

Mechanical mechanisms through working in details as a kinetic function of the elements of the design process

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Abstract:

The process of establishing a comprehensive analytical structure is defined by the symbolic and metaphorical aspect of the technical framework interpreted in the working in details drawings. The tectonic representation of these drawings refers to the principles of producing and assembling blocks that integrate the basic components of the content of the design process; function, structure, and materiality through a detailed arrangement without dissipating the intent or extent of the design within the implementation of kinetic mechanisms in the late 20th century. The Working details and technical drawings became an official language and an operational approach to model designs recognized between the designers to display ideas and express knowledge from one mind to another. They are reference analytical codes to understand every detail concerning the structure and the principles and joints governing the assembly of the unit as a whole. The mechanical mechanisms are the technical and efficient elements, embedded within the processes of the design and the production, to add a functional dimension to the elements of interior architecture. Kinetic properties emerged as a multifunctional dimension applying methods and elements of movement due to advances in mechanics, electronics, and robotics. The practical part of the study done the authors is represented in the working detailed drawings that analyze the wooden structure of a classical unit. It demonstrates how to integrate mechanical mechanism to the leaves of the cabinet in order to meet the user's needs. As a conclusion, these units adopted the concept of kinetic movement as a technological design strategy aimed to create adaptive types of interior elements and design destinations that are efficient in form, flexible in structure and adaptable to the diversity of purpose and multifunctional concept. As well as studying the modification of the traditional system of interior architecture through the implementations of kinetics.

Keywords:

*technical drawings
mechanical systems
mechanisms
multifunctional aspect
assembling joints
fabrication and production
techniques.*

Paper received 10th February 2017, Accepted 19th March 2017, Published 15st of April 2017

1. Introduction

Working details drawings are not simply an abstract illustration tool but constitute a mode of assembling and manufacturing techniques, in that its operation extends into structures inheriting a functional concept that lie beyond direct cognition and control. In interior design, technical drawings are habitually defined as fixed and often finite procedures of step by step instructions understood to produce the designed element. They can be interpreted as the translation of structures of joints and connections that interface with dimensions into performance and executive ideology continuously to be built and assembled. In other words, the working drawings are an interpretation of the theoretical concept of the design into detailed engineering drawings. With the development of modern technology, unusual patterns and designs emerged following unprecedented kinetic behavior that requires

genuine solutions⁽¹⁾. The infrastructure of these designs is implanted with mechanical processors and dynamic patterns that alter the use and the traditional system of different units⁽²⁾.

The synthesis, integration, and flexibility of the kinetic mechanism are the incentive potential to produce adaptive elements of the interior architecture. These structures adopt automated mechanisms of kinetic movement that have abandoned all that is traditional within the terms of form and function. Combining different techniques into a single complex design involves a multi-input by repetitious measures, it's a process described in the detailed technical drawings that allow the designer to transform structural ability into a recital description, to turn visualization into actuality. The detailed illustrations of the structural function are a constant summons that must be understood and perceived to produce responsive spaces.

This paper identifies the basis of the dynamic axis to produce a balanced design features through the implementation and intermingling between the components of design and the practical framework, plus the overlap between the vocabulary of interior spaces, the space itself, function, assemblage ability, quality and adaptation to the environmental surroundings, thus responding to the requirements of the users of the space⁽³⁾. The mechanisms of motion in interior design aims to create a unified set of elements in unprecedented series configurations that not only fit the actual functional requirements but complement them so that they can be utilized to the maximum extent and assembled by using different materials.

1.1 Significance of the study

The paper seeks to develop a new theoretical framework that includes the development of the traditional style in the design of interior architecture and mechanical mechanisms in order to clarify the technical basis on which the scheme of production relay;

- The concept of kinetic aspect as an important and influential part in the composition of mobile architecture and hence in interior design.
- The possibility of multifunctional concept adjusting the function and performance of integrated units due to the implementations of mechanic mechanisms of different types and forms to the currents of the execution of ideas.
- Principles and theories relating to the working details drawings and technical illustrations through orthographic projections, crossed sections and isometric perspectives of the unit.

1.2 Research problem

As we evolve, new trends in architecture and design emerge. The exterior facades and urban planning are exposed to constant changes to respond to the environmental surroundings and by turn to the requirements of every day's needs. These changes reflected on the elements of the interior that can self-transform and alter their infrastructure. To allow such ability, first we must integrate the appropriate mechanism interpreted in the mechanical movement of automated systems. This function dimension couldn't be achieved without a fundamental base of knowledge and understanding of assembling techniques and analytical detailed structure of different elements translated in the working drawings within an efficient framework to create a coherent performance between the units, the space itself and the user.

1.3 Aim of the study

The aim of the research is to demonstrate the effectiveness of the application of kinetic methods, the mechanical mechanisms of motion, in the process of design to adapt to the surrounding environment and the interior space through the metamorphism structures with kinetic mechanisms and intelligent systems. Beyond the structural function, the kinetics is predefined as mechanical devices that transmit movement force from source to output point. Mechanical formations combine the dynamic behavior, interactive response with mechanical function through a series of joints and sequential hinges moving in a specific pattern so that the entire links move relative to each other displayed in the working drawings. This study provides the ability to apply the proper kinetic systems to the infrastructures to provide an adequately functional property.

1.4 Research methodology

A descriptive scheme is required in order to achieve the objective of this study and deciphers the kinetic approach derived with the working drawings and the integration of mechanisms disciplines between architecture and mechanical engineering through;

- The theoretical framework that links kinetic and motion variables in the interior architecture, which describes the reciprocal relationship of the influence of the technical and aesthetic factors in the configuration of the elements of interior design and dynamic function.
- Detection of contemporary design methods, the mechanisms and kinetic systems in design and its reflection on the working details drawings.
- The practical analytical study of a wooden classic unit and the development of its designs and implementation of different materials, by the applied example with mechanic mechanisms interpreted in the technical illustrations.

2. Kinetic approach as an estuary

Kinetic behavior is a progressive methodology in architecture and design that allows some parts to move by mechanics or sensors, without reducing the overall structural integrity. The kinetic behavior adopted by the elements of interior architecture expressed its function format, which reflects the applications of the aesthetic technology to change the structure from a fixed stable form to variable configurations that move smoothly and flexibly⁽⁴⁾. The possibilities for applications of the kinetic architecture process increased significantly in the late 20th century due

to advances in mechanics, electronics and robots. After the fourth dimension of the design process, time through motion and mechanisms of mobility,

Enhance aesthetic design characteristics.

spaces became interactive and respond to its users, it was developed to;

Achieve functions impossible to be performed by a static structure.

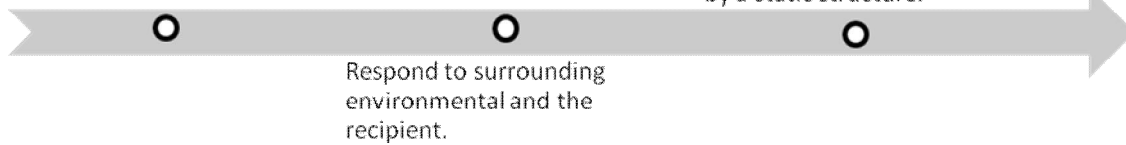


Figure1.the basic principles of the kinetic behavior and the progressive process to the concept of multifunctional dimension.

The concept of multifunction design and performance emerged, which in turn provided solutions and processors for narrow spaces. The aim of the movement mechanisms used is to change the design style from a physical system to a responsive mobile structure by creating a unified set of elements in unprecedented series configurations that correspond to the actual functional requirements but complement them so that they can be maximized and assembled using different materials and materials. The style of construction here is simple, lightweight, easy to install, progress in materials technology has helped the emergence of intelligent motor systems based on modern materials in manufacturing, which is characterized by light weight, flexibility and included structures are folding, jaw and installation and the transformation of parts to change the shape -Shape Shifting. There are also some kinetic systems that allow design elements to respond to changing conditions, as well as mobile structure of design shapes that allow easy transfer and re-employment in the inner space.

The kinetic function has become a fundamental feature of anatomical structures that have mechanized mechanisms that can be set in motion. Responsive Skins have emerged as an

evolutionary movement of the traditional stationary destinations and have added another function dimension which is the response to spatial adaptation and interaction with surrounding environment conditions.

2.1 Morphology of mechanical systems of motion

The morphology of the mechanical systems of motion is represented in the shifting design as the architectural facades and the elements of interior architecture with the mechanical mechanisms, dealing with the functional dimension. It added the fourth dimension through time in the design process, but there is also the aesthetic aspect in the movement arising from the use of motion mechanisms .

This study deals with this transitional part in the different mechanisms of movement between the external and internal spaces and the emergence of mechanically used furniture and the innovative materials which depend on the mechanisms of movement and its elements, in search of the aesthetics inherent in the kinetic concept and expressed in the working in details drawings. The study deals with the detection and clarification of the development of kinetic design in architecture and interior design.

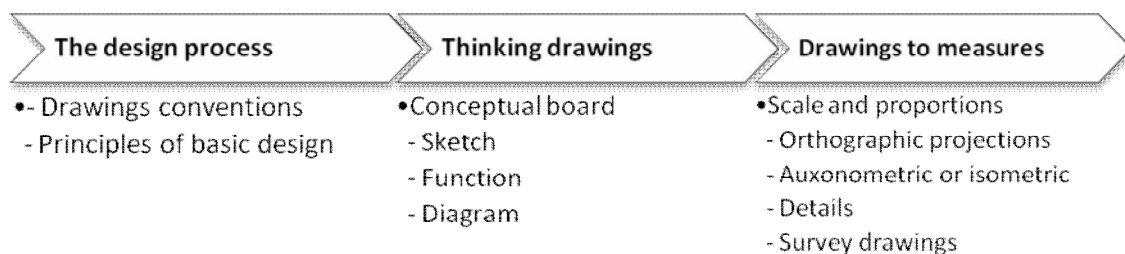


Figure2.the progressive process to an efficient balanced design step by step from visualization to actuality to be illustrated through the working details drawings.

Kinetic design usually refers to the field of architecture and exterior surfaces; however, there are many models of advanced technology in the field of architecture reflected in the adaptation and use of mechanisms of motion in interior design

within the horizontal and vertical contents of interior spaces. The development of the design ideology in the parameters of the spaces generated new formulations called the kinetic configurations. The composition here is used as a progressive

term, allowing a deliberate and unspecified approach to implant the proper mechanism in the

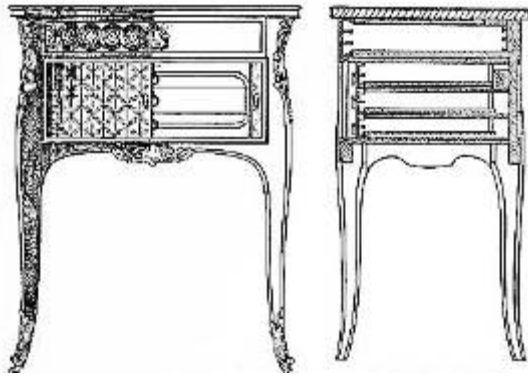


Figure 3, 4. demonstrates the working details drawings of a classical wooden commode and the wooden joints dovetailing connecting the outlined frame of the drawer and the application of the drawer slider mechanism and its installation to the unit to enhance its performance and add a kinetic function to it(5).

Transcendent mechanisms have crystallized the detailed theoretical framework of adaptive design concept and its relationship to the determinants of interior spaces through the continuous progress in the techniques of construction systems to meet the user's requirements. This was the base of the research to understand and offer a comprehensiveness scheme of kinetic design by adopting the intersection of the two main perspectives; the analytical aspect translated in the technical drawings and the function dimension using mechanisms to produce more efficient structures that interact with the user and adapt to space itself. It concludes the applied procedures to draw and present the results in form of engineering detailed drawings of applying these systems and studying the ways of integrating them into the traditional design processes.

2.1.1 Systematic approach of technical engineering design

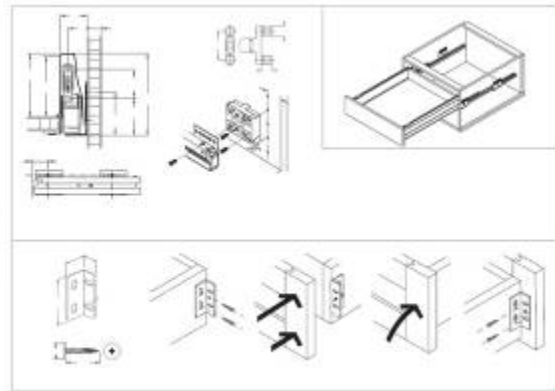
Mechanisms are considered a systematic approach in intricate planning and structural design process. It has a great potential for presenting design's solutions and strategies to surmount many complications that the designers encounter⁽⁶⁾. Engineering design is not a concept that can be easily defined, and several terms have emerged to expound the dialectic of the design in architecture and interior spaces which are:

- The distinguishing feature of engineering design is the recognition of the needed requirements, the existence of a problem or defect and the establishment of a system to meet that need and seek to solve it⁽⁶⁾.

In addition, useful definitions of engineering design are given by the exchange of experiences in engineering design (SEED) and the Accreditation Council for Engineering and Technology (ABET).

- The SEED definition refers to the

elements of the design, especially furniture.



engineering design as the overall activity necessary to establish and identify solutions to problems not resolved before, or to provide new solutions to problems while taking into account optimal performance.

- ABET 1990: Engineering design is the process of developing a system, component or process to meet the requirements for optimal resource transfer. The basic elements of the design process are the development of objectives and standards, analysis, construction, testing, and evaluation.

2.2 The aim of these kinetic systems

These systems aim to create spaces that are able to re-configure, self-optimize and customize their feature according to both users and the surrounding conditions. Kinetic systems can be used to convert one space into a multi-functional space that can occupy various activities by quickly re-configuring itself spatially to truly accommodate each particular function when needed. As kinetic systems allow buildings to adapt and respond to changes in the surroundings such as aerodynamic currents, light, and temperatures, they also allow buildings to react and adapt to long-term changes such as changes in environment patterns. Using kinetic systems, structures are able to respond to changes that and regulations and can be easily constructed, dismantled, reassembled, stored and transported⁽⁷⁾.

The design of the kinetic systems and automated mechanisms was based primarily on the advances in the material technology which helped to create formations and compositions with more advanced machine function and enable intelligent mobile systems. Different materials are applied in these structures variable in their lightweight and

flexibility. Smart materials are most inherently to design the corporations, the furniture and the ornaments of the elements of interior architecture. They can include structures as a whole or consist of a partial mechanism such as folding, sliding, extending, expanding, and even convert parts of them to become from motionless to multi-functional.

Some kinetic systems exist within each larger scale in a fixed position that allows them to respond to changing conditions. Other kinetic structures exist in a temporary location allowing structures to be easily moved while acting independently to the comprehensive context.

3. The art of woodworking through kinetic mechanisms

Kinetic systems can find flexible solutions for

sustainability. Also, these systems can present innovative solutions to meet customers' changing desires and needs. Although it is important to include kinetics since the early stages of the design process, kinetics can also be applied to existing built structures as a restoration. Kinetic solutions vary in complexity using any local materials with/without embedded control systems or advanced materials and high techniques⁽⁸⁾.

The classical wooden units are valuable for the application of kinetic mechanism as it is blessed with a privileged infrastructure and aesthetic feature as well as the availability of various functional spaces; drawers and inner cabinets. The application of kinetics to the elements of interior design helped to introduce a new era in the art of woodworking⁽⁹⁾.

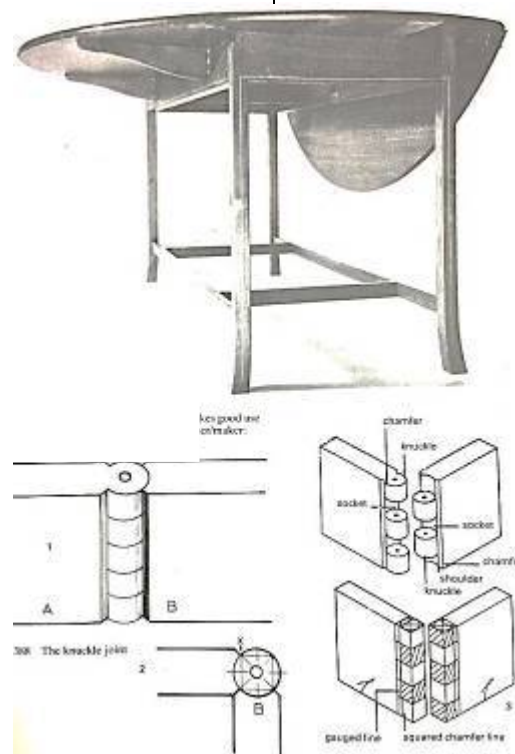


Figure 5. The application of a wooden hinge to fold the external part of the top of the table. The table is made of solid walnut with the traditional knuckle joint. Designer: Peter Kuh. The hinges follow the traditional style of woodworking adopting the same material as the table. It is created by chamfering the edges of the wooden boundaries.

The practical part is divided into two main axes, upon which the study was based. The significance of the research is represented in;

- The first emphasizes the emergence of kinetic mechanism and determines the most important scientific dialectic related to the assembling techniques as well as the application of the main criteria of the design process which can increase the aesthetic design and achieve interactive potential through the elements of interior architecture that respond to the requirements of the

recipient.

- The second axis can be divided into two axes; theoretical and practical. The theoretical approach indicates the aspect of the relationship between the user and the kinetic product. The practical part indicates the effect of the kinetic system the elements of the interior design illustrated by the engineering drawings. This is achieved by developing the traditional style in the implementation of mechanical hinges, joints and jaw mounting intelligent systems towards the advancement

of technological concept and merging | materials⁽¹⁾.

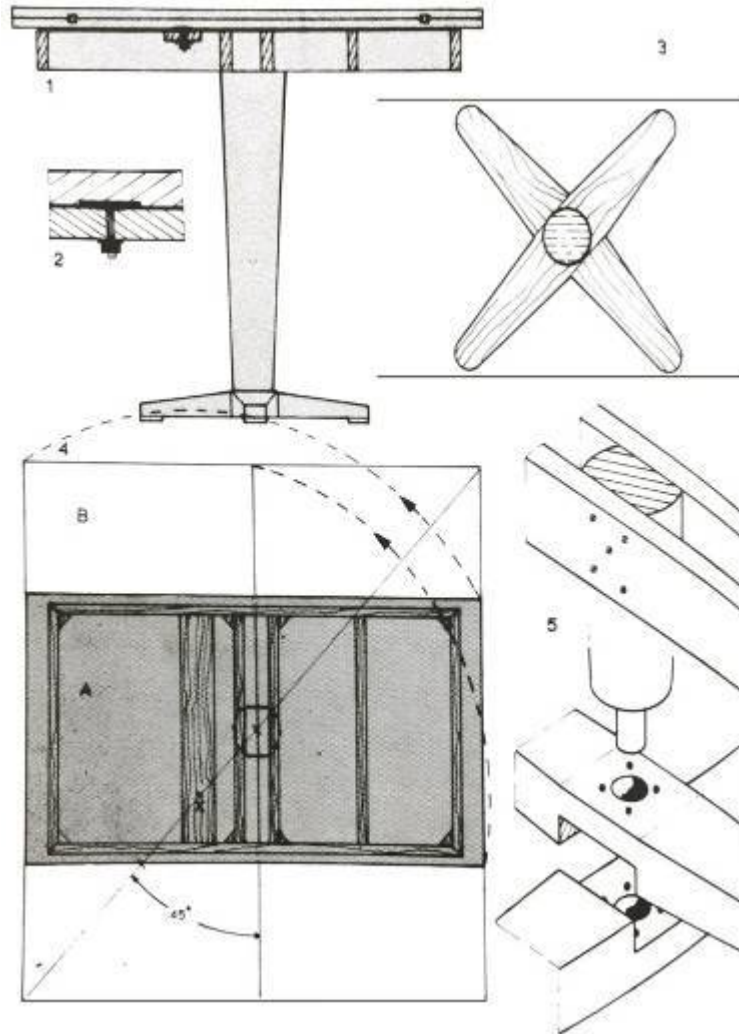


Figure 6. illustrate the working details of a pivoting top of a wooden table and its kinetic movement through a wooden axis, the detailed points are as following⁽⁵⁾;

1. Elevation view that demonstrate the detailed mechanism of motion.
2. A cross section of the pivoting mechanism and the central axis.
3. The displacement movement of the supporting beams of the top of the table.
4. A cross section of the plan demonstrating the woodworking and joints
5. A Disjuncted isometric view of the pivoting mechanism.

3.1 Working drawings defined within a theoretical framework

The executive technical drawings are a necessity for the presentation of ideas notably in the field of private industry, architecture, and engineering design. Architects and designers use native symbols and common perspectives to analyze and translate the assembly techniques, measurement, standard systems, and page layout. Together these agreements constitute a tangible expression help to ensure clarity and understanding of the executive drawings⁽³⁾. The intensification of these drawings

are formulated in accordance with the standards and specifications internationally accepted, and thus the working drawings exceeded the framework of the barrier technical illustrations and became a comprehensive synthesis of information and perception of mechanical concepts, complex compositions, joints and connectors of the elements of design.

3.2 Aim of the working drawings

Engineering drawings are usually characterized to provide all the executive details that enable the designer to fully understand without explanation how to implement and manufacture of the design to a realistic physical finished model.

- Provides a system of proactive and efficient infrastructure construction for translating the design into illustrated information about the design.
- Provides the detailed drawings required to implement mechanism or assembly of all the parts to finish the final design.

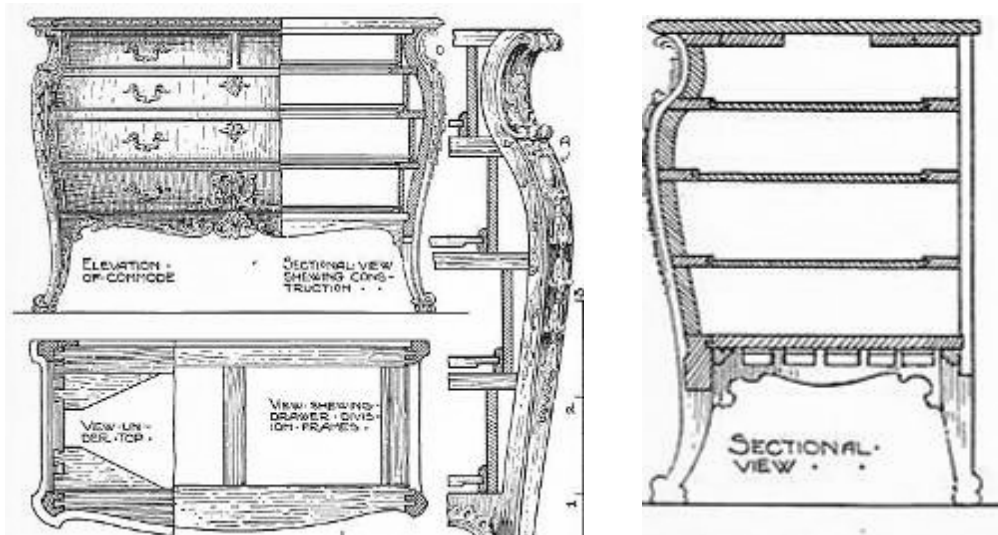


Figure6. Demonstrate an intersected presentation of the working drawings, half illustrating the assembling details of the technical drawings and the other the orthographic projection of the Chippendale commode.

They are an accurate expression and functional characteristic of the design since the concept of the functional basis of the drawings is a subjective interpretation of the implementation of the design of the different units. These drawings are presented in orthographic projections (horizontally and laterally) and detailed sections of the constituent element⁽⁷⁾. Finally, the perspectives and isometric views assembled or deconstructed to clarify the joints between the parts.

4. The practical working drawings

This study is based on the introduction of a new structural approach, the kinetic construction. Kinetics, when used in architecture and design, can be a part of a structure or a composition as a

whole depending on why and how they are used. As a result, it is important when designing structures to study its planned compatibility with changes that occur either in the way of use, the number of users, or any other change factors. The application of kinetic helped to add new possibilities for future adaptation of motion and self-optimization⁽¹⁰⁾.

The following working drawings done by the author under the supervision of the supervised doctor represent the woodworking details and joints that assemble the wooden classical unit. The wooden boundaries are assembled using tongue and mortise and Mitre 45 angle joint.

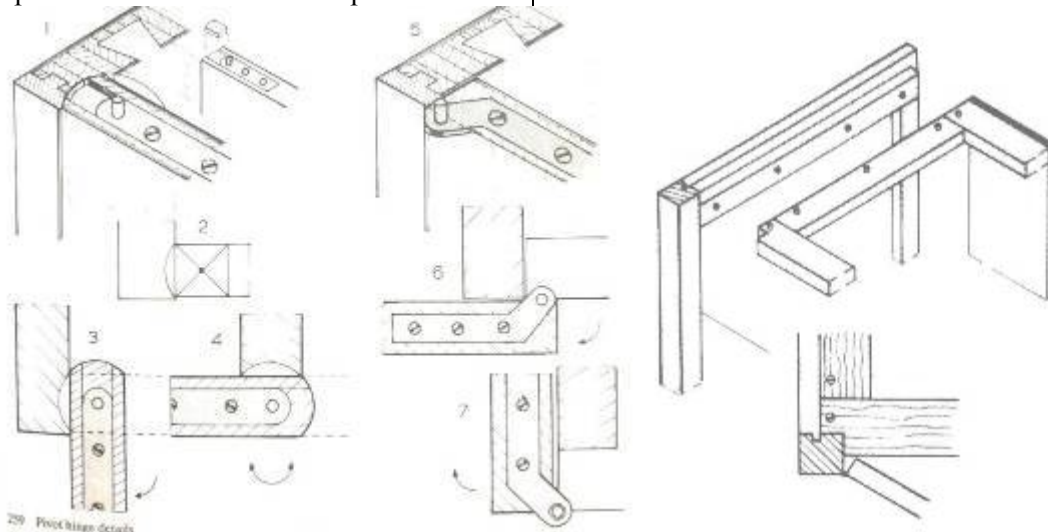


Figure7. A simple assembling of a wooden framed carcasses and the pivoting hinge mechanism installed to allow the movement of the cabinet door.

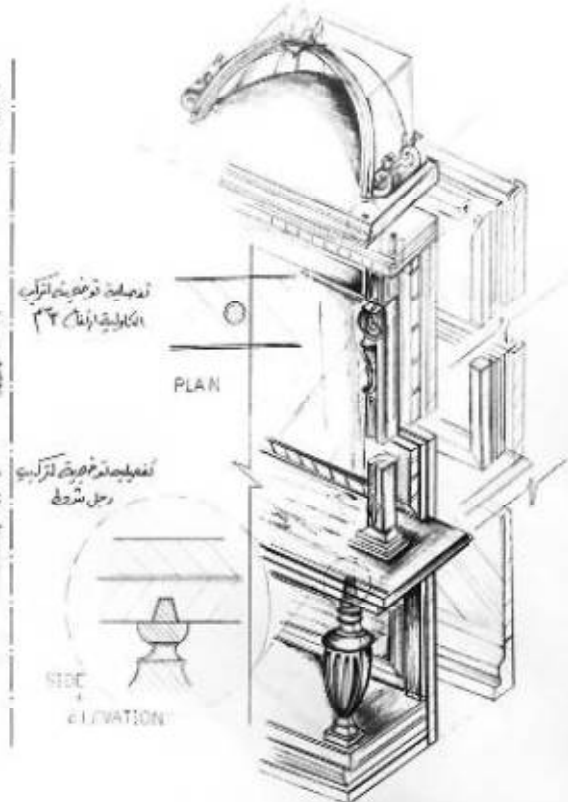
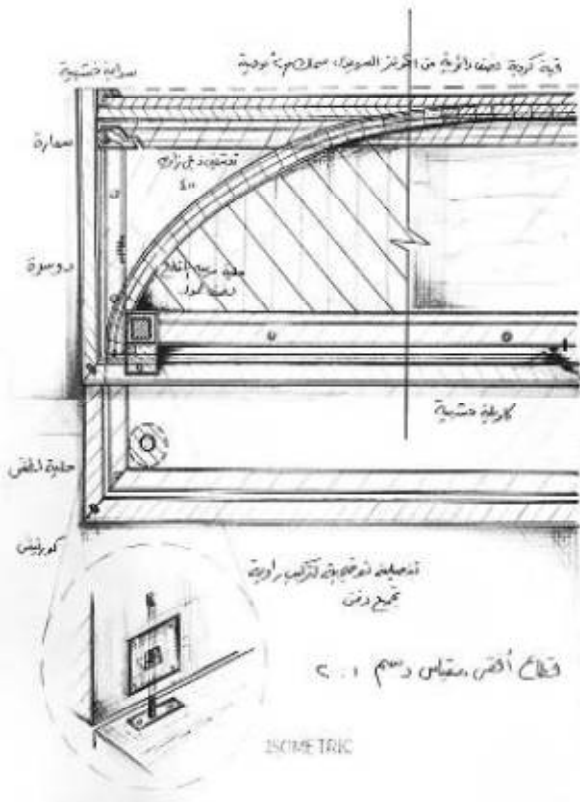
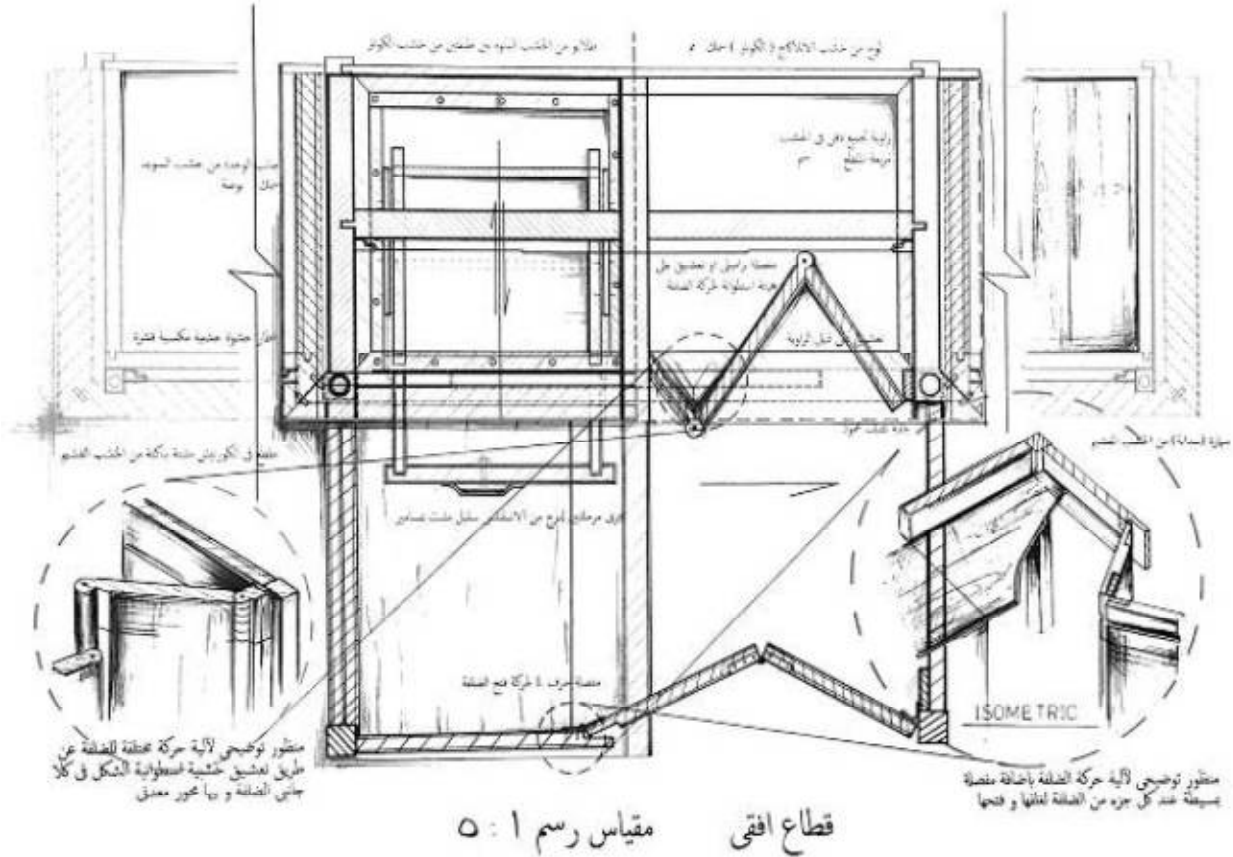
The solid infrastructure is based on the dovetailed to the top and bottom rails and a front pilaster planted on and either tongued and grooved, as shown, or glue blocked on the inside with a small bead or grooved at the junction of the side frames.

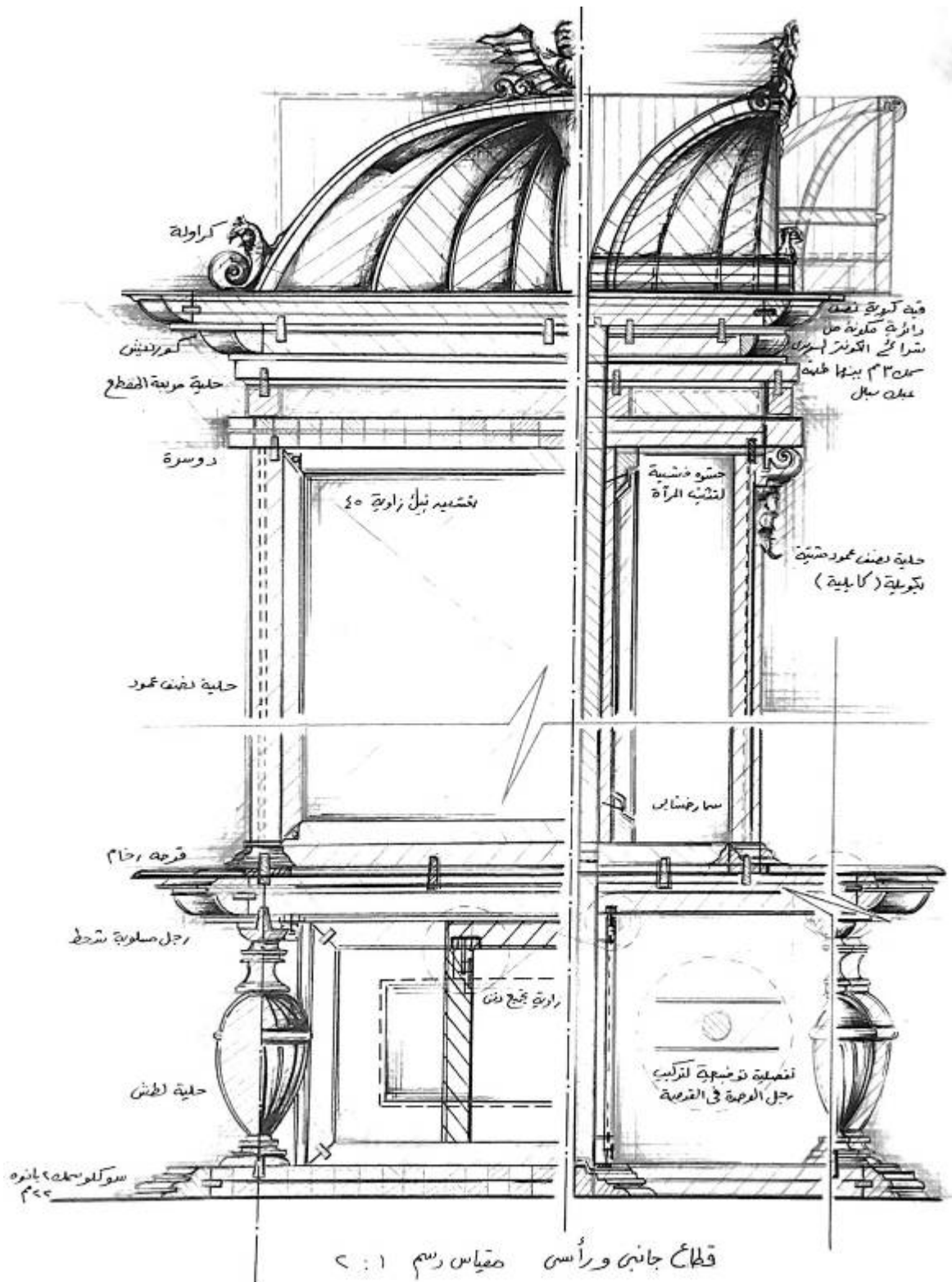
Miscellaneous hinges

The reversible screen hinge allows the separate wings of the screen to fold either way. With these the screen thickness must not be more than distance between the knuckles centers, while if it

is less the movement will not be affected but the wings will show a gap.
 Another types in demonstrated in a detailed option in an isometric perspective, a type of invisible hinge. The rule joint with extra wide plate to clear

the hollow in a molded rule joint, with the knuckle on the reverse side allows a full 90 degree drop⁽¹¹⁾. Kinetic construction can maximize the function and change the orientation or expand the size according to need or desire.





Above are these drawings drawn manually by the author to demonstrate the assembling details of the wooden unit. They represent intersected cross sections of the elevation and side view of the console combined in a single drawing. The basic joints are the Mitre 45, tongued and grooved joints with lipping edges of veneer⁽¹²⁾. The thinner posts require the end rails tenoned through wedged and the long rails doweled in.

5. Conclusions

This kinetic potential was reflected in the design of internal architecture and then emerged mechanisms of movement to change the

traditional style towards a responsive lifestyle that its users gives the ability to interact with the elements of interior architecture, and the possibility to change the static structures that surrounds him. Moreover, kinetic construction can



act and respond to weather changes as well as the changing needs of users. New technologies have a role in the development of kinetic structures, such as new materials (nanoparticles, those used in navigation, aeronautics and space science). Also, it will maximize the utilization of actual and synthetic resources alike. The mechanical mechanisms are the simplicity of motion that was the key to produce efficient designs, and provided smart solutions, where it secured the user in a space with the best amenities and requirements of modern life.

- The mechanism of the movement is a feature of the age and the ambition of the future; it has provided a new model "for the movement of design in the interior architecture and in the postmodern.

- This architecture has enjoyed a great deal of flexibility as it can adapt to different environments, meet human requirements and diverse activities, and provide formal possibilities for different functions.

- The materials for these units have the potential to be recycled. They are considered to be new and easy to trade materials, as well as "environmentally friendly materials that meet the requirements of sustainable architecture.

- Providing alternative economic solutions and different raw materials suitable for different units in the interior space and architecture.

6. References

1. Bayazit N. Investigating design: A review of forty years of design research. *Design issues*. 2004;20(1):16-29.
2. Arno J, Miller-Mead G, Truini J. The art of woodworking. Time-Life Books, Richmond, Virginia, Encyclopaedia of Wood. 1993.
3. Ferguson ES. Engineering and the Mind's Eye: MIT press; 1994.
4. Asimow M. Introduction to design: Prentice-Hall Englewood Cliffs, NJ; 1962.
5. Brazell KM, Everts RG, Rickard HG, Miyamoto K, Shiotani T, Sato M, et al. Drill press having a movable head and a tilt table. Google Patents; 1997.
6. Pahl G, Beitz W. Engineering design: a systematic approach: Springer Science & Business Media; 2013.
7. Griffiths B. Engineering Drawing for Manufacture: Elsevier; 2002.
8. Wierzbicki MN. Topologies and design methods for folding kinetic structures: expanding the architectural paradigm. 2014.
9. Gregory A. The Art of Woodworking and Furniture Making: Law. Press; 2011.
10. Kimbell L. Rethinking design thinking: Part I. *Design and Culture*. 2011;3(3):285-306.
11. Leospo E. Woodworking: Furniture and Cabinetry. Egyptian Civilization: Daily Life (Turin, 1988), fig. 1988;215.
12. Joyce E, Peters A. Encyclopedia of furniture making: Sterling Publishing Company, Inc.; 1987.