Architectural Forms and Distribution Characteristics of Beacon Towers of the Ming Great Wall in Qinghai Province

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Abstract
Through consulting literature discussing the specific military function of beacon towers, this paper classified the architectural forms of 116 beacon towers of the Ming Great Wall in Qinghai province, and determined their distribution characteristics. According to related documents, their architectural forms can be divided into six types based on the relationship between their stage body and circumjacent buildings (the moat, enclosing wall and small flint) with spotty and linear distribution features. To further explain the linear distribution characteristics, the concept of a beacon tower link was used to illustrate the military intelligence routes and transmission orientation of the intelligence system of the Xining Guarding Post during the Ming Dynasty. By researching the change rule of the beacon tower elevations situated on such links, the authors found that most of these elevations have decreasing trends along their military intelligence orientation. In addition, beacon tower links closely surround the Xining Guarding Post with a radial shape, and they follow some important river systems and ancient roads. Many links follow the rule that beacon tower elevations can change suddenly at the corners where they are located, which reflects the wisdom of ancient Chinese architectural design.

Keywords: beacon towers; architectural forms; distribution characteristics; beacon tower links

1. Introduction
The Great Wall of China spans over 5000 miles, and dates back to the 7th century BC (Keshavan, 2015). In any Chinese mind, the Great Wall is the most famous man-made architecture, the construction of which began in the Qin Dynasty governed by Qin Shihuang who was the first emperor to unify the whole of ancient China (Scobell, 2003)¹. Being an important type of defense building, the Great Wall played a key role in protecting the Chinese people living in northern China from invasion by nomadic invaders in ancient times (Chu and Ju, 1993)². With the passage of time, the Great Wall has witnessed the change and development of traditional Chinese culture, as a national symbol (Waldron, 1990)³. Today, the Great Wall is prominent for preservation and tourism and has been designated as a World Heritage site since 1987 and regarded as a common treasure belonging to all human beings (Su and Wall, 2014). As a part of cultural heritage, it contains special spiritual values (De la Torre, 2002)⁴. It also reflects the vitality and creativity of the Chinese nation, and has significant meaning for enhancing Chinese confidence and cohesion (Agnew and Demas, 2002)⁵.

In terms of the establishment of the Ming Great Wall, it was built, reinforced and extended by decree from Hongwu (1328-1398), the first emperor in the Ming Dynasty, who deployed a double line of defence based on the Great Wall built by previous dynasties with the aim of protecting the territory and resisting attacks from the Mongols or any other non-Chinese enemy. After that, the Great Wall took on renewed importance for this imperial court: from 1569 to 1583, Qi Jiguang, the famous general, undertook the well-known reinforcements of the Ming Great Wall, which took the lives of thousands of men and took much longer than former efforts (Evans, 2006)⁶. According to stereo mapping, the Ming Great Wall was built over a period of more than three centuries, from the 14th to the 17th century, with a total length of 8851.8km (Chen et al., 2010). The Ming Great Wall in Qinghai province was constructed from 1546 to 1596, with an arch shape
surrounding the Xining Guarding Post, a vital military position. A project in 2008 investigated the national Great Wall; this portion of the Ming Great Wall has one main line and five branches, consisting of rammed earth walls, trenches, enemy towers, passes, castles, beacon towers, precipitous mountain areas, marine insurance and other architectural types (Pu, 2011).

As an important component of the Great Wall, the beacon-tower system played a vital role in military communication (Djordjevic et al., 2010). Specifically, when an enemy came, the soldiers would ignite the beacons to transfer important information from one tower to another, so the latest enemy intelligence could be spread at the fastest speed (Shao, 2006). The beacon tower is also a high stage for monitoring enemy invasions. The beacons often made significant smoke in the daytime, while they were lit at night. Beacon towers were also called wolf smoke towers as wolf excrement was used as the fuel for the beacons (Lin, 2013). After establishing the Great Wall, the beacon towers began to be closely combined with the wall and were responsible for military alarms and defence.

This paper studied the architectural forms and distribution rules of the beacon towers in Qinghai province. To visually illustrate their distribution, 12 beacon tower links were plotted and their elevation characteristics were analysed in combination with their orientations, locations, architectural forms and the military functions of the beacon towers on such links. Furthermore, the authors studied the beacon tower elevations on such links to obtain their characteristics combined with their transmission orientation. This work can provide a reference for research about other architectural types of the Great Wall. Moreover, this study offers a theoretical basis for further studying of the defence system of the Ming Great Wall of China.

2. The Classification of Beacon Tower Architectural Forms

There are 116 beacon towers in Qinghai province. Based on the combination patterns of their stage bodies with circumjacent buildings including the moat,
enclosing wall and small flint, their architectural forms can be classified into six types: single stage body (Fig.1.a), the combination of stage body and moat (Fig.1.b), the combination of stage body and enclosing wall (Fig.1.c), the combination of stage body, enclosing wall and moat (Fig.1.d), the combination of stage body and small flint (Fig.1.e), and the combination of stage body, enclosing wall and moat (Fig.1.f) (Ren et al., 2012)\textsuperscript{10}.

As shown in Fig.2, the single stage body type is the main architectural form, accounting for 75\% of the total beacon towers in Qinghai province. The total percentage of other types constitutes 25\%, and the combination of stage body, small flint and moat has the smallest proportion (only 0.86\%) (Ren et al., 2012)\textsuperscript{10}.

3. The Distribution of Beacon Towers

The beacon tower is mostly located on a high mountain, monitoring military dangers which could happen (He, 1985)\textsuperscript{11}. According to an official investigation from the Qinghai Bureau of Cultural Relics Administration, the distribution of beacon towers can be classified into two types: spotty and linear distributions (Ren et al., 2012)\textsuperscript{10}. The linear distribution is mainly reflected by the 12 links formed by 70 beacon towers: the Eastern Link of the North Shore of the Yellow River, the Western Link of the North Shore of the Yellow River, the Link of the South Shore of Huangshui River, the Western Link of the North Shore of Huangshui River, the Link of the South Side of Huangshui Valley, the Link of the North Shore of Huangshui River, the Link of the North Shore of the Yellow River, the Link of the North Shore of the Yellow River, the Western Link of the North Shore of Huangshui River, the Link of the South Shore of Huangshui River, and pass it to Hezhou Guarding Post in Gansu province. Therefore, all of these links complete the transmission process from Xining to Hezhou Guarding Post. Except for the Link of Heilin River, the other links are distributed inside the Great Wall main line, taking over strategic military locations and transferring important information to deliver military intelligence to Xining Guarding Post and connect two significant guarding posts (Xining and Hezhou). In addition, there are a number of castles distributed close to these links. All of the aforementioned distribution rules are consistent with the beacon towers’ dominant task: to pass the latest message to each castle at the fastest speed and to coordinate all of the architectural types of the Great Wall to further their military function\textsuperscript{12}. So beacon towers can work with the wall and the castles to form a tight network of military intelligence as an important part of the defense system.

3.1. The Distribution of Beacon Tower Locations

As shown in Fig.3, as the military centre, Xining Guarding Post can receive important information from all of these links except for the Link of Hualong which is far away from the main line of the Great Wall in Qinghai province. In this paper, the authors mainly studied these 11 links (except for the Link of Hualong) to explain their military intelligence routes in detail: The Link of Heilin River is located on the periphery of the Great Wall main line, transferring military information to the Link of Beichuan River and eventually to the Xining Guarding Post; the Links of Beichuan, Shatangchuan, Nanchuan and Xichuan closely surround the Xining Guarding Post with a radial shape, which is responsible for communicating and alerting most of the castles situated around those links, finally sending messages to Xining Guarding Post. Passing through the links of the South Side of Huangshui Valley and the South Shore of Huangshui River along with Huangshui River and the Southeastern Post Road, messages can be sent from the east of Xining Guarding Post to the Western Link of the North Shore of Huangshui River which connects the Yellow and Huangshui Rivers. In addition, part of the beacon towers located in the Western and Eastern Links of the North Shore of Huangshui River are distributed in the peripheral Great Wall main line, which can transmit enemy information from the periphery to the inner side of the southeast of the Great Wall and then to the Link of the South Shore of Huangshui River. Thus, the Western Link of the North Shore of Huangshui River can receive information from these three links simultaneously. Then, the Western Link of the North Shore of the Yellow River can deliver this information to the Eastern Link of the North Shore of the Yellow River, and pass it to Hezhou Guarding Post in Gansu province. Therefore, all of these links complete the transmission process from Xining to Hezhou Guarding Post.

Based on historical documents and official data about beacon tower locations collected from the Qinghai Bureau of Cultural Relics Administration, the authors summarized and drew the orientation and distribution of each link\textsuperscript{11-12}. From Fig.3., as the military centre, Xining Guarding Post can receive important information from all of these links except for the Link of Hualong which is far away from the...
Fig. 3. The Plot of the Distribution of Beacon Tower Links and Specific Transmission Orientations
(The Base Map is from Google Earth)

Fig. 4. The Plot of the Spotty Distribution of Beacon Towers
(The Base Map is from Google Earth)
4. The Elevations and Orientation of Beacon Tower Links

To further study the characteristics of the aforementioned beacon tower links, the author explored the relationships between the beacon tower elevations on each link and their transmission orientation combined with their locations, architectural forms and military functions. Through this comparison, three cases of elevation rules for the beacon tower links were found.

4.1 The First Case of Beacon Tower Links

Among these 12 links, the elevations of the beacon towers distributed on four links, namely, the Eastern Link of the North Shore of the Yellow River, the Western Link of the North Shore of the Yellow River, the Link of Shatangchuan and the Link of the Heilin River, gradually decrease with their transmission orientation.

The Eastern Link of the North Shore of the Yellow River (Fig.3.) is located in the eastern Qinghai province, and messages can be sent via this link to Chuancheng beacon tower within Gansu province and then to Hezhou Guarding Post, passing through the beacon towers of Majiachuan and Houping. Moreover, it is adjacent to the Western Link of the North Shore of the Yellow River; using this link, Hezhou Guarding Post can receive military information from the north shore of the Yellow River directly. Therefore, this link is a message bridge that connects Xining and Hezhou Guarding Posts. The beacon towers of Chuancheng and Duanling are situated in Gansu province, not Qinghai province, and their elevation data have not been obtained in this study. From Fig.5.a, the elevations of the Majiachuan and Houping beacon towers gradually decrease with their transmission orientation.

The orientation of the Western Link of the North Shore of Huangshui River (Fig.3.) mostly followed the Ancient Road of the North Way. The beacon towers of Shengli and Dunwan Village are located outside of the Great Wall and they are therefore convenient for monitoring the enemy and acquiring this information directly. Therefore, this link can transfer intelligence from the periphery wall to the inner wall by these two beacon towers. Moreover, the beacon tower elevations on this link decrease gradually with orientation (Fig.5.b).

The Link of Shatangchuan (Fig.3.) can pass messages from Baimu Gorge to Weiyuan camp and then to Xining Guarding Post. Therefore, this link is an important information channel that connects this gorge with Weiyuan camp and Xining Guarding Post. The beacon tower elevations on this link (Fig.5.c) gradually decrease with its transmission orientation.

The Link of Heilin River (Fig.3.) is distributed in the peripheral Great Wall, and all of the beacon tower architectural forms on this link have ancillary facilities (they are not the single stage type). Specifically, beacon towers of Kuanduoluo and Xiamabosheng are a combination of the stage body and moat, while Shizhuang beacon tower is a combination of the stage body, enclosing wall and moat. These forms might strengthen their defence strength. These towers are located on the periphery of the Great Wall, which means they would face greater pressure from the enemy, so these combination forms with stronger defence strength fit this typical military need. As shown in Fig.3., this link can send the information from outside of the Great Wall to its main line and then pass messages to the Link of Beichuan River so that Xining Guarding Post can receive this information. With the same distributing rule, all of the beacon towers on this link have decreasing elevations with its transmission orientation (Fig.5.d).

Fig.5. The Elevations of the Beacon Tower Links in the First Case: (a) The Eastern Link of the North Shore of the Yellow River. (b) The Western Link of the North Shore of Huangshui River. (c) The Link of Shatangchuan. (d) The Link of Heilin River
4.2 The Second Case of Beacon Tower Links

There are five links (the Beichuan River Link, the Nanchuan Link, the Eastern Link of the North Shore of Huangshui River, the Xichuan Link and the Link of the South Side of Huangshui Valley) where the overall trend of beacon tower elevation decreases, although several towers do not follow that tendency. It is noteworthy that most of those particular beacon towers tend to be located at corner points on their links. The authors infer that because corner places might create some blind spots for the other towers, these towers should be built in such locations that may be better and more convenient for monitoring both sides of such corners on these links.

The Link of Beichuan River is situated inside the Great Wall following the distribution of Beichuan River (Fig.3.). On this link, the corners appear around the No. 1 and No. 2 beacon towers of Pingle, with high elevations that do not decrease with the message transmission orientation. These two towers were built on both shores of Beichuan River; therefore, the authors infer that this distribution rule aims to meet the military need to link the two sides of this river. From Fig.3., this link can be divided into two parts. One part consists of Shangguan beacon tower, Fangma beacon tower and the No. 2 beacon tower of Pingle, and the other consists of the No. 1 beacon tower of Pingle and the No. 2 and No. 1 beacon towers of Changning. All of the beacon towers of each part have decreasing elevations along with their transmission orientation, although the decreasing trend in the first part is less evident than that of the second (Fig.6.a).

Inside the Great Wall, the Link of Nanchuan (Fig.3.) followed the Ancient Road of the South Way. Among all seven beacon towers on this link, only the elevation of the No. 1 beacon tower of Chenjiatan had a non-decreasing trend. Furthermore, the corner comes out near this tower. This link could also be divided into two parts: the first part consists of the beacon tower of Shuica Ditch, the No. 1 and No. 2 beacon towers of Jiaya and the No. 1 beacon tower of Chenjiatan, while the second part consists of the No. 2 beacon tower of Chenjiatan and the beacon towers of Xiejiazhai and Yuanbaozi. All of the beacon tower elevations in each part have decreasing trends with their transmission orientation (Fig.6.b). In addition, as shown in Fig.3., each part of this link is approximately straight, but a sudden change in elevation appear at the corner where the No. 1 beacon tower of Chenjiatan is located. This rule is similar to that of the Link of Beichuan River discussed above.

There are two beacon towers located outside of the Great Wall in the Eastern Link of the North Shore of Huangshui River (Fig.3.), namely, the Zhanhuawan and Najiazhuan beacon towers. Their architectural forms are similar to those of beacon towers on the Link of Heilin River: they are combinations of a stage body and an enclosing wall or of a stage body, an enclosing wall and a moat to improve their military defence strength. Moreover, their function is similar to that of the Western Link of the North Shore of Huangshui River, which can send messages from outside to inside the Great Wall using two towers situated outside of the main line of the Great Wall. Taking a wide view of this link, the overall elevation trend is decreasing although the beacon tower of Najia Village and the No. 1 beacon tower of Mengjia Bay Village have slightly increasing heights (Fig.6.c). Moreover, the corner appears around the locations of these two towers whose elevations jump abruptly, so this link follows the rule that the beacon tower elevations can change suddenly at the corners where they are located. In addition, this link

Fig.6. The Elevations of the Beacon Tower Links in the Second Case: (a) The Link of Beichuan River. (b) The Nanchuan Link. (c) The Eastern Link of the North Shore of Huangshui River. (d) The Xichuan Link. (e) The Link of the South Side of Huangshui Valley
mostly followed the Ancient Road of the Mid Way.

The Link of Xichuan (Fig.3.) has only three beacon towers, and the elevation of Duosi is marginally higher than those of Zhama and Sanqi. However, as a whole, their elevations also have the overall decreasing trend with their orientation transmission (Fig.6.d). Moreover, this link followed the trend of the Ancient Road of the South Way that was the necessary path from Xining to Guide county, which is consistent with the important military position for this link.

The Link of the South Side of Huangshui Valley (Fig.3.) followed the Southeastern Post Road with an overall decreasing trend of elevations. However, there is a corner near Shijiaying beacon tower with an elevation that increases suddenly, which can reflect the rule that the elevations of beacon towers can change suddenly at the corners where they are located (Fig.6.e).

4.3 The Third Case of Beacon Tower Links

There are three links of beacon towers that do not have overall decreasing trends of elevations, and their heights and trends with their transmission orientation are not sufficiently clear. These are the Western Link of the North Shore of the Yellow River and the Links of the South Shore of Huangshui River and Hualong.

The Western Link of the North Shore of the Yellow River (Fig.3.) followed the Southeastern Post Road with an overall decreasing trend of elevations. However, there is a corner near Shijiaying beacon tower with an elevation that increases suddenly, which can reflect the rule that the elevations of beacon towers can change suddenly at the corners where they are located (Fig.6.e).

5. Conclusions

This paper classified the architectural forms of 116 beacon towers in Qinghai province and applied the concept of a beacon tower link to explain their linear distribution. Furthermore, it elaborated and further researched the characteristics of such links by analysing the elevation and the architectural forms characteristic of beacon towers located on each link as well as the trend of important rivers and ancient roads. The following conclusions can be drawn:

1. According to the different patterns of combinations of stage body with surrounding buildings including the moat, enclosing wall and small flint, the architectural forms of beacon towers in Qinghai province can be divided into six types: the single stage body, the combination stage body and moat, the combination of stage body, enclosing wall and moat, the combination of stage body and small flint, and the combination of stage body, enclosing wall and moat. Among these, the single stage body is the main architectural form.

2. The distribution of beacon towers can be divided into two types: spotty and linear distributions. There are 70 beacon towers forming 12 links; there are also
46 beacon towers that cannot form links and do not have clear orientations, showing a spotty distribution. Specifically, these are distributed near gorges, trapdoors or castles.

3. The trends of the beacon tower links closely surrounding Xining Guarding Post have a radial shape, following some important river systems including Huangshui, Yellow, Heilin, Nanchuan and Beichuan Rivers and some vital ancient roads such as the Southeastern Post Road and the Ancient Roads of the North, South and Mid Ways.

4. Among these links, the beacon tower elevations distributed on four links gradually decrease with their transmission orientation. Similarly, there are 5 links where the overall trend of beacon tower elevation decreases although several towers do not follow the decreasing trend. However, the elevations of beacon towers on the other three links do not have overall decreasing trends, and their heights and trends do not reflect clear rules.

5. In such 12 links, only the Link of Heilin River is distributed in the peripheral Great Wall, and all of the architectural forms of the beacon towers on this link have ancillary facilities. The aim of such forms is to strengthen their military defence strength. Moreover, two beacon towers on the Eastern Link of the North Shore of Huangshui River also follow this rule.

6. Many beacon tower links follow the rule that the beacon tower elevations can change suddenly at the corners where they are located. This means that if the corners on such links occur, then the elevations of the beacon towers located around these corners will increase or decrease dramatically. The authors infer that this arrangement would be better for monitoring the beacon towers on two sides of such corners, as the corners could create some blind spots. This distribution would address this problem skilfully.

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References


Notes