Abstract  
This paper deals with the plans of a paper money factory built in Tokyo in 1876, and considers the development of the architectural practice of one of the prominent Oyatoi engineers, Thomas Waters. The project of the paper money factory, which highlights the prominent brick-made western architecture in the early Meiji period, was thought to have originally been designed by T. Waters and then succeeded by Charles Boinville, although the detail of this has until now remained unclear. Other than the floor plans and elevation with the signature of T. Waters, the author has found some plans of the paper money factory, and as a result can clarify the detailed process of the project. In addition, the author makes use of the various plans of the paper money factory and has made a restored CAD copy of the factory in order to analyze the particulars of T. Waters' plans. Further to this, it is compared with the plans of another project connected to him, thus T. Waters' significant influence is considered as to the secure control of goods and labor circulation.

Keywords: Thomas Waters; Charles Boinville; Oyatoi engineers; paper money factory; Meiji architecture

1. Introduction  
In the mid-19th century, Japan opened its doors to western countries and became keen to import western technologies and architecture. For this purpose, it employed a lot of western specialists to oversee these westernized building projects. These specialists were called Oyatoi, or Oyatoi Gaikokujin (Employed foreigners). They were considered as contributors to Japan's modernization in the Bakumatsu and Meiji periods (1860s.-1900s.) (Muramatsu 1995).  

One of these Oyatoi engineers, Thomas Waters¹, built some important projects at the beginning of Japan's modernization (Fujimori 1993, Hori 2003). This paper focuses on the architectural plans of a paper money factory built in Tokyo in 1876, and considers the development of his architectural experience. The building was demolished in the Great Kanto Earthquake in 1923.

Up to the present, several researchers have looked at the paper money factory project by T. Waters. The first person to describe the paper money factory from an historical viewpoint may be Kingo Tatsuno² (Tatsuno 1901), who noted that the paper money factory was firstly designed by T. Waters, then succeeded by Charles Boinville³ and completed under his supervision. It is said that Tatsuno's description here depends on some interviews with Seiichi Asakura, one of the pioneering Japanese engineering officers of Kobusho (Ministry of Engineering or Public Works) at that time. Then, Saburo Horikoshi (Horikoshi 1929) summarized the architectural details of the paper money factory according to Tatsuno's description. In 1979, Shigekatsu Onogi (Onogi 1979) first found the old plans of the paper money factory in the collection of the National Archive of Japan, and pointed out that the façade design of the paper money factory was a baroque style showing the dome and the giant orders in front. Furthermore, as this façade design in T. Waters' plan is different to the completed building (Fig.1.), he...
concluded that the plans of the paper money factory were completely re-designed by C. Boinville. In fact, the completed building showed the three coupled giant orders and the gable decorated with the imperial chrysanthemum emblem. The method used to design the gables like a picture-frame could be observed in some of Boinville's masterpieces including the auditorium of Kobu Daigakko (Imperial College of Engineering) built in 1877.

Onogi's essay evaluates T. Water's plans and his design in the context of the history of Meiji architecture. The author also researched his plans of the paper money factory, and as a consequence found some other plans that have not been dealt with by scholars. According to these investigations, it is expected that the completed building was also influenced by T. Waters' plan with regard to the arrangement of rooms and corridors regardless of the difference of façade design. The aim of this paper is to clarify the above details.

Additionally, as one of the prominent Oyatoi engineers, the life and work of T. Waters has been studied recently (Jackson 2010, Vivers 2013). According to this research, T. Waters trained himself as an engineer in a shipbuilding yard in Glasgow and his uncle's office in London before arriving in Bakumatsu and Meiji Japan. The jobs in Japan were also introduced to him by his uncle. Therefore, it seems that, although he could do the design of steel structures or bricklaying, it may have been difficult for him to prepare the various plans of buildings. Lacking the experience of proper education in architectural schools, or practice in architectural firms, he had participated in some building projects including sugar mills in Kagoshima, the Imperial Mint in Osaka, plans for the imperial palace and military barracks in Tokyo, and a brick town development in Ginza, some of which required special knowledge in the layout of rooms and the circulation of goods and labor. By means of analyzing the plans of the paper money factory, this paper considers how he struggled and developed his architectural practice over his career.

The contents of this paper are as follows. Firstly, the author will organize the existing plans of the paper money factory according to their contents, the date of preparation and the person who prepared them. At the same time, the details concerning the establishment and construction process will be clarified to analyze the plans, referring to relevant public documents of the Japanese government. In the next chapter, the plan of T. Waters is deeply analyzed with regard to the arrangement of rooms and the control of goods and labor circulation. The author then looks at his other projects to compare them with the plan of the paper money factory and considers the development of his architectural practice.
three architectural drawings that illustrate each floor plan of the three-storied building (Fig.5.). As the contents of the site plan and floor plans correspond with each other showing the U-shaped building, they were prepared together to describe the same building. As noted in the title, they are rough sketch plans drawn only with single lines. All plans are made on paper with the printed heading of ‘Agency of Imperial Government of Japan’ on the top of the front side. The size of the paper is 43.6cm by 97.3cm for the site plans, and 28.4cm by 45cm for the floor plans.

The U-shaped building here, although prepared for the paper money factory as shown on their titles, are obviously different to the building on T. Waters’ plan. In the U-shaped plan, the factory is a three storied building to house three departments to produce the banknotes; printing and engraving departments on the ground floor, printing and chemical departments on the second floor, and storage rooms on the third floor.

In addition, the collections of the National Archive of Japan contain another plan of the paper money factory showing the plan and elevation of the foreign foremen’s residence⁵. The building on it is truly western style architecture, surrounded with a verandah on the front and both sides. It regrettably lacks a date and signature.

In the collection of Shigenobu Okuma⁶, a prominent politician in the Meiji period, a copy of T. Waters’ plan is conserved with the report to the emperor as for the establishment of the paper money factory⁷. As far as this plan is concerned, it is remarkable that as the name of the rooms in Japanese are tagged on it (Figs.6. and 7.), we can understand the use of the rooms and their functions in the process of paper money making. The plan and report are made on Whatman paper with the watermark dated 1873. The size of the plan is 74.5cm by 54.5cm, although it is now divided into two pieces.

As shown in the above, the plans of the paper money factory contain several varieties. We know of a U-shaped and three-storied plan other than T. Waters' plan. In order to understand the date, the person who prepared the plans, and their intention, the following section studies the background and detail of the establishment of the paper money factory.

2.2 Detail of the Establishment of the Paper Money Factory

After the Meiji Restoration of 1868, the Meiji government had taken the place of the Tokugawa Bakufu government and reigned over the whole country. As a result, they needed a new banknote and currency system in place of the Ryo and Koban of the Tokugawa era. Reliable currency manufactured with western printing technologies reflected 'modern' country, a status that Japan had aimed for in those days.

Firstly, the Japanese government tried to produce the new banknotes within Japan⁸, but their technology was poor, and false banknotes were circulated on the
demanded the steady supply of banknotes and the construction of a modern paper money factory in their nation (National Printing Bureau 1971).

As a result, the Ministry of Finance submitted a request to the Daiyōkan (Great Council of State) for the instruction to build a paper money factory in May 1874, with rough plans of the factory and water gate, together with a brief explanation of the plans. The plans for the factory and water gate have now gone missing in the official records, however a copy of the brief explanation connected with these is observed in another place (Watanabe 1921, pp.386-388). According to the explanation, the paper money factory was a three-storied building with three sections; a chemical department, engraving department and printing department within the one building. As the arrangement described here corresponds to the contents of the U-shaped floor plans without date and signature in the collection of the National Archive of Japan, we know that the site plan and floor plans of the U-shaped building were prepared for the purpose of submitting together with the request for the instruction from the Ministry of Finance in May 1874. It is said that the explanation and plans were made by Japanese officer Sakuro Yajima in the Printing Bureau.

Thus, while the request together with the plans for the new paper money factory were submitted by the Ministry of Finance, they were rough plans and did not contain details of the buildings and the estimated costs for the project. Daiyō Daijin (Chancellor of the Realm) Sanetomi San’yo ordered the Lord of Engineering Hirobumi Ito to examine the project of the building soon after. However, the examination by the Ministry of Engineering was delayed, and the estimation and plan for the foreign foreman’s residence was only submitted on the 23rd of September. The plan of the two storied building with verandahs held in the National Archive of Japan was probably prepared at this time.

In the Ministry of Finance, Ryosuke Tokuno, who was the head of the Printing Bureau at that time, submitted a long report to establish the paper money factory on September 25th to prompt action on the project. Eventually, the Ministry of Engineering answered him and submitted the new plan, estimation and specification for the paper money factory on November 27th. According to the specification, the factory was a two storied brick building covering an area of 938 tsubo (c.3039 square meters) with a high raised part at the front. The height of the outer walls was to be 40 shaku (12.12 meters). The brick walls were to be white-plastered inside. The floors were to be boarded. The ceilings were to be arranged in the central halls both at the entrance and upstairs. Inner walls were to be constructed of timber with glass windows. The estimate was 10,987 Japanese yen. The plans submitted are missing at present, however as the descriptions in the above specification are consistent with T. Waters’ plan, we know that his plans for the paper money factory (Figs.2. and 3.) were prepared for submission by the Ministry of Engineering in late November. In fact, the dates of October 29th and November 5th on the two plans by T. Waters are well before the submission of the estimations. Furthermore, ‘Mr. Hiraoka’ noted by T. Waters himself on the elevation (Fig.3.) indicates that he worked under the direction of Michiyoshi Hiraoka, engineer of the Ministry of Engineering.

The estimations of the Ministry of Engineering were examined in Daiyōkan, and on December 10th 1874, the construction of the new paper money factory was approved. Owing to financial reasons, the high raised part, as illustrated at the center of the building in T. Waters’ elevation, was removed.

Thus, the execution of the building was authorized, and the paper money making machines were ordered from Germany in April 1874, arriving in Japan on January 25th 1875. However, the term of employment of T. Waters, who made the floor plan and elevation for the paper money factory, ended at the end of February 1875. When the paper money machines arrived, the Ministry of Finance considered employing ‘a British engineer formerly employed in the Ministry of Engineering’ to supervise the construction, although the agreement could not be realized owing to the labor conditions including the salary of 1,000 Mex. dollars per month. Possibly, this engineer was T. Waters.

Consequently, the construction of the paper money factory was to be carried out by the Ministry of Engineering, and, under the supervision of another Oyatoi engineer, C. Boinville, the construction started in May 1875 and was completed on the 10th of October 1876. The iron pieces were ordered from engineering works in Hyogo and England. C. Boinville had been employed in the Ministry of Engineering since January 1874.

It should be noted that the date and purpose of the copy of T. Waters’ plans in the Shigenobu Okuma Collection are still unsure. Judging from the contents prepared together with the report to the emperor and the fact that the plans were in the hands of the former
Lord of Finance, it seems that the copies were prepared after the submission by the Ministry of Engineering at the end of November 1874 and for the purpose of forming official governmental records to present to high ranking persons.

As mentioned previously, the completed facade of the paper money factory was different to the elevation of T. Waters. Despite the difference in the design of the elevation, the completed floor plan which appeared in the official publication of the National Printing Bureau in 1903 shows the I-shaped building with wings on both sides (Fig.8.). Regardless of some slight differences in the arrangement of rooms and corridors in the wings, the significant parts including the entrance, halls and staircase at the center of the building, and the long corridors at the front side, are observed in the floor plan of the completed building. Therefore, it can be said that the floor plan of the completed building followed the design of T. Waters' floor plan, and in place of the high raised dome which originally appeared in T. Waters' elevation and removed owing to financial reasons, C. Boinville added the information of the copy of the Shigenobu Okuma Collection to analyze the character of the planning (Fig.9.).

The plan of T. Waters shows the I-shaped plan with central blocks and two side blocks connected to each other by the long wing block. The central block is 59 shaku (17.88 meters) in width, with the portion of 24 shaku (7.27 meters) by 31 shaku (9.39 meters) stuck out at the rear. The side blocks are 60 shaku (18.18 meters) in width and 91 shaku (27.57 meters) in depth,

3. Particulars of T. Waters' Plan

3.1 Architectural Details of T. Waters' Plan

As discussed above, the plan of the paper money factory prepared by T. Waters was the original model of the completed building. This chapter analyzes the particulars of his plan, and considers the development of his architectural experience. As for the floor plans by T. Waters, the plans held in the National Archive of Japan contain English memos concerning the architectural details (ceiling, floors finishes) and the size of every part of the building. The other copies held in the Shigenobu Okuma Collection are attached with tags indicating the names of the rooms in Japanese. Comparing these two plans, there are some other slight differences with regard to the indication of doors, and the arrangement of the walls. Here, the author has copied the plan of the National Archive of Japan and added the information of the copy of the Shigenobu Okuma Collection to analyze the character of the planning (Fig.9.).

The plan of T. Waters shows the I-shaped plan with central blocks and two side blocks connected to each other by the long wing block. The central block is 59 shaku (17.88 meters) in width, with the portion of 24 shaku (7.27 meters) by 31 shaku (9.39 meters) stuck out at the rear. The side blocks are 60 shaku (18.18 meters) in width and 91 shaku (27.57 meters) in depth,
and the wing blocks are 102 shaku (30.90 meters) in length (front width). The outer walls are 2 ft. thick at the ground floor, and 1.5 ft. thick at the first floor. The inner walls vary between 1.2 and 1.5 ft. in thickness. They are made of bricks, but timber walls are also fixed at some parts. According to the specification submitted by the Ministry of Engineering in November 1874 as already mentioned above, the height of the walls are 40 shaku (12.12 meters).

With regard to the ground floor plan, the central hall behind the main entrance of the portico with six giant orders is arranged at the center of the building. The staircase is also arranged at the central hall. According to T. Waters’ comment on his plan, the central hall was the only room on the ground floor to have a ceiling. The room may be decorated as a main entrance for ceremonial occasions. Watchmen and gatekeepers were stationed at the corners of the room. The engines and boilers are behind the staircase. The engine room is surrounded by 2 ft. thick walls and the boiler room is attached further behind. The side blocks are divided into some small rooms. The name of the rooms indicate that the blocks contain the engraving department, the chemical department, inspections, finishing processes, strongholds and changing rooms for the laborers. The wing blocks contain the printing department both at the ground and first floors. A corridor runs along the front side of the blocks. The thin walls of ‘wood and glass’ are fixed between the corridor and printing rooms. These may be timber framed with glass windows.

The arrangement of the first floor (upstairs) basically follows that of the ground floor. The central hall there is used for the superintendent's office. The side blocks are divided into small rooms, and the wings are used for printing departments with a long corridor at the front side. T. Waters’ memos on the plans direct that the ceiling covers all rooms of the first floor, and the specification of November 1874 directs that the walls be faced with white stucco inside, both at the ground and first floors. Later, Tatsuzo Sone, pioneering Japanese architect, recollected that the water tank had been prepared on the first floor of the factory and supported by cast iron I-beams. In fact, there is a tag with a note indicating 'Yosui (water tank)' on the roof of the boiler room. He may be referring to this.

In the floorplans for the paper money factory by T. Waters, the most particular points seem to be the arrangement of the corridors and the circulation of labor. In relation to this point, we notice that at the ground floor in the left side block, the entrance and clothing changing rooms are specially designed for male and female laborers respectively. Laborers have to enter the building through the designated entrances here and change their clothes after entering. It is possible that any personal belongings could not be brought into any part of the building for security reasons. Between the printing rooms and long corridors along the front side of the wing blocks, small offices are arranged for the caretaker's room. Judging from the floorplans, it is understood that people working in the printing rooms could not go into any room other than the caretaker's rooms. They all had to go through them, where they probably received inspections. In addition, the toilets are specially situated near the printing rooms. People working there could not leave at all during working hours, even for the toilet.

The arrangement to make the three departments (Chemical, Engraving and Printing) in the one building may be the influence of the original ideas of the Ministry of Finance’s plan prepared by Sakuro Yajima. However, the central halls with engine rooms and long corridors on the front side cannot be recognized in Yajima’s plan. Therefore, the author refers to the comparative research with other works by T. Waters, and considers where the planning arrangement in his floor plan came from and then developed as the project of the paper money factory.

3.2 Comparison with Other Works of T. Waters

Before working on the paper money factory, T. Waters had experienced designing a floor plan that required the special arrangement of goods and labor circulation in the project of the Imperial Mint, built in Osaka in 1871. Similar to the paper money factory, the Japanese Government faced the problem of stable supply of coins accepted on the international market at the start of their reign. To resolve this problem, they purchased the former Hong Kong Mint, established by the Hong Kong colonial government and closed in 1868, including the coining machines, the plan of the buildings, and the engineering members. As a result, Thomas Kinder, the former captain of the Hong Kong Mint, and some engineers under him had exported these resources to Osaka. In Osaka, T. Waters worked on the construction and arranged the plan of the Hong Kong Mint to remodel the picturesque Gothic façade of the office into the Greek classic style portico. This is because the mint office, which was originally placed in front of the workshop in Hong Kong, was removed to another building in the compound at Osaka.

The room layout of the workshop of the Osaka Mint was very peculiar (Fig.10.). The workshop was a rectangular block of 225 shaku (68.18 meters) in width and 84 shaku (25.45 meters) in depth. The whole width of the block was divided into 9 bays with iron columns and inner walls, so that every bay was 25 shaku (7.58 meters) in width and 84 shaku in depth. As the layout of the rooms depends on these 9 bays, they become very narrow, and several rooms lack windows. Ventilation and sunlight can only be gained through the top of the roof. The engine room connected with the boilers at the rear occupies the bay at the center of the block. The remaining 8 rooms serve for gold melting, silver melting, rolling & cutting, coining, annealing etc., weighing and stocks in accordance with the process of coin making. In front of the narrow rooms, the long corridor runs along the side of workshop
building. As the entrance to every room is arranged to face this long corridor, laborers should go through the corridor and the small office placed at the entrance of every room. They may have had their belongings inspected here.

Obviously, the particular arrangement of corridors and small offices in T. Waters' floor plan of the paper money factory of 1874 is similar to that of the Osaka Mint built in 1871, although the very narrow rooms without windows were not included in the paper money factory. The latter was constructed by T. Waters himself, while the plan and design concept of planning had been imported from the Hong Kong Mint. Both the paper money factory and mint, where T. Waters happened to be connected in the construction in the first half of the 1870s, basically required special arrangements to control the circulation of goods and labor for the security of precious products. In the project of the paper money factory, he probably made use of his experience at the Osaka Mint, which had been completed just three years before, to design a security-based plan to control the goods and labor circulation. In addition, the idea of the planning of Osaka Mint itself was not invented by T. Waters himself but imported from that of the Hong Kong Mint. That is, the security-based planning including the long corridor and small offices at the entrance was developed between Hong Kong, Osaka and Tokyo by the hand of T. Waters.

Once again, T. Waters was not an educated engineer but a man trained in practical jobs. In the frontier of the beginning of westernization, some Oyatoi made full use of what skills he had and successfully developed solutions to answer the native's expectations. The author believes that the project of the paper money factory is significant in telling their struggle and efforts.

4. Conclusion

The main points of this paper can be summarized as follows.

(1) As for the plans of the paper money factory, there are two kinds. One is the I-shaped floor plan of the Baroque style elevation designed by T. Waters. The other is the U-shaped floor plan of the three storied building. The former was prepared together with the specifications and estimated by the Ministry of Engineering on November 1874. The latter was prepared by a Japanese officer, together with the original request from the Ministry of Finance in May 1874. This was eventually abandoned and replaced by T. Waters' plan.

(2) C. Boinville, another Oyatoi engineer, succeeded the construction of the paper money factory because the employment of T. Waters had ended before the commencement of construction. However, the completed building, though its façade was different to T. Waters' original elevation owing to financial reasons, followed T. Waters' floor plans including the layout of the central hall, rooms and corridors.

(3) The floor plan by T. Waters was a strong security based design. The circulation of goods and labor were under strict control and inspection at the designated entrance to the building, the small offices at the entrance of the workshops, and the layout of the toilets. Additionally, some of these arrangements could be observed in the floor plan of the Imperial Mint of Osaka, where T. Waters did the security based planning copying that of the Hong Kong Mint. That is, T. Waters seems to have applied his previous experiences to design the security based floor plans of the project of the paper money factory.

Illustration Credits

Fig.1. National Printing Bureau ed, (1921) Insatsukyoku 50 Nen Ryakushii (Brief History of 50 Years of the National Printing Bureau), Front-piece. (in Japanese)
Figs.2.-5. National Archive of Japan, Call No. 附 A00024100.
Figs.6. & 7. Waseda University Library, Okuma Shigenobu Collection, Call No. 附 A1798.
Fig.8. National Printing Bureau ed. (1903) Insatsukyoku Enkaku Roku (Record of the Detail of Establishment of National Printing Bureau), folded plate in end-pieces. (in Japanese)
Fig.9. Prepared by the author referring to the floor plans of Thomas Waters held both in the National Archive of Japan and Waseda University Library.
Fig.10. Prepared by the author referring to the plans in the Japan Mint.

Notes

1. Thomas James Waters, 1842-1898.
2. Kingo Tatsuo, 1854-1919, one of the first generations of Japanese architects in the Meiji period.
3. Charles Alfred Chastel de Boinville, 1850-1897.
4. National Archive of Japan, Kobun Fuzoku No Zu, No.24, Shiiheiry Seizosyo Zu (Plans of the Paper Money Factory), Call No. 附 A00024100.
5. National Archive of Japan, Kobun Fuzoku No Zu, No.25, Shiiheiry Gaikokujin Kyokan No Zu (Plan of Foreigners' Residence of the Paper Money Factory), Call No. 附 A00025100.
6. Shigenobu Okuma, 1838-1922, appointed to Lord of Finance from 1873 to 1880.
It is said that the Japanese private commercial bank Mitshi Gumi had printed these banknotes (Watanabe 1921, p.383). Mitui Gumi bank was one of the masterpieces of Givōfie, or the earliest westernized architecture in Japan.

National Archive of Japan, Kobunroku, Meiji 7 Nen, Dai 130 Kan, Okurasho Ukagai (1) (Records of the Official Documents in the Year of 1874, Vol. 130, Ministry of Finance, No.1) (Hand-written Japanese official documents). Basically, the following description of chapter 2 depends on this document.

Sakuro Yajima, 1839-1911. Japanese officer and industrialist in the Meiji period. He traveled to London and Europe to study Western sciences from 1868 to 1874, then was soon appointed to the officer of the Ministry of Finance until 1877. See, Tamura 2006.

Ryosuke Tokuno, 1853-1937. one of the first generations of Japanese Architects.

Although T. Waters had arrived and worked in Japan since the 1860s, his appointment to the Ministry of Engineering commenced on 1st March of 1874 and ended on 25th February of 1875. See, Hori (2003) p.87.

Michiyoshi Hiraoka, 1831-1917. Japanese officer in the Meiji period. Other than the paper money factory, he was concerned with some important projects of early Meiji architecture including the Ginza Brick Town Developments (1873-), the Imperial College of Engineering (1877), Ueno Museum (1881), the Rokumeikan (1883) etc. See, Architectural Institute of Japan ed. 1910.

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