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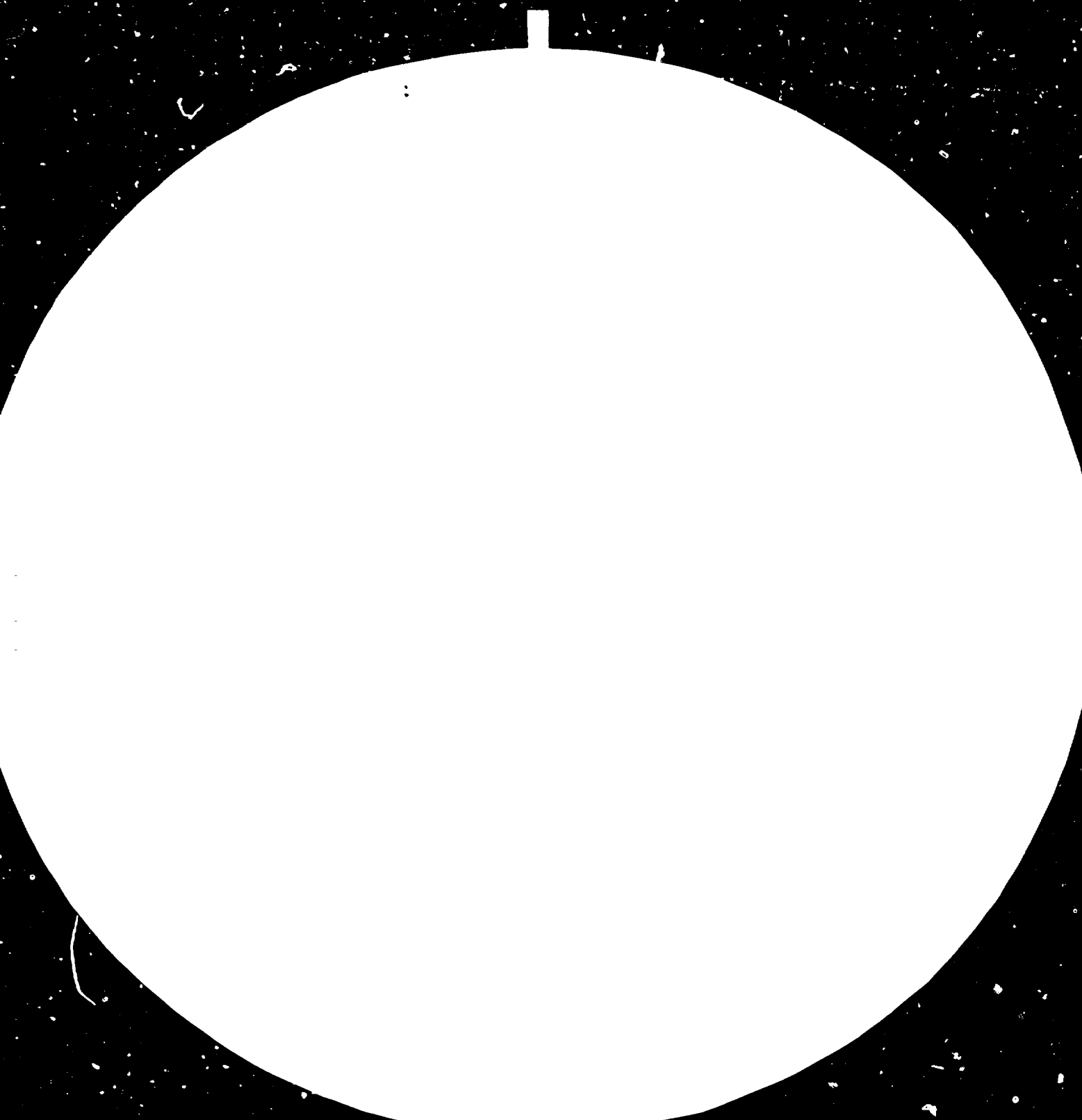

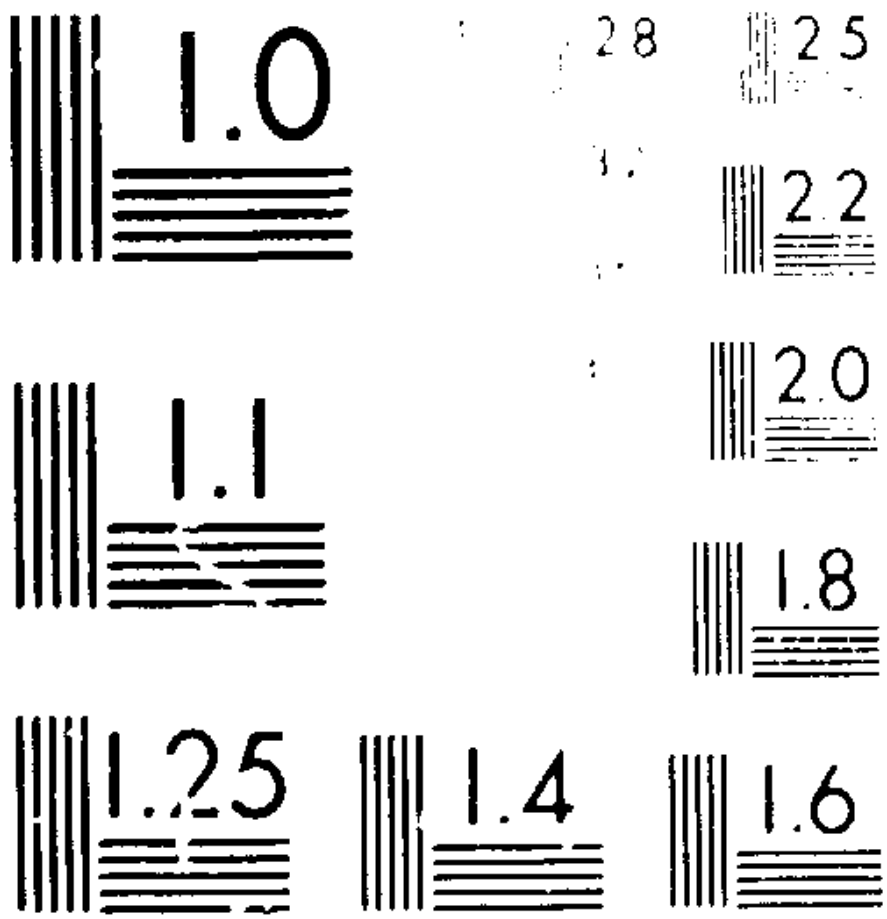
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THE DEVELOPMENT OF WOOD-BASED PANELS ENHANCES THE CHANGE IN FURNITURE CONSTRUCTION *

by

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During the past 20 years or so, the wood-based panel industry of China has developed rapidly. It is now capable of making use of residues from the processing of logs into wood products, thus providing the furniture and other wood using industries with a new type of material: wood-based panels. Since this type of panel material has properties quite different from those of solid wood, therefore, it has introduced some changes in the structure of the furniture. These are a result of adoptions of advanced techniques used in foreign countries and combining them with actual conditions of our own country. Here we shall try to make a brief introduction of the condition and our appreciation of these changes.

1. The concept of wood-based panels

Wood-based panels mentioned here primarily refer to fibre board, particle board, block-board, cellular board and hollow boards with either lattice square cores or lattice honeycombs as filler. These wood-based panels have many qualities solid wood does not possess. For example, they have wider breadth, less deformation, more uniform texture, stabler performance and greater strength. They are excellent material for use in vehicles, vessels and buildings, especially for making furniture.

Since furniture came into use, this industry has been using solid wood as its main raw material, and after years of incessant change and improvement, the traditional construction method of wooden furniture gradually began to take shape. But, after the appearance of wood-based panels and their application in the furniture industry, new problems have arisen, because they have properties that are not quite similar to solid wood boards. The traditional construction method is no longer adaptable to the new material. Therefore, it is necessary to conduct studies on how to make correct and appropriate use of wood-based panels to produce furniture. After repeated trials and investigations, we have realized that, in order to make the fullest use of the conspicuous role wood-based panels play in furniture making, it is essential to change the original construction method. Thus, it can clearly be seen that the appearance and development of wood-based panels have, to a great extent, fostered a change in furniture construction and enriched

the style. In return, the improvement of furniture construction also broadened the scope of use of wood-based panels further so that today not only furniture of the cabinet type but also other types like chairs, beds, tables and racks make use of them. In this way, the construction, form and processing techniques of this type of wood-based panel furniture is maturing day by day, giving birth to a new series of panel furniture and opening up a new field of furniture production.

However, what is worthy of note is that wood-based panels used in furniture making are somewhat different from those used for other purposes. In order to reduce the weight of a furniture unit, the density of the wood-based panels used should not be too high (about 700 kg/m^3), and, to guarantee the physical performance of furniture, their modules of rupture should be above 150 kg/cm^2. Besides, to satisfy the requirements of outward appearance and guarantee the quality of assembly, they should be of uniform thickness with very little deformation. Therefore, some countries have specially stipulated quality standards for wood-based panels.

2. The traditional construction method for furniture

As timber has such features as smaller density, higher strength, easier processing, more comfort to the touch and nicer grain, therefore, people prefer to use timber to make furniture, and have gradually created a relatively integrated traditional structuring method for wood furniture - the combined tenon and mortise form known as the tenon-mortise construction. In this respect China has a long history. As early as five or six hundred years ago, in the Ming Dynasty, this form of construction method has already been in use, and the Ming style of furniture well-known all over the world has been created. They are not only beautiful and elegant in form, but in structure they are also extremely tight and fitting. As hardwood of very hard texture and high strength were mostly used at that time, therefore, the cross-sections of the material used are considerably smaller than those used today. This furniture also had different tenon and mortise joints used at different positions in a rational way. At the same time, special emphasis is given to the precise matching of tenon and mortise. Therefore, many pieces of furniture produced in that time have been handed down to us . Although they have undergone the wear and tear of several hundred years, they are still

firm and intact. This proves that the skill in using the tenon-mortise construction by the crafted and talented carpenters of that time had reached a very high level.

The density and hardness of the wood we use today are far lower than those of the hardwood we used decades ago, and so the cross-sections of the material now used has become larger. Besides, in order to adapt all processing to mechanical means, some changes in the concrete shape of the tenon and mortise have also occurred. The tenon-mortise construction we use today is a tenon sawn at one end of a piece of wood to be joined together to another with a mortise drilled to match. Then glue is applied to both to join them together (Fig. 1). This method of processing is simple and

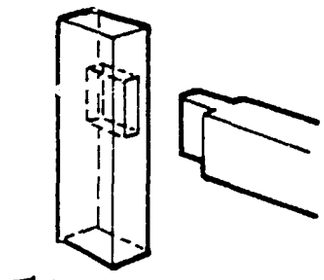


图 1

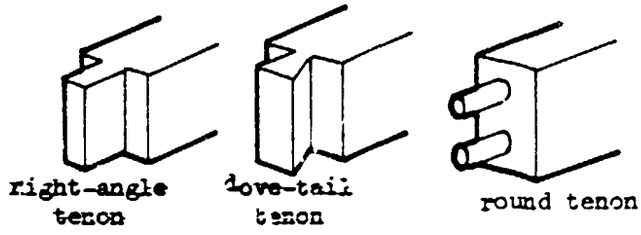


图 2

Fig. 1: Simple mortise and tenon joint Fig. 2: Certain types of single tenons

the assembly easy. It also has a high adaptability. As the strength requirements of different positions vary, so various kinds and types of tenon-mortise combinations have appeared to serve different purposes, like right-angle tenon, dove-tail ones, round ones (dowels) etc. (Fig. 2) as well as single and double tenons used in rails and stiles, and multi-tenons for fitting boards (Fig. 3). Then there are through-hole tenons with larger gluing surfaces and wedges can

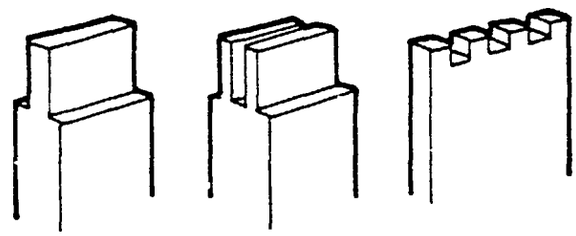


Fig. 3: Types of single and multiple tenons

be driven into them to give the joints more strength, while tenons that do not show on the surface make such joints more aesthetically appealing. Besides these, there are also open and closed tenons of various types (Fig. 4).

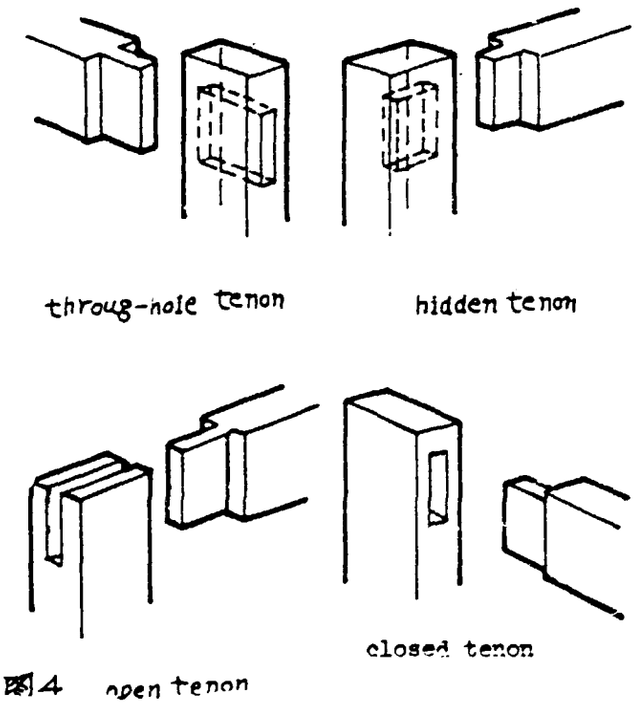


Fig. 4: Various types of tenon and mortise combinations

A component can be formed by using the tenon-mortise combination to assemble rails and stiles into frames and then thin boards onto them. When these components are assembled, they will become furniture of some kind or another. Furniture made by the traditional construction method are known as the frame-type.

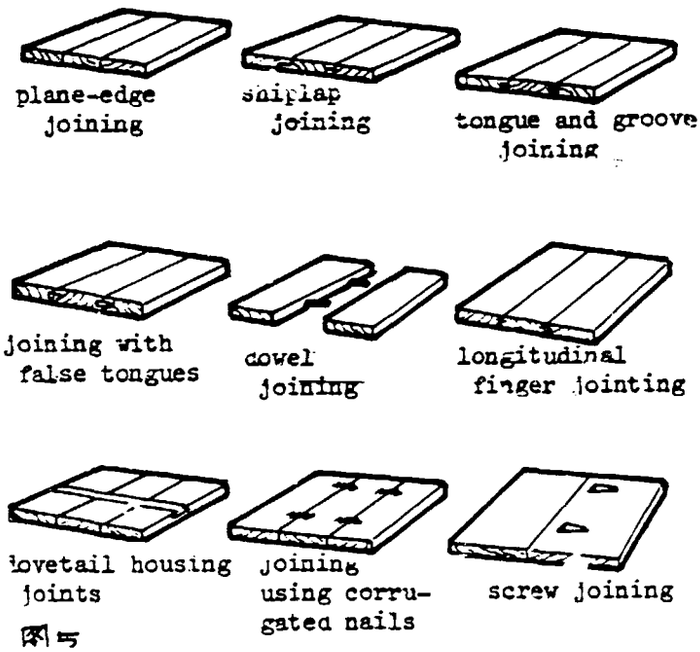


Fig. 5: Various methods of jointing boards

Before the appearance of wood-based panels, panels needed by the frame-type furniture were made of narrow planks of the same thickness jointed together. This can be done in several ways such as plane-face jointing, zigzag-face jointing, tongue and groove jointing, through-rib jointing, dowel-insertion joints, finger jointing, band jointing, metal connector jointing, screw jointing and so forth (Fig. 5).

The history of frame-type furniture is long. It is rich in form. Its artistic style also differs in various countries and in different historical periods. In the history of development of furniture, the frame-type has played an important role, and it still remains one of the main structural forms in wood furniture, especially those of high quality. The tenon-mortise method used for frame-type furniture is easier to do manually. Therefore, in times when mechanical processing was not developed, it was widely used over a great length of time. However, this method has its own defects. The tenon-mortise combinations can be very many and their structure complicated, thus making production technology rather complex and entailing more work and greater waste of material. Besides, its labour productivity is low and mechanized mass production is very difficult to realize when using these combinations. This is, in some sense or other, a stumbling block to the rapid development of the furniture industry.

3. The transition of frame to panel type furniture

As a result of social development, the material and cultural life of the people become richer and more varied day by day, and so new demands are incessantly placed on the furniture industry. This is especially so in China as the standard of living is rising, thereby, the demand for more and better furniture is growing.

Although the traditional frame-type furniture have many strong points, they are restricted by their own complicated structure, and so it is difficult to raise the productivity and lower the cost in batch production. In order to be able to provide people better and cheaper furniture in great quantity, it is necessary to modify frame-type furniture, to bypass the tenon-mortise construction method, to simplify production technology and to create a new construction method so as to meet the requirements of industrialized mass production.

The production of particle board and medium-density fibreboard calls for higher production technology and other conditions, and, before we have these prerequisites, necessary studies have to be made on such aspects as structure and material and some transitory measures have also to be taken to realize the preliminary production of components. The technological process we have adopted is to varnish the components first, and then to assemble them.

One of the transitional alternatives adopted in material utilization is to make full use of plywood, the production of which dates much earlier in China than that of the other wood based panels, and it has now assumed a considerable scale. It was able to supply furniture production needs in good batches years ago, but due to structural limitations at that time, it was used merely as panels for frame-type furniture, substituting the use of joined solid wood panels. Thus, the role it played was limited. In the process of transition to panel furniture, it is paramount to let plywood play a major role in producing components of panel furniture.

The first way is to glue thin plywood faces on both sides of rectangular frames made of rails and stiles to form a component for a door, a side, a partition, a top, etc. of a cabinet type of furniture, thus abolishing the tenon-mortise combination frame and simplifying technology, only calling for porcesses like material preparation, gluing under pressure and edge trimming to finish a component.

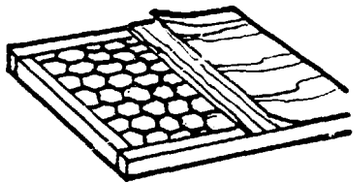


图6

Fig. 6: Latticed hollow board

图7

Fig. 7: Honeycomb hollow board

An alternative method is to cut cardboard of 1.0 mm thickness into long strips of a definite breadth, and then saw cuts of half the breadth at regular intervals. After that, all the strips are meshed to form a lattice by fitting the saw-cuts into one another so as to serve as core-filler material. This lattice core is surrounded by rails and stiles, and on both surfaces two pieces of veneer are placed and then pressed to form a latticed hollow board (Fig. 6).

Thick paper like kraft paper, glued like a honeycomb can also be used as core filler material. This can be mechanically assembled instead of being done manually and then be pressed to form the cellular board (Fig. 7).

The technology involved making use of these methods to process the component panel material for furniture is simple, and it can also be done by hand without resorting to complicated equipment. However, this sort of wood-based panel must be made according to pre-designed components with pre-determined dimensions, and once pressed sawing and cutting off of any sections at random is no longer possible. This kind of hollow-core board component can be assembled into furniture units after surface coating and the requirements for component production have thus been realized.

Besides this, the block-board is also a very good form of transition from plywood to other panels. It is produced using residues of other wood processing operations. These are sawn into long strips of standard breadth and thickness, and then joined together edgewise and endwise by applying glue on their edges and ends, prior to being pressed into boards of specified dimensions. Finally, veneers are glued and then pressed on both faces, again to form panel material as specified. This not only allows a rational processing of what can otherwise only be considered to be residues, but also forms a separate use of wood itself, enabling the block-board to have properties like stable performance and non-deformability characteristics of wood-based panels. Besides, it also retains some properties of natural wood with good nail-holding strength. Tenons and mortises can be made on it, and it can be sawn and machined at will. It is also suitable for the tenon-mortise construction method, and taht of joints used in the panel furniture. Therefore, it is a good material for furniture making. In places lacking the technique and equipment to produce wood-based panels, block-board is an ideal transitional form. Even in countries where the wood-based panel industry is fairly well developed, block-board is still considered to be a good material for making high-grade furniture.

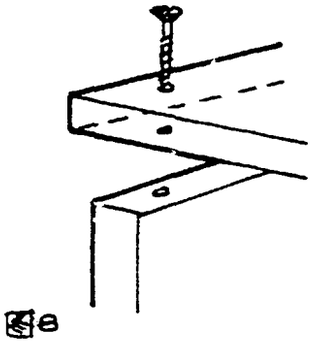


図8

Fig. 8: Screw to join two boards.

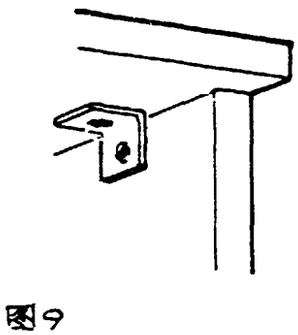


図9

Fig. 9 Use of metal angle piece for joining two boards.

Frame-type furniture is the joining together of plane components into a three dimensional units through the tenon-mortise structure. By using composite wood based panels described above we have been able to make a transition from the frame to the panel type component method of production. However, it is also necessary to adopt a form of transition in the method of assembling the components. By far the simplest way is to use nails and screws to join two boards together directly (Fig. 8). Wooden dowels and metal angle pieces can also be used for joining (Fig. 9). Besides, reverse-teeth plastic screws or plastic expansion tubes have the effect of joining too (Fig. 10). If a permanent assembly is desired wooden dowels can be used.

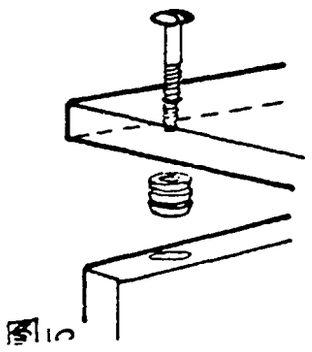


図10

Fig. 10: Reverse teeth screws and plastic expansion tubes used for joining.

The construction methods described above are simple and workable, and are transitory measures enabling a start in panel furniture production to be made.

In using these transitory forms of panel meterial and the construction method in furniture making, the operations relating to the pressing of the composite panels into components are relatively complicated, yet it has

simplified production technology and created advantageous conditions for later processing. Some plants in Beijing and Tianjin that have adopted the above technology to produce furniture of the cabinet type have all conspicuously increased their output and raised their rate of production. At the same time, the furniture produced had features like lighter weight, better strength and durability. Some of these products have shown no signs of lowering of quality like detachment due to failure of the joints, delamination and warping after more than ten years of use. From these conditions in trial production it is not difficult to see that the method of transition from the frame-type to the panel-type furniture not only allows a comparitively simpler technology and mechanical equipment to be used, but investments are lower and quicker returns are possible. Furthermore, it also economizes the use of timber, and raises the efficacy of production. So it is advantageous to change the old way of producing furniture and foster the development of the furniture industry.

4. The quality of panel furniture

The appearance of panel furniture has rapidly attracted the attention of the public. Especially after new hardware fittings have been designed and produced, and the problem of construction and assembly has been solved, the large scale production of particle board and medium density fibre board have further enhanced the speedy development of panel furniture which is popular with a broad section of the public. This is so because the panel-type furniture has certain qualities that the frame-type lacks.

a) The inherent quality of panel furniture is higher than the frame-type: Thin boards used in frame-type furniture are all thin made up from solid wood which show phenomena like easy cracking, warping and loosening when changes occur in temperature and humidity that affect their inherent quality, while the raw material used for panel furniture are mostly wood-based panels that have a wide breadth, an even surface, a uniform thickness and a stable performance, thereby raising their inherent quality.

b) Panel furniture simplifies the technology of furniture production: As this kind of furniture is chiefly made up of wood-based panels and hardware fittings, tenons and mortises need not be machined to

complete the porcessing of components. When compared to the frame-type, several work procedures have been simplified. In this way, labour productivity is raised and the cost of furniture lowered.

c) Panel furniture saves production expenses: As the panel-type belongs mainly to the assembly type, it is possible to achieve the technological flow of component production. During the production process, it is not necessary to assemble the components into a complete furniture unit, thus greatly facilitating production, storage and transportation. As producing components needs less working space and as the storage and transportation of components are not as bulky as furniture units, considerable savings can be achieved. The creation of this advantageous condition can be felt in the long distance transportation, especially in export.

d) Panel furniture offers a brand new form. The assembly structure of panel furniture is eminently suited for making compound and multi-purpose units. This not only makes it more flexible in making structural changes, but also gives furniture more variety making the people's homes more beautiful. The raw material and the construction method used in panel furniture are different to those used for frame-type furniture, thereby bringing a new change to furniture form. Furniture composed of smooth and plane wood-based panels do not have visible lines, cracks and decorations like those of yore. They are substituted by clear neat lines and modest brand-new forms.

e) Panel furniture is suited for designs for serial production: By introducing automation in flow lines to produce panel furniture, output has increased, but the defect of less varieties has also come with it. The contradiction between standardized production and multiplicity of product can be solved by taking steps to design modular, common, standard components making possible also the method of organizing production planning and control and increasing productivity. As wood-based panels used for panel furniture all have a definite standard specification they embody all the pre-

requisites for serial production. When desigining, the height of a standard drawer is often taken as the basic module for cabinet height. At the same time, consideration should be given to the rational cutting-up of the board so that the offcuts and waste are minimized.

f) Surface finishing of panel furniture can be varied: There are many ways of surface finishing of wood-based panels. Among these can be mentioned: coating with varnish or paints, laminating decorative paper or decorative plastic films, applying melamine sheets, or wood veneers or directly printing the grains of various species of wood on the panels. From this it appears that surface finishing of panel furniture can be ruch and colorful.

g) Panel furniture brings convenience to seller and user alike: common standard components and hardware fittings that are convenient to handle result in ease in packaging, in effecting the sale and in using the panel furniture. The fact that it is possible to sell components individually, packaging expenses can be reduced, and users can buy standard components and hardware fittings to assemble all kinds of furniture according to their own likes, in harmony with th living environment. As assembly is easy, it is possible to make alterations at will to the room's furniture arrangement as well as tc the furniture's form.

5. <u>The technological processes of panel furniture production</u>

The production technology of frame-type furniture with the tenon-mortise as the main construction pattern is relatively complex. The production cycle from round log processing to the finished end product usually takes two to three months. It has to undergo more than ten processes like sawing, drying, machining, planing, sanding, making tenons, boring mortises, mounting components, assembling the product and varnishing the surfaces. Woodworking machines and euqipment needed are many and varied, including band and circular saws large and small, planers ,thicknessers, sanders, tenoners, borers and assembly machines. These operations also exceed ten in number. Plants that adopt this kind of a technological flow line to produce furniture

not only have to invest more capital, but also waste more material and yet the quality of their products is difficult to guarantee.

Raw material used for panel furniture are wood-based panels with standard specifications and stable quality. These, coupled with a structure capable of being assembled at any time and at random (because components are interchangeable), facilitate the realization of production of components and lays the foundation for charging the original form of furniture production technology.

Panel furniture can also be produced through a division of labour according to specialty: wood-based panel plants that specialize in the production of board material, and furniture component plants that specialize in producing all kinds of components, others for producing the necessary hardware fittings and finally panel furniture plants that complete all the final processes in furniture making. After such a labour division by specialty, the technology and equipment of these furniture plants can be simplified to a great extent and thus facilitate the automation of the production flow. From the above it is clear that the difference between the production technology of panel and frame-type furniture is great.

According to the division of labour, the wood-based panel plant supplies all kinds of wood-based panels especially used in furniture production while another specialized plant supplies all kinds of hardware fittings. Thus, the first operation in a furniture plant is to saw the wood-based panels into specified dimensions according to requirements on a double cut-off saw. and then pass them through a double-edge banding machine which applies the banding material using hot melt glue. After this operation is completed, the necessary holes are drilled for dowels and hardware fittings. This is a relatively more important procedure in the production of panel furniture than for frame-type furniture, because the crux of the quality of assembly depends on the precision of the size of the holes and their position with respect to one another and/or the edges of the panel. If this operation is not done accurately, it will not only create difficult assembly, but also affect the strength of the furniture unit. As such, this procedure should be done on a special adjustable multi-spindle drill so as to ensure precision. If the surface of the board material is laminated with a plastic

sheet or with decorative paper, it indicates that the component has been completely processed and furniture assembly can be done.

If the wood-based panel is decorated with a veneer, then coating and polishing is necessary. Before varnishing, the surface of the component should first be sanded and after brushing and cleaning, be coated with filler and then varnished when dry. If conditions permit, the best approach is curtain coating. This not only does away with the fatigue of labour in applying the varnish, but also economizes the use of coating material, while at the same time resulting in better quality coating.

The final assembly operations are done on the assembly press. The plant can also turn out components for sale and let users assemble them themselves. This is especially suitable with large size furniture like wardrobes, cabinets, beds and shelves. This way of doing things gives joy to users who purchase furniture components and assemble them with their own hands. Great is their pleasure indeed when they see the fruit of their own labour.

6. The hardware fittings used in panel furniture

Since the wood-based panels were first produced furniture designers of many countries have endeavoured to use them extensively in furniture. They have designed and produced various kinds of hardware fittings for use in different positions of a furniture unit according to the level of their processing technology and the quality of the wood-based panels. The use of these hardware fittings spurred the development of panel furniture further.

Taking function into consideration, hardware fittings for panel furniture can be divided into two categories: those for permanent assembly of the elements and those for knock-down assembly.

a) Permant assembly: This is a procedure that permits assembly only once, after the processing of all the components is completed, and there is no further need to disassemble (knock-down) the furniture again. It is suitable for products that are small in size and is best done in the factory. The hardware fittings often used are listed on the following page.

(i) Nails: Nails are used to join two pieces of board components together directly or using a square or rectangular lath for nailing them together (Fig. 11).

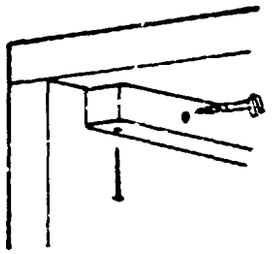


图 11

Fig. 11: Assembly of panels using nails or screws.

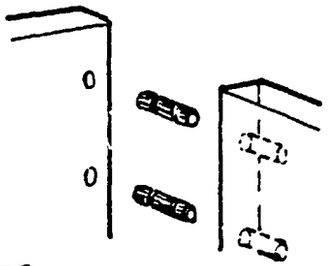


图 12

Fig. 12: Assembly of panels using dowels.

(ii) Wood screws: The use of wood screws instead of nails for the same assembly mentioned in (i) above (Fig. 11).

(iii) Dowels: After holes are bored in corresponding positions on two board components, glue is applied to the inner walls of the holes. Then dowels are inserted in one set to join the components together (Fig. 12).

(iv) Nylon double toothed socket: This is a kind of hardware fitting made of nylon or injection-formed plastic of high rigidity. It is a round rod with circular teeth in opposite directions. These teeth increase the resistance of the inner wall of the hole in the board. To use this kind of hardware fitting effectively, the position of corresponding holes on two boards to be joined must be drilled with a high precision. Put the nylon double toothed socket on the hole, and press it into it with force, and it will serve as the joint (Fig. 13).

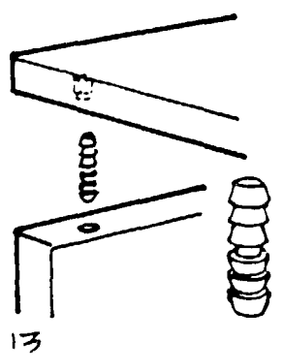
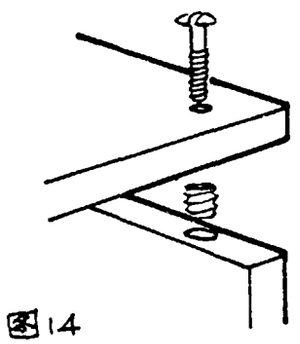


图 13

Fig. 13: Nylon double toothed socket.

b) Knock-down assembly: Panel-type components completely processed can be repeatedly assembled and disassembled repeatedly using appropriate hardware fittings. In order to do so, these should be suited for this purpose and the techniques involved should be easy to master. Besides, provisions should be made to allow the assemblers to use ordinary tools for this purpose so that if necessary assembly can be done at home or in a warehouse without having to resort to special tools. The following hardware fittings are often used for this kind of construction:

(i) Machine screws: It is possible to use machine screws and plastic or metallic tooth sockets to join the components of panel furniture together (Fig. 14).



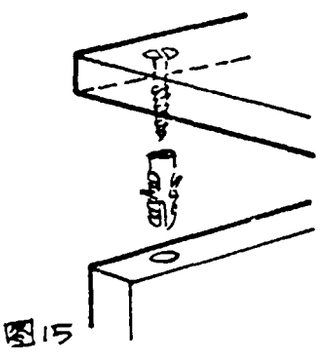


Fig. 14: Tooth socket and machine screw

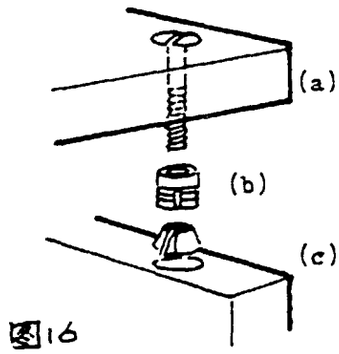
Fig. 15: Plastic rawlplug

(ii) Plastic rawlplug: This kind of hardware fitting was originally used on walls for fixing screws. Because of its possibility to expand we have designed a kind of plastic rawlplug especially suited for use with wood-based panels of appropriate thickness. Matched with screws, it can play the role of joining two pieces of boards together (Fig. 15). Maybe this fitting cannot be dis-assembled and re-assembled many times. If glue is applied into the hole, it will become a permanent assembly fitting. The cost of this kind of expansion tube is low, and it is convenient to use. Its drawback is that the machine screws can be seen on the outer surface and so affect

the general appearance of the furniture. Therefore, it is prudent to use this type of hardware fitting in less prominent positions.

We have conducted some necessary experiments on withdrawal resistance of new hardware fittings often used on the basis of actual conditions of use, and the results obtained are compared with those of screws as shown in the table on the following page.

(iii) Spread type socket: Their design is based on the toothed socket to which some improvements have been introduced, and it consists of a tapered nut and spread socket. When these two components are fitted into the hole in the board, the tapered nut will spread the socket somewhat thus producing the necessary friction to assure a rigid joint. After the machine screw that has penetrated through the board is driven into the tapered nut, it will be drawn up and, with the increase in the screwing force, it will spread the socket some more, thereby adding more frictional force on the inner wall of the board hole and increasing withdrawal resistance (Fig. 16).



(a) machine screw

(b) slit socket

(c) tapered nut

Fig. 16: Knock down fitting

Since this system involved two elements, it takes more time in assembling, but the spreading socket of the sleeve increases the strength of the joint.

(iv) Dovel nuts: They are machined from a metallic rod having a diameter of 12 mm by cutting to length, boring and tapping.

Specific Withdrawal Resistance Of Some Plastic Fittings And Screws On Particle Board

Material	Density (g/cm^3)	Nailing Direction	Fitting (kind of screw)	Dia. (mm)	Hole dia. (mm)	Nailing Depth (mm)	Appl. of Glue	Specific Withdrawal Resistance (Kg/mm)						
								1	2	3	4	5	6	Aver.
Particle board	0.86	Parallel to the surface	Wood screw	4.0	3.0	25.0	Nil	6.0	6.4	7.5	5.3	7.2	8.0	6.7
		"	Self-tapping screw	5.0	4.0	15.0	Nil	8.9	7.0	7.4	9.2	10.8	-	8.7
		Perpendicular to the surface	Wood screw	4.0	3.0	10.0	Nil	11.0	14.0	12.0	12.3	15.2	10.7	12.5
		Parallel to the surface	Expansion tube	8.0	8.4	20.0	Yes	3.3	3.7	5.5	4.5	3.4	4.9	4.2
		"	"	8.0	8.4	20.0	Nil	1.0	1.2	1.2	1.6	0.7	-	1.1
		Perpendicular to the surface	Reverse-tooth nut	11.0	11.5	10.0	Nil	12.0	13.6	12.1	-	-	-	12.5
		"	Nylon with teeth in opposite Direction	8.0	6.8	15.0	Yes	4.5	6.1	6.8	-	-	-	5.8
		Chord Direction of the Wood Screw		4.0	-	25.0	Nil	10.0	8.2	-	-	-	-	9.1

It is often used together with an inner hexagonal screw (Allen screw) to join panel-type components (Fig. 17).

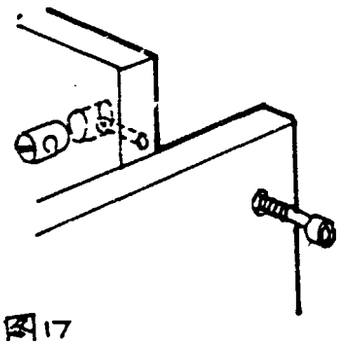


图17

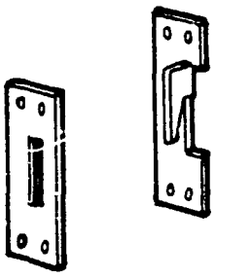


图18

Fig. 17: Dowel nuts

Fig. 18: Flush mounts fittings.

Its features are simple to process, easy and very convenient to use. Its price is low: its strength relatively high; and so it has become a kind of hardware fitting widely used in panel furniture. It is also often used for joining components of sofas and chairs.

(v) Flush mounts fittings: They are formed by punching steel sheets of 2 mm thick to produce two matching pieces: the male hook and the female part (Fig. 18) of various forms. They are simple to manufacture and are easy to use; on the other hand their strength is somewhat low and their field of application is not broad.

(vi) Eccentric hardware fittings: This type of fitting is either formed by die casting a zinc-aluminium alloy or it is punched from steel sheets. The former type includes a toothed socket, a linking screw and an eccentric element (Fig. 19), while the latter is made from two punched and stamped metal sheet discs spot-welded together. Making it possible

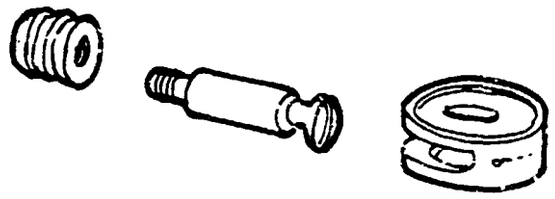


图19

Fig. 19: Eccentric hardware fittings

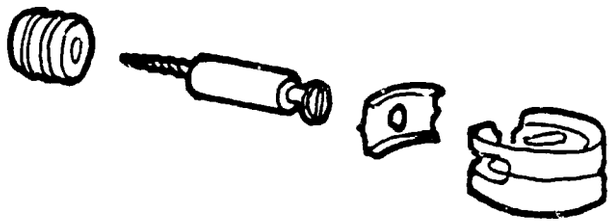


图20

Fig. 20: Stamped eccentric hardware fittings

to facilitate its rotation, arched plate is added (Fig. 20). When manufacturing the latter an ordinary stamping press and punch will do, while the former calls for the use of a pressure-casting (die casting) machine for metals. This type of eccentric hardware fitting is highly adaptable, and so they can be used in many positions in panel furniture without showing any screw on the surface thus giving the furniture a neat appearance. Since the cost of this fitting is slightly higher they should be used mainly in positions of vital importance.

The hardware fittings often used in panel furniture described above are of many kinds, each having its own characteristics. This makes it necessary for the designer to choose one or two according to different requirements and specific positions for their use in assembling the furniture he desires. In a single item of furniture, it is prudent not to select too

many types of hardware fittings for use so as to avoid confusion in manufacturing and assembly. At the same time, the cost of furniture has to be kept in mind.

7. Folded-board construction for panel furniture

With the vigorous development of panel furniture, a new form of panel furniture construction is claiming more and more attention from the public. This construction method needs no other components and so has its own distinctiveness.

To utilize this construction method, it is necessary to choose particle boards or fibreboards veneered with a flexible covering material (like the decorative plastic film), since a right-angle V-shaped groove has to be made at the desired position on the inner side of the board (taking care not to damage the decorative material on the outer surface) and then hot melt adhesive is applied in the groove, finally the board is folded over for gluing (Fig. 21).

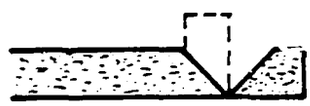


图21

Fig. 21: Folded-board construction, showing machined groove, and, in dotted lines, final position of folded board.

This kind of board-folding and gluing method enables boards not only to be folded once, but twice or even thrice (Fig. 22). It can also be

图22

Fig. 22: Folded board construction showing board with two folds.

used in place of conventional edge banding of panel furniture without the need to use other kinds of edge-banding material and has the effect of increasing the strength of the product. Normally it has to be used at the point of construction; it can replace some hardware fittings and serve the purpose of assembling pieces. This method can be used advantageously to make drawers since it will save both labour and material. The strength of the product is also higher.

A feature of the folded-board construction method for panel furniture is self-gluing which is a relatively simple and easy construction method for panel furniture. If this method is to be adopted in production, certain prerequisites must exist: (a) it demands uniformity of thickness, smoothness of surface, and no probability of warping of the wood-based panels used; and, (b) higher machining precision is needed in machining the V-grooves.

This construction method is not yet very common, but once the quality of wood-based panels attains a certain level, and after further research has been conducted and improvements made, (especially in raising the production technology of wood-based panels as well as a series of measures to ensure precision in machining have been adopted), its application will grow very rapidly.

8. Limitations of panel furniture

During the past ten to twenty years, users have given panel furniture a warm welcome because it has many qualities frame-type furniture does not have, and so its development is rapid. Yet, like all other things, panel furniture has its strong points and also its defects. It is a new construction method which cannot substitute all other methods used by the furniture industry. It is clear from this study that it is very suitable to furniture products that can be mass produced and those that involve, between the various types only, little changes in construction. It has shown its superiority fairly conspicuously in certain kinds of furniture like kitchen furniture and cabinets, but in furniture with supporting frames like sofas, chairs, and others produced in smaller quantities with frequent changes in form, the panel-type is not superior to the frame-type. Therefore, when designing, one should decide what form of construction to use while taking actual concrete conditions into consideration.

Although panel furniture has now been known to broad sections of the public, and has commanded a certain degree of their attention, it still deserves further promotion by furniture designers. They should make good use of its strong points and avoid the weak ones so that panel furniture may play a greater role in changing the life of man.