

## THE ROLE OF COSTRUCTION ON THE QUALITY OF FURNITURE

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**Key words: furniture construction elements, quality of construction, assurance of quality of final products**

### **Summary:**

*The paper is representing the main issues of furniture construction related to the quality of the final product. The old carpentry methods of joining parts of product or furniture parts were adapted to be produced with modern machining methods and processing technologies. Modern furniture constructions are defined to assure the final quality of the products. The other fittings which modern furniture is using are tested also assure the quality of joints and movement while using furniture. Most modern manufacturing processes are designed to fulfill the needs of constructions to satisfy the standards of quality requested.*

**Ključne riječi: Elementi konstrukcije namještaja, kvaliteta konstrukcije, osiguravanje kvaliteta završnog proizvoda.**

### **Sažetak:**

*Referat u kratko prezentira glavne elemente konstrukcija namještaja vezano za kvalitetu završnog proizvoda. Stare stolarske metode za povezivanje elementa proizvoda ili namještaja su prilagođeni da bi mogli proizvedeni sa modernim strojevima za preradu drva. Nove konstrukcije kod namještaja su definirane da bi osigurali završnu kvalitetu proizvoda. Drugi proizvodi za povezivanje elementa namještaja, posebno novi testirani su da bi osigurali kvalitetu veze za koju su namijenjeni. Većina modernih metoda proizvodnje i procesa dizajnirani su da bi osigurali potrebe konstrukcije, da bi u konačnici udovoljili zahtjevnim standardima.*

## 1. INTRODUCTION

In the modern furniture that we can find all over the world we can find the recommended standards concerning the quality needed for the products to be in the market. Unfortunately, most buyers are looking for furniture that will satisfy their request for suitable design to fit in the place they planned to use it. So the producers are fulfilling mostly the request of the buyers with the minimum quality recommended for the product. The quality recommendations for furniture start with its elements of construction, the material integrated and the details of joining and the respect of all processing phases in quality sense of machining.

Salah-Eldien Omer: THE ROLE OF COSTRUCTION ON THE QUALITY  
OF FURNITURE

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In the new era of processing and manufacturing, the machine manufacturers for certain production process specialize for all types of furniture production for solid wood or board products. For every operation planned for the production of furniture they have specialized machines and tools. So whatever design is being operated by defined constructions and are prepared for production process can be implemented and operated through machines designed for that and the tools are adapted for the needs of processing.

Taking that in consideration, all the designed and planned construction elements can be done with high quality processing. So it comes down to the construction elements designed for each product. If they are well planned and implemented in the production process they will guarantee the quality of product. The joints of all furniture parts play a big role in the final quality of the product if they are well performed. The combinations of classical joints and modern joints showed a satisfied level of quality of joining the parts of products. The new types of fittings for every type of joining operation are also well advanced and modernized to assure the quality of joining.

The modern manufacturing is largely a 20th-century industry, its development having awaited the growth of a mass consumer market as well as the development of the mass-production technique. Earlier furniture making was handcrafted, going back to the most ancient civilizations.

Examples of ancient furniture are extremely rare, but there is considerable knowledge of the pieces made by craftsmen all over the world. Beds, tables, chairs, boxes, stools, chests, and other pieces were nearly always made of natural solid wood, though veneering was known in Egypt, where it was used to produce coffin cases of great durability. The Romans too used veneers, though mostly for decorative purposes. Bronze was also used in Roman tables, stools, and couch frames. Pompeian wall paintings show that plain, undecorated wooden tables and benches were standard in kitchens and workshops and that paneled cupboards were common. Chests for valuables were covered with plates or bound with iron.

The early Middle Ages were much poorer in household furnishings of every kind than the Roman world, but in the 14th and 15th century a growing affluence brought a major revival of furniture making, with many new types of cupboards, boxes with compartments, and various sorts of desks appearing. The mortise and tenon and mitre provided greatly improved joints.

The growing sophistication in technique brought a revolutionary change in the men who made furniture. They where previously carpenters and joiners had made furniture along with every kind of building construction in wood, several circumstances combined to create a new profession: that of cabinetmaker.

In the earlier system of framework and panel, the framing gave the required strength in both length and width, the panel being a mere filling held in grooves. Its attractive appearance was the result of highlights and shadows produced by the framing, moldings, and carving, which formed the chief means of decoration. The grain of the wood was incidental.

In the new system of construction, plain, flat parts are dovetailed together and then veneered. It can be contrasted with the traditional framed method of rails and stiles put together with mortise and tenon joints, the panels fitting in grooves.

Coinciding with this change, or preceding it by a few years, was another breakaway: that of the chair maker, who had become another specialized craftsman. At first chair making was closely associated with wood turning but by the 18th century turned legs were largely replaced by shaped legs of the cabriole type. Chair making has remained a separate branch of furniture making ever since.

This growth of cabinetmaking as a trade of its own eventually resulted in a considerable degree of standardization of methods of construction, particularly in the types of joints used and in the thicknesses of wood for the various parts. It also resulted in an increased division of labor. Turnery became a separate trade, while the cabinetmaker assembled the turned parts; veneer and parquetry cutting was not done by the cabinetmaker although he laid both; carving too called for the skill and experience and tools of a craftsman who did nothing else.

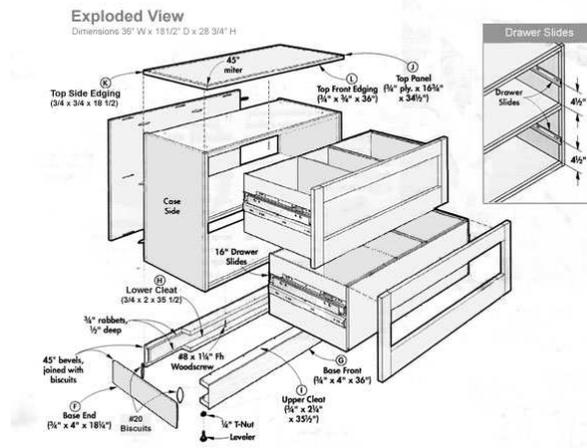
## 2. MODERN FURNITURE CONSTRUCTION

Modern furniture construction is marked by a number of innovations. While some see the modern period as the end of high quality hand-built furniture, this is not so. Furnishing an entire house was possible for only the wealthier citizens. Hand-made furniture were made the most efficient way possible, but it was still a labor-intensive and expensive craft. Modern manufacture made stylish furniture accessible to nearly everyone. Innovations have included high-speed machine wood preparation and joinery, spring upholstery, and the use of plywood and other modified-wood products (1). In the machine-age, dowel joinery largely replaces mortise-and-tenon, and dovetails are machine-cut and joined in seconds. Modern adhesives are stronger than wood, set rapidly, and withstand adverse environments and intense use. Nails, screws, and other fasteners - once made individually by hand - have become inexpensive as well as sophisticated. They now replace and even improve the strength of some joinery in new construction. In much modern furniture, joinery that was traditionally unseen is shown for decorative effect. There are really only a few ways to successfully join wood, whether building a house or a chair. Joints do more than make use of small pieces of wood. They make frames, increase length, and make large surfaces of solid wood. Many of these ancient methods were still found after the advent of metal fasteners (nails, screws, etc.) simply because the joints had proven so strong. The strongest method for joining wood at right angles is the mortise-and-tenon. The joint is like a squarest peg (the tenon) fitted precisely to a squarest hole (the mortise). There are literally hundreds of variations on the mortise-and-tenon joint, each suited to particular purpose or craft tradition. The most common tenon is rectangular in cross-section, as is the mortise. This gives great resistance to twisting forces. You can probably guess that a round mortise-and-tenon is not as strong. The tighter the fit, and the longer and taller the tenon, the stronger the joint will be. The so-called through-tenon, with the tenon completely penetrating the mortise-bearing member, is the strongest of all. It is important that the tenon not slide out of the mortise, whether the joint is for furniture, house, or ship. The most common means to secure the tenon is a peg, which fits into a hole near the opening of the mortise. In some cases, such as portable furniture, lashing is also used in combination. Wedges which spread the tenon in the mortise are sometimes seen. This also prevents the tenon from being pulled out of the mortise.

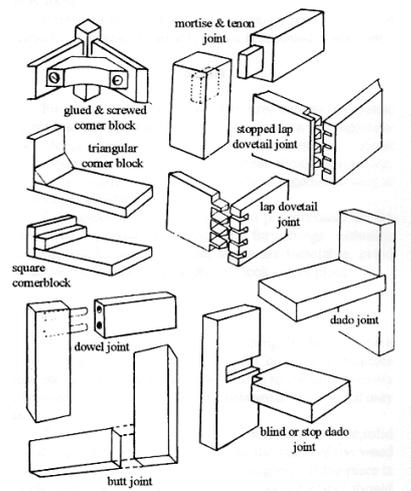
Probably the next development in joinery was the dovetail joint, which is often seen in box or drawer construction (2). The joint is comprised of a wedge-shaped tenon (the "tail") on one component which overlaps a corresponding wedge-shaped slot in a second component. The portion of wood surrounding these slots is called the "pin." Except in the case of decorative joinery, all the pins are on one board, all the tails on another. The term "dovetail joint" can refer to one tail, or many in a row, such as on a drawer side. As in the case of mortise-and-tenon, the strongest dovetail joint is made when the pins and tails go all the way through the joint. In the best mortise-and-tenon and dovetail joinery, no glue is required. More elaborate joinery, such as tongue-and-groove (a modified mortise-and-tenon), are used only for alignment of the mating surfaces. Veneering can also be thought of as a specialized form of edge gluing.

Joints which increase length are called spline joints. These have been used whenever the wood being available is not long enough, such as in house building. However, splining is also used for special properties, such as for greater strength of wooden ship masts. Splining is not often seen in furniture though, because it unnecessarily complicates construction. A mortise-and-tenon frame with legs would lift it off the floor. Doors of frame and panel construction would enclose the case. These are frames joined by mortise-and-tenon, with panels (perhaps two or more edge glued boards) fitted into a groove of the inside edge of the frame. There might be drawers; typically, these would also be of dovetail construction. The new fittings are usually used lately in different furniture constructions (3).

Salah-Eldien Omer: THE ROLE OF COSTRUCTION ON THE QUALITY OF FURNITURE



Picture No.1 : Modern construction of simple cabinet



Picture No.2: Standard construction details which are used in modern construction of furniture



Picture No.3: Modern Furniture fittings for furniture

### 3. MODERN FURNITURE MANUFACTURING

Modern methods of furniture construction and manufacturing are largely based on the availability of man-made materials such as reliable plywood, laminated board, chipboard, and hardboard as distinct from natural solid wood. It is not merely that manufacturers prefer the one to the other but rather that these substances are free from the great drawback fundamental to wood—movement. Natural wood shrinks as it dries or swells as it absorbs moisture from an atmosphere more humid than itself, and this movement must be allowed for in the method of construction. Unless this is done trouble may arise: splits along the grain or open joints on the one hand or jammed drawers or doors on the other. Over the years cabinetmakers have worked out ingenious systems to avoid these troubles in the use of solid wood, but today made-up materials may be regarded as inert if of good quality. To an extent solid wood has still to be used, notably for items that have to be turned, cut to shape, or molded, and for lippings to conceal the edges of manufactured boards; but virtually everything in the form of flat panels is made up.

One of the influences on the construction of furniture is the introduction of new types of adhesives in place of the traditional animal glue. Many are highly water resistant, some waterproof. Some can be applied cold, avoiding the complication of heating joints before assembly. They can be cured by heat in a matter of minutes, leaving presses and other apparatus free for other work.

A basic preliminary in all furniture production is the provision of working drawings. In a firm of any size there is invariably a special department where full-size drawings are prepared from small-scale drawings provided by the designer. In some cases the designer may make his own full-size, detailed drawings; but in a large firm it is more usual for a draftsman to work out the practical details, though usually in consultation with the designer, who advises on proportions and decorative details. The hand craftsman, in contrast, usually does the whole thing himself. In the small-scale drawing the general form and essential requirements are worked out; the full-size drawing shows proportions and constructional details. When the work is to be produced in quantity, costs are lowered considerably because only one setting of the machine and only one set of cutters are needed for the whole run of any particular part.

#### 3.1 Flat-pack furniture

The design of flat pack furniture (capable of multiple assembly/disassembly) that utilizes mechanical fasteners challenges to explore new and historic methods of component connection. Intersections between components must be carefully analyzed, the stress directions determined and a solution found. Without reliance on fasteners, students become adept at using the structural loading of the furniture (i.e., the user's

weight) to 'lock' the assembly together. The importance of accurate tolerance is reinforced, as is the use of tapers, locking pins and traditional wood joining systems. Students experiment with the notion of utilizing the inherent memory of a material under tension to maintain an assembly, and discover the difficulties of designing for home assembly by an unskilled user without tools.



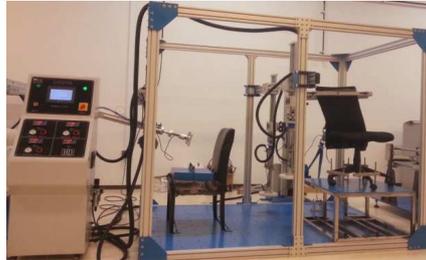
Picture No.4: Flat-pack furniture assembled without the use of tools

Furniture design is an excellent vehicle to stimulate 3D design education. A piece of furniture is a large product with inherent contextual, aesthetic, ergonomic and structural issues for the student to resolve. Successful designs rely on an understanding of materials, their properties and associated manufacturing processes.

It is an intimate product that is used in varying social and cultural contexts and it must be comfortable, appropriate for the chosen environment, and address the needs of user and environment. Studies of designing furniture have the opportunity to demonstrate aesthetic and human centered sensibilities and design proficiency in a context that allows real world understanding and evaluation. In many instances, furniture design exists as the culmination of the designers' learning; a validation of the educational journey manifested as a designer-produced artifact. Prototypes can be evaluated against ergonomic and aesthetic criteria, assessed for load bearing and functional performance, and then exhibited to validate the design and as a means of self-promotion. The furniture design curriculum is ideal for multi-disciplinary design programs, as it encompasses a wide range of skills and results in design outcomes that are easily accessible for the wider community.

#### **4. QUALITY OF CONSTRUCTION IN FURNITURE PRODUCTION**

Most of the construction elements used in modern furniture are modifications of old carpentry construction elements which proved that they are most implemented in furniture and after testing the furniture they showed a very high quality of product. The need for high quality and quantity production of furniture, elements of connection in the construction of wood products direct to a certain final shapes and quality. Standards of testing the quality of connection of products elements are recommending the minimum strength, tensile or compression, to be assured.



Picture No. 5: Tension mechanism for furniture testing.

In many cases before production, the construction of final product when the pro-type of is produced, they send it for testing according to the define needs to confirm the quality of the implemented construction. When the construction contains certain joints in combination with gluing process, they test the glued joint in final product and the adhesion strength of the glued area. Usually the quality of construction depends on the joining system and the quality of material integrated. The testing laboratories are mostly equipped with testing units for material testing, gluing quality, and testing of joints in different direction (5). Mainly the testing is planned to assure the quality of construction which define the total quality of the product.



Picture No. 6 : Special furniture testing machine for chair seat impact

Although most furniture testing for durability and performance is entirely voluntary in many markets, it allows manufacturers to have third-party validation of their brand.(6). Performance testing to national, international or industry standards gives you a competitive edge and adds value to your products. You can gain confidence in knowing how your product stacks up against the competition. Durability testing evaluates how well a product holds up when put to the test beyond its expected or designated function. We provide testing for furnishing fabrics, filling materials, furniture components and more.(7).



Picture No. 7: Tailored testing machine for multi purpose testing.

## 5. CONCLUSIONS

Here by we can conclude the following from the above mentioned material:

1. The construction of basic elements when it comes to wood based products and furniture are mostly taken from old carpentry joints,
2. The influence of design specially the modern design, is creating a lot of problems for the furniture producers when comes to quality of good construction which could be well processed,
3. Modern furniture design is mainly produced in small serial numbers where the specific of each construction are planned to be assured based on the place of final usage and durability recommended. It means that the construction of the product must be very good and supported by high quality joints and fittings if needed,
4. Furniture of modern and classic design is stimulated no a days with plenty of 3D design software which allow the expansion of the product where the engineer can apply the needed connections and joints to assure the quality of the product in production and usage sense,
5. The role of construction of furniture products is definitely influenced by the details of selecting the write joining or fittings applied to the write material built in the product.
6. The quality control methods and equipment are well established so every pro-type of construction or product could be checked and advanced after getting the write information,
7. Construction methods mainly depend on the type of material of product and could be solved in different ways based in the combination of joints and modern types of glues.

## 6. LITERATURE

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