ADAPTING THE JAPANESE LEGACY OF SPACE REUSE

TO THE DESIGN OF THE US RESIDENCES

How can the Japanese reuse of residential space educate and inform the design of the US residences

By

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__________________________
Chair
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Abstract

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Purpose

This study is a cultural and historical research of the contrast in recycling in two countries. The study explores the methods of reusing materials, building structures, and interior spaces in the USA, and Japan. The researcher investigates the differences of the recycling methods of materials, building structures, and interior spaces in the two cultures and the reason for the differences. A major focus of this study is taking one element; the recycling of space, and expanding it into a design prototype.

The researcher intends this study to raise awareness towards the recycling in the Western culture of the United States by applying the Eastern method of reuse for materials and spaces. In the Introduction, the motivation towards recycling in the USA is not very apparent. However, the USA is one of the largest industrialized countries, so that its impact on the environment cannot be ignored. Therefore, it is crucial for the development of recycling to raise awareness of people in the USA towards recycling.

A part of this research is to provide more variety of residential types for designers in the
USA by the exposing them to a Japanese method of reuse in the US culture.

**Process**

In order to explore the possibility of Japanese method of recycling in terms of materials, buildings, and spaces this study took three steps: the Literature Review; the Case Studies; and, the Design Proposal.

Firstly, the researcher focuses on a cross-cultural and historical research in the Literature Review to see the differences of approaches and motivation towards recycling in the USA and Japan. Secondly, the study proceeds to the Case Studies in order to expand the findings from the Literature Review of the Japanese concept of reusable space. Thirdly, the researcher undertakes a design approach in the Design Proposal chapter to create a design prototype that achieves a residential space.

**Findings**

Through the studies in the Literature Review, the Case Studies, and the Design Proposal, it was found that there are some key elements to expand Japanese concept of reuse in the US culture to develop the concept of material reuse and resource saving. Those are: reuse of materials itself; reuse of building structures; reuse of interior spaces; the use of a modular; and the maintenance of flexibility and privacy.
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CHAPTER 1: GENERAL INTRODUCTION

“It is possible to alter these growth trends and to establish a condition of ecological and economic stability that is sustainable far into the future.”

—words from the Limits to Growth (Meadows, 1972)

1.0. Introduction

Ecology, environmentalism, or sustainability has been a major topic of concern since the publication of Silent Spring by Rachel Carson in 1962. Researchers in many fields have been trying to solve the problem, as it appears that environmental problems could be destructive to human civilization (Meadows, 1972). In the design field, researchers and designers are undertaking and expanding a variety of approaches at many scales, from urban design to environmentally friendly materials. Collectively, these attempts are known as sustainable design, green building, etc. This study aims to expand on the understanding and methodology for sustainability by looking at one issue from cross-cultural and historical perspective.

Among several topics in sustainability, this study focuses on recycling. Recycling is already accepted as a daily activity to the general public. Therefore the researcher is approaching the subject of sustainability from where is close to our everyday life.

Although recycling exists worldwide, the researcher focuses on just two countries, the USA and Japan. These two countries have contrasting characteristics in terms of their approaches. Japan has historically recycled materials, buildings, and spaces, and the USA has not. The researcher sees an example of clear contrast between countries which are enthusiastic about the development of sustainability, and countries which are reluctant about sustainability. Exposing
and expanding the difference between these approaches is part of the aim of this study.

1.1. The Purposes of the Study

Overall, this study aims to understand the tradition of recycling, and to apply it to another culture. A purpose of this study is to explore the Japanese method of recycling in contrast to the US method. In this study, the researcher investigates the differences of recycling in materials, building structures, and interior spaces in the two cultures and the reason for the differences. A major focus of this study is taking one element of recycling; the recycling of space and expanding in a design prototype for the reuse of space.

1.2. Justification

The researcher intends this study to raise awareness towards the recycling in the Western culture of the United States by applying the Eastern method of recycling for materials and spaces. The USA is one of the largest industrialized countries, so that its impact on the environment cannot be ignored. Therefore, it is crucial for the development of recycling to raise awareness of the US people towards recycling.

A part of this research is to provide more variety of residential types for the US designers by the exposing them to a Japanese method of recycling in the US culture.

1.3. Research Process

In order to explore the possibility of Japanese method of recycling in terms of materials, buildings, and spaces this study has four chapters excluding the Introduction: the Literature Review in Chapter 2; the Case Studies in Chapter 3; the Design Proposal in Chapter 4; and, the
Discussions and Conclusions in Chapter 5.

Firstly, the researcher focuses on a cross-cultural and historical study and documentation in the Literature Review to see the differences of approaches and motivation towards recycling in the USA and Japan. Secondly, the study proceeds to the Case Studies research in order to expand the findings from the Literature Review of the Japanese concept of reusable space. Thirdly, the researcher undertakes a design approach in the Design Proposal chapter to create a design prototype that achieves a residential space. Finally, Chapter 5 concludes the analyses and findings taken in the chapters 2 through 4 as a whole, and exposes the elements of reusable residential spaces of Japan and the contribution of the reusable residential spaces to sustainability.

1.4. Limitations

This study aims to limit its investigation to residential spaces. There are two reasons for this limitation. The first is that researcher sees residential spaces as clearer examples for the cross-cultural studies as they particularly reflect cultural characteristics. Secondly, recycling is known to people in their everyday life, and residential spaces are where people’s everyday life takes place. This study does not mention spaces other than residential, but the purpose of this study is to allow the outcomes to be applicable at different scales and in different building types.
2.0. Introduction

The intent of this chapter is to review the literature of two cultures – Japan and the USA – in their customs of reuse. This study researches the concept of reusable materials, structures, and spaces of a single culture of Japan, which is different from the US culture. In this Literature Review chapter, the researcher intends to establish the basic knowledge of recycling in the USA and Japan tracing the cultural and historical background of recycling in the two countries. This chapter has three sections excluding Introduction and Conclusion: 2.1. Definition of Reuse; 2.2. An International History of Material Reuse; and, 2.3. Module and Space Reuse. The first section determines the word usage and its definition for this thesis before the exploration on historical and cultural study. The second section studies the sustainable design, and the history of recycling in Japan and the USA. The third section is the cross-cultural research on modules, which enable recycling of materials, structures, and spaces in Japan.

2.1. Definition of Key Terms

Before getting into the detailed historical and cultural research on recycling, this section establishes the word usage and its definition that are used throughout the thesis.

There are several current uses of the word related to recycling. The words, such as “reuse” “recycling,” “remanufacturing,” “refurbishing,” are often used as the same definition, and this can be confusing. Therefore, the researcher finally does not use the word “recycling,” but the word “reuse” with the meaning, using materials or spaces twice or more.

For reference, the researcher shows the quotes below, which are the definitions of words related to recycling. Quotes from Japanese books and articles appear in this section and the
following sections. The English sentences right after the Japanese quotes beginning with [TRANSLATION] are the researcher’s English translation from original Japanese quotes.

- リサイクルという言葉が資源や物を再利用するという意味で使われはじめたのは、昭和四十九年 (1974年)のことである。[市橋貴「リサイクルの仕事」1991年]
  [TRANSLATION] “When the word ‘Recycle’ was first used with the meaning of ‘to reuse resources and goods’ in Japan was in 1974” (Ichihashi, 1991 (translation)).
- (Recycle is) “To put used objects or materials through a special process, so that they can be used again” (Longman Dictionary of Contemporary English, 1995).
- (Recycling, or reuse is) “Minimizing waste generation by recovering and reprocessing usable products that might otherwise become waste (e.g., recycling aluminum cans, paper, and bottles, etc.). (As defined by the EPA)” (Spiegel & Meadows, 1999).
- (Recycle is) “To process (as liquid body waste, glass, or cans) in order to regain material for human use” (Merriam Webster Online, 2002).
- “Recycling is what happens when we decide to do something good with the trash we would normally throw out. When we recycle, we separate different kinds of trash that can be reused. We put the separated trash into containers. The separated trash is cleaned and used to make materials which can be made into new products for us to buy” (White, 2002).
- To recycle is to extract refrigerant from an appliance and clean refrigerant for reuse without meeting all of the requirements for reclamation. In general, recycled refrigerant is refrigerant that is cleaned using oil separation and single or multiple passes through devices, such as replaceable core filter-driers, which reduce moisture, acidity, and particulate, matter. These procedures are usually implemented at the field job site” (U.S. Environmental Protection Agency [EPA], Definition of “Recycle,” 2002).
• (Reuse is) “To use something again” (Longman Dictionary of Contemporary English, 1995).

• “In the case of computer … REUSE: The computer would be used again in its original form for the same purpose by simply moving its location/user, or making minor software/hardware changes. An example of reuse would be donation to a non-profit organization” (EPA, What is the Difference between Recycling and Reuse?, 2002).

• (Reuse is) “The use of a product or material again in its original form or with little enhancement or change to be utilized again for the same purpose” (EPA, Definitions for the Purpose of This Guide, 2002).

• (Recycling is) “The process of treating things such as paper or steel so that they can be used again” (Longman Dictionary of Contemporary English, 1995).

• (Recycling is) “…the activity of reprocessing, reshaping and reusing materials…” (Ackerman, 1997)

• “In the case of a computer…RECYCLING: The computer would be separated into its component parts, breaking it down into “raw” materials such as metals and plastics” (EPA, What is the Difference between Recycling and Reuse?, 2002).

• (Recycling is) “a process of collecting a product or material, separating and processing it and then returning it to the economic mainstream in the form of raw materials; or remelting into a new finished good” (EPA, Definitions for the Purpose of This Guide, 2002).

• “In the case of computer…REMANUFACTURING: The computer could be rebuilt into a “new” product for sale (EPA, What is the Difference between Recycling and Reuse?, 2002).

• (Remanufacturing is) “the process of restoring used durable products to “new” condition, to be used in their original function, by replacing worn or damaged parts” (EPA, Definitions for the Purpose of This Guide, 2002).
• "The guides now make clear that ‘recyclable’ includes the reuse, reconditioning, and remanufacturing of products or parts in another product. Similarly, ‘recycled content’ includes products and packages that contain reused, reconditioned or remanufactured materials, as well as recycled raw material. Previously, ‘recyclable’ included only those products or packages that were reused in the form of ‘raw materials’ in the manufacture or assembly of a ‘new package or product” (Federal Trade Commission, 1998).

2.2. An International History of Material Reuse

This section explores the recent situation of environmental protection, and historical research on material reuse in Japan and the USA in order to understand the background of material reuse of present time. Section 2.2 includes four subsections: 2.2.1. Sustainability and Material Reuse; 2.2.2. The History of Material Reuse in Japan; 2.2.3. The History of Material Reuse in the U.S.A.; and, 2.2.4. The Differences of Material Reuse in Japan and the USA.

2.2.1. Sustainability and Material Reuse

In 1972, the world was shocked at the report issued by Donella and Dennis Meadows, and called "the Limits to Growth – A Report to The Club of Rome.” The report briefly stated that the current civilization would die out within the 21st century because of the shortage of natural resources and food production unless people fulfill the ecologically and economically sustainable society (Pestel, 1972). It was the time when people first noticed the significance of sustainability.

The word “sustainability” had been used before it was clearly defined. The clear definition of sustainability was first set in the World Commission on Environment and Development in 1987. The commission published a book “Our Common Future,” and there is a definition of
Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It contains within it two key concepts:

- The concept of ‘needs’, in particular the essential needs of the world’s poor, to which overriding priority should be given; and
- The idea of limitations imposed by the state of technology and social organization on the environment’s ability to meet present and future needs (Our Common Future, 1987).

Sustainability is one of the largest mottoes from the latter half of the 20th century to the 21st century to carry over both the environmental protection and continuous technological development at the same time. The effort towards the sustainability by people, industries, and government has been made for thirty years since the first United Nations Conference on the Human Environment in Stockholm. There was also the Earth Summit in Rio de Janeiro 10 years ago, and the World Summit on Sustainable Development in Johannesburg in 2002 to stimulate the movements for the sustainable society (Annan, 2002). The researcher found that now in 2003 one of the measures towards sustainability in the international context is material reuse because material reuse saves resources as well as reduces wastes.

However, material reuse is not a new concept. From the ancient times, people have reused the materials all over the world. Especially in Japan, people have been enthusiastic about material reuse because of the small land mass and little amount of natural resources. Material reuse is now in 2003 a continuous movement in Japan.
2.2.2. The History of Material Reuse in Japan

Japan does not have a large land mass or sufficient natural resources for industries. Due to lack of resources, material reuse had been done to save dumps and the resources for a long time. The material reuse business that had the longest history in Japan was paper reuse. The earliest record of paper reuse business was written around 1750. Material reuse was not only for paper, but also for fabric and glass bottles, but none of them were able to survive without decline because of the increase of people’s consciousness towards sanitation and the change of the garbage collecting system after WWII. However, Japan realized the importance of material reuse again by having two major social occurrences, the oil shortage in 1973 and the landfill crisis in 1984. Then, the businesses that declined were revived again. In addition to the revitalized businesses, new material reuse businesses, such as aluminum cans, steel cans and plastic reuse, occurred along with the large surge of material reuse in Japan.

a) Paper Reuse

The history of paper reuse in Japan can be traced back to over two hundred years ago. There is a record shown in Takashi Ichihashi’s book titled *Works of Recycling* that mentions about paper reuse in Edo (ancient Tokyo) city.

江戸時代の中ごろには「紙屑買」という商売が成立していた。宝暦四年（1754年）にはそれを独占しようとする者が現れた。...すでに人口100万人の都市に発展していた江戸では紙の消費量も増えて、野心的な商人にとって魅力的なものになっていたのだろう。回収ビジネスが成立するなら、エンドユーザーがなくてはならない。...大口のユーザーは近郊の農家で、漉き返し紙が生産された。

はじめは浅草あたりで生産されたので「浅草紙」の名がある。しいいに江戸の北東部に広がり、日光街道の千住宿、いまの足立区千住あたりを中心に一種の地場産業として成立した。...郷土史などでは「農家の副業」と書いているが、統計資料のある明治初期の数値ではコメの出荷量をはるかにしのいでいた。その製法は、古紙を大釜で煮て、纖維をほぐし、水で洗い、ホテイアオイの根を叩いて搾った汁を糊として加えて平らなザル状のものをすくい取って天日乾燥する。...
浅草紙といっても知らない人が多いが、知る人は下級のチリ紙の代名詞のように言う。実は昭和四十年代まで二百年にわたって生産されてきたもので、年配の人は知っているわけだ。

（市橋貴「リサイクルの仕事」1991年）

[TRANSLATION] By the middle of the Edo Era, ‘Wastepaper Buyer’ as a business was already established. In 1754, there was a person who tried to monopolize the business. ...The business might have looked attractive to ambitious merchants because the amount of paper consumption increased in Edo city whose population already exceeded one million. There had to be end users where the paper collecting business was settled. ...The biggest body of end users was farmers lived near Edo city. They remanufactured paper from the wastepaper.

At the beginning, the paper was manufactured around Asakusa area, so that the paper has been called ‘Asakusa Paper.’ The business gradually spread out to northwest of Edo, and then, Asakusa Paper was settled in Senju area as its local business. ...Their local history tells that the paper business was the farmers’ side job, but there is a statistical data in 1868 that says the amount of the paper production was much more than that of rice production. The method of manufacturing was; boil wastepaper in a big pan to untie fibers, wash the fibers with water, add glue from roots of hollyhocks, scoop the mixture of fiber and glue with flat bamboo sieve and dry the things from sieves up in sunshine.

Though many people do not know Asakusa Paper, a few people who know it recognize as low-quality toilet paper. Actually, Asakusa paper had been manufactured for over 200 years until 1970s, so older people know the paper (1991).

The Edo era was the time from 1603 to 1867 while Tokugawa Shogunate reined in Japan. During that time, Asakusa paper had been manufactured by hand. Asakusa paper continued to
be made after Tokugawa Shogunate was ruined in 1867, and finally, a paper-reuse factory was built in Senju, which is northwest area of Tokyo around 1910. However, this paper reuse business started in Edo era declined as time passed (Ichihashi, 1991).

b) Fabric Reuse

In addition to paper, fabric was also a large part of material reuse in ancient times. People reused Kimonos several times by unstitching and re-stitching before modern materials made it obsolete in the late 19th century. After modern industrial methods were imported from Western countries, waste fabrics were reused into paper (not Japanese paper, but Western-style paper), dustcloths for industrial use, or regenerated fiber products. Some examples were presented in Ichihashi’s book.

[TRANSLATION] Fabrics, whether used or new, were distributing nationwide like rice and alcohol because fabrics were valuable before the modern age. Almost all Kimonos are in one size, so that they are easily reused as secondhand clothes. Besides, Kimonos, even if the ones as everyday wear are regularly washed whole, are supposed to be done ‘Araihari (Wash and Stretch)’ formally. This means that Kimonos are unstitched into cloths and washed. Thus, it was also easy to re-distribute as reused cloths at that time (1991).

The first use of waste fabric in modern industries was as the material for paper. Japanese
government needed to plan production of Western-style paper urgently in order to provide paper money and newspaper domestically. At that time, paper companies in Western countries were producing paper out of cotton or hemp cloths. Japan imported that paper making technology...(1991).

Along with the development of paper industries, the system of collecting waste fabric was arranged, and there had been wholesale stores specialized in waste fabrics by 1890. In addition, a demand on industry-use dustcloths got increased because locomotives and steamships were at the height of prosperity. In such ways, modern ‘reclaimed resource businesses’ in Japan had been established (1991).

Following to paper and dustcloths, industries started to demand on waste fabric as the material for regenerated fiber products in 1900s (1991).

However, these fabric-reuse businesses also declined from 1950s, and there were almost no businesses of fabric reuse in 1991 (Ichihashi, 1991). It is cheaper to create new products than to reuse old products because industries can import cheap raw materials because of the strong yen rate.

c) Glass Bottle Reuse

After Japan opened the country and started to establish diplomatic relations with Western countries in 1854, Japan imported Western cultures one after another. One of the things was
beer, and glass bottles were also imported at that time. Ichihashi also stated about glass bottles in his book.

ガラス瓶は明治二年（1869 年）、ノルウェー生まれのアメリカ人ウィリアム・コープランドが横浜でビール工場をつくった時から流通はじめめる。この国産ビールは輸入ビールやワインの空き瓶に詰めて販売され、その空き瓶はやはり販売の逆ルートを辿って回収された。

（市橋貴「リサイクルの仕事」1991年）

[TRANSLATION] Glass bottles started to distribute in Japan after William Copeland, who was an American born in Norway, founded a beer factory in Yokohama. This domestic beer was sold in bottles, which are formerly used for imported wine and beer. The used bottles of domestic beer were collected again by following the reverse route of sales (1991).

Beer in a bottle manufactured in the industry is first delivered to a liquor store, where a consumer buys the beer at the store. After the consumer drinks the beer, the consumer brings the empty bottle to the liquor store, and the bottle is brought to a bottle seller. (Figure 1)

Although Japanese companies started to manufacture glass bottles in 1900 and to mass-produce them in 1916, they have still continued to collect used bottles to reuse until now. However the bottle reuse also faces a severe problem of decline around 1990, because of the rise of plastic bottles (Ichihashi, 1991).

d) Decline and Revival of Material Reuse

After the WWII, the circumstances around Japanese material reuse had completely changed. From 1960s, along with Japan’s radical growth in economy and manufacturing industry, material reuse business became non-economical because people disliked the products made of wastes in
terms of their perception that the products could not be clean, and strengthening of the yen rate enabled for industries to import raw materials from foreign countries. Moreover, 1952 when the Japanese government and the Tokyo city assembly decided to invite the Olympic Games to be in Tokyo, Tokyo City started to plan a new garbage collecting system. As a result, people began to prefer disposing wastes rather than material reuse. Ichihashi explained the new garbage collecting system in his book.

昭和三十六年（1961年）から三年計画で容器収集が始まりました。当時ようやく普及始めた「ポリバケツ」を各家庭で購入し、家事も雜事も入れて、決められた場所に決められた時間に出しておくと収集してくれるという、今日ほぼ全国的に行われているシステムがこのとき生まれた。...

このシステムはニューヨーク市で行われていたものの真似である。リップマンと言う清掃作業課長を招いたりして計画されたものです。 （市橋貴「リサイクルの仕事」1991）

[TRANSLATION] From 1961, Tokyo city gradually started to collect garbage with large containers. The plan was to be completed in three years. Every family bought a plastic garbage container ‘Poly-Bucket,’ and the family put any waste including kitchen garbage into the container. If the family brings the container to the arranged place at the arranged time, garbage trucks come by and collect the waste out of the container. This system is almost the same as the one that currently works all over the country (=Japan). ...

This system was an imitation of the one that had been done in New York City. It was planned with the help of Lippmann who was a section manager at the City of New York Department of Sanitation (1991).

Material reuse business, which was once in a decline, has been revived since the two major incidents happened. First, there was a sudden and severe shortage of oil, caused by OPEC (Organization of the Petroleum Exporting Countries) that greatly increased the price of crude oil
in 1973. The second was the landfill crisis that we still have since the 1980s. This is particularly
ture of Tokyo where there is no space to dispose of any garbage. Ichihashi stated about the oil
shortage called “the First Oil Shock” and the landfill crisis.

清掃行政は市民の面倒を減らす方向で発展してきた。...そうした流れを逆転させたのが昭和四十八
年（1973 年）の第一次オイルショックだった。資源の節約が世論になった。
（市橋貴「リサイクルの仕事」1991年）

[TRANSLATION] The government tried to decrease the burden for citizens to make efforts to
manage wastes.... What reversed the stream of waste management was ‘the First Oil Shock’

いま東京では「第二次ゴミ戦争」がささやかれている。なにしろ昭和五十九年（1984 年）の秋か
らゴミが急激に増えはじめ、年間の処理量でこの五年間に100万トンも増えてしまった。
（市橋貴「リサイクルの仕事」1991年）

[TRANSLATION] Now in Tokyo, people are telling a rumor about ‘the Second Waste War.’
Somehow the amount of waste started to increase tremendously in autumn of 1984. Finally
the annual amount of waste disposal is one million tons more than the amount of five years

In order to solve the social problems of resource saving and waste reduction, material reuse
was reconsidered and has penetrated into people’s everyday life as the way it used to be in
ancient times.

e) New Material Reuse Movement

After the oil crisis, not only the citizens but also industries noticed the importance of material
reuse to save resources. Although fabric reuse has not revived as a large business yet, paper and
glass bottle reuse are steadily recovering their market. There are associations that are making
efforts to promote material reuse from industrial world such as Japan Paper Association for paper reuse, and Glass Bottle Recycling Promoting Association for glass bottle reuse. In addition to paper and glass bottle reuse as the existing businesses, aluminum can, steel can, and plastic reuse business were established after the oil shortage. Aluminum Can Recycling Association, Japan Steel Can Recycling Association, and Plastic Waste Management Institute drive the material reuse movement. According to the reports that the associations presents, the reuse rate of glass bottles, aluminum cans and steel cans is now about 80 percent, and that of paper is about 60%.

Furthermore, Japanese government also supports the material reuse movement by promulgating laws about material reuse consecutively. They are: Law for the Promotion of Utilization of Recyclable Resources (資源の有効な利用の促進に関する法律) in 1991, Law for Promotion of Sorted Collection and Recycling of Containers and Packaging (容器包装に係る分別収集及び再商品化の促進等に関する法律) in 1995, Law for Recycling of Specified Kinds of Home Appliances (特定家庭用機器再商品化法) in 1998, Law Concerning the Promotion of Procurement of Eco-Friendly Goods and Services by the State and Other Entities (国等による環境物品等の調達の推進等に関する法律), Construction Materials Recycling Act (建設工事に係る資材の再資源化等に関する法律) in 2000, Food Recycling Law (食品循環資源の再生利用等の促進に関する法律), and Basic Law for Establishing a Recycling-Based Society (循環型社会形成推進基本法) in 2000, Law Concerning Special Measure against PCB waste (ポリ塩化ビフェニル廃棄物の適正な処理の推進に関する特別措置法) in 2001.

In 2003, material reuse is an urgent problem in Japan, but it is apparent that it is being tackled on many fronts by citizens, industries, and the Japanese government. The political and social concern for material reuse in Japan can be seen as a historically based reaction to a need from the outset.
2.2.3. The History of Material Reuse in the USA

The earliest material reuse business in the US was the paper industry in the nineteenth century. Meanwhile, other materials, such as household goods, clothing, building materials and metals, were also reused, but all of those material reuse businesses were declined by 1930s with exceptions of household goods and metal reuse. The absence of material reuse had lasted till 1960s though there was a patriotic movement of material reuse during the WWII. In Silent Spring published in 1962 by Rachel Carson, the author stimulated the federal government to drive environmental protection. At that time, reuse of beverage containers and newspapers also started. Nevertheless, those material reuse businesses died out by mid-1970s because of the slump of demands except aluminum can reuse. The second absence of material reuse movement finished in the late 1980s. There was a severe landfill crisis nationwide, so that American people had to think about material reuse as a solution for the waste reduction. Through 1990s, the US had the new generation of material reuse that targeted a wide range of materials in contrast to the existing material reuse that aimed at one or few materials. Then again, the third absence of material reuse is about to happen now in 2003. New York city stopped reuse plastic and glass bottles because of its high cost. Unlike Japan, material reuse in The USA is not considered an urgent task.

a) Fabric-to-Paper Reuse

Before the Industrial Revolution, There was “a golden age of recycling” in England (Ackerman, 1997). They reused many materials like clothing, building materials, and metals. Particularly, fabric reuse was the most successfully done as a paper industry. This tradition of material reuse moved across to The USA in the nineteenth century. In the book “Why Do We Recycle?,” Frank Ackerman wrote about this primitive paper industry.
Paper continued to have almost 100% recycled content until well into the nineteenth century. The U.S. paper industry was originally centered in western Massachusetts, close to the abundant sources of rags in the urban Northeast. (1997)

In order to secure the sufficient supply of rags, a business called scavenging existed at that time. Scavengers looked for mainly rags and other fabric at dumps, and sold them to junk dealers. Even though scavenging is not recognized as respectable job now, it seemed that they used to be accepted as a reputable job. There is a description of scavengers in Ackerman’s book.

A Winslow Homer etching from 1859 shows scavengers hard at work in Boston’s Back Bay—today a fashionable address, but then, literally, a dump. Scavengers were sometimes politely referred to as chiffoniers, i.e., collectors of “chiffon” (a French word that meant ornamental trifles, as well as a type of silk). A more earthy description arose from the practice of ocean dumping of garbage by New York City and other coastal communities. There the scavengers, who rode on the garbage barges, or scows, and sorted through the refuse up to the last moment, were called “scow trimmers” (1997).

However, the fabric-to-paper reuse started to decline before the 1860s because of a shortage of used rags due to the expansion of the business. Although they finally used even cloths that wrapped Egyptian mummies for their business, the business completely disappeared in the 1880s, after the new technology to make paper from wood was imported from Germany. Along with the decline of fabric-to-paper reuse, scavenging was also declined by the early twentieth
century (Ackerman, 1997).

b) Reuse of Household Goods and Metal

While the paper industry as the major material reuse business had been declined, reuse of household goods and metal has been surviving until the present. Ackerman states that:

Older modes of recycling have diminished in importance, but never entirely vanished. Today’s scrap yards, the modern descendants of early junk dealers, are quite efficient at recycling junked cars and other metal waste; they recover much more steel than the local recycling programs that collect cans. Household repair and reuse are far from completely disappearing, even if most of us cannot match our great-grandparents’ accomplishments in this regard. Used furniture and major appliances almost never end up at landfills; instead, they seem to circulate in a vast, informal network of yard or garage sales, donations, and a new form of curbside scavenging that occurs late at night or early in the morning before the garbage truck arrives (1997).

c) Material Reuse as the Environmental Protection

The decline of material reuse occurred in the 1930s had continued until 1960s, though there was a material reuse movement driven by patriotism during the WWII exceptionally. There were two major reasons why material reuse recovered in these years of time. One was that it was the time when no deposit beverage containers first appeared in the market. So many beverage cans and bottles were thrown away at public spaces, that it became a significant social issue to manage those wastes of cans and bottles. Another was the publication of *Silent Spring* written by Rachel Carson, which was the first book that mentioned about the environmental issues
(Ackerman, 1997). Carson’s opinion was exposed to severe criticism, but finally her opinion stimulated the public as well as the federal government to drive the movement towards the environmental protection. Kunihiko Takeda explains the hard situation around Rachel Carson at that time.

[TRANSLATION] Rachel Carson’s *Silent Spring* was under severe attack from the public. It was same as any new things in any period of time that had been exposed to attacks from ordinary people. It was said that the blame that Carson received was not inferior to the one Darwin received after he presented *the Origin of Species*. Moreover, it was the time when there still discrimination for women existed, so that even *Time*, which was famous for its calmness and steadiness in its articles, groundlessly denounced that her expression stirred up people’s emotion too badly.

Later, when President Kennedy read and highly praised the *Silent Spring*, Carson’s honor recovered, and she suddenly became famous. Also, her book stimulated human beings to start studying about pollutants, and as a result, she saved the human beings from a danger (2000).

Then, the U.S. federal government carried out policies for environmental protection one after another: The Solid Waste disposal Act of 1965, The Resource Recovery Act of 1970, the
establishment of the Environmental Protection Agency in 1970, and The Resource Conservation and Recovery Act in 1976. However, this material reuse movement was brought to an end by mid-1970s again except aluminum can reuse, because demands on reused products got decreased.

**d) The Landfill Crisis and the New Generation of Material Reuse**

The halt of material reuse had continued through 1981 to 1989 during the Reagan Administration. What revived the material reuse again was the landfill crisis in the late 1980s. Since the late 1970s, incineration had been a popular way to manage waste because it decreased the amount of waste disposal thrown away in dumps, as well as it could generate electricity. Yet, many incineration plants were cancelled nationwide because of its inefficiency in electric generation compared with nuclear plants, and high toxicity of ash from the plants. Therefore, people returned to use landfill instead of incineration, and this caused the landfill crisis. There was a famous incident in State of New York, called “the Voyage of the Mobro,” which occurred as a result of the severe landfill crisis. The story shown below is quoted from Carrie Moenke’s web site.

During the spring of 1987, the small town of Islip, New York hit national headlines. The media focused not on the people of the town, but rather on its garbage—nearly 3,200 tons of it. The landfills near Islip were filled beyond capacity, so Islip officials made a deal with Jones County, North Carolina, to handle Islip’s trash.

When the Mobro—the barge transporting those tons of garbage from Islip—reached its destination, Jones County officials refused to accept the trash after determining that the cargo held hospital waste and other non-paper trash as well. Fearing contamination of county
water supplies, the North Carolina County sent the Mobro away.

For four months, the barge traveled along the Atlantic Cast to the Gulf of Mexico trying to find a state willing to dispose of the garbage.

Unsuccessful, the Mobro even approached Mexico, Belize, and the Bahamas, but to no avail. The barge returned to dock at New York Harbor after a frustrating 6,000-mile (9,654-kilometer) voyage and awaited word from New York officials as to exactly what would become of its smelly cargo. A Brooklyn, New York, incinerator finally burned the garbage, reducing the volume to about 430 tons of ash, which was then dumped in a landfill back in Islip (2002).

In order to reduce wastes and solve the landfill problem, material reuse was again lighted up. The movement for this time was different from the ones done before. The preceding material reuse targeted only on one or a few materials, but the new one targeted several kinds of materials. Although the federal government had not participated in the material reuse until 1994, state governments initiated instead.

e) The Current Situation

Now, material reuse faces the third crisis of regression. In the early 1990s, it was found that the landfill crisis was just a misunderstanding of data. What had been presented was just the numbers of dumps decreasing at that time, but the area of the dumps were increasing, not decreasing. It meant that the strongest justification of material reuse disappeared.

In fact, New York City stopped collecting plastic and glass bottles on July 1 2002 because it costs high to reuse those bottles, and the bottle reuse will be suspended at least for one year. Michael Bloomberg, the mayor of New York City claimed in the interview, “There currently
aren’t commercial markets for the reuse of these items,” and “Picking up glass and plastic for recycling costs the city about $40 million a year. That’s money we simply can’t afford to waste” (Cuza, 2002). In contrast to Japan, though the starting point was similar, material reuse in the USA has not really taken social root even though there were actions by both citizens and the government several times to carry out the material reuse towards environmental protection.

2.2.4. The Differences of Material Reuse in Japan and the USA

Looking through the history of material reuse in Japan and the US, there are two stages of material reuse, conventional and modern. Conventional material reuse is material reuse, which had been done since ancient times all over the world, based on economical benefits. Modern material reuse is material reuse, which started after the publication of *Silent Spring* by Rachel Carson, based on environmental concerns. Conventional material reuse had been done because it was more inexpensive to reuse than to make products from virgin materials before the WWII. After the WWII, material reuse both in Japan and the US almost died out because the rapid technology development lowered the cost of making products from virgin materials. However, people started to consider material reuse again in 1960s because they realized the environmental damages caused by mass-production and mass-consumption. People recognized the necessity of material reuse in spite of its economical inefficiency. This is modern material reuse that continues to the present.

In the book *Why Do We Recycle?*, Frank Ackerman also defined conventional (traditional) material reuse and modern (contemporary) material reuse in the US as “the hallmark of these traditional styles of recycling is that they are motivated primarily by economic considerations. ... In contrast, what is new in contemporary municipal recycling is not only the organization of
formal programs to promote it, but also the primacy of altruistic or ecologically concerned motivations: in almost all cases, modern recycling offers no personal economic benefit for participation” (1997). Ackerman determines the material reuse movement during the WWII as the beginning of modern material reuse. To the researcher, however, the material reuse during the WWII does not appear to be the real beginning of the modern material reuse because it did not aim at the environmental issues, but came from the patriotism due to the war. The patriotic material reuse was done not only during the WWII, but also during the WWI and even the Revolutionary War (Baltimore Department of Public Works 1), so the patriotic material reuse is not a modern idea. The researcher determines that the actual beginning of modern material reuse is during the 1960s after the first recognition of the environmental issues stimulated by Rachel Carson’s *Silent Spring*.

Analyzing Japanese material reuse and the US material reuse by using the aspects of conventional material reuse and modern material reuse, Japanese material reuse is modern because Japanese people are enthusiastically carrying out material reuse though they know it is not cost-effective. According to the calculation in Kunihiko Takeda’s book *Do Not Recycle*, the cost to remanufacture a PET (polyethylene terephthalate) bottle is three times as much as the cost to manufacture a PET bottle from virgin materials (2000). In spite of the inefficiency of the cost, the material reuse movement is still active: the government continues to promulgate laws for material reuse, and methods for material reuse are one of the largest themes in material engineering (Takeda, 2000).

In contrast, material reuse in the USA is not really modern. Material reuse in the USA started as modern material reuse as an answer to the problems pointed out in *Silent Spring*, but it still stays as conventional one because the people in the USA tends to stick to cost-efficiency.
For example, as recently as 2002, New York City stopped bottle reuse due to the high cost, as mentioned in the subsection 2.2.3-e).

The reason why Japan could shift their material reuse style from conventional to modern is that Japan does not have a large land mass or natural resources such as petroleum, iron ore, and bauxite. The people must be sensitive about the shortage of the resources from foreign countries. On the other hand, the U.S.A. is blessed with plenty of natural resources inside the nation, so the people tend not to notice the shortage of the resources in the world though it is pointed out that there is a limitation of natural resources and people will reach it soon.

2.3. Building Reuse as a Japanese Tradition

Based on the findings in the section 2.2, which Japanese material reuse is more successful because of their tradition of reuse, the researcher conducts deeper study on Japanese tradition of reuse aiming the building reuse in this section. The section 2.3 contains two subsections: 2.3.1. Reuse of Buildings in Japan, 2.3.2. Space Reuse and Module. The first subsection explores the history of religious building reuse and housing reuse which is getting popular recently. The second subsection deals with the systems of Japanese wooden buildings, including houses, which enable the building to be reused.

2.3.1. Reuse of Buildings in Japan

As mentioned in the section 2.2, Japan had a long tradition of material reuse. Japanese people in ancient era reused not only paper and fabric, but also wooden buildings by dismantling into parts, and rebuilding. Unfortunately, there are no old records that show residential buildings were reused by dismantling and rebuilding because houses were not regarded as an important part of architecture in ancient time. However, Shintoism shrines have been actually dismantled
into parts and rebuilt with new parts every 20 years. The dismantled parts are usually reused in other shrines that had lower status. This system is called “Shikinen-Zotai,” or “Shikinen-Sengu,” which means rebuilding and moving a shrine on the designated year. Japanese Institute of Architects (JIA) published a book *Japanese Architectural History Pictures and Drawings*, and there is a mention of Shikinen-Sengu of Ise Shrine.

There is only one shrine, which is Ise Shrine, that still has the custom of Shikinen-Zotai in the 21st century. There used to be, however, some more shrines in the ancient period that had a custom of Shikinen-Zotai, such as Kasuga Shrine and Shimogamo Shrine.

伊勢神宮は…皇大神宮(内宮)と豊受神宮(外宮)とからなる。…両宮とも持続天皇の時代に式年遷宮の制度が始まると伝えており、1973年の造替を60回目と数えている。式年遷宮制は戦国時代に戦国時代におよそ120年間ほど途絶えるが、それ以外はほぼ正確に20年ごとに造営が繰り返された。

（日本建築学会「日本建築史図集」1997年）

[TRANSLATION] Ise Shrine … consists of Kotai Jingu [the Imperial Shrine], which is also called Naiku [the inner shrine] and Toyouke Jingu [Toyuke Shrine], which is also called Geku [the outer shrine]. …Both of two shrines tell that the system of Shikinen-Sengu started in the period of Empress Jito [mid 8th century], and the rebuilding in 1973 was counted as the 60th one. Though the system of Shikinen-Sengu ceased for 120 years during the Turbulent Age [1490 to 1573], rebuilding has been repeated almost exactly every 20-year (JIA, 1997).

There is only one shrine, which is Ise Shrine, that still has the custom of Shikinen-Zotai in the 21st century. There used to be, however, some more shrines in the ancient period that had a custom of Shikinen-Zotai, such as Kasuga Shrine and Shimogamo Shrine. Nara City’s Tourism Section provides the information of Kasuga Shrine including Shikinen-Sengu on its website, and Kyoto City’s Tourism Section also provides the information of Shimogamo Shrine’s custom of
At Kasuga Shrine, Shikinen-Zotai (remaking into the original form on the designated year) had been done every 20-year since Kamakura Era [= 1192 to 1333]. The current building is the one rebuilt in 1863, but the shape from the Heian Era [= 894 to 1192] well remains. Since the Meiji Era [1868 to 1912], Shikinen-Zotai has not been undertaken ever, but fixing, mainly re-roofing, has been done instead of rebuilding (Nara City, 2002).

(Shimogamo Shrine) existed in its present form by the beginning of the 11th century, and was ritually rebuilt at regular intervals thereafter (Kyoto City, 2002).

The dismantled parts from Ise Shrine have been reused in other shrines, such as Atsuta Shrine as an ancient example, Kanbe Shrine and Misoyabashira Shrine as recent examples. The researcher found three articles that mentioned about the reuse of shrine parts: an article was written by CasaNavi; another was by Mauyamanaka Parents and Teachers Association; and the other was by Miyake Town.

以前の熱田神宮の本宮は伊勢神宮の本殿をリユースしたものという説があるほどです。

(カーサナビ「木の話前編」2003年)

[TRANSLATION] There are some researchers who insist the main building of former Atsuta Shrine was the one reused from the main building of Ise Shrine (CasaNavi Co., Ltd., 2003).
神戸地区の中心には、「穴穂（あなほ）の宮」といわれる神戸神社があります。伊勢神宮遷宮の後には神宮古材を使って本殿の式年造替を二十年ごとに行っています。

[TRANSLATION] At the center of Kanbe area, there is Kanbe Shrine, which is also called “Anahono-Miya.” The shrine carries out Shikinen-Zotai every 20-year by using the old shrine parts from Ise Shrine every time Ise Shrine has rebuilding and moving (Maruyamanaka PTA, 2002).

本殿（三十八柱神社）は、伊勢神宮式年造替にあたり、下付された古式な建造物でたいへん貴重なものである。

[TRANSLATION] Our Shrine building is very traditional and valuable because it was given from Ise Shrine at the time of Shikinen-Zotai (Miyake Town, 2002).

In contrast to shrines that has a long tradition of building reuse, housing reuse is a new trend among Japanese people. Many examples of houses which are built partially, or thoroughly with reused building parts, are on the pages of popular magazines. Toshio Akiyama writes about the current trend of housings which are built with reused building parts.

かつては特殊であったリフォームや再生が、大勢の人たちの手によって各地で行われ、雑誌などを賑わしている。個々の家ばかりではない。町並みもそうだ。住宅ばかりではない。工場や倉庫、
Many people are participating in residential interior renovation and building revival that used to be uncommon to the public, and some of the cases are enlivening the pages in magazines. Not only an individual house as a piece, but also streetscapes are being revived. Not only houses, but also factories, warehouses and offices are being revived, too. The objects of the building revival is now spreading from wooden to brick, steel, and even reinforced concrete structures (Akiyama, 1999).

The method of housing reuse varies. In some case, one just dismantle the old house and rebuilt a new one on the same lot with the same plan, or with the different floor plan by adding some new parts into it. Some people dismantle the old house and rebuilt it on a different lot, or one might take some of the parts from dismantled old house(s) and put the parts into a new building.

2.3.2. Module and Space Reuse

There are some systems that make Japanese wooden buildings reusable. One of the features is the use of module. Most of Japanese houses are designed with the same modular grids, so that the building parts from old buildings can be easily replaced in new buildings. However, the module is not native of Japan. Modules have been used all over the world since the ancient age, but they stayed as local standards. Around the time of WWII, people started discussing to have one standard module in the world to encourage the industrialization in architecture field. Meanwhile, Japanese building design has been with its own module for a long time. The use of module enables Japanese houses to be reusable in terms of material reuse, as well as space reuse.
Space reuse is as effective for the sustainable design as material reuse because space reuse can extend the durability of buildings, and spatial configuration.

a) Module in the Global Context

The use of module is not a new concept. Tracing back the history, ancient Greek and Rome was dealing with modules to build their temples. Those modules were, nevertheless, used only in local culture. The module in ancient Greek may not be employed in Persian buildings. The time when people start to think about one unified module that is applicable all over the world is around the WWII. At that time not a few researchers and designers proposed their modules for architectural design, such as Albert F. Bemis of the USA, Ernst Neufert of Germany, Bergvall and Dahlberg of Sweden, and Le Corbusier of France (United Nations, 1966).

Before the WWII, Bemis introduced his study in which the module should be 4 inches. During the WWII, Neufert presented “octometer” system in which the basic module should be 12.5cm, which equals to 1/8 meter. Bergwall and Dahlberg also did their study during the WWII, and they concluded the module should be 100mm (= 3.94 inches), which is almost same as the dimension of Bemis’s module (United Nations, 1966). The “Modulor,” which Le Corbusier proposed in 1954 was developed from the combination of human dimensions and golden section. Because of the complicated numbers in the theory (such as 1829mm, 1130mm, 698mm, …), the Modulor could not be common in the current world (Jeanneret, 1954).

Finally, some international organizations were formed to determine the globally standardized module: European Productivity Agency in 1955; International Modular Group in 1960, which became Counseil international du batiment later; and, Technical Committee 59 of International Organization for Standardization. Now in 2003, ISO standard is recognized as the global rule,
and it determines the basic module to be 4 inches, 100mm, or 1M (= 100mm) (United Nations, 1966).

Following the global trend in module, the USA also organized a committee to form its own module. The committee is called Technical Committee E06-62 of American National Standards Institute (ANSI). According to U.S. Department of Commerce National Bureau of Standards (NBS), the committee agreed to employ the basic module of 4 inches, which was the one proposed by ISO (1980).

b) Module in Japan and Space Reuse

As the Western countries had their own modules locally, Japan in the Eastern world has its own module to design buildings. The basic module in Japan is expressed in the dimensions of a plane of 3 尺 x 6 尺 (= 2.98ft x 5.96ft), by using Japanese original dimension unit 尺, or Shaku, which has a length of 303.0mm, or 11.9 inches. In the western part of Japan, the modular of 3.15 尺 x 6.3 尺 (= 3.13ft x 6.26ft) is used. Uchida, Ono, Yshida, Fukao and Segawa explain the Japanese module systems in their book, *The Building Construction*.

日本の木造軸組構造のうち、江戸間と呼ばれているものは 3 尺を単位とするグリッドに従って設計・施工が行われる。…京間は…畳の寸法を 6 尺 3 寸×3 尺 1 寸 5 分として統一したものですのである。

（内田祥哉 他「建築構法第三版」1996年）

[TRANSLATION] Among the wooden frame structures in Japan, the one called “Edoma” is designed and constructed by following the grid with the unit of 3 Shakus. …”Kyoma” structure is the one in which the dimensions of a Tatami mats is unified as 6.3 Shakus x 3.15 Shakus (1996).

The basic modular plane is applicable to floor panels, partition walls, and openings. The floor panels are called “Tatami” mats, while translucent partitions are called “Shoji” screen, and
solid partitions are called “Fusuma” partition. Shoji and Fusuma are compatible as partition walls, and door/window panels

These modular panels help Japanese houses have more flexibility. One floor plan can have many configurations with several uses, or no use of Fusuma partitions and/or Shoji screens because of their compatibility. Uchida states the compatibility of modular building parts.

ある大きさをいくつかに分割する場合に、モデュラーコオーディネーションを行えば、普通性をもった割付けとることができる。すなわち、建物の部分や部品に互換性をもたせることが可能となる。

（内田祥哉他「建築構法第三版」1996年）

[TRANSLATION] In the cases of dividing a certain size into some pieces, one can create an universal division by modular coordinating. It means that building parts can have compatibility with themselves (1996).

There is an example, on the next page, of a traditional Japanese house in countryside, and its spatial configurations at different occasions: usual daytime configuration; usual nighttime configuration; and, special occasions such as wedding or funeral ceremonies.

2.4. Conclusion and Findings for the Literature Review

This review became a report of the cross-cultural and historical customs of reuse. The researcher found that there were some apparent differences in the motivation towards reuse. Japan and Northern American appeared to have different motivation and approaches towards material reuse, tradition of building and space reuse. Through the cross-cultural and historical research on customs of reuse, the researcher found that there are some differences between Japan and the USA, in terms of their motivation towards material reuse, tradition of building and space reuse.
Figure 2-3: An example of a Traditional Japanese House and Its Spatial Configurations at Different Times and Occasions
As mentioned in the section 2.2.4, the motivation towards material reuse is different in the two countries. While Japan keeps its motivation comparatively high whether or not there is cost-efficiency of material reuse, the USA tends to stop reusing materials when the costliness of material reuse became an issue.

One of the reasons why Japan can keep their reuse motivation highly is Japanese long tradition of reuse of materials, as well as building structures and interior spaces. 3尺 x 6尺 module grids enables Japanese structural parts and interior parts; such as columns, beams, floor panels; and partition panels to be reusable.

However, the concept of structural reuse may not be applied to the US culture because the difference in durability of buildings. Durability of Japanese wooden structures usually comes to and end in 25 years of use, so that is one of the reasons of the custom of Shikinen-Sengu. According to an article “Enclosure Durability – Durability Implications” by Dr. Ted Kesik, on the contrary, the durability of North Amerian residential buildings is 50 to 99 years (2002). Therefore, since north Ameican houses do not have structural change as much as Japanese houses do the Japanese reuse concept of structures may not be applicable to the US houses.

This Review is a historical survey to investigate recycling of materials, structures and the use of the modular as a background for the investigation of the reuse of space in residential design. Through the further studies in the following chapters, the researcher will investigate the concept of reusable space of Japan by comparing and contrasting the US and Japanese residential design, and will hope to reveal how Japanese houses are different from the US houses. At this point, the investigation will raise a case study approach to augment the findings of the Literature Review.
CHAPTER 3: METHODOLOGY – CASE STUDIES

3.0. Introduction

The purpose of this chapter is to explore the idea introduced in the previous chapter that Japanese house plans differ from the US American house plans due to the concept of reuse of materials, structures, and spaces. By conducting case studies on the floor plans of residential buildings in Japan and the USA, the researcher does detailed studies on the differences between Japanese houses and the US houses.

This chapter has three sections excluding Introduction and Conclusion: 3.1 Description of the Design Examples; 3.2 Method for the Case Studies; 3.3 Findings from the Case Studies; and, 3.4 Analysis for the Case Studies. The first section describes the eight design examples for the case studies and explains how those examples are chosen. The second section shows the method to examine the floor plans, and the third section illustrates the findings on each residential building. The fourth section analyzes and synthesizes the findings from the case studies.

3.1. Description of the Design Examples

Eight design examples are chosen for case studies: In the USA, Monticello designed by Thomas Jefferson in 1808; a house proposed by Catherine E. Beecher in her book *American Women’s Home* in 1869; Jacobs House designed by Frank Lloyd Wright in 1936; and, an example of postwar housing. In Japan, a traditional farmer’s house built in the 17th century; House of Chestnut Tree designed by Tsutomu Ikuta and Haruki Miyajima in 1956; the Row House in Sumiyoshi designed by Tadao Ando in 1976; and, a typical ready-built house built in the 1990s.
3.2. Methods

On the first floor plan of each example, graphic analysis is done in terms of functional zoning, spatial flow, circulation pattern and visual connection. The researcher colors each room of the building for the analyses of functional zoning and spatial flow, and drew arrows or lines for the analyses of circulation pattern and visual connection. Functional zoning is for looking at the relationship between the function of each space and the space itself. Spatial flow shows how the spaces are divided and connected to each other. To show the circulation pattern, the researcher looks at the variety of possible circulation paths. The visual connection implies how the lines of sight are drawn in the buildings.

3.3. Findings from the Case Studies

From the next page, there are findings from the case studies. Each page has one graphic analysis of one floor plan. The pages are sorted from the US examples to Japanese example. Within the US examples, the pages are sorted by the year of built: Monticello; Proposal in American Women’s Home; Jacobs House; then, Postwar Housing. Japanese examples are also sorted by the year of built: Traditional Farmer’s House; House of Chestnut Tree; Row House in Sumiyoshi; and, Ready-Built House. Within each example, there are four graphic analyses in order of functional zoning, spatial flow, circulation pattern, and visual connection.

Each analysis has a numbering in the page in bold letters. The US examples have US in front, while Japanese examples have JP in front. The next number implies the order of the year of built. The oldest building in each culture has number 1, and the newest one has number 4. The last two alphabets mean the type of analysis. “fz” stands for Functional Zoning, “sf” stands for Spatial Flow, “cp” stands for Circulation Patterns, and “vc” stands for Visual Connection.
For example, the example number US-1-fz in the page means the functional zoning analysis on Monticello from the USA, and JP-3-cp is the circulation pattern analysis on Row House in Sumiyoshi from Japan.
1. The US Examples

Housing Type 1: Monticello (1808) by Thomas Jefferson

US-1-fz – Functional Zoning

Research Notes: Spaces are clearly divided in terms of activities.
1. The US Examples

Housing Type 1: Monticello (1808) by Thomas Jefferson

**US-1-sf** – Spatial Flow

![Floor plan of Monticello]

*Scale: 3/64"=1'-00"*

**Research Notes:** There is one area where spaces overlap internally (orange circle).
1. The US Examples

Housing Type 1: Monticello (1808) by Thomas Jefferson

**US-1-ep** – Circulation Patterns

Research Notes: Most circulation paths are linear. At the pink circle area, however, there is a circular circulation path between the dining room and the tea room.
1. The US Examples

Housing Type 1: Monticello (1808) by Thomas Jefferson

**US-1-vc – Visual Connection**

![Scale: 3/64"=1'-00"](image)

**Research Notes:** Lines of sight are mostly short and stay between the rooms side by side. However, the line of sight in the middle that goes through the parlor and the entrance is long, and connects outside and inside (yellow circle). In addition, the line of sight in the dining also continues to the outside through the tea room.
1. The US Examples

Housing Type 2: Proposal in *American Women's Home* (1867) by Catherine E. Beecher

**US-2-fz** – Functional Zoning

Research Notes: There is an overlapping of activities at the area with an orange circle due to the use of a movable screen between the dining and the living.
1. The US Examples

Housing Type 2: Proposal in American *Women’s Home* (1867) by Catherine E. Beecher

**US-2-sf** – Spatial Flow

Research Notes: Spaces overlap at the areas with orange circles because of the use of a movable screen between the dining and the living, or sliding doors between the kitchen and the utility.
1. The US Examples

Housing Type 2: Proposal in American *Women’s Home* (1867) by Catherine E. Beecher

**US-2-cp** – Circulation Patterns

![Diagram of a floor plan with pink circles indicating circulation paths. Scale: 3/32”=1'-00”](image)

**Research Notes:** Circulation paths are very flexible everywhere on the floor plan (pink circles).
1. The US Examples

Housing Type 2: Proposal in American *Women’s Home* (1867) by Catherine E. Beecher

**US-2-vc – Visual Connection**

![Visual Connection through Divisions](image)

Scale: 3/32" = 1'-00"

**Research Notes:** The lines of sight are mostly long. At the blue circle area, the line of sight connects multiple rooms internally. At the green circle areas, lines of sight bring outside to inside. The line of sight with yellow circle penetrates the room from the outside.
1. The US Examples

Housing Type 3: Jacobs House (1936) by Frank Lloyd Wright

**US-3-fz – Functional Zoning**

*Research Notes:* Jacobs House is one of Frank Lloyd Wright’s houses. There are only two areas (areas with orange circles) with overlapping functions. It is said that Wright employed flexibility of Japanese houses into his houses.
1. The US Examples

Housing Type 3: Jacobs House (1936) by Frank Lloyd Wright

**US-3-sf – Spatial Flow**

*Research Notes:* There are two areas where multiple spaces overlap (orange circles). The overlapping of outside and inside is more obvious on the floor plan (red circle).
1. The US Examples

Housing Type 3: Jacobs House (1936) by Frank Lloyd Wright

**US-3-ep – Circulation Pattern**

**Research Notes:** Most of the circulation paths are in one direction. The only exception is the one in the dining/living area (pink circle), but this circulation does not go through to the other spaces.
1. The US Examples

Housing Type 3: Jacobs House (1936) by Frank Lloyd Wright

**US-3-vc – Visual Connection**

**Research Notes:** There is no visual connection that goes through more than two spaces. It means that spaces are visually divided, and inversely, privacy is protected in each divided space.
1. The US Examples

Housing Type 4: Postwar Housing (1950s~60s)

**US-4-fz** – Functional Zoning

**Research Notes:** There is a strict relationship between activities and spaces except the area with orange circle where dining, living and circulation are overlapping.
1. The US Examples

Postwar Housing (1950s~60s)

**US-4-sf** – Spatial Flow

**Research Notes:** Spaces exist without having any overlapping.
1. The US Examples

Housing Type 4: Postwar Housing (1950s~60s)

**US-4-cp** – Circulation Pattern

![Circulation Pattern](image)

Scale: 3/32"=1'-00"

**Research Notes:** Circulation paths are totally linear. The circular path in the living does not go through any other rooms.
1. The US Examples

Housing Type 4: Postwar Housing (1950s~60s)

**US-4-vc** – Visual Connection

Scale: 3/32"=1'-00"

**Research Notes:** The visual connections are limited in rooms side by side.
1. The US Examples

Housing Type 5: LB House (2002) by Stan Allen

**US-5-fz** – Functional Zoning

*Research Notes:* There are three areas where two activities are overlapping (orange circle).
1. The US Examples

Housing Type 5: LB House (2003) by Stan Allen

**US-5-sf** – Spatial Flow

*Research Notes:* At the orange circle areas, multiple spaces are overlapping internally. At the red circle area, interior space flows out to the outside.
1. The US Examples

Housing Type 5: LB House (2003) by Stan Allen

**US-5-cp** – Circulation Patterns

Research Notes: Circulation Paths are mostly linear except the circular circulation path at the pink circle area.
1. The US Examples

Housing Type 5: LB House (2003) by Stan Allen

**US-5-vc – Visual Connection**

![Diagram of housing type 5 with visual connections marked by blue and green circles.](image)

Scale: 3/32"=1'-00"

**Research Notes:** At the blue circle area, the line of sight connects multiple rooms internally. At the green circle areas, lines of sight bring outside to inside.
1. The US Examples

Housing Type 6: A House in Inland Northwest (2003)

**US-6-fz** – Functional Zoning

**Research Notes:** Activities are mostly divided clearly except the orange circle areas. Two activities overlap at the orange circle areas.
1. The US Examples

Housing Type 6: A House in Inland Northwest (2003)

**US-6-sf** – Spatial Flow

Research Notes: Spaces are mostly clearly divided. However, multiple spaces are overlapping at orange circle areas.
1. The US Examples

Housing Type 6: A House in Inland Northwest (2003)

**US-6-cp** – Circulation Patterns

Research Notes: Circulation paths are mostly linear and stay within a space, except the pink circle area where the circulation path goes through multiple spaces.
1. The US Examples

Housing Type 6: A House in Inland Northwest (2003)

**US-6-vc** – Visual Connection

![Diagram of Housing Type 6: A House in Inland Northwest (2003)](image)

Scale: 3/32”=1’-00”

**Research Notes:** The lines of sight are mostly short. At the blue circle areas, the line of sight connects multiple rooms internally. At the green circle areas, lines of sight bring outside to inside.
2. Japanese Examples

Housing Type 1: Traditional Farmer’s House (17th century)

**JP-1-fz** – Functional Zoning

Research Notes: There are many areas that have two or more activities in one space (orange circles). At the areas with blue circles, there are vague borders between circulation and kitchen or reception room.
2. Japanese Examples

Housing Type 1: Traditional Farmer’s House (17th century)

**JP-1-sf** – Spatial Flow

**Research Notes:** Spatial overlapping are everywhere on this floor plan. At orange circle areas, spaces complicatedly overlap internally. Inside and outside also overlap frequently at red circle areas. There are the areas with green circles where one space flows easily between inside and outside.
2. Japanese Examples

Housing Type 1: Traditional Farmer’s House (17th century)

**JP-1-cp** – Circulation Pattern

Scale: 3/32"=1'-00"

**Research Notes:** There is no circulation core or corridor on this floor plan, and conversely, everywhere could be circulation.
2. Japanese Examples

Housing Type 1: Traditional Farmer’s House (17th century)

**JP-1-vc – Visual Connection**

Research Notes: Lines of sight tend to be long because there are few walls and columns that interrupt the visual connections. Especially at the yellow circle area, the line of sight completely penetrates the building. At the green circle areas, the lines of sight connect two or more rooms to the outside. There is also an internal visual connection through three rooms at the blue circle area.
2. Japanese Examples

Housing Type 2: House of Chestnut Tree (1956) by Tsutomu Ikuta and Haruki Miyajima

**JP-2-fz – Functional Zoning**

![Functional Zoning Diagram](image)

Scale: 3/32"=1'-00"

**Research Notes:** There are several areas where you can see the overlapping of functions. There are two areas, which are used for more than two purposes (orange circles), and also two areas that are used as either circulation or activity spaces depending on demand (blue circles).
2. Japanese Examples

Housing Type 2: House of Chestnut Tree (1956) by Tsutomu Ikuta and Haruki Miyajima

**JP-2-sf** – Spatial Flow

Research Notes: There is a lot of overlapping of spaces seen on the floor plan. At the spaces with orange circles, interior spaces are overlapping. Overlapping of inside and outside is also seen at the areas with red circles. The remarkable thing on this floor plan is the areas with green circles where one space flows easily between inside and outside.
2. Japanese Examples

Housing Type 2: House of Chestnut Tree (1956) by Tsutomu Ikuta and Haruki Miyajima

**JP-2-cp** – Circulation Pattern

**Research Notes**: In the most of areas, circulation paths are in one direction similar to The US houses. However, there are two areas that have Japanese characteristic of circulation patterns (pink circles). In those areas, the floor plan provides residents multiple opportunities of movement.
2. Japanese Examples

Housing Type 2: House of Chestnut Tree (1956) by Tsutomu Ikuta and Haruki Miyajima

**JP-2-vc – Visual Connection**

![Diagram of House of Chestnut Tree with visual connections marked]

**Research Notes:** Lines of sight in this Japanese example go beyond more than two spaces frequently. Clear examples of these lines of sight are the visual connections between outside and inside which are provided in each room (green circles). At the blue circle area, three spaces are visually connected internally.
2. Japanese Examples

Housing Type 3: Row House in Sumiyoshi (1976) by Tadao Ando

**JP-3-fz – Functional Zoning**

Research Notes: The relationship between a space and an activity in the space is clear except the area surrounded by orange circle. There is a functional overlapping of dining and kitchen at the area.
2. Japanese Examples

Housing Type 3: Row House in Sumiyoshi (1976) by Tadao Ando

**JP-3-sf – Spatial Flow**

![Diagram of Row House in Sumiyoshi](image)

Scale: 3/32"=1'-00"

**Research Notes:** Because of the glass walls, which face the center courtyard, spaces are overlapping between inside and outside (blue circle), and between living and dining beyond the courtyard (blue circle). In addition, there is an internal overlapping between the kitchen and the dining at the orange circle area.
2. Japanese Examples

Housing Type 3: Row House in Sumiyoshi (1976) by Tadao Ando

**JP-3-cp** – Circulation Pattern

![Circulation Pattern Diagram]

Scale: 3/32" = 1'-00"

**Research Notes:** Although there is a circular circulation pattern within each space, it does not go beyond the room. The circulation paths between spaces are totally linear.
2. Japanese Examples

Housing Type 3: Row House in Sumiyoshi (1976) by Tadao Ando

**JP-3-vc** – Visual Connection

![Diagram of visual connections in a row house](image)

*Scale: 3/32"=1'-00"*

**Research Notes:** There are visual connections that bring outside into inside (green circles). At the areas with yellow circles, two spaces are visually connected with an outside space between the interior spaces.
2. Japanese Examples

Housing Type 4: Ready-Built House (1990s)

**JP-4-fz** – Functional Zoning

Research Notes: Spaces are clearly divided in terms of activities except the orange circle area.
2. Japanese Examples

Housing Type 4: Ready-Built House (1990s)

**JP-4-sf – Spatial Flow**

Research Notes: Spaces are internally overlapping at orange circle areas. At the blue circle area, bathroom and circulation overlap. There is also an area where inside and outside overlap.
2. Japanese Examples

Housing Type 4: Ready-Built House (1990s)

**JP-4-cp** – Circulation Pattern

Research Notes: Flexible circulation path occurs at the area with a pink circle.
2. Japanese Examples

Housing Type 4: Ready-Built House (1990s)

**JP-4-vc** – Visual Connection

**Research Notes:** A long line of sight penetrates the building (yellow circle). There are also strong visual connections between inside and outside (green circle).
2. Japanese Examples

Housing Type 5: Ready-Built House (2000s)

**JP-5-fz** – Functional Zoning

**Research Notes:** Activities are mostly divided clearly except the orange circle area where two activities are overlapping.
2. Japanese Examples

Housing Type 5: Ready Built House (2000s)

**JP-5-sf** – Spatial Flow

**Research Notes:** There is an overlapping of four spaces at the orange circle area. At the red circle areas, interior spaces flow out to the outside due to the use of sliding doors.
2. Japanese Examples

Housing Type 5: Ready-Built House (2003)

**JP-5-cp** – Circulation Pattern

![Diagram of circulation pattern]

**Research Notes:** At the pink circle area, a variety of circulation paths are provided beyond spaces.
2. Japanese Examples

Housing Type 5: Ready-Built House (2003)

**JP-5-vc** – Visual Connection

Research Notes: At the blue circle area, the lines of sight connect multiple rooms internally. At the green circle area, the line of sight bring outside to inside.
2. Japanese Examples

Housing Type 6: Pao House (2001) by Kazuhiro Ishii

**JP-6-fz** – Functional Zoning

Research Notes: Two activities are overlapping at the orange circle areas. At the blue circle areas, there are vague borders between the circulation and living, or circulation and dining.
2. Japanese Examples

Housing Type 6: Pao House (2001) by Kazuhiro Ishii

**JP-6-sf** – Spatial Flow

*Research Notes:* Spatial overlapping are everywhere on this floor plan. At orange circle areas, spaces complicatedly overlap internally and externally. Inside and outside also overlap in the red circle area. There are the areas with green circles where one space flows easily between inside and outside.
2. Japanese Examples

Housing Type 6: Pao House (2001) by Kazuhiro Ishii

**JP-6-cp** – Circulation Pattern

Research Notes: At the pink circle areas, multiple circulation paths are provided beyond spaces.
2. Japanese Examples

Housing Type 6: Pao House (2001) by Kazuhiro Ishii

**JP-6-vc – Visual Connection**

Research Notes: Lines of sight tend to be long because of the use of glass walls. At the green circle areas, the lines of sight connect two or more rooms to the outside. There is also an internal visual connection through more than two rooms at the blue circle area.
3.4. Analysis for the Case Studies

From the analysis, a conflict between privacy and flexibility is revealed. Japanese houses tend to have more flexibility but less privacy. This flexibility enables the reuse of spaces. Conversely, the US houses tend to have more privacy but less flexibility.

From the further analysis of the relationship between privacy and the division of the spaces, Matrix 1 was determined. Matrix 2 was made by analyzing the relationship between the degree of flexibility and physical elements in the buildings.

Matrix 1 shows that there are five levels of division from level 0 to level 4. The levels of division are set in terms of how much privacy is secured in the divided space. Level 0 division means there is no division in a space (or, spaces). Although a level 0 division is not really a division, “level 0” is defined for convenience’ sake.

Level 1 division is named Implied Spatial Division. Implied Spatial Division divides a space, but people’s physical, visual, acoustical communications are not interrupted by the division. Inversely, Implied Spatial Division does not secure any privacy between the spaces.

Level 2 division, which is named Physical Division, divides a space and people’s physical communication, but people can still communicate with each other visually, and acoustically. Physical Division guarantees a little privacy by avoiding people’s physical invasion.

Level 3 division, or Visual Division, divides a space, physical communication, and visual communication. People can still communicate acoustically. Privacy is secured by avoiding physical and visual connection between the spaces.

Level-4 division, which divides a space, physical, visual and acoustical communication, is named Acoustical Division. Through Acoustical Division, people cannot communicate with each other at all. However, the privacy is completely secured between the spaces.
Matrix 1: Levels of Division in Relation to Privacy

<table>
<thead>
<tr>
<th>PRIVACY</th>
<th>LEVEL</th>
<th>NAME</th>
<th>DESCRIPTION</th>
<th>SENSES/ACTIONS</th>
<th>SYMBOL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>0</td>
<td>No Division</td>
<td>There is no division in the space(s)</td>
<td>O O O O O O</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>Implied Spatial Division</td>
<td>People notice the division, but still can communicate each other through the division in any ways</td>
<td>O O O O O O</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Physical Division</td>
<td>People cannot move though the division, but can communicate each other visually and acoustically</td>
<td>X X O O O O</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Visual Division</td>
<td>People cannot see through the wall, but still can communicate each other acoustically</td>
<td>X X X O O O</td>
<td></td>
</tr>
<tr>
<td></td>
<td>High</td>
<td>Acoustical Division</td>
<td>The spaces are completely divided. People cannot even hear through the wall.</td>
<td>X X X X X X</td>
<td></td>
</tr>
</tbody>
</table>
Matrix 2 is based on a list of physical features in each building: Separated Public/Private, Kitchen/Utility Core, Exterior Focus, Shared Activity Zone, Layers of Spaces, and Movable Partitions are the features that define flexibility; Fixed Walls, Distinct Corridor, Distinct Activity Zone, Internal Focus, Scattered Utility/Kitchen, and Mixed Public/Private are the features the define non-flexibility. If a building has one of the features, the researcher put an O in the area of the matrix.

From the Matrix 2, the researcher found that the US houses tend to have more flexibility elements in the interior spaces, while Japanese houses tend to have more privacy elements. However, as time passes, the characteristics of houses in the two cultures become more similar: the US houses begins to have more flexibility; and, Japanese houses starts to have more privacy.

3.5. Conclusion for the Case Studies

The case studies were used to explore aspects of spatial division in domestic structures to act as a frame of reference for the design proposal. At this point, the investigation will raise a design proposal approach to expand the findings of the Literature Review and the Case Studies. The design approach in the following chapter will explore how the concept of reusable spaces of Japan works in the US residential design, and will continue to investigate the difference in approach of the Japanese and the US residential design.
Matrix 2: Flexibility and Buildings

<table>
<thead>
<tr>
<th></th>
<th>USA</th>
<th>Japan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monticello</td>
<td>1808</td>
<td></td>
</tr>
<tr>
<td>Beecher’s Proposal</td>
<td>1869</td>
<td></td>
</tr>
<tr>
<td>Postwar Housing</td>
<td>1950s–60s</td>
<td></td>
</tr>
<tr>
<td>Jacobs House</td>
<td>1936</td>
<td></td>
</tr>
<tr>
<td>House in Inland NW</td>
<td>2003</td>
<td></td>
</tr>
<tr>
<td>LB House</td>
<td>2002</td>
<td></td>
</tr>
<tr>
<td>Pao House</td>
<td>2001</td>
<td></td>
</tr>
<tr>
<td>Ready-Built</td>
<td>2000s</td>
<td></td>
</tr>
<tr>
<td>Ready-Built</td>
<td>1990s</td>
<td></td>
</tr>
<tr>
<td>Row House</td>
<td>1976</td>
<td></td>
</tr>
<tr>
<td>House of Chestnut</td>
<td>1956</td>
<td></td>
</tr>
<tr>
<td>Farmer’s House</td>
<td>17C.</td>
<td></td>
</tr>
</tbody>
</table>

**Flexibility Elements**
- Separated Public/Private
- Kitchen/Utility Core
- Exterior Focus
- Shared Activity Zone
- Layers of Spaces
- Movable Partitions

**Inflexibility Elements**
- Fixed Walls
- Distinct Corridor
- Distinct Activity Zone
- Internal Focus
- Scattered Utility/Kitchen
- Mixed Public/Private
CHAPTER 4: DESIGN PROPOSAL

4.0. Introduction

The purpose of this chapter is to propose a design prototype of a residential space based on the findings from the Literature Review and the Methodology chapters. In the Literature Review chapter, the researcher concluded that the motivation towards material reuse is higher in Japan than in the USA due to the Japan’s long tradition in reuse of materials, as well as building structures and interior spaces. The researcher also revealed the importance of the investigation in Japanese method of reuse in material and spaces. To explain the argument in the Literature Review, the researcher carried out case studies in the Methodology chapter to look at the differences between Japanese houses and The US houses in terms of the concept of reuse. As a result of the analysis in the case studies, the researcher uncovered two matrixes that increase the understanding of residential spaces in the concept of reuse.

Based on these findings from the previous chapters, the researcher explores how the Japanese concept of space reuse and the conflicting ideas of flexibility and privacy contribute to develop a residential space in The US culture in this design approach. The researcher chose a loft, which is a new residential prototype in the USA, as the object for the study. The goal of this chapter is to create a residential space that has the Japanese concept of the reuse of space in it, and that also provides appropriate levels of privacy and flexibility depending on residents’ demands.

This chapter has three sections without the introduction and the conclusion: 4.1 Site Description; 4.2 Design Process; and, 4.3 Design Analysis. The first section describes the chosen residential unit and the building, in which the residential unit exists. The second section includes the method and development of the design. The third section discusses the contribution of this design process for expanding possibilities of Japanese space reuse concept in the USA.
4.1. Site Description

The site that the researcher has chosen for the Design Proposal chapter is a loft, which is a new residential prototype that has opportunities that do not exist in traditional residential spaces. The loft unit is in a brick building, which is located in downtown Spokane, WA, USA. The building was built in 1910, and is undergoing a revitalization process in 2003. The building has four stories, and the area of each floor is 5560.08 square-feet. The first floor is planned to be a parking space. There are windows on the north and the south sides of the building, and the other sides are attached to other buildings. The main access to the building is on the north side on the first floor. The floor plan for each floor of the building is shown in the Appendix A.

The chosen unit is at the northeast corner on the third floor of the building, with 710.69 square-feet as its area. The shape of the unit is a rectangular with 28 feet for the longer edge and 25 feet for the shorter edge. There is a column at the center of the unit. All of the four windows in the unit are facing north. The entrance from the corridor to the unit is at the southwest corner of the unit. The ceiling height is 8 feet everywhere in the unit. The floor plan and a section drawing for the unit are given as Figure4-1 on the next page.

4.2. Design Process

The overall purpose of this design process is to create a residential space that achieves the ideas introduced and found in the previous chapters: Japanese concept of reusable spaces, flexibility, and privacy. The researcher explores the ideas in three phases.

Phase 1 is a design with a dry wall system to understand the basic functions and activities in a residential space in order to figure out the levels of divisions needed in the unit, which is a finding from the Methodology chapter. In Phase 2, the researcher explores the flexible living
Figure 4-1: Floor Plan and Section of the Residential Unit (Not to Scale)
environment, in which the spatial configuration is adaptive to residents’ demand, to find out a way to resolve the conflict between privacy and flexibility, which is also a finding from the Methodology chapter. The unit is designed for one resident in Phase 1 and 2 in order to simplify the design problems into privacy and flexibility. In Phase 3, the modular system, which is a finding from the Literature Review chapter, is employed to attain a residential space with the Japanese concept of reusable space, and the maintenance of both privacy and flexibility. The unit is designed for two residents in Phase 3 in order to create a more challenging situation for the achievement of the ideas.

4.2.1. Phase 1: Design with Conventional Wall Systems

The design process started with designing a residential space by using conventional walls. The conventional walls used in this phase are not movable or removable, but fixed to the floor and/or the ceiling. A wall may have doors. In order to concentrate on the issue of privacy at this stage, the resident in this unit is only one for this phase. The researcher does not assign detailed information on the resident to keep the proposal general. The resident would need a space to sleep, relax, eat, cook, bathe, and excrete in this unit.

The residential unit is divided into four areas with the column as the center point: a kitchen/dining area; a living area; a sleeping area; and, a bath/storage area. More public spaces – the kitchen/dining area and the living area are relatively near to the entrance. The kitchen/dining area is located the nearest to the entrance, and the living area is next to the kitchen/dining area by two windows. There are no walls between these areas, but two columns on both side of the walls, which contribute as an implied spatial division. Conversely, more private areas – the sleeping area and the bath/storage area are relatively far from the entrance. The sleeping area is at the farthest corner from the entrance, and the bath/storage area is at the corridor-side corner and
Figure 4-2: Floor Plan and Section for Design Phase 1

Residential Unit: Design Phase 1
Spokane, WA
Scale: 1/4" = 1'-00"
farther from the entrance. The sleeping area is divided from the living area with a wall that is not reaching the ceiling. This wall works as a visual division. There is a wall that reaches the ceiling between the sleeping area and the bath/storage area. This wall works as an acoustical division. The bath/storage area is accessible both from the kitchen/dining area and the sleeping area through a door on each side of the wall.

The floor plan and section drawing of Phase1 are given as Figure4-2 on the previous page.

4.2.2. Phase2: Design with Movable Partitions

Based on the spatial configuration determined in Phase1, the researcher proceeds to Phase2 by replacing the walls into flexible partitions with keeping the functions of the walls on them.

Two walls are replaced into movable partitions: one between the living area and the sleeping area; and, the one between the sleeping area and the bath/storage area. The other wall that divided the kitchen/dining area and the bath/storage area in Phase1 is partially replaced due to the existence of toilet. The basic floor plan for the phase2 is shown as Figure4-3 on the next page.

The wall between the sleeping area and the living area is replaced into four movable partitions. There are mainly two patterns in the use of these partitions. One is when they are placed in a line to create a visual division. In this pattern, the resident can separate the sleeping area from the living area, as well as can separate the private areas from the public areas. Figure4-4 on the following page of Figure4-3 shows a pattern of the partitions creating a visual division.

Another pattern is when the partitions are slid to the walls on both sides to create an implied spatial division. In this pattern, the resident can use the sleeping area as an extension of the
Residential Unit: Design Phase 2-Basic Floor Plan
Spokane, WA
Scale: 1/4"=1'-00"

Figure 4-3: Basic Floor Plan for Design Phase 2
Residential Unit: Design Phase 2 - Pattern 1
Spokane, WA
Scale: 1/8"=1'-00"

Figure 4-4: Floor Plan and Sections for Design Phase 2 – Pattern 1

Residential Unit: Design Phase 2 - Pattern 2
Spokane, WA
Scale: 1/8"=1'-00"

Figure 4-5: Floor Plan and Sections for Design Phase 2 – Pattern 2
living area physically and/or visually. Figure 4-5 on the previous page shows the pattern of the partitions creating an implied spatial division.

There could be more patterns of the use of these partitions between the sleeping area and the living area, such as to place two of them in a line in the middle and slide the rest to the walls on both sides, and so on.

The wall between the sleeping area and the bath/storage area is replaced into two movable shelves. There are mainly two patterns to use these shelves. One is when both of the shelves are slid to one side to create an implied spatial division. Figure 4-4 on the next page shows this pattern. In this pattern, the resident can expand the view from the bath/storage area towards the windows in the sleeping area.

Another is when they are shut off to create a visual division between two areas. Figure 4-5 on the next page shows this pattern. In this pattern, the resident can separate the sleeping area from the bath/storage area.

The wall that divided the kitchen/dining area from the bath/storage area is partially replaced to two roll-up blinds. Since the toilet must have solid walls to surround it, there are still solid walls in the bath/storage area. There are mainly three patterns in the use of the roll-up blinds. One is when the blind(s) is closed off to the floor to create a visual division. The blind A in the floor plan of Figure 4-4 shows the pattern with closed-off blind. In this pattern, the resident can make the bath/storage area closed off to keep his/her privacy in the space.

Another is when the blind(s) is half-open to create a physical division. The blind B in the floor plan of Figure 4-4 shows this pattern. In this pattern, the resident can make the two areas – the kitchen/dining area and the bath/storage area – visually connected, but can avoid the physical invasion.
The last one is when the blind(s) is rolled up to the ceiling to create an implied spatial division. The blind A and B in the floor plan in Figure4-5 shows this pattern. In this pattern, the resident can connect the kitchen/dining area to the bath/storage area.

In this phase, the toilet space is separated from the bathtub/wash-basin area. The reason of the independent toilet space is because the level of division required for toilets and the bathtubs/wash-basins are different. Toilets require the highest level of division in order to shut the sound and smell, while bathtubs/wash-basins need Level 3 division not to be seen from the outside of the space. The level division between the bathtub area and the other could be lower than Level 3 if only one resident is living in the unit because no one would see him/her taking a bath from the outside. Therefore the researcher decided to employ the Japanese bathroom planning to this phase of design, in which toilets, bathtubs and wash basins are in different rooms.

4.2.3. Phase3: Design with Movable Partitions and Modular Grid System

Different from the previous phases, the number of residents in the unit is not one, but two because two people in one unit needs more privacy than the one that is necessary for the one resident in one unit, such as the privacy for bathing time. The description of residents is:

- The residents are not a family, but roommates.
- The gender of the residents is not specified in order to keep generality.
- Both of the residents are working, or studying outside of the unit during daytime of weekdays.
- Both of the residents are usually not working/studying on weekends, but they might bring some work/study home.
Both of the residents might bring their friends home on weekends, and the friends might stay over night at home.

Derived from the residents’ description, the researcher made six different cases of residents’ activities within the unit in terms of the times and occasions, in order to see how the design proposal contributes to the privacy and the flexibility of the unit in each case. The six cases are:

1. Weekday-Daytime: Both of the residents are out to work/study, so that no one is in the unit.
2. Weekday-Nighttime: One of the residents is working/studying, and another resident is watching TV.
3. Weekend-Daytime without guests: Residents are talking together.
4. Weekend-Nighttime without guests: One of the residents is sleeping, and the other is watching TV.
5. Weekend-Daytime with guests: One of the residents has two guests, and the other is working/studying.
6. Weekend-Nighttime without guests: One of the residents has two guests, and the other is sleeping.

Before getting into the actual design, the researcher made a bubble diagram to see how the activities and spaces within the unit are related to each other in terms of privacy, flexibility and individuality. First, the researcher made a list of activities that could happen in the residential space, and then place them in diagrams that shows the level of privacy, flexibility, and individuality of the activities. The possible activities in a residential space are: sleeping; relaxation; personal recreation (doing hobbies or something for fun personally); studying/working; bathing; grooming; excreting; eating; cooking; and, socializing.

In the first diagram shown as Figure 4-9 on the next page, the ten activities are placed with
Figure 4-6: Activity Configuration in the Relationship of Privacy and Flexibility for a Residential Space

Figure 4-7: Activity Configuration in the Relationship of Privacy and Individuality for a Residential Space with 2+ Residents

Figure 4-8: Activity Configuration Diagram for the Design Phase 3
two axes, privacy; and flexibility. The possible activities are placed in right side, and the ones that have to be less flexible are placed in left side, while the activities that need more privacy are placed in upper side, and the ones need less privacy are placed in lower side. This diagram is general, so that it would be applicable for any number of residents.

The second diagram – Figure 4-7 on the previous page shows the activity configuration specific for two or more residents because there is an issue whether a space could be shared by residents, or not. Figure 4-7 is made to investigate this issue by placing the activities in two axes: privacy and individuality. The activities that could be in shared spaces are in right side, and the ones that should be in individual spaces are in left side of the diagram, while the activities that need more privacy are in upper side, and the ones that need less privacy are in lower side.

In this diagram, the researcher found that there needed to be three different areas in a residential and has another one at the bottom to have another extension. These partitions can provide all of the four levels of division that are presented in Chapter 3: Implied Spatial Division; Physical space: individual-private area; sharable-private area; and, sharable-public area. Individual-private area is the area assigned for each resident for his/her personal activities that are not usually sharable with someone. This area contains sleeping, relaxation, personal recreation, and studying/working. Grooming could be in this category as well. Sharable-private area is the area assigned for both of the residents, but the activities held in the area are individual. A sharable-private area contains bathing and excreting, and could contain grooming. Sharable-public area is the area assigned for both of the residents to use the area at the same time. This area includes eating, cooking, and socializing.

Finally, based on the two diagrams, the bubble diagram – Figure 4-8 is created as a base for
the following design processes. It shows the configuration of activities and spaces in a residential unit.

The floor plan for Phase 3, which is shown as Figure 4-9 on the next page, is designed deriving from Figure 4-8. Less flexible activities, such as cooking, bathing, and excreting are placed at the corners to create larger space for the rest of the activities. Also, all of the walls in the unit except the walls around the toilet are taken away. Instead of walls, the unit could have movable/removable partition panels to separate the spaces. There are rails on the ceiling for lengthwise and crosswise every 6 feet in order to let the partition panels run to separate the spaces on residents’ demands. The distance between each rail is determined by the findings of international module from the literature review chapter. An international module was found to be determined to a constant measurement.

The size of a partition panel is 3 feet x 6 feet, which is also determined by the finding on the international module from Chapter 2. A panel has a hook at the top to be hanged from the ceiling rails, and has another hook at the bottom to have an extension panel whose dimension is 1 feet x 3 feet. The extension panel also has a hook at the top to be hanged from another panel, Division; Visual Division; and, Acoustical Division. An Implied Spatial Division is provided by the use of extension panels by hanging them directly from the ceiling. An Physical Division is provided by the use of 3x6 partitions without extension panels. Visual Division is provided by the combinatory use of 3x6 partitions and extension panels. An Acoustical division is provided by the set of two panels, and putting soundproof material between the two panels. The drawings of the partition are in the Appendix B.

For each of the six cases that are presented on page 10, the researcher designs a floor plan with the partitions. The floor plans are given on page 105.
Residential Unit: Design Phase 3
Basic Floor Plan & Section
Scale: 1/4"=1'-00"

Figure 4-9: Basic Floor Plan and Section for Design Phase 3
Figure 4-10: Floor Plans for Design Phase 3 in Different Times and Occasions

Residential Unit: Design Phase 3
Spokane, WA
Scale: 1/8" = 1'-00"
4.3. Design Analysis

In order to see how the space is used in each phase, the researcher color-codes by three categories of space use on the floor plan(s) of each design phase. Three categories are Individual-Private area, (Sharable) Private area, and (Sharable) Public area. Individual-Private area is color coded by yellow, (Sharable) Private area is blue, and (Sharable) Public area is red.

For Phase1, the use of the space is very rigid. There is only one pattern that the space could be, and there is no overlapping of each area. Areas are clearly divided by solid walls. The color-coded floor plan of Phase1 is shown on the next page as Figure4-10.

For Phase2, the use of the space is more flexible than Phase1. There are some patterns in the use of space, and two of them are shown as Figure4-11 on the following page of Figure 4-10. On the floor plan of Pattern1, there is no overlapping of categories between Public area and Private area, or Public area and Individual-Private area because the divisions between the spaces are closed. However, Private and Individual-Private areas are slightly overlap at the green circle on the floor plan. It is an effect of movable shelves between these two areas.

On the floor plan of Pattern2, there are two areas where two different categories overlap. One is at the purple circle, in which Private and Public areas are overlapping. Another is at the orange circle, in which Individual-Private and Public areas are overlapping. It is revealed that reuse of space can be seen slightly in Design Phase2.

For Phase3, the researcher color-codes for all of the six floor plans. The color-coded floor plans are shown as Figure4-12 on the following page of Figure4-11. Since there are less numbers of divisions between the areas, overlapping of categories are everywhere on each floor plan except Case5 in which more partitions are placed. Furthermore, not only the space of reuse in the same time, but also the reuse of spaces in different times is seen when comparing the six
Figure 4-11: Spatial Configuration of Design Phase 1
Figure 4-12: Spatial Configuration of Design Phase 2 in Two Patterns

Scale: 1/8” = 1’-00”
Figure 4-13: Spatial Configuration of Design Phase 3 in Various Time and Occasions

Case 1: Weekday - Daytime
- Resident A: Out to work/study
- Resident B: Out to work/study

Case 2: Weekday - Nighttime
- Resident A: Studying/Working
- Resident B: Watching TV

Case 3: Weekend - Daytime w/o Guests
- Resident A: Talking w/B
- Resident B: Talking w/A

Case 4: Weekend - Nighttime w/o Guests
- Resident A: Sleeping
- Resident B: Watching TV

Case 5: Weekend - Daytime w/Guests
- Resident A: Having 1-2 guests
- Resident B: Studying/Working

Case 6: Weekend - Nighttime w/Guests
- Resident A: Having 1-2 guests, 1 guest stays over night
- Resident B: Sleeping

Residential Unit: Design Phase 3
Spokane, WA
Scale: 1/8" = 1'-00"

Figure 4-13: Spatial Configuration of Design Phase 3 in Various Time and Occasions
floor plans. For example, a part of the area that is used as Sharable-Public area in Case3 is used as Individual-Private area in other cases.

Not only flexibility, but also privacy for each resident is also kept in Phase3. Looking at Cases2, 4, 5, and 6, one of the resident can obtain a proper level of privacy with proper use of partitions, and the privacy does not obstruct flexibility of the unit because the private area could be broken up into public area.

It is revealed that there is more reuse of spaces in Phase3 than previous phases because of the use of grid system and movable partitions, but the privacy for the resident is still kept.

4.4. Conclusion for Design Proposal

The researcher found that the Japanese concept of reusable space can increase the flexibility in a residential space. It is also apparent that the Japanese concept of reusable space does not suspend the privacy in residential spaces. In this design approach, the appropriate use of movable/removable partition in different times and occasions allowed the space to keep both the flexibility and the privacy in the residential unit. Therefore, the use of movable/removable partition can create a residential space that meets residents’ demand for various times and occasions.
CHAPTER 5: DISCUSSIONS AND CONCLUSIONS

5.0. Introduction

The intent of this chapter is to sum up the findings and analyses of three chapters overall: the Literature Review; the Case Studies; and, the Design Proposal.

Chapter 5 has four sections after the Introduction. The first section is 5.1. Summaries for Three Chapters. This section contains the summary of the findings and analysis for each chapter. The second section is 5.2. Overall Analysis for the Three Chapters. This section analyzes the three chapters as an entirety. The third section is 5.3. Conclusions. This section is for the conclusion of the study as a whole. The last section is 5.4. Recommendations for Further Studies. This section suggests possibilities of further studies from this thesis.

5.1. Summaries for the Three Chapters

This section has three subsections: 5.1.1. Summary of the Literature Review; 5.1.2. Summary of the Case Studies; and, 5.1.3. Summary of the Design Proposal.

5.1.1. Summary of the Literature Review

In the study of literature, the researcher traced and documented the historical evolution of reuse in the US culture and Japanese culture. To the researcher, it appears that the Japanese concept of reuse has a long tradition in several areas such as materials, building structures, and interior spaces. Material reuse is commonly accepted by the word “recycling” now in 2003, and is one of the keys for the sustainable development as well as in the global context. In contrast, the reuse of building structures and interior spaces is unique to Japan. The reuse of building structure is effective for the material reuse because there is less need for new materials for new structures. The reuse of interior spaces is important for saving materials so that the user can use
the structure for a long time without having major structural changes.

It was also found in the readings that the use of a modular is essential for the reuse of building structures and interior spaces. Unlike Japan, reuse of building structures in the USA is not applicable due to the longer durability of the buildings in the USA. Therefore the researcher concluded that the major focus of this study would be reuse of residential space and the modular definition of interior space.

5.1.2. Summary of the Case Studies

In order to enhance the finding that Japanese houses have more flexibility with the concept of space reuse which stimulates the saving of material, the researcher conducted case studies of houses from the two countries – the USA, and Japan. Through the four kinds of graphic analysis on the floor plans of twelve design examples, the researcher found that privacy and flexibility tend to conflict with each other. A further study on privacy and flexibility was undertaken to investigate the conflict between them. As a result, a matrix of the levels of divisions and privacy, and a matrix of flexibility elements were exposed. Finally, the Case Studies chapter concluded that the appropriate use of the matrixes could resolve the conflict of privacy and flexibility in a reusable residential space.

5.1.3. Summary of the Design Proposal

The study of Literature concluded that space reuse is crucial for the development of material saving and reuse in the USA, and that the use of a modular has a large role in this process. The Case Studies revealed that the consistency of privacy and flexibility is the key to create residential spaces with the concept of space reuse. From these findings, the researcher suggests a design prototype of reusable residential space in the USA for the Design Proposal chapter. The researcher took three steps for approaching the final prototype, and proposed a design with the
idea of use of modular, movable/removable partitions, and the maintenance of privacy and flexibility. Through the process of design, the researcher realized the importance of the appropriate configuration of human activities in a reusable residential space.

5.2. Overall Analysis for the Three Chapters

Through the studies in the chapters 2, 3 and 4, it was found that there are some key elements to employ the Japanese concept of reuse in the US residential design. These are: the reuse of materials; the reuse of building structures; the reuse of interior spaces as conceptual elements; and, the use of a modular; and the maintaining of flexibility and privacy as design elements. The conceptual elements are the basic ideas that supports the reusable residential space conceptually, while the design elements the methods to achieve the reusable residential space in design approaches.

There are three conceptual elements for saving resources, which is an important part of the concept of sustainability: reuse of materials, reuse of building structures, and reuse of interior spaces. Material reuse directly contributes to resource saving, and the other two – reuse of building structures and interior spaces, which are unique to Japanese culture – contribute indirectly. Structural reuse encourages the resource saving through avoiding the use of new material for new structures, while space reuse activates it through avoiding the major structural and/or interior remodeling by a changeable floor plan.

A design element, the use of modular plays an important role for both the reuse of building structures and the reuse of interior spaces when designing a residential space with the Japanese concept of reuse. The use of a modular enables structural parts to be used in other buildings, as well as partitions that divide spaces to be usable in multiple spaces.
Furthermore, there are two design elements to be thought of when designing a reusable residential space: flexibility; and, privacy. Flexibility means the changeability of spaces, and is the basis of space reuse. However, flexibility sometimes has a conflict with privacy because of the several kinds of invasion into the private area, such as physical invasion, visual invasion, and acoustical invasion because of less division in the space. Therefore, it is crucial to solve the conflict between privacy and flexibility for the employment of the Japanese method of reuse.

5.3. Conclusions

Figure 5-1 below is a diagram that shows the elements of reusable residential spaces of Japan as mentioned in the previous section. The diagram also shows the contribution of the reusable residential spaces to sustainability.

Sustainability has become a global issue which needs to be addressed at all scales of the built environment. This study just deals with the small-scale residential design, but it also emphasizes the need for cross-cultural awareness.
Through the cross-cultural study, the researcher revealed that there are differences between the USA and Japan in terms of the approaches towards reuse. A reason for the differences is the distinctiveness of each culture. Since Japan does not have a large land mass and large amount of natural resources, the Japanese have to keep thinking of saving materials and spaces. Now, the Japanese effort towards reuse is an element that composes Japanese culture. In contrast, the USA does not have a legacy of reuse due to its large land mass and sufficient natural resources. The lack of history in the USA is not necessarily a negative element because the USA is always open to employing ideas from foreign cultures that have more history. Therefore, it is possible for the US people to understand and employ the Japanese concept of reuse in their residential design.

5.4. Recommendations for Further Studies

As mentioned in the Introduction, this study limited the area of study to residential design. Thus, the exploration of the spaces other than residential could be pursued further in a future study.

The idea of reusable residential space into larger scale residential spaces could also be researched further, as this study only dealt with small-scale residential units.

From the readings, it is apparent that beyond the historical evidence there is a recycling ideology that is moving closer together across the nations. In 2003, this aspect of this study would have to be understood in the new context of the future and not the past, and to be understood as a knowledge base to build on in the new aspects of international recycling and reuse.
REFERENCES


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APPENDIX A

DRAWINGS FOR

1910 BRICK BUILDING, SPOKANE, WA, USA
Urban Loft Condominiums, Spokane, WA
Fourth Floor
Scale: 1/8"=1'-00"

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APPENDIX B

DRAWINGS FOR

THE MOVABLE/REMOVABLE PARTITIONS

IN DESIGN PHASE 3
APPENDIX C

PRESENTATION SLIDES
The Contrast of Adaptive Reuse of Japanese and North American Residential Space
How can Japanese reuse of residential space educate and inform North American residential design

Abby Ito
April 30, 2003

Background

Sustainability
– it has been a major topic of concern since 1960’s as it appears that environmental problems could be destructive to human civilization.
Aims of the Study

1. Recycling
   already accepted as a daily activity to
   the general public
2. Cross-Cultural and Historical Approach
   the USA and Japan
3. Residential Space
   reflection of cultural characteristics
   where people’s everyday life takes place.

Purpose of the Study

1. Explore the Japanese method of recycling in
   contrast to the North American.
2. Investigate the differences of recycling in
   materials, building structures, and interior
   spaces in the two cultures and the reason for
   the differences.
3. Take one element; the recycling of space and
   expanding this concept in a design
   investigating the reuse of space.
   International residential prototype
Justifications

1. To raise awareness towards recycling in the Western culture of the United States by applying the Eastern method of recycling of materials and spaces because of the lack of evidence in the literature.

2. To provide more variety of residential types for North American designers by exposing them to a Japanese method of recycling that is not considered in the literature.

3. To raise aspects of space reuse that has not apparently been of consideration or brought to designers’ attention before.

Methodology

1. Literature Review
   - to become familiar with the terms & different cultural approaches

2. Case Studies
   - to expand on the Literature Review

3. Design Proposal
   - to expand on the Literature Review & the Case Studies

4. Summary and Conclusion
Literature Review

A historical survey to investigate recycling of materials, structures and the use of the modular as a background for the investigation of the reuse of space in residential design

Contents

• Definition of Reuse
• History of Material Reuse in the USA
• History of Material Reuse in Japan
• Building Reuse as a Japanese Tradition
Definition of Reuse

There are several current uses of the word related to recycling.
- Reuse, Recycling, Remanufacturing, Refurbishing, … etc.

REUSE
= using materials or spaces twice or more

History of Material Reuse in the USA

People tend to stop recycling when they notice that it becomes inefficient due to cost.
Literature Review

History of Material Reuse in Japan

Before 1867

- In ancient Japan, everything was recycled including buildings

1867 - 1972

Decline of Recycling

- Due to the import of Western industries
- People were less serious about saving natural resources and energy
History of Material Reuse in Japan
After 1972

Revival of Material Reuse
reasons
1. The severe shortage of oil (the First Oil Shock) in 1973
2. The landfill crisis in Tokyo Metropolitan area

Building Reuse
Structure & Modular

Reusable Structures
by dismantling and rebuilding

Reuse of Structures
Use of Modular
Building Reuse
Space

Changeable
Space on users' demands
- open floor plan
- use of movable/removable partitions (Shoji, Fusuma)

Reuse of Spaces

Conclusions
for the Literature Review

The USA
- The Approach towards recycling is economically driven & not a traditional custom.

Japan
- The tradition of Reuse is a cultural continuum without economic pressures
  Specifically...
  - Modular Approach
  - Reuse of Spaces
Case Studies

In-depth study of space use in Japanese houses and North American houses
- What made Japanese houses suitable for recycling
- What are the differences of Japanese houses & North American houses

North American Examples

1808 – Monticello
1869 – Beecher’s Proposal
1936 – Jacobs House
1950s – Postwar Housing
2002 – LB House
2003 – House in Inland NW
Japanese Examples

17C. - Traditional Farmer's House
1956 - House of Chestnut Tree
1976 - Row House in Sumiyoshi
1990s - Ready-Built House
2001 - Pao House
2000s - Ready-Built House

Results from the Case Study
- Overall

The United States
- Houses tend to have more privacy, but less flexibility.

Japan
- Traditional houses tend to have more flexibility, but less privacy.

Influence
- As time passes, houses tend to have more privacy.

Privacy VS Flexibility
### Results from the Case Study

#### 1. Privacy

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<th>Level</th>
<th>Name</th>
<th>Description</th>
<th>Symbols</th>
<th>Symbol</th>
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<td>Low</td>
<td>No Division</td>
<td>There is no division in the space(s)</td>
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<td>○ ○ ○ ○</td>
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<td>Implied Spatial Division</td>
<td>People notice the division, but still can communicate each other through the division in any way</td>
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<td>○ ○ ○ ○</td>
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<td></td>
<td>Physical Division</td>
<td>People cannot move through the division, but can communicate each other visually and acoustically</td>
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<td>○ ○ ○ ○</td>
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<td></td>
<td>Visual Division</td>
<td>People cannot see through the wall, but still can communicate each other acoustically</td>
<td>X X X ○</td>
<td>○ ○ ○ ○</td>
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<tr>
<td>High</td>
<td>Amalgam Division</td>
<td>The spaces are completely divided. People cannot even hear through the wall.</td>
<td>X X X X</td>
<td>○ X X X</td>
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#### 2. Flexibility

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Note: The symbols represent different flexibility levels, with ○ indicating a lower level of flexibility and ○ ○ ○ ○ indicating a higher level of flexibility.
Design Proposal

1. Explore how
   - the Japanese concept of space reuse, and
   - the conflicting ideas of flexibility and privacy
contribute to develop a residential space in
North American culture.

2. Create a residential space with
   - Japanese concept of the reuse of space
   - appropriate levels of privacy and flexibility
     depending on residents’ demands

Site Description

- A residential unit in downtown Spokane
- Area: 700 sq ft
Design Process

Phase 1 – Design with a dry wall system
to understand the basic functions and activities

Phase 2 – Design of a Flexible living environment
to find out a way to resolve the issue of privacy and flexibility

Phase 3 – Design with a modular system
to attain the Japanese concept of reusable space, and
the maintenance of both privacy and flexibility

Design Phase 1

To understand the basic functions and activities in the unit
Design Phase 1

Basic Floor Plan

- Design with a dry wall system
- No movable/ removable partitions
- One Resident

Design Phase 1

Spatial Configuration

- Rigid spatial configuration
- Areas are clearly divided by solid walls
Design Phase 2

To find out a way to resolve the issue of privacy and flexibility

Design Phase 2
Basic Floor Plan

- Design of flexible living environment
- Replacing the walls into flexible partitions
- One Resident
Design Proposal

Phase 2
Different Patterns

Design Phase 2
Spatial Configuration

- More flexible than Phase 1
- Areas are slightly overlap
Design Phase 3

To attain the Japanese concept of reusable space, and the maintenance of both privacy and flexibility

Resident's Description

- Two Residents
  Not a family, but roommates
  - The gender of the residents is not specified

Both of the residents are working, or studying outside of the unit during daytime of weekdays.
Both of the residents are usually not working/studying on weekends, but they might bring some work/study home.
Both of the residents might bring their friends home on weekends, and the friends might stay over night at home
Design Phase 3
Six Different Cases

1. Weekday-Daytime
   - Both of the residents are out to work/study, so that no one is in the unit.

2. Weekday-Nighttime
   - One of the residents is working/studying, and another resident is watching TV.

3. Weekend-Daytime without guests
   - Residents are talking together.

4. Weekend-Nighttime without guests
   - One of the residents is sleeping, and the other is watching TV.

5. Weekend-Daytime with guests
   - One of the residents has two guests, and the other is working/studying.

6. Weekend-Nighttime with guests
   - One of the residents has two guests, and the other is sleeping.
Design Phase 3
Basic Floor Plan

- Design with a modular system
- Two Residents

Design Proposal

Design Phase 3
Different Patterns

Design Phase 3
Findings from Design Phase

1. The concept of reusable space can increase the flexibility in a residential space.
2. The concept of reusable space does not suspend the privacy in residential spaces.
   - the appropriate use of movable/removable partition
3. The use of movable/removable partition can create a residential space meeting residents' demand for various times and occasions.
Conclusions

- Sustainable Design has become a global issue which needs to be addressed at all scales of the built environment.
- This study just deals with the small scale residential design, but it also emphasizes the need for cross-cultural awareness.
“It is possible to alter these growth trends and to establish a condition of ecological and economic stability that is sustainable far into the future.”

---Words from the Limits to Growth (Meadows, 1972)