

# The Initial Probe into the Ship Type of Zhang Baogao's Jiao Guan Ship

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## Abstract

The Jiao Guan Ship was a sea ship, used by Zhang Baogao, the Silla great sea merchant, in the marine trade with china during the 8<sup>th</sup> century A. D. and the 9<sup>th</sup> century A. D..

Studying on the Ship type of the Jiao Guan Ship is the urgent problem to be solved, in the sphere of learning about the history of communication between China and Korea.

The authors take the initial probe into this subject, by researching Zhang Baogao's marine activities, and point out that the Jiao Guan Ship's original type should be the Sha Ship which was the sea ship sailing the sea in northern China, in the tang Dynasty. At the same time, the authors estimate the constructions and equipment of the ship.

Keywords: Zhang Baogao, Jiao Guan Ship, ship type

Ambassador Zhang Baogao was a great Silla sea merchant in the 9th cent. A.D.. Although his achievements in marine trade in east Asia had been recorded in marine history, it is a great pity that writing on his ships can scarcely be found. The name "Jiao Guan Ship of Ambassador Zhang" [1] was once mentioned in "Ennin's Daily" 《入唐求法巡礼行记》 written by his contemporary Japanese monk Ennin (圆仁), but nothing more can be learnt as to the ship type, ship structure and equipment. In view of this, we think the study on Jiao Guan Ship is now an urgent problem to be solved in the sphere of research on Zhang Baogao and the marine communications history between China and Korea.

## 1. General Considerations on the Study of Jiao Guan Ships

Jiao Guan Ships were the merchant Ships on which Zhang Baogao opened up trade with China. On the whole, we tend to think that it took Tang ship (唐船) as its original model, or probably

they were just Tang ships employed by Zhang Baogao without making any alteration. The main reasons are as follows:

### **1.1 Tang ship was the best in terms of quality in east Asia at that time.**

During the 8th cent. A.D. to the 9th cent. A.D., Tang Dynasty excelled all the other countries in east Asia in every way. Ship-building was no exception. “On the sea routes from China to Korea and China to Japan, almost all the ships were made in China except a few made in Silla.” [2]

Compared with Tang Ships, Japan and Silla ships were simple and crude and hardly adequate to the navigation across the Yellow Sea (黄海) and the East Sea (东海).

At that time, Japan's “Qian Tang Shi ship” (遣唐使船) was more often subject to sea perils like “Shipwreck and drowning etc.” [3] because “Japan-made ships were different from the China-made ones in many ways”: “iron sheets were only linked without the use of iron nails”; “only grass was used to fill the seams without the use of MaJin Tong oil”; what's more, “the sail hung in the middle of the mast, which made difficult the revolving of the mast under all the wind conditions except the favorable wind.” [4]

There was no record in history on the ship-building levels of the Silla ships and Bai Ji ship (百济船) in Tang Dynasty. The latter was once the original model for Japan Ships, whose quality can hardly be rated as good. According to the writing of Xu jing (徐兢) who visited Gao Li (高丽) in 1123 A.D., North Song Dynasty (北宋), Gaoli Ships were “very simple and crude with one mast in the middle, with sculls and rudders but without roof [5]. As was recorded in the 18th Chapter of “Shi Zong Shi Lu” 《世宗实录》, even in the early part of the 15th cent., Silla Ships were still “made of wet pine wood planks with wooden nails, which explained their loose structure, many seams, water leaks and rots in windy weather”. The Ship-building industry in Silla didn't made its great advances until later Silla Ship-builders adopted China Ship-building model in building Bei Yang Sha Ships (北洋沙船), that is, “iron nails were used in beams and decks were plastered with mortar and then reinforced by using Acasia wood planks.”

### **1.2 Since Zhang Baogao Knew China very well, he would take Tang ship as the original model for Jiao Guan Ship or employ Tang ship directly without making any alternation for marine trade**

At his youth, Zhang Baogao had stayed in China for a long time and knew very well about the coasted areas in Shang dong (山东) and Jiang su (江苏) provinces. After returning to Silla, he was assigned by the government to Qinghai Town (清海镇) in charge of marine trade with China exclusively. Besides, he built Faha Monastery (法华院) in the south-east end of Shangdong Peninsular as the transfer station for trade with China. We can be certain of his wide knowledge about the qualities of ships made in China, Japan and Silla. It seemed impossible and not necessary for him to build and employ ships with weak bodies, simple structure, crude equipment and bad performance as the means of transport for international trade. Also, at that time, the mutual communications among Tang and Silla people from all walks of life were quite common, esp. among ship owners, seamen and craftsmen. It was out of question that Silla people and Chinese may build

ships jointly. Ennin had once mentioned in his book that Silla ambassador in Dengzhou (登州), Zhang Yong (张泳) “built ship from last winter and finished his work by this February for sending Ennin and other people back home.” [6] There should be no doubt that the ship built in China by Silla people must be Tang ship, or else, they must be modelled on Tang ship.

## 2. Discussions on ship Type of Jiao Guan Ship.

If what we have assumed above was true, which ship type may Zhang Baogao's Jiao Guan ship actually be?

As far as ancient China's merchant ships were concerned, they can be roughly classified into 3 main types: the Sha Ship type in the northern sea areas; Fu Ship type (福船) in the south-eastern sea areas and Guang Ship (广船) type in the southern areas. In view of the fact that communications between Tang and Silla mainly concentrated on the north of the Yellow Sea and East Sea, which was the traditional China BeiYang Fleet sea route, the ship type of Jiao Guan Ship should most likely be the Sha type on the northern sea areas.

Named after Congming sand, Sha Ships could be seen in Taicang(太仓), Songjiang (松江), Tongzhou (通州) and Haimen (海门). ” [7] They covered large navigation areas.

Sha ships became the typical ship type in the Beiyang sea areas because of ancient seamen's knowledge of Beiyang sea areas' general configuration form of having many hidden sandbanks and shoals and their mastery of the peculiar navigation laws. For example, “there were numerous reefs and hidden sandbanks in Shangdong Peninsular sea areas” ; [8] “there were large number of reefs, submerged rocks, sandbanks and rushing currents to the east of Cheng Shan Mountain” ; [9] “in the north of Jiangsu Province sea areas, where the Yellow river joined the sea, the river was turbid and the sea was clear, so sand and mud were easily deposited” ; [10] “at the mouth of Changjiang River, in spite of some ports there, too much sand deposit made it difficult to bear heavy weight. ” [11] In brief, “the abundance of Tieban sand along the coastal areas in Shang dong and the south of Changjiang River posed great challenge to navigation. ” [12]

To accommodate the special navigation features in the northern sea areas that ships will be stranded but not necessarily be capsized, a new type of sand prevention ship was produced. Jiao Guan Ship often sailed along the coastal areas in Shang dong and Jiangsu where there appeared to be shallow and sandy. The employment of Sha type merchant ship will ensure smooth and safe navigation.

The main features in the shape of Sha ship were flat bottom, square bow and stern. The flat bottom allowed large capacity, shallow draught. Such ship will not be easily capsized while crossing shoals. The square bow and stern not only reflected the traditional shape of the Chinese Character “舟” (ship) in the inscriptions on bones or tortoise shells of the Shang Dynasty as 舟, but also facilitate the operations on the bow and stern.

Sha Ships were land-and-water through or amphibious ships employed in the rivers and the sea in north China, and became so advanced in Tang Dynasty that they were the main water transport means in the northern sea areas and also the mainstay in inland river shipping.

As to the size of the Jiao Guan Ship, it may be estimated to be like that of the middle-or-small-sized merchant ships in Tang Dynasty with deadweight capacity of 1000 dan (石) to 400 dan

(about 60 tons to 24 tons) . The 1000-dan ships were few in Zhang Baogao's fleet, in which the majority was assumed to be 400-dan ships, about the size of Zhuanfeng ships employed in Beiyang water transport in Yuan Dynasty (元朝) in China.

According to the measurement on the dimensions of the ship bodies, the usual ratio of length to width of the traditional Chinese wooden sailing ships was between 2.4 and 2.6. [14] Suppose the length of 1000-dan Jiao Guan ship was 10 Zhang (30m), the width should be 4 Zhang (12m). Such ships were the broad ones. As was described by Zuhuo (朱彧) in North Song Dynasty in his book "Ping Zhou Ke Tan" 《萍洲可谈》, these ships were broad and almost square. Such shape was especially suitable for carrying cargoes and was very much alike to the stout KoKe ships (科克船) built by Hansha Alliance in the west.

### **3. The Main Ship Structure of Jiao Guan Ship.**

Since the Ship-building technology in Tang Dynasty had been rather developed. Modelled on Sha ship, Jiao Guan ship should have the following main features in structure:

#### **3.1 With Flat Keel**

Keel was the main part in ensuring the longitudinal strength of the ship body. Sha ship being the flat-bottomed type, the shape of its Keel was different from that of the usual ships with narrow body and tapering bottom.

The key to Sha ship's ease with sandbanks was its special keel structure: on the longitudinal centre line on the ship base was the flat diamond-shape keel made up of thick wooden planks narrow at the 2 ends and wide in the middle. This was the flat keel and commonly called "centre bottom". It ensured the ship having enough longitudinal strength and can evenly bear the weight of the ship body when it got stranded and can resist the friction of the shoals when crossing them.

#### **3.2 With Big La**

Big la (la is a kind of tree) was installed on the top of the boardsides, which was more or less like the Top Beam on the thickened boardside on modern ships, with the aim to enhance the longitudinal strength of the ship body. Both boardsides on the top of the sha ship had its own Big la weighing on the ship's bow and stern. Big la on big-and-small-sized sha ships were made of 4 to 6 big fir lumbers interlinked and bound together side by side by nails. They were just like 2 guides to the ship and can resist strong wind and wave. Because of the fact that the main boardside of sha ship wasn't very tall, Big la, close to the surface of the water, actually protected the wooden planks on the side boardside. In addition, the effective ship breadth was broadened when the ship sailed on one side. Therefore, there was an old folk saying: "Ships were not steady without Big la. "

#### **3.3 With Watertight Cabins.**

The crosswise strength of the sha ship was obtained not by lots of hull frames as was on the western

woodern sailing ships, but by watertight cabins all over the ship. The installment of watertight cabins was one traditional Ship-building technique, exclusive to ancient China. Judged from the shape of the Chinese character “舟” (ship) in Sang Dynasty inscriptions, ships at that time were already installed with beams or partitions. By examing the many ancient ship models and ship wreckage unearthed in China since 1950s', we can see that watertight cabin installment technique was adopted on the building of all the ancient Chinese ships. For instance, the Tang wooden ship unearthed from Rugan County(如皋), Jiangsu in 1973 had 9 watertight cabins.

These watertight cabins separated the ship into many independant and interlinked cabins. It assumed dual roles: one was enhancing the crosswide strength and preventing the ship body from being twisted and deformed by the linked partitions; the other was enhancing its sinking resistance by these watertight cabins. In case one single cabin leaked and had water inflow, sea water won't flow into other cabins.

### **3.4 With Poop or Forecastle**

Poop or forecastle was the superstructure on a ship. It served 2 purposes: one was for the seamen to climb and look far ahead to broaden their visions; the other was increasing space needed by all the crew members for their work and daily life.

As early as the Chun Qio Zhan Guo Periods (春秋战国时期), ships with poop had been built. In Han Dynasty, they became more and more developed. Liu Xi (刘熙) in East Han Dynasty had mentioned ships with 3-storey poop in his book “ShiMing” (《释名》). However, for Jiao Guan ship which was mainly used for cargo transportation, one or two storeys was suitable and they should be better installed at the back of the ship because it had the features of Sha Ship: broad, flat and low gravity centre.

### **3.5 Nailing-Mortising and Seam-filling Techniques.**

The examination on Tang Ships unearthed from Yangzhou (扬州), Jiangsu and Rugao showed that the advanced technology of using wooden pieces to mortise and iron nails to reinforce had been adopted on both ships. The difference was that on the former one, iron nails were driven in obliquely to link the parts side by side; while on the latter, iron nails were driven in vertically to link them one above the other. The adoption of the advanced nailing-mortising technique was the most important factor contributing to the solidity and reliability of ancient China's sailing ships.

Though the wooden planks on the hull were linked by nailing-lmortising, it was unavoidable that there would be seams left between them and the nail holes left will be exposed to air and seawater and thus be subjected to corrosion. The technique adopted to solve these problems was called seam-filling: the seams and holes were then filled up with a mixture of Tong oil, mortar, bamboo thread and MaZong etc. to make the ship body seamless and thus enhance its strength.

## **4. The Main Auxiliary Equipment of Jiao Guan Ships**

Auxiliary equipment refers to those used in ship operation, which is an important indication of the performance of the ship and its navigation level. Taking into consideration the need of Jiao Guan ships sailing along Beiyang sea areas like the Yellow sea etc. and the development level of ship and navigation in the Tang Dynasty, we think Jiao Guan ships may be installed the following auxiliary equipment in general:

### **4.1 Main Propelling Equipment:**

The relatively greater resistance that the broad, flat-bottomed Jiao Guan ships of the Sha ship type may meet made necessary highly effective and handy propelling equipment. Therefore, we think Jiao Guan ships may take multimast sails, which can be adjusted to various wind conditions, as its main propelling equipment aided by oars, barge-poles and sculls.

#### **4.1.1 Multi-mast Sails**

Sails in China can be traced back to ancient times. They had become rather developed at the latest in the Han Dynasty (汉朝). From “Nan Zhou Yi Wu Zhi”(《南州异物志》) by Wan Zhen (万震), a government official in East Wu (东吴), we can learn that during the Three-Kingdom Period(三国时期), multi-mast sails had been used, they were movable, revolving and allowed additions and deletion in sail number according to needs.

On the Yellow Sea areas where Zhang Baogao often sailed, sail-making technology had been efficiently directly to Shangdong Peninsular during the North South Dynasties (南北朝) in the 5th cent. A. D.. Till the flourishing ages in the Tang Dynasty, the Chese sail-propelling equipment and its operation had been rather advanced. Since Jiao Guan ships were small-or-middle-sized merchant ships at that time, most of them may employ double-mast sails one in front and the other behind; and some relatively bigger ones may have three-mast sails. the sails may be rectangle, lengthwise, balanced ones made of closely-knitted tough awning. in operation, such ships can gain enough propelling force under various wind conditions by adjusting and rectifying the sails.

#### **4.1.2 Oars, Barge-poles and sculls**

Oars were the oldest ship propelling equipment used mainly under windless, unfavorable wind conditions or when it was expedient. Traditionally, two names for oars were used in China: Ji (楫) and Zhao (棹). Generally speaking, short oars were called Ji, while long oars were called Zhao; those paddled when the oarsman was sitting was called Ji, while those paddled when the oarsman was standing was called Zhao. Chinese oarsman faced the bow ahead which was different from their counterparts in the west.

Barge-poles were another old ship-propelling equipment invented at the same time with boats. They were usually made of long bamboo poles or long wood poles used mainly. When boats were crossing shallow waters or entering and leaving the wharf.

The invention of Sculls by Chinese navigators was a breakthrough in ship-propelling technology. They were made by lingering the long oars or by refitting them into “s” shape. Sculls were fixed on the edge of the boardside. The blade under the water will produce continual propelling force, if the rod was kept swaying. They were more efficient than oars.

## 4.2 Main Ship Control Equipment

### 4.2.1 Stern Rudder

Rudder is the main equipment for controlling the course. Chinese rudder was called stern rudder which was fixed in the middle of the stern, They had been widely used in the Han Dynasty. When Zhang Baogao held marine trade with China, China rudder-making technology had been rather advanced. The balanced rudder, on which there were some blades before the rudder stock, was labor-saving, sensitive and thus: ensured the flexibility in controlling the course, still another was called elevator rudder. The in-water depth of whose blades can be easily adjusted. The rudder can be lowered in deep waters, which can raise its efficiency and floating resistance; while in shallow waters it can be lifted to facility in operation.

### 4.2.2 Anchor

Anchor is the equipment by which a ship is moored. The earliest anchor was stone anchor made by using ropes and rattans to thread natural stones together. Later, in order to enhance its adhesion to the ground, there appeared wood stone anchor using wooden poles and stones at the same time. The anchor Hung on the bow of the East Han Dynasty Tao ship (陶船) model was this kind. Chinese wood-stone anchors had been rather developed by the Tang and Song Dynasties, which can be seen from the detailed introduction to its structure and function by Xujing (徐兢) on his trip to Gaoli (高丽) while sailing on Bei Yang Sea: “there were two poles between which was an anchor bound by ropes of 500 chi (1meter=3chi) long on the top and with big stones hanging under it. Both sides of the stone were fixed by wooden hooks.”[15]

The anchors used in Jiao Guan ships should mainly be wood-stone anchors. But in view of the fact that there had appeared more efficient iron anchors in North-South Dynasties at the latest, it was possible that some of Jiao Guan ships may use them.

### 4.2.3 Pi-Shui Plates (披水板)

Pi-Shui plates referred to the ship control equipment that were used to lessen the rocking and transverse floating in head wind. They were made up of plates fixed on both boardsides. As was introduced in “Tai Bai Yin Jing” 《太白阴经》 by Li Jian, (李鉴) Hai Gu ship (海鹞船) in the Tang Dynasty “had plates on both boardsides like the wings of Gu (a kind of bird) to keep the ship steady in windy and stormy weathers.”

#### **4.2.4. Tai Ping Baskets(太平籃)**

Tai Ping Baskets (太平籃) were ship control equipment made up of baskets filled with stones. When the ship was rocked hard by winds and storms, the baskets can be hung into the water to resist or subside the force of the waves and improve ships' steadiness, Jiao Guan ships had no reason to ignore their great use.

### **5. Conclusions and suggestions**

As was stated above, we come to the following conclusion and suggestions.

5.1 In view of Zhang Baogao's distinct life and work experiences, the Jiao Guan ships he employed in marine trade with China may take Tangship, which was the most advanced in East Asia at that time, as its original model; or probably, Tang ships were directly employed without any alterations.

5.2 In view of the fact that Zhang Baogao's fleet mainly sailed on the areas habitually referred to as Bei Yang Sea areas, the Jiao Guan ships were probably the Sha ship type.

5.3 Zhang Baogao fully applied the advanced technology adopted in building Chinese Sha ship to Jiao Guan ships' main ship structure and auxiliary equipment.

5.4 Deeper and thorough research should be made on Zhang Baogao's Jiao Guan ships and based on which we hope that we can redesign a ship modeled after the ancient one as the important proof of ancient Sino-Korea marine communications history by the joint effort and cooperation between China and Korea.



## Explanatory Notes

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