Design Guidelines for Designing Ming Dynasty Style furniture suited for Modern life

by

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Abstract

Chinese traditional furniture has an extremely long history, which can be traced back to 5000 years ago. Because of development of the society, economy and the advanced technology, Ming dynasty furniture achieved greatness, and became the well-known golden age of traditional furniture. (Ye,Wang，2003). Chinese traditional furniture not only represent the highest level of manufacturing technique, but also stands for the quintessence of Chinese traditional culture. From this reason, Ming Dynasty furniture has a substantial value in aesthetic, structure, manufacturing technique, and material selection, for the younger generations to learn from.

Unfortunately, this peak did not continue very long. Currently, the younger generation of Chinese not only did not inherit the traditional Chinese furniture but also are losing the ability to appreciate the beauty of it. Moreover, based on the product function theory traditional Chinese furniture cannot satisfy the current society. As a result, certain changes need to be made in order to help the traditional Chinese furniture fit in the current market, and meet the needs of modern life.

As an Industrial Design thesis, this research was conducted to study the furniture design from the aspects of Ming Dynasty style and modern society requirements with a focus on the ability of Ming Dynasty furniture to transmit traditional Chinese aesthetics to modern society requirements.

For the cultural heritage, Ming Dynasty furniture was chosen as an inspiration for this study. The emphasis of this study was to establish a guideline of all kinds of Ming Dynasty Furniture and apply this guideline to modern furniture design. The expectation is that these design

guidelines will help designers build a furniture with Ming Dynasty furniture style while meeting the needs of modern life, and thus continue the cultural heritage of Chinese traditional culture. This research acts as the foundation for future study that focuses on traditional Chinses culture.

Acknowledgments

After a stressful period of two semesters, today is the day: writing this page of thanks is the finishing touch on my thesis. It has been a period of intense learning for me, not only in the design arena, but also on a personal level. Writing this thesis has had a big influence on me. I would like to reflect on the people who have supported and helped me so much throughout my graduate student life.

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Table of Contents

List of Tables

List of Figures

Chapter 1

Introduction

1.1 Problem Statement

Chinese traditional furniture has an extremely long history which can be traced back to 5000 years ago and can be divided into three main phases, until the Ming Dynasty, “with the development of the society and economy and the advanced technology, Ming dynasty furniture made a great achievement, and became the well-known golden age of traditional furniture.” (Ye,Wang, 2003). Unfortunately, the Chinese furniture industry started to gradually fade after the Qing Dynasty and has not regained prominence yet. Moreover, in the 20th century, world art, design and culture preferences seems to lean towards Western culture. We can tell from the “Furniture Today's Upholstery Fabric and Style Survey, 2015” that casual styles have become the best sellers for stationary sofas, while contemporary styles are tops in the recliners. Even though the Chinese furniture industry has developed into a very important factor for the furniture manufacturing industry, it is still playing the role of producer. In the meantime, there is a rise in Asian influence among general product design, as the article “Asian Design comes of Age” indicates (Balfour, 2007). One example will be Hans Wenger, whose work were mostly inspired by Chinese furniture. Although, more and more designers are becoming aware of the importance of using traditional Chinese aesthetic to furniture design, there are few design guidelines that have been established to guide the designers to design a piece of furniture with Ming style that suits modern life.

1.2 Need for Study

Chinese traditional furniture has an extremely long history, which is a very important part of Chinese heritage. It can be traced back to 5000 years ago, and the development of Chinese traditional furniture can be divided into three main phases, which are mat-level, low-platforms and high furniture. “With the development of the society and economy and the advanced technology, Ming dynasty furniture made a great achievement, and became the well-known golden age of traditional furniture (Ye，Wang，2003. It has become synonymous with Chinese traditional furniture, and represents traditional Chinese culture and the wisdom of ancient Chinese. Unfortunately Chinese traditional furniture industry started to decline from the time of the Qing Dynasty. From then until now, the Chinese furniture industry has played the role of producer.

Even though in current society, world art, design and culture preference seems lean towards the west, it is still undeniable that Oriental designs have a great influence on modern design. As Ellsworth (1970) mentions in “Chinese Furniture,” “It is much more than the observers recognized that the origin of contemporary western furniture design depends on the oriental elements.” A good example is famous Denmark designer Hans J. Wagner, whose work are mainly inspired by traditional Chinese furniture, especially the famous “the Chair” which was designed in 1949, inspired by the traditional Chinese “round arm Chair”.

Furniture is the product that relates closest to human life; it is the outcome of the influence of social development, production mode, aesthetic, and lifestyle which is also heavily related to culture. Moreover, furniture is part of the culture; it contains the

cultural context and represents the spirit of a society. Thailand design master Suwan Kongkhunthien (Z., & H ,2007) said, “Go back to see the origins of our culture, it will give you the most of understanding.” Most of the people who can simultaneously contact Chinese and Western cultures feel like there is a huge potential in the market for Chinese style furniture. And as a Chinese designer, it is our responsibility to carry forward the traditional Chinese culture to the world, to let the world know more about China. Because Ming Dynasty Furniture is synonymous with Chinese traditional furniture, it represents the highest level of aesthetic, handcraft skill and material selection of traditional Chinese furniture. Therefore, in this thesis characteristics of Ming Dynasty furniture will be studied and summarized. Also, the differences between modern mass production technique and handicraft techniques of Ming Dynasty will be compared in order to find out the new form features to meet the requirement of modern mass production and that contain Chinese traditional cultural context as well. In turn, a guideline will be developed for helping designers develop furniture that is suited for modern life based on traditional Ming Characteristics.

1.3 Objective of Study

- To study the history of traditional Chinese furniture.
- To study the influence factors on furniture design.
- To study the definition of product function.
- To study the characteristics of mass production techniques in current society.
- To study the characteristics of Ming Dynasty furniture’s form features.

- To study the characteristics of Ming Dynasty furniture's materials.
- To study the characteristics of Ming Dynasty furniture's construction feature.
- To summarized the characteristics of Ming Dynasty furniture.
- To compare the traditional handicraft techniques with modern mass production techniques.
- To transfer the form feature of Ming Dynasty furniture to the one that is best suited for current society.
- To develop a design flow chart to help designers develop a piece of furniture that is suited to current society but contains Ming Dynasty Characteristics.
- To develop an evaluation tool to help the designers evaluate the design outcome.
- To apply the design guideline in furniture design.

1.4 Assumptions of Study

This study was directed based on the following assumptions:

- Chinese Design is drawing an increasing amount of attention all over the world.
- Furniture that is suited for modern life can combine with Ming style.
- Furniture with Ming Style will gain higher market value.
- Ming Style furniture can represent traditional Chinese furniture.
- Western designers do not know Ming Style furniture well, and there are few design guidelines in designing furniture with Ming Style that are suited for modern life.
- People who do not know Ming Style furniture well can still distinguish Ming Style and non-Ming style.

- Designers who do not know Ming Style furniture well can develop a better understanding about Ming style after reading this thesis.

1.5 Scope and Limitations

For this study, the scope will be limited to Ming Dynasty. The traditional Chinese furniture development can be divided into three phases, each one with its own characteristic. The focus will be in the form features of Ming Dynasty hardwood furniture. There are other additional materials used among Ming Dynasty furniture, but only hardwood furniture will be studied in this thesis. Moreover, hardwood will be the only kind of material that will be considered as the main materials in the new design, and only the woodwork production technique of current society will be studied. Additionally, the focus of this thesis will be on the form features of each kind of Ming Dynasty furniture. Complex decoration, cut outs, patterns and accessories will not be studied in this thesis.

1.6 Procedures and Methods

This study was both investigated and developed using the procedures described below. The procedures and methodology mentioned below can be applied to different kinds of furniture including sitting devices, tables, storage device, couches, beds and others.

1. Study the characteristics of each kind of furniture.

Method: Gather all the existing Ming Dynasty furniture of a certain category, and study the category's materials, proportions, and overall form features. Divide the furniture into several components, and study each components form features and proportions. Each component should have a basic form and several form variations. Sum up all the possible forms of each component in one summary chart, as shown below.

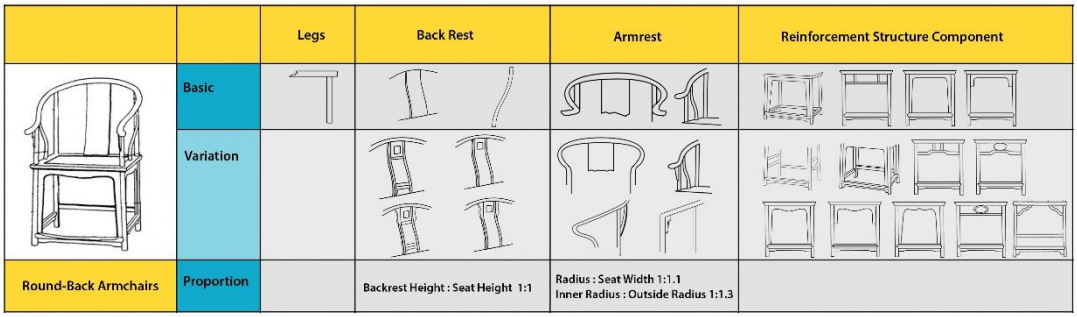


Figure 1, Characteristic of Round-Back Armchairs

2. Summarize the characteristics of each kind of components and form rules.

Method: After studying the characteristic of each kind of furniture, the possible form features of each kind of components can be summarized in one chart. Several common features can be found, and several form rules can be established.

3. Analyze the summarized form chart and develop new form features.

Method: Based on the mass production techniques, certain levels of changes can be applied to the form features of Ming style furniture. After this step, varying degrees of simplified form language will be obtained.

4. Develop a design flow chart for designers to design furniture with Ming Style that suit current life.

Method: Based on the product function theory, and currently existing furniture design methods, a design flow chart has been developed. The design process has five steps, including human function development, style development, design evaluation, structural analysis and material selection.

5. Apply the form feature of Ming style furniture to a new product.

The history of Chinese furniture will be studied as a whole. Then, the research will be divided into five categories; sitting device, tables, couches or beds, storage devices and others. Characteristics of each categories' furniture will be studied separately. Characteristics of each component will be summarized, including configuration, proportions, and the meanings of configurations. Finally, the guidelines will be applied to the process frame for furniture manufacturing.

1.7 Anticipated Outcomes

The primary outcome of this study is providing a new design guideline for designers to design furniture with Ming Style that is suited for modern life. Existing Ming Dynasty furniture will be studied and used as a reference in research and development. The study will cover the information that is related to modern mass production techniques. All reference information will improve the actual usage rate of

the final design approach. A practical product will be developed from the preliminary sketch based on the design guideline.

Chapter 2

Literature Review

2.1 Motivation of this research

Chinese traditional furniture has an extremely long history, which can be traced back to 5000 years ago, and its development can be divided into three main phases. These include mat-level, low-platforms and high furniture. “The early history of Chinese furniture recorded in excavated material, engraved stone and stamped brick reveals a mat-level furniture culture.” (Evarts, 2016). The appearance of the low platforms furniture is a significant achievement in Chinese furniture history, which were brought by the eastward migration of Buddhism from India. During this stage, which lasted from Shang to Han (see timeline in Figure 3 below), furniture developed from low profile to high profile, and increasingly developed into rich varieties.

Figure 2, Sitting on the ground

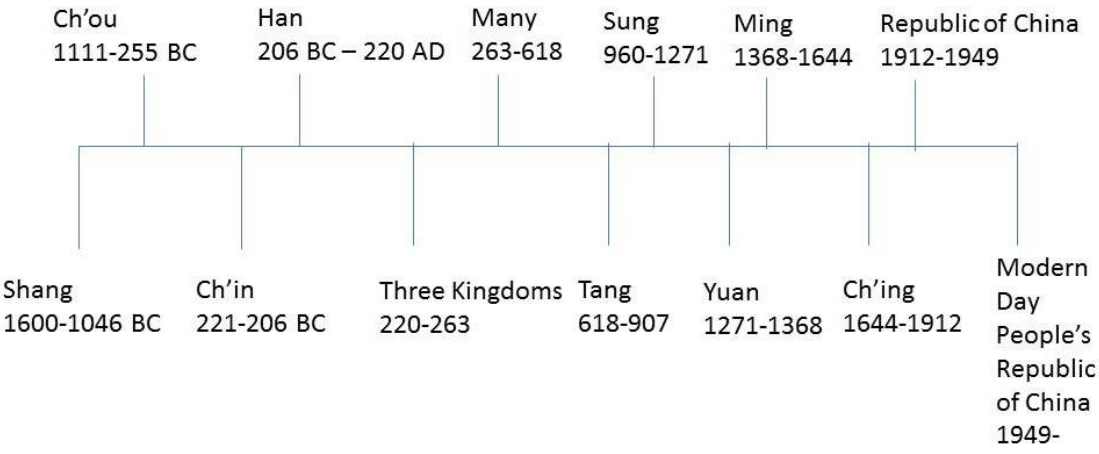


Figure 3, Chinese history timeline. (Rodgers & Rodgers,2014)

"By the Tang dynasty (618-907 AD), stools and chairs had become common amongst the elite and those of rank. Prototypes of the yoke back chair as well as the round back chair appear in contemporary paintings and wall murals and depict the sitter with legs both pendant and crossed" (Evarts, 2016) This indicated that by the Tang Dynasty, sitting with both legs pendant had already appeared, and Tang Dynasty was in a transitional period. When it came to the Song Dynasty, the lifestyle of sitting high has already been established, which contributed to the advanced development of high furniture.

Because of the development of the society and the economy, the demand for well-made furniture increased, which encouraged the craft standards to achieve unprecedented levels. Moreover, the import of hardwood also contributed to the development of the furniture industry during the Ming dynasty, which all can be traced in the historical records. All in all, "because of development of the society and economy and the advanced technology, Ming dynasty furniture made a great achievement, and became the well-known golden age of traditional furniture" (Ye, Wang， 2003). Furthermore, Yang Yao, a famous scholar of Chinese traditional furniture, claimed that the achievements of Ming Dynasty furniture in modeling art and craft technology reached the highest level of the world. (Yang， 2002)

As discussed above, until the Ming Dynasty, Chinese traditional furniture has established a well-developed distinctive design style, which can be described as, Simple, natural and poised in the form; appropriate proportion; precision and firm in structural; expertise in the selection of materials. (Yang， 2002) Moreover, it not only represents the highest level of manufacturing technique, but also stands for the quintessence of Chinese traditional culture. From this point, it can be understand that Ming Dynasty furniture has a great value in aesthetic, structure, and manufacturing techniques for the younger generations to learn from.

Unfortunately, this peak only continued until the early Qing Dynasty. After that because of the changes of the social system, the furniture industry gradually declined just like the other handicraft industries. Until now, the Chinese furniture industry has not fully recovered, according to the Chinese furniture market survey for 2015 (Yau,

P,2015). The classical style Western furniture has taken a huge proportion in the Chinese furniture market, and it has already became a well-developed manufacturing chain, which we can tell from the great variety of styles, colors, and designs that the buyers can choose from. Moreover, as more people buy villas in china, the demand for this style furniture will risen even more. Even though Chinese furniture industry has developed into a very important factor of the furniture manufacturing industry, it is still plays the role of producer. Western design companies are still the ones that develop new product or determine the market trends, even in the Chinese market. (Yau, P， 2015）. For current statues, world art, design and culture preferences seem to lean towards the western which is shown in "Furniture Today's Upholstery Fabric and Style Survey, 2015" （French, 2015） that Casual styles have become the bestselling for stationary sofas, while contemporary styles are top in the recliners. From this point of view, we can easily tell that traditional Chinese furniture is no longer as highly regarded as it used to be. Moreover, the younger generations of Chinese not only did not inherit the traditional Chinese furniture but also are losing the ability to appreciate its beauty. Fortunately, the young generation of designers in China are desperately trying to find a way to combine the traditional Chinese furniture elements into modern furniture in order to revive Chinese furniture. There are several brands that have started to be recognized by consumers, including More or Less, Lost& Found, and BANMOO. In the meantime, Western society is beginning to pay more attention to Oriental elements as well. As the latest design trend of furniture design (*Jurgita*, 2016) just released shows, combining Chinese elements into modern furniture design will be a hot new trend in the furniture

market.

In fact, the design method of combining traditional Chinese furniture elements into modern furniture has already been proven to be feasible by the market. For example, the well-known “wishbone chair” designed by Danish designer Hans Wegner in 1944, was inspired by portraits of Danish merchants sitting in Ming Chairs. It took the profile of the armrest of the traditional round-arm chair and integrated the Scandinavian design principle into it. This chair was produced in 1950, and until now it is still one of the famous works that stands for Scandinavian style and is well accepted by the customers. (Wishbone Chair, D,2016)

As discussed above, Ming Dynasty furniture is the essence of the traditional Chinese furniture, standing for not only the aesthetics of traditional Chinese society but also representing the traditional Chinese culture. From the furniture design point of view, Ming Dynasty has a great value for the younger generation to learn from. With the whole word leaning towards western culture, simply repeating the Ming dynasty furniture design will not let the world appreciate the beauty of Chinese furniture, so combining the Ming Dynasty furniture with modern furniture will be the only way to bring a new vitality to Chinese furniture and let the Western society develop a new understanding of Chinese furniture. It should be a responsibility for the new generation Chinese designers to revitalize the Chinese furniture. Moreover, instead of being blindly stuck in the past learning and improving should be the right attitude for the new generation of Chinese designers to build national pride.

2.2 Influence factors on furniture design

Regarding the development of furniture design, some contributing aspects influence furniture styles. In this chapter, the four main factors will be discussed.

Furniture is one of the products most closely related to human life: “a piece of furniture can always reflect how a group of people interact with each other, and what kind of lifestyle they have.”（Moreman,2005）. Likewise, different lifestyles have a great impact on furniture design. “Differences in national and racial habits are also disclosed by the dimensions and design of such articles as seats and tables”. (Gloag, 1966) For example, “There is a difference in the sitting ritual between Western people and Japanese people. Perhaps the sitting technique takes a major part of our body movement, and there are great influences of how things and spaces should be.” (Ando, 1990). The manner of sitting and the subsequent furniture designs distinguish one religion from the other.（Moreman,2005） Low profile furniture is one of the biggest distinguishing feature of Japanese furniture, which is influenced by the habit of sitting on the ground. “The Chinese, Japanese, Burmese, Hindus and some nations of the Middle East sit with their legs comfortably arranged in a horizontal position, a posture that affects the design of their furniture” (Gloag, 1966).In the meantime, Western society leans more towards high and big profile furniture. Not only the different lifestyle between religions can result in different kinds of furniture style, but also with the development of society, people’s lifestyle can have a great change which will also result in changes in furniture design, such as, with development of the society and the eastward migration of Buddhism from Indian, the Chinese furniture changed from low profile to

high profile.

Another influencing factor that contributes to furniture design is culture. The relationship between design and culture can be described as interaction and interdependence, from which we can tell that design and culture are both formed and sustained by economics, politics and technology (Sparke, 2007) “Design forms part of our culture and embraces all types of items” (Asensio, 2002), and “Furniture reveals many confidential things about the social life of the past and present; like architecture it amplifies and illuminates the story of civilization in nearly every country, and provides an intimate, personal record of habits, postures, manners, fashions, and follies” (Gloag, 1966).

Furniture represents the aesthetic, philosophical concepts and cultural significance of the designers. Therefore, the connotation of the national culture must have a great influence on furniture design. For instance, in ancient Egypt, people worshipped the sun and believed that the sun created the people, land and plants. Therefore, most of the decorations of ancient Egypt furniture are lions, eagles, cobras, cattle heads, and beast hooves in order to represent the dignity and majesty of the God or emperor. For the furniture form, ancient Egypt kept it symmetrical so as to emphasize authority and social status. Another example to prove this theory will be the birthplace of Bauhaus-Germany. The reason why the clean and simple design style which Bauhaus initiated can be well accepted and developed is that Germans lean towards rigorous and, simple and abandoning luxury.

In addition to these two factors, the development of manufacturing technology

and available materials has a great impact on furniture design as well. In the 20th century, "the development of bent and laminated wood veneers was one of those significant innovations, making it possible to construct furniture using fewer pieces and allowing designers to obtain greater visual unity and fluidity." (Era Armchair,D,2016) It is difficult to imagine the work of Michael Thonet or Hans J. Wegner without this technology. The famous chair Marais A56 Armchair was made of galvanized steel, which was new in 1934. The introduction of this new material made the chair durable and robust, yet still extremely light. For the form factors, galvanized steel provides designers much more freedom to express their creativity. (Tolix® Marais A56

Armchair,D, 2016)

Figure 4,Era Armchair with Upholstered Seat Design by Michael Thonet.(Era Armchair,D,2016)

*Figure 5,*Marais A56 Armchair. (Tolix® Marais A56 Armchair,D, 2016)

As seen above, furniture is the kind of product that contains cultural connotations, representing the lifestyle and production level of a region. From the development of the furniture, changes of the culture and society can be seen. Since the implement of the reform and opening-up policy, Western culture and Oriental culture have massively affected China, which resulted in a diverse culture for modern China and has been accepted by the modern Chinese. But, Chinese traditional culture still is the main factor that affects modern Chinese lifestyle and values. Therefore, with this situation simply copying the form of traditional Chinese furniture cannot stimulate the interest of the consumers any more. Identically, blindly imitating the western furniture design cannot stand for modern Chinese values and represent modern China. In order to represent the divers culture of modern China, combining traditional Chinese furniture with modern design style will be the only efficient way. Moreover, requirements and needs of modern Chinese must be taken into consideration, in order to satisfy the consumers.

2.3 Symbolism in design

"Symbol is the artificial thing that can represent and refer to something else and can be understood by public. In community life, symbol communicates a kind of conventional information by accumulating and depositing culture." (Wu, Na, 2006). A symbol is consisted of two different parts, which is signifier and signified. (Wu. 2007) The main function for a symbol is sending a message. A symbol expresses meaning which usually contains culture, spirt and conception, by making use of the visual elements which will stimulate earlier experiences and associations.

A product combines people's lifestyle and artistic conception, and also a product is the coagulation of people's comprehension about truth, beauty, elegance, and sanctity. So from the symbol point of view, a product is a kind of symbol. (Wu, Na, 2006). A product is the creative result that designer created with visual signs. (Sun,Li,Ling,2013).It is an information carrier that aim to convey. (Fu,Yu,2012) "Long standing findings from design, art, and advertising research indicate that visual elements such as shape, color, logo, and typeface are not only perceived in terms of their formal or technical properties but also in terms of the symbolic or affective connotations they embody." (van Rompay, 2009) Based on the symbol definition, a product symbol has two different parts as well. The signifier symbol stands for the form language, materials, color and external elements, while the signified symbol stands for the spirit, culture meaning, and the message that the designer wants to deliver to the users.(Wu, Na, 2006) Based on this theory, when people look at a product, they should be able to get the spirit, cultural contexts, social concepts and so on though the signified elements. For example,

when people look at a Bauhaus product the reason why they can tell it belongs to Germany style is that the visual elements stimulate the earlier experiences that stands for German culture, German social spirit, and German lifestyle. From this people can tell the product belongs to German style. Furthermore, from the symbolic point of view, the reason why people can differentiate the products of different culture is that the signified elements applied to the product stands for different cultures. Furniture is the closest product related to human life, so that it share the same symbol theory with product.

As material and immaterial substantiality, culture is produced or created by humans, but culture is different from 'working production'. Culture is the human meaning and conception implicated in the working production and it shows the existent state and life style of people. (Li & Karakowsk,2001) Based on the symbol definition, culture has two different parts as well, and the form of working production will be the signifier side of cultural symbols. Thus, when a product has certain cultural context features, these features can contribute to making a new product with a similar cultural context. (Wu, Na, 2006)

The core element to build a piece of modern furniture with traditional Chinese style is to define the symbol that can represent the traditional spirit of China and modernity at the same time. It is better to reconstruct or re-organize a symbol based on an existing one rather than create a new symbol. (Fu , Yu, 2012). Therefore, in this thesis, a guideline will be developed to reconstruct the symbol that can stands for modernity and China at same time, based on a traditional Chinese furniture symbol. The reason that

Chinese traditional furniture is chosen as the basis is that the traditional products have gone through creating, testing and redesigning by thousands of generations. “The traditional demiurgic culture symbols which had formed in the traditional life style weren’t created by individual person or even weren’t the outcomes of human working only, but they had emerged many peoples’ wisdoms and evolutional power of nature together. This feature of traditional symbols can be clearly seen from the coming into being process of folk craftworks, folk artworks and so on.” （Wu, Na, 2006） Consequently, the traditional symbols have already experienced a long-term selection process by most people. Through this process, the traditional symbols have become the coagulation of the Chinese wisdom, and the spirit of even standings for the Chinese culture. In current society, modern Chinese are still influenced by the traditional Chinese culture. Therefore, reconstructing the symbol based on the traditional Chinese symbol is the most efficient and effective way to integrate modern and traditional concerns.

2.4 Design for modern life

Dating back to the 19th and early 20th centuries there is a philosophical movement that arose in western society that start to change the way people think when doing design work; it is called Modernism. Modernism refers to not a design style, but commonly it is defined as a mode of thinking, especially in the West. Followers are those who see it as a socially progressive trend of thought that affirms the power of human beings to create, improve and reshape their environment with the aid of practical experimentation, scientific knowledge, or technology. (Berman, 1988).

And when it comes to art, Modernism can be applied to all forms of creative activities, such as music, painting, design, architecture, films, and so on. It includes many different ways to look at the world, for example, constructivism, Dadaism, futurism, cubism, and symbolism. In spite of the differences between these ideologies, the common key spirit of modernism is “form follows function”. “Modernism was an escape from this rigidity, and a multitude of cultural and aesthetic movements grew from it.” (Eyþórsdóttir, 2011). Even though Modernism is not a design style, it has a great influence on modern design, which is part of Modernism as well.

Although modern design dates back to the early 19th century, the philosophy and aesthetic of simplicity it established is still going strong, and the design philosophy of current times is still influenced by this philosophical movement. As the retailer CB2 President Marta-Maria Calle, says "Modern design hasn't really changed, it's about simple lines, honest materials, new technologies." (Keeps, 2009). Modern - inspired designs are still prevalent in many manufacturers’ product lines, no matter if the item is in upholstery, case goods or accessories. What is more, right after modern design first appeared in the 19th century it attracted a group of loyal consumers, even until now, “ …the number of the aficionados has grown as many of the same ideals that preceded the evolution of modern design—less excess, minimalism, architectural influences—have been embraced by new generations.” (Keeps, 2009) Lexington Home Brands’ CEO Phil Haney once said that “many consumers are gravitating toward simple, clean lines to create timeless, ageless interior settings.” （Hodnett, Russell,2015）. From these statements, it can be understood that modernist philosophy is still a great influence on

today's design work, and it is still well accepted by the market.

Influenced by the modernist philosophical movement, a theory of artifact's function has been established by Walter Schaer (Schaer,1978). In his theory, a product needs to satisfy three different aspects of functions, human function, product function and technical function.

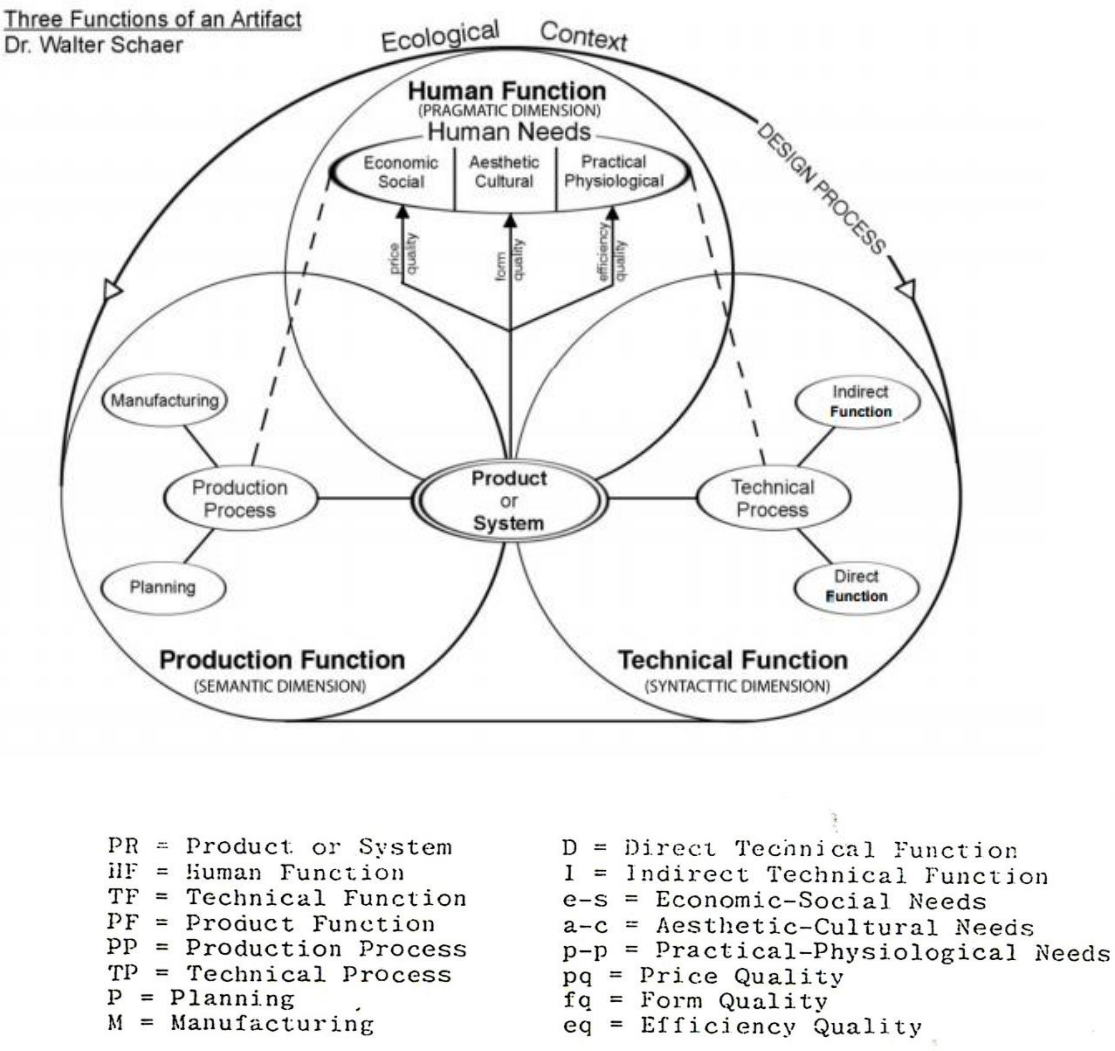


Figure 6, Three Functions of an Artifact [Schaer, 1963]

The human function of an artifact is the function that satisfies the users needs, and contains three aspects: economic-social needs, aesthetic-cultural needs and practical-physiological needs. These three aspects of users' needs are not only related to

humans' body and behavior but also are related to users' cultural background and society. A product or a system meets the users demand through their own quality which contains three aspects as well: price, form and efficiency quality. Based on this theory, a piece of furniture must be able to satisfy the human function, which means not only the ergonomic factors of user needs to be taken into consideration, but also the aesthetic and culture factors. Because the goal of this research is to build a piece of furniture that contains Ming Dynasty style, a certain kind of form language must be applied. As discussed earlier form features stands for certain kind of culture context, so that if the Ming Dynasty Furniture's form language must be applied then the culture context of the furniture will be Ming. However, based on different target users, culture preference and background of users need to be take into consideration as well. Even though certain kind of form language must be applied, Ming Dynasty furniture is the product that is influenced by human's needs and aesthetic of that time, which is not suitable for current life. Because of these two points, the form language of Ming Dynasty furniture cannot be used directly, so certain changes need to be made.

The technical function of an artifact is the function that delivers the utilities of the product effectively, which includes direct and indirect technical functions. Direct function refers to the relations between parts, components, or subsystem of a product, while indirect function refers to the relations between a product and the environment or the context in which it performs its function. For this research, direct technical function of the furniture refers to the joints that connect parts together, while the indirect one refers to the environment that the furniture will be placed. In order to satisfy the technical

function, the target environment needs to be cleared before design work starts.

The production function is the function that makes the product efficient to produce, which is related to the relationships between a product and its production planning, tooling, manufacturing, and production cost. For instance, Charles and Ray Eames (2016) originally designed their chair- Eames® 4-Leg Armchair in metal. With the development of technology, they refashioned it with light yet strong fiberglass two years later. But, because fiberglass is detrimental to the environment, Herman Miller decided to use more sustainable options, ultimately ending up with recyclable polypropylene. In 1950, with the development of the technology, which proved that fiberglass is a green production method, the Eames Molded Fiberglass Chair (1950) turned out to be the final results (Design Within Reach, 2016). To satisfy the production function is the reason that causes several changes in design.

In the Ming Dynasty, because of the limitation of manufacturing technology all the furniture were made by hand, which resulted in well-made furniture with extremely high prices but in limited quantity. Only the Imperial family or rich people could afford that furniture. With the development of industry and the influence of modern design and the industrial revolution, products are made for public and should be affordable for the majority. As a result, handcraft is no longer suitable for this purpose. Modern wood working factories are indispensable for quality, productivity and cost-effectiveness production. Currently, most commercial and production furniture is created by large machinery, much of it automated and controlled by computer. The prevalence of high-tech machinery increases the accuracy and speed of manufacture, but also removes much

of the craftsmanship involved (Xaxx，2016). For example, in the Ming Dynasty the drying process usually used natural drying methods took more than a decade, while in a modern factory, natural wood joints are brought to the required moisture content in a kilning section. “In the kiln, air is forced through stripped stacks by fans that periodically change the direction of the air flow. In recent years radio-frequency heating has been widely used to dry both natural wood and plywood.” (Hayward，2016). Furthermore, modern methods of furniture construction are largely based on the availability of man-made materials. As discussed earlier, available materials and technology have a heavy impact on furniture design. So in order to satisfy the production function of furniture and fulfill the needs of modern life, the form language of Ming Dynasty furniture is no longer appropriate and needs to be changed. For instance, wood carving and complex cut outs rely heavily on hand craft and come with a high cost, so carving and complex decoration have largely disappeared from modern commercial furniture. Instead of cutting and sanding with hands, in modern factories, timber cutting mostly relies on precision saws and CNC (computer numerically controlled) routers. Considering the production and timing cost, simpler and straight line forms are more preferred. For the joint aspect, compared to traditional ones modern joints are simpler and easier to produce with mass production, even though the construction beauty will be lost in certain cases.

As discussed above, Ming Dynasty furniture is the outcome of influence of the society, aesthetic, and production mode of that time, so it is no longer suitable for modern society. Simply replicating applications cannot fulfill the needs of modern life. Moreover, based on the theory of product function in order to satisfy the three aspects

of the product function, Ming Dynasty not only needs to be changed in functional aspects but also in form language and construction aspect which should be based on current production technology. Therefore, the goal of this thesis will be focus on how to transfer the form symbol of Ming Dynasty furniture to one that is friendly for modern production techniques but still keeps the cultural context. This will result in a process of transforming and regrouping form symbols.

2.5 The Characteristics of the Ming Dynasty furniture

2.5.1 Material

With the development of society and ocean transportation in Ming Dynasty, a large amount of high quality timber was introduced to China from Southeast Asia, which provide a condition for the development of Ming Dynasty furniture. During that period, people highly valued the quality of timber. They appreciated the timber with fine grain and purer color. Thus, despite elegant forms, luxurious and close-grained hardwoods, are part of the reason that traditional Chinese furniture drew the whole world's attention, and has high artistic value.

The main material of Ming Dynasty can be divided into two parts, which is a hard wood and nonrigid wood. Elegant furnishings are mostly made with hard wood while non-rigid wood was for household furniture of common people. Or, the timber which had a fine grain was typically used in a prominent position, such as the back plane of the chair. No matter what kind of timber the furniture used, all pieces shared one

feature that the natural grain contributes to their beauty. This area of the research will focus on the introduction of hard wood.

Among all kinds of hardwood, Zi Tan(紫檀) （Pterocarpus indicus）is the one most prized by the Chinese and commanded the highest prices. Zi Tan is a very rare kind of timber, mostly imported from India. Furthermore, it is extremely difficult to produce large pieces in Zi Tan, so, few larger pieces of furniture are made of Zi Tan. According to some scholars, Zi Tan has been used in China since the Tang Dynasty. (Yang Yao, 2002) The wood is very dark brown with a smooth surface. It is extremely dense timber, with some part the grain unable to be seen. Ancient Chinese appreciated Zi Tan most, not only because it was the rarest timber, but also because its dark brown color represents the character of steady and quiet which ancient Chinese valued highly.

Another kind of high quality and rare kind of timber is Hua Li (花梨). Like Zi Tan, Hua Li "was used in China as early as the Tang Dynasty and on into the 18th century for the furniture of the well-to-do, high functionaries and rich merchants." (Craig，1988) It was the main material of furniture during Ming and early Qing Dynasty. But unlike Zi Tan, Hua Li's color is much lighter, ranging from honey yellow to orange of various depths and it has an elegant, lively and changeable grain. Moreover, the center part of Hua Li is denser and the color tends to be brown while the sapwood is lighter and the color tends to be lighter. It is far easier to produce large pieces of materials with Hua Li; even a large tabletop can be made with it. The reason why ancient Chinese applied Hua Li so much is that the color and the grain of Hua Li has the sense of luxury and elegance at the same time.

Two different finishing techniques are used on Hua Li and Zi Tan, one is carving and the other is plain. Most people preferred plain surface over carving for these woods, because carving destroys the beauty of the grain.

A timber which is much softer than the two discussed above, but still one of the important parts for traditional Chinese furniture's material, is chicken wing wood（鸡翅木）. The reason why it was called by chicken wing wood because its grain looks like a feather, especially with a sloping profile. Unlike the other two types, chicken wing wood has a rough surface. For its color, different depths of dark purple-brown consist of a unique pattern and will becomes gray with age. Therefore, it is always protected by a coating. "Chicken wing wood was frequently used after the Ming Period." (Crai,1988)

Figure 7, Samples of hard wood

In addition to those three kinds of timber, there are several more kinds of hard wood that would frequently be used in Ming dynasty, including Mesua（铁力木） and Wu Mu（乌木）. Mesua is the biggest and cheapest kind of hard wood among all. Therefore, it was usually used for large pieces of furniture. Its color is similar to Chicken Wing wood. Wu Mu has a similar color to Zi Tan.

From the existing legacy of Ming dynasty furniture and the ones recorded in literature, it can be summarized that material selection of Ming Dynasty follows those principles.

- The grain of the timber should be cleared, lively and flexible.
- Timber's color which is steady, quiet and uniform will be preferred. Hardness and cubic weight should be appreciating.
- Dense timber would be preferred. (Yang，2002）

Intended use of different timber is another method of material selection. The different color combinations of the timbers can achieve the effect of decoration. It is hard to find excessive decoration among the Ming Dynasty furniture, because excessive decoration covered up the beauty of the timber, which ancient Chinese valued greatly. Another way to demonstrate the beauty of the grain is to cut the thick timber in half and used the pieces as doors which can achieve the beauty of symmetry.

In addition to all solid wood furniture, there are several other kinds of materials that coordinate with solid wood and play the role of supporting, decorating, and cooperation, including stone, copper or iron, and palm or other kinds of woven material. It is a common production method for sawing stone into plates in order to make table plates, cabinet doors, and screen. Because of the weight issue, it is better to use stone as part of the door or screen. Sometimes, seat platforms are made of stone, but it is not usual as can be seen in Qing Dynasty. Another way to make seat, bed and stool's platform is to use woven materials, which was common way during Ming and early Qing. The hinges in Ming dynasty furniture were mostly made from copper and iron. For the furniture made with a plain wood plate, copper and iron component served the role of decoration. This kind of component can be added in the corner or on the surface. Some of the variation of copper and iron components are shown below.

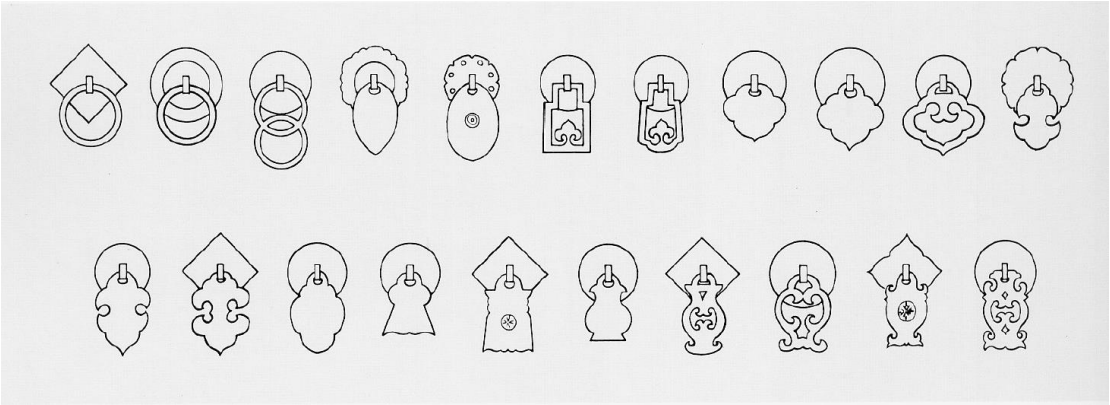


Figure 8, Copper and iron components samples (Wang,1999)

In general, high quality, dense hardwood is the main material of Ming Dynasty furniture. The beauty of the timber and the shape of the furniture complement each other to form the unique style of Ming Dynasty Furniture. In ancient China, Confucianism was highly valued. In Confucian theory, jade was treated as the representation of scholars because of the characteristics of moist, fortitude and flawless. The hard wood that was chosen to make Ming furniture has the same characteristic with as jade, and this is why ancient Chinese appreciated hard wood so much. Using hard wood without extra treatment or finishing represents the theory of advocating natural beauty which is promoted by Taoism. (Yao, 2004) Moreover, this feature of the timber represents the personality of Chinese which is introverted, reserved and humble. It can hardly be denied that making use of high quality of hardwood is one of the most important reasons that Ming Dynasty furniture achieved such a great artistic level and have such a great impact on modern furniture design. Therefore, in order to modernize Ming Dynasty furniture, material selection deserves close attention. Even though the precious timber is hard to get, the wood selection should preserve the characteristics of quiet, steady and pure.

2.5.2 Variety forms of Ming Dynasty Furniture

By the Ming Dynasty, the form of traditional Chinese furniture had been developed into quite diverse areas. In accordance with the functional classification Ming Dynasty furniture can be divided into five categories, which is sitting device, table, storage device, couches or bed, and the others. (Wang, 1999) Each category contains varied forms of furniture and carries its own characteristics. This chapter will discuss the first four categories separately, and will focus on the symbols that can stand for each one.

2.5.2.1 Sitting Device

This category contains several different forms of sitting devices, and based on whether they have backrest or not, the category can be divided into three subcategories. The one without backrests contains Wu Deng (杌凳), Jiao Wu（交杌）, Chang Deng（长凳）, and Zuo Dun（坐墩）, while, the one with backrests can be called chair, which contains arm chair （扶手椅）, round-backed armchair （圈椅）, backrest chair（靠背椅）, and Jiao Yi （交椅）. The last sub category of sitting device is Bao Zuo（宝座） which was intended for the imperial family based on the large scale of chairs.(Wang，1999) Each category has its own basic style, and there are many of variations based on the basic form

Wu Deng （杌凳）, Jiao Wu （交杌）, Chang Deng （长凳）, and Zuo Dun（坐

墩）

Wu specifically refers to the kind of sitting device without a back rest. There is a specific name for each part of the sitting device. This research will discuss the feature of Wu Deng in three aspects, which is seat surface, leg, and doorpost（枨子）. As a result of culture variations, designers have to study varied designs of line configurations, patterns, and proportions from the specific culture and innovate the design elements with which people can identify (Liang, 1996). Only line configurations and proportions will be discussed here.

Among pieces of traditional Chinese furniture, if the sitting device is a square shape it can be classified based on whether it has Shu Yao （束腰） or not, despite the special cases. Therefore, there are two basic style for Wu Deng, as shown below in figure 7. Features of each style will be discussed separately. (Wang，1999)

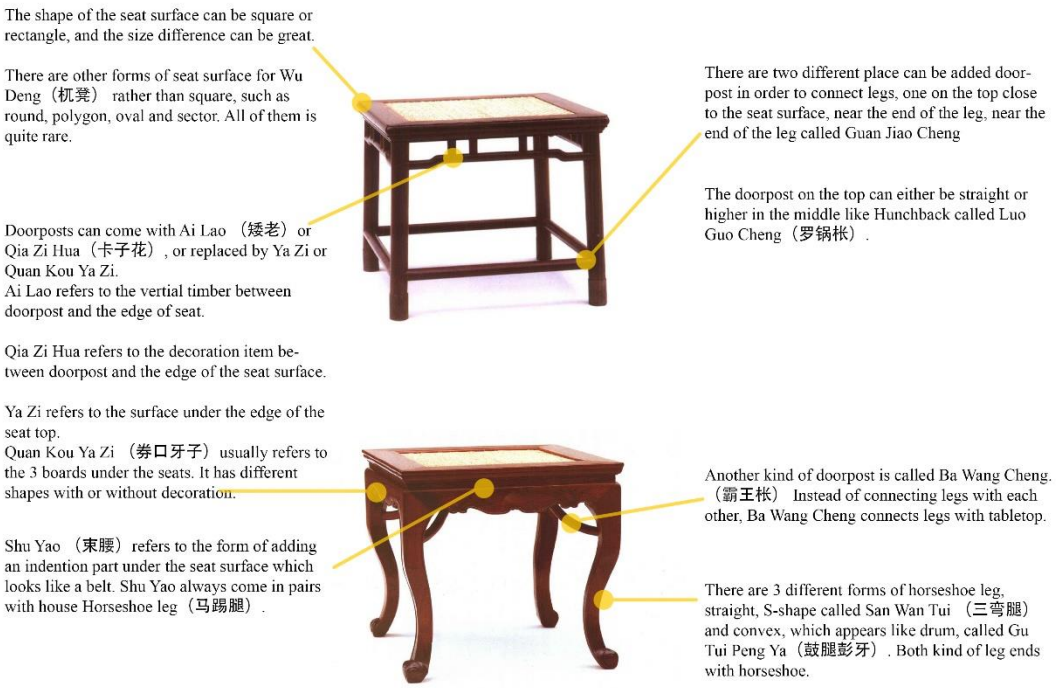


Figure 9, Detailed features of Wu Deng

Jiao Wu （交杌） refers to the sitting device that is similar to Wu Deng but can be folded and carried around. The legs of the Jiao Wu intersect with each other. The basic form of Jiao Wu only contains eight pieces of wood, as shown below. The seat surface was usually made of woven leather bands or ropes. There was more decoration features in the delicate pieces. Because Jiao Wu is a unique kind of sitting device that was only widely used in China and it shares some features with Wu Deng, it will not be discussed in detail in this research. (Wang，1999)

Zuo Dun is called that because the sitting surface was always covered with mats made with fabric in order to increase the sense of beauty. It is not only for indoor use but also for outdoor use. As a result, there are more handed down that are made with stone or porcelain rather than the one made with wood. The overall shape of Zuo Dun

looks like drums, and it holds the features of nails that look like drums, and the cut out area is the same as Teng Dun （滕墩）. Features of Zuo Dun will be shown below in the Form 1. (Wang， 1999)

Figure 10, Detailed Features of Zuo Dun

Chang Deng refers to the sitting device without a backrest and with a narrow and long shape. There are three different forms of Chang Deng, Tiao Deng （条櫈）, Er Ren Deng （二人櫈）, and Chun Deng （春櫈）. They all share the same features with Tiao Zhuo , Tiao An, and Wu Deng, with the only difference the size and height. Therefore, they will not be discussed in detail in this research. (Wang， 1999)

Each kind of traditional Chinese furniture has basic form and a great many of variant forms based on the basic form. In this research, common variant forms will be summarized in different aspects in a chart. Basic and variant forms for Wu Deng and Zuo Dun are summarized below. (Wang， 1999)

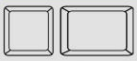
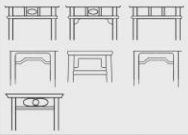
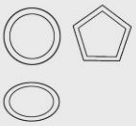
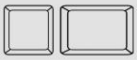
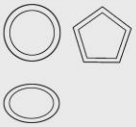
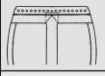
		Legs	Doorpost On the top	Doorpost On the Bottom	Seat
	Basic			 NA	
	Variation				
Wu Deng without Shu Yao	Proportion	Height Around 500mm			Size can be variety
	Basic			NA	
	Variation		 With Decoration		
Wu Deng with Shu Yao	Proportion	Height Around 500mm			Size can vary.
	Basic				
	Variation		 NA With Decoration	 With Decoration	
Zuo Dun	Proportion	Height Around 500mm			Diamater can vary, ranging from 30-40mm.

Table 1, Configurations and proportions Wu Deng and Zuo Dun

Chair

Chairs refer to the sitting device that contains backrests except Bao Zuo. Chairs are in variety of sizes and forms, and based on the form they can be divided into four kinds which are backrest chairs, arm chairs, round-backed armchairs, and Jiao Yi. Each of them has basic and variant versions. (Wang，1999)

Backrest chair

Backrest chairs refers to the chairs that do not have arm rests. The back usually contains four parts, which is Da Nao（搭脑）, backrest plate, and two pieces of wood on both sides. Based on the form of the Da Nao, backrest chairs can be broken down into two different kinds. The one with both ends of the Da Nao longer than the wood on

the side called is Deng Gua Yi （灯挂椅）, while, the one that Da Nao connects the wood on both sides is called Yi Tong Bei （一统碑）. The former is called Deng Gua Yi because its appearance looks like the item used for hanging lights. This research will discuss the features of back rest chairs based on three aspects, which are legs, backrest, and the parts under the seat surface.

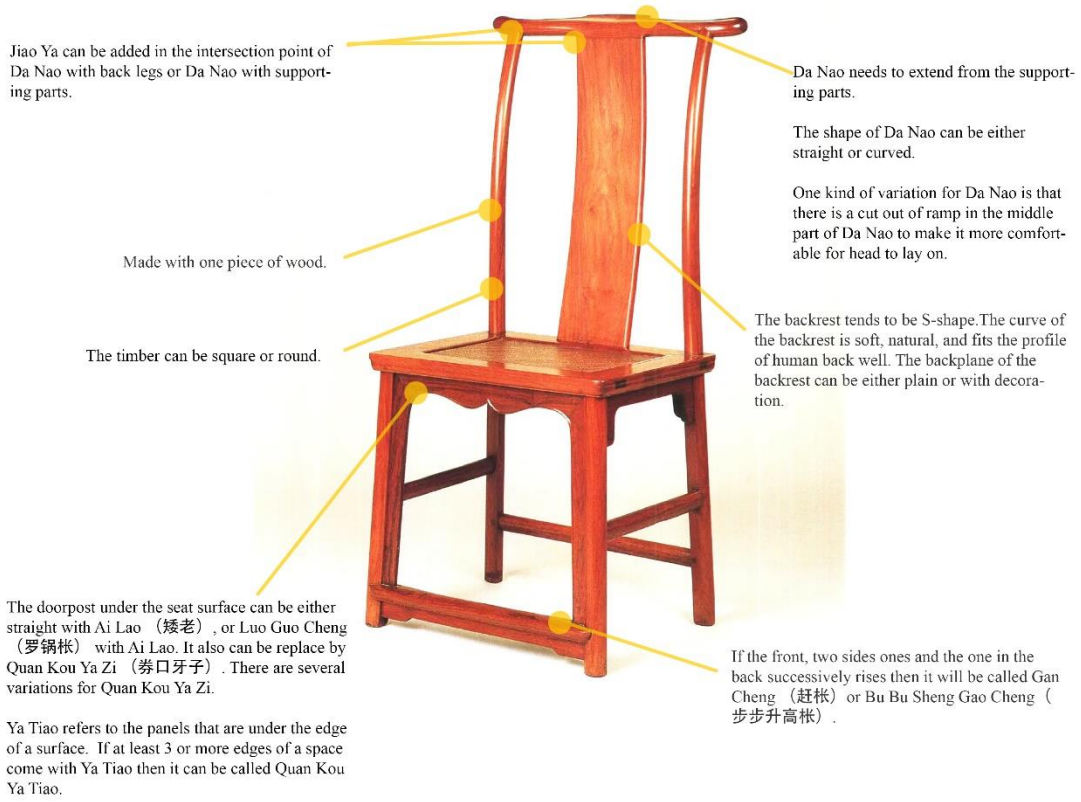


Figure 11, Detailed feature of Deng Gua Yi （灯挂椅）

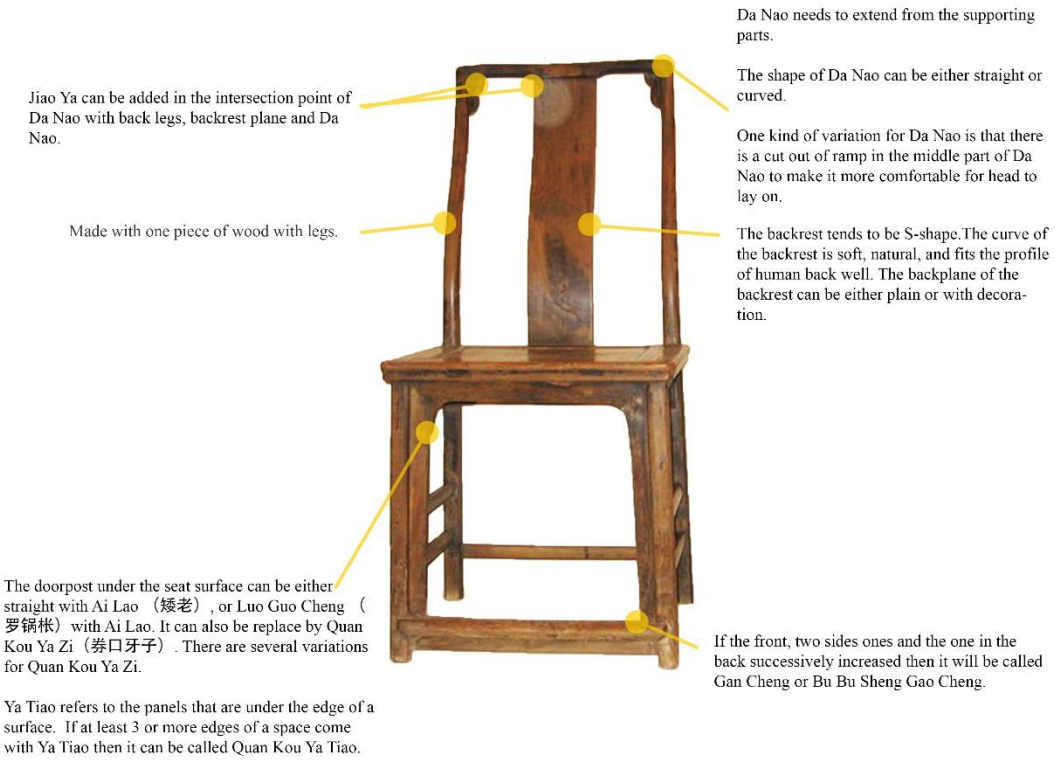


Figure 12,Detailed feature of Yi Tong Bei （一统碑）

Basic and variation forms of back-rest chairs are summarized below.

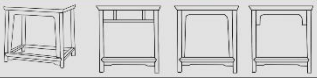
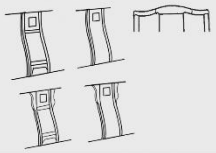
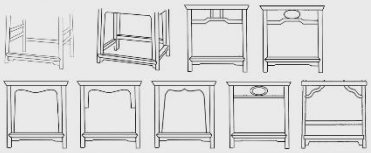
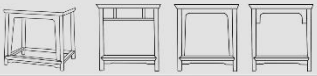
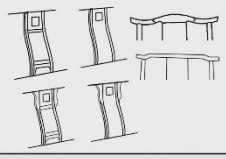
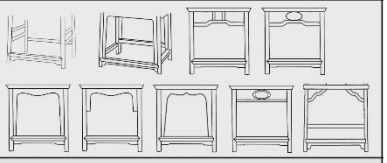
		Legs	Back Rest	Reinforcement Structure Component
	Basic			
	Variation			
Yi Tong Bei	Proportion			
	Basic			
	Variation			
Deng Gua Chairs	Proportion		Backrest Height : Seat Height 1:1 Backrest Height : Width 2:1	

Table 2, Configurations and proportions of back-rest chairs

Armrest Chair

If the chair has both a backrest and armrest, then it can be called an armrest chair, except for the Jiao Yi （交椅） and Round-armrest Chair （圈椅）. There are three main forms of armrest chairs in this category, which is Rose Chair （玫瑰椅）, Official Chairs （官帽椅） and Southern Official Chairs. （南官帽椅）

Rose Chair refers to the chair where the body is shorter and smaller than the others, and the armrest and backrest are vertical to the seat surface. Moreover, there is small height difference between the two rests. The advantage for the Rose Chair is that it is light and handy. Because of the relatively low backrest it will not block user's sight. Rose Chairs usually appear in pairs. Most Rose Chairs are made with Huang Hua Li, and barely any are made with Zi Tan.

Figure 13, Detailed feature of Rose Chair

Official Chairs Yi and Southern Official Chairs share a similar form. The one where Da Nao and armrest are both longer than the supporting parts are called Official Chairs, while the one where Da Nao and armrest connect each supporting parts are called Southern Official Chairs. They are called these because the overall shape is similar to the hat of ancient Chinese officer's hat which is lower in the front while higher in the back. Official Chairs are called yoke back chairs as well because the shape of the Da Nao is similar to a yoke.

This research will discuss the features of each kind of armrest chairs based on four aspects, legs, back rest, arm rest and the additional structure component.

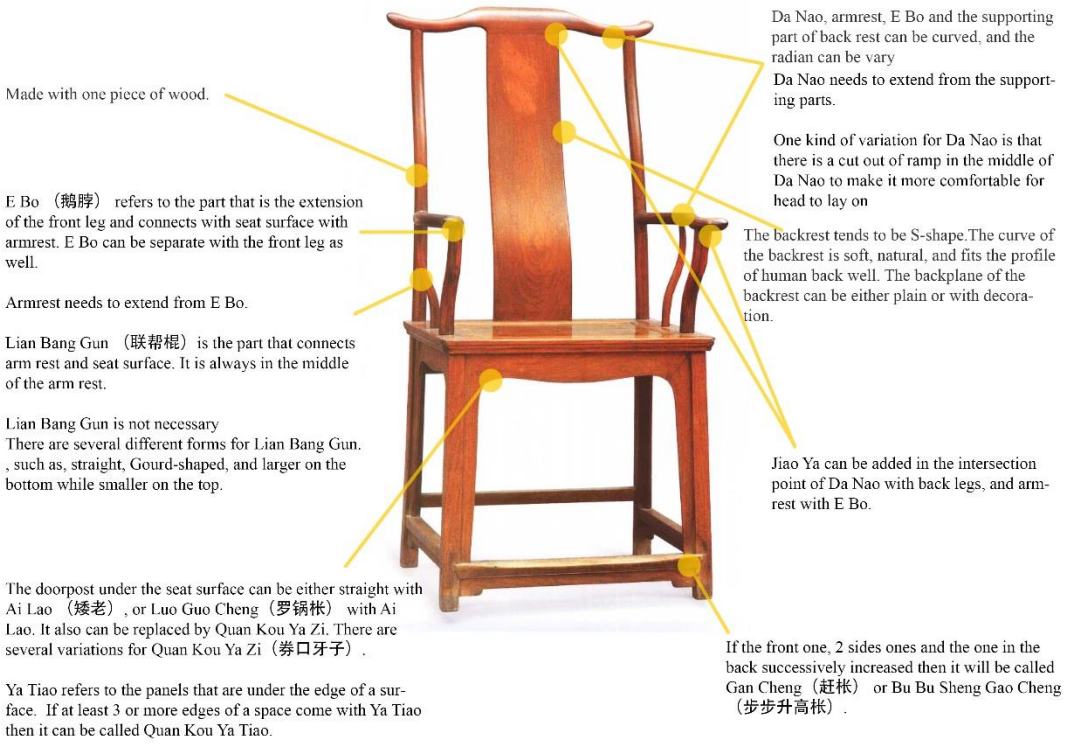


Figure 14,Detailed features of Official Chair

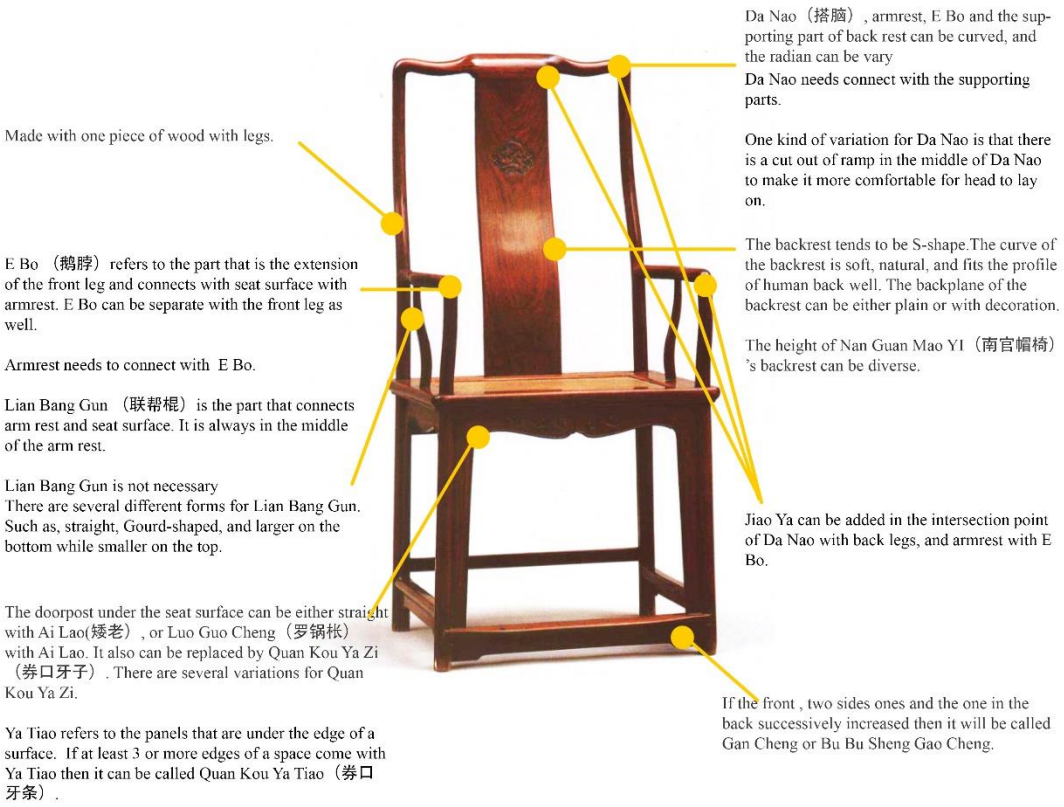


Figure 15,Detailed feature of Southern Official Chiar

Basic and variation forms of arm-rest chairs are summarized below.

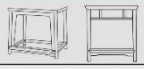
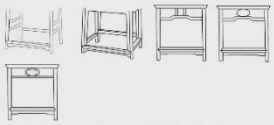
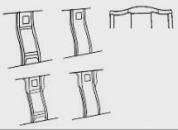
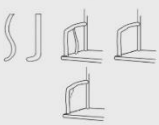
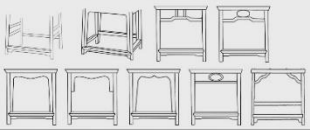
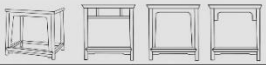
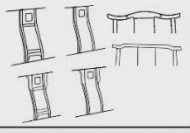
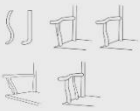
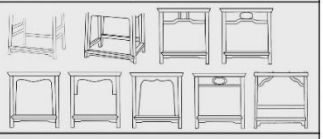
		Legs	Back Rest	Armrest	Reinforcement Structure Component
	Basic				
	Variation				
Rose Chair	Proportion			Armrest Height: Backrest Height	
	Basic				
	Variation				
Southern Official Chairs	Proportion				
	Basic				
	Variation				
Official Chairs	Proportion		Backrest Height : Seat Height 1:1 Backrest Height : Width 2:1	Armrest Height: Backrest Height 1:2.8	

Table 3,Configurations and proportions of arm-rest chairs.

Round-backed armchair

Round-backed armchairs are called this because of the shape of the backrest. “It emerged simultaneously with other high-back chairs during the Tang and Song dynasties.” (Evarts，2016) Unlike yoke back chair or other kinds of armchairs, the backrest appears to be round and smooth, downward sloping to the armrest, which is extremely comfortable for arms because it not only provides support on the elbow but also on the armpit. “Round armrest chair is one of the most graceful forms of chairs of traditional furniture.”（Evarts，2016). The round armrest chair is a unique kind of chair that only appears in China. (Wu Jiaen，2009). In this research, features of round-backed armchairs will be discussed in four aspects: legs, backrest, armrest, and the parts under the seat surface.

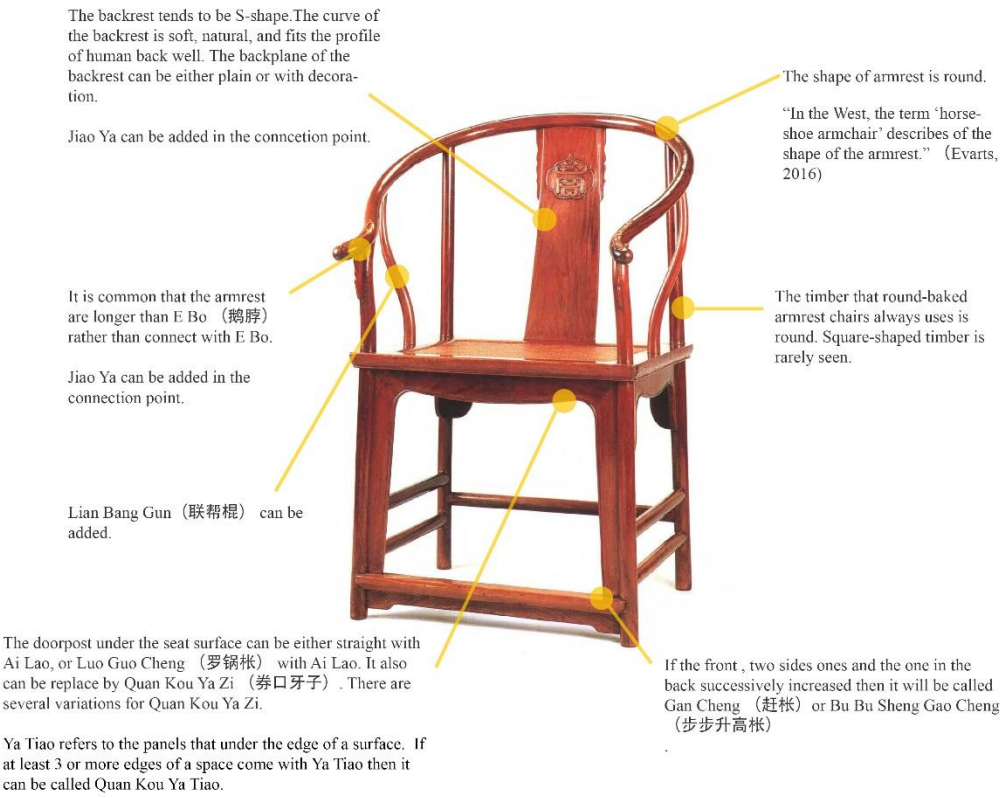


*Figure 16,*Detailed feature of Round-Back Armchairs

Basic and variant forms of round-back armchairs are summarized below.

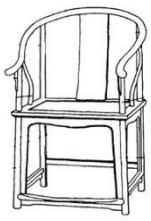
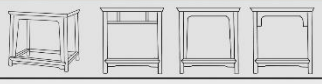
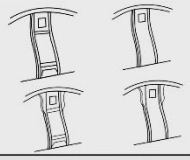
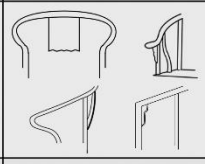
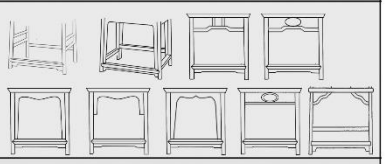
		Legs	Back Rest	Armrest	Reinforcement Structure Component
	Basic				
	Variation				
Round-Back Armchairs	Proportion		Backrest Height : Seat Height 1:1	Radius : Seat Width 1:1.1 Inner Radius : Outside Radius 1:1.3	

Table 4,Configurations and proportions of round-back armchairs.

Jiao Yi / Folding Chair

Jiao Yi, which is also called a folding chairs, is constructed with crossed legs that are joined at their intersection with pivot hinges. "Jiao Yi was popularized during

the Song dynasty, round-back and square-back are in evidence." （Evarts, 2016). Jiao Yi is used for highlighting a user's special status especially the round-back one. There is a saying in China that "No.1 Jiao Yi" expresses the premier and sublime. But after the Qing Dynasty, Jiao Yi was gradually eliminated.

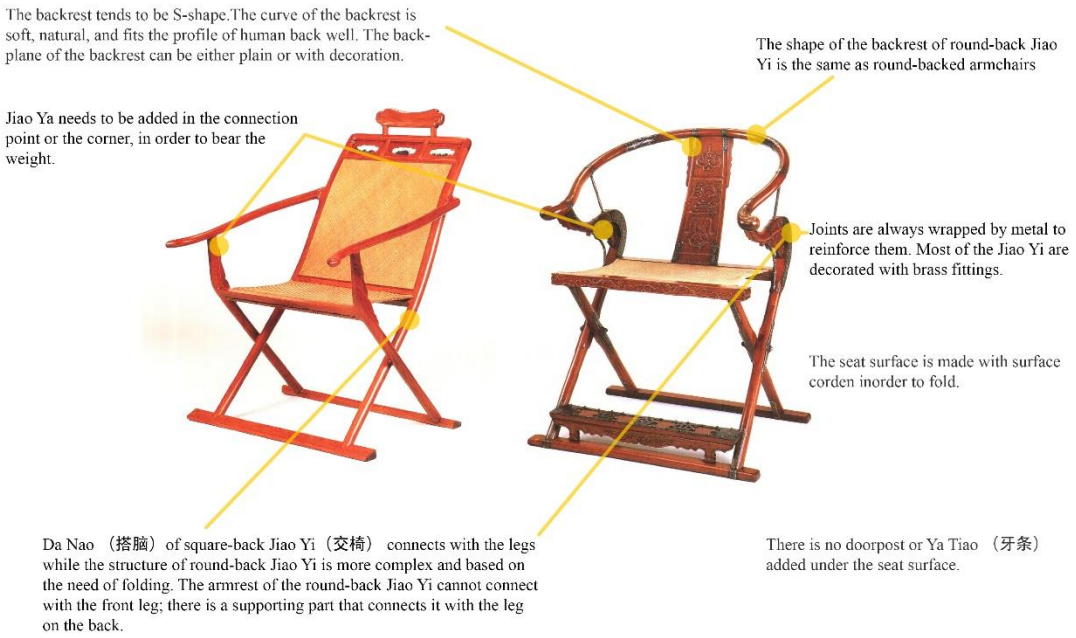


Figure 17,Detailed features of Jiao Yi

Bao Zuo

Bao Zuo is not a kind of household furniture; it can only be seen in the Imperial palace, official place, and temples. It was designed based on a large-scale seat with complicated decoration in order to show the honor of the royal family. Because of the particularity of Bao Zuo, this research will not discussed its features in detail

Conclusions:

As discussed above, each kind of chair has its own characteristics. But in the same time, it can be easily seen that they share several common features. Moreover, several configurations principles can be summarized, as indicated below:

Features in common:

- There is a special way to build the backrest plane called Cuan Kao Bei （攒靠背）, which divides the backrest plane into three parts.
- Horseshoe legs （马踢腿）always come with Shu Yao.
- Horseshoe legs and Shu Yao are rarely seen among chairs. The first reason is because, horseshoe legs usually come with Shu Yao which will break the concise form connecting the armrest with the legs. Secondly, Shu Yao, horseshoe legs and Tuo Ni （托泥）always appear together which seems to be a burden for chairs.
- The doorpost on the bottom of the legs can be in the same surface or successively rises.
- The doorpost right below the seat surface can be either straight or higher in the middle hunchback. It can come with Ai Lao （矮老） or Qia Zi Hua （卡子花）.
- Ya Tiao （牙条） can be added under the seat surface or under the doorpost on the bottom of the legs.

2.5.2.2 Table

This category contains the largest kinds of furniture. According to what Wang Shixiang (1999) stated in the book <*Ming Dynasty Furniture*>, this category can be divided into seven parts based on the functions. They are Kang Zhuo （炕桌）, Kang

An （炕案）and Kang Ji （炕几）; Xiang Ji （香几）; Jiu Zhuo （酒桌）, Ban Zhuo （半桌）; Square Tables （方桌）; Tiao Ji （条几）, Tiao An （条案）, Tiao Zhuo （条桌）; Shu Zhuo （书桌）, Shu An （书案）, Hua Zhuo （画桌）, Hua An （画案）; others. However, if a table was named Ji（几）, An （案） or Zhuo （桌） then the construction will be correspondingly the same; the only difference will be the width. Therefore, in this research, the features of the different forms An, Ji and Zhuo will be discussed together. Like chairs, each has basic forms and variations.

Xiang Ji

Xiang Ji is so called because it was mostly used for holding incense burner in ancient China. Most of the time Xiang Ji was placed individually in a space, indoor or outdoor. Therefore, every angle of Xiang Ji is favorable to look at. After the Qing Dynasty, Xiang Ji gradually fell out of fashion, but the tea table that used today evolved from Xiang Ji. In this research, features of Xiang Ji will be discussed in three aspects, which are legs, platform, and the additional structural components under the platform.

Figure 18,Detailed feature of Xiang Ji

Basic and variation forms of Xiang Ji are summarized below.

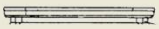
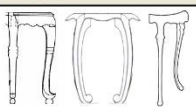
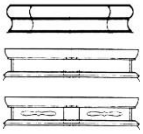
		Legs with Ya Zi	Shu Yao	Tuo Ni	Table Top
	Basic				
	Variation	 With Decoration	 High Waist With Decoration	 With Decoration	
Xiang Ji	Proportion	The number of the legs is mostly in odd number, either 3 or 5. Height can be different based on the environment	Height Of Shu Yao: Height Of High waist:		Size can be different based on the environment

Table 5,Configurations and proportions of Xiang Ji.

Ji, An and Zhuo

Zhuo stands for the tables whose legs are right on the edge of the table top. Ji

stands for the tables that are made up with three boards or the same as Zhuo but narrower. An refers to the tables whose legs are placed in an indention on the edge of the tabletop. If a table was named Ji, An or Zhuo then the construction will be correspondingly the same, with the only difference being the width. If the tables were named Tiao （条）, then the shape will be narrow and long. If the width of the table reaches 84cm then it could be used for reading or drawing. The difference between reading desks and drawing desks is that reading desks contains drawers while drawing desks do not. In this research, features of Zhuo, Ji and An will be discussed separately in three aspects, which are legs, table tops and the additional structural components under the tabletop.

Figure 19, Detailed feature of Ji

Figure 20,Detailed features of Zhuo

Based on the form of the tabletop, An can be divided into two categories. The one with flat tabletop is called Ping Tou An （平头案） while the one whose table top tiled on the end is called Qiao Tou An （翘头案）, as shown below. Within these 2 categories, there are plenty of variations for An with Chuck Tenon （插肩榫）, summarized in the chart below. In this research, features for An will be discussed in three aspects which is legs, table top and additional structural components.

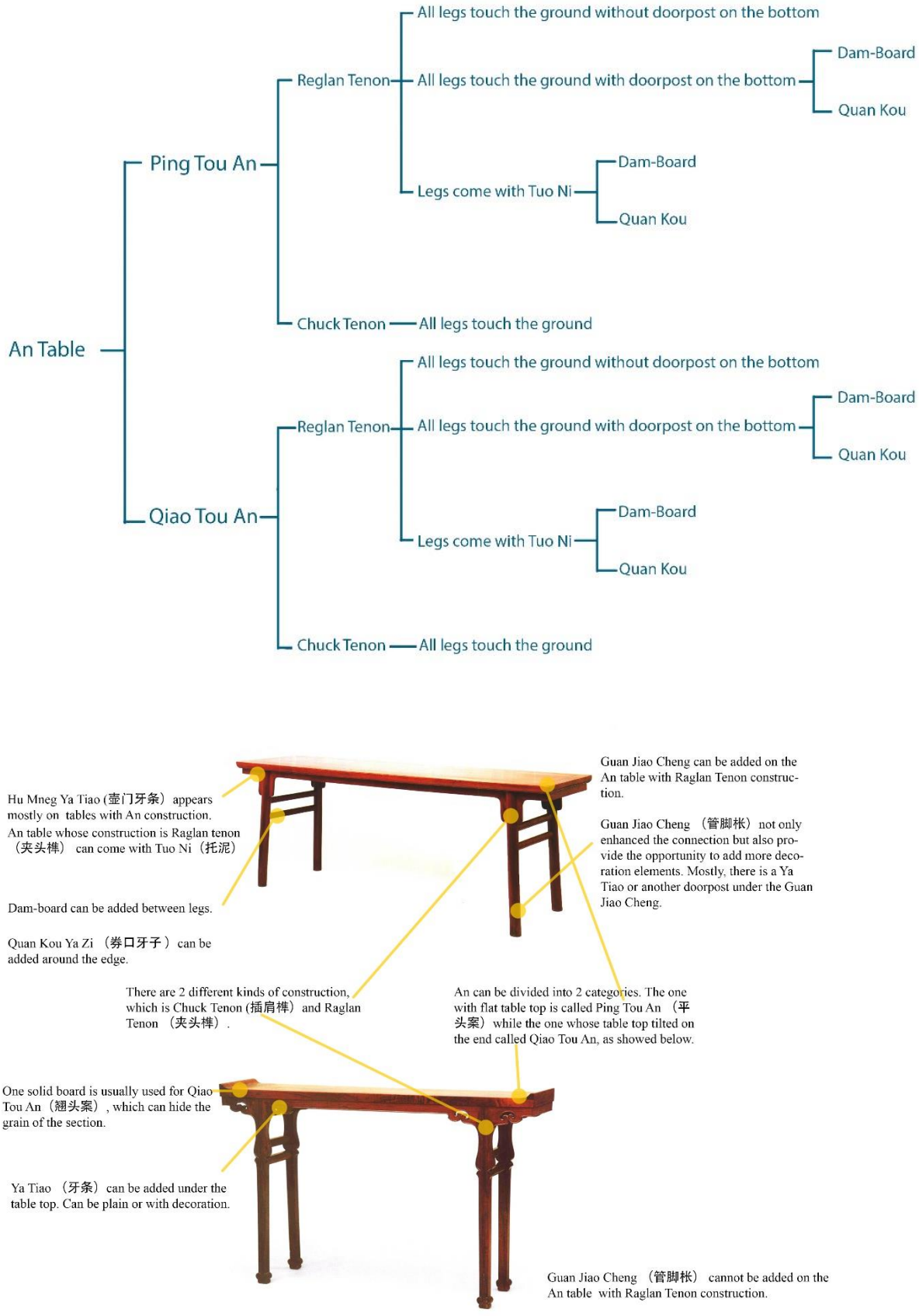


Figure 21, Detailed features of An

Kang Zhuo, Kang Ji and Kang An

This is a low profile kind of furniture that is intended for using in the bed. The difference between these three is Kang Zhuo （炕几）is always placed in the middle of the bed while Kang Ji and Kang An （炕案） are placed on the edge of the bed.

Jiu Zhuo and Ban Zhuo

These two are comparatively smaller rectangle tables. Because they were used for serving wine and food, there is a raised line on the edge of the tabletop in order to prevent wine from wetting the clothes. Ban Zhuo （半桌）is called this because it is half the size of the square table. Even though they are called Zhuo, they utilize An's construction. Jiu Zhuo and Ban Zhuo have similar features as other forms of table, so they will not be discussed in detail in here.

Basic and variant forms of Ji tables, An tables and desk are summarized below.

		Legs	Table Top	Reinforcement Structure Component On the top	Reinforcement Structure Component On the Bottom	Drawer Reading desks contains drawer
 Ji Table	Basic			NA		NA
	Variation	With Decoration				
 Desk without Shu Yao	Basic				NA	
	Variation	With Decoration				With Decoration
 Desk with Shu Yao	Basic				NA	NA
	Variation			With Decoration		
 An Table with Chuck Tenon	Basic				NA	
	Variation			With Decoration		With Decoration
 An Table with Reglan Tenon	Basic				NA	
	Variation	With Decoration		With Decoration		With Decoration

*Table 6,*Configurations of Ji table, An tables and desks.

Configurations:

- Luo Guo Cheng （罗锅枨）can be added under a straight doorpost, but in order to achieve visual harmony each should be relatively thinner.
- Luo Guo Cheng can be positioned right under the tabletop so that Ai Lao or Qia Zi Hua can be disregarded, which achieves a clean and simple effect.
- There two places where a drawer can be added, which is between the tabletop and Ya Zi （牙子） or between Ya Zi and the doorpost.

- According to the arrangement of the drawer, a reading table can be divided into two kinds. One is where all the drawers stay on the same surface, and the other is where the lower edge of the middle drawer is higher than the others.
- Xiang Lu Tui （香炉腿）refers to the legs, which curve outwards on the bottom.
- The characteristic of An for drawing is that it uses stout timber. Its legs, doorposts and table planes are all thicker than the other forms of table that are the same size.

Proportions:

	Height	Table Tops	Reinforcement Structure Component On the Bottom	Reinforcement Structure Component On the top
Kang Ji, An, Desk	**Around 25-35cm**	Zhuo Length:Wide 3:2 Ji An Length:Wide >3:2 **Angle between the Ji's side board and platform can be larger than 90 degrees.**		
Tiao Ji, An, Desk	**Around 80-85cm**	The length of Ji or Zhuo : 1-10/3 meter The length of An can be longer than 3/10 meter, around 1-13/3 meter Distance between 2 legs are smaller than the table top edge Length:Wide around 3:1 **Angle between the Ji's side board and platform can be larger than 90 degrees.**	Distance between doorpost and ground Is around 20-30cm	
Reading/ Drawing An, Desk	**Around 80-85cm**	Wide needs to be larger 84cm	Distance between doorpost and ground Is around 20-30cm	**There are two places where drawers can be added, between the tabletop and Ya Zi or between Ya Zi and doorpost**
Square Table	**Around 80-85cm Will be shorter if the table top is smaller**	Length:Wide around 1:1 **3 different length: 1m, 13/15m, 12/15m**		

Table 7,Proportions of Ji tables, An tables and desks.

Except for the forms of tables that are discussed above, there are several other kinds of tables, for example, the tables for holding instruments, chess tables, tables for worshipping, round tables and etc. However, very few of them were inherited, which has caused as lack of study. Moreover, their configuration is not representative. Therefore, this category will not be discussed in detail in this research.

As discussed above, each kind of tables has its own characteristics. However, at the same time, it can be easily seen that they share several common features. Moreover, several configurations principles can be summarized, as indicated below:

Features in common:

- Shu Yao always comes with horseshoe legs.
- The horseshoe legs, which curve inwards, are more suitable for square tables.
- It is better to use Yi Tui San Ya（一腿三牙）for square tables than rectangle tables.
- For the tables with Shu Yao, most of the time Ba Wang Cheng （霸王枨） will be added if there is no doorpost between each leg.
- If tables with Shu Yao do not have any forms of doorpost, then Jiao Ya （角牙） will be needed for strengthening connections.
- Jiao Ya can only enhance the connection in the corner.
- Hu Men Ya Tiao （壶门牙条）is mostly used among An.

2.5.2.3 Beds and Couches

Based on the configurations, beds can be divided into three categories, which are daybeds （榻）, canopy beds （架子床）and Luo Han Beds （罗汉床）. Day beds refers to the one with an open-frame. Railings （围子） distinguish Luo Han beds. “The development of railings may be related with the early placement of screen panels around

the back and sides of the platform." （Evarts, 2016), while the canopy beds are characterized by the "super structure fitted to the top of the bed, which was enclosed with panels and/or hung with draperies." （Evarts, 2016). Because the beds base of these three kinds shares similar characteristics, in this research, features of these three kinds of beds will be discussed together in four aspects, which is legs, bed plank, additional structural components and railing or panels. In Ming Dynasty, beds, especially canopy beds and Luo Han beds are mostly made with feet holders.

Figure 22,Detailed features of daybeds

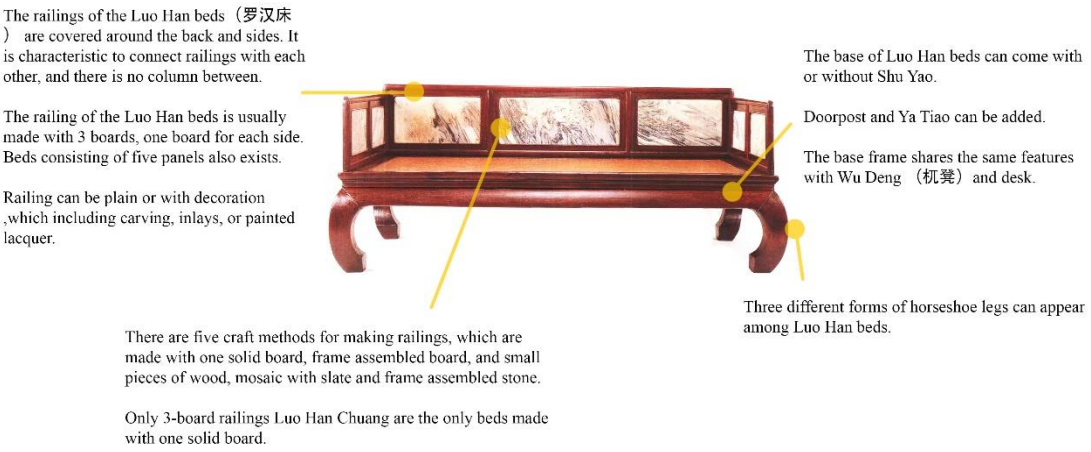


Figure 23,Detailed features of Luo Han beds

Figure 24,Detailed features of Canopy beds

Feet holders are always present on chairs and beds. Some feet holders are part of the furniture, such as Jiao Wu and Jiao Yi. Some of them are made separately for instance, the one with Bao Zuo and beds. After the Ming Dynasty, chairs were rarely made with feet holders. The beds are the only furniture that comes with feet holders. Because feet holders are the annex of the beds, they have many similarities in shape with the bed frame. In this research, feet holders will not be discussed in detail.

Basic and variant forms of day beds, Luo Han beds and Canopy beds are summarized below.

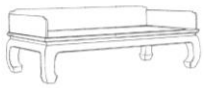
		Frame Base				Railing Or Canopy
		Legs	Bed Plank	Additional Structural Components	Additional Structural Components on the Bottom	
	Base				NA	NA
	Variation	With Shu Yao Without Shu Yao		With Decoration High Waist Structure		NA
Day Beds	Proportion	Height Of Shu Yao: Height Of High-waist: Bed's height around:480mm	Wide around 940mm Length around 2000mm Aim for single person			
	Base				NA	
	Variation	With Shu Yao Without Shu Yao		With Decoration High Waist Structure		With Decoration Inlay Stone
Luo Han Beds	Proportion	Height Of Shu Yao: Height Of High-waist: Bed's height around:480mm	Wide around 940mm Length around 2000mm Aim for single person			Consists of three or five panels The height of the panel is around 315mm
	Base				NA	
	Variation	With Shu Yao Without Shu Yao		With Decoration High Waist Structure		With Decoration
Canopy Beds	Proportion	Height Of Shu Yao: Height Of High-waist: Bed's height around:480mm	Wide around 1600mm Length around 2000mm			Consists of four or six columns The height of the column is around 1500mm

Table 8, Configurations and proportions of day beds, Luo Han beds and Canopy beds.

2.5.2.4 Shelf and Cabinet

The application for the furniture of this category is mainly display and storage. Based on the configuration, it can be divided into four kinds, which are shelf, Liang Ge Gui （亮格柜）, round corner cabinet （圆角柜） and square corner cabinet （方脚柜）. Shelf refers to the furniture which horizontal plates that, divide the space and is composed of four vertical wood pieces into several layers. There are several variations for this one, as the picture shows below. However, if horizontal and vertical plates in several grids in different sizes divided the space, then the shelf will be considered Qing Dynasty style.

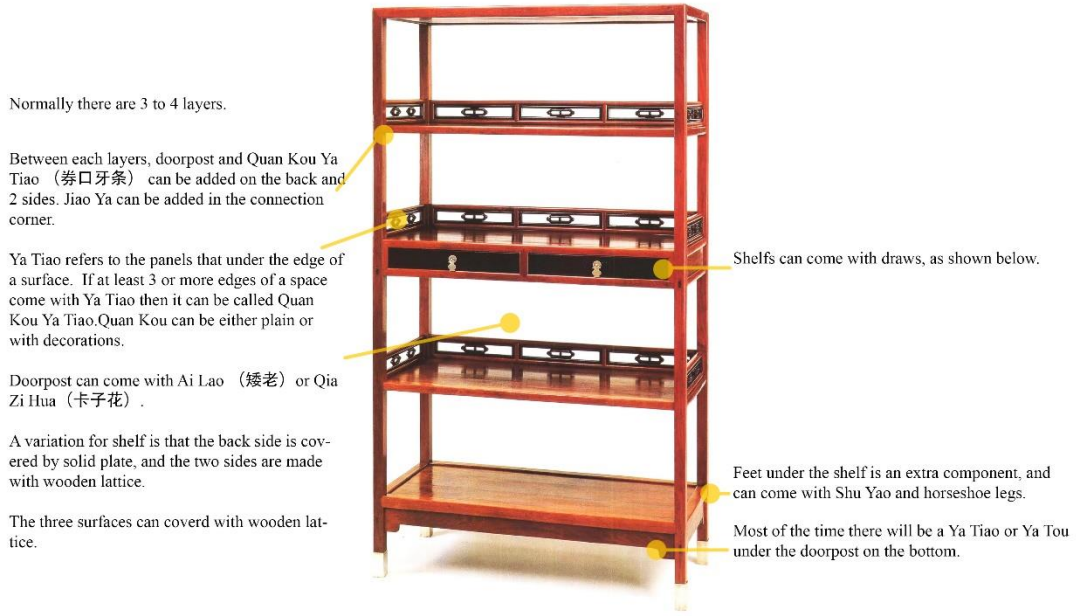


Figure 25, Detailed features of shelf

*Figure 26,*Detailed features of Liang Ge Gui

Liang Ge Gui is a combination of shelf and cabinet. Mostly, the shelf is placed on the top of the cabinet in order to make sure the center of gravity stays stable. Its basic form is shown above.

Square or round corner cabinets are called this because of the shape of the corner on the top. The difference between these two forms are caused by the different installations of doors. Because square and round corner cabinets share similar features, in this research they will be discussed together through three aspects, which is layout, doors, and additional structural components.

Figure 27,Detailed feature of round corner cabinet

Figure 28, Detailed feature of square corner cabinet

Basic and variation forms of different kinds of cabinet and shelf are summarized below.

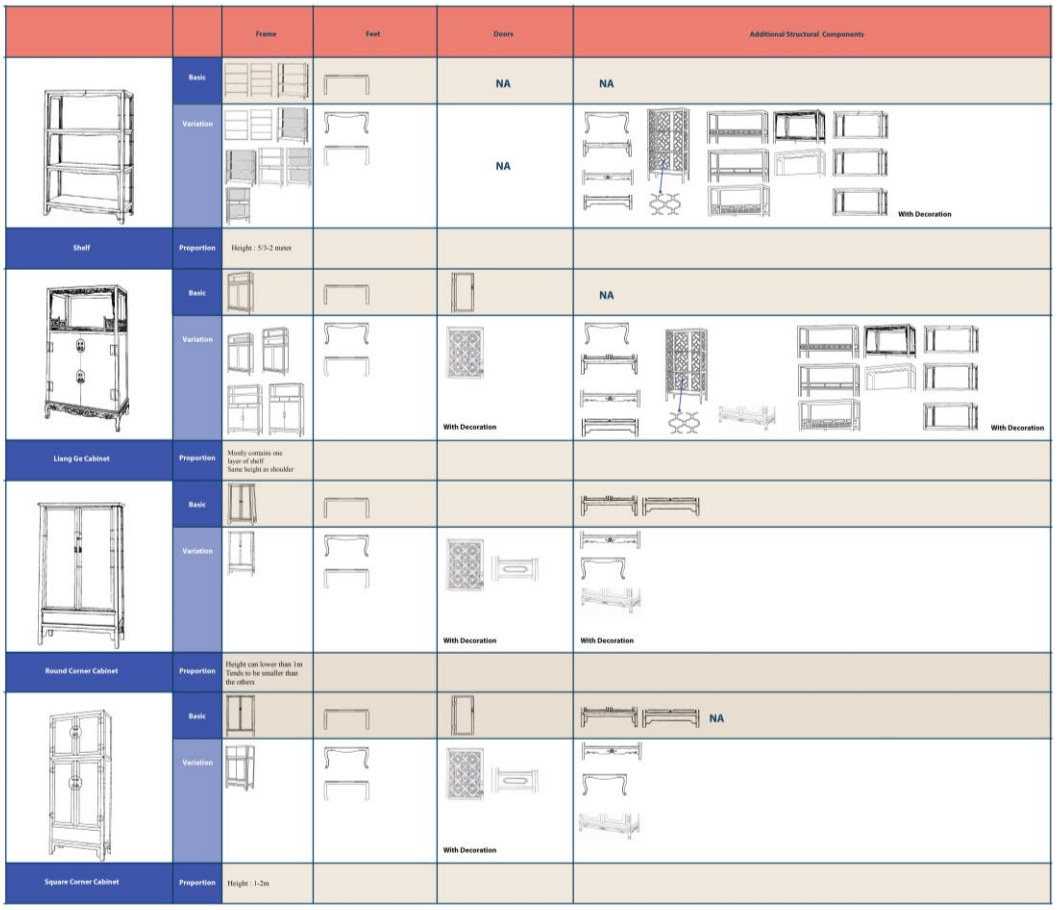


Table 9,Configurations and proportions of shelf.

2.5.2.5 Others

In addition to the five categories discussed above, there are other kinds of furniture that do not fit into the categories above because of application features, so they will be classified as others. Because some kinds of furniture in this category are so unique, they were only widely used during ancient China, and there is little reference value for modern furniture design or the configurations features are too similar to the other kinds furniture discussed above. Examples include, suitcases, carrying-cases, balance's shelf, Brazier frame （火盆架） and Zhen Deng （枕橙）. Therefore, in this research they will not be discussed in detail. Instead, screens, clothes hangers and basin

shelfs are selected to discuss in detail in this research.

Screen

Screen refers to all kinds of furniture that play the role of space division. Based on the configurations, screens can be divided into two kinds, with base called Zuo Ping Feng （座屏风）, without base called round screen. For Zuo Ping Feng, the screen can be either connected with the base or be removable, and both of them are fixed on the ground. There is a small-scale Zuo Ping Feng intended to be used on the table. For this kind, the decoration features on the base are usually substantially reduced, while; compared to Zuo Ping Feng, a round screen is more flexible. It can be folded and moved around. It is called a round screen, because it can be placed as a circle. In this research, features of the two kinds of screen will be discussed together in three aspects, frame, screen boards, and additional structural components.

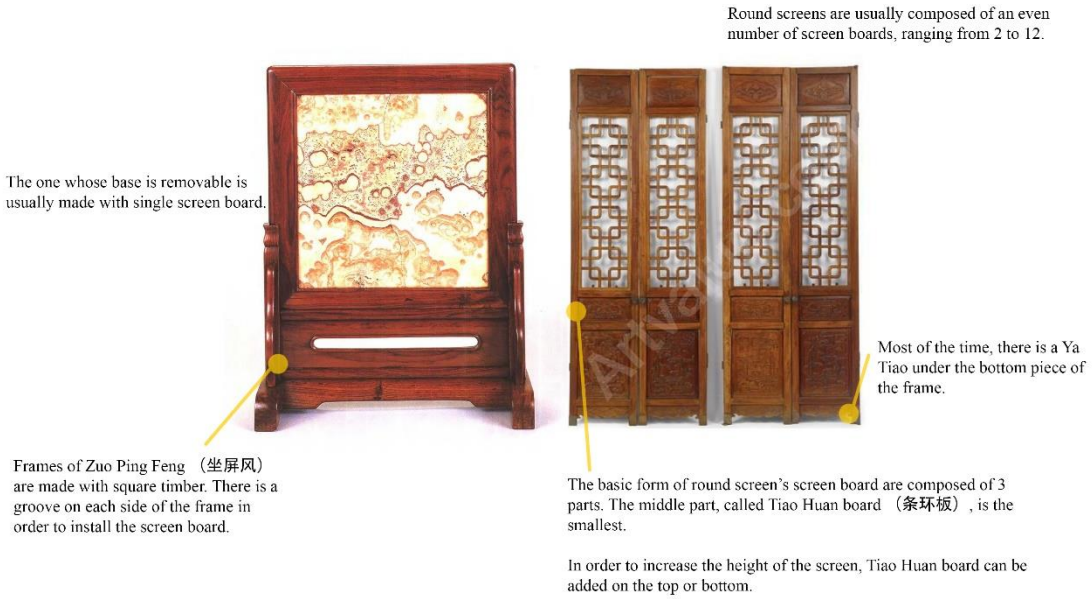


Figure 29,Detailed feature of screen

Basic and variant forms of screen are summarized below.

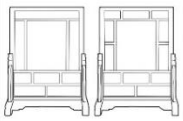
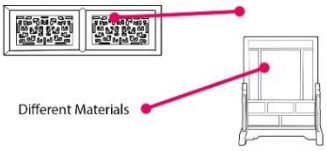
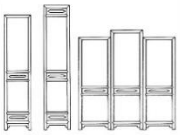
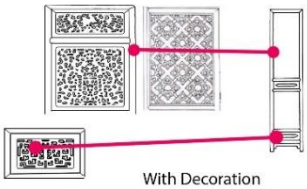
		Screen Number	Frame	Additional Structure Component	Center Sreen area
	Basic	1			Plain
	Variation	3,5		 With Decoration	 Different Materials With Decoration
Zuo Screen	Proportions				
	Basic	2,4,6		 NA	Plain
	Variation	10,12		 With Decoration	 With Decoration
Round Screen	Proportions				

*Table 10,*Configurations and proportions of screen.

Clothes Hanger

Unlike modern clothes hanger, the ones in ancient China are used for holding the clothes instead of hanging them, that there is no hook on it. Clothes hangers can be divided into two kinds, plain and decorative. Plain clothes hangers are usually composed of three parts, the base, the column on the top of the base and the horizontal timber used for connecting each column. For the decorative hanger, there are more additional structural components added at every connection point between the horizontal and vertical timbers, as showed below. The additional structural components can be in different forms, such as carved or cut out.

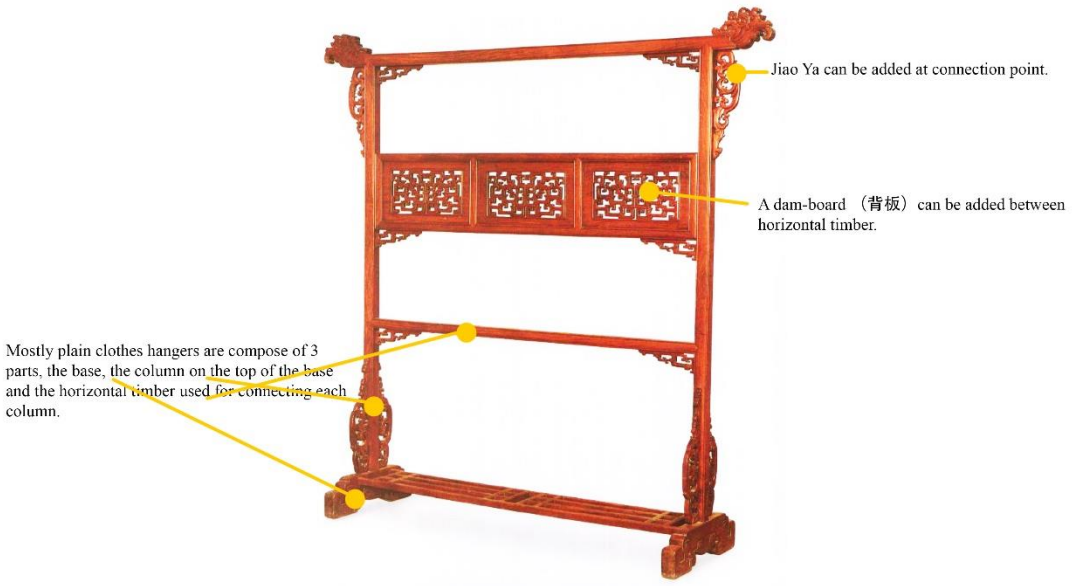


*Figure 30,*Detailed feature of clothes hanger

Basin Shelf （脸盆架）

As the name suggests, basin shelves are used for holding washbasins. There are two kinds of basin shelves based on height differences. The lower ones typically come with three, four or six legs, as showen below. The one with three legs cannot be folded while the other two can. The high basin shelf, shares similar features with the lower one if it has four legs, as shown below. For the one with six legs, four legs on the front are similar to the lower one while the back two legs extend, and additional structural components will be added such as a doorpost or Da Nao, which can be added in order to connect the two back legs; Jiao Ya can be added at the connection corner, and Ya Tiao can be added under the doorpost in order to reinforce the structure. Within the six legs of the washbasin shelf, only two of them are connected by the doorpost, one each for top and down. The others have only a short piece of timber added in order to be foldable, as shown below. In some cases, Jiao Ya will be added at the connection corner

between the doorpost and legs.

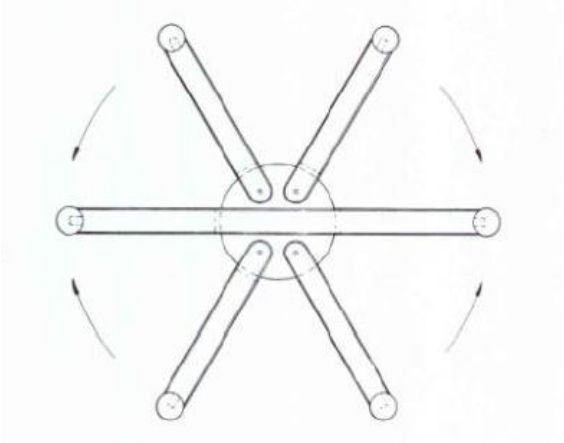


*Figure 31,*Structure detail of basin shelf

2.5.3 Characteristic of traditional Chinese furniture- Construction and Joinery

In addition to the simple, clean, steady configuration and the attentive selection of the materials, different kinds of construction and joinery also make a significant contribution to the splendid achievements of Ming Dynasty furniture. There even is a saying that the establishment of the traditional Chinese Furniture's shape is due to the construction and joinery. (Yang， 2002) "…members are not only connected together to form a functional object, but also manifest integrated conceptualization." (Evarts, 2016) The technique of traditional Chinese furniture's construction and joinery are born from the ancient timber architectural systems from the Song Dynasty. Through continuous improvement and development, this technique achieved maturity. Each part is connected together without any kinds of screws or nails, and adhesive are rarely used as well. Lao Zi who was a great philosopher in ancient China once said, "The object which exist as the way it supposed to be is in the best state." (Guan,Wu, 2014) This theory is reflected

perfectly in Ming Dynasty furniture's joint. Each part of the furniture connects together by the way of interpenetrating which maintains the original properties of the wood.(Guan, Wu,2014). Mostly vertical timbers are used as the pillar while the horizontal ones are used as connection parts. In this research, different kinds of joinery will be discussed in three categories. They are combined surfaces to surfaces, combined surfaces to vertical timber, and combined vertical and horizontal timbers.

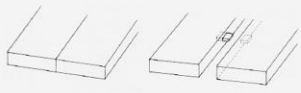
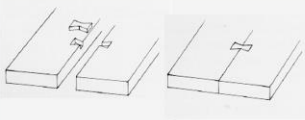
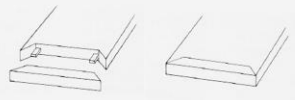
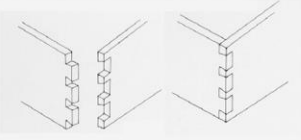
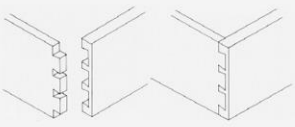
Category	Joint	Application	Chararacteristic
Surface to Surface		• Table Top • Doors of cabinet • Main body of the cabinet	The thickness of the board is no more than 2cm. Used to combine boards together in order to achieve certain width.
Surface to Surface		• Table Top • Doors of cabinet • Main body of the cabinet	The thickness of the boardis no more than 2cm. Used to combine boards together in order to achieve certain width.
Surface to Surface		• Table Top • Doors of cabinet • Main body of the cabinet	The thickness of the board is no more than 2cm. Used to combine boards together in order to achieve certain width. Trapezoid shape batten can be added in order to prevent boards from bending.
Surface to Surface		• Railings of the Luo Han Chuang. • Shelf's board.	The thickness of the board is either 3-4 cm or 7-8 cm. Used to combine boards together in order to achieve certain width.
Surface to Surface		• Railings of the Luo Han Chuang. • Shelf's board.	The thickness of the board is either 3-4 cm or 7-8 cm. Used to combine boards together in order to achieve certain width.
Surface to Surface		• Railings of the Luo Han Chuang. • Shelf's board.	The thickness of the board is either 3-4 cm or 7-8 cm. Used to combine boards together in order to achieve certain width.
Surface to Surface		• Table top of An table or any kind of thick table top. • Railings of the Luo Han Chuang	In order to hide the grain of the board's fracture surface. To prevent the board from cracking.
Surface to Surface		• Table top of An table or any kind of thick table top. • Railings of the Luo Han Chuang	In order to hide the grain of the board's fracture surface. To prevent the board from cracking.
Surface to Surface		• Table top of An table or any kind of thick table top. • Railings of the Luo Han Chuang	In order to hide the grain of the board's fracture surface. To prevent the board from cracking.
Surface to Surface		• Table top and leg of the Ji table	The thickness of the board is 4-5cm. In order to connect vertical board with horizontal board
Surface to Surface		• Drawer	The thickness of the board is 4-5cm. In order to connect vertical board with horizontal board
Surface to Surface		• Drawer	The thickness of the board is 4-5cm. In order to connect vertical board with horizontal board

Table 11,Characteristics of joint that connect surface to surface.

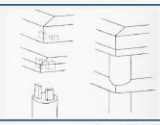
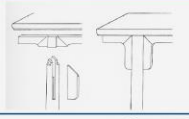
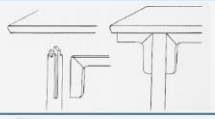
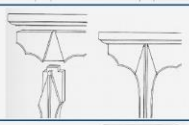
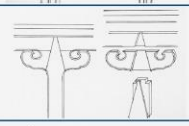
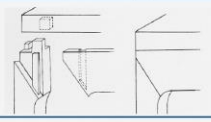
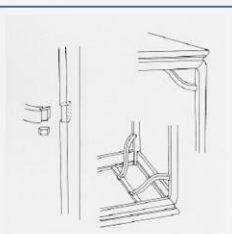
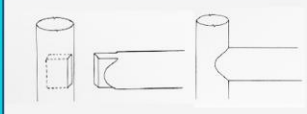
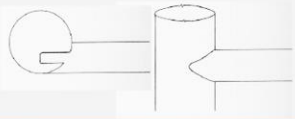
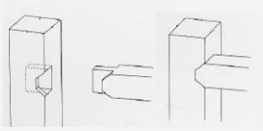
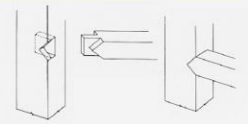
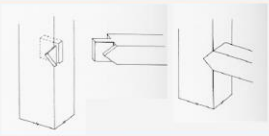
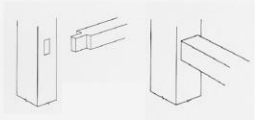
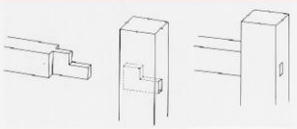
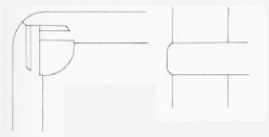
Category	Joint	Application	Chararacteristic
Surface with Vertical Timber		Wu Deng or Table without Shu Yao.	In order to avoid the mortise on the frame of the top surface, one of the tenons is shorter.
Surface with Vertical Timber		Wu Deng or Table without Shu Yao.	In order to avoid the mortise on the frame of the top surface, one of the tenons is shorter.
Surface with Vertical Timber		Wu Deng or Table with Shu Yao.	Shu Yao and Ya Tiao can be made either with one whole piece of wood or separately
Surface with Vertical Timber		Tables with high waist structure.	Similar joints as the one with Shu Yao. Another mortise needs to be added between 2 tenons in order to connect with the Shu Yao. Shu Yao and Ya Tiao needs to be made separately.
Surface with Vertical Timber		Tables with high waist structure.	Similar joints as the one with Shu Yao. Another mortise needs to be added between 2 tenons in order to connect with the Shu Yao. Shu Yao and Ya Tiao needs to be made separately.
Surface with Vertical Timber		An Table.	This kind of joint called Jia Tou Joint. Mortise on the leg press both Ya Tou and Ya Tiao together from both sides and connects with the table top.
Surface with Vertical Timber		An Table.	This kind of joint called Jia Tou Joint. The mortise on the leg only holds Ya Tiao. Ya Tou is connected separately with the leg This kind of connection is not as strong as the earlier one.
Surface with Vertical Timber		An Table.	This kind of joint called Jia Tou Joint. The mortise on the leg only holds Ya Tiao. Ya Tou is connected separately with the leg This kind of connection is not as strong as the earlier one.
Surface with Vertical Timber		An Table.	This kind of joint is called Jia Tou joint. Similar in structure to Jia Tou joint Top part of the leg's out layer is cut into triangle in order to make the joint more stable. Ya Tiao and Ya Tou are made together.
Surface with Vertical Timber		An Table.	This kind of joint called Cha Jian Joint. Similar in structure with Jia Tou Joint. Top part of the leg's out layer is cut into triangle in order to make the joint more stable. Ya Tiao and Ya Tou are made separately.
Surface with Vertical Timber		Furniture who is flat in both sides. Mostly used in tables.	
Surface with Vertical Timber		Armchairs whose legs go through the seat.	
Surface with Vertical Timber		Connect top surface directly with legs.	

Table 12,Characteristics of joint that connect surface to vertical timber.

Category	Joint	Application	Chararacteristic
Vertical and Horizontal Timber T Shape		Connect Da Nao with legs. Connect with cabinet's legs doorpost on the bottom. Connect armrest with legs.	Vertical and horizontal timber's radius is the same.
Vertical and Horizontal Timber T Shape		Connect doorpost with legs or arm rest. Connect Ai Lao with doorpost.	Vertical timber's radius is larger than the horizontal one. The horizontal timber is in the center of the vertical one.
Vertical and Horizontal Timber T Shape		Connect doorpost with legs or arm rest. Connect Ai Lao with doorpost.	Vertical timber's radius is larger than the horizontal one. The horizontal timber is tangent to the vertical one.
Vertical and Horizontal Timber T Shape		Connect square doorpost with legs. Connect square Ai Lao with legs. Connect vertical and horizontal timber which is square shape.	Outside surface of vertical and horizontal timber is in the same surface. Tip of the joint is been cut in order to increase the bond area.
Vertical and Horizontal Timber T Shape		Connect square doorpost with legs. Connect square Ai Lao with legs. Connect vertical and horizontal timber which is square shape.	Outside surface of vertical and horizontal timber is in the same surface.
Vertical and Horizontal Timber T Shape		Connect square doorpost with legs. Connect square Ai Lao with legs. Connect vertical and horizontal timber which is square shape.	Outside surface of vertical and horizontal timber is in the same surface.
Vertical and Horizontal Timber T Shape		Connect square doorpost with legs in both sides.	
Vertical and Horizontal Timber T Shape		This kind of joint usually used in the condition which the vertical timber is round in the outside square in the inside while the horizontal one is round.	If both timber is square then only the rough workmanship one use this kind of joint.
Vertical and Horizontal Timber T Shape		Connect square doorpost with legs in both sides.	Mortise should not concentrate on one point on the vertical timber, in order to increase the strength of the timber
Vertical and Horizontal Timber T Shape		Connect doorpost with round shape legs.	Vertical timber needs to be cut into square shape in order to connect with the horizontal doorpost.
Vertical and Horizontal Timber T Shape		Connect doorpost with round shape legs.	Vertical timber needs to be cut into square shape in order to connect with the horizontal doorpost.

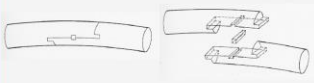
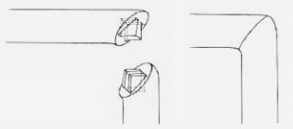
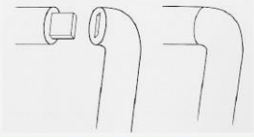
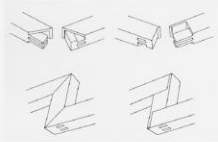
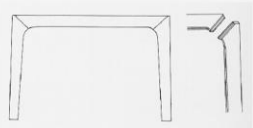
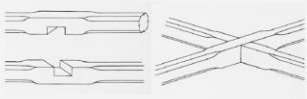
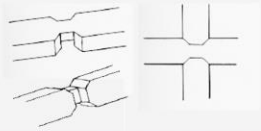
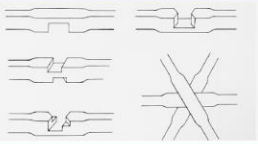
Category	Joint	Application	Chararacteristic
Vertical and Horizontal Timber Round Shape		Armrest of the round-backed armchair. Top surface's frame of round shape furniture. Xiang Ji and round Wu Deng's Tuo Ni.	Cogged scarf joint is used to fix the 2 pieces of timber.
Vertical and Horizontal Timber Round Shape		Armrest of the round-backed armchair. Top surface's frame of round shape furniture. Xiang Ji and round Wu Deng's Tuo Ni.	Cogged scarf joint is used to fix the 2 pieces of timber.
Vertical and Horizontal Timber Corner		The connection between each timber in Luo Han beds and canopy beds' railing.	Square shaped timber
Vertical and Horizontal Timber Corner		Connect armrest with legs and Da Nao with legs for southern official armchairs and rose chairs.	Round shaped timber
Vertical and Horizontal Timber Corner		Connect armrest with legs and Da Nao with legs for southern official armchairs and rose chairs.	Round shaped timber
Vertical and Horizontal Timber Corner		The connection between each timber in Luo Han beds and canopy beds' railing.	
Vertical and Horizontal Timber Corner		Connect each pieces of timbers in Quan Kou Ya Zi. Connect Ya Tou with Ya Tiao.	3 pieces of Quan Kou Ya Zi are mostly used in chairs, Liang Ge Cabinet's shelf. 4 pieces of Quan Kou Ya Zi are mostly used in tables.
Vertical and Horizontal Timber Corner		Connect each pieces of timbers in Quan Kou Ya Zi. Connect Ya Tou with Ya Tiao.	3 pieces of Quan Kou Ya Zi are mostly used in chairs, Liang Ge Cabinet's shelf. 4 pieces of Quan Kou Ya Zi are mostly used in tables.
Vertical and Horizontal Timber Corner		Connect each pieces of timbers in Quan Kou Ya Zi. Connect Ya Tou with Ya Tiao.	3 pieces of Quan Kou Ya Zi are mostly used in chairs, Liang Ge Cabinet's shelf. 4 pieces of Quan Kou Ya Zi are mostly used in tables.
Vertical and Horizontal Timber Crossing		Cross-shape doorpost used in Wu Deng. Cross-shape openwork motifs.	
Vertical and Horizontal Timber Crossing		Cross-shape doorpost used in Wu Deng. Cross-shape openwork motifs.	
Vertical and Horizontal Timber Crossing		Cross-shape doorpost used in the bottom of the basin shelf.	

Table 13,Characteristics of joint that connect horizontal timber to vertical timber.

2.5.4 Conclusion and Comparison between Modern & Ming Dynasty furniture

Characteristics of the five categories of furniture are listed above in tables 11 to 13. It can be seen that, even though each category of furniture has its own unique form and characteristic, several common features and modeling rules can be summarized.

Among all the Ming Dynasty furniture about three quarters' of them are in square or rectangle shapes. No matter if the furniture is a table, desk, sitting device or bed it can be classified into two categories, which is with Shu Yao or without Shu Yao. Each category follows certain modeling rules, and the characteristic of forms can be reflected from the structural characteristics. The characteristics of each category are listed below in Table 14.

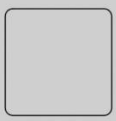
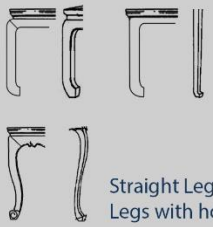
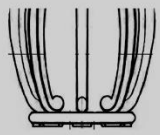
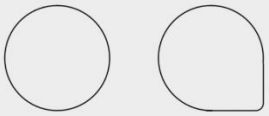
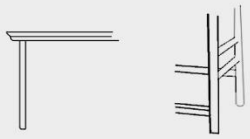
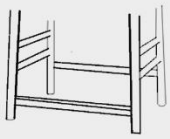
	Cross-Section of Legs	Form of legs	Other Compoments under the legs
With Shu Yao	 Cross-Section of legs are mostly square	 Straight Legs or Curved Legs with horseshoe	 Tuo Ni can be added under the legs
Without Shu Yao	 Cross-Section of legs are ethier round of round outside square inside	 Straight Legs without horseshoe	 All legs touch the ground

Table 14,Characteristic of furniture with or without Shu Yao.

According to the design philosophy of modern design furniture should be simple in form and avoid extra enrichment. From the overview the development of the traditional Chinese furniture, Ming Dynasty furniture is the one of the most respected simple designs, but decoration elements are still widely used. Other than the traditional decorative techniques such as carving, opening and inserting, there are unique decorative techniques within traditional Chinese furniture called structural decoration. Structural decoration refers to the component that not only play the role of supporting, reinforcement and connecting, but also there is certain effect of decoration. It can be seen that the biggest discussion between modern design furniture and traditional Chinese furniture is the balance between functionality and decoration; therefore, each structural component of furniture has been discussed according to decorative or functional properties, as shown below. Also, moulding which refers to the variety shapes of cross-section, makes a great contribution to the decoration of Ming Dynasty furniture. But according to the design philosophy of modern design: extra enrichment should be avoided, so it can be understood that moulding for the furniture is not suitable and should be avoided. Thus in this research, moulding of Ming Dynasty furniture will not be discussed in detail.

In ancient China, Chinese people advocating human values stands for the perspective of being people oriented, which is the same with modern design. (Wang，2010) This theory can be seen by the form features of the furniture. For instance, the back rest's shape of the armrest chairs appears to be S-shaped in order to fit the human's

back and provide enough support. Also, the shape and height of the round-back armchairs is made in such way because it can provide support not only in the elbow but also in the armpit.

Even though both ancient Chinese design and modern design advocate human values, the design philosophy of ancient China also focused on the spirit of humans, so the design work is based on humanity and ritual. It was also influenced and constrained by traditional culture. The overall design principles for ancient Chinese is that, the dignity and spirit of humans come first, and comfort comes next. Moreover, when there is a conflict between these two ideals, then comfort needs to give way to dignity and spirit. (Wang，2010)Ming Dynasty furniture provides comfort and at the same time limits people's behavior. (Guan，Wu,2014). On the contrary, modern design always put the comfort and need of users first. For instance, in ancient China, people advocated Confucianism, in which the main function of sitting device should focus on helping the users to show a dignified and refined posture which is complementary with the etiquette of Confucianism. Therefore, the angle between seat and backrest is approximately 90 degrees. (Wang，2010). However in modern furniture design, this kind of design will be considered uncomfortable. Another example is the Rose Chair. In ancient China, females were the ones that were required the most dignity in appearance and behavior, and the Rose Chair was the one most closely connected with females. The relatively low and vertical back rest is made to help the female user sit straight even though it is not comfortable. (Guan, Wu, 2014). Confucianism praises highly the virtues of uprightness and honesty, which highly influenced the form feature of Ming Dynasty furniture as well.

Most of the furniture is structurally symmetrical, and there is no tilt component. Moreover, furniture is also in the use of pairs, which all represent the characteristic of upright. It is for this reason as well that the center of gravity of traditional furniture is mostly in the lower part of the piece.

In addition to people oriented theory and ritual how people view the world also made a contribution to form features. In ancient China, people thought the sky is round and ground is square; this theory can be found in the round-back armchair, the cubic seat and round-shaped armrest.

As discussed above, Ming Dynasty furniture has its own unique form characteristics and style. These characteristics not only consider user's needs but also reflect the aesthetic of ancient China, how people view the world and the characterristics that people worship. More importantly, these features restricted by traditional Chinese culture and ritual are also the main factors that shaped the character of the Chinese people. According to symbolism theory, in order to build modern furniture that has the Ming Dynasty style, the signifier symbol, which can represent traditional Chinese culture, must be applied to the design work. However, according to the philosophy of modern design and the theory of product function, features of Ming furniture are not suitable. Therefore, the form characteristic needs to be transferred. As an industrial design thesis, the focus should be on how to transfer the form language from Ming style to meets the requirements of modern design philosophy. Moreover, the result should still be able to represent traditional Chinese culture and the spirit of Chinese.

Chapter 3

The design guideline for designing Ming Dynasty Style furniture suited for modern life

3.1 Overview

Based on the product function theory discussed earlier, the design outcome should satisfy three aspects of functional features, which are human function, production function and technical function. In order to achieve these goals, the form features of Ming Dynasty furniture needs to be changed according to modern production technology and the needs of modern life. Based on the theory of symbol discussed in Chapter 2, furniture is a kind of symbol, which contains two aspects. The signifier symbol stands for the form language, materials, color and external elements, while the signified symbol stands for the spirit and culture context. From this point of view, designing Ming Dynasty Style furniture is suited to modern life can be viewed as a process of simplifying and regrouping symbols. However, if the form features are overly simplified then they will lose the cultural context that they carried. Therefore, the result should achieve a balance between simple enough for manufacturing and contain Ming Dynasty taste. In this thesis a design flow chart of how to design a Ming Dynasty style furniture that is suitable for modern life has been developed and is explained in this chapter. The guideline contains three steps, which is to first identify the design category, secondly analyze the product and, lastly, develop the design, including function, style, result evaluation and structure development. The design flow chart consists of the following:

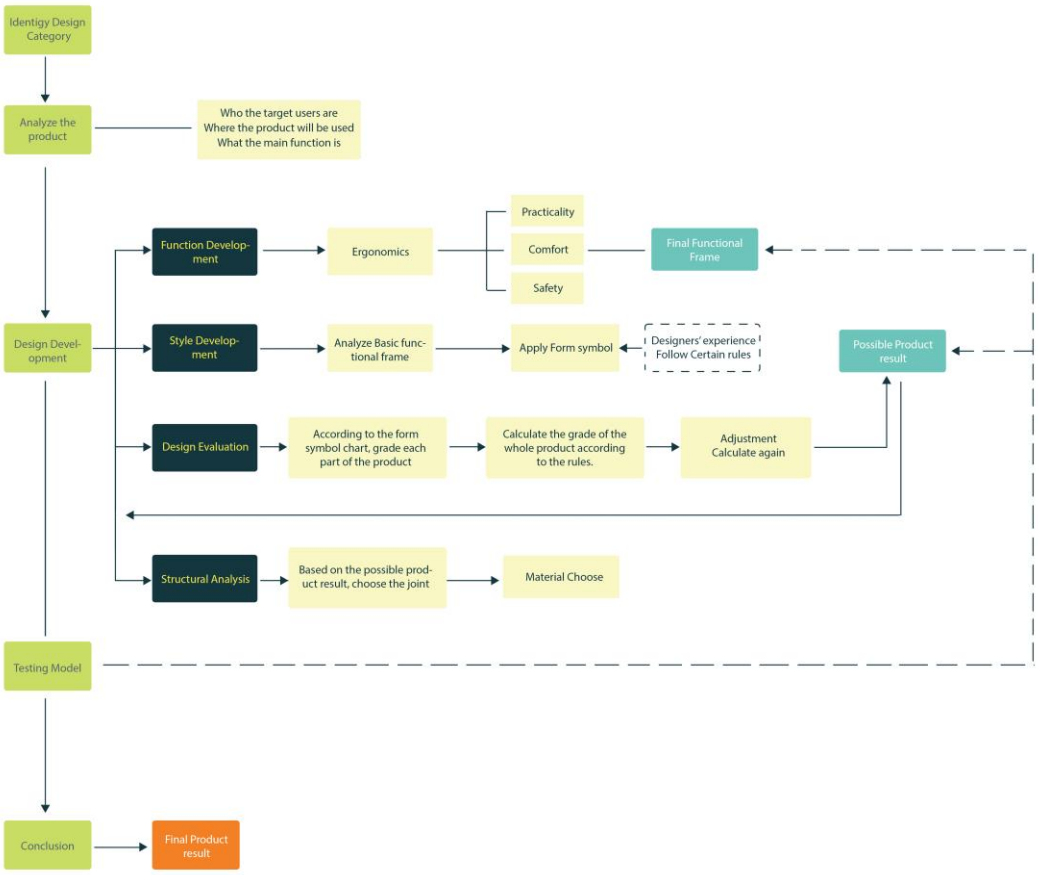


Figure 32,The Flow Chart of designing a Ming Dynasty Style furniture that is suitable for modern life.

3.1.1 Identify design category:

In order to define the scope of the design, a certain design category needs to be identified. According to the product function feature, the category can be classified as one of five categories which are sitting device, tables, storage device, beds or couches and others.

1) Analyze the product.

Based on the product function theory the function of furniture contains three

aspects, including human function, technical function and production function. These three aspects can be decided into two categories, the first of which is related to mankind, containing human function, and the second of which relates to machines, containing technical and production functions. The human function of a product refers to the relationships between target users and user's mind, behavior, body and society, while the technical and production function of product are related to the direct and indirect technical function, production cost, and product materials factors. In order to satisfy these three aspects of function, several influencing factors associated with a product; need to be addressed before design work begins, as listed below:

Human factors:

- Who is the target user?
- What are the users' needs?
- Where will the product be used? The answers includes the natural and social environment.

Machine factors:

- The production technology limitation.
- Materials selection.
- Production cost scope.

3.1.2 Design Development.

1. Human Function development:

As discussed in Chapter 2, human function is related to four aspects, which are aesthetic, social, cultural cognitive and physical factors. The first three factors are more related to style development so in this step only the physical factors, which are closely related to ergonomic features, will be considered. “The approach of human factors is the systematic application of relevant information about human capabilities, limitation, characteristics, behavior, and motivation to the design of thing and procedures people use and the environment in which they use them” (Sanders & McCormick, 1992, p5). Therefore, the ergonomic aspect is the interaction between the human body and furniture. As discussed earlier, unlike the Ming Dynasty furniture, comfort and human needs are always the first thing a designer needs to be concerned about when designing for modern life, which makes ergonomic factors more important within furniture design area. Moreover, according to the modern design philosophy “Form follows function”, style development should be based on satisfying users’ needs. After this step a basic functional frame should be achieved, which includes the dimensions of all the parts.

2. Style development:

The first step of style development is analyzing the basic functional frame, and dividing the frame into parts according to the functional features. According to the symbol theory, in order to build furniture with Ming Dynasty style that contains traditional Chinese context, a certain form language needs to be applied. However, as indicated earlier, the form features of Ming Dynasty furniture heavily rely on handcraft with high production time cost. This form language cannot satisfy the production

function based on modern society's needs. Moreover, the form features of Ming Dynasty furniture are influenced by the society, aesthetic and production mode of that time, which cannot satisfy the human functions of the current time. Therefore, a certain level of changes needs to be made to meet the requirements of mass production.

As shown below, the first chart is a form features' summarized chart for each part of the Ming dynasty furniture. The second chart is the variable form features' chart. From these charts, it can be determined that carving, complex decorations and cut outs have been removed because of the high cost. From the right to left side, it is a smooth transition process to simplify the form features of Ming Dynasty furniture. The rightmost category is the one that fulfills the requirement of mass production, but without Ming Dynasty characteristics. In contrast, the leftmost one refers to the one from the most Ming Dynasty characteristics, but is not appropriate for mass production.

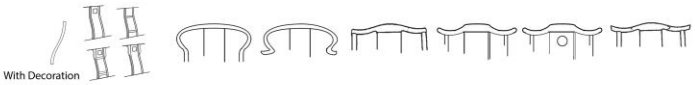
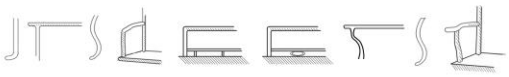
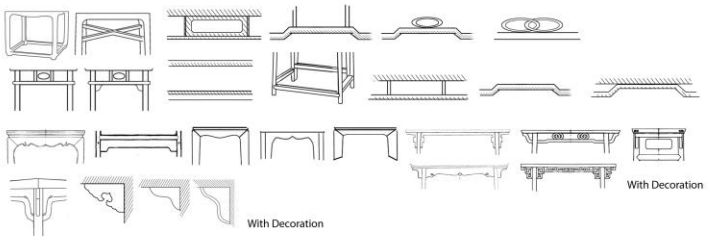
Category	Form Features
Legs Vertical Supporting Components	
Backrest Including Da Nao Backrest Plane	
Surface	
Armrest	
Doors and Drawers	
Extra Supporting Components	

Table 15,Form Features' Summarized Chart

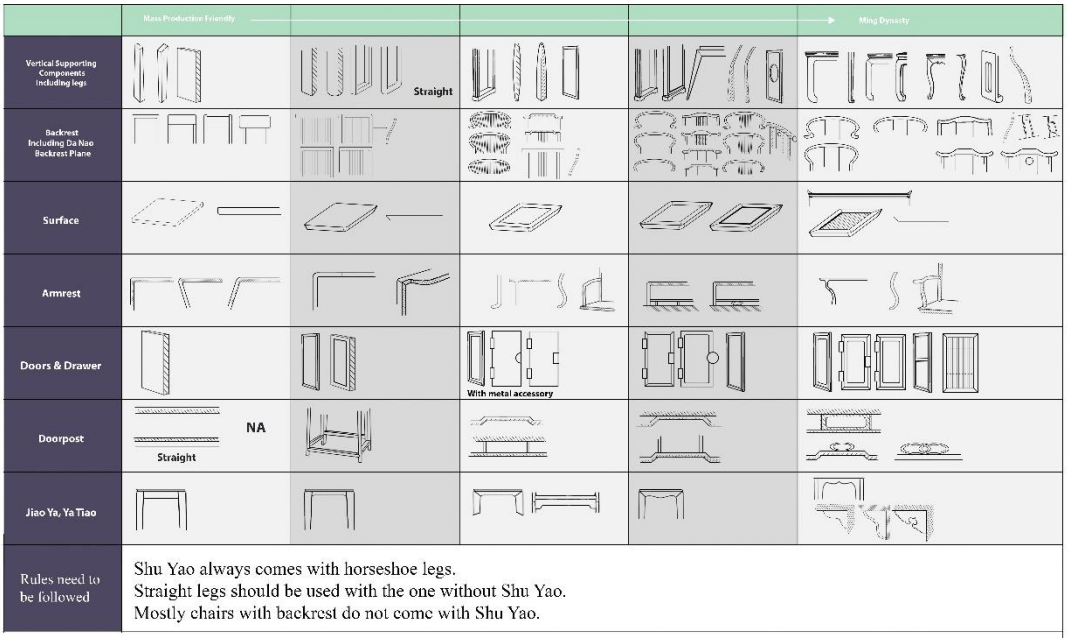


*Table 16,*Variation form features' chart

The next step of style development is using the two charts as a reference and applying the form language to the basic function frame. During this step, several principles need to be followed in order to achieve the Ming Dynasty style.

- Shu Yao always comes with horseshoe legs.
- Straight legs should be used with the furniture without Shu Yao.
- Mostly chairs with backrest do not come with Shu Yao.

Application of this step depends largely on the personal experience and aesthetic of the designers.

3. Design evaluation.

Simply applying the form symbols from variation form features' chart to the product may result in overly simplifying the form features and losing the cultural context, because there is no objective definition of new Chinese style. Therefore, in addition to the design flow chart, an evaluation tool has been developed in order to help the

designers evaluate the design outcome and find the appropriate balance between mass production requirement and the Ming Dynasty style requirement in order to satisfy the target users (product function).

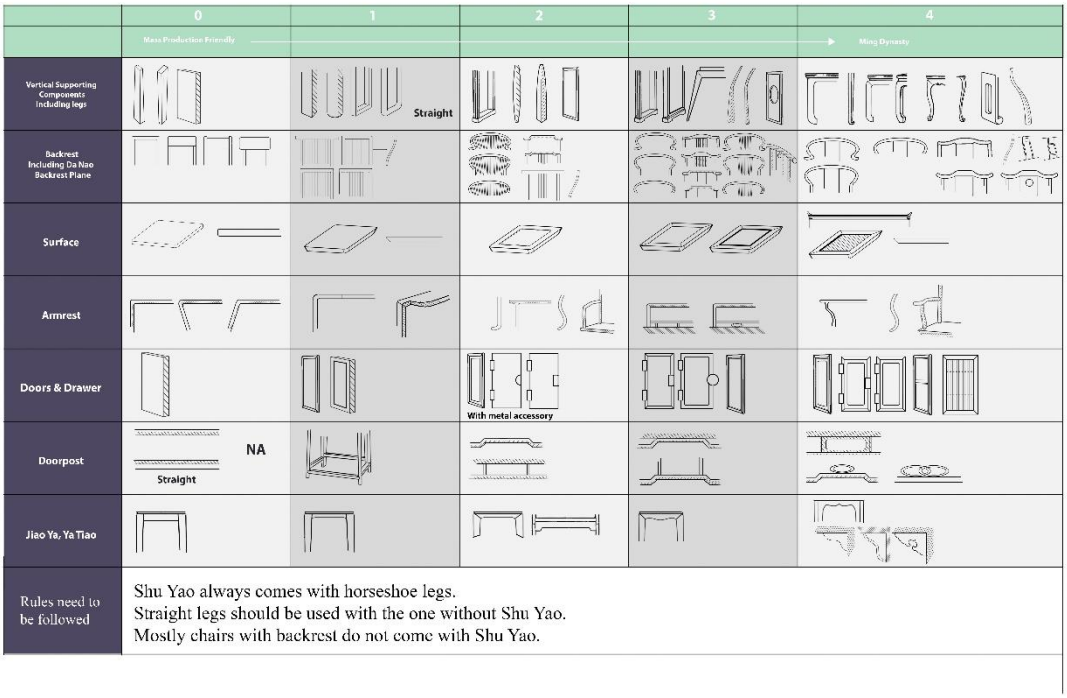


*Table 17,*The evaluation chart for form features

The evaluation chart above (Table 17) is based on the variation form features' chart. According to the degree of simplification there are five categories from Ming Dynasty form characteristics simple enough for mass production. Each category has a corresponding score ranging from 0 to 4, which means that each part of the design outcome should have a corresponding score. In order to evaluate the design outcome, scores of the whole product need to be calculated, adding the scores of each part. But because some part of the furniture plays a more important role in identifying the design style, for instance the backrest of round-back armchairs, when calculating the scores of the whole product, the score of that part needs to be doubled. The way to determine

which part has more influence in identifying the style is that first, it should contain a strong Ming Dynasty characteristic that only appears within that style. Secondly, the form features of that part remain the same while the other parts have different variations. Applying this determination, each kind of furniture has only one part that plays more important roles as listed below:

Chairs with backrest: Backrest

Tables and Chairs without backrest: Legs

Cabinet: Doors

Shelves: Legs

Beds without upper component: Legs

Beds with upper component: Backrest

The score of the whole product stands for how much cultural context it contains. Because different kinds of furniture contain different number of parts, the score range of the whole product can have great differences. As discussed earlier, different target users and use environment can result in different product functions, which are related to a different society and culture. Therefore, the design outcome that the designer is trying to achieve will be different depending on the users and their environments. Correspondingly, there will be no score scope that can be defined to represent the suitable result. However, the target score range should be settled according to the result of the second step, and designers can use the interval distribution of the scores to evaluate the results.

If the results reach close to the full possible mark, then it means the design style

of furniture leans towards Ming Dynasty style, and the production and time consumption cost may be relatively higher. If the results reach close to zero, then it means the design result are more appropriate for mass production but at the same time with less Ming Dynasty style. Full marks and score zero should be avoided, because a full mark means every part of the furniture uses exactly the same form as Ming Dynasty furniture, which already been shown to not satisfy the product function of current society. On the other hand, score zero refers to the one that fulfilled the massive production requirement, but have completely lost the taste of Ming Dynasty style which is against the purpose of this research.

Following is an example to explain the evaluation tool. The chair below is the product from independent brand Lost & Found, which is based on Chinese market and aims at creating Ming Dynasty Style furniture for modern life. The style of their furniture leans towards more to high end Ming Dynasty style. Therefore, the score range of their chair should belong to the higher half. As discussed earlier, the backrest plays a more important role in identifying the design style, so the score of that part needs to be doubled. Because this chair can be divided into five parts, which is backrest, legs, vertical supporting component, seat surface and doorpost, its total score should range from 0 to 24. According to the evaluation chart the total score of the whole product is: 13 which is in the higher half, meeting the requirement. That means the design style of this chair leans towards Ming Dynasty style, but at the same time takes into account the mass production requirement.

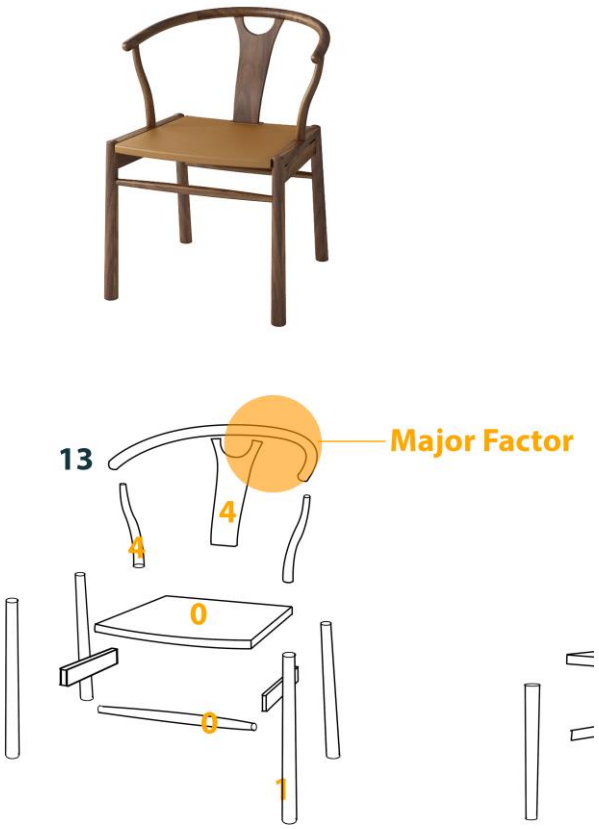


Figure 33,Example with score

After the evaluation step, certain adjustment may be necessary in order to achieve the design intent.

4. Manufacturing Development

The modern manufacturing process represents a substantial change in wood furniture design (Chou, 2007). Today, the industry, which was influenced by the industrial revolution, is particularly aimed for limited cost and high efficiency. This factor not only has had an impact in mass production techniques, but also in shipment and storage methods, such as flat packs are more preferred right now because of the low

cost, which needs to be easily installed by the users. However, the traditional joint not only requires higher level of production technique, but also require professional technique and extra tools during assembling, which will increase the cost. Therefore, a modular design that can be manufactured across pieces needs to be considered when designers design a piece of furniture.

In ancient China, the tenon joint is made by hand. It is one of the most important features about Ming Dynasty Furniture; moreover, the form features are based on the joint structure. “Tenon joint is a very traditional skill in furniture making which can show a craftsman’s skill, sense of beauty and united functional artistry” (Chou, 2007). Because of the importance of the tenon joint, this feature cannot be removed even with mass production, but an adjustment needs to be made. Designers should make certain adjustments according to their own design intent. The tenon joints that are mostly used currently for massive production are listed below; designers can use them as a reference.

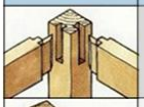
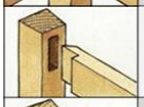
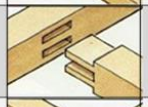
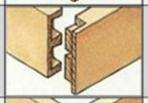
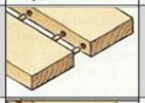
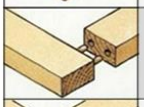
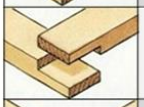
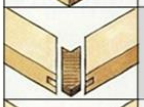
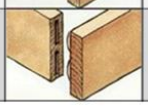
Joint	Application	Joint	Application	Joint	Application	Joint	Application
	Vertical and Horizontal Timber Corner Shape Solid wood		Vertical and Horizontal Timber or Surface T Shape Solid wood		Surface and Surface Corner Shape Solid Wood Plywood Blockboard		Surface and Surface Solid Wood Plywood
	Vertical and Horizontal Timber T Shape Solid wood		Vertical and Horizontal Timber or Surface T Shape Solid wood		Surface and Surface Corner Shape Solid Wood Plywood Blockboard		Surface and Surface Solid Wood Plywood
	Vertical and Horizontal Timber T Shape Solid wood		Vertical and Horizontal Timber or Surface T Shape Solid wood		Surface and Surface Corner Shape Solid Wood Plywood		Surface and Surface Solid Wood Plywood
	Vertical and Horizontal Timber Corner Shape Solid wood		Vertical and Horizontal Timber or Surface T Shape Solid wood		Surface and Surface Corner Shape Solid Wood Plywood		Surface and Surface Solid Wood Plywood
	Vertical and Horizontal Timber Corner Shape Solid wood		Vertical and Horizontal Timber or Surface T Shape Solid wood		Surface and Surface Corner Shape Solid Wood Plywood Blockboard		Surface and Surface T Shape Solid Wood Blockboard
	Vertical and Horizontal Timber Corner Shape Solid wood		Vertical and Horizontal Timber or Surface T Shape Solid wood		Surface and Surface Corner Shape Solid Wood Plywood Blockboard		Surface and Surface T Shape Solid Wood Blockboard
	Vertical and Horizontal Timber Corner Shape Solid wood		Surface and Surface Corner Shape Solid Wood Plywood Blockboard		Surface and Surface Corner Shape Solid Wood Plywood Blockboard		Surface and Surface T Shape Solid Wood Plywood Blockboard
	Vertical and Horizontal Timber Corner Shape Solid wood		Surface and Surface Corner Shape Solid Wood Plywood Blockboard		Surface and Surface Corner Shape Solid Wood Plywood Blockboard		
	Vertical and Horizontal Timber Corner Shape Solid wood		Surface and Surface Corner Shape Solid Wood Plywood		Surface and Surface Corner Shape Solid Wood Plywood Blockboard		

Table 18,Joint by Application form (Albert Jackson, 1995)

5. Testing model

By following this process through to the previous step, a design solution has been achieved, including form and structure. A full-size testing model is suggested, in order to help the designers to get a better understanding about the overall proportions and form features. Also, designers can test whether the tenon joint is strong enough and suitable for the design through the model. Moreover, designers can use this test model to analyze whether the dimensions of each part are comfortable for the users. After this step, certain adjustments may need to be made, including the ergonomic aspect, form features and structure. As a result, designers may need to go back to step 3. Because it is a testing model, materials selection will not be taken into

considerations at this point, so designers can use pine or any other kinds of timber that is easy and cheap to obtain.

After this step, a pre-final design solution should be achieved.

6. Materials selection

The last step of design development is choosing materials. As discussed earlier, three aspects need to be considered, which is the grain, the color, and the hardness of the timber. Designers should take these three aspects into consideration based on the form and structure of the design.

Also, during this step, appropriate finishing should be determined, based on the materials selection and design.

3.1.3 Conclusion

At this stage of the process, the designer should have the final result of the design process, including form, structure and materials.

Chapter 4

Application Result

The guidelines and design flow chart that have been developed in previous chapters will be demonstrated in this chapter. This chapter will focus on following the design flow chart, and applying Ming Dynasty symbols in order to achieve a design result that satisfies the product function of modern life while containing Ming Dynasty

style. A result that meets these objectives can be expected.

4.1 Identify design category

There is a saying that “Chairs are perhaps the most sculptural of Chinese furniture forms.” (Evarts, 2016). Moreover, the chair is one of the most necessary products in human life. The relation of chairs to human is inseparable. Therefore, in this chapter the design guidelines will be applied to the chair.

4.2 Analyze the product

Based on the product function theory discussed earlier, several influenc factors associated with the product need to be addressed before design work begins. Firstly, this design is aimed for household furniture that can be afforded by those who earn salaries rather than hourly wages. Secondly, this chair is designed for placing in the dining room or Asian restaurant together with high counter or bar tables. Finally, because a bar and counter are not very common among Chinese families, the target market should be western countries. As a result, this design should be aimed for a higher-end Chinese style while fitting the modern lifestyle. Since the target users of this chair are the salaried, then the form and construction of this chair need to satisfy the requirements of mass production technology and unnecessary for hand finishing. The main function of this chair is sitting while eating or drinking. Because; eating and drinking are a kind of social activity that may last a relatively long period of time, back support is necessary.

4.3 Design Development

4.3.1 Human function development

The main function of the backrest is to conform the contour of the spine to decrease stress on the back muscles. (Openshaw & Taylor, 2006). The most prominent point for supporting back muscles is 5’9’’-9’8’’ from seat surface, according to the BIFMA (2016) chair design guidelines. Dimensions of each part of the chair are shown below in Table 19. Because the bar chair is not aimed for sitting for a long time and relaxing it is not necessary to provide support on the shoulder and neck. Therefore, the backrest height of this design is set to be 12.2 inches, and the backrest width is 14 inches.

		Measurement	Specifications BIFMA Guideline	Allsteel Sum Chair
Seat Height	A	Popliteal height + Shoe allowance	15.0″ - 19.9″	15.0″ - 22.25″
Seat Depth	B	Buttock-popliteal length- Clearance allowance	No deeper than 16.9″ (fixed) 16.9″ included (adjustable)	15.0″ - 18.0″
Seat Width	C	Hip breadth, sitting+ Clothing allowance	No less than 18″	18.0″
Backrest Height	D	None	At least 12.2″	24.0″
Backrest Width	E	Waist breadth	14.2″	16.0″
Backrest Lumbar	F	None	Most prominent point 5.9″- 9.8″ from seat pan, in and out 1	Infinite through ht. of back (AutoFit™ technology)
Armrest Height	G	Elbow rest height	6.9″ - 10.8″ 7.9″ - 9.8″	7.0″ - 11.0″
Armrest Length	H	None	None	10.5″
Distance Between Armrests	I	Hip breadth, sitting+ Clothing allowance	18″ (fixed) 18″ included (adjustable)	16.5″ - 19.0″

*Table 19,*Specific BIFMA chair design guideline measurements. All measurements are in inches (Down Under Company, 2016)

The seat height is not only related to the human, but also has a close

relationship with the height of the table. As a result, the height of the bar chair is different than the regular chair. It can be seen from the Figure 34 below that, the seat height of the chair that is designed for bar table range from 28 to 30 inches. In this design, seat height has been set for 30 inches. Because of the height issue, extra support for legs and feet needs to be provided in order to decrease the stress on the leg. Therefore, a door-post needs to be set in the front for supporting the feet, and the height of it should be 13 inches according to the BIFMA chair design guideline measurements.

Unlike a regular chair, the seat depth for the one aim of eating is shorter. (House Plan Helper, 2016) For a kitchen counter and bar, "each person needs at least 24 inch wide and 15 inches depth to eat comfortably." (B4U designs, 2016), as it is shown in Figure34 below. Therefore, the seat depth of this design is set to be 16 inches.

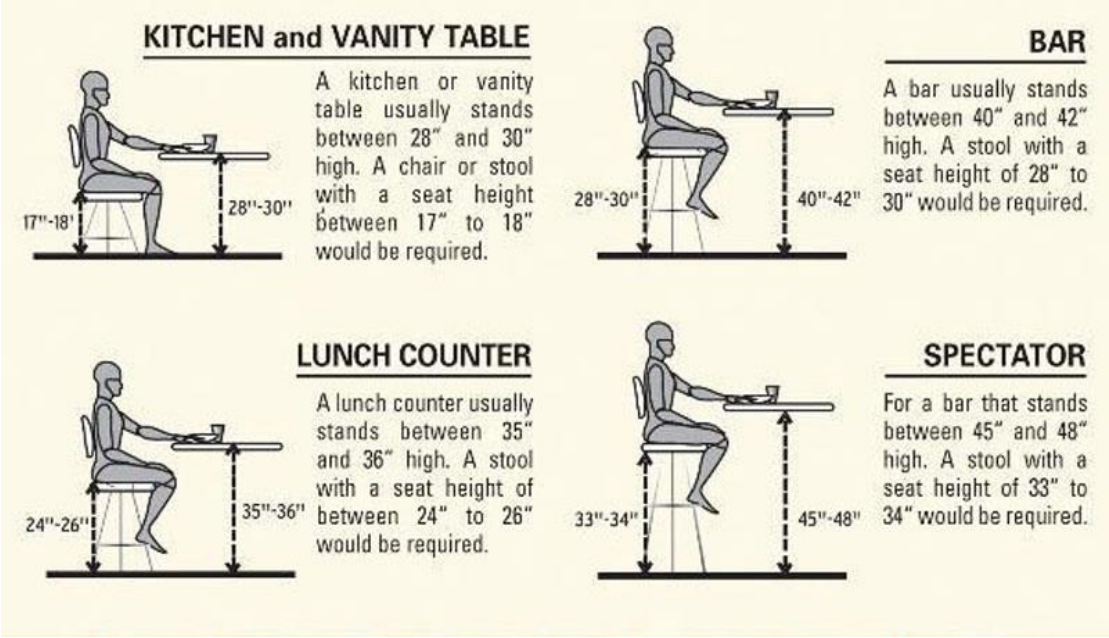


*Figure 34,*Table and sitting device height (B4U designs, 2016).

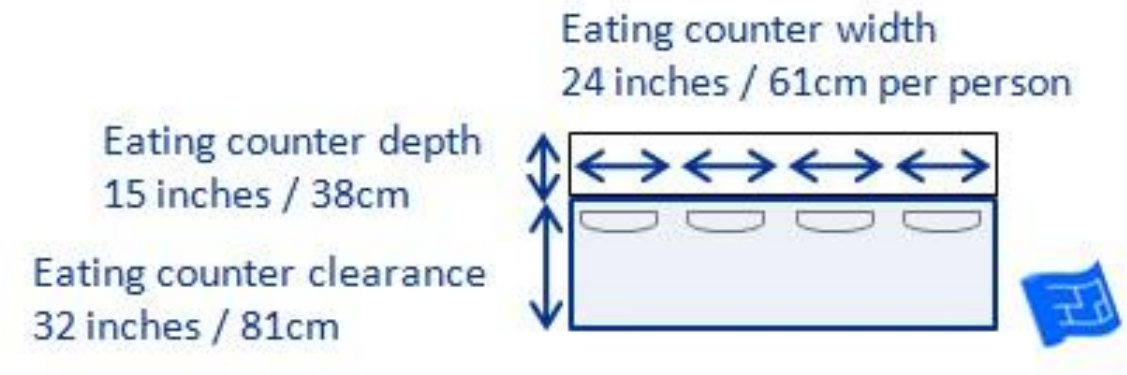


Figure 35,Kitchen dimensions of eating. (House Plan Helper,2016)

For an eating chair, an armrest is not necessary; moreover, in order to provide more space for the users to move around, the armrest has been eliminated in this design. A basic functional frame has been achieved, which includes the measurements of all the parts, as shown below.

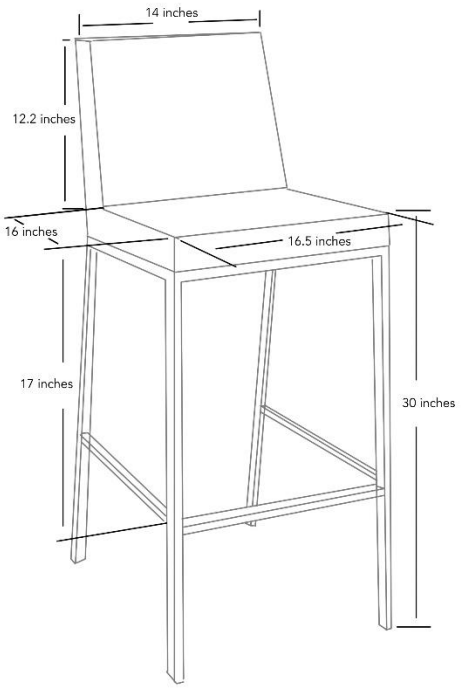


Figure 36,Basic functional frame.

4.3.2 Style development

Based on the basic functional frame achieved by the last step, the bar chair contains five parts, including, the seat surface, backrest, legs, structure components under the seat and the door-post on the bottom, as shown in Figure36. The next step is choosing the form features from Table 16 and applying them to each part. Eight concepts have been achieved after this step.

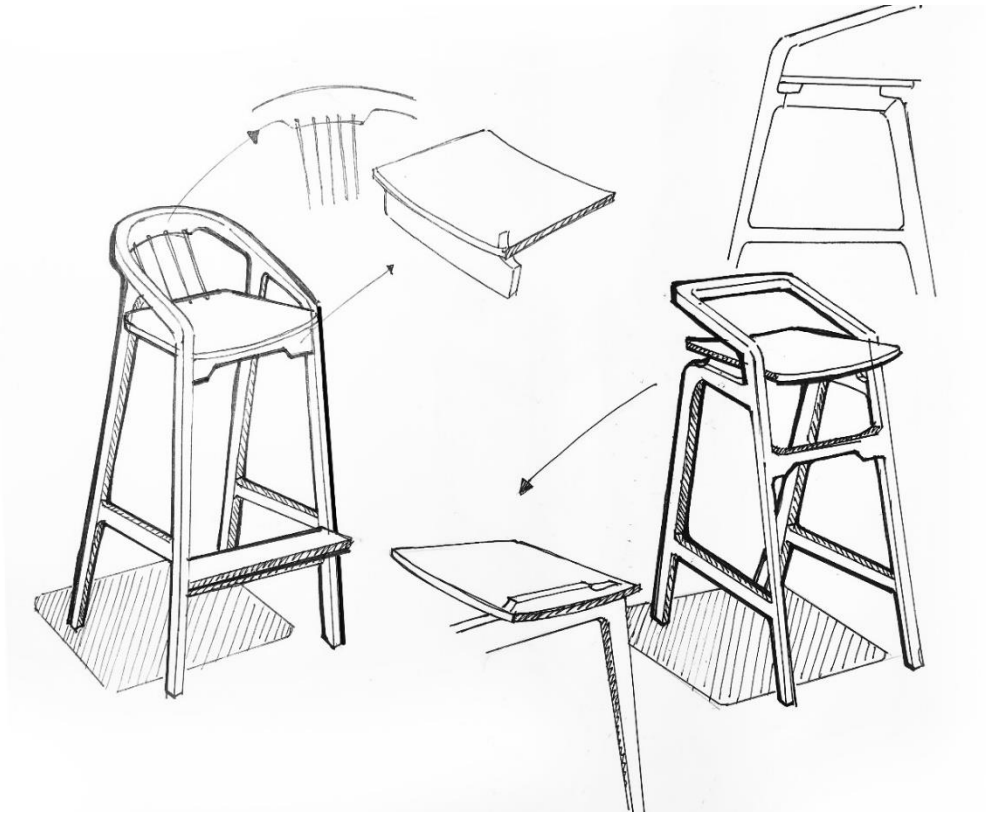


Figure 37,Concept 1, 2.

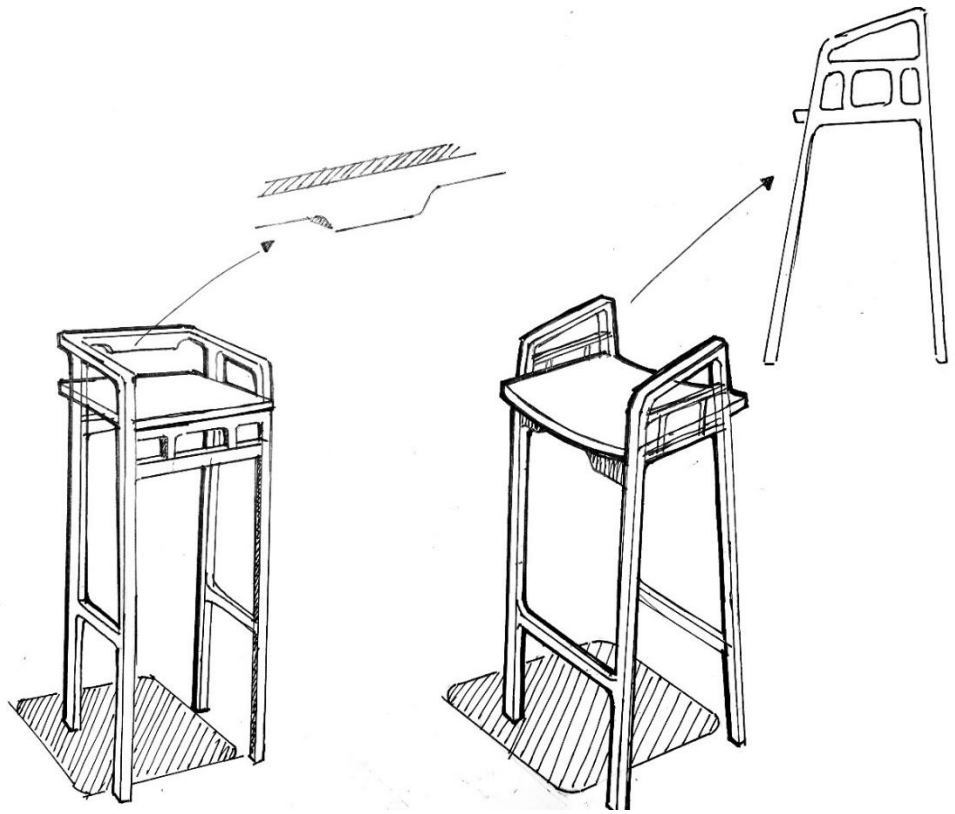


*Figure 38,*Concept 3, 4.

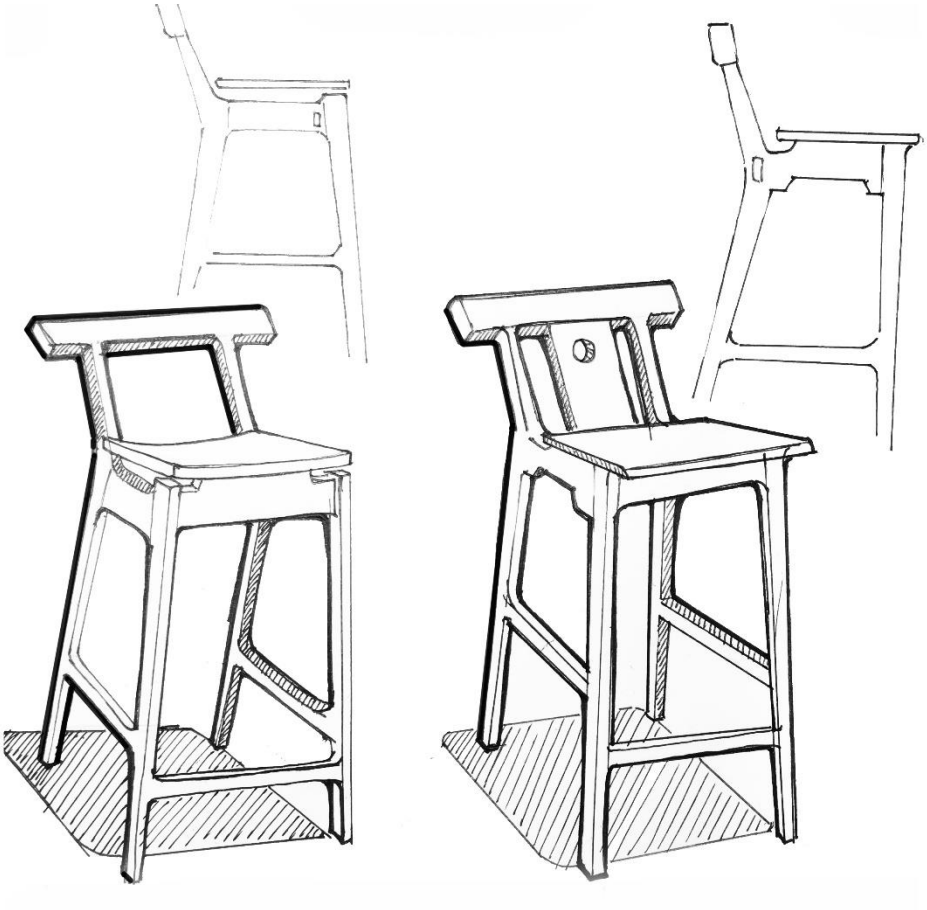


*Figure 39,*Concept 5, 6

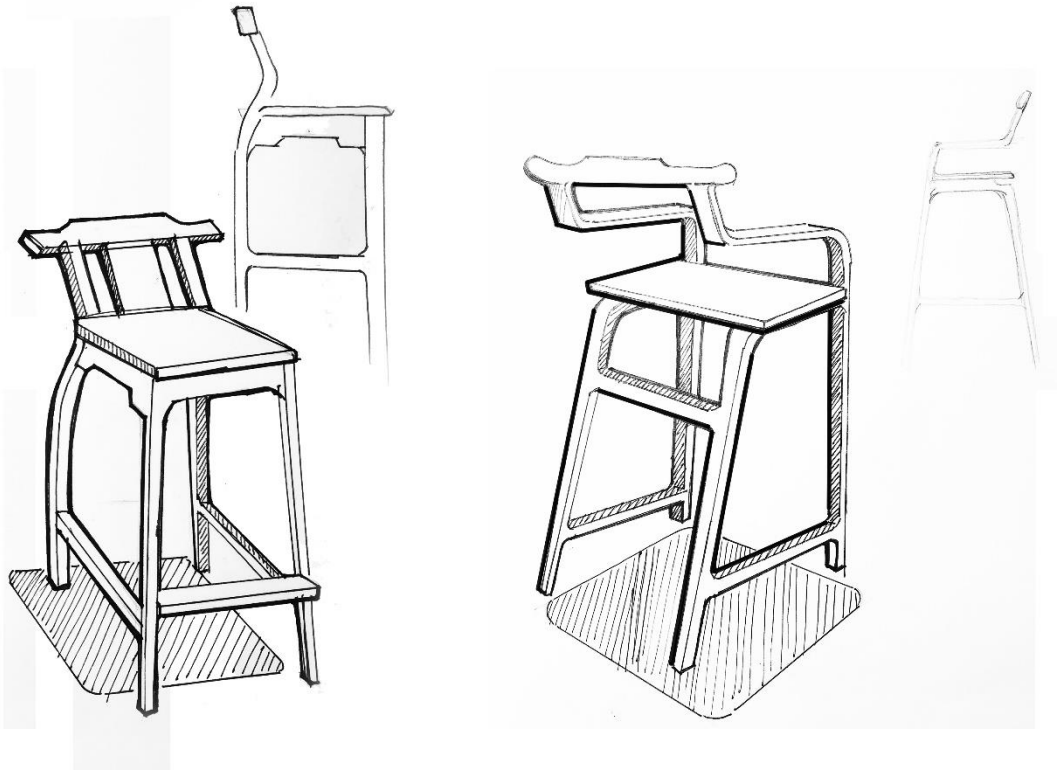


*Figure 40,*Concept 7, 8.

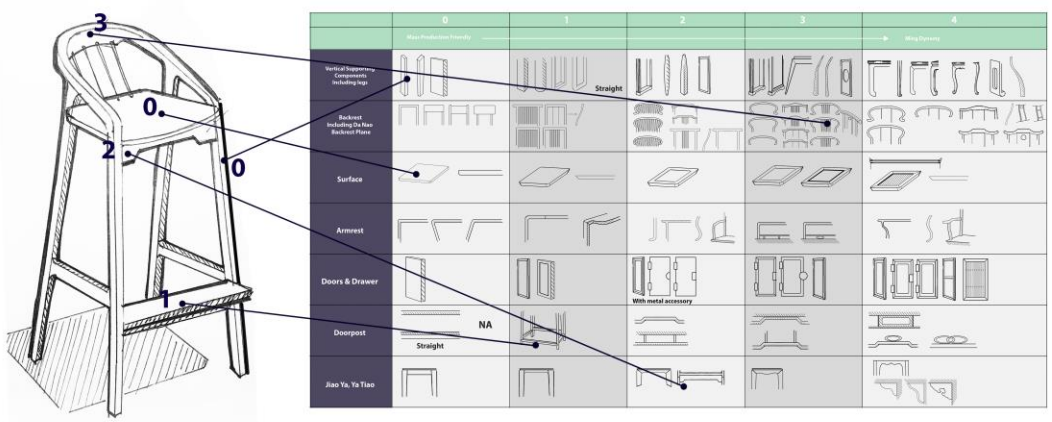
Based on the designers' experience and aesthetic, concept one, five, six, and seven have been selected to go to the next step.

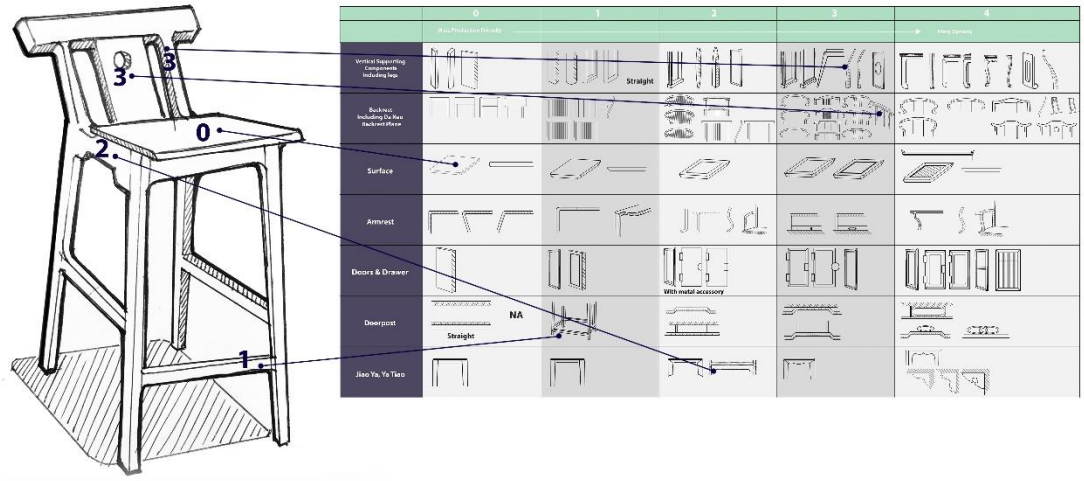
4.3.3 Design evaluation

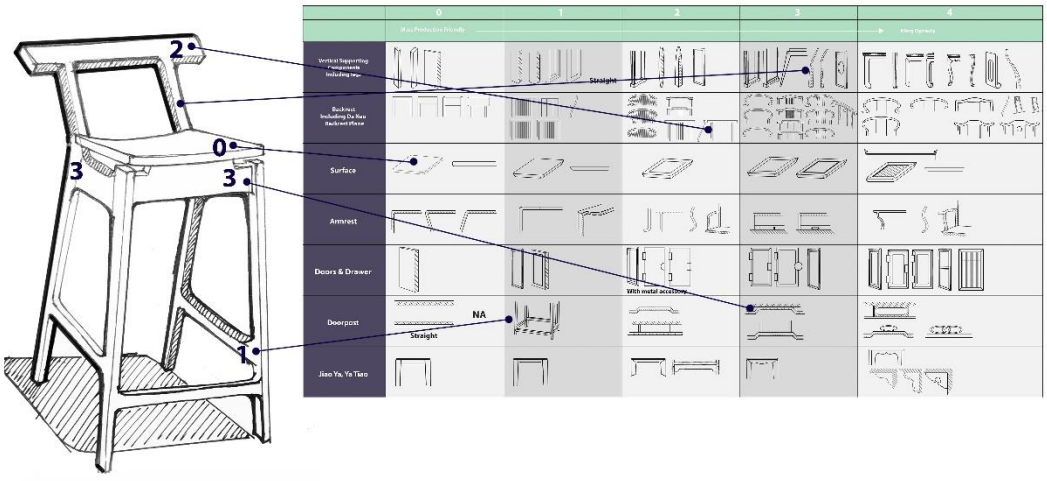
Based on the design flow chart, the next step uses the evaluation chart to evaluate the design concept in order to find the balance between mass production and Ming Dynasty style requirements. As indicated earlier, bar chairs contain five parts, but because the backrest plays a more important role in identifying design style, the score of backrest needs to be doubled. As a result, the score range of the whole chair is from zero to twenty-four. The target market of this design is a high-end Chinese style that can be coordinated with other styles, therefore, the score range of the design should be a range

from eleven to thirteen.

According to the evaluation chart, each concept's score is shown below. It can be seen that concept five and six's scores belong to the target score range. Concept seven's score is higher than the thirteen which indicate that the design leans more towards to Chinese style, so it may a little bit complex for the mass production technology to produce. And for concept one, the score is lower than eleven, which indicates that its design style contains less Ming Dynasty style, which cannot satisfy the design objective. Therefore, concept six and seven have been chosen for further development.




3
3
0
2
1
Straight
NA
Straight
With metal accessory


2
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3
3
1
Straight
NA
Straight
With metal accessory

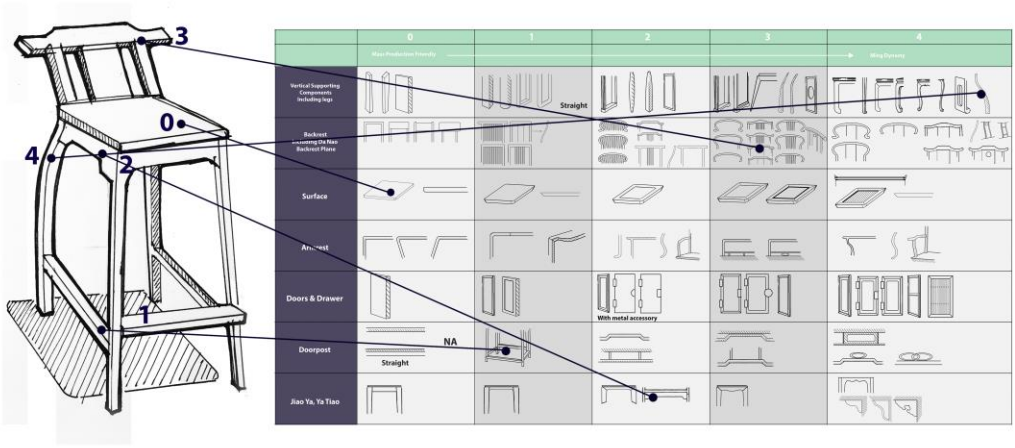

Figure 41,Concepts with score

Figure 42,Second round sketch

Figure 43,3D model

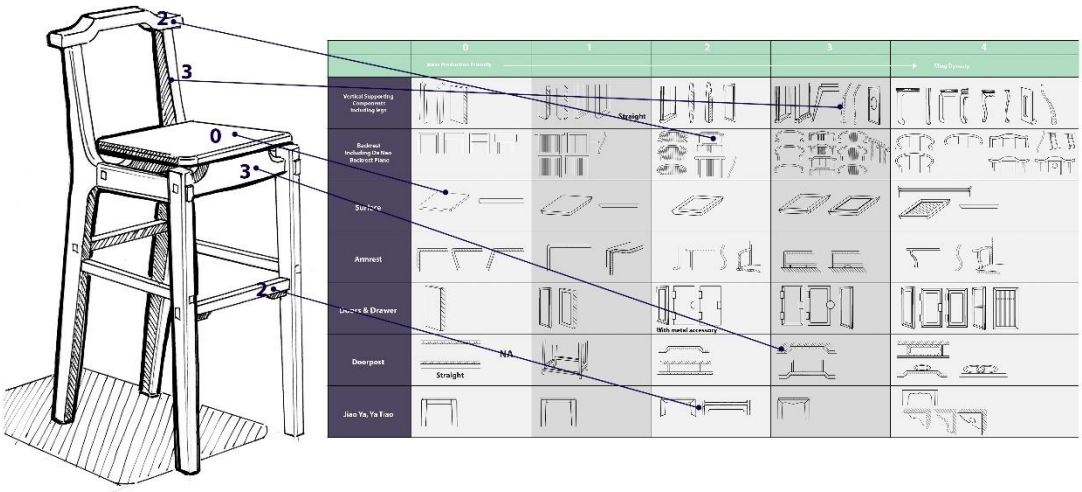

Figure 44,Second round sketch with evaluation

*Figure 45,*Final result of style development

4.3.4 Manufacturing development

The tenon joint is one of the most important features of Ming Dynasty furniture that cannot be removed from the design. In order to keep this features and satisfy the mass production requirement, several adjustments have been made based on the traditional joint. With the help of 3D software, a full size model can be built precisely to the designer's specifications, and a precise technical drawing can be developed based on the 3D model.

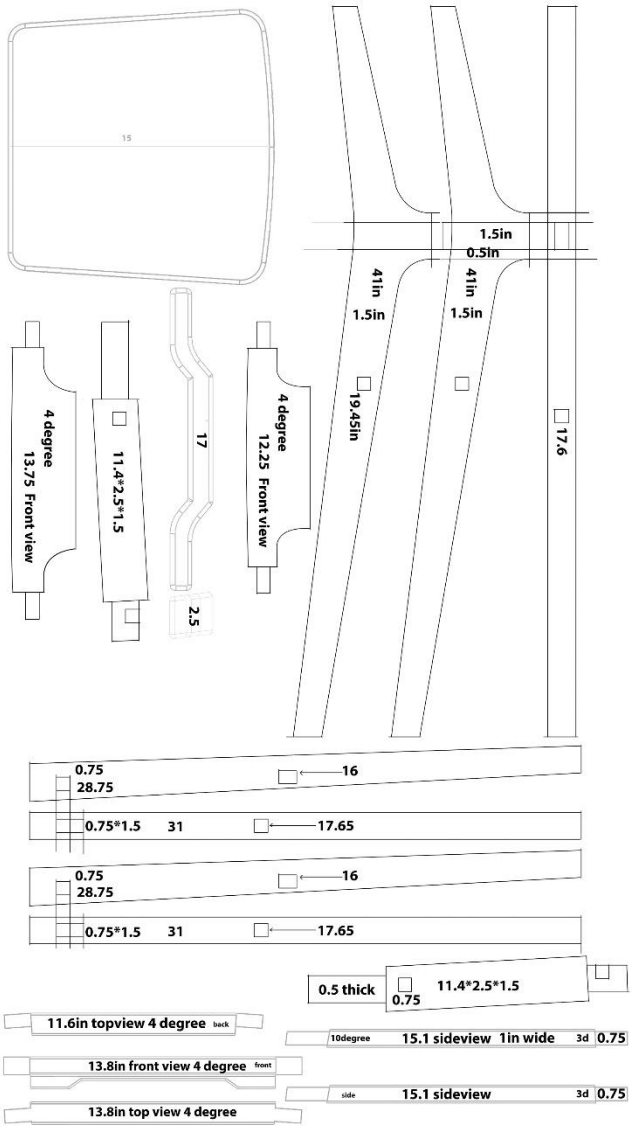

Figure 46, Technical drawing

4.3.5 Testing model

In order to get a better understanding of the overall proportions and, form features, and test whether the ergonomic aspect can satisfy users' needs, a testing model has been made as shown below in Figure 47. After the testing, several problems were identified, described as follows.

Figure 47,Testing model

1. Because of the limitation of the handy craft technique, the tenon joint that connects the back leg with horizontal supporting pieces cannot be achieved. Therefore, that kind of joint has been replaced by another kind, as shown below.

*Figure 48,*Testing model, tenon joint detail

2. For the testing model, the front piece appears hidden in the shadow, so it needs to be brought forwards. Therefore, the joint connecting the front piece with the front leg was changed as shown below, with those three pieces interlocking, as shown in Figure 49.

*Figure 49,*Front piece tenon joint detail.

3. After seeing the testing model, the overall proportion fits the expectation, except, the width of the back leg and side piece seems too wide compared to the other piece, so it needs to be narrowed.
4. After the user testing, there are several problems that need to be addressed.
    1) The sitting surface tends to be a little small for a male of large physique.
    2) The back rest piece is stepped out to much, which is not comfortable to lean back on.
    3) The angle of the sitting surface that leans backwards needs to be smaller for

eating.


2
1
3

*Figure 50,*User testing

Based on the conclusion from the testing model, several adjustments have been made, as shown below. Because the form symbols stay the same, re-evaluation is not necessary.

*Figure 51,*3D model of re-design

4.4 Materials Selection

As talked earlier, in addition to tenon joint and specific features, an attractive hardwood selection is also an important factor of Ming Dynasty furniture. For this design, mahogany has been chosen to be the material. There are several reasons: 1. The grain of the mahogany is relatively consistent and very sophisticated. 2. “Mahogany is equally known for its superb dimensional stability. Flat pieces will remain flat. Joints and glue-ups will remain intact.” (Meier, 2016). This characteristic of mahogany can help the tenon joint stay stable and strong. 3. “Mahogany is known for its cooperative nature and easy sanding and machining, with a Goldilocks-esque balance of density that’s just hard enough but not too hard.” (Meier, 2016). 4. The color of the mahogany leans towards reddish-brown, which is similar to Hua Li.

For the finishing aspect, Tung oil has been selected as the final choice. During ancient China, Tung oil was also been widely used. “Tung oil has been known about for

hundreds of years in China, where it was used as a preservative for wood ships." (Tung Oil-Woodwork Details,2016) Tung oil can not only make the grain of the timer a perpetual wet look that highly actualizes the grain of the wood, but also can give the timer a much richer, warmer, and pleasing color. (Tung Oil-Woodwork Details, 2016)

Figure 52,Sample of mahogany

4.5 Conclusion

Figure 53,Final model

Figure 54,Final model front view

Figure 55,Final model detail view

Figure 56,Final model using in context

Because of the limitation of manufactory technique in school and fund, the final model cannot be made by automation manufactory machines, it was made by hand. But the aim of this design was targeted as modern manufactory technology. As talked earlier in chapter 2, instead of cutting with hand, the timber was cut by precision saws and CNC

(computer numerically controlled) routers based on modern manufactory technology. So that, simpler and straight line forms are more preferred. It can be saw that expect the back legs and supporting pieces under the seat surface are in slightly curved shape, all the other pieces are in straight line forms, which is fully suitable for the mass production requirements. For the construction aspects, all the joints that been chosen are from the common joinery list which are friendly for mass production technique. Moreover, it doesn't require extra tools and professional skills for assembling. As a result, the chair can be assembled by the retail seller and flat shipped which can help to reduce the cost. All in all this design is fully satisfied the production and technique function based on modern society.

Chapter 5

Conclusions and further development

5.1 Conclusion

The intention of this thesis was to develop a design guideline that contribute to create Ming Style furniture that also fits the needs of modern life. Three aspects have been studied in this research in order to limit the whole design guideline development, including product function, influence factors on furniture design and the characteristic of Ming Dynasty furniture. It can be understood from the research that Chinese traditional furniture reached its peak in Ming Dynasty, and that it holds high worth for

future generations to learn from. However, Ming Dynasty furniture cannot meet the modern product function and the needs of modern life due to its handmade and ornate nature. The main idea of the guideline was to help the designers gain a better understanding about Ming Dynasty furniture and guide them to build a furniture that contains Ming Dynasty characteristics while fitting the needs of modern life. An evaluation tool was developed at the same time to help the designers evaluate their resulting design.

Designers may use the design guidelines to apply Ming Dynasty furniture's symbols on the furniture that fit modern life's needs. Moreover, construction and manufacturing aspects of furniture must be taken into consideration as well. A full size modern design has been developed from the evaluation of several possible concepts in order to demonstrate the application of the design guideline.

5.2 Further Development

This design guideline provides designers another choice other than the existing design processes. This design guideline can be changed with the development of manufacturing technique and society, and feedback from users. The scope of this study does not include the graphic pattern on the traditional Chinese furniture or new materials within modern design. These two areas can be studied further. A new design guideline can be developed based on the result of further study.

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