 €	

Using the discounted cash flow method, considering the time value of money, and referring to similar temple investments in China, the discount rate is 6.6%. In the base case, the market value of the museum after five years of operation is EUR 1,047,387.65.

## 6. Digital technology tools

### 6.1 Digital preservation and restoration of frescoes

The frescoes of Zhaohua Temple are very similar in style to those of Dunhuang and have been called by scholars "movable Dunhuang frescoes", occupying an important place in the history of Chinese religious painting. However, the murals are greatly affected by the environment, climate, and temperature. Currently, the murals are threatened by a variety of diseases such as armor, bulging, peeling, chalking, and fading. In the history of mural conservation work, people have used copy reproduction, modern photographic camera, and other techniques to record the information and changes of the mural, but these image materials are difficult to preserve lastingly, image reproduction will produce information distortion and other serious problems. Digital fresco protection and restoration work can be permanently preserved fresco information and can use the computer to virtual restoration of frescoes, assist in fresco protection and copying, to achieve a virtual display of fresco realism and other work. Digital fresco conservation restoration provides an adequate scientific basis and testing environment for the physical conservation process of frescoes, minimizing the dangers of conservation work. We will provide technical support for the future development of this project by analyzing the digitization technology of Chinese Dunhuang murals.



### 6.1.1 Application of digital technology in the conservation of frescoes

The application of computer digital technology not only makes a very good means of protecting precious mural information, but also serves as a good supplement to conventional technical methods, increasing the efficiency of conservation work, improving the quality of work, and greatly enhancing the effectiveness of conservation work. The main application methods are:

- 1) **Mural Information Protection:** The digitized mural information not only preserves the original information of the mural, but also reflects the current status of mural conservation, reflecting the current state of the mural, so the digitized mural images not only become first-hand mural information materials, providing basic information for preservation and research, but also provide a reliable basis for developing measures for mural conservation and studying the causes of mural changes and are mural Protection of important archival information.
- 2) **Mural protection status survey:** on the basis of acquiring and producing high-precision mural original images, through interpretation and field investigation, drawing out each cave mural preservation status and disease occurrence status that is mural protection status survey map, supplemented by the relevant cave microenvironment monitoring and mural sample analysis, comprehensive for the cave mural protection status of basic information, for cave mural protection to provide objective can be back to the basic data.
- 3) **The tracking of conservation measures** using digital technology can easily collect mural painting image information before and after restoration and over a considerable period, forming a series of comparative research data for assessing the effectiveness and timeliness of conservation measures as well as methods, which undoubtedly has important practical significance for systematically summarizing conservation materials, methods, etc.
- 4) **Conservation research simulations:** for the study of fresco diseases and fresco color changes, computer simulations based on digital fresco images can provide a visual and intuitive change process that can help develop specific restoration work methods and avoid direct damage to the frescoes.

### 6.1.2 The digitization process of frescoes

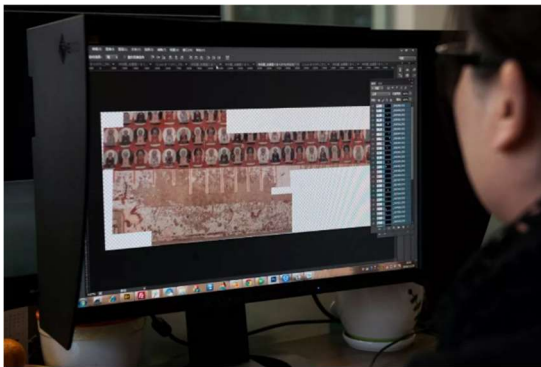
The traditional way of recording frescoes usually takes years and is very error prone. The intervention of digital technology provides new ideas for the permanent and non-destructive preservation of mural art information, in addition to the combination of artificial intelligence and image processing techniques to study the evolutionary process of mural decline and to recreate its original appearance. The main steps can be outlined as follows:

- 1) **Photography Acquisition:** It is the first important part of the mural digitization, using a customized track to capture the mural frame by frame and line by line photography. The camera uses cold light to protect the mural to the maximum extent. The data of the photographed row will be transmitted to the computer, and the technical staff will do a check on the technical parameters such as exposure, sharpness, overlap and quantity of the image, and then the photographer will proceed to the next row after meeting the

requirements.



- 2) **Image processing:** The original photos collected by the front photography are processed by post image processors for image stitching, and the overlapping 50% images are stitched together into a complete image. The combination of automatic stitching and manual stitching provides better control of the stitched image in terms of deformation and color. The stitching process usually takes a long time.



- 3) **Positioning correction:** The final stitched image uses the point cloud image intensity map obtained by laser scanning to perform image deformation correction using the mural positioning, correction and measurement system, which can control the graphic deformation within 2 mm.
- 4) **Panoramic roaming:** Photography acquisition is the basic work of panoramic roaming production. The number and position of the nodes are selected according to the shape of the room, the tripod is supported at the node position, and the rotation angle of the head and the number of shots is decided according to the lens used. After finishing the acquisition, check the focus, white balance, exposure and overlap of adjacent images. Making sure there is no problem with the captured content before moving the tripod for the next node.



- 5) **Data Verification:** The Dunhuang Research Institute designed and developed its own error-free Dunhuang Grottoes mass data transfer verification software, which allows data to be transferred in chunks and then combined for different media transfer rates to ensure consistency and integrity of data transfer.
  
- 6) **Data Storage:** The data storage is very important for the whole digitization, the data of Dunhuang cave murals digitization has accumulated nearly 100TB of data, the data volume grows more than 20TB per year. for such a huge amount of data, the institute has established data management rules and regulations, divided the logical storage space, through the hardware storage equipment to build disk arrays to ensure the safe storage of data.
  
- 7) **Intelligent copy-assist technology:** This technology mainly includes computer-aided generation of line drawings (using vectorization techniques and interpolation algorithms to simulate a certain degree of different styles of line drawings, with fine modifications to some of the lines) and computer-aided coloring (through pattern recognition methods, artificial intelligence techniques, etc. for coloring murals made by computer assistance).
  
- 8) **Color Virtual Recovery Technology:** Using intelligent object color layering techniques, area and edge extraction techniques to complete mural object segmentation. Color restoration of murals is achieved using knowledge of color coordination, color styles, and other information.

### 6.1.3 Create an online resource library.

To further apply digitization to cultural heritage conservation, the project could create an online platform in the future that would enable online tours for visitors and permanent preservation of heritage. A similar case is "Digital Dunhuang" which is a virtual project for the conservation of Dunhuang that includes virtual reality, augmented reality and interactive reality to digitize Dunhuang's treasures, break the constraints of time, space and meet the needs of people to visit, enjoy and study. Using mapping and remote sensing technology, we are committed to virtualizing all cultural relics such as the shape of Caves and sculptures with millimeter precision in the computer, integrating cultural conservation, cultural education, and cultural tourism. Through this website, netizens from all over the world can log on and to enjoy

high-definition digital images of the murals 360 ° inside the caves as well as textual descriptions of the murals, and to have a virtual roaming experience.

The website digitizes all 30 caves and 4,430 square meters of frescoes with a collection accuracy of 300 DPI, allowing us to visit online through the official website without leaving home. You can see the detailed information of each mural on the home page, and click on it to see the high-definition images, which will always remain clear when you keep zooming in.



## CLASSIC MURAL

Cave Number (Mogao)023 The North Wall of Main Chamber

**TIME: High Tang Dynasty(A.D.713-766)**

In the center of the north wall is a preaching scene, and around it are episodes from the Lotus sutra. Some of the scenes are vague and those identifiable ones include the illustrations of different chapters like the Introduction, Expedients, Fables, Predictions, and Emerging from the Underground.

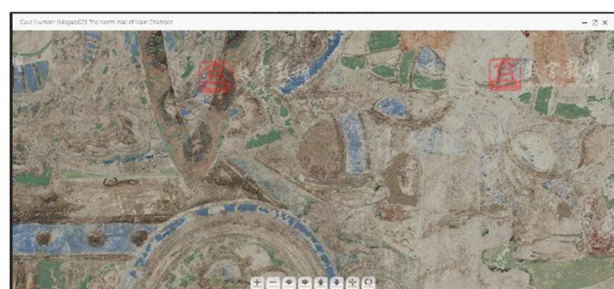
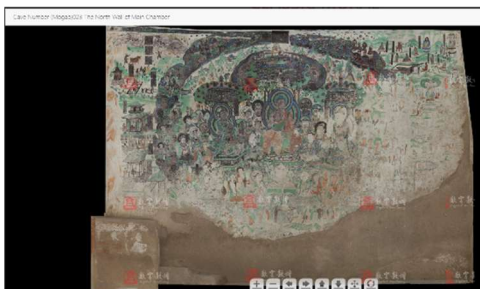
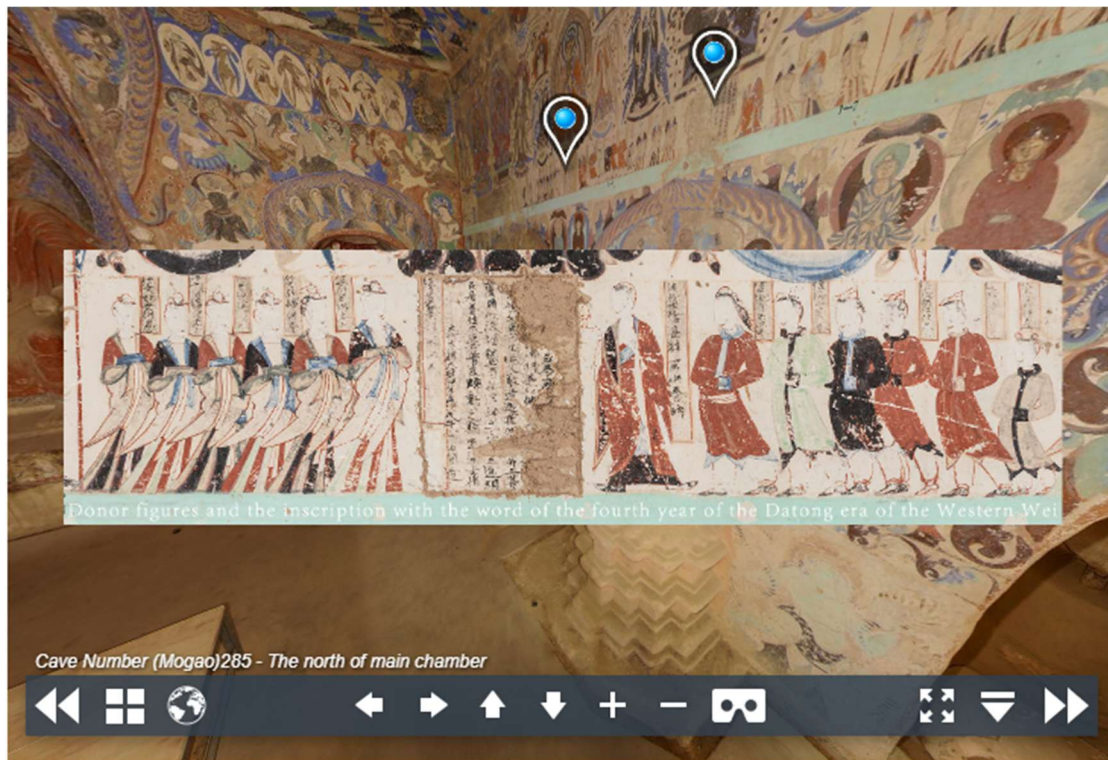


Cave Number (Mogao)323 The North Wall of Main Chamber

**TIME: Early Tang Dynasty(A.D.618-712)**

The upper part is decorated with the thousand-Buddha motif, and the middle part shows five stories from west to east: 1. Emperor Han of the Western Han obtaining a gold image from the Huns and then sending Zhang Qian to explore the Western Regions; 2. The pond and stone where Sakyamuni washed and dried his kasaya; 3. the miracles of Fo Tucheng; 4. King Asoka worshipping the pagoda of the heretics; and 5 the magic power of Kang Senghui. The lower part is a picture of seven bodhisattvas.

You can also directly click on each cave, and you will see a panoramic roam, then you click on the icon, and it will show the frescoes in the corresponding location.



With the rapid development of technology, the integration of culture and technology has become a new type of business, and some products of the integration of culture and technology have come into being. Using information technology such as digital photography, 3D information acquisition, virtual reality, multimedia and network, the text, image, sound, video, and 3D data information related to cultural heritage are digitized and can be preserved permanently, so that the public can maximize and equitably enjoyment of cultural heritage. On the one hand, digital technology will bring the methods and means of research and conservation of cultural heritage to a new level. On the other hand, digital conservation often aims to "rescue" cultural heritage that has already been destroyed, i.e., to ensure the preservation of these fresco treasures in their original and permanent images under existing technological conditions, while the real test of conservation is preventive conservation.

## 6.2 Digital technology in O&M management of historical buildings

Historical architecture is an important part of human cultural heritage and a physical carrier of human historical transformation, but because of its long formation time, the original information cannot reflect the current situation, and the traditional way of measuring and photographing cannot record the building quickly, completely, and authentically. Since the archaeological excavation, the overall quality of Zhaohua Temple is not good, but its historical and cultural value cannot be overlooked. The building has been conserved many times and still needs further restoration and renovation at the present time, along with a high demand for daily maintenance. Its architectural features and characteristic murals will certainly bring many visitors in the future, and its users and managers will face some difficulties and problems in daily operation and management(O&M). Using digital technology in the operation and maintenance management of historical buildings can provide a brand-new path to solve these difficulties and problems.

### 6.2.1 Application in architectural mapping

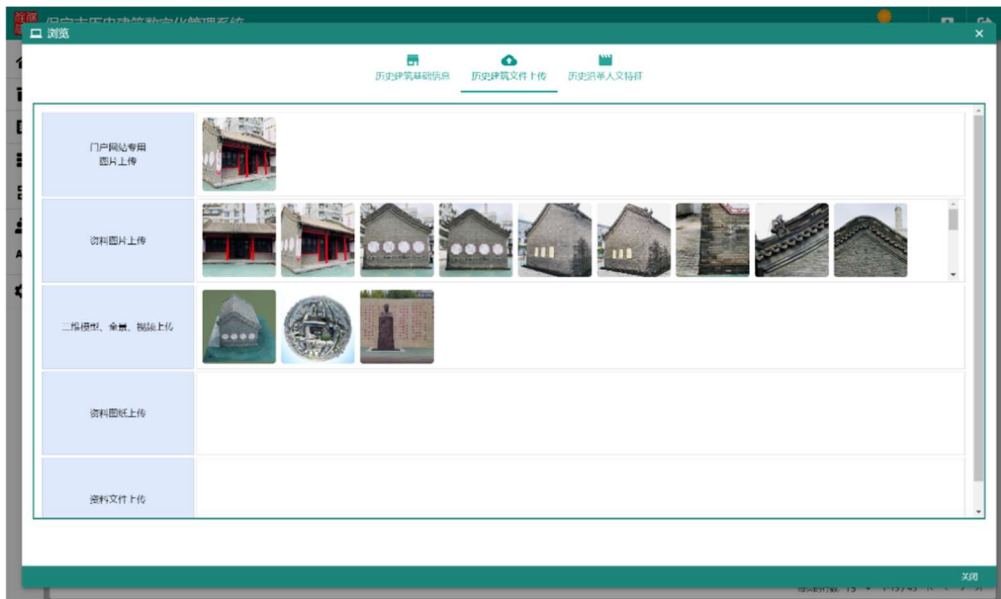
**Floor plan mapping:** Through 3D laser scanning technology, GPS and drones, etc., the outdoor spatial information data of the building complex can be quickly obtained, and the fused 3D data model can be drawn in 2D and 3D linkage in the computer, and then the general floor plan of the building can be realized. After the actual comparison, the site and the internal implementation efficiency has increased nearly ten times compared with the traditional way.

**Roof mapping:** The roof layout of historic buildings is often more complex than that of modern buildings, and traditional mapping can only be carried out by climbing onto the roof for manual measurement, which is inefficient, error-prone, and risky to implement. The use of UAV (Unmanned Aerial Vehicle) photogrammetry can easily carry out the work.



**Facade mapping:** Most of the facades of architectural heritage are irregular in shape, with many decorative details and spatial curves, so it is quite difficult and time-consuming to use traditional techniques for mapping. Using ground-based 3D laser scanning technology can obtain the spatial coordinate information of building facades quickly and without contact. It also avoids the risk of climbing and damage to historical buildings. At the same time, the scanned data can be directly imported into the computer for mapping operations, which solves the problems of data conversion, information asymmetry and reworking, improving the efficiency of mapping greatly.





Based on this, the management system can also integrate personalized requirements such as propaganda display, news release, accident reporting and training notification according to various needs such as management and promotion.

The results of digital mapping archives of buildings can be used to build a public-oriented real-time search and browsing platform to show the value and cultural charm of historical buildings to promote public attention and participation in the protection of historical buildings.



This chapter analyzes and discusses the technical tools which will be used in the process of valorisation and reuse of Zhaohua Temple. These technologies can be applied to the restoration of frescoes and buildings at Zhaohua Temple, while also improving the efficiency of future building operations and management. The use of new technologies will be complementary to the development of new functions at Zhaohua Temple.

## 7. Conclusion

Through our research and analysis above, we have seen many aspects about Zhaohua Temple as a cultural heritage. It has suffered more serious breakage in its history. Although the government and related departments have carried out some work on architectural conservation and restoration, they have not brought Zhaohua Temple to its ideal state so far, probably due to related policies, funding, and other reasons. Zhaohua Temple has its historical and age value in terms of architectural structure, form and internal frescoes, so it needs to be protected and conserved to some extent, and we also considered adopting some digital technologies to increase the efficiency.

We considered different opportunities and challenges that the project may face, including endogenous (the condition of the building itself, supporting facilities, its own characteristics, etc.) and exogenous (development opportunities, promotion policies, etc.), aiming to explore its potential and available conditions, hoping to bring added value to the local area on top of its own value being seen and spread. With the Winter Olympics bringing rare opportunities and people to the area, local governments should seize the opportunity to think about how to participate in such a trend. The valorization scheme involved in this case focuses more on the building itself and how to increase its attractiveness. Using the temple as a cultural backdrop and the murals as a feature, a series of activities are developed to reuse different parts of the building as well as to expand it. Also, the type of architecture of the temple is a complement to the local tourism industry.

In Hebei Province and the surrounding areas, there are many historical and cultural heritage sites similar to Zhaohua Temple, which have great historical value but are not well protected and utilized, which is a pity for people. Through the comprehensive analysis and valorization means of this project, it may provide a referable direction for the reuse of projects which have similar situations in China.

## 8. Reference

- Digital Protection and Restoration of Dunhuang Mural, Pan Yunhe, Lu Dongming
- [https://www.dpm.org.cn/study\\_detail/100202.html](https://www.dpm.org.cn/study_detail/100202.html)
- <https://www.ihchina.cn/project.html>
- <https://www.e-dunhuang.com/index.htm>
- <https://zhuanlan.zhihu.com/p/346588189>
- 《昭化寺》河北省古代建筑保护研究所（《Zhaohua Temple》, Hebei Institute for the Protection of Ancient Buildings）
- [http://czt.hebei.gov.cn/root17/zfxx/202306/t20230606\\_1815081.html](http://czt.hebei.gov.cn/root17/zfxx/202306/t20230606_1815081.html)
- <https://tjgb.hongheiku.com/djs/35365.html>
- [http://www.citypopulation.de/en/china/hebei/admin/1307\\_\\_zh%C4%81ngji%C4%81k%C5%8Fu/](http://www.citypopulation.de/en/china/hebei/admin/1307__zh%C4%81ngji%C4%81k%C5%8Fu/)
- 
- <https://www.travelchinaguide.com/china-trains/high-speed/beijing-zhangjiakou.htm>
- [https://www.researchgate.net/figure/Location-of-the-Zhangjiakou-City-study-area-in-Hebei-Province-PR-China\\_fig1\\_319715570](https://www.researchgate.net/figure/Location-of-the-Zhangjiakou-City-study-area-in-Hebei-Province-PR-China_fig1_319715570)