

The Wave Kitchen: A Cross-Cultural Product Design

by

Shinya Iwata

A Master's Degree Project submitted to
the Faculty of Environmental Design
in partial fulfillment of the requirements for the degree of
Master of Environmental Design (Industrial Design)

Faculty of Environmental Design
The University of Calgary
Calgary, Alberta, Canada

June, 1991

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ISBN 0-315-71094-2

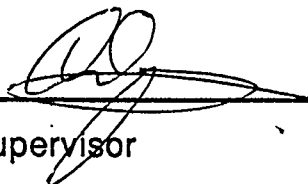
Canada

Faculty of Environmental Design

The undersigned certify that they have read, and recommended
to the Faculty of Environmental Design for acceptance,
the Master's Degree Project entitled:

The Wave Kitchen: A Cross-Cultural Product Design

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Supervisor

Dr. D. Thompson

Faculty of Environmental
Design

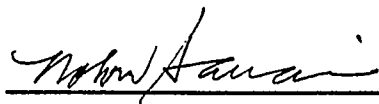
Environmental Science Program



D. Gadbois


Faculty of Environmental
Design

Industrial Design Program



N. Sawai

Faculty of Fine Art



Dean's Appointee

J. Love

Faculty of Environmental
Design

June 20, 1991

Abstract

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Shinya Iwata

Faculty of Environmental Design
The University of Calgary
Calgary, Alberta, Canada

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The purpose of the MDP was to examine cultural influences in kitchen design. In each culture, there was a traditional way of designing kitchen space that reflected diets and styles of food preparation. The recipes and the way to use the kitchen had been passed on from mother to daughter. The current kitchen design in the North America has left this traditional kitchen usage. This kitchen design reestablishes a manner of kitchen usage based on the Japanese tea ceremony. The manner of the tea ceremony was strictly determined. Motions are extremely efficient yet elegant. The concept of *hare*, *ke* and *iki*, (special occasions, daily life and stylishness) are merged in the kitchen and illustrated by the use of different colours. The colours can be hidden (*ke*) or visible (*hare*) by closing or opening the kitchen.

KEYWORDS: industrial design, cross cultural, kitchen, Nihon, tea ceremony, hare, ke, iki.

Acknowledgements

During my study in the faculty, a number of people encouraged me all the time. During the first two years, I was like a visitor from the Far East to this Great Western Country. In my mind, the new life in Canada cannot be separated from academic study in the faculty. Those people guided me, helped me to find a place where I could fit in this society and let me perform as far as I wanted in studio. Right from the beginning, they acknowledged me and made me not even notice how much disadvantage I had. I would like to thank them and dedicate this MDP to the following people to demonstrate that I can stand alone.

Professor Dale Taylor, who reminds me of a Zen wise man, for his silent support.

Dr. Dixon Thompson, who reminds me of an early time real samurai, for his powerful support.

Professor Noboru Sawai, who reminds me of a haiku master, for his restrained support.

Edie Adams, Barry Wylant and Rob Beamish, the people who I disturbed most, for their forbearance and support.

Mike Kosten, my first Canadian friend, for the joyful support.

All the support from my parents and family, Masayo and Kazuma.

Even though I am putting an end to my student life, I would never forget the gratitude for their warm care. If I become a good designer, that effort will demonstrate how much I thank them.

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Void: Introduction

This Master's Degree Project (MDP) is based on the design of a kitchen. This kitchen, which is called the Wave Kitchen, is intended to be used in North America. This project provides with me an opportunity to merge my Nihon (Japan) cultural background with my experience of North American living. The concept, which is central to the Wave Kitchen, is that it has been designed as a kitchen that has an added spiritual meaning to the serving of food; it is more than a food processing place. This concept originated in the traditional Nihon way of serving tea at the tea ceremony.

This MDP is organised into two sections. Firstly, the conceptual basis of the Wave kitchen, the traditional Nihon concept of serving a meal, and the kitchen as envisioned by North American society, are described. The second section contains the actual design of the Wave Kitchen, including the aesthetic value, human factors, and manufacturing methods of the kitchen.

The objective of this MDP is to design a product based on an examination of a cross-cultural influence. The kitchen is a vehicle for investigating cross-cultural influences. In this thesis, I am adapting a Nihon way of thinking to a North American domestic product, the kitchen. The activities that occur in the kitchen relate directly to the culture as well as the meaning of those activities. There are differences among cultures regarding how to serve food.

The way I look culture is sum of many customs. One way to understand another culture is to take one custom that is a representative example and look closely at it. The Nihon tea ceremony, with each motion highly conceptualised and holding a specific meaning, serves as this kind of example in this MDP.

The Japanese tea ceremony provides an example of cultural values made evident in the serving of food. In the tea ceremony, the view of life as art extends to its every aspect. The person entering the tea ceremony room does so as an individual. In the tearoom, everybody is free from any social rank and role.

Based on cultural references, both Nihon and North American, the following design assumptions can be drawn. These assumptions illustrate the conceptual approach to the design of the Wave Kitchen.

- 1) Food is special
- 2) Cooking and meal preparation are special
- 3) Space for cooking and meal preparation are special

Both Nihon and North Americans have special occasions that are related to use of the kitchen. Too often in this rapidly changing society, these meanings are lost. The design of the Wave Kitchen celebrates the special quality of every day life, and strives to ensure that the special meaning is not lost.

The wave form is a common graphical subject among traditional Nihon arts such as sculpture, painting, print and crafts. For Nihon people, water is a familiar subject since their small country is surrounded by the sea and subject to frequent rain fall. Over time, water has become one of the most common motifs for graphics. In the characteristic simplification that is a part of the graphic style of Nihon, the wave shape has been refined to a simple line design. (Figure 1, 2 and 3 below)

The approach I am taking is to concentrate on the design of the kitchen, since it is a sophisticated object in its own right. Designing a kitchen includes designing the organisation of the utensils, dishes, pots and pans, and the provision of a comfortable work-space when the user is cooking a good meal.



Figure 1 17C.
Painting, Detail



Figure 2 18C.
Painted Dish



Figure 3 18C.
Lacquered Box

The Wave Kitchen is an arrangement of horizontal and vertical structures that make countertops, cupboards, and shelves. Additional parts that complement the structure include sinks,

options that are not a part of the Wave Kitchen design are the island counter, side counter, extending table, and base unit with open upper shelf.

The Wave Kitchen is a kitchen where the user can enjoy preparing a meal. It is designed to be comfortable and easy to use, as well as flexible to accommodate different people and different types of meals.

Wind: Nihon (Japan)

The first tea master of the past to emphasize the spiritual aspects of the tea ceremony was Murata Shuko (1422-1502), who developed three important conceptual approaches for incorporating spiritual aspects into serving tea. He claimed that purity of mind, rather than an outward appearance of cleanliness, should be observed at all times. In relations between the host and the guests, self-control and consideration should be maintained. A person of a lower social status should be given the same degree of respect as one who comes from a high-social level. The tea ceremony served to emphasize the personal, private nature of the gathering.

This traditional ceremony is described in the book "The tea ceremony" (Tanaka, 1973). Each movement of the tea ceremony was strictly ordered to achieve the most efficient and elegant way of serving tea. In this book, Tanaka quoted the words from "The Book of Tea", written by Okakura Kakuzo (or Tenshin, 1862-1913):

Tea with us became more than an idealization of
the form of drinking; it is a religion of art of life.

The beverage grew to be an excuse for the worship of purity and refinement, a sacred function at which the host and guest joined to produce for that occasion the utmost beatitude of the mundane. The tearoom was an oasis in the dreary waste of existence where weary travellers could meet to drink from the common spring of art-appreciation.

(pp. 75-76)

The tea ceremony was considered an experience separate from normal daily activity. All verbal exchanges were conducted in a prescribed form.

Harmony with nature formed the essential basis of the tea ceremony, for it was regarded by its originators as the best means of awakening aesthetic appreciation. The special style of tea houses and gardens are an indication of this ideal. Japanese tea rooms and gardens are designed to blend in harmoniously with their natural surroundings. During the ceremony, the host and guests discuss the garden, the interiors, and the utensils, each of which are carefully prepared by the host to reflect nature and, more specifically, the season.

The people involved in the ceremony appreciated not only the tea but also nature itself. They were sensible people, and they paid close attention to ensure that their performance was conducted in the proper manner. The attitude held toward the tea ceremony also applied to the practical aspect of everyday life and toward art. The tea ceremony could not exist at all if its practitioners did not view the whole of life itself as an art.

"Stories from a Tearoom Window", edited and translated by Mori (1982), a re-published version of "Chaso-kanwa" written by 17th century tea master Shigenori Chikamatu in 1804, has 129 short stories related to the tea ceremony. One of the short stories in "Stories from a Tearoom Window" described how Japanese people adapted themselves to harmony with nature:

Jo-o taught Rikyu about the garden outside the tearoom with a poem:

Look with deliberate attention
At the flowers in the autumn,
And you will surely find

Various flowers in the grass.

[Jo-o explained] Can the true significance of this poem be understood? In the olden days flowering trees or plants were not disliked in the garden; but Kobori Enshu did not plant flowering trees in his garden, so that the flowers arranged in his tearoom might be the more appreciated. Since then there has been a rule not to plant flowering trees in the garden.

There are three historical figures in this quotation. Takeno Jo-o (1502-1555) was a tea master and teacher of Sen'O Rikyu. Sen'O Rikyu (1522-1591) was the greatest tea master, who perfected the tea ceremony. Kobori Enshu (or Kobori Masakazu, 1579-1647), was a feudal lord, tea master, poet, and architect.

Like the tea ceremony, the traditional Japanese way of preparing a meal was also bound by convention. The traditional Nihon kitchen had a clay floor. The clay floor was needed to support a mortar that was used to pound rice for special occasions. The dining room was located beside the kitchen, with the dining room floor raised and covered with tatami

mats. The raised floor surface was intended to keep the eye level the same between someone sitting in the dining room and someone standing in the kitchen. The dining room was also a living, working and sleeping room when not in use for food service. (Ueda,1990)

Cha-shitsu: Japanese style tearoom for ceremony,
usually a hut built in a quiet garden.

Ichigo ichi-e: importance of moment

In the Zen temple, there are three rooms considered to be special places. The bath room, wash room, and dining room are the special places in the temple. These three rooms are directly related to human existence; they are places for energy input and output. Since the kitchen is a place where sustenance for existence is prepared, the kitchen is a sacred place for the Zen priests.

The Nihon tea ceremony takes place in a small hut in the garden, which is called "*cha-shitsu*". The *cha-shitsu* is built to emphasize the concept of the tea ceremony. This concept is called "*ichi-go ichi-e*", or, *one moment one contact*. As

related to the tea ceremony, *ichi-go ichi-e* means that one must spend this moment carefully and serve guests in the best manner, since every moment is a precious moment that will not be repeated if it is missed. This is a common concept among other Nihon customs: ikebana (flower arrangement), bushi-do (chivalry), and haiku (poetry), for instance. In haiku, all kinds of thought, meaning, moments, and surroundings are concentrated into a 17-syllable format.

This concept of *ichi-go ichi-e* punctuates the moments of one's daily life. The great Zen master stated that "Zen is the behaviour, life and daily experience itself" (Suzuki, 1975, p.1). Along with the usual forms of religious training at the temple, cleaning, cooking and farming also are significant parts of Zen training. The tea ceremony separated the making of the tea from the Zen training. It became a training tool in its own right; one could learn the manner and rule of the Zen-based tea ceremony concept separately from all other aspects of Zen religious training.

The tea ceremony has strict manners and rules to follow. People appreciate the results of their tea ceremony activities

more when they perform the ceremony according to the rules. Every single movement, the order of performance, the location and direction of each utensil is prescribed. In the book "Stories from a Tearoom Window", the editor and translator Mori quoted the words of Okakura Kakuzo:

(The tea ceremony) is a cult founded on the adoration of the beautiful among the sordid facts of everyday existence. It inculcates purity and harmony, the mystery of mutual charity, the romanticism of the social order. (p. 18)

Drawn from daily life, the tea ceremony has been refined to a point of great stylization. Every movement is prescribed with this strict discipline giving rise to harmonious action and total awareness of the moment.

The Zen approach to the tea ceremony popularized it among feudal lords and warriors. When the host had a tea ceremony, he was an actor in a performing art. The *cha-shitsu* became a stage set for this play, with the audience being the guests. Like any other theatre audience, the guests were severe critics, and the host was not allowed to make excuses for a poor performance. The guests also felt some responsibility for the performance. They had to be knowledgeable enough to fully

understand all of the actor's performance. When both the host and his guests were seriously involved in the ceremony, the guests or audience also became a part of the performing element and began to exchange spontaneous performances. The relationship between the host and the guests become purified, similar to what can occur between musicians in a live music session.

In Nihon, almost all technological and philosophical ideas originated in China. In 1191, it was the Zen priest Eisai who first brought powdered tea to Nihon and encouraged tea-drinking among his fellow priests. He planted green-tea bushes around his temple in an effort to promote tea drinking as a way of spreading Zen teaching in Nihon. This early connection between Zen religion and the tea ceremony encouraged other tea masters to study Zen philosophy, (although this could hardly be avoided at the time since the only teachers of the ceremony were the Zen priests). The preparations involved in the tea ceremony are a reflection of Zen thought. Zen emphasizes the concept of "Void." The awareness of "Void" as it affects the present cannot be separated from the knowledge that the past no longer exists

and the future does not yet exist. The operation whereby Zen relates the present back to the void begins with its refusal to view past, present, and future in their continuous aspect, seeing them instead as an eternal present in which the past and future are comprehended.

This concept of "Void" is reflected in the difference between the present tea ceremony and other common sense aspects of daily life. That is not all, however, the actual tea ceremony, in which the art of the devotee finds its summation, occurs only once. Like the actor's performance, the moment of the tea ceremony is over and disappears without trace. And more, even though the same performance is repeated every day for a month, it is impossible to ask the actor to play exactly the same performance every time. Each act is different.

The great tea master, Sen'O Rikyu, established the theoretical and philosophical manners which we now call the tea ceremony. The tea ceremony is a technique aimed at intensifying the meeting of human beings. At the heart of the ceremony is a means of formalizing that meeting to an extreme degree. If such a formalisation can be called art, it

represents, in its most profound sense, the transformation of life.

At the time Rikyu played an active role in the tea ceremony, it was a turbulent era. The samurai had been fighting for years. The samurais were prepared to lose their life in any moment of battle. The concept of *ichi-go ichi-e* held deep personal meaning for them. At the tea ceremony, the conversation between host and guests took place with carefully selected words. The amount of conversation was limited. Rikyu served the tea for the samurai in a small hut located in a quiet garden. To the samurai the tea ceremony was a form of retreat before they went into battle. Through the tea ceremony, Rikyu attempted to establish a sense of emotional contact with the samurai. In this chaotic society, where no one knew if the battle would ever come to an end, the tea ceremony served to illustrate the value of structure. When the tea ceremony was over, the samurai may have had a conversation similar to this:

Samurai,

"Thank you for the wonderful tea, I have no
regrets now,"

Master,

"That's good."

In those short conversations, they completely revealed their thoughts regarding the experience of the tea ceremony.

Kai-seki: special meal for tea ceremony

Mizu-ya: highly-organized small kitchen, usually built in *cha-shitsu* .

At the tea ceremony sometimes meals called "*kai-seki*" were, and still are served. A small kitchen called a "*mizu-ya*" was located in the *cha-shitsu* for *kai-seki* cooking. This small kitchen was used when the host held a tea ceremony. It was usually built beside the tea house. Like the tea house, the *mizu-ya* had a minimum of equipment and strict way of organizing the equipment.

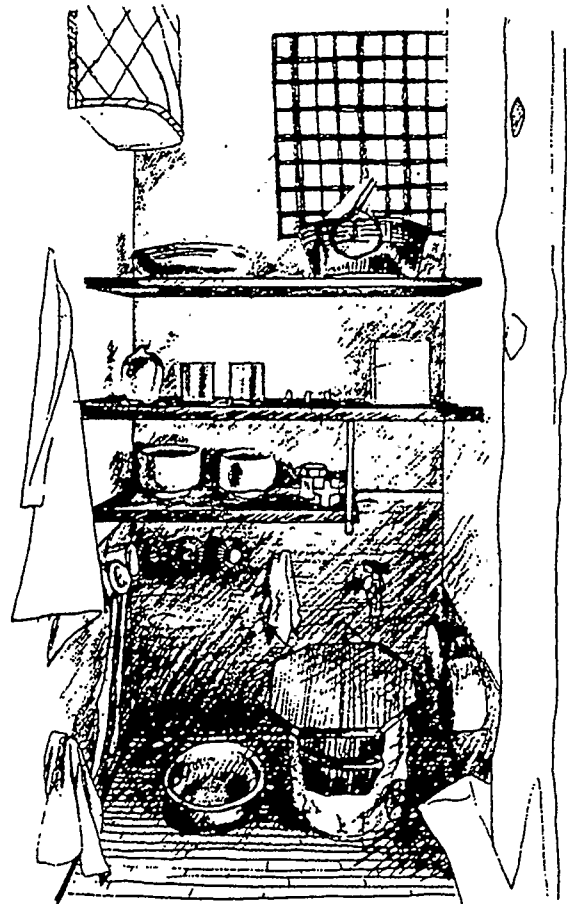


Figure 4 Mizu-ya

(Tanaka, 1973) (Figure 4)

The *mizu-ya* is used as a kitchen, as well as a storage room for dishes and tea ceremony equipment. As with most ordinary kitchens, it has a stove, sink, drying shelf, and storage space for dishes. In the same fashion as the tea ceremony, every piece of equipment has a specific location in this kitchen. Once you learn where every piece of equipment must be put, you are able to work in this kitchen without distraction. There are unwritten rules on how to use this kitchen. Each movement and the order of movement are determined, just as in the tea ceremony. The storage space is an open shelf, nothing is hidden behind doors; thus the equipment is easily found.

Dai-dokoro: kitchen

There is an example of one kind of traditional Nihon *Dai-dokoro* in Okuda house in Osaka. (Yamaguchi, 1988) The Okuda house *dai-dokoro* has a U-shaped stove. The stove was designed for ease of use when several burners were being used at the same time. The burners were arranged with the user at the centre. This minimized the reaching distance between the burners. This traditional, U-shaped stove usually had five

burners with a few portable burners. The size of the stove represented the degree of wealth in the house, since the stove was considered the centre of the *dai-dokoro*. Of the usual five burners, one or two were large in size, and were used for special occasion meals. The rest of burners were small, for daily use. (Figure 5)

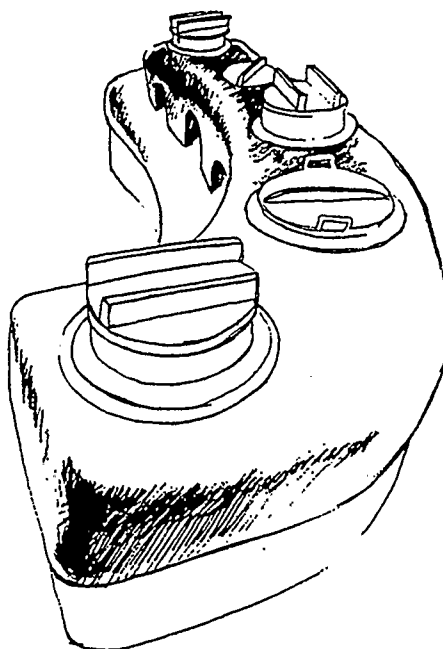


Figure 5 Okuda house dai-dokoro

The *dai-dokoro* was designed for flexible use to accommodate both daily use and special occasions. The food that came out of the *dai-dokoro* was varied. Preserved food is one example of this variety. Preserved food was important because of its efficient in cost and time. In spite of the effort required in

its preparation, preserved food was efficient because produce in season was less expensive per quantity. Preserved foods were often ready to serve. They added flavour at the table without any additional preparation time.

Hare: formal life, special and formal occasion.

Ke: daily routine, ordinary, usual, everyday life

There are special occasions in traditional Nihon life called "*hare*" as opposed to the routine life "*ke*". For special occasions (*hare*), people decorate the interior of their homes and wear bright-coloured clothing such as purple, yellow, red, and green. These clothes are different from traditional everyday colours. The colours found in the *hare* clothing are the strongly contrasting colours that are located on opposite sides of the colour wheel. The bright and contrasting colours give people a feeling of well being for the *hare* days.

Special meals are also served on *hare* days, just as North Americans serve special meals at Thanksgiving or Christmas. On the special occasion days, meals have defined meanings, different from the daily food. Everyone understands the

special meanings, and experiences the common feelings together. Today, the old traditions are no longer followed, but the *hare* feeling is still shared when meals are shared. In both the traditional and contemporary events, people appreciate their lives together more than the actual meals.

The same thing happens in daily life, too. Having a meal together as a family ties the family relations tighter. The social time of a family meal can be considered as a *hare* moment in a routine *ke* life.

Iki: stylishness, chic

Yabo: crude, loud, bad taste

During the Edo era in Nihon (1603-1867), the government refused entry to all foreigners, until a demand for opening the country arose from both internal and external pressures. Ironically, this long-term national isolation policy provided a rare opportunity for Nihon people to develop their unique culture. (Nish, 1968)

Trade was also restricted during the Edo period. The feudal

lords, who were representatives of the Shogun's government, controlled trade in an effort to make a profit from local products. This trade restriction led to the establishment of sophisticated and unique crafts in each local area, with a high degree of competition among the practitioners of the crafts.

At the same time, the central government of the Shogun controlled the lives of the ordinary people, including the newly emerged middle class from the urban areas. One of the ordinances that had to be followed was a stringency policy. The government representatives, Samurai, were thrifty people, since they had to save their assets for sudden war. Because of this strict policy, the middle-class people developed a taste for style, called "*iki*". Ordinary people were not allowed to wear bright-coloured clothing. Instead, they were only allowed to use subdued colours such as brown, grey, navy blue, and black. Since these were the only colours people were permitted to wear, they subdivided the colours into many distinctions. For example, there were 48 different names for browns and 120 different greys based on very subtle distinctions in how the cloth was made and which dyes were used (Sano, 1990). With these distinctions, people were able

to discriminate between shades of the same colour. Importantly, people assigned positive and negative values to these subtle differences in shade. For example, one grey could be judged more sophisticated than another grey.

Another example of *iki* is that some people used bright-coloured patterned fabric as a lining for their otherwise plain-coloured kimonos. This lining would seldom, if ever, be seen by anyone else. When these efforts become obviously stylish, it was called "*yabo*" (crude, loud, bad taste). People in the Edo era considered the samurai's taste to be *yabo*. Since samurais were practical people, they did not see the value of putting a great amount of effort into something that was not visible. Therefore, samurais would deliberately display bright colours in obvious places. By developing the uniqueness of the *iki* taste, the middle-class people established their emotionally dominant position. This was in an attempt to undermine the strong social ranking system of the Edo era.

When the bright-coloured liner was accidentally exposed (for example, sudden body movement,) the impressions of that bright colour gave a stronger impact than colour that had been

placed in an obvious location. The middle class people appreciated the idea of these drastic changes. A common technique in Nihon culture is to make a presentation with sensational representation. The traditional Kabuki play, for instance, had many surprising changes including backdrop scenery and quick costume changes. (Gunji and Keene, 1985) and (Kawatake, Iwata, and Kai, 1985)

These scenery and costume changes not only alter the stage affect, but also change the colour dramatically. The movie director Akira Kurosawa uses similar techniques. In his recent movies "Kagemusha" (1980) and "Ran" (1985) he often changes between scenes quickly and each scene has a complex composition of colours. In both the Kabuki theatre and in Kurosawa's works, the goal is to encourage the audiences to enjoy the effect. As well, the audience comes to expect more surprises.

Fire: North American Kitchen

In contrast to the isolationist policies of Nihon, North America tends toward a culture that encourages participation from people of many different cultural backgrounds. This mosaic resulted from a blending of the originating cultures into a form different from any of the contributors and distinctly North American.

As with Nihon tradition, the North American kitchen is used to prepare food for special occasions. However, the North American kitchen is not a place where the food preparation shares equal significance with the expression of gratitude for the meal or the experience of unity with nature.

Although the historical situation is not the same as that of today, consideration of the development of the North American kitchen can help us to understand contemporary kitchens. Historically, special occasions had special meaning in a calendar year. For example, in England in the Middle Ages (c.1600), a lack of fodder during winters led to the slaughter of cattle in autumn. The meat had to be smoked or salted to preserve it. To save the limited amount of preserved food,

people ate only small amount of food during winter. However, Christmas was a bright moment during the winter. Christmas was a time of 'large tabling and belly-cheer' (Harrison,1972 p. 29).

In this modern age, both homemade and ready-made preserved foods remained popular. Some foods are preserved in the traditional style, and others such as frozen food are the result of modernization. Today, we can not imagine a kitchen without a freezer. When preserved food is served with a meal prepared from fresh ingredients, it contributes to a more complete dinner. The kitchen should allow for the preparation and serving of all food types.

Historically, fire in the kitchen represented warmth, light, and protection. The kitchen has been seen as the hub of the home culture. It provided for the physical as well as the spiritual requirements of the family.

In the North American kitchen, there are two main types of ingredients: fresh foods requiring minimum or no processing and those foods requiring more complex processing. Normally,

food is processed through either aging, heating, cooling, transforming (cutting, mixing, or forming) or a combination of these methods. This process is called "cooking".

The kitchen is the room in which this process takes place. The kitchen, however, functions not only as a room for cooking, but also serves as a place to eat, entertain, and carry on household chores. Children often gather here to play. In Conran's words the kitchen is also a "living room" (Conran, 1977, pp.9). In the book, "The Kitchen in History", Molley refers to an anonymous American writer who describes his 18th century New England home.

The kitchen was in fact the most comfortable room in the house, cool in summer and perfumed with the breath of the garden and orchard; in the winter, with its roaring blaze of hickory, it was a cozy resort, defying the bitterest blast of the season.... In the autumn [it contained] barrels of beef and pork, barrels of cider, bins of potatoes, turnips, beets, carrots and cabbages. The garret, which was of huge dimensions, at the same time displayed a labyrinth of dried pumpkins, peaches, and apples,

hung in festoons upon the rafters, amid bunches of summer savoy, boneset, fennel and other herbs - the floor being occupied by heaps of wool, flax, tow and the like.... (Harrison,1972 pp. 99)

The words of his beautiful sentence show how the kitchen symbolizes warmth, light, and protection. One can imagine actually seeing this wonderful kitchen scene.

The setting in family shows in North American television programmes is often the kitchen. "Family Ties" and "The Cosby Show" are good examples of this. Billy Joel, an American rock singer wrote a song in 1989 entitled, "We Didn't Start the Fire". Its promoted video referenced the kitchen. The video shows that all outside effects came into the house through the kitchen. Intimate friends of the family also entered the house through the kitchen. Historically, eighteenth century English, kitchen maids were warned against gossiping with charwomen and servants in the neighbourhood. The servants' visitors too would have brought news and gossip into the house through the kitchen (Harrison,1972).

Kitchen design for North Americans

Efficiency is a significant part of the North American lifestyle. The kitchen must, therefore, be equipped for two separate purposes: firstly, it must be capable of producing a "good meal" for daily requirements. Secondly, the kitchen must have facilities to prepare meals for special occasions.

A survey about how many American used their kitchen was reported on "The US News", on January 15, 1990. Twelve hundred adults were asked how many of their dinners during a typical week were eaten at home, prepared mostly "from scratch," using fresh ingredients. The results of the survey were:

25% seven times	10% three times
15% six times	6% twice
20% five times	5% none
13% four times	1% no response

The survey showed sixty percent of adults who were interviewed had homemade dinners five or more a week.

This result indicates the importance of the domestic kitchen. If 60% of the adults surveyed eat dinner at home at least 5

days a week, it may safely be said that the place to prepare these dinners, the kitchen, must be an important part of the home.

The Allied Ironfounders Capsule Kitchen (Birley, Farrow, Frame, and Mahaddie,1972) was designed on the assumption that a sink is unnecessary. When using disposable products, the need for a dish-washing facility is eliminated. Further, the assumption is that all foods are pre-prepared and supplied directly into temperature-controlled storage compartments. Water is dispensed in measured amounts at preselected temperatures up to the boiling point. (Figure 6)

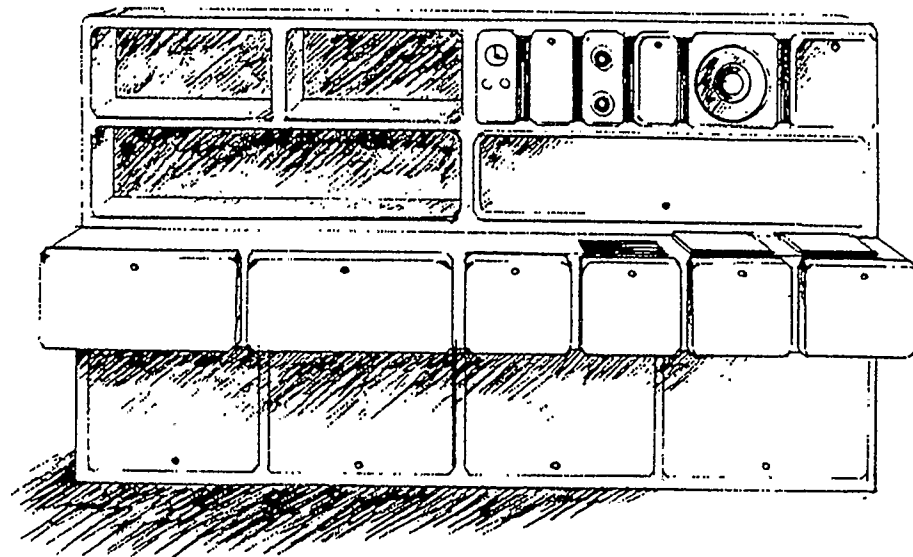


Figure 6 Allied Ironfounders Capsule Kitchen

There are two criticisms regarding the Allied Ironfounders Capsule Kitchen. First, this kitchen concept conflicts with the findings of the US News survey which indicates that the majority of North Americans regularly cook in their own kitchens. The Capsule Kitchen does not have the necessary requirements for daily cooking. Second, from another perspective, a major concern in the 90s is the environment. Disposable packaging used for meals in the Capsule Kitchen creates excess waste.

Given the importance of the kitchen in the home, one should also consider satisfying the needs of all members of the family as kitchen users. One member of a family may use the kitchen more than others. Some family members are likely to be less familiar with the kitchen than the others. The unfamiliar individual may have difficulties finding equipment in the kitchen without a visual clue. Open shelves or glass-covered doors are two possible ways of providing clues as to where kitchen equipment is located. Murrell advised learning the idea from the English nineteenth century open-shelf kitchen. The advantage of open shelves is that they provide more accessible storage and take up less space than any form

of cabinet. (Murrell,1986) The disadvantage is, however, the contents must be kept tidy; they are visible at all time. Also, people have a difficult time keeping the glass doors clean.

In 1943-44, a manufacturer of industrial glass, Libbey-Owens-Ford, released a full-sized prototype kitchen called "The Kitchen of the Day after Tomorrow," designed by H. Creston Doner. (Corn and Horrigan, 1984). (Figure 7) Three versions of the kitchen were built and offered to department stores throughout the United States. Reflecting the sponsor's product, the kitchen had glass-front storage cabinets and a completely glassed-in oven. The kitchen was popular, as over 1.6 million people were reported to have seen it. In spite of the popularity of this glass door kitchen, most kitchens today still feature opaque or closed doors on the kitchen cabinets. Most people would probably prefer opaque or closed doors because of their comparatively easy maintenance.

In the North American family, it is common for both parents to be working. Because of conflicting working schedules, many families eat their breakfast and dinner separately and at different times. There is a good chance that family members miss each other at meal times. In such families, both adults

may share the kitchen work. This is not the traditional family model but the realistic family of today.

For most families in this situation, cooking may be just another daily task, nothing more. Ready-made, precooked meals are likely to be the most convenient and therefore most used meals. Family members may focus their interest on other family members. Such families would likely appreciate a more functional design in their kitchen.

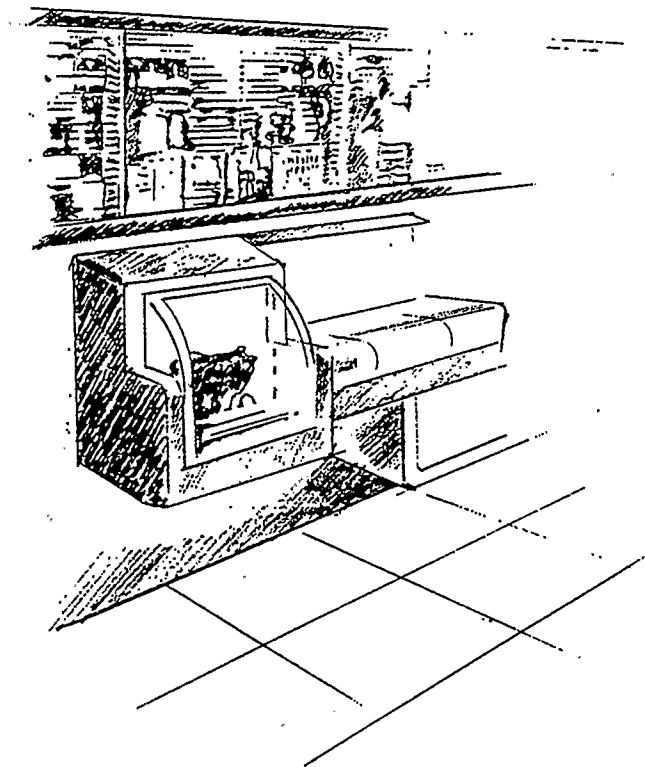


Figure 7 The Kitchen of the Day after Tomorrow

What kind of kitchen is needed for these families? A small

corner counter with a microwave or stove and sink? There are some kitchens designed according to this minimal kitchen concept. These concepts are best suited for single people who often eat out. Three minimal kitchen concepts are "Eroica" manufactured by Boffi (Figure 8), "Kitchentree" designed by Stefan Wewerka (Figure 9), and a kitchen that won the Birds Eye's Design Award in 1986, designed by Ilana Henderson (Figure 10). All of these kitchen concepts feature components attached to a central structure. The user works around the kitchen in a circular fashion rather than in the working triangle: refrigerator, sink, and stove.

The main problem with these kitchen concepts is that each time the user moves from one activity to another, he or she must walk around the circumference of the kitchen structure. Also, because of its layout, it is impossible for the kitchen to offer wide working surfaces.

An aeroplane kitchen is another example of a small functional kitchen. A plane's kitchen is efficiently designed. The linear layout allows several people to work together in a small space. Because meals served do not require cooking, only heating or

removal from a refrigerator, the small kitchen is sufficient for serving a large number of people. A sink, with cold and hot water taps, and food warming equipment is all that is required for this limited service. However, these facilities limit the types of meals that can be served. Usually, the kitchen is the place family members, and friends end up. Even if they are not actually involved in cooking, dish washing, or other activities, they stay in the kitchen. One person may be trying to prepare a major meal while another is making a quick snack (Murrell, 1986). The problem with the minimal kitchen for domestic use is that it is not flexible enough to accommodate both daily cooking and special occasions.

The meal preparation process

'Space in the home' described the activity zone for a typical, four-person household. (Birley, Farrow, Frame, and Mahaddie, 1972) It is reported that every type of kitchen should provide for food preparation and cleaning-up after meals. Although the processes of preparing and cleaning-up are complicated operations and are not usually carried out systematically, this report identifies and arranges in sequence distinct groups of activities. During cooking, one must frequently double back,

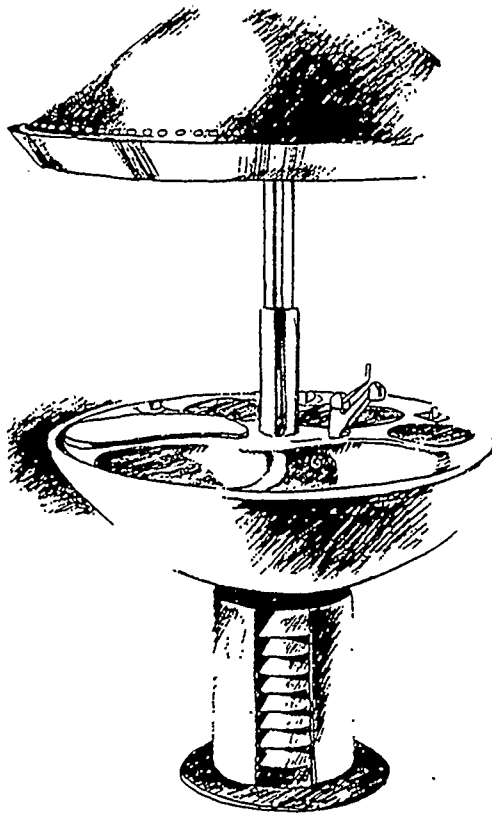


Figure 8 Eroica

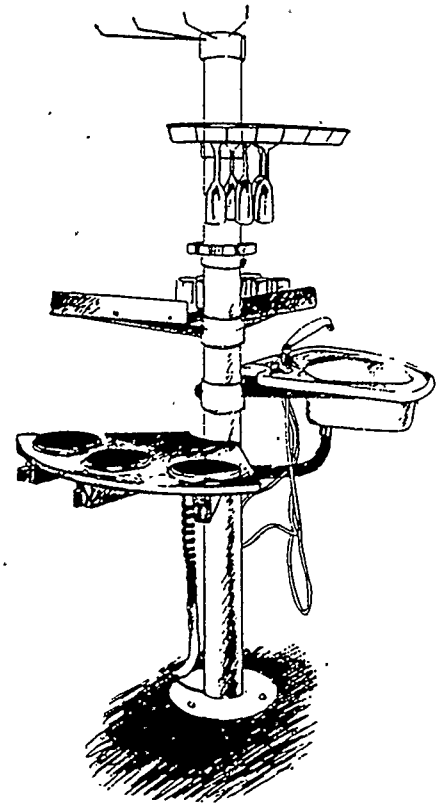


Figure 9 Kitchentree

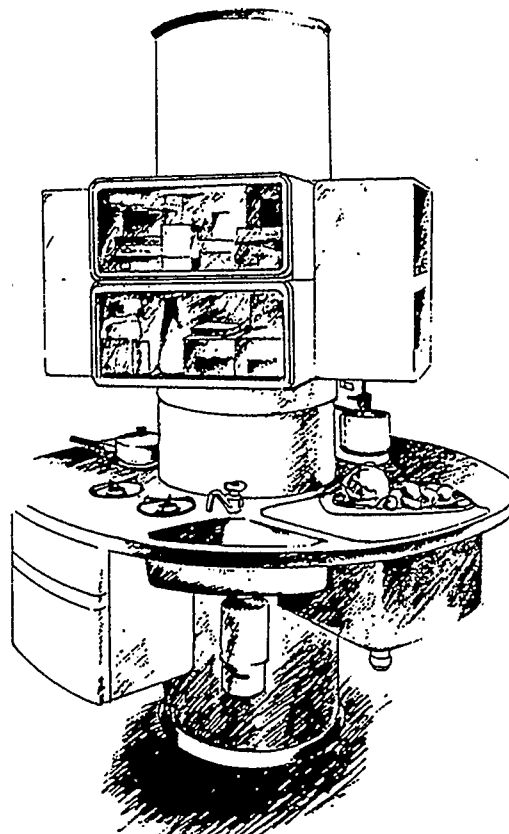


Figure 10 Henderson's Kitchen

doing one thing while another person is cooking, or washing utensils between some operations. According to the report, a carefully designed kitchen increases its efficiency.

Furthermore, this report refers to the place in which cooking and other related operations occur as an *activity zone*. It includes the work surfaces and appliances required for the activity, together with storage for the materials and utensils. The nature of activities in the kitchen is such that there are no definite boundaries. There are overlaps between zones and also overlaps with items that are needed for several processes or in several locations.

In spite of these overlaps, it is still possible to categorize kitchen activities into distinct zones. Those zones are: preparation, mixing, cooking, serving, eating, and washing-up. Figure 7.1 shows the component activities in each of those zones. Figure 7.2 shows the arrangement of the activity zones within the kitchen space. Both preparation and washing-up require water, so both normally would share the same zone centred on the sink. The meal preparation area usually includes the place to store some or all types of food.

Perishable food is kept in the refrigerator or in a ventilated food cupboard in the zone where it is to be used. Foods requiring a temperature of 6-12 degrees C, and usually relatively high humidity, such as fresh vegetable and fruit, are kept in the ventilated food storage. However, a survey in England shows that the temperature in cupboards ventilated to the outside air was rarely below that of the kitchen itself, often 21 degrees C and above. (Birley, Farrow, Frame, and Mahaddie, 1972)

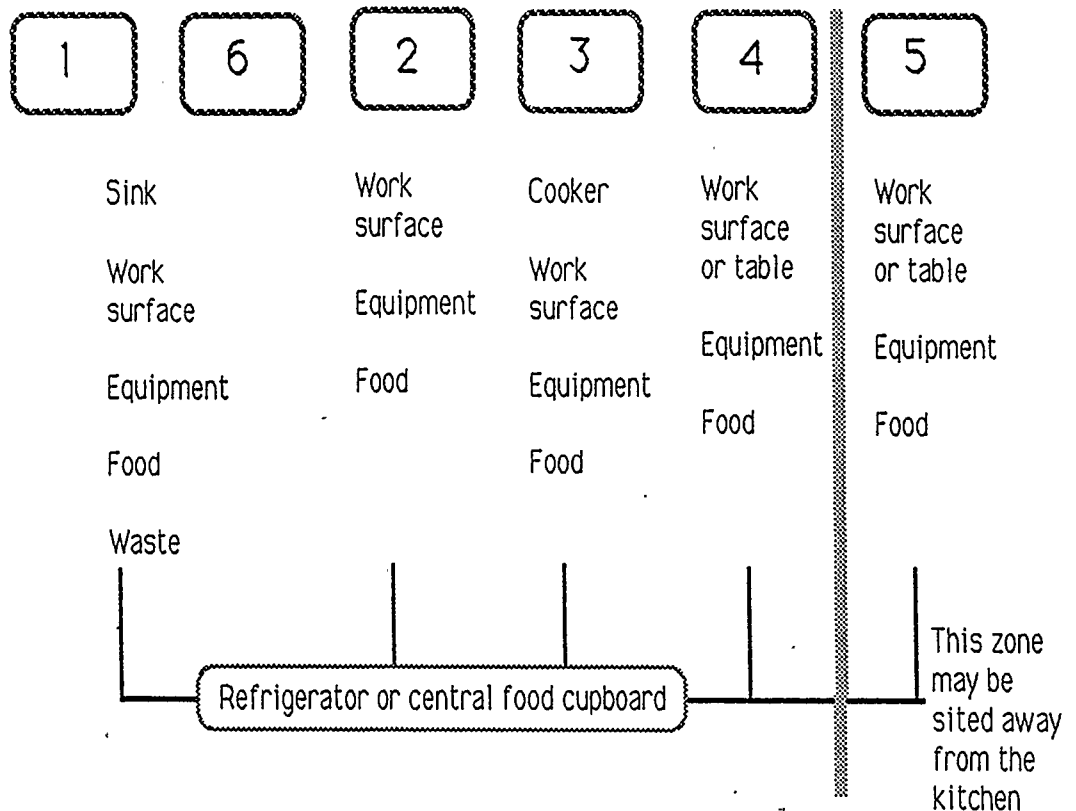
Food Storage

"The Space in the Home" reported that the temperature in cupboards ventilated to the outside in Britain, was rarely much below the kitchen temperature, often 21 degree C and above (Birley, Farrow, Frame, and Mahaddie, 1972). In the case of a Canadian winter, the result would be much different. The temperature can be much below freezing, and so a ventilated cupboard would not be an ideal solution. Some Canadian homes have a cool-storage room in the basement or other cool place in the house. In Canada, this cold storage area is more practical than a ventilated cupboard, and prevents the food from freezing.

Figure 11 Activity sequences

1 Prepare	2 Mix	3 Cook	4 Serve	5 Eat	6 Wash-up
Unwrapping	Weighing	Baking	Keeping food	Table laying	Disposing of waste
Washing	Measuring	Boiling	and dishes hot	Eating	Stacking
Peeling	Mixing	Frying	Putting food	Cleaning away	Washing
Chopping		Grilling	onto dishes or plate		Drying
Mincing					Putting away
Adding water					

Figure 12 Arrangement of activity zone



People usually store a large volume of preserved food and fresh vegetables and fruits in the cold storage areas and take a small quantity to the kitchen refrigerator. If the house does not have a cold-storage space, there are refrigerators with multi-temperature control which are more suitable than standard refrigerators, for example, the Bosch KGE 7001, Panasonic NR-D33P1 or Traulsen URS 48 DT. This multi-temperature control system keeps the food fresh longer than the normal refrigerator. The Traulsen is made for professional use. There is optional triple-pane tempered glass on the refrigerator door; this feature is in keeping with the idea of exposing the contents of shelves and cupboards to facilitate orientation within the kitchen space.

Freezing is a popular method of keeping food over long time periods. The temperature of -6 to -12 degrees C must be maintained for short-term storage and -12 to -18 degrees C for long-term. Many homes in Canada have a chest-type freezer in the basement or garage. This type of freezer is for long-term storage. The freezer section of the kitchen refrigerator is used for short-term storage.

Foods that tolerate a temperature of above 12 degrees C and a relatively low humidity are best stored near a heat source to keep the space dry, for example, immediately above the refrigerator or under the sink close to the hot water pipe. Examples of such foods include tinned goods, biscuits, dried fruit, flour, and sugar. With these foods, humidity is more important than the temperature (Birley, Farrow, Frame, and Mahaddie, 1972).

The previous descriptions of the traditional Nihon kitchen, as exemplified in the tea ceremony, and the contemporary North American kitchen, have brought to light two principles that will help to focus the design of the Wave Kitchen. These two principles are:

1. The Wave Kitchen provides for both day-to-day and special occasion uses while allowing for individual customization of kitchen activities, and
2. the Wave Kitchen capitalizes on the positive features of cross-cultural considerations, using the best aspects of traditional Nihon ways, for example, to foster a fertile and exciting approach to the design of kitchen space.

Water: Implementation

The Wave Kitchen is conceptually based on two main ideas. These two ideas arise directly from earlier descriptions of the Nihon and North American approaches to kitchens.

1) The first idea (Nihon) that forms part of the conceptual base of the Wave Kitchen is that the kitchen incorporates historical and cultural precedents as a way of meeting the non-functional requirements of the kitchen space. The requirements of special occasions are met, as well as meeting the day-to-day needs of the kitchen user. The earlier description of the Nihon customs is an example of this kind of historical, cultural precedent. Form determination, or the composition and aesthetics of the kitchen as a physical entity, are the means by which these historical and cultural precedents are made evident in the design of the Wave Kitchen.

2) The second (North American) idea that forms part of the conceptual base for the Wave Kitchen is that the kitchen provides for the physical needs of the North American users. This concept implies that the approach to designing for individual demand will be followed in the design of the Wave

Kitchen. Modularity is one means through which the Wave Kitchen meets individual demand.

There are at least six different uses of a kitchen: 1) Primary purpose, cooking and food preparation. 2) ceremony, as exemplified by the tea ceremony. 3) social communication (the eighteenth century English maid in a kitchen for example). 4) dining. 5) storage for food and equipment. 6) cleaning, eventually one must clean the kitchen and utensils. The Wave Kitchen must provide for all these different uses. Furthermore, it must do so in a way that is adaptable to the requirements of a particular user. The kitchen must not be designed such that people are forced to spend unpleasant hours every day cooking the meals. Rather, the kitchen must be flexible enough to adapt to the needs of the user.

There is an argument that North American society also homogenises cultural customs (MacLuhan, 1968). Efficiency is a significant part of this homogenization. Today's kitchens are not necessarily places where people express gratitude for a meal or experience unity with nature, as they may have been in the originating culture. In North American society, people tend

to follow similar lifestyles, as if all the contributing societies discard their own cultural values and follow the dominant North American lifestyle. In contrast, a great diversity of people with different cultural backgrounds live in North America because the society provides fertile ground for transplanting other cultures. It would be safe to say this cultural mosaic will accept a wider variety of kitchen designs.

One of the present directions of industrial design is to design for individuals (Whitney,1989). Historically, the Industrial Revolution caused a move toward a mass-produced, standard product. The Industrial Revolution made it possible to produce thousands of the same products, in opposition to the craft-based cottage production of goods that preceded the Industrial Revolution. The methods of mass-production influenced the product's form, and the meaning of aesthetics incorporated the means of production. The "best" products were products made by an industrial means of manufacturing. Hand-made goods were not pleasing. The "best" products were the same for everybody, regardless of their particular situation.

In a society served by well-established markets, the people

who have the fundamental products necessary for survival will come to recognize that their market is not completely served by an industrialist approach. It is important to understand what the end user needs and expects from the product. At the ICSID (International Council of Societies of Industrial Design) '89 Nagoya, Whitney (1989) noted that manufacturing methods of our time were changing from mass production to flexible production. In the design sector, this departure from mass production was an important change in that manufacturing could more quickly respond to the need of consumers. For example, Toshiba now spends less than half the time developing their word processors than they did just three years ago. (Toshiba, 1990) A comparison of how five automobiles (Jeep, and Nissan's Be-1, Figaro, Pao, and S-cargo) have been manufactured illustrates the advantages of flexible production.

A traditional industrialist influence can be found in military equipment which is used in extreme conditions. The Jeep is an example of this kind of military equipment. Because of its character as a military vehicle built just before the Second World War, each component of the Jeep was designed to be

assembled easily. All parts were standardized, and the press patterns were simple. Together, the parts created a durable body form. This military vehicle is an example of a mass-production approach to products. In spite of complicating its manufacturing process, when the manufacturer introduced this vehicle on the civilian market as a recreational vehicle, it had to offer optional features to the individual buyers.

Today, Japanese car manufacturers spend three years developing a new model, while American and European manufactures take a minimum of five years to put a new model on the market. (Morozumi, 1985) By using advanced technologies, Japanese automobile manufacturers are able to produce several models on the same assembly line. The Italy-based consumer textile company, Benetton, does the same. Based on global sales data, Benetton can programme the production plan of colours or patterns for each specific market. (Pearlman, 1990, p. 46-51)

The cars Nissan has made in the last two years, the Be-1, the Pao, the S-cargo, and the Figaro, are other examples of cars made using flexible manufacturing. The number of vehicles

was limited to 20,000, which is an unusually small number for the ordinary small commuter car. Nissan claimed the value of producing those types of cars was that they met market demand, such as that described by Whitney. Consumers were eager to purchase these cars because the cars fit their lifestyles, even though the cars were both difficult to acquire and expensive. Naoki Sakai, who calls himself "the concept specialist" of the Be-1, Pao cars, and Olympus O, the new retro look brushed aluminium camera, does not design products but rather develops the concept of the product. (Pearlman,1990) All the products that he is involved with have common characteristics: a 'retro' form with a high-tech mechanism and a limited production number. (Figure 13, Figure 14, Figure 15, Figure 16, and Figure 17) He describes the development of product concepts as follows:

We can target a new concept to fill an emotional void that has previously been unnoticed. Then, once the product has been designed, we make sure it is an exclusive, limited-edition item. This means that a lot of people who want it will never be able to purchase it even though they have the money. An unfulfilled desire burns hotter, and primes the

buyer for the next offering. (Pearlman, 1990, p. 50)

Both Be-1 and Pao were sold out even before the cars were put on the market. When the Figaro appeared on the market on February 1991, potential buyers had to win a Nissan dealers' draw to purchase the car, since it had a long list of hopeful buyers.

Another example of a manufacturer who is using the strategy of meeting the individual demands of the end user is Herman Miller. John Berry, the director of corporate communications for the manufacturer, says

The key now is understanding the diversity and uniqueness of individuals and giving the individual more control over the environment. Ideally, the office should be flexible. It should be able to change with the person and the job. (Flanagan, 1990, p. 113)

Similar to an office, the kitchen is the workstation of the home. The point Berry makes, to design a product suite for the individual user and task is as equally applicable to home kitchen design as it is to office design. Kitchens, too, must

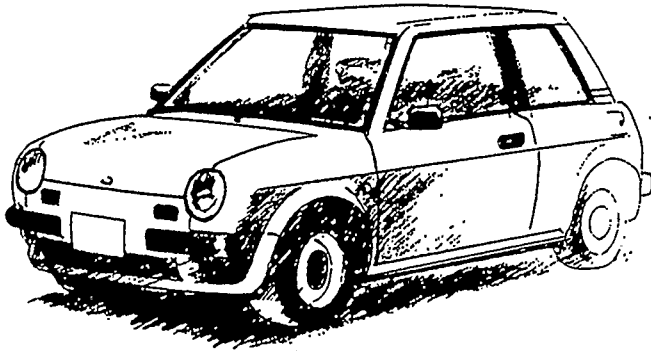


Figure 13 the Be-1

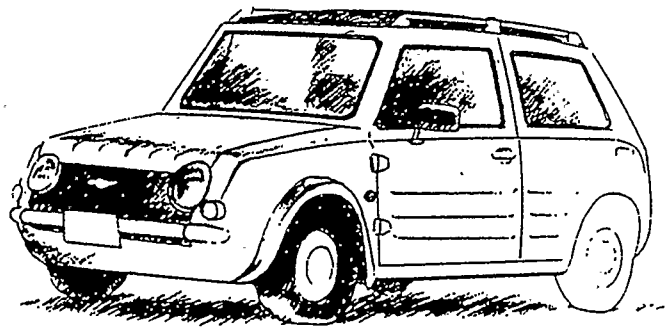


Figure 14 the Pao

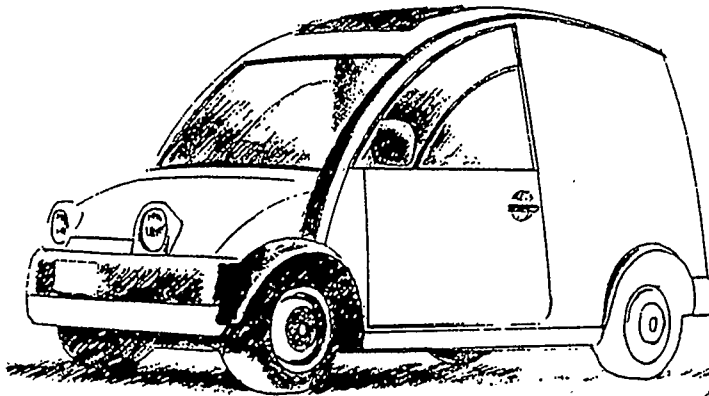


Figure 15 the S-cargo

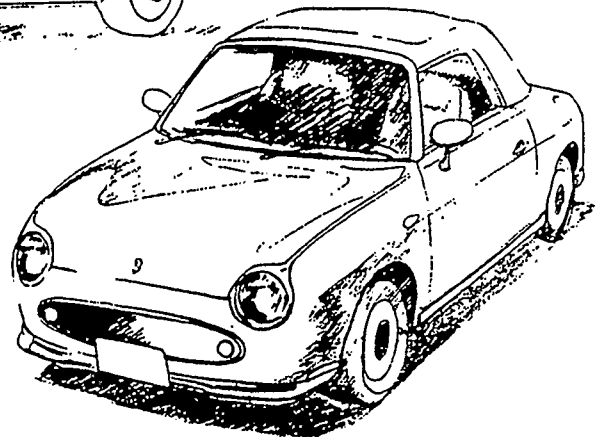


Figure 16 the Figaro,

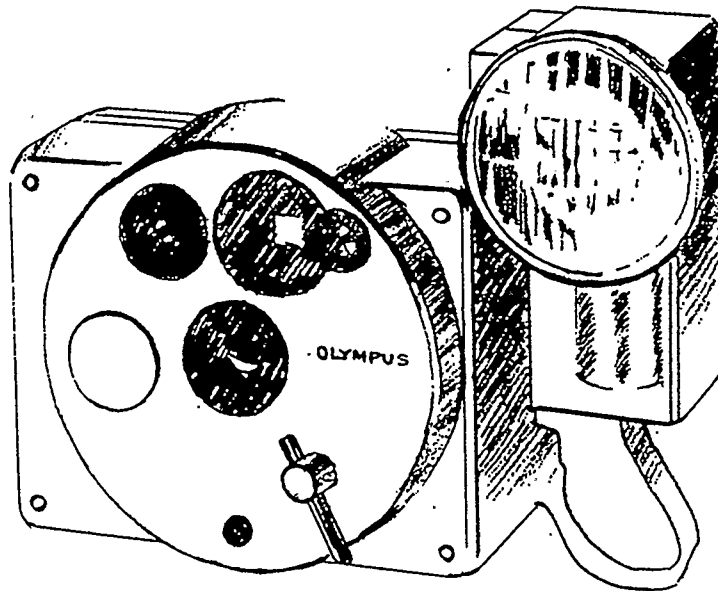


Figure 17 Olympus O

meet the diverse and unique needs of the individual.

There are three design and manufacturing approaches that can be used to meet the needs of the individual. These are: 1) limited production numbers, 2) transforming the product, and 3) making a product modular.

This approach is most likely to be used if manufacturers have a flexible production line. As a result, keeping the production numbers low maintains the scarcity value of the product. The

Nissan Be-1 is an example of this approach.

Transformation of product form is a method in which the user is involved in determining the form of the product. Issei Miyake has designed an asymmetrical skirt that has no indication of the front or the back (Polledri, 1989). The owner can try moving the skirt around her waist, until she finds the right position. This self-positioning is like that which happens with the tea cup in the Nihon tea ceremony. In the Nihon tea ceremony, the host relies on his or her aesthetic sense to choose which position of the cup is the most beautiful. This position is placed toward the guest. With Miyake's clothes, it is as if the clothes change; the author of the changes is not the designer, however, it is the person who wears the clothes.

Gaetano Pesce has designed pieces of furniture that do not look as if they were mass produced. (Polledri, 1989) His "Feltri" chair, for example, maintains a feeling of uniqueness and incompleteness although it has been industrially produced. It adapts to the user's habits and comfort through its wirelike structure. It is the user who completes the design process by

giving the chair its final form.

Finally, use of modularity as an approach to meeting individual demands can be seen in Mazda's entries for the Tokyo Auto Show '89. Mazda presented a modular car in which body parts were interchangeable. The body panels were available in different colours, and the car could be configured as the buyer desired.

Each of these three approaches, limited production numbers, transforming the product, and making the product modular, can be used to meet individual demand.

The second idea that forms part of the conceptual basis of the Wave Kitchen is that the kitchen optimally incorporates historical and cultural references into its design. The Wave Kitchen relies on an application of traditional Nihon ways.

The Nihon concepts of *hare*, *ke*, and *iki* will be evident in the design of the Wave Kitchen. To adapt these concepts to the kitchen design, daily activities will be divided into the two categories, *hare* and *ke*. Using the kitchen provides a time of

activity. If the kitchen users appreciate the active moment, a *hare* feeling will be present. When the kitchen is inactive and calm, the *ke* feeling will be present. The kitchen should give pleasure to the users. As in the tea ceremony, the kitchen user performs; and, like an actor in a stage set, he or she must be able to be observed in the kitchen. The user should enjoy performing in this small theatre, before the audience for whom the meal is being prepared.

While we prepare meals for our family or friends, the *hare* feeling is established and we can appreciate the whole meal preparation process. When *hare* and *ke* concepts are brought into the kitchen, the kitchen will have two distinct faces. The two faces of the kitchen will give completely different impressions. When users understand that the cooking is a ceremonial performance, they will appreciate their lives while they prepare meals for the people they know. When the kitchen is in use, it must have a unique character to let people know that they are celebrating life. If the kitchen does not have this unique character, then the meal might as well be prepared simply for survival.

One way to have the kitchen reveal the *hare* quality is to design the kitchen with the exterior of the cabinets showing subtle colours (*ke*) and the interior of the cabinets showing bright colours (*hare*). The traditional Japanese lacquered bowl is painted black on the outside and red inside. This bowl has a lid which is painted the same colours. When this bowl is brought to the table, one can see the plain black lacquered bowl (*ke*) until it is opened. As soon as the lid is removed, the food is found sitting in the bright red bowl (*hare*). It is a sensational moment when the bowl is opened. The example of the lacquered bowl also illustrates the concept of *iki*. The design effort of the visual impressions is concentrated on the inside.

During the Edo era (1603-1867), people used subtle colours like grey or brown as the dominant colours for clothing, but often had bright coloured liners. The Wave Kitchen follows a similar aesthetic sense in the organization of its colour scheme. The idea of having two opposite kinds of colour themes for the two situations, *hare* and *ke*, fits the *iki* taste, since bright colours are hidden and do not disturb *ke* life. Those bright colours inside the kitchen are taken from typical

have colour combinations: purple, yellow, red, and green. Those colours are only exposed when the kitchen is used. If the bright colours were always exposed, it would give a *yabo* feeling to the people who see the kitchen.

In the Wave kitchen, the bright colours, coupled with open shelving, function as an indication of utensil location. When Nihon people use *mizu-ya*, the small kitchen used for the tea-ceremony, the predetermined location of each utensil eases the organization and use of this small kitchen.

Composition, or form, is the means through which the conceptual bases of the Wave Kitchen are incorporated into its design. The expression of the cultural traditions on which the kitchen is conceptually based, and the manner in which the Wave Kitchen meets the needs of its users, is evident in the kitchen's form.

The transmission of a message through form follows from Lengyel's (1989) assertion that even though the focus of design has changed over the course of this century (for example, the methodology and science of planning in the

sixties, the social responsibility of the seventies, and the sensuousness of the eighties. Lengyel, 1989), the desire to transmit a message through form has remained constant. The form of the product is the means by which users interact with the product. The form is how users "see" the product even though functionally the product could potentially have many forms. According to Lengyel, product users are increasingly growing more sophisticated, and so are becoming more interested not only in the functional aspects of the product exhibited in the form, but also in the spiritual or conjectural aspects as revealed through the product's form. The product's form is a means of communication. It symbolically represents the identification of the user. "A product can hold very personal, emotional meanings for the product users" (Adams, 1990, pp. 63).

A second aspect of form determination that is important to the Wave Kitchen is the relationship between form in the aesthetic sense and functionality. When products are designed, it is evident how the physical aspects of the product relate to its value. A good part of the value of a product is determined by how well the product works. The aesthetics of a product

contribute to the value of the product. The word "aesthetics" originally meant "pertaining to things perceptible by the senses" (Durant, 1989), but in the mid-nineteenth century took on a different meaning: the theory of taste, or the perception of beauty in nature and in art. This definition relies on the word "beauty" to convey a sense of the positive. The Oxford English Dictionary defines beauty as "that quality, or combination of qualities, which affords keen pleasure to the senses, or which charms the intellectual or moral faculties through inherent grace, or fitness to a desired end". Beauty, then, is to be found in those things which perfectly, or nearly, perfectly, fulfil their intended function. Once again, the connection of form, even in the aesthetic sense, is intertwined with function.

People would be agree that good design is a harmony of functional and aesthetical aspects. Those two aspects should not be evaluated separately. When the Wave Kitchen was designed, the curved form was chosen because it satisfied those two considerations. The Wave Kitchen will rely on its form to be the point at which contact with the user occurs in both communicative and aesthetic senses.

Earth: The Wave Kitchen

The following paragraphs describe the Wave Kitchen, beginning with a general description of the principles along which the kitchen is organized. Secondly, the Wave Kitchen is described in detail, including a description of the physical characteristics and materials. Thirdly, the modular composition and the means of assembly for the Wave Kitchen are described. Lastly, the major human factors considerations for the design of the kitchen, including counter height, reach, and depth of counter top are described.

General Description

The Wave Kitchen is organized according to two basic principles: the storage and organization of equipment, and second the creation of a comfortable working area. The most expedient solution to the problem of storage and organization of equipment is to provide a large amount of storage space. Unless there is some order to the storage space, the large storage space will only be a cause for confusion. The design of the Wave Kitchen minimizes this kind of problem by following the design principal of the *Mizu-ya*, where there is a defined

place for all that is needed in the kitchen.

Based on the kitchen in the Okuda house in Osaka, (Miyazaki, 1988) the Wave Kitchen has the stove hubs placed around the user; the sink and counter top of the Wave Kitchen enfold the body. Then, when the kitchen is in use, the user becomes the centre point of the work area. This “U” shaped layout reduces the walking distance and allows additional people to work together in the same area.

The space in the Wave Kitchen is organized into four main horizontal areas: 1) storage area for seldom-used utensils above the zone of comfortable reach, 2) the common work area at the zone of comfortable reach, 3) the work area where the cooking and preparation activities occur, and 4) the storage area for seldom-used utensils below the zone of comfortable reach. Based on the Nihon concept of *hare*, the four dominant colours with which the kitchen is organized are purple, yellow, red, and green.

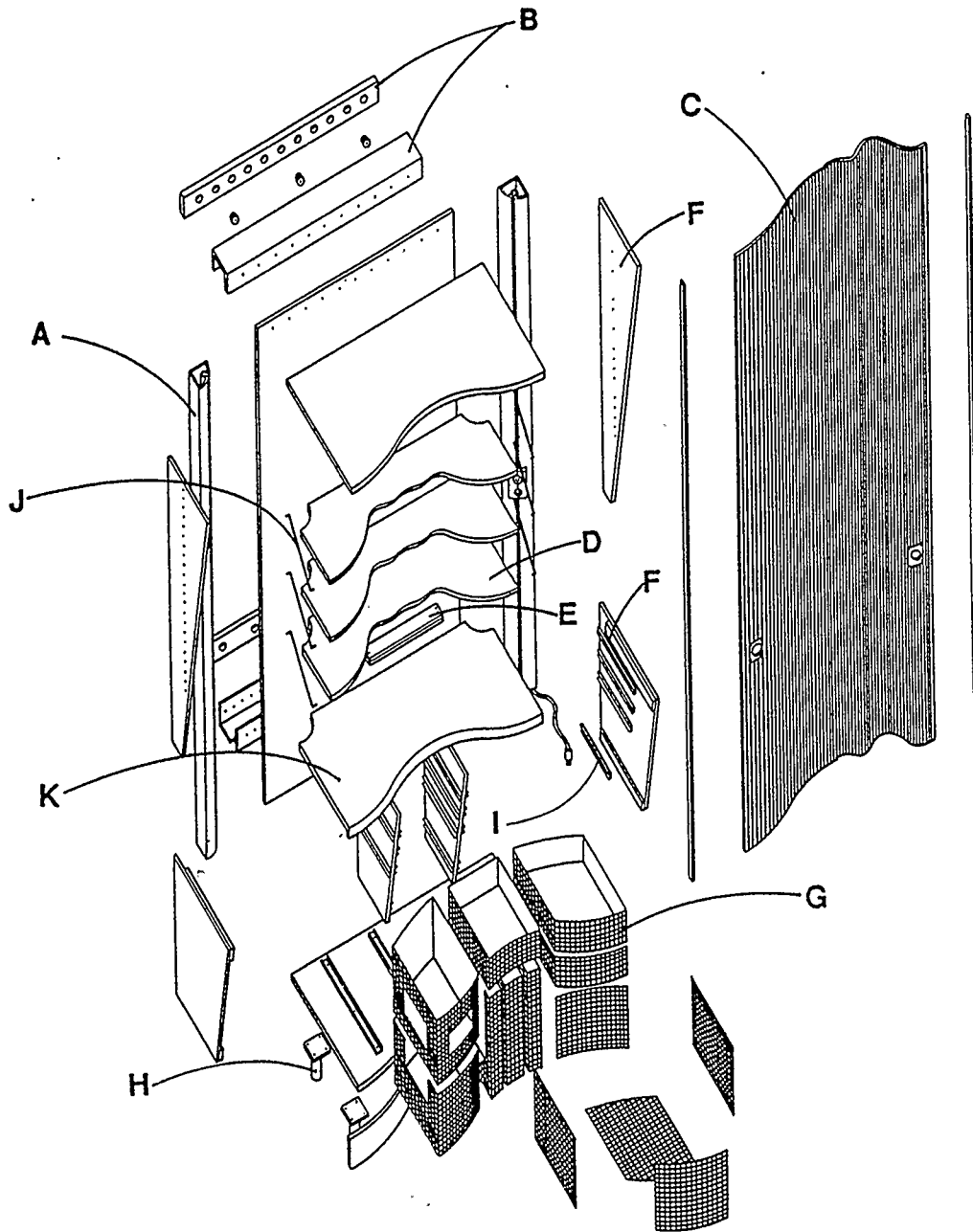
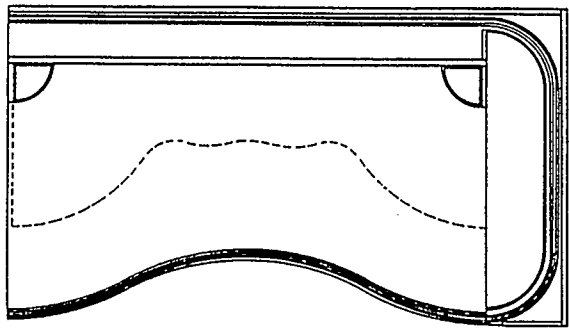


Figure 18 Exploded view



STD. Module
H: 2300 mm
W: 1200 mm
D: 750 mm

Side Module
H: 2300 mm
W: 200 mm
D: 750 mm

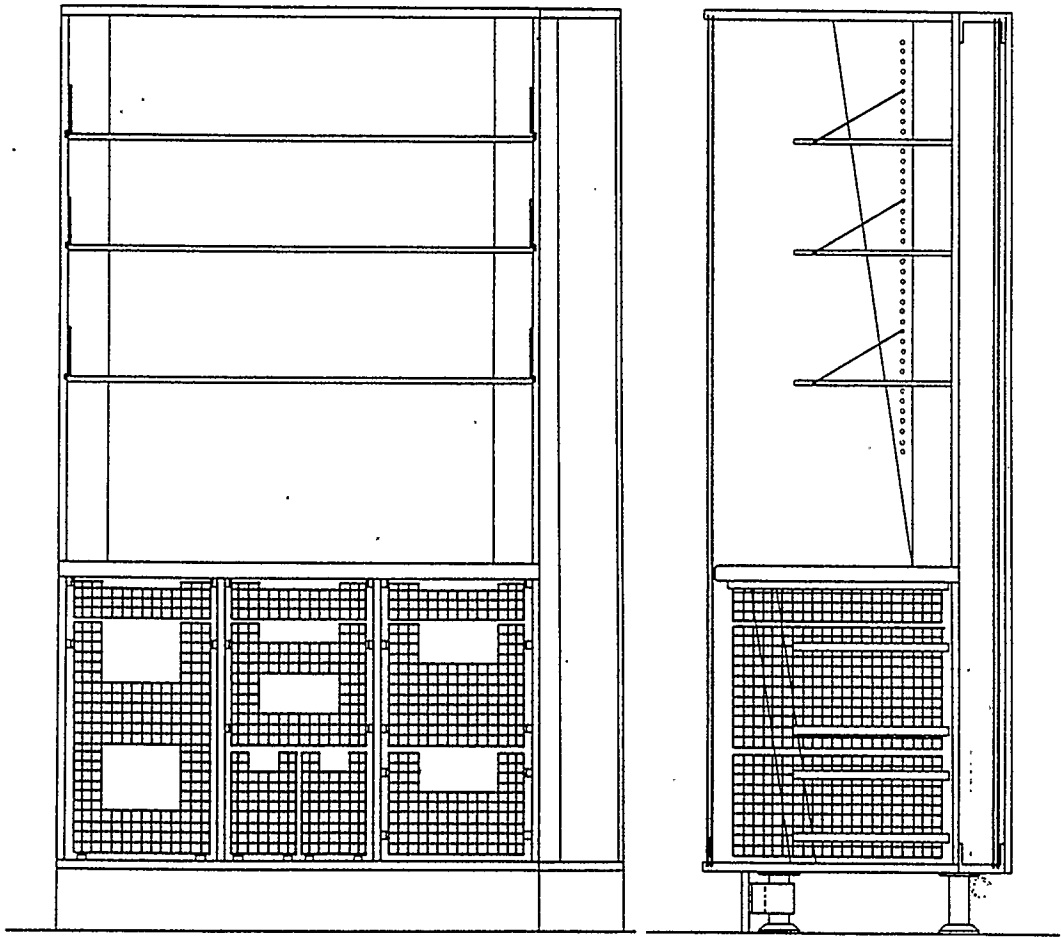


Figure 19 General Arrangement

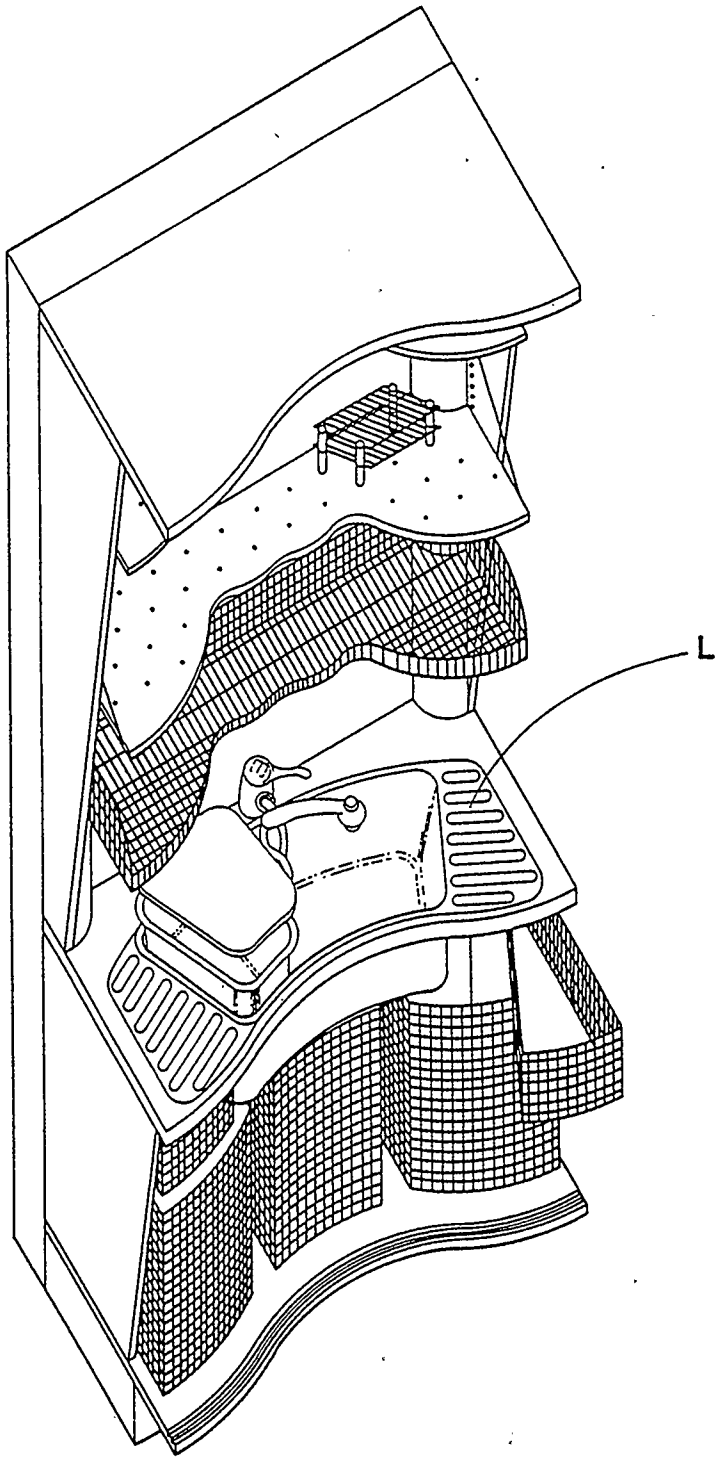


Figure 20 preparing/Washing Zone

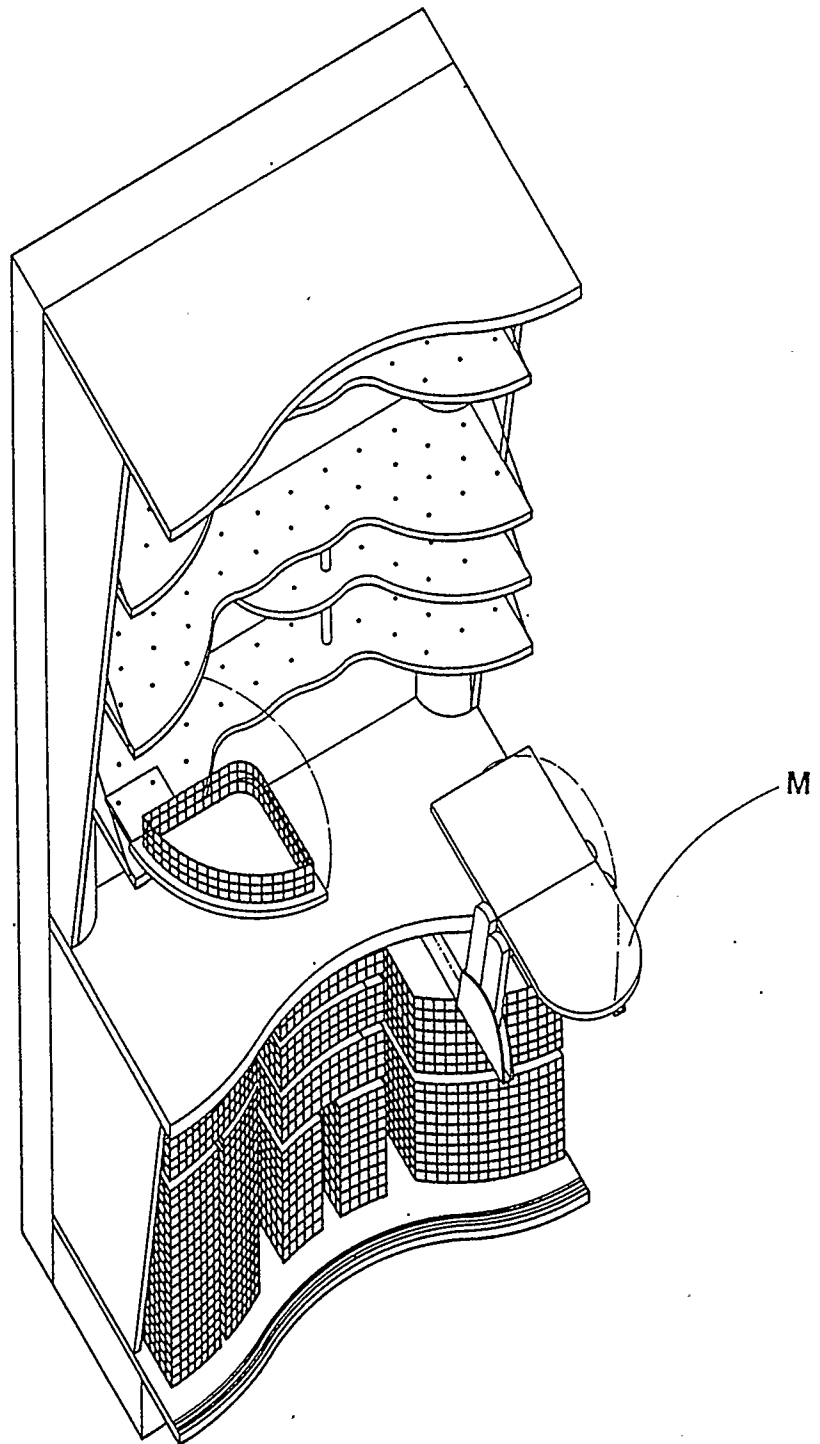


Figure 21 Mixing/Serving Zone

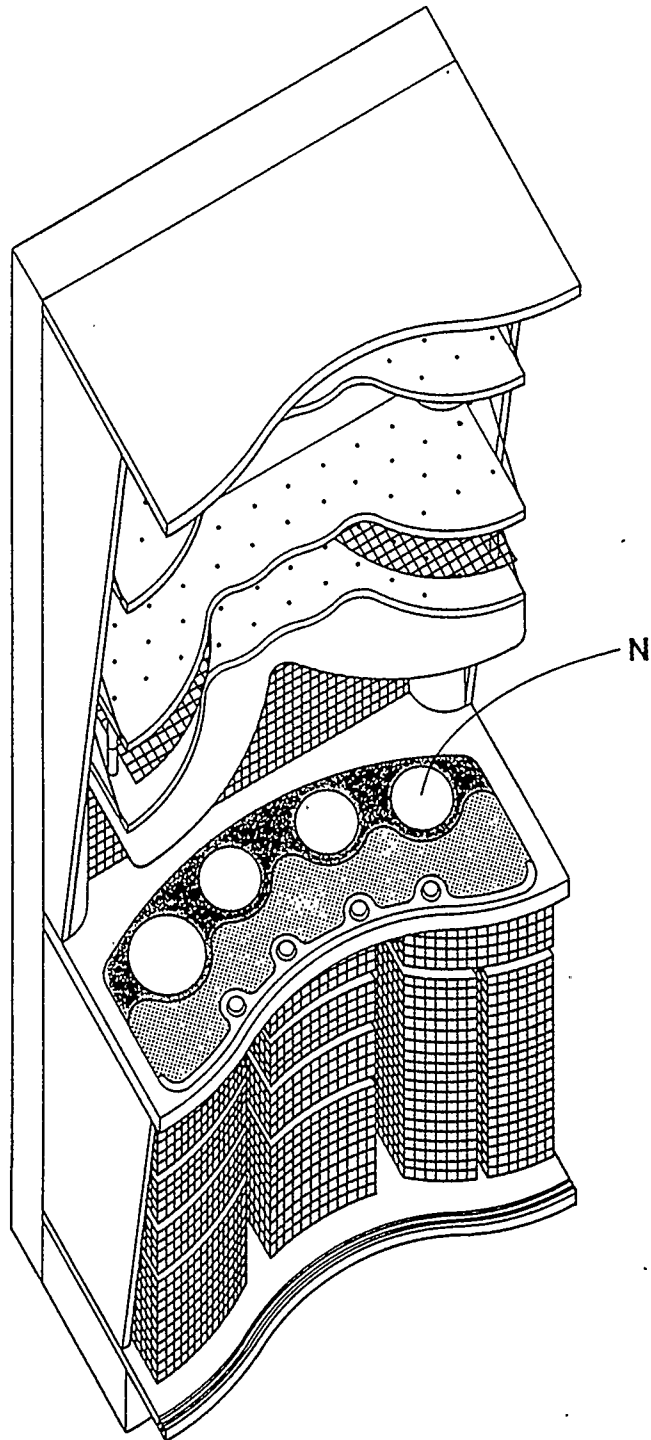


Figure 22 Cooking Zone

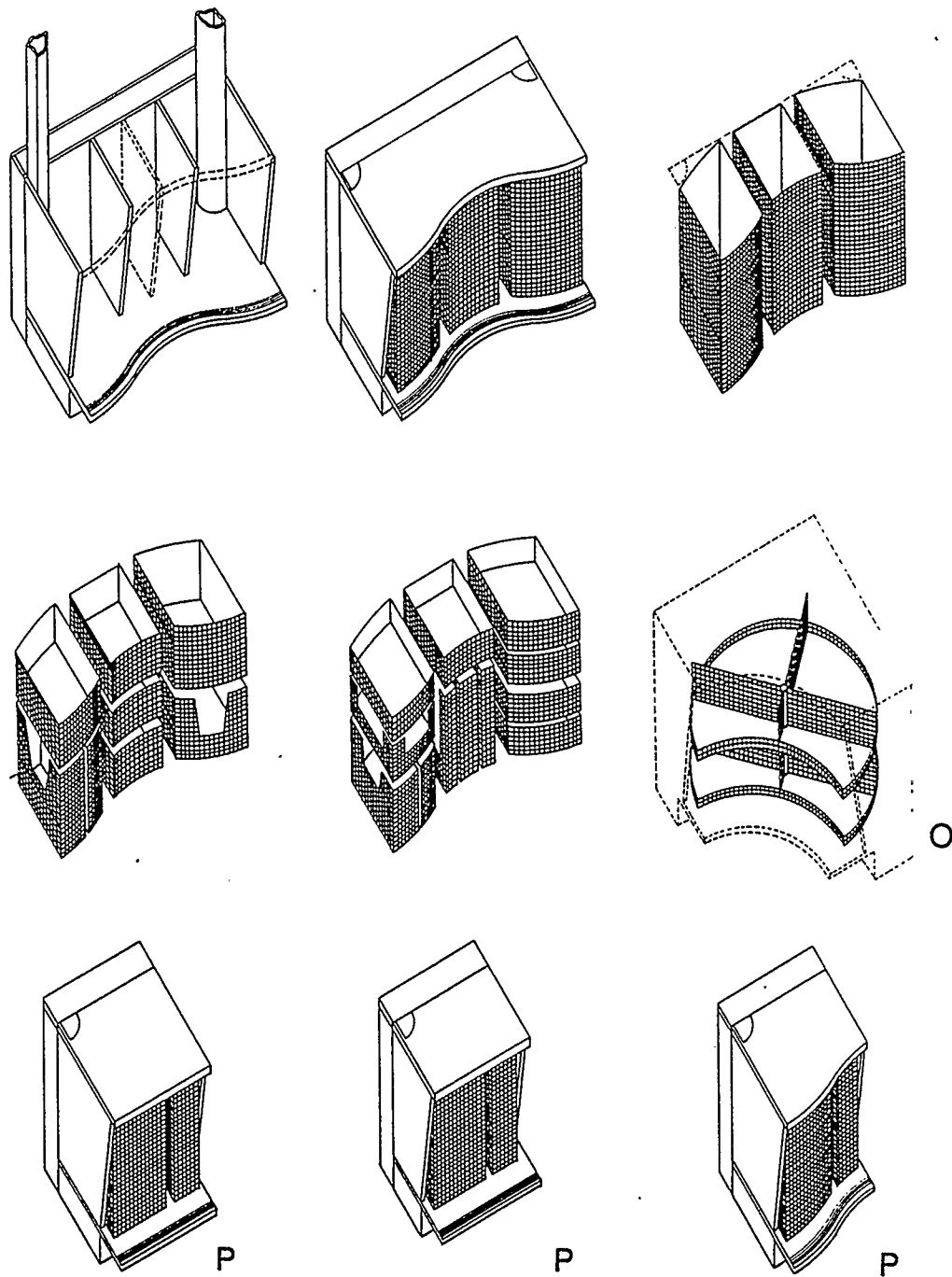


Figure 23 Lower Cupboard Arrangements

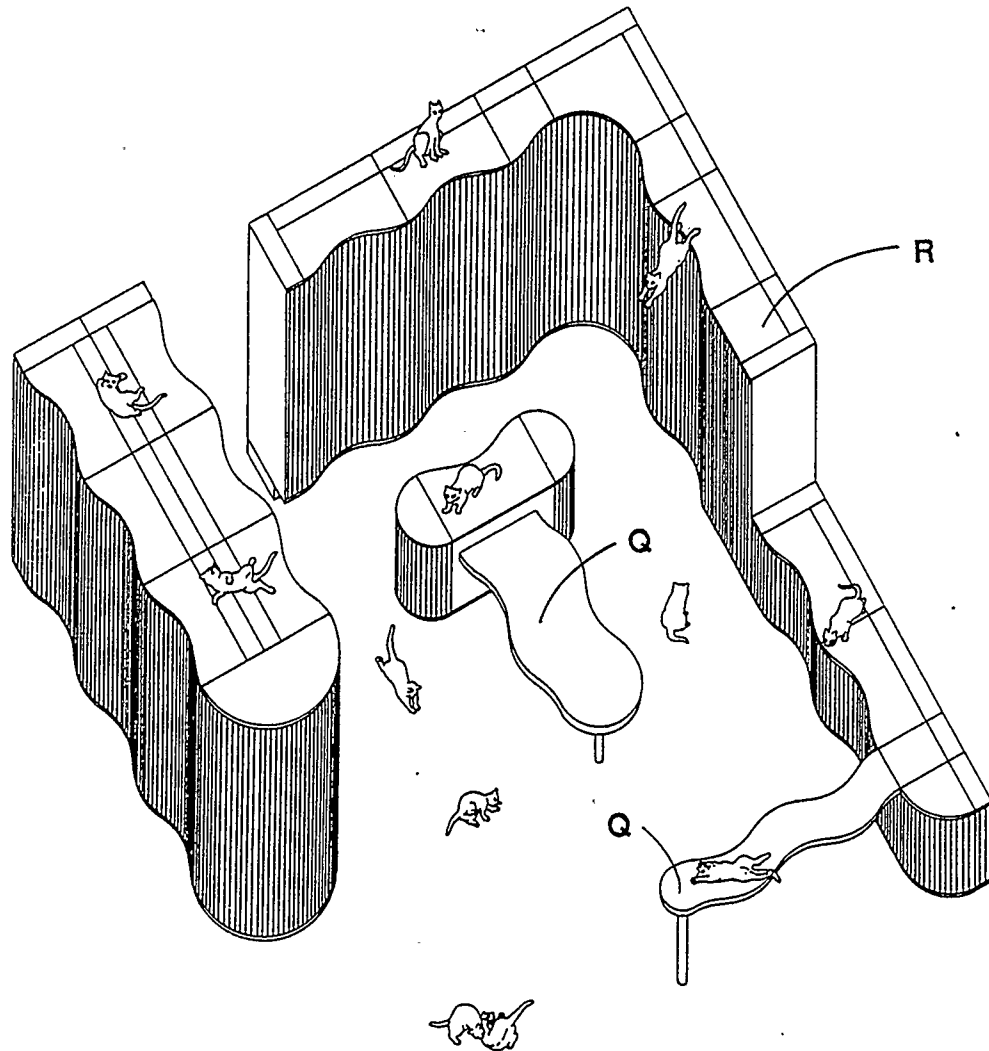


Figure 24 Layout Sample

Detail Description

The Wave Kitchen is divided into five different components: Standard, Special, Corner, Half, and Additional Units. The units have similar structural characters, vertical supports, and horizontal planes.

1) STANDARD UNIT

A) structure supported from wall and floor (Aluminium extrusion) <Figure 18>

-pillars are hollow aluminium extrusion for wiring

B) existing wall balancer <Figure 18>

C) tambour door for cupboards <Figure 18>

2) CUPBOARD

upper cupboard

D) shelf (MDF) <Figure 18>

-upper cupboard is open 200 mm in depth to 300 mm

-shelves/cupboards suspended from vertical wall
structure

E) downlight <Figure 18>

lower cupboard

F) side wall(MDF) <Figure 18>

G) wire mesh basket <Figure 18>

H) adjustable feet (like for vertical supports) <Figure 18>

hardware

I) drawer runner <Figure 18>

J) shelf supports <Figure 18>

fitting

connector screw

counter

K) countertop (Corian) <Figure 18>

-cut out 150 mm, leaving 450 mm in the middle area

L) sink (Corian) <Figure 20>

M) height adjustable countertop (installed under the counter as a pullout shelf) <Figure 21>

N) stove (induction heater) <Figure 22>

3)SPECIAL UNITS

O) corner units <Figure 23>

-same structure as standard unit

P) half unit <Figure 23>

-both top shelves and bottom cupboards in half width

Q) additional unit

-table, counter (MDF, Corian) <Figure 24>

filling unit (MDF)

-filling the end space between the kitchen unit and wall
appliances

R) large appliances go as separate flat front units (unlike the ordinary kitchen counter, the Wave kitchen counter is not deep enough to install large appliances.) <Figure 24>

-refrigerator, microwave, oven, dishwasher, stove hood

The Wave Kitchen is designed with a variable with 450 mm to 600 mm counter depth. The centre of the countertop, at 450 mm deep, is the location where the user usually stands. This dimension, 450 mm, satisfies the minimum depth Birley, Farrow, Frame, Mahaddie, and Sheppard determined. (1972) Both ends of the module are 600 mm depth, the same depth as the standard counter depth.

The upper cupboard shelves of the Wave Kitchen have 200 mm depth in the shallow part and 300 mm in the deep part, meeting the specifications of Birley, Farrow, Frame, Mahaddie, and Sheppard (1972). This 200 mm shallow shelf makes the objects on the shelf more easily visible than the usual deep shelf. This is an important point when one is working in the kitchen and wants access to the utensils or food immediately.

The height of shelves is adjustable; therefore, people can place the right amount of space between shelves. Those are important considerations since the two main reasons for bad access and waste of space are deep and fixed shelves (Murrell, 1986).

The material of the shelf is a painted MDF. MDF board is easily available and handled; only standard wood working skill is needed to process it. The shelves are painted in green or red, two colours from the four *hare* colours: green, red, yellow, and purple. The shelf above the comfortable reach is painted in green and red in the common work area at the zone of comfortable reach.

The shelf has a quarter circle at both ends (300 mm deep) and a wave cut-out in the middle (200 mm deep). The wave cut-out in the middle reflects the entire Wave Kitchen form in a small scale, and each quarter circle break the routine pattern, like an actual wave rhythm. The shelf has holes on top, and one hole in both sides of the shelf. The holes on top hold optional wire-grid attachments to hold dishes, glasses, cups, or small bottles. Two holes on both ends hold a wire hanger, which is suspended from the vertical side panel to support the shelf

board.

The shelf is supported with these two hangers on both sides and two dowels. The dowel sticks out from a hole on the vertical side panel.

Vertical side panel

The vertical side panel is screwed on the vertical quarter pipe on the both sides of the module. This side panel has holes in a line where hangars and dowels are placed in order to suspend shelves. There are other types of vertical panels underneath the counter: usually four panels, two on both sides with others between. Those panels hold sliders for the wire-grid baskets that are described in the 'bottom cupboard arrangement' section. When the kitchen modules are assembled, all side panels are screwed together and the modules became one solid kitchen.

32 mm grid system

In Europe, the kitchen cabinet manufacturers are using a standardized 32 mm grid system (Manefeld, 1985). For instance, the holes on the side panels are made every 32 mm,

centre to centre. The size of the hall is 5 mm and hard-ware such as connectors, screws, door bumpers, shelf supports, extension runners, and construction fittings are also standardized. Moreover, manufacturing machinery is designed for this system. While this system was started in Germany, now hardware and machinery are available in North America. To reduce the manufacturing cost, the Wave Kitchen has been designed with this 32 mm grid system.

Width

Since modular kitchen systems are not popular in Canada, a standard kitchen unit width does not exist. However, there is a recommendation to follow; Birley, Farrow, Frame, Mahaddie, and Sheppard, determined the cupboard and counter length of a kitchen in a average four-person household. The total length is 3900 mm without the length of refrigerator (1972). The width of one module wave kitchen is 1200 mm. A minimum of three modules is required to make a complete kitchen, such as, preparation/wash-up, mixing/serving, and the cooking unit. The total length is 300 mm shorter than the required length. It would not be a problem when an additional 300 mm in total or 100 mm for each unit can be adjusted by a corner, a half, or a

filling unit. The module length, 1200 mm, was decided from the length of the minimum 'U' shaped stove and the sink requirement.

The counter top material can be any material that is stable, hard, heat resistant, water-proof, smooth, and non-toxic. The choice of common materials for counter tops are: a laminated plastic surface on MDF (Medium Density Fibreboard) or plywood, stainless steel, tile, and natural or artificial granite.

Laminated plastic, such as a product called "Colour Core", has less heat resistance than stainless steel, tile, or natural or artificial granite. Since the core material of a laminated plastic countertop is MDF or plywood, it expands if water gets into the core material.

A stainless steel countertop has very good heat resistance (more than 1000 degree C, compared to the acrylic based artificial granite temperature, 180-240 C). However, stainless steel does not provide insulation against electrical shock. It is not a safe material for a work place where wet hands are common (Woodson, 1981). Even though, stainless steel has a

wonderful heat and stain resistance feature, electric conductivity is a crucial fault with this material.

Natural granite is very attractive, but the material is too hard for a countertop that is used on day to day basis. People must pay careful attention when they put fragile objects like glass or porcelain on the counter. These objects can easily chip. Also, because of its hardness, it is not an easy material to handle; it requires special manufacturing skill. Tile has the same chipping problem with heavy and hard objects, and it is difficult to clean the tile joints.

An artificial granite counter top is made with either a polyester base or an acrylic base. There are three ways to make the artificial granite: as a solid, as a laminate, or as a mixture of resin and natural rock powder. The advantage of solid material is that the user can sand the surface if it is damaged, stained or scratched. An acrylic base has a higher heat and stain resistance than a polyester based countertop. (Uchida, 1987) Two major solid artificial granite products are 'Avonite' by Avonite Inc., Ca. and 'Corian' by DuPont Company, Del. Avonite is a Polyester base and Corian is an Acrylic. Both

are solid materials and have good heat, scratch, impact, chemical, and stain resistance. These are easy materials to work with; only basic wood working skills are needed. Since the materials are solid, cut off sections look exactly like the as top surface. Like wood, these products can be glued together, or to other materials such as, metal, ceramic tile, and wood. The material is hard, yet soft enough to prevent glass chipping. Even though polyester-base solid material has similar features to acrylic-base material, acrylic base has better heat and stain resistance. Therefore, the material of the counter top I would like to choose for the Wave Kitchen is the acrylic-base plastic counter top, "Corian". It is a stable material for long-term use and satisfies all considerations above. Corian comes with 11 different colours. DuPont supplies inlay stripes in seven different colours. Corian has more useful features than other counter materials for the Wave Kitchen.

Following the colour scheme of *hare*, the colour for the counter is supposed to be red. The problem with a red counter is that when food is arranged on the dish, it is easier to judge the colour coordination of the food with a neutral colour

background than with a primary colour. There is a Nihon saying that, "You eat dish with Nihon food". This means that the dish you choose and way you arrange the food on the dish is equally as important as the meals. In order to facilitate a fair colour judgment, I have chosen a Corian grey counter top with red inlay trim on the front edge.

Sink materials

There are many kinds of sink materials found on the market: enamelled steel, stainless steel, glazed fireclay, and artificial stone such as Corian by Dupont for example. Both enamelled steel and glazed fireclay chip easily. Stainless steel is chip, rust, and heat resistant. It will also stand abrasion and acids (Conran, 1977, pp.136). The disadvantage of stainless steel is its noise. Stainless steel has been chosen as a material for the small removable sink which requires a light-weight and durable material. Despite the advantage of a stainless steel sink, I prefer using Corian as a material for the main sink. The texture of Corian is more warm appliances than stainless steel; this is important for the user if he or she is to enjoy using the kitchen.

As with sink materials, the number of sinks is another decision to be made. One or two sinks is common. Conran (1977) found double-bowl sinks to be desirable in the family kitchen. This sink would accommodate a variety of activities, such as vegetable preparation, kettle filling, and cloth soaking. The arrangement of bowls and drainers depends upon the user's left or right hand sequence. The most efficient depth of the sink bowls was a minimum of 180 mm. (Conran, 1977)

The Wave Kitchen has a large Corian single sink-bowl which follows the shape of the counter top. The sink has a small removable stainless-steel insert which fits inside the main bowl. The insert is topped with a nylon drain/cutting board on top of it. Both sides of the sink have risen patterns for drying dishes. The removable sink may be positioned on the left or right hand side of the main sink interior. This flexible sink system can adapt one product to left or right handed users and therefore makes production efficient.

Bottom cupboard drawer arrangement

A bottom cabinet with four layers is more advantageous than an ordinary three-drawer cabinet (Murrell, 1987). The top two

drawers are for commonly-used heavy equipment such as cast iron pans and pots. It is safer to store heavy equipment within a height range close to the counter height than in lower cupboards. The bottom two drawers are for bulky equipment, such as stew pots.

The storage space of the Wave Kitchen is arranged with wire grid basket drawers of different depths and shapes, suited to the individual needs. This arrangement not only allows as Murrell has suggested, four drawers, but also allows a greater variety of layers, shapes, and heights for a wide range of objects. (Figure 23) . The front side of these wire grid baskets are formed in a curved shape following the shape of the counter top. In the case of the standard 1200 mm module, each module is divided into three sections: the right, centre, and left. Each unit can, as well, be divided vertically. Following the Wave kitchen's basic "U" shaped form, the left and right baskets are symmetrical.

Upper cupboard height

The height of the upper cupboard itself is not as critical as that of the counter; commonly used kitchen equipment can be

placed within easy reach, and the area above and below the reach can be used for other items. However, the bottom end of the upper cupboard is critical. The study by Iwata compares the height of the ordinary top cupboard and the top cupboard of the shallow counter kitchen. The ordinary top cupboard's far corner is difficult to reach for 5th percentile elderly and 50th percentile female users. The 50th percentile male is almost able to reach that corner without rotating or bending his body. The 5th percentile female is probably unable to open the door unless the handle is placed on the lowest end of the door; she still has a problem reaching the upper shelf. The problem is not likely to be solved by moving the top cupboard down on the counter top. It shows upper body movement turning from the top of the pelvis. The angle is 60 degrees, which is the average of the maximum upper body angle without bending the spine, based on Human Scale. (Iwata 1988)

Birley, Farrow, Frame, Mahaddie, and Sheppard (1972) describe a user-adjustable system of storage location which seems to be the most practical way of avoiding the waste of a comfortable upper reach for the shortest person and the lowest reach of the tallest person. This report suggests:

firstly, that frequently needed articles should be placed in a zone which extends from arms outstretched at shoulder height to the tips of fingers when arms are down at attention; secondly, that lighter items can be placed in a zone extending up to the full reach of the arms and down to the hand height associated with half trunk bending; and thirdly, the zone above and below these should be set aside for the storage of seldom-used articles.

Special units, Appliances

Stove

The hubs are arranged in a 'U' curb on the counter. In front of these hubs is a space for the pot to rest. To prevent accidents, there should not be a gap between the hub and the counter. The stove has a system called induction heat, that uses the magnetic field as an energy source to heat up a steel pot; food in the pot then heats up. This system only heats up the steel on the hub. The pot itself becomes a heat source not the hub. Even if the stove switch is left on, the stove remains cool; nothing will be heated if the steel object has been removed from the hub. There is no chance of fire catching the sleeve or other flammables because fire is not involved in this heating

process. The only type of accidents that could happen are from touching the heated pot or hub part. While cooking, the hub becomes hot because of conducted heat from the pot. Even if the switch is still on, the hub starts to cool down as soon as the steel pot is removed. There are a few things to remember about an induction stove: the pot must have a flat bottom and must be made of steel. If the user has other types of flat bottom pots (copper, heat resistance glass, or enamel coated pots, for instance), they can be usable. Place a piece of steel disc under the pot. Even though, it will not produce heat as quickly as does heating a steel pot directly, the steel disk generates heat and the heat conducts to the pot. Despite the limitation of the pot choices, I have chosen the induction stove for the Wave Kitchen because of its safety features.

The stove surface is a piece of heat resistance glass. This flat surface is easy to clean and safe to slide heated pot on since there are no gaps. The space to rest the pots is on the same glass area. The visual distinction of these two areas is graphically presented (Figure 22). The control knobs are located along the front side of the glass. The knobs are on the raised edge, which will stop a pot that slides down from the

stove.

Specifications involving other design decisions regarding the Wave Kitchen can be found in Appendix A. Included are sinks and taps, lighting, floor materials, circuits and switches, appliance selection, and hood location.

Assembly

The modular composition and the means of assembly for the Wave Kitchen are described in the following section.

In order to utilize the Wave Kitchen's organizational principles of storage, equipment placement, as well as the need for a comfortable work area, the kitchen must rely on a modular composition. This modular composition allows customization to meet the particular needs of most individuals. The great number of tasks and different uses of the kitchen space mean that it is likely that some level of customization will be beneficial to all users of the Wave Kitchen. Complete customization, however, is unrealistically costly; so, the Wave Kitchen bears some degree of standardization and sharing of common components. (Figure 24)

The modular organization of Wave Kitchen components is in keeping with the modular character of many systems of office furniture. The partitions, desks, shelves and lockers of many office furniture systems fit together to make cohesive work stations. The electrical conduits, as well as telephone and computer lines, are hidden inside panels or structural pipes along the edges of the furniture: Ergota Office System, designed by Urs Bachmann, Zurich, Switzerland, for example. (Busch, 1987, pp. 96)

The module office furniture made by Steelcase of Grand Rapids, Michigan, called the "Context Furniture System" (ID Magazine of International, July/August, 1990, pp.116) is a good example of this modular approach to office furniture. This system is composed of freestanding desks or core units that can be customized with the addition of various storage units, boundary walls, and privacy screens. All wires are installed in steel bar-rail cases or inside the units. (Figure 25)

Like this office furniture system, the Wave Kitchen

components adopt this modular approach. Also, like the "Context" system, the Wave Kitchen internally routes electrical wiring and plumbing as well.

The assembly of the component modules of the Wave Kitchen is purposefully simple for the knock-down system.

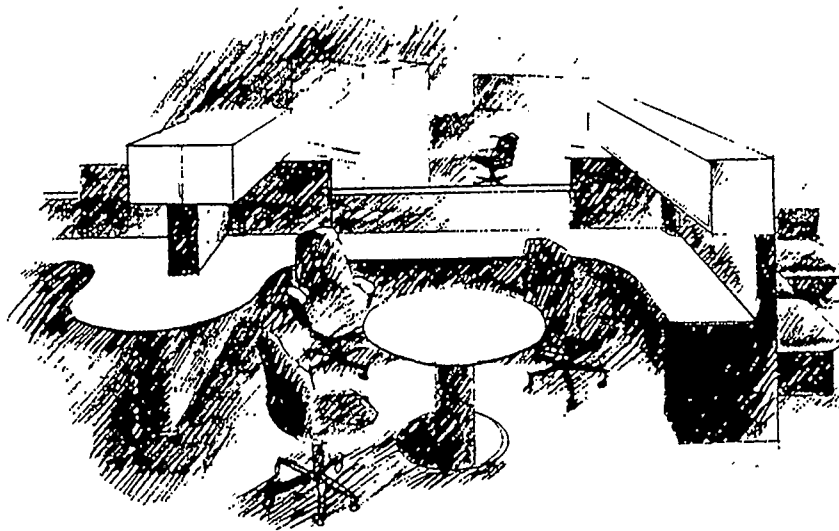


Figure 25 Context furniture system

This system is commonly used when manufacturers distribute the products from the factory. Rather than shipping a product in one piece, a products is broken down into several pieces and the retailer or end user assembles the product. The manufacturer is able to reduce the labour cost. A knock-down method of manufacturing leads to easy self-assembly. Another

advantage of knock-down assembly is that all of the kitchen components can be packed flat, which results in cost savings in shipping and warehousing. The assembly starts from the base, wall, bottom, and wall sections. All parts are assembled in this order from the package. (Figure 18)

Conclusion

The Nihon concepts of *hare*, *ke*, and *iki* (special occasions, daily life and stylishness) are merged in the Wave Kitchen and illustrated by the use of different colours. Based on the concept of *hare*, the four dominant colours with which the kitchen is organized are purple, yellow, red, and green. Also for the contrast between *hare* and *ke*, those dominant colours are only used as the interior colours where they would be completely hidden when sliding doors are closed. The exterior colour is therefore a subtle colour, metallic grey. The bright *hare* colours are hidden and do not disturb the *ke* atmosphere, these colour usages fit *iki* aesthetics.

The kitchen appliances are selected from the existing products. Particularly for the refrigerator, the glass door type is recommended since that would show all contents while the kitchen is in use. These appliances are completely hidden when the kitchen is closed.

Even though the Wave Kitchen is high-end product designed for the family use in a house, there are other potential markets, an institutional kitchen for example. The transformation of the

colours will adapt to the working environment. Because of the type of materials that are chosen for the long term usage, the initial manufacturing cost will be expensive. Most likely the initial product line would be designed to prepare the modifications to reflect the market reactions, the choice of the colours for instance.

For the comfortable use, all contents of the Wave Kitchen are exposed in *hare* situation. This open shelf kitchen eases the finding of needed equipment during the cooking process. Also, the initial concept of the U-shape counter has been developed during the human factors research. The U-shape counter increases the reach envelope of the vertical and horizontal access. That will result in easy access for the users.

The Wave Kitchen is a kitchen where the user can enjoy preparing a meal. It is designed to be comfortable and easy to use, as well as flexible to accommodate different people and different types of meals.

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Appendix A

Woodson's recommendations

Sink and tap

Woodson (1981) described a basin shape and faucet configuration that can be applied to any kitchen sink. The basin shape and faucet configuration should combine to capture water rather than splatter it all over the user and the floor. Sharp edges and corners should be avoided on basins and hardware. Birley, Farrow, Frame, Mahaddie, and Sheppard (1972) describe a single sink which should be large enough to take an oven shelf, the largest object commonly washed there, and should therefore be at least 500 mm X 350 mm X 175-200 mm deep. If the depth is increased to 250 mm, it would be suitable for laundry use. For common North American 762 mm (30 inch) ovens, at least a 650 mm wide sink is needed to take an oven shelf. Woodson recommended a single, long-arm tap handle that can control both hot and cold water.

Lighting

According to Woodson (1981), lighting standards for residence kitchens are between 50 to 75 foot candles. Good quality illumination is required throughout the kitchen, not only for inspecting food and washing dishes, but also for using cutlery in a safe manner. He suggested setting lighting around the stove top, underneath cabinets, and around the sink. The light source should not be visible to the observer. The light bulb or lamp should be screened either by some type of baffle or by a

distributing screen. Accordingly, I designed the working light with a distributing screen under the top panel. Birley, Farrow, Frame, Mahaddie, and Sheppard (1972) also make similar recommendations.

The following design recommendations from Woodson (1981) are outside the scope of this modular kitchen design.

Floor material

The floor material must be non-slip and easy-to-clean material. Hard-wood flooring is too slippery, and cork flooring is difficult to clean. P.V.C. floor tile is a good flooring material.

Circuits and switches

Use ground circuit interrupters for all kitchen circuits and locate all switches far enough from the sink so that no one whose hands are in water or who is touching the sink fixture can reach them.

Appliance selection and installation

Select cooking appliances which have controls that are out of reach of small children and which do not require the person who is using them to reach across hot burners or utensils. Mount stove hoods where they are not easily bumped when the person who is using the stove bends over the stove top. The hood should have rounded corners. Make sure that the stove or oven selected is well-insulated so that the exterior surface

will not become hot when the appliance is in operation.

Hood location

Woodson (1981) makes recommendations for hood location; when a hood depth is less than 460 mm, the height should be 1420 mm, and when a hood is more than 460 mm in depth, the height should be 1520 mm.

APPENDIX B

The following table shows suitable storage spaces for various kitchen items. (Birley, Farrow, Frame, Mahaddie, and Sheppard, 1972)

Preparing/washing zone

STORAGE

ITEMS

SUITABLE PLACES

Foods

Fresh fruit

Fresh vegetables

Tea, coffee etc. (if not provided for at cooking zones)

Equipment and utensils

Kitchen crockery

(This could be kept at the serving zone, near the dining table or in any other convenient place, e.g., above a casual meals counter)

On adjustable shelves below 1650mm in a wall cupboard or in racks on the back of a wall cupboard door.

Cups and jugs can be hung on hooks either in a wall cupboard or below it

Saucepans, colander etc.

On pull-out racks; or deep drawers in the base cupboard

Knives, peelers, small strainers etc.	In a shallow drawer immediately below the worktop, or on wall rack, or on a rack on the back of a cupboard door
Plastic bags foil string, paper, clean towels, aprons, etc.	In drawer(s) in the base cupboard
Tea towels and hand towels in current use	<p>There is no ideal place for storing these items. Towels should be easily reached and well ventilated. They are probably most conveniently (if untidily) kept in holders on a spare piece of wall or the end of a fitment.</p> <p>Unless a special heater is provided towels should not be enclosed.</p> <p>Some special compartments with heaters are available but towels in them are not immediately accessible</p>
Empty jars and bottles	On shelves above 1 650mm in wall cupboards
Washing-up materials and utensils	On lowest shelf of the wall cupboard near the sink; or in a base cupboard below the sink; or in a rack on the back of the cupboard door

Mixing zone**STORAGE****ITEMS TO BE STORED****SUITABLE PLACES FOR STORAGE***Foods*

Flour, sugar, dried fruits, cake mixes etc.

Cupboard immediately above a refrigerator or in one through which a hot-water pipe passes

Seasonings, spices etc.

Shelf or rack at a low level in the wall cupboard, or below it

Utensils and minor appliances

Mixing machine, kitchen scale or other weighting machines

Ready for use at the back or in a corner of a counter; on a special stand or pull-out shelf near counter level

Mixing attachments, hand-held mixers, measuring and mixing spoons, whisks, small sieves rolling pin, pastry-cutters etc

On wall rack or rack on the back of the base cupboard, door or in a base cupboard or in a deep drawer near counter level

Pastry board, cooling rack, large sieves, baking tins, mixing bowls etc.

In a base cupboard, preferably in deep drawers or pull-out racks. All except heavy bowls and boards could be kept in a wall cupboard if necessary

Cooking zone

STORAGE

ITEM TO BE STORED

SUITABLE PLACES FOR STORAGE

Food

Seasonings (if not provided for at mixing zone)

Narrow shelf in wall cupboard or immediately below wall cupboard or on back of wall cupboard door

Tea, coffee etc. (if not provided for at preparing / washing or serving zone)

In cupboard

Utensils and minor appliances

Coffee percolator (if not provided for at shelf preparation / wash-up zone); portable hot-plate (if not provided for at eating zone)

At back of counter; or on lowest of wall cupboard

Cutlery

In shallow drawer immediately below worktop

Dinner ware (unless provided for at preparation / wash-up zone or eating zone)

On adjustable shelves below 1650mm in wall cupboard: large items may be on pull-out shelves or racks in base cupboard if required

Frying pans, baking tins, casseroles etc.;saucepan lids

On pull-out shelves; or on racks; or in drawers (in base or wall cabinets)
(Heavy items are best kept in base cupboards so that there is less risk of dropping them from a height)

Skewers, ladles spoons, fish slice etc. In shallow drawer; or hanging

from rack on wall; or back of cupboard door

Electric frying pan (may also be kept at serving zone)

In base cupboard; or if in constant use at back of counter

Serving Zone

STORAGE

ITEMS TO BE STORED

Foods

Cereals, jams, sauces, pickles etc.

(At room temperature in dry atmosphere) On shelf in wall cupboard; or rack on back of cupboard door

Bread

(In airtight container at room temperature) In special drawer in base cabinet ;or in bin

Utensils and minor appliances

China and glassware (if not provided for at preparing / washing zone or eating zone)

On adjustable shelves in wall cupboard, sometimes double sided for easy access from both kitchen and dining area

Serving utensils and table cutlery (if not provided for at preparing / washing zone or eating zone)

In shallow drawer below counter (often shared with cooking zone)

Trays

In narrow compartment in base cabinet; or vertical slot between base cabinets; or base cabinet and side wall

Table mats and linen (if not provided for at eating zone)

In drawer in base cabinet