

A Study on Furniture Design for Disassembly

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ABSTRACT

Modernity which is superficial phenomenon set off the mass scale for mass consumption and provide uniformly artificial environment. But natural destruction, environment pollution, resources exhaustion and so on has been caused by this and now ecology is threatened by destruction and damage beyond the limitation and human beings survival is even threatened. Accordingly furniture development for environment preservation considered environment problem is the urgent real situation. Recent paradigm is the concept of Eco-design which is the green design possible to live together in symbiosis, and new types of alternative furniture are needed in Korea as well. 'Furniture for disassembly' is presented as new method for alternative furniture. Furniture for disassembly can be presented by mainly two directions. The first main characteristic is what is assembled by the use of woodworking joints technique as an assembly structure system without any hardware. The second is what is presented as the structure possible to be assembled by simple manual tools with hardware without any glue. The advantages of furniture for disassembly are environment preservation, space application, transportation efficiency and shapeliness. In manufacture method which is different from present furniture, the application of traditional truss technique which uses various types of custom-made and connection technique in case of assemble structure system without hardware is the typical differences. This assembly method expects not only interest induction about assembly and disassembly of diagram per sub materials but also the development of emotion, the improvement of collaboration, space perception ability and shape sense, the improvement of solid body structure insight and so on, when it use in the furniture for children with the application to many kinds of structure with BANGDOOSANJ (Wedged), JUMUGJANGBU (Dovetail) or NABIEUNJANG (Dovetail Keys) and so on.

Key words: Furniture for disassembly, Knock down system.

INTRODUCTION

The Purpose of Study

Communication and Transportation which has been started since 19 century perfected Modernism and took an approach to the age of mass scale for mass consumption due to Modernity. So mankind was reborn as more affluent society than the past but the society is attended with serious problems which are wastes of energy, the exhaustion of resources and so on. Destruction of nature and the environment pollution caused by these phenomenon threats ecosystems over the limitations and finally does the existence of human as well. According as the desire for agreeable global environment is grown and the concern about reservation of resources is raised, the world comes to reach an agreement on Rio Earth Charter as the gist of 'sustainable development' in order to maintain economic growth without more destruction of global environment. And also the

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naissance of 'Green Round'² which is focused on environmental problem and regulates Trade is heralded. Now, beyond the passive attitude that the issue of environmental protection practices for agreeable environment, the age that it would be impossible to produce, sale and trade without any endeavor which considers environment comes. Throughout this background, developed countries fix the study of environmental protection products to preserve their environment and resources. But the study of environmental protection products in Korea remains unsatisfactory compared with other developed countries. And Korean domestic furniture industry also remains seriously concerning environmental pollution because there are a lot of resource losses and emissions of noxious substance from consumption pattern of Mass production, Mass consumption and Mass disposal. Especially, furniture design development and quality control due to small scale production system is in poor condition, and cognizance of environmentally friendly furniture remains unsatisfactory as well. Recently, furniture by the tightening of Korean 'The Waste Control Act' is included in the item of emission of large size wastes, and the procedure of declaration and emission of wastes, according to the standard of large size wastes guidance, becomes strict with high disposal charge.

So alternative furniture of new format which considers production condition, technique basis and materials scientific side is needed. Furniture For Disassembly, as one of the methods, can be a focus of the concern.

This study has the purposes which establish the concepts of Furniture For Disassembly as a means of practical and environmentally friendly production system, and which present development directions for practical competitiveness base for Korean furniture industry through case studies that apply assembly structure system as practical methods and establish a strategy of furniture design for disassembly.

Study Methods and Scopes

This study is considered comprehensively from broad precedent studies concerning the theory related to environmental affinity and 'Design For Disassembly: DFD. In order to establish the concept of DFD with environmental views, it studies fundamental differences between furniture of various forms and DFD, and it establishes the concept. And it presents disassemble-ability, space utilization, environmental protection, load-ability and conveyance-ability, use of sustainable material and production method possible to disassemble as well, and it elicits differences from existing furniture and modeling character.

DEFINITION OF THE CONCEPT OF FURNITURE DESIGN FOR DISASSEMBLY

Comprehension of the concept of Furniture For Disassembly

Design For Disassembly that has been started in a corner of industrial design in 1990s was considerate in order to reuse or disassemble easily after products life. This can be shown as a turning point in the side that considered environmental factors in design.

Comprehension of the concept of Furniture For Disassembly has the meaning of moral relationship concerning environment beyond physical relationship between human and furniture. This is based on functionality and maximization of usability from prior development, energy reduction, optimization of material use, diffusion of rational production technique and all the factors of system application for reuse. In other words, this tells the furniture designed in system that human and nature is synchronized with nature technique with an aim of Sustainable Development presupposing De cycle and Up cycling from production of furniture.³

²The creation of an environmental organization that would handle so-called 'Green Round: GR' was expected in the signing ceremony of Uruguay Round: UR agreements held in Marrakech, Morocco, on April 15, 1994.

³ The subject at the Rio De Janeiro Earth Summit, 1992.

Recently, new types of furniture appear, like Knocked Down Furniture, Unit Furniture, Prefab System Furniture, Sectional Furniture, DIY Furniture (Do It Yourself), Built-in Furniture, etc., because of efficient use of space, recycle and reuse, load and conveyance, well-being, and so on. Comparative Analysis concerning various physical variable structure of this kind of furniture is as Table 1.

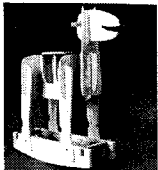
Definition of the concept of Furniture For Disassembly

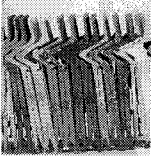



The concept of ‘Furniture For Disassembly’ is ‘Design For Disassembly: DFD. The boundary is ambiguous, compared to various forms of Furniture by new paradigm. It is the contrary concept to the furniture which views the completion as the existing “Assembly” state because “Disassembly” itself is an object when, most of all, looking at the sentence itself.

Design For Disassembly is another approach concerning effective recycling. This is the purpose of minimization of time and costs spending on disassembly, classification and recycling by manufacturing with possible minimum of materials, including unitizing components and products. It will be much more emphasized that designing to assemble furniture quickly is no less important than to disassemble effectively. And also it can have the meaning of replacement furniture in modern times that saving resources, minimization of wastes, reuse and recycling is recognized as important issue, and we can know the differences from existing completed furniture even in modeling factors.

Furniture For Disassembly can be defined by two concepts at large. First is assembling by the use of MAT-CHUM (Join) technique, and second is defined by modular system, that is foldaway furniture, which assembles by the use of hardware with simple manual tools, which are hammer, driver and so on, without any glue. Also, unit or expansion structure, scaling and rack structure and so on are similar to Furniture For Disassembly in the aspects of space utilization and recycling, but it can not be told as Furniture For Disassembly having real meaning because there are some cases that use glue partially and do not disassemble entirely.

Table 1. Various physical variable structure comparative analysis of furniture

Variable Furniture	Project' name, year of production	Structure	Structure Characteristic	Main Object Furniture	Main Material	Remarks
	A, Cedron & C, Giorgi. 1978	Knocked Down System	Easy assembly by hands without any hardware or glue. Possible structure to disassemble	Table, Chair, Stool, Playing equipment, Rack cabinet	Wood, Metal, Plastic, Corrugated cardboard	Various forms, Possible to display use, Minimization of volume when disassembling, Easy mobility.

	Techno, 1999	Folding System	Metal and Plastic hardware use. Structure folding and unfolded in a point of contact similar to joints in human body	The system furniture; furniture supporting for human body (Especially, furniture using in large quantities) Multi-purpose case goods etc.	Wood, Plastic, Metallic Material	Functional expansion, Functional display when unfolding, Volume reduction when folding, Easy mobility.
	comfort, 2000	Unit System	Metal and plastic hardware use. Structure assembling standardized monomer to various forms.	Case goods, Office furniture etc.	Wood, Plastic	Space rapport, Increasing space utilization, Functional and exterior variety.
	Korea Furniture Design Association: KFDA, 2001	Inflating System	No hardware use. Structure discharging gas or liquid, or pumping them in as bag form similar to tube.	Armchair, Water bed, The other furniture for leisure.	Synthetic Resin, Rubber, Fiber etc.	Minimization of volume when discharging water pumped in, Cushion effect by the mobility of liquid or gas pumped in.
	Kartell, 2000	Modular System	Metal and plastic. Structure assembling through modularizing each part.	Case goods, Office furniture.	Wood, Plastic	Variation of standard, Advantage of iterative connection.

CHARACTERISTIC OF FURNITURE DESIGN FOR DISASSEMBLY

Disassemble-ability

It is possible not to use hardware by MAT-CHUM (Join) technique and to assemble and disassemble by the use of hardware with simple manual tools without any glue. It was very difficult to separate and collect with the whole disassembly when disposing of because existing furniture was designed for convenient purposes of assembly (many use of glue and hardware) if we study this characteristic concretely. On the other hand, Furniture For Disassembly has the advantages that are easy to disassemble, classify and recycle, and that save time and costs, because of the design appropriate for reuse, recycle, reduce, refill, and regeneration as an ecological design for disassembly.

Environmental Protective Aspects

It has characteristic which has an economical effect at the same time as minimization of wastes naturally because it prolongs furniture life span through changing its damaged subsidiary materials to new ones. And also it can be ecological furniture design because it is very easy to separate and

collect by materials when scrapping, even though various materials are used, owing to be manufactured subsidiary materials by units.

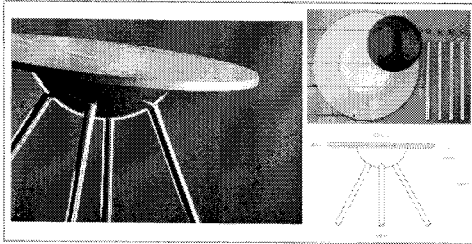


Fig.1. Mark Harrison, 1996.

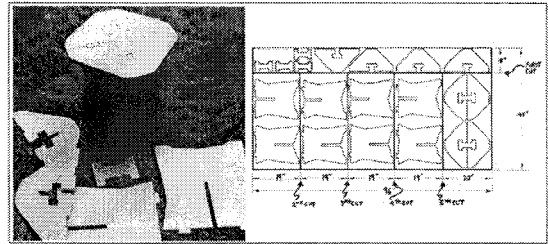


Fig.2. Nan Del Monte, 1973.

Space Utilization Aspects

The bounds of space utilization in a small living room or all-purpose room which should tidy frequently can be enhanced by disassembly and assembly from sheer necessity. The efficiency of loading space compared to existing furniture, when keeping physical distribution, owing to easy entire disassembly.

Even though scaling rack structure system furniture, expansion structure system furniture and unit structure system furniture is efficient when taking a side view of space efficiency, the aspects of using glue partially or not entire disassembly to subsidiary materials are the differences from Furniture For Disassembly.

Load-ability and Conveyance-ability

The development of transportation caused the activation of leisure life, the increase of single-handed migration population and the increase of suburban residents, and, as a result, alternative furniture is needed instead of bulky and heavy one. Furniture For Disassembly is very convenient for carrying and mobility because it can be loaded to small volume by disassembly. The more light materials are used, the higher the efficiency goes. And also conveyance costs can be saved because it can be loaded to smallest volume through disassembly according to subsidiary materials with keeping the quality of furniture as it is.

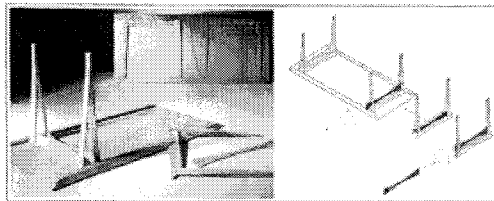



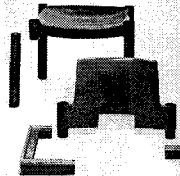
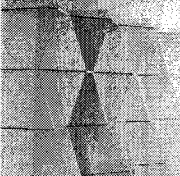
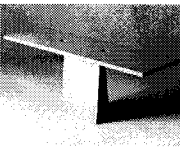
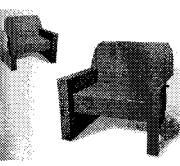


Fig.3. Spamo, Jacob Gebert, 1996.

Characteristics of Materials

Materials used in Furniture For Disassembly are various such as wood (log, plywood, medium density fiberboard), metal, plastic, glass, stone, cardboard and so on. If consider advantage in processing, as follows;

Table 2. Characteristic and issue of materials in the view of furniture for disassembly

	Project name, year of production	Materials	Characteristic	Advantage	Disadvantage
	Jens Nielsen, 1976	Wood & Wood based Materials	Traditional material and greatest usage because of many advantages.	Possible to process various forms of materials and to mass-produce	Weak in humidity and happen connecting sections abrasion
	Unknown, 1997	Metal	Process-ability and precision of material is high and possible to mass-produce.	Possible to mass-produce in various production methods and high precision of connecting sections	Necessary large energy for production and disadvantage of heavy weight
	Unknown, 1993	Plastics	Economical excellence, Light, and easy to manufacture and use.	Possible to mass-produce with economical price and to process to various colors and forms.	Difficult to reuse and generate endocrine disruptors
	Unknown, 2001	Glass	Various based on clarity	Possible to try various finishing methods such as spraying, etching or etc.	Less energy consumption compared to metal, but happen connecting sections crack
	Unknown, 1974	Stone	Mainly use in street furniture because of excellent durability.	Excellent durability and conveyance-ability owing to reduction of volume when disassembling.	Generating harmful materials to the health in processing operations
	Student Work, 2002	Corrugated cardboard	Environmental affinity materials and easiest materials to recycle. Inexpensive producing costs can broaden users range.	Structure fitted and assembled without deviation, easy to disassemble and lightness without any comparison with any material furniture in weight.	Unusable for long due to weakness in water resistance. Impossible to place a heavy object due to low tensile strength.









PRODUCTION METHOD POSSIBLE TO DISASSEMBLE

Assembly in Production Method

The original intention of MAT-CHUM (Join) or YI-EUM (Edge to Edge) Technique in traditional furniture is cementing, but JJA-IM (Joints) Technique in Furniture For Disassembly has

the purpose that fixes each subsidiary material, which consists of the structure of furniture, without any glue and can be easy to disassemble. And also when assembled in JJA-IM(Joints) Technique, an appropriate technique should be selected according to places and materials that intend to do MAT-CHUM (Join) through the perception of stress such as tensile strength and shear strength concerning load and pressure on the structure of furniture. The MAT-CHUM (Join) parts can be disassembled by some strength in disassembly. So the use of the various forms of MAT-CHUM(Join) Technique, YI-EUM (Edge to Edge) Technique, SAN-JI (Wedge) for stiffener and JANG-BU (Tenon) for stiffener in Furniture For Disassembly can be application for traditional GYEOL-GU (Structure) Technique.

Table 3. JJA-IM in production method

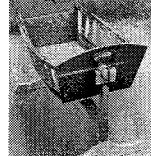
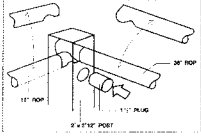

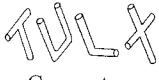

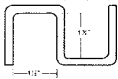
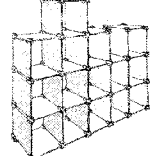
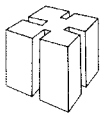
furniture applied by JJA-IM	Project' name, year of production	JJA-IM(Joints) structure	Characteristic
	A, Cedron & C, Giorgi, 1978	 BAN-TEOK-MAT-CHUM (Cross-Lap)	Cross format structure is a combination which pick away halves of the center of each boards as the application for traditional BAN-TEOK- MAT-CHUM. (Cross-Lap)
	Student Work, 2002	 NA-BI-EUN-JANG (Dovetail Keys)	Technique which embed EUN-JANG (Keys) in the butt joint boundary of two subsidiary materials
	Luligl Colani, 1978	 JANG-BU-MAT-CHUM by SAN-JI(Wedged)	It plays a key role in assembling and disassembling Furniture For Disassembly)
	Jung Yeob Han, 2006	 Compound SA-GAE-MAT-CHUM(Finger Joint)	The technique using by mixture of more than 2 MAT-CHUM Techniques(Finger Joint)

Assembly in Production Method

It can be reassembled without any damage of assembly sections using metal stiffener in case of disassembly as the technique manufactured by the use of simple hand tools. Connectors,⁴ Friction Locking Clamp, Plug-Together System, Inter Locks, Aluminum Corner Post and so on are used. Various forms of hardware are also used.

⁴James Hennessy, 『NOMADIC FURNITURE』, Pantheon Books, 1973. p89.

Table 4. Hardware in production method

Furniture applied by Hardware	Project' name, year of production	JJA-IM structure	Characteristic
	James Hesty, 1970	 Inter Locks	As a very special system used in furniture, if putting MAT-CHUM-stoppers in and fixing, then locking. ⁵
	WTHUS SOFT. 2006	 Connectors	Possible to assemble shelf, bookcase and so on by the use of various forms of connectors
	Fiy Line, 2000	 Friction Locking	Supporting shelves and objects by Friction Locking without any processing
	James Hesty, 1970	 Plug-Together System	Use in assembling shelf bracket, jungle gym or boxes.

Comparative Analysis of Production Method

Comparative analysis concerning advantages and disadvantages of assembly structure system using JJA-IM (Joints) and metal stiffener is as Table 5.

Table 5. Advantages and disadvantages comparative analysis according to the existence of hardware use.

Assembly Structure System		Assembly Structure System Using Hardware	
Advantages	Disadvantages	Advantages	Disadvantages
Functional Aspect			
Easy to assemble and disassemble with bare hands.	The phenomenon of abrasion of connecting sections in frequent assembly and disassembly occurs.)	Stability is stiffened.	Simple hand tools should be carried in assembly and disassembly.
Environmental Aspects			
Only damaged subsidiary materials can be changed to new one	Environmental problems according to material use with the first consideration in log products	Possible to separate and collect in disassembly	Subsidiary materials should be changed totally if hardware and connection part is worn away in frequent assembly and disassembly.
Modeling Aspect			
Possible to design in combination with standards, forms and colors of furniture subsidiary materials, and to produce naturally.	Impossible to process exterior form clearly due to connecting sections structure.	Possible to design in various forms by the development of relatively various forms of hardware	No big different from the existing furniture on exterior form.)

⁵James Hennessy, 『NOMADIC FURNITURE』 Pantheon Books, 1973. p126,127.

CONCLUSIONS

This study establishes the core proposition, which is ‘the concept of Furniture For Disassembly’, and presents study directions and practical use plans. As antecedent studies, differences between new types of furniture and Furniture For Disassembly were examined, and the characteristics were presented. Empirical studies were fulfilled through production methods and case studies as well, and the following conclusions were established through comparative analysis concerning it. The case which uses glue or doesn’t disassemble perfectly can not be defined as real Furniture For Disassembly. It became known that the only Knocked Down Furniture meets the requirements of Furniture Design For Disassembly. As the conclusions that the characteristics of Furniture For Disassembly are classified and presented as disassemble-ability, space utilization, environmental protection, load-ability/conveyance-ability and the use of sustainable materials, it can be laid down as following guides ;

First, space utilization which saves space loading and keeping subsidiary materials owing to easy disassembly, when unnecessary, is high because it is easy for consumers to disassemble and assemble by hand, and the point of easy disassembly and loading is effective against the reduction of shipping expenses and physical distribution cost in business sectors. The need of Furniture For Disassembly which can be disassembled simply and moved, instead of the existing big volume furniture is increased by the increase of single-handed migration population which residences should be migrated due to employment, entering school and so on frequently. Minimization of wastes and economical effects can be achieved naturally at the same time because service life is prolonged through changing the damaged subsidiary materials of furniture to new one.

Second, the central use of log is appropriate for well-being life style which considers health because of the harmlessness in human body. Finally, various assembly structures applied simple assembly method and JJA-IM(Joints) Technique are worth as learning instruments which improve emotional development, or which improve the insight of stereo-structure, space perception ability, formative sensibility, cooperativity and so on. Based on this study, further full-scale study concerning Knock-Down System, which is the production method of Furniture For Disassembly, is needed, and especially the study of the compositive application structure concerning Korean Traditional MAT-CHUM Technique and E-EUM Technique applicable to analytical factors should be continued.

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