



Voice of Academia

Academic Series of Universiti Teknologi MARA Kedah
Vol. 7, No. 2, 2012
ISSN 1985 - 5079



UNIVERSITI
TEKNOLOGI
MARA

The Chronology of REITs Development in Malaysia

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*Persuasive Technology Adaptation in CAPD
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*Sustainable Design: Exploration of Recycled
Materials Physical Forms in Furniture Studies*

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*Pengurusan Emosi Dalam Surah Maryam Ayat
21 hingga 26*

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Sustainable Design: The Exploration of Physical Forms of Recycled Materials in Furniture Studies

This research was supported by the Excellence Fund 2011/2012, UiTM.

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ABSTRACT

Environmental issues have become hit issues nowadays, as the critical usage of natural resources can cause damage and destruction to the environment. Designers and manufacturers currently are searching for and finding solutions to overcome this major problem. New technologies were developed to aid manufacturers in developing new materials from discarded forms or waste materials. In order to save costs, some of the materials were used in a continuous cycle or it is been used in reiterate order called recycling or reusing. Wastes can be considered as non – waste when the wastes are transformed into products giving new functions which will help in reducing the environmental issues. The recycling process will help in preserving the environment for the next generation and at the same time benefiting the economy of the country. The aim of the paper is to determine and identify the flow and flexibility of recycled materials in physical forms to enhance their usage in furniture design.

Keywords: Environmental issues, recycled materials, recycling, flow, furniture design.

Introduction

The design world today has grown to be one of the demanding industries worldwide. Design involves creating and developing new ideas for products and visuals. It engages with the manufacturing process for mass production. Generally, all products that have been produced will be distributed by manufacturers to the consumers and are used as a daily- use product for home and business tasks.

Sustainable product designs have become a new paradigm for the design world, where all products must be fully compatible with nature throughout their entire lifecycle. Designers and manufacturers are in the league to find better design solutions and manufacturing processes that can reduce the cost, material, energy and manpower consumption (Datschefski, 2001). Products that used fewer materials selections will reduce the manufacturing costs and the energy consumptions as different kinds of materials use a different approach of utilization. Datschefski (2001) states that the unsightliness that cannot be foreseen lays behind an individual product which looks harmless but can cause environmental depletion.

Environmental issues are caused by the extensive usage of raw materials (Gibson, 2008; Schischke, 2005) and inappropriate process of production. Product or furniture design using materials that are not suitable or green may cause environmental burden. The extensive usage of raw material can jeopardize nature and will affect the future.

The Understanding of Sustainable Design Globally

Sustainable design has been discussed factually since the early nineties and has become an ethical and big issue where most organizations, manufacturers and others have taken part to find a solution to prevent this issue from becoming bigger. When involved in designing consumer products, consciously or not, the design of products and processes is the main determinant of environmental impact (Datschefski, 2001).



Sustainable Design Principles

Datschefski (2001) has stated five basic principles as a guideline to sustainable design which is ***cyclic, solar, safe, efficient and social***.

Cyclic: Using recyclable materials as a basic etiquette of cyclic product manufacturing, all of the materials can be recycled and which can be organic or inorganic materials that can be produced again to be new types of products.

Solar: Environmental performance can be improved extensively when less energy is consumed by the product designed. Wind, wave, biomass and photovoltaic (PV) are the main power supplies that are very useful.

Safe: All the materials or others that are disposed during the product processing will be nutrients for the environment and it is crucial to use the environmentally friendly materials during the manufacturing processes to avoid the environmental consequences.

Efficient: This concept, generally known as eco - efficiency, means there will be a cost and energy saving to benefit the environment, consumers, designers and manufacturers by reducing the usage of energy, materials and water.

Social: Humans are involved mostly in operating the industry. A good and healthy working condition will influence the total efficiency of the products. Workers must be treated right and the principle of workers must be practices so there will be a continuous improvement in the performance of the workers.

Sustainable Design Four Steps Model

According to Charter and Chick (1997), with the four steps model of sustainable design with adds to harmonizing the social, ethical, environmental and economic issues while designing products. It started with 'Re - think' the way manufacturers operate, function of the product and provided services to the consumers. Then the sustainable design step model continues with 'Re - design' where designers play a vital role at this stage

in designing or developing new products. 'Re - fine' will be the next step to refine the accessible processes and product synchronization with the concept of sustainable, eco or green design. 'Re - pair' is dealing with finding a new proposal solution after getting the results to refine the previous design stage and it will be the fourth stage of sustainable design or 'end of pipe' solution.

Seven Golden Rules of Sustainable Design

According to Tischner (1997), there are seven golden rules of sustainable design that must be taken into consideration in design processes, which are:

The assessment of the environmental impacts of goods has to integrate the whole life cycle. All the materials or the environmental resources have to be estimated as the sources must not be used in the wrong way because it will affect the environment consciously or not.

The service intensity of processes and goods has to be increased drastically. The production and manufacturing of products in appropriate ways must be maintained and improved radically as the benefits and advantages will be the strength of sustainable product principle.

The material intensity of processes and goods has to be reduced drastically. The usage of materials that can cause an environmental crisis must be reduced similarly the usage of hazardous materials or substances that may cause destruction and devastation of ecological must be avoided.

The energy intensity of processes and goods has to be reduced.

A production and manufacturing process involves the extensive usages of energy and might cause a deficiency. The usage of energy such as electricity must be reduced or replaced with natural energy resources to help in cost reduction.

The land – use through processes and goods has to be reduced

The usage of recycled materials that are reproduced again can reduce the volume of land filled as most of the recycled materials will be used and not to be buried down into the earth. This also helps in reducing transportation cost.



The emission and use of toxins have to be eliminated

Hazardous materials or harmful chemical substances must not be used and the other alternative elements by nature are always the best solution to replace the usage of these types of substances.

The ecologically sound use of renewables has to be maximized

The good thing is to use a renewable that comprises natural energy. Using environmentally friendly and renewable materials using help in maximizing the environmental performance.

Recycling in Malaysia

Kementerian Perumahan dan Kerajaan Tempatan (KPKT) (2006) has defined *recycling as the activities of (1) separation and collection of waste materials, (2) preparation of waste materials for reuse, reprocessing and remanufacturing, (3) reuse, reprocessing and remanufacturing of these waste materials*. This includes activities of:

- a) Separating, retaining of waste materials at generation source to be reused, collected or sold to collectors.
- b) Delivering the waste materials to recycling centres or any collection points.
- c) Trading or any business dealing with selling and buying of waste materials from one party to another party. Reprocessing or remanufacturing the waste materials into other products (including composting process).

Importance of Waste Minimization

Ministry of Housing and Local Government with JICA Study Team (2006) have conducted a study on National Waste Minimization in Malaysia to promote waste minimization program which is the 3Rs (Reduce, Reuse, Recycle) as to be in line with the Malaysian Solid Waste Management Policies. As stated by Lucas (2011), recycling is a possible action and can be done by everyone.

Reduce

To manufacture long lasting products

Manufacturers have to produce products that are lasts longer and more durable as it's a way to reduce the cost in production, material usage and time saving which provides more benefits to the manufacturers.

To use products as long as possible

Consumers will find and purchase products that can be used as long as possible through its lifecycle.

To buy recycled or recyclable products

There are several manufacturers and companies that are into this area of recycled materials or products by providing services of collecting, buying, producing, selling and consultancy. The government found that this is also another way to promote recycling activity in Malaysia.

Reuse

To reuse disused goods

The local authority has provided a place where the community can place the unwanted products there. The entire disused products will be sent to manufacturers or factories which make use of the materials to produce a new form of products.

Recycle

To utilize recyclable materials as resources

All the recycled materials can be used again or reproduced as new products. The idea is to make use of this material widely as it has been applied by most of the people around the world. The materials do not just produce new products but also can be huge earnings for people who are involved in this valuable industry.

Reduction of land filling volume and collection and transportation cost

If the recycled materials are reproduced again, surely it can reduce the volume of land fill, where most of the recycled materials will be instead of being buried down into the earth and also transportation cost can be reduced.



Reduction of exploitation of natural resources

Recycled materials can reduce the mistreatment of natural resources as the materials were from disused goods and will be used to produce new or same products and all the materials will go through the same process in future.

Objectives of Research

- a) To identify suitable and proper materials that can be recycled and reused to produce furniture design.
- b) To identify the flow of design that can be achieved by recycled materials in producing furniture design.

Research Question

- a) How can the materials be manipulated to become a different form or structure of materials?
- b) How can the recycled materials usage save cost and reduce the extensive usage of raw materials?

Research Methodology

The exploration on recycled material flexibility will allow the materials to extend and strengthen beyond the physical form of the materials to develop to become more diverse. The researcher used a qualitative method to perform this research. Descriptive data will be retrieved from books, journals, reports, magazines and article whereas primary data are gathered from the experts and the respondents. Other than that the researcher will measure the flexibility and characteristic of recycled material towards its application and usage in the furniture designs that may result as solutions to minimize the widespread usage of raw materials in furniture industries and to overcome the ecological crisis.

Preliminary Data Gathering

Data and information about sustainable design and recycling has been

gathered from previous research designs, books, journals, magazines, articles and from online sources.

Observation and Survey

The researchers have done observations and surveys of 15 furniture designs of students' projects. The students were required to produce furniture designs that used recycled materials as the main materials. From the observations, the researchers have managed to identify the types of recycled materials that have been used and determined the physical forms of the furniture designs. A questionnaire was designed to discover the difficulties and problems that occurred during the prototyping processes. 15 students were asked to answer the questionnaires.

Semi Structured Interview of Focus Group

From the 15 chosen furniture designs, 5 designs were selected based on the different material usage. Questionnaires were distributed among the design lecturers in order to get valid results from the experts. They have suggested improvements on the recycled material application or design in sequence to produce better furniture designs.

Analysis of Findings from Questionnaires and Interviews

The data that have been obtained from both students and the design experts will be analyzed to identify the application and flexibility of recycled materials in the prototyping process. 15 designs were chosen and will be analyzed in order to identify the use of recycled materials and the flow or physical form of recycled material application in furniture studies (Please refer to Table 1).

Material Usage in Furniture Studies

Based on the research, several types of recycled materials have been identified and categorized into groups of recycled materials (Please refer to Table 2 and Table 3).

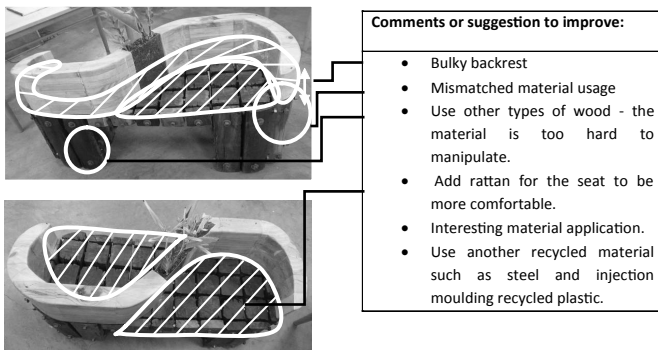
According to the tables, it can be concluded that most students have difficulties to produce designs using recycled metal and wood but have no



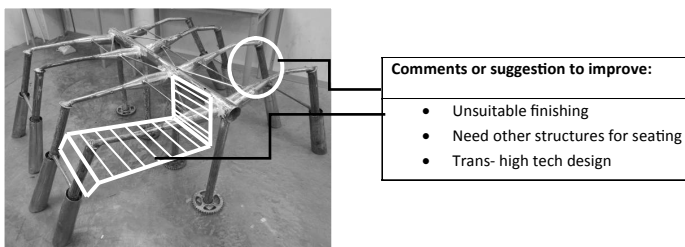
problems to explore the flow or flexibility forms of the designs using paper, aluminium cans and other mixed materials. The difficulties they had faced while using the recycled metal and wood may be caused by the condition of the material itself. Metals can only be used by the students by cutting, welding and bending without altering or modifying the metal condition (by melting or reheating process). However, there are 3 types of wood, which are soft, medium and hard that have been used to produce furniture designs. The usage of hard wood may limit the students' abilities to explore and manipulate the materials.

Results and Discussion

From the 15 designs of recycled furniture, 6 designs were selected based on different types of recycled material application in furniture design and comments were given to improve the designs. 5 experts (design lecturers) were chosen to identify the flow on recycled material's physical forms that can be revamped and improved.



Eco Design Outdoor Bench



Recycled Exhaust Pipe Park Bench



Comments or suggestion to improve:

- The structure should use recycled materials.
- The newspaper need to be stacked to be stronger. Different paper, different strength.
- The overall design needs to be improved.
- Good material selection.

Eco Design Lounge Chair



Comments or suggestion to improve:

- Armrest and backrest need to be improved - using soft and no sharp edges materials
- Good material selection but structured wrongly.
- Need improvement on design and material selection

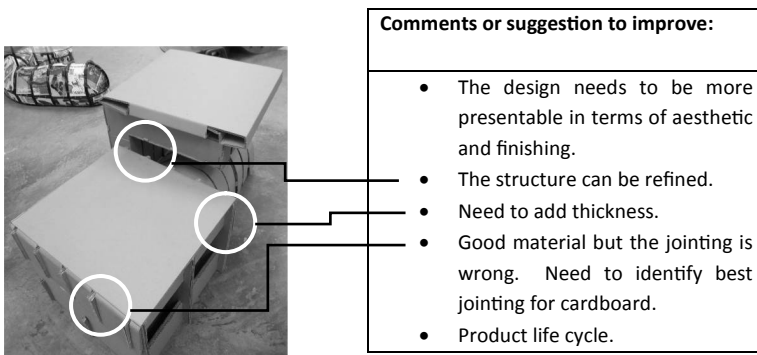
Eco Design Lounge Chair



Comments or suggestion to improve:

- The outer structure of wall shelves needs to be thicker than the inner structure.
- Recycled steel is acceptable but not the ice cream sticks. Ice cream sticks should become tooth picks.
- Add lighting to become more interesting.

Eco Design Wall Shelves



Cardboard Stool and Table

Based on the findings above, all 5 designs were needed to be improved. The experts have offered new suggestions to form new designs as the current designs need to be improved. The white lines/shapes are the new suggestions that the flow of the recycled materials should be designed and be revamped.

Conclusion and Recommendation

In a nutshell, the usage of recycled materials in furniture studies will allow the students to explore and experiment in order to achieve the best designs. The recycled materials usage will help the students to save cost from using the raw materials to produce a furniture design. Based on the research questions and method of research that have been done, all of the questions have been answered.

a) How can the materials be manipulated to become a different form or structure of materials?

There are certain stages of manufacturing processes that recycled materials can go through to produce new types of product designs manually or by using high technology equipment or machineries. Recycled materials are the best alternative solution to replace the extensive usage of raw materials because recycled materials are cheaper than the raw materials as most of

them had been used to produce other products. The students were allowed to do experiments by cutting, dismantling, bending, welding and joining the materials without altering the structures and original molecule forms of the recycled materials. All of the processes were done in the workshop with lecturers' and technicians' supervision and it is different from the processes done by manufacturers or factories which are fully equipped with certain machinery to help them to alter or modify the molecule structures of recycled materials. This process is not allowed for the students because recycled materials may contain certain chemicals that can only be done with supervision by experts and using high technology equipment.

b) How can the recycled material usage save cost and reduce the extensive usage of raw materials?

Recycled materials are cheaper than the existing raw materials because most of the recycled materials were discard by previous users. This occurred when the materials have reached its maturity or end life of its life cycle where all of these materials will be discarded and sold cheaply to the collection centres. As for this research, students must search and gather the recycled materials by themselves or retrieve for free from the collection centres. For the overall cost, with RM150 students must not exceed more than to produce a new furniture design using recycled and mixed materials. These budget restrictions will help the students to produce a design with cheaper costs because most of the current designs by manufacturers cost more than that amount.

From the findings and data that has been collected, it can be concluded that this research has met its objectives. The researchers have found that;

- There are several recycled materials that have been identified and can be used as new materials in furniture design.
- Recycled materials can save the cost of production and manufacturing.
- Recycled materials can be explored to become a new form or structure of materials by doing certain processes manually or by using machinery.
- The usage of recycled materials in furniture design allows the students to explore and combine the recycled materials to best suit the design and function of the furniture.



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Furniture design		Problem/ Difficulties in design processes
1.	Newspaper side table	To weave the newspapers. The newspapers were not an easy material to deal with because the material is fragile and easy to tear.
2.	Malay Low Table	to join the firewood to made the rounded shape of the low table structures.
3.	Exhaust Park Bench	to weld all metal parts and problem occurred while trying to hoist the chair because of the limited structured.
4.	Eco Design Lounge	to weave the mixed fabrics.
5.	Eco Design outdoor Bench	to cut and shape the railway wood because the wood was hard, solid and heavy.
6.	Eco design Television Console	to join and bend the pine wood and shape the coconut husk.
7.	Cardboard Chair & Table	to join the cardboard because of the limited jointing system to be applied to the material.
8.	Console Table	to weld and bend the metal rod because of the rusty condition of the old swing.
9.	Coffee Table	to bend and weld the bicycle rims to the tubular steel.
10.	Eco design park Bench	to bend the small square mixed types of wood.
11.	Eco design wall shelves	to bend the rusty recycled tubular steel.
12.	Room divider	to cut and make an oval shape over the wood pallet because the material is easy to break.
13.	Wall shelves	to weld and join every part of the chain.
14.	Coffee Table	to bend the solid tubular steel to suit the design
15.	Coffee Table	to bend the tubular steel.

Table 1 The difficulties that were faced by the students in the production stages

Furniture design		Recycled Materials				
		Paper	Metal	Wood	Mixed fabric	Other material
1.	Newspaper side table	/	/			
2.	Malay Low Table		/	/		
3.	Exhaust Park Bench		/			
4.	Eco Design Lounge		/	/	/	
5.	Eco Design outdoor Bench		/	/		
6.	Eco design Television Console		/	/		/
7.	Cardboard Chair & Table	/				
8.	Console Table		/			
9.	Coffee Table		/			/
10.	Eco design park Bench		/	/		
11.	Eco design wall shelves		/	/		
12.	Room divider		/	/		
13.	Wall shelves		/			
14.	Coffee Table		/		/	
15.	Coffee Table		/		/	

Table 2 Recycled material usage in furniture prototyping process. There are five main recycled materials that have been used to produce the designs. These five materials are the common materials used in the production of furniture design.



Furniture design		Recycled Materials	
		Flexible	Limitation
1.	Newspaper side table	Paper	Metal
2.	Malay Low Table	Aluminum can	Wood
3.	Exhaust Park Bench	-	Metal
4.	Eco Design Lounge Chair	Mixed Fabric	-
5.	Eco Design outdoor Bench	-	Railway wood
6.	Eco design Television Console	-	Coconut husk
7.	Cardboard Chair & Table	Cardboard	-
8.	Console Table		Metal
9.	Coffee Table	Belt	Metal
10.	Eco design park Bench		Metal Wood
11.	Eco design wall shelves	Ice cream stick	Metal
12.	Room divider		Wood Pallet
13.	Wall shelves		Bicycle Chain
14.	Coffee Table	Bag strings	Metal
15.	Coffee Table	Colored String	Metal

Table 3 Recycled material flexibility and limitation parts in furniture prototyping process. The materials have been identified based on the flexibility and the limitation while the production processes were in progress.



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