REDUCING COST IN KITCHEN CONSTRUCTION THROUGH DESIGN ALTERNATIVES

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ABSTRACT

The study of cost-saving measures involved in the fit-up of the kitchen is explored, and two strategies of cost-saving are identified: reducing kitchen area; and, simplifying construction materials and assembly techniques. Alternative area requirements, as well as alternative materials and assembly techniques are examined in an effort to reduce cost. The cost of a series of compact kitchen layouts are analysed with respect to alternative construction techniques. A method that assesses the functional requirements of the layouts and costs involved is applied and various cost effective designs are examined.

RESUME

L'étude explore des mesures pour économiser sur les coûts impliqués dans le montage de la cuisine; deux stratégies pour économiser sur les coûts sont identifiées: réduire la grandeur de la cuisine et simplifier les matériaux de construction et les techniques d'assemblage. Afin de réduire les coûts, des alternatives sont examinées concernant les exigences d'espace ainsi que les matériaux et les techniques d'assemblage. Le coût d'une série de dessins de cuisines compactes est analysé en ce qui concerne les techniques alternatives de construction. Une méthode qui établit les exigences fonctionelles des dessins et des coûts supposés est appliquée et divers dessins économiques sont examinés.

ACKNOWLEDGEMENT

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1.0 INTRODUCTION

Within the last half century the kitchen has developed from a small, strictly utilitarian space to the most important room in the house. This change has resulted in the kitchen becoming the most difficult room in the entire house to design and the most expensive to construct. Hence the kitchen requires an ever increasing amount of the house construction budget. A survey done by the American National Kitchen and Bath Association and published in *Builder Magazine*, states in a 1990 cost estimate that the average kitchen costs the home buyer $17,803.00[1]. This figure represents between 15% and 25% of the construction cost for a majority of houses. Of this cost, 65% is for cabinets, fittings and the labour involved in construction, 20% for appliances, 10% for flooring and windows, and 6% for miscellaneous. As indicated, the majority of the total cost involved is in the millwork and in the labour to construct it.

The high cost of kitchen construction is due, in part, to an increasingly popular trend toward larger kitchens. The same survey done by the American National Kitchen and Bath Association also states the majority of kitchens constructed in 1990 have an average area of 15-30m^2 (150-300ft^2). Of the total number, 66% fall within this range while 10% of the kitchens are larger than 30m^2 (300ft^2). In a 120m^2 (1200ft^2) home a kitchen of this size accounts for 15% to 25% of the total floor area. (The fact sheet in the publication does not indicate if the eating space is included in this

figure.) The complexity and quantity of equipment in the kitchen has made it the most expensive area in the house to construct.

1.1 OUTLINE OF THE PROBLEM

In this study two opportunities for reducing cost were examined: 1) Reducing the kitchen size; 2) Simplifying the kitchen construction materials and construction techniques. A reduction in kitchen size will reduce the overall quantity of materials required for construction of the dwelling unit resulting in a cost saving. Likewise, simplifying the construction techniques and materials in the fabrication of millwork results in a reduction in cost. These cost savings would have a positive impact on the 15-25% of the total costruction cost the kitchen represents thus reducing the overall cost of the dwelling unit. This study reviews kitchen examples of reduced size as well as simplified construction techniques for kitchen workspaces. A review of the construction costs for selected examples is made and compared to the cost of a conventional kitchen in both size and construction, as provided by the American Kitchen and Bath Association in a publication of *Builder Magazine*. A literature review of the development of kitchen functions including work-centres, storage facilities and kitchen equipment is also undertaken.

ENDNOTES:

1. "Kitchen Facts." *Builder Magazine*, April, 1992: p92.

2.0 LITERATURE REVIEW

2.1 INTRODUCTION

This literature review focuses on historical examples of cost-saving measures in the development of the kitchen. It highlights those developments that were economical and examines the savings that were involved. Some of these innovations and ideas, not obviously cost-effective at first glance have, through development, become the basis of the modern manufactured kitchen and form the cost-saving practices used by current manufacturers. Modular kitchen cabinets are one example of an innovation that, through development, has become an economical way to mass produce kitchen furnishings.

The review also examines the functional aspects of the kitchen, which, in Le Corbusier's term, is a "machine for cooking".[1] While materials used for floors, walls and ceilings are important, this review will focus primarily on built-in kitchen furnishings. As new proposals for kitchen development emerged they were studied and examined by leading manufacturers in an effort to standardize, simplify, and mass-produce as a means of economizing. This historical overview categorizes kitchen types according to how they have tried to minimize costs. In terms of cost-saving, the types of kitchen layouts that have been studied all have merit. The categories of layouts that have been established are:

1. The compact kitchen,
2. The simplified kitchen,

3. The modular kitchen,

4. The work-centre kitchen,

5. The open kitchen.

While this list is not all-inclusive, it highlights many of the innovations in terms of both time-saving and cost-reduction. Although time saving was an important factor in the initial stages of kitchen development, this paper will only highlight the stages important to the development of cost-saving strategies. It should be pointed out that the categories established can be combined; for example, a modular kitchen can be a compact work-centre, which could also be an example of an open kitchen.

2.2 THE COMPACT KITCHEN

Early examples of kitchen dressers emphasized space-saving compactness. The turn-of-the-century dresser was a single, subdivided cabinet holding utensils, food and cleaning equipment (Fig.1). Many kitchen dressers came equipped with dry sinks as well. As Lifshey points out, the appearance of these dressers (with built-in cabinets and continuous counter work surfaces) marked the first step in the development of today's modern kitchen.[2]

Soon after the kitchen dresser was developed it underwent technical changes and refinement. Wood cabinets were replaced by steel cabinets, which were more durable and less costly to fabricate. The cupboard kitchen or compact kitchen continued to develop to the point where it became a complete self-contained kitchen unit.

Figure 1: Kitchen Dresser, C. 1900
Source: Earl Lifshey, *The Housewares Story*, (Chicago: National Housewares Manufacturers Association 1973).

In 1935 General Electric sponsored an architectural competition entitled the 'House for Modern Living'[3] While the competition was initiated to consider the entire house, it was the compact kitchen that became the major focus (Fig.2) Here was a complete integration of appliances and work centres in a compact functional arrangement, the organization of the kitchen according to the work triangle, and the total disappearance of the pantry. Although the kitchen had a direct link to the dining room (Fig.3),

the majority of kitchens had separate cooking and eating areas establishing the kitchen as a functional machine for food preparation. In an effort to economize space, almost all kitchen wall surface was given over to counters, cupboards or appliances, creating efficient U-shaped or galley kitchens. The view of the work oriented kitchen continued into the 1940s and was reinforced by high housing demand, a tight economy and a limited supply of building materials.

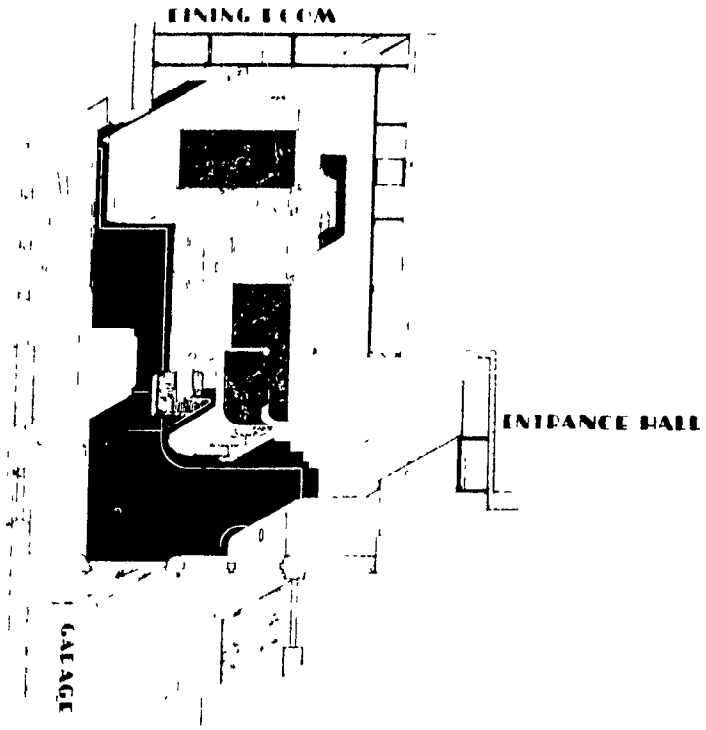
Another example of that time period was the product of research into low-cost housing done at Purdue University. Four work-centres were identified in the Purdue kitchen:

1. Food preparation,
2. Cooking,
3. Serving,
4. Cleaning and working.

This sequence of kitchen activities was considered important when properly arranging equipment into compact, efficient spaces.[4] Counter space was required for the placement of equipment and the rectangular kitchen was considered a more satisfactory arrangement than the square kitchen of the same area because it provided more perimeter space for counters. In the rectangular kitchen the dimensions averaged between 2.4 - 2.75m long and 1.9 - 2.2m wide, allowing for equipment on both sides of the kitchen (Fig.3). The work areas were free of doorways to prevent breaks in working surfaces and storage spaces were arranged and sized according to function for

efficiency. Practical cost-saving measures included using moveable trays rather than shelves, and bins rather than drawers. Guidelines were put forward in an effort to minimize work spaces by making them more efficient.[5] The refrigerator was located near the worktable and serving centre, the range between the sink and worktable units, and the sink and worktable were opposite each other, leaving the sink and serving units combined In the example shown (Fig.3), the dining room is combined with the living room.

Figure 2: Work Centre Layout
Source "House for Modern Living," *Architectural Forum* (Apr. 1935)



An extreme example of the compact kitchen is the "cupboard kitchen", designed as a single unit. It usually consisted of a sink, two electric burners, a refrigerator, and in some cases, an oven (in recent models,

a microwave) (see Fig.4 & 5). The small size of the unit (240 x 104 x 61cm) made it ideal for compact quarters. Some units even came complete with a collapsible worktable mounted on the door. This type of kitchen was considered adequate for couples and small families, since it included only the essential storage for utensils and food. Once finished, the doors were closed and the kitchen was out of sight. While this type of kitchen is highly efficient and economical in size, the specialized equipment and appliances necessary result in an increase in cost, because while small, a sink, refrigerator and stove are still required as the basic appliances of a kitchen.

Figure 3: Work Centre Layout
Source: House for Modern Living *Architectural Forum*, April 1935

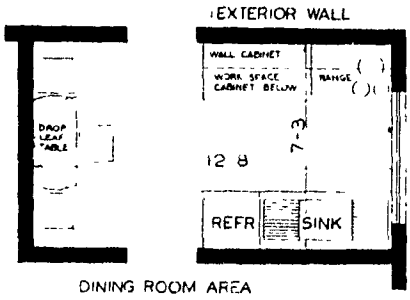


Figure 4: Cupboard Kitchen

Source. *Domus* 535 (July, 1974)

Figure 5: Cupboard Kitchen

Source Terence Conran, *The Kitchen Book* (New York Crown Publishing, 1977).

2.3 THE SIMPLIFIED KITCHEN

A simplified kitchen uses the minimum amount of equipment necessary to

fulfill the activities required. The kitchen found in the Weissenhof settlement of Stuttgart in 1927 and designed by J.P. Oud is an example of a simplified kitchen. In his design Oud showed a desire to eliminate costly decoration and deal primarily with function. The Oud kitchen is an example of the organization of work processes creating its own form, and shows a close relationship of work-centres. It was specifically designed as a low-cost kitchen for workers' housing.[6] The kitchen has a continuous storage, cleaning-preparation and cooking centre (Fig.6 & 7). This arrangement was designed with the pantry under the work surface (ventilated from the courtyard), food cleaning and preparation were done over a smooth work surface, plain sink, built-in refuse serviced from the courtyard, and at right angles, the cooking centre. The kitchen was linked directly to the dining room via an open serving window. The Oud kitchen consisted of only the bare essentials and its success was in its continuous working surfaces. The architect emphasized functional work spaces in the kitchen by providing the bare necessities and by eliminating upper and lower cupboards and replacing them with shelves.

In North America the Usonian houses designed by Frank Lloyd Wright had a similar approach to minimization. Cooking utensils, hung in open view, were readily accessible and open shelves were used for storage. This kitchen incorporated Wright's ideas of organization and efficiency.

What Terence Conran, in *The Kitchen Book*, calls the shelf kitchen could be considered a modern day version of the Oud kitchen (Fig.8). Using

Figure 6: J.P. Oud Kitchen

Source: Thomas Fisher, "Weissenhofsiedlung, Low Cost, High Design" *Progressive Architecture* Oct 1988

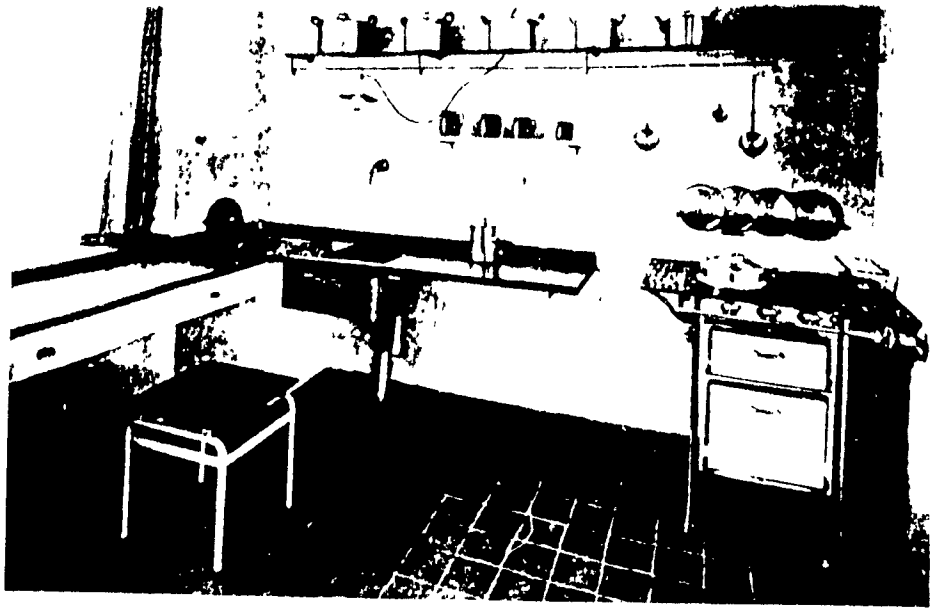
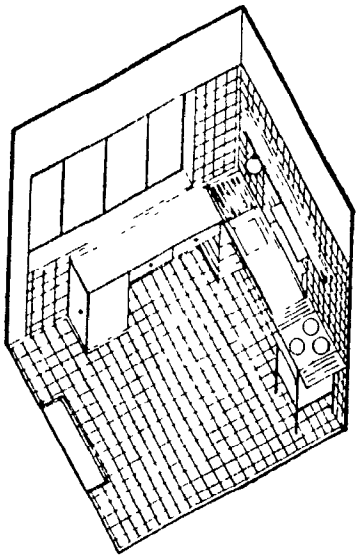


Figure 7: J.P Oud Kitchen Diagram

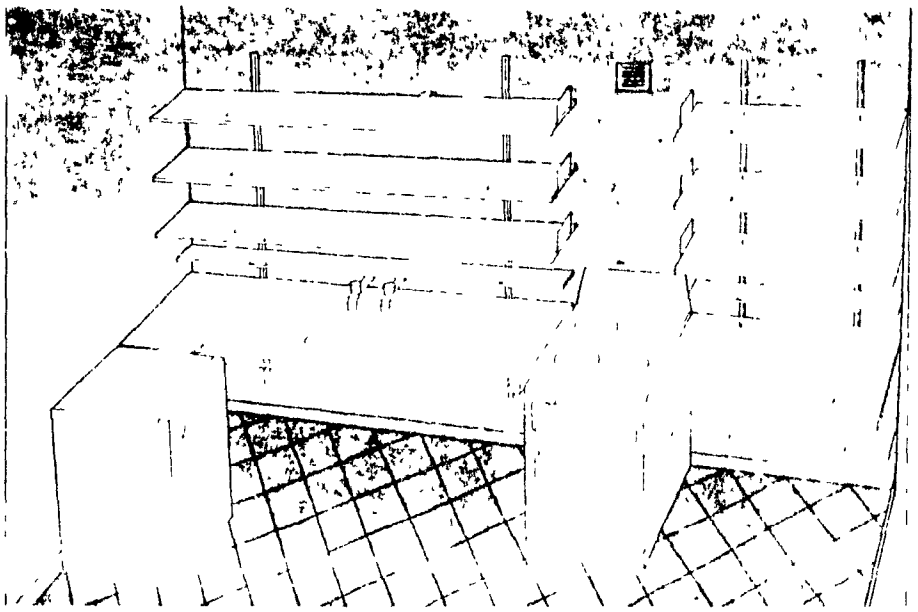
Source: Thomas Fisher, "Weissenhofsiedlung, Low Cost, High Design." *Progressive Architecture* Oct 1988



brackets and a metal wall channel system, an entire kitchen unit is hung from the wall, like shelves. (Extra long brackets are used to support the

work-top.) The kitchen consists of a few simple components. two plastic laminate working surfaces, wood shelving, a metal channel system, wall brackets, a sink, fridge and stove. The quality of the materials depends on the amount of money available as other components such as wire basket shelves and wall units could be added One advantage of this type of kitchen is that it can grow as funds become available.[7]

Figure 8: The Shelf Kitchen
Source. Terence Conran, *The Kitchen Book* (New York Crown Publishing, 1977)



2.4 THE MODULAR KITCHEN

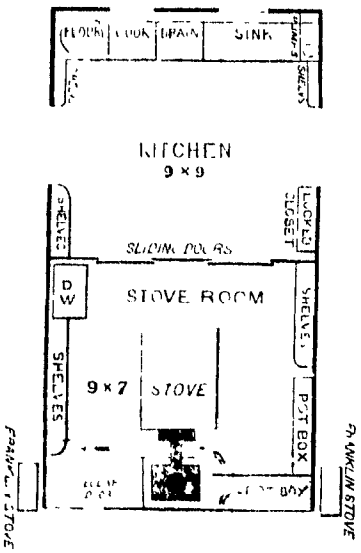
The organization of bare essentials in kitchen equipment has not been a popular approach for kitchen manufacturers. Instead, manufacturers have moved towards the standardization of kitchen furnishing to lower its cost. The use of standardized kitchen equipment made up of modular components is the major direction in kitchen manufacturing today Modular units along with new materials and construction techniques are the primary source of

cost reduction.

The first evidence of this approach appeared as early as 1869. Catherine Beecher, in *The American Woman's Home*, highlighted domestic life and examined how kitchen equipment and furnishings might be arranged.[8] Beecher's aim was to increase the efficiency of work spaces. It resulted in the organization of the work process, and a continuous, unobstructed work surface (Fig.9 & 10). In planning the kitchen, Beecher moved away from isolated cabinets and a table to a simplified work-centre. The storage-preservation and cleaning-preparation work-centres were grouped together, becoming more compact and efficient. It is important to note that the stove/range was isolated for safety and practical reasons.

Figure 9. Kitchen Plan

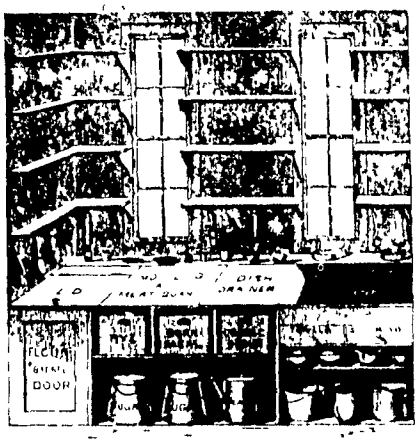
Source: Catherine Beecher, Harriet Beecher-Stowe, *American Women's Home* (New York: J B Ford Company 1869)



Mechanization of the assembly line in manufacturing (around 1910)

Figure 10: Work Space Organization

Source Catherine Beecher, Harriet Beecher-Stowe, *American Woman's Home* (New York J B Ford Company, 1869)



soon spread to the home and studies of domestic chores gained interest in America. Motion studies of single elements -the table (the work space), the dresser (storage), and the range (cooking) -were also being carried out.[9] Each of these elements was handled as a self-contained unit With the study of overall kitchen planning it became apparent that an increase in efficiency could be achieved by integrating work-centres and creating a single kitchen unit. The consolidation and development of a continuous work surface, and the organization of a work centre stemmed from an appreciation of the importance of saving time and money. This increased the efficiency of the work process allowing for the organization of standardized components to be

pursued.

Early insights into standardization are evident in the work of Walter Gropius in an experiment for workers' housing in Weissenhof, Stuttgart in 1927. Gropius looked at the industrialization of the house and incorporated mass production of standard components while allowing for changes in form. As kitchen components were designed in modular sizes, the manufacturing and assembly of standardized components became a means of cutting costs in the final product. Organization of the work process into a rational sequence was further consolidated when manufacturers of gas and electrical appliances, and the kitchen cabinet industry agreed to a set of standards for kitchen units. These were: depth of counter: 630mm (25 1/4"), height of base cabinets: 900mm (36") and the width of base and upper cabinets in modules of 75mm (3"). A uniform height and depth allowed for a continuous uninterrupted work surface, which was considered necessary in a compact kitchen. It also created a standard product that could be assembled from modules or components.

An American kitchen advertisement of 1942 described the advantages that the manufacturers hoped to achieve: everything within reach, cabinet components arranged in a logical order, and a modern and efficient kitchen where one could add cabinets as the budget permitted (see Fig.11). Work flows uninterrupted from storage to preparation, and from cooking to serving. Though not the first appearance of the kitchen as a standardized unit, this example demonstrates the efficiency, cost-saving, and streamlining

that manufacturers hoped to achieve.

Figure 11: Kitchen Advertisement

Source Siegfried Giedion, *Mechanization Takes Command* (Oxford University Press, 1948)

In the 1950s further changes were made to improve standardization and modularity of kitchen equipment. These changes were made in an effort to reduce costs by concentrating on a few sizes to maximize the savings Manufacturers, architects, building associations and research centres agreed on recommendations for: one standard height: (900mm) 36", and one standard depth: from (612mm - 600mm) 24-1/2" - 24". All appliances were to conform to this depth and a standard module for cupboard width was determined. The participants agreed that standardizing the components would result in the use of less materials, less time and energy to assemble parts and create components which would be interchangeable This standardization resulted in more competitive prices and increased quality in

Figure 12: Modular Kitchen Componenets
Source: *Domus* 535 (1974)

the final product.

The Cornell kitchen study, carried out in conjunction with manufacturers in 1949, recommended a 600mm (24") counter depth.[10] It proposed standardizing the kitchen into six modular work-centres from the previous three: an (2400mm) 8ft sink centre, a (1200mm) 4ft range centre, a (1200mm) 4ft built in wall hung refrigerator, a (600mm) 2ft built in oven, a (1200mm) 4ft mix centre and a (1200mm) 4ft service centre. These recommendations were intended to increase efficiency by providing sufficient space to carry out each function. It was suggested that some of the work-centres could be eliminated or combined for economic reasons. Other proposals put forward by the Cornell study included a continuous electrical

service in the backsplash and a centralized location for heating, ventilation, air conditioning and plumbing fixtures.

The Combimax unit (*Domus*: Italy, 1974), another example of a modular kitchen, put into practice proposals for developing standardized modules in kitchen assembly (see Fig.12). The Combimax units could be assembled in many different configurations and similar modules were made for wall cupboards and full height cupboards. Units included special housing for ovens, dishwashers and other electrical appliances. The example in Fig.12, used a 600mm width increment eliminating problems at corners. Manufacturers increased their range to 300, 400, and 500mm units to accommodate kitchens of different dimensions. The worktop consisted of a continuous plastic laminate counter while unit frames and doors were made of melamine. Today, some manufacturers (e g. IKEA) market their components as self-assembly units in kit form to reduce cost.

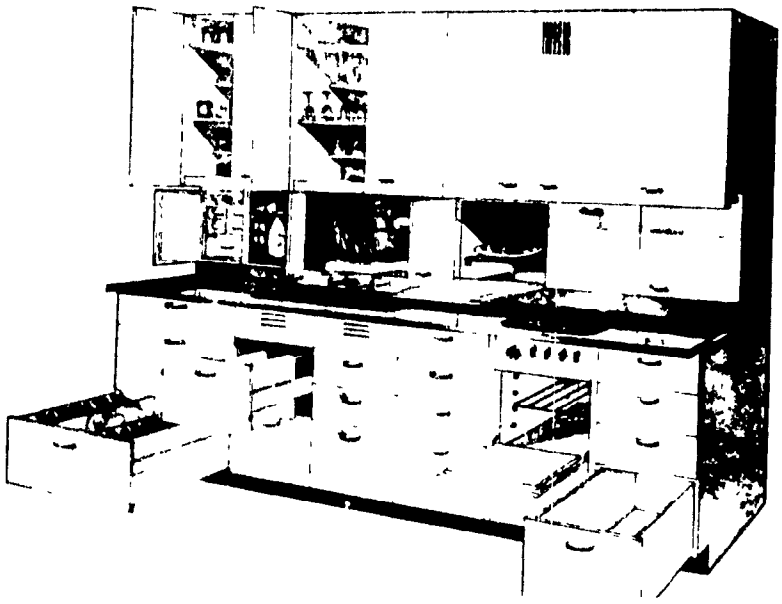
2.5 THE WORK-CENTRE KITCHEN

The work-centre kitchen represents the concept of a kitchen as an integrated unit and requires that kitchen equipment be redesigned to reflect this idea. A number of economic benefits are attached to the work-centre kitchen. A standard unit could fit into the more compact space of an apartment or a small house. It was hoped that the consolidation of functions into a central core would make the cost of shipping, merchandising and servicing less than the cost for each separate piece of equipment. The kitchen would no longer

have to be considered a separate room but rather as a work-centre within a larger space.

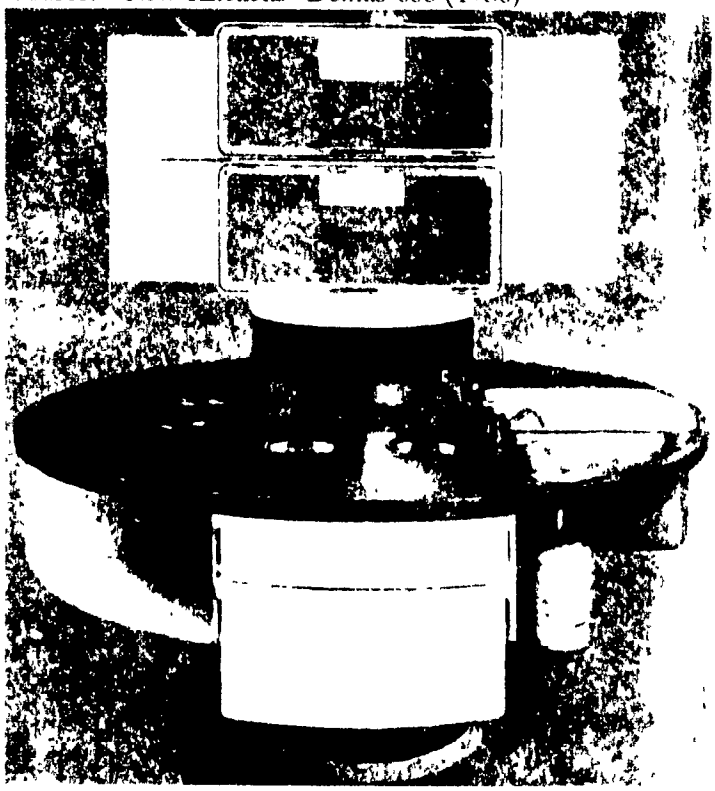
An early example of a work-centre unit is the Earle kitchen unit (United States, 1943 – Fig.13). In this example, kitchen equipment was redesigned to fit within the built form. Refrigerated drawers under the counter were a major innovation. Other features included a towel and dish dryer, a sink, an electric cooker, a range and storage space. Base cabinets were set away from the wall to accommodate the refrigerator. The unit was to be made of aluminum with a stainless steel counter; the abundance of post war aluminum also made the unit economical.[11]

Figure 13: The Earle Kitchen
Source *Architectural Forum* (Aug 1943)



The second example of a kitchen work-centre integrates greater innovation in design than in cost-reduction. The work-centre designed by

Figure 14: The Henderson Kitchen
Source: "New Kitchens" *Domus* 606 (1980)



Ilana Henderson (London, 1980), brought together the major features of a kitchen and arranged them around a core (Fig 14).[12] This was achieved by using a single cylindrical unit with all essential cooking and storage units in two levels, revolving independently of each other around the central service core. The circular work top has two electric and two gas elements, a triangular sink fitted with a chopping block top, and a second sink for dish washing. Below the counter were the freezer and storage spaces. The upper section of the unit consisted of an oven, a microwave, a refrigerator, a second freezer and four storage cabinets arranged in a cruciform pattern. The counter could be lifted hydraulically to service the central core.

The example of an 'island unit' (*The Kitchen Book* T. Conran,

England, 1977), shown in Fig.15 & 16, consisted of standard units placed back to back with storage units suspended from the ceiling on metal brackets. Services such as water supply and waste pipes were under the floor while electrical and ventilation ducts were in the ceiling space. Counter space over the base units and the refrigerator created an L-shaped work-centre and the work triangle moved in a counter clockwise direction around the periphery of the work-centre.

Figure 15: Work Island Kitchen
Source: Terence Conran, *The Kitchen Book* (New York. Crown Publishing, 1977)

Fig.17, shows a prototype for a prefabricated unit that went a step beyond the centralized kitchen by combining the kitchen, bathroom and

Figure 16: Work Island Kitchen Diagram
Source: Terence Conran, *The Kitchen Book* (New York: Crown Publishing, 1977)

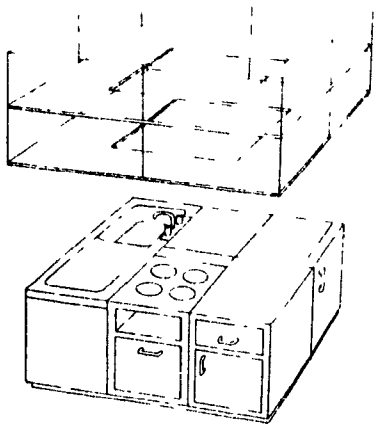
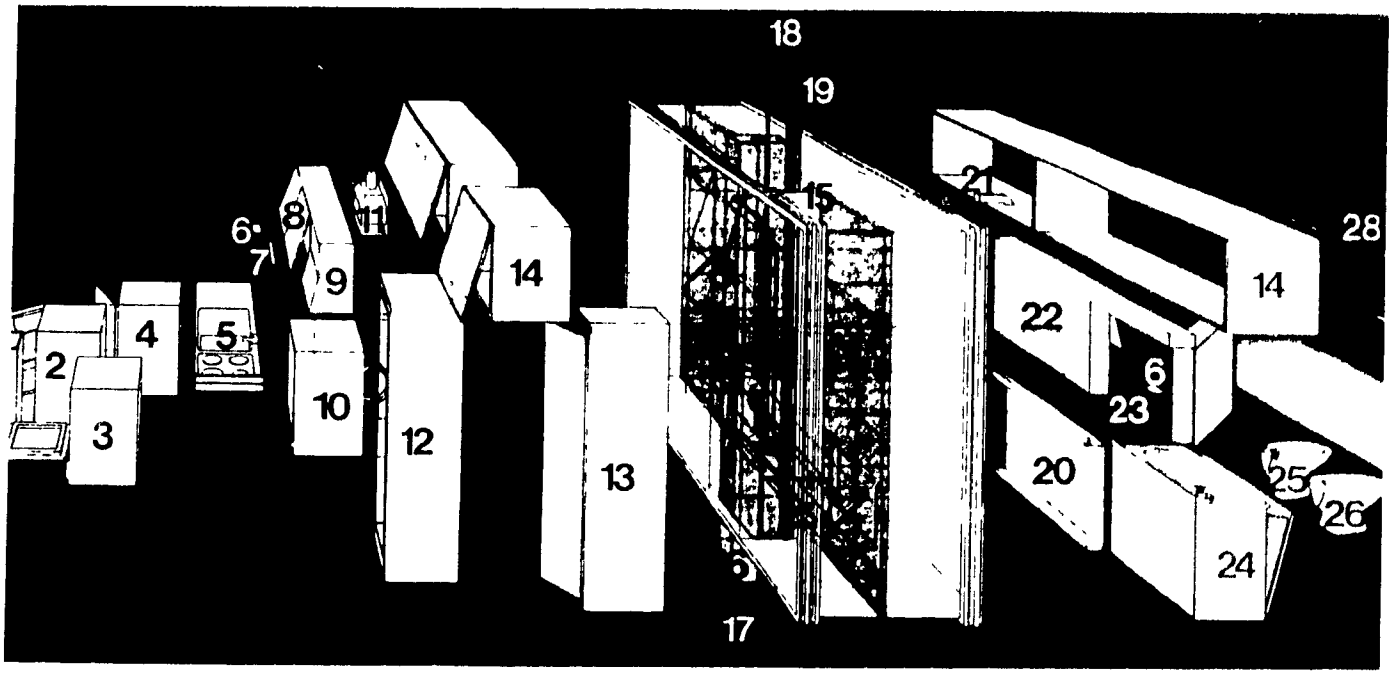


Figure 17: Central Service Core
Source: "New Kitchens" *Domus* 606 (1980)



laundry as components attached to a single service core. The designer's intention was to allow for flexibility to meet current needs, and to permit

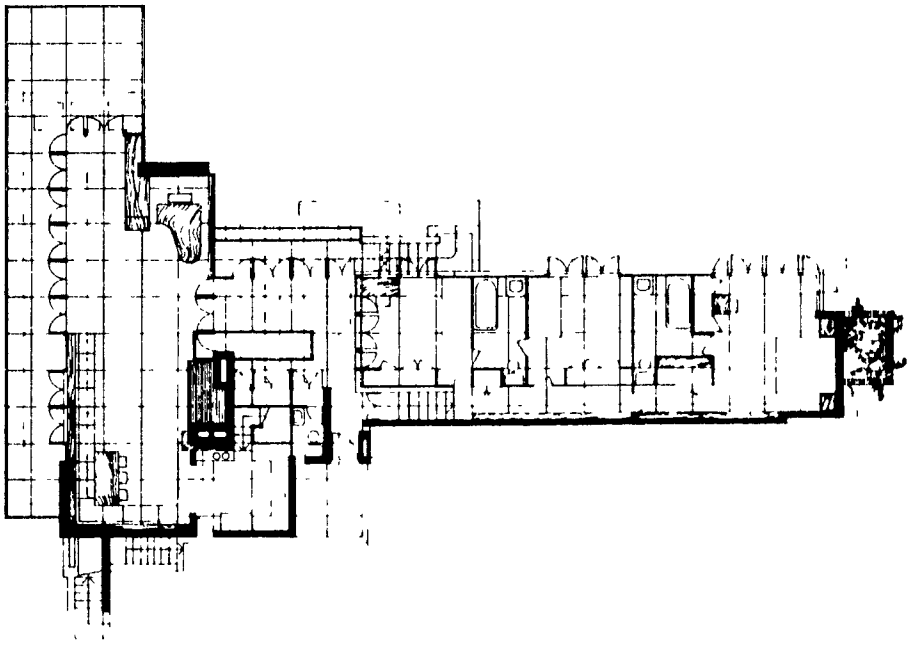
expansion or changing functions. Kitchen, bathroom and laundry components could be attached to the service core and removed when desired. Consolidating the services of the kitchen, bathroom and laundry in one prefabricated unit, meant only one service core would be necessary for a home or apartment. The prefabricated modular unit, with a centralized service core, cut down on the number of workers and time needed for installation.

2.6 THE OPEN KITCHEN

The notion of the kitchen or work-centre attached to the living room, creating an open kitchen, gained attention in Frank Lloyd Wright's Usonian houses. As early as 1934, Wright proposed opening the kitchen along its entire length into the dining space. This open plan was taken even further in the Affleck house of 1940, where Wright made the dining area part of the living area as well (Fig.18). The plan consisted of one large room, an "L", part of which was for dining, with one corner partitioned off for the kitchen but open to the dining area. The Usonian house began as a one zone house to economize space, and to address the consumers inability to afford servants. As pointed out by Sergeant, consumers preferred the two zone house (which was larger) with an isolated kitchen.[13] The kitchen integrated into the living space did not gain widespread acceptance until the 1950s, and it was not until the 1970s that the kitchen was joined with the family room. In the typical home of the 1980s the kitchen was finally the centre of the

household, with the majority of family activities taking place there.[14] The living room had become smaller and in some cases nonexistent as the kitchen-family room gained prominence. Cost-saving could be found in the consolidation of living, dining and food preparation spaces into one larger space having less area than three separate spaces.

Figure 18: Affleck House
Source: John Sergeant, *Frank Lloyd Wright's Usonian Houses* (New York. Whitney Library of Design, 1975)



2.7 CONCLUSION

This literature review has highlighted historical examples in the development of the kitchen. Five examples of kitchen types have been examined: the compact kitchen, the simplified kitchen, the modular kitchen, the work-centre kitchen, and the open kitchen A review of these groups concludes that historical trends in cost-reduction have involved the planning of kitchen work

spaces as well as research into new materials and assembly techniques. Both directions were pursued in an effort to reduce costs and provide more efficient kitchens. The development of work-centres and appliances lead to the establishment of the work triangle used today as a measure of kitchen efficiency. The efficiency of work-centres followed the demand for smaller homes and more compact kitchen layouts in an effort to provide a product at an affordable price. The development of standardized measurements progressed to modular components and appliances which could be combined in a variety of ways. Along with standardized components, new materials helped in the simplification of kitchen construction and provided a major opportunity for cost-saving. Both directions represent historical trends for potential cost-savings and have been developed into the current strategies for cost-reduction detailed in the following chapters.

ENDNOTES

1. Giedion, Siegfried. *Mechanization Takes Command.* Oxford: University Press, 1948.

2. Lifshey, Earl. *The Housewares Story.* Chicago: National Housewares Manufacturers Association, 1973.

3. "The House for Modern Living." *Architectural Forum*, April, 1935.

4. Beecher, Catharine. Harriet Beecher-Stowe, *The American Woman's Home.* New York: J.B.Ford and Company, 1869.

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6. Fisher, Thomas. "Weissenhofsiedlung, Low Cost, High Design." *Progressive Architecture*, October, 1988.

7. Conran, Terence. *The Kitchen Book.* New York: Crown Publishing, 1977.

8. Beecher, Catherine. Harriet Beecher-Stowe, *The American Woman's Home.* New York: J.B.Ford Company, 1869.

9. "Prefabrication, Unit Kitchens." *Architectural Forum* August 1943.

10. Ibid.

11. "Earle Kitchen Unit." *Architectural Forum*, August, 1943.

12. "New Kitchens." *Domus* 606, 1980.

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14. "Glorious Necessities." *Architectural Record*, Mid April, 1986.

3.0 COST-REDUCTION THROUGH AREA MINIMIZATION

3.1 INTRODUCTION

Area minimization forms the basis of the first strategy of cost reduction. This strategy examines the function of kitchens of reduced area, since reducing the area of the kitchen work-space reduces the quantity of material used resulting in a reduction in construction cost. According to the American National Kitchen and Bath Association 1991, average kitchen area can range anywhere from 15 to 35m^2.[1] In *Ergonomics of the Home*, Etienne Grandjean suggests that an area of 10m^2 is acceptable for a household of four persons.[2] For this study this figure is assumed to be the maximum area, and an investigation of kitchens of less than 10m^2 has been undertaken. The important question is: "How much smaller can the kitchen area become and still maintain its function?" A survey of over two hundred kitchen types each having an area of 10m^2, or less, is carried out.

The kitchen layouts are examined acording to kitchen area, storage capacity, work-top area, and efficiency to determine which kitchen type best suites a compact layout plan. To validate the appropriateness of a kitchen layout only working models were used. All examples reviewed are either built kitchens already in use, or kitchens tested as working models.

3.2 RESEARCH METHOD

The method used to study cost efficiency in kitchen layouts is quantitative analysis. Quantitative analysis is particularly appropriate when common

measures can be determined, in this case, the common measures are: cost savings, storage area, and the efficiency of compact kitchen layouts.

The quantitative analysis is a two stage approach with each stage involving the application of a specific technique. The first stage involves a study of kitchen layouts and calculations of storage capacity and kitchen area. The results of the evaluation are used in the second stage, which concerns strategies for simplifying the kitchen. The following section explains the procedure used to review the kitchen layouts.

3.3 REDUCING THE KITCHEN SIZE

The procedure begins by examining the proposal of providing similar functions to those found in a kitchen of standard size ($15m^2$), in a reduced space of less than $10m^2$ Data relating to compact kitchen designs was then collected. Two hundred examples of compact functional kitchens were reviewed; all examples reviewed were the result of a bibliographic search. In view of the concern that these kitchen units should function as working kitchens, the majority of examples were chosen from built projects which included: small house plans, compact housing projects, housing projects designed with cost reduction in mind, low-income housing, subsidized housing, relief housing projects, and proposals for compact kitchens. The resource material used included architectural magazines, builders magazines, trade magazines, housing journals, theoretical papers, housing plan books, commercial planning magazines, study reports, advertisements, government

design standards publications, renovation magazines, and competition publications.

3.3.1 Selection of Kitchen Layouts

With cost reduction through area minimization as the main objective of this section, parameters were established as a guide in the selection of kitchen layouts best suited for this study.

Because the North American market is the basis of this study, examples included for the first screening in the selection process were those suited to a North American lifestyle. Examples chosen from Canada, the United States and Europe were from regions that were considered to have similar lifestyles, standards of living, food preparation techniques, and eating arrangements to those appropriate to the North American consumer market.

The time frame from which the examples were selected spanned from the 1930s to present day. The 1930s was chosen as a threshold date because it was at that time that the widespread introduction of the mechanical refrigerator occurred in the North American kitchen.[3] It was also the beginning of the application of the concept of three primary work-centres: sink, range and refrigerator. In addition the 1930s marked the elimination of the kitchen pantry, thus providing for the storage of food and processing equipment within the kitchen. Using these initial parameters a list of two hundred kitchen layouts was compiled.

For the second screening in the selection process an emphasis was

placed on the efficiency of the work triangle and compactness of design. Each kitchen had to have the three work-centres which make up the work triangle: food storage, food preparation and cleaning, and the required equipment located in each. The work-centres each encompass a distinct phase of kitchen activity: the refrigerator centre for receiving and food storage, the sink centre for food preparation and cleaning, and the range centre for cooking and serving. In some examples a fourth piece of equipment, the microwave, was included in the range centre. The other parameter considered at this time was the kitchen area. In *Ergonomics of the Home*, Etienne Grandjean suggests that a kitchen area of $10m^2$ is acceptable for a household of four persons.[4] The examples selected in the second screening all had total kitchen areas of less than $10m^2$. This parameter reduced the number of kitchen layouts from two hundred to seventy-five examples.

For the final screening layouts were graded according to: overall efficiency, circulation, difference of layouts and function of space. Each kitchen had to function efficiently; where equipment was awkwardly placed, where work spaces were too restrictive (width smaller than 800mm) or where other functions were combined with the kitchen (i.e., laundry centre, desk work-centre), these examples were eliminated. It was important that general circulation did not interfere with the work sequence in the kitchen and that doorways to other spaces did not fragment the work-space into separate entities. Kitchens of similar layouts, or nearly identical layouts,

were eliminated to prevent redundancy in examination and analysis. From the original two hundred examples reviewed at the beginning of the selection process, thirty-five examples were selected for further study.

3.3.2 Examination of Kitchen Layouts

The sample group of thirty-five kitchen layouts was examined in detail. Each layout was drawn to the same scale so that comparisons could be made between kitchen area, storage capacity, and efficiency (see Appendix 1).[5] Included in each diagram were a sink, range, refrigerator, wall-hung cupboards (dotted lines) and the work area (broken lines). Each layout was coded according to its kitchen type: single-wall layouts, galley layouts, U-shaped layouts and L-shaped layouts. Included with each kitchen layout was a brief description of its context and source (Fig.19).

Calculations for each kitchen established general units of measurement for comparative purposes. The first measurement was the total kitchen area, which included the work area. The counter top area, measured in square metres, determined the amount of work space available in each kitchen layout (the sink was included in this calculation but the area taken up by the refrigerator and range were not). The volume of storage space, measured in cubic metres, was shown as two figures: the base cupboard volume and the wall hung cupboard volume. The calculation for storage area was handled in a similar manner. The final calculation examined was the work triangle (calculated in metres), which measures the efficiency of the kitchen and is

formed by a triangular line joining the sink, range and refrigerator.

The work area, storage area, storage volume and work triangle were plotted on graphs to be analyzed in the following sections. The kitchen area was used as the independent variable in all graphs. By having a constant for the dependent variable, it became possible to examine not only each graph but also the relationships between graphs.[6] On each graph the kitchen was identified according to kitchen type, as well as according to individual layout.

3.4 ANALYSIS

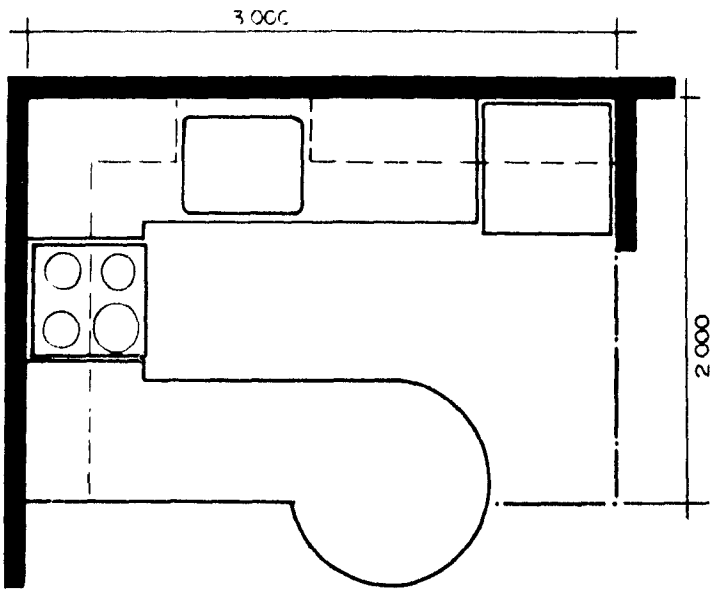
3.4.1 Introduction

The intent of this section is to analyze the relationship between storage area and volume, work-top area, efficiency and kitchen area. The emphasis is on kitchens that provide the maximum amount of storage and work space in as compact an area as possible. Relationships between different kitchen types will also be examined.

3.4.2 Kitchen Area

For the purposes of this study, the kitchen area has been defined as the floor area that is occupied by the counter and floor appliances including a 900mm wide circulation space in front of the counter and appliances (fig.19 and diagrams appendix #1). Of the thirty-five samples examined, kitchen area ranged from 2.7 to 7m2. A conventional kitchen had an average area of 15-30m2 as indicated through a survey, by the American Kitchen and Bath

Figure 19: Typical Kitchen Layout Description Sheet



- Kitchen floor area	5.46 sq.m.
- Counter top area	2.94 sq.m.
- Base cupboard volume	2.4 cu.m.
- Wall hung cupboard volume	.78 cu.m.
- Base cupboard shelf area	4.92 sq.m.
- Wall hung cupboard shelf area	3.21 sq.m.
- Work triangle	4.1 m.

KITCHEN TYPE: U-shape kitchen

CONTEXT:
- Built by contractor
- Single detached residence
- Dwelling unit built
- Area of dwelling unit 150 sq.m.
- Location: Yorktown Heights

NOTES:
- Base and cupboards custom made

SOURCE:
- Dickinson, Duo. The Small House Toronto : McGraw-Hill Book Company, 1986.

US·2

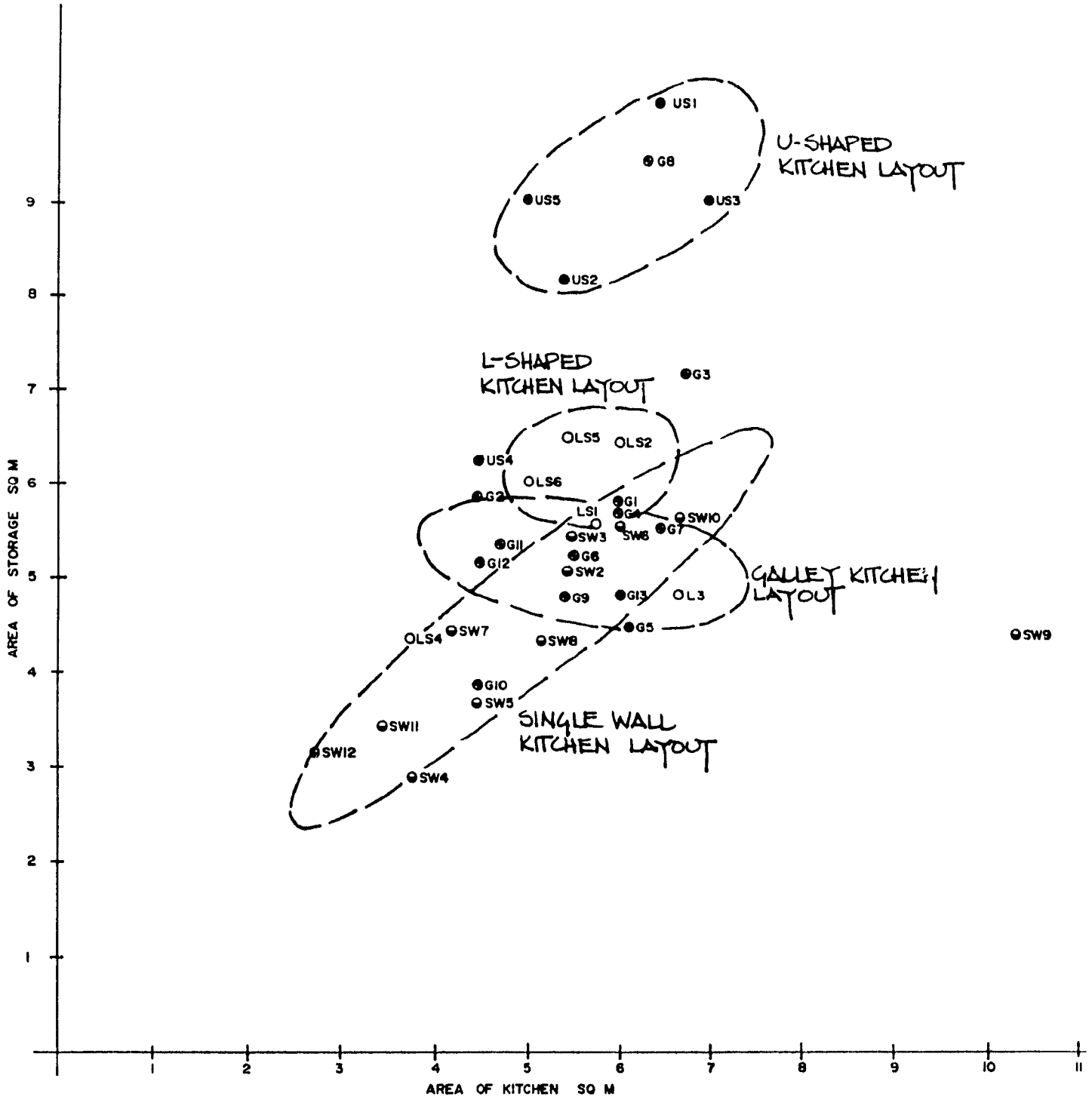
Association, of kitchens constructed in 1990.[7] The examples reviewed in this study are on average one quarter the area of the conventional kitchen. The analysis showed that the galley layout and single-wall layout were the most numerous. The prevalence of single wall and galley kitchen types in compact house plans is due to the adaptability of single-wall and galley layouts to confined conditions, as well as their ability to be combined with an adjoining living-dining room. The single-wall layout has an example with the smallest kitchen area (SW12 2.7m^2), while the galley, U-shaped layout and L-shaped layout all have examples of similar area (within the range of 4.5m^2 to 7m^2). The cupboard kitchen (SW12) is an example of extreme efficiency where, to save space, not only the storage but also the appliances were redesigned to create a more compact solution (2.7m^2 area). The U-shaped layout, on the other hand, has the largest area. Of the examples studied, the area of U-shaped layouts was within the mid-range 5-6m^2 of kitchen area as well as an upper range of 7m^2. The U-shaped layout is arranged along three sides and thus requires more floor area to function properly (see U-shaped layouts US1 - US6 Appendix #1). A review of the galley and L-shaped kitchen areas show similar results to those of the U-shaped layouts. The majority of kitchen areas were within the 4-6m^2 range. It appears that the L-shaped and galley layouts require a similar amount of kitchen area to the U-shaped layout, but the ratio of circulation space to total kitchen area is greater than in the U-shaped layout. This is due to the fact

that the U-shaped layout has more counter space than the other layout types providing a more efficient layout.

3.4.3 Kitchen Storage Area

Storage area is taken to be the total area of cupboard shelving in base and wall hung shelves (storage area does not include counter top area). Initial comparisons between kitchen area and storage area would suggest that as kitchen area increases so does storage area, however Fig.20, Comparison of Storage Areas for Four Kitchen Layout Types, suggests that this relationship only occurs once the different kitchen types are identified. Single wall, L-shaped, U-shaped and galley layouts form distinct groupings. The U-shaped layouts, at the top of the graph, have the greatest ratio of storage area to kitchen area because they provide storage on three sides, minimizing the amount of floor space required for circulation and maximizing the potential for storage space (in this case a high ratio is desirable because it means greater storage capacity). From the graph, Fig.20 it can also be seen that the L-shaped kitchen types have a higher storage capacity than the galley kitchens of the same area by an average of 10%. A review of galley layouts shows many examples to have upper wall hung cupboards on only one side of the kitchen thus decreasing storage area.

Figure 20: Comparison of Storage Areas for Four Kitchen Layout Types: Storage area vs Kitchen area



As indicated in Fig.20, the majority of galley layouts occupy a mid-range for storage area and kitchen area; the galley layouts were clustered within a kitchen area of 4.3-6.3m^2. This suggests that the galley layout is most efficient within this range, and the corresponding storage area of 4.6 to 6m^2 suggests that this is the **maximum practical storage potential** for galley layouts of this area range rather than the maximum storage potential. It is important to note the variety in the amount of storage area in galley layouts of similar floor area. These variations are due to the elimination of wall-hung cupboards on one side of the kitchen, necessary to open the kitchen to an adjoining room. Therefore the term **maximum practical storage potential**, suggests there was potential for more storage but for various reasons it was not practical to be fully exploited.

G8 in Fig.20, located in the U-shaped group for storage areas, is a hybrid form of galley layout because of its approach to kitchen storage. G8 also proved to be the kitchen with the second highest storage area when compared to the thirty-five layouts, and it rivalled the storage capacity of the U-shaped layouts. G8 consisted of a conventional work-top counter with limited upper cupboards on one side of the room and floor-to-ceiling wall hung cupboards (300mm deep) on the other. This wall of cupboards provides excellent storage for kitchen equipment and food staples and provides more storage space than the conventional base and wall hung cupboards. Single wall layouts proved to have the largest variety of kitchen areas, ranging from the smallest (SW12, a cupboard kitchen, at 2.7m^2), to

one of the largest (SW9, 10.3m^2). Storage area appeared to be directly proportional to kitchen area with a ratio of almost 1:1, except for kitchen SW9 (an island kitchen) which has a 1:2 ratio. Of the four different kitchen types examined, the single wall has the lowest ratio of storage area to kitchen area, since the arrangement of storage along one wall results in a greater amount of work space required to serve that storage area. When examining the extremes within the single-wall layout category in Fig.20, SW9 stands out from the group. SW9 consists of a service column having all the storage and work spaces surrounding the column. The circulation area extends 900mm around the perimeter of the circular work counter which increases the circulation area, thus increasing what is considered kitchen area. Although SW9 appears to be a compact and cost efficient approach to kitchen storage and work space, the total area required is excessive.

L-shaped layouts appear in the mid-range of kitchen areas (approximately 5.5m^2). As seen in Fig.20, L-shaped layouts are larger in area than single wall layouts and appear to have more storage than the majority of the galley layouts, but they can only function efficiently within a certain range of areas. This is also true of galley layouts and U-shaped layouts. Fig.20 shows that the storage area of L-shaped layouts is greater than that of either galley layouts or single-wall layouts.

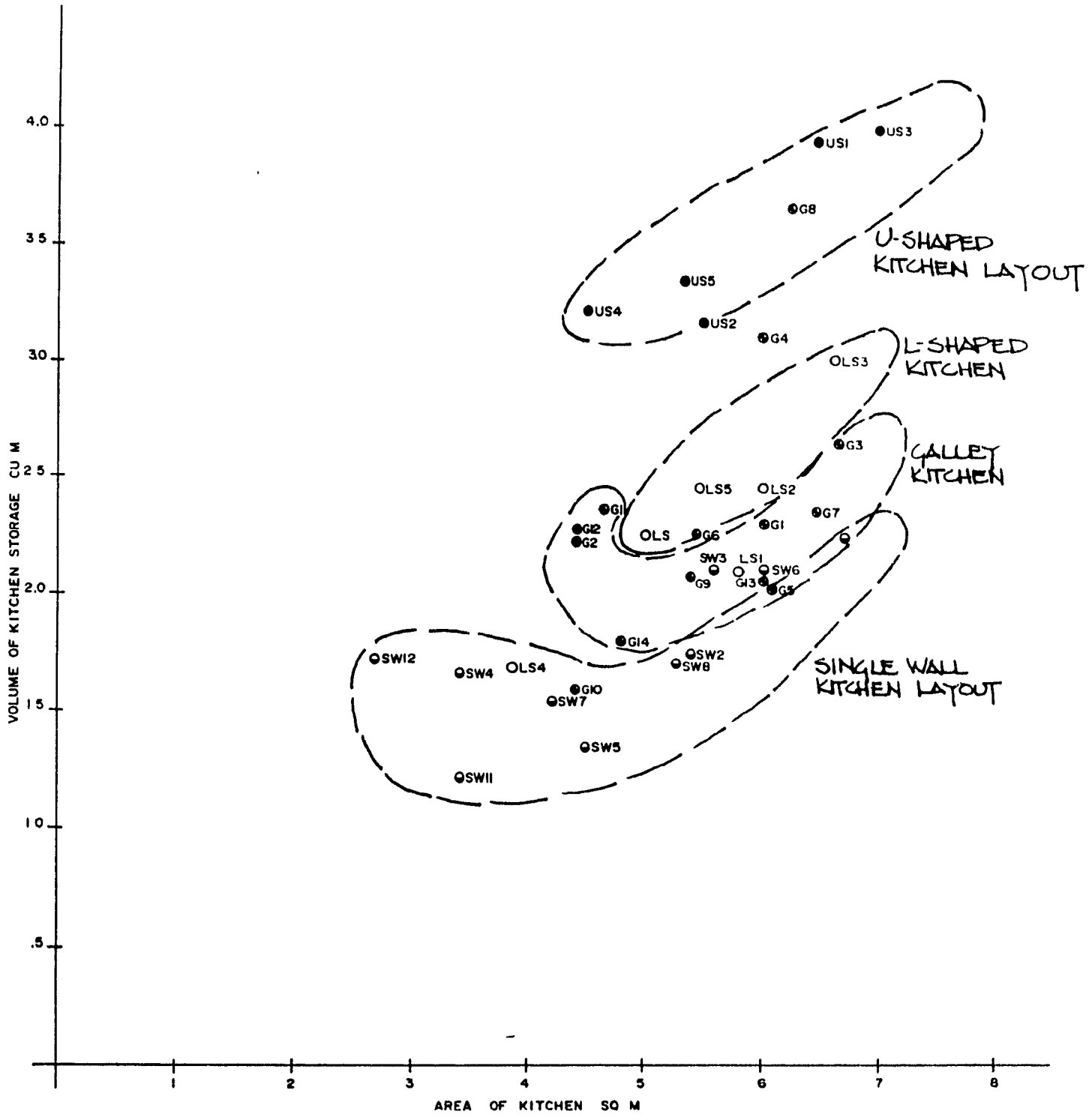
3.4.4 Kitchen Storage Volume

Storage volume is defined as the volume of base cupboards, and wall

cupboards. The ratio of storage volume to kitchen area is plotted in the Fig.21. An assessment of this graph suggests that storage volumes are similar to storage areas and, as with storage area, the greater the ratio of storage volume to kitchen area the more desirable the layout. Generally, as kitchen area increases so does storage volume. In Fig.21, distinct groupings occur: U-shaped layouts form the upper portion of the graph, while single-wall layouts again are found to occupy the lower portion. Within the midrange are found galley layouts and L-shaped layouts. The storage volume of the galley layout is within a small range (2-2.3m^3), and does not increase in proportion to the kitchen area, however further study of the galley layout shows that as kitchen area increases, changes in the nature of the storage occur. Upper cupboards disappear creating an island kitchen with one wall opening onto another room. This also occurs in the U-shaped layout and to a lesser degree in the L-shaped layout; after a certain point, increases in kitchen area do not necessarily result in a corresponding increase in storage volume.

As with storage area, in Fig.21 galley kitchen G-8 stands out with the third highest volume of storage. The majority of the galley layouts are within the range of 2.0 - 2.75m^3, no matter whether the kitchen area is large or small. The L-shaped layouts found within the same range of kitchen areas show a direct increase in storage volume with an increase in area; the ratio of storage volume to kitchen area is 1:2. The U-shaped layout follows a similar pattern of greater storage volumes with a ratio of 1.5:2.

Figure 21: Comparison of Storage Volumes for Four Kitchen Layout Types: Storage Volume vs Kitchen Area



An examination of the U-shaped layouts indicates that U-shaped kitchens have the highest ratio of storage volume to kitchen area and form a separate group from the other layouts. U-shaped layouts also show a relationship of increased storage volume to increased kitchen area, a relationship that is more defined than the relationship of storage area to kitchen area for U-shaped layouts. Fig.21 shows that an increased kitchen area results in an increase in storage volume but not in storage area. While US3 has a greater kitchen area and storage volume than US1, US1 has a greater storage area than US3. This is because US1 has more wall-hung cupboards than US3 which provide more storage area but less volume than base cupboards.

Fig.21 shows that the single-wall layout has the lowest ratio of storage volume to kitchen area. This indicates that the single-wall layout has least amount of storage volume to kitchen area and is therefore not as desirable as the U-shaped layout which has a greater ratio. This is similar to the findings observed in Fig.20 where the ratio of storage area to kitchen area was also the lowest of the four kitchen types. Single-wall layout SW12, with a storage volume of 1.72m^3, has a ratio of storage volume to kitchen area of 1:1.5 placing it in the same range as L-shaped layouts having the second highest ratio. One reason for this high storage volume is that the entire kitchen including appliances is found within the space of a cupboard. Its volume is calculated as the entire space within the closet doors (see kitchen layout diagram SW12 Appendix #1).

3.4.5 Work-top Area

Work-top area is defined as the area of kitchen counter including the sink. Fig.22 Comparison of work-top areas for four kitchen layout types, shows three groupings of kitchen layouts stacked one on top of the other. The single-wall layout is found near the bottom of the graph followed by galley layouts and U-shaped layouts. In effect the single-wall layout has counter space along one wall, the galley layout has counter space on two walls thus doubling the counter area and the U-shaped layout organizes its counter space along three walls, tripling the counter area. The fourth group, the L-shaped layout straddles both the single-wall and the galley layout groupings

The work-top is essentially used as a work space but also for the storage of equipment. While corners are not ideal for working in they do provide storage space for frequently used equipment. In the case of the galley layout and the single-wall layout, the degree of work-top efficiency is greatest because there are no interior corners. The L-shaped layout has one corner and the U-shaped layout has two corners which function as short term storage areas.

Fig.22 shows examples of the greatest work-top area for a given kitchen area. Three different kitchen layouts are shown on this line. The single-wall layout provides the greatest amount of counter area in the smallest kitchens (the smallest kitchens all are single-wall layouts), the galley layout in a limited mid-range of 4.5-5m^2 followed by U-shaped layout which provides the greatest amount of counter area in kitchens of 5-7m^2 (U-shaped

layouts can only be found within this range).

Fig.23, Percentage of Work-top Area for Each Kitchen Layout Type, shows the relationship between work-top area and kitchen area. The greater the work-top area for a given kitchen area, the more efficient the layout. The U-shaped layout has the greatest amount of work-top area followed by the galley layout, the L-shaped layout and the single-wall layouts. Fig.24, Comparison of Work-top Area Calculations to Survey Measurements, shows the ratio of work-top area for each layout type corresponding with survey measurements for each of the four layout types examined. Kitchen G8 falls well below the 45% line of work-top area for galley layouts because one side of the galley kitchen is floor to ceiling cupboard storage with no work-top. The variety in sizes of appliances also influenced the overall work-top area. Other factors included architectural details such as: extensions of the counter for eating space, curved counters which increased the amount of work-top area or the addition of storage closets in the kitchen area which reduced the amount of work-top area.

Figure 22: Comparison of Work-top Areas for Four Kitchen Layout Types: Work-top Area vs Kitchen Area

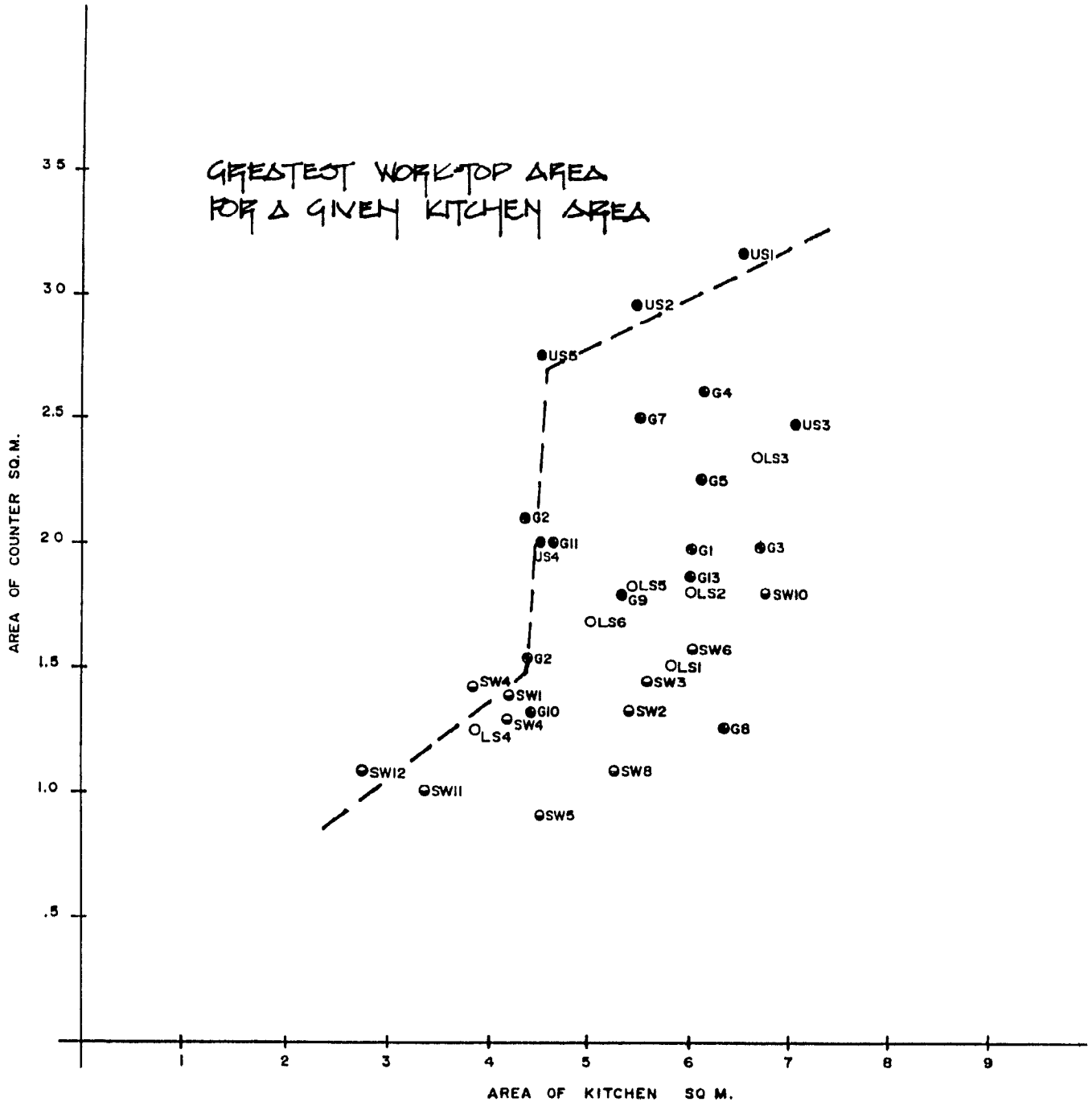


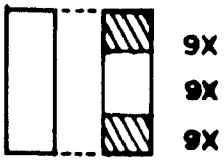
Figure 23: Percentage of Work-top Area for Each Kitchen Layout Type*

6X 9X 6X

U-SHAPED KITCHEN LAYOUT

$$\frac{\text{COUNTER TOP AREA}}{\text{TOTAL KITCHEN AREA}} = \frac{270\ X^2}{504\ X^2} = 54\ \%$$

6X 9X 6X



GALLEY KITCHEN LAYOUT

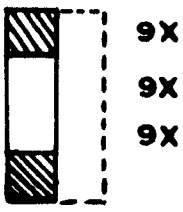
$$\frac{\text{COUNTER TOP AREA}}{\text{TOTAL KITCHEN AREA}} = \frac{270\ X^2}{567\ X^2} = 44\ \%$$

6X 9X 9X

L-SHAPED KITCHEN LAYOUT

$$\frac{\text{COUNTER TOP AREA}}{\text{TOTAL KITCHEN AREA}} = \frac{180\ X^2}{576\ X^2} = 31\ \%$$

6X 9X



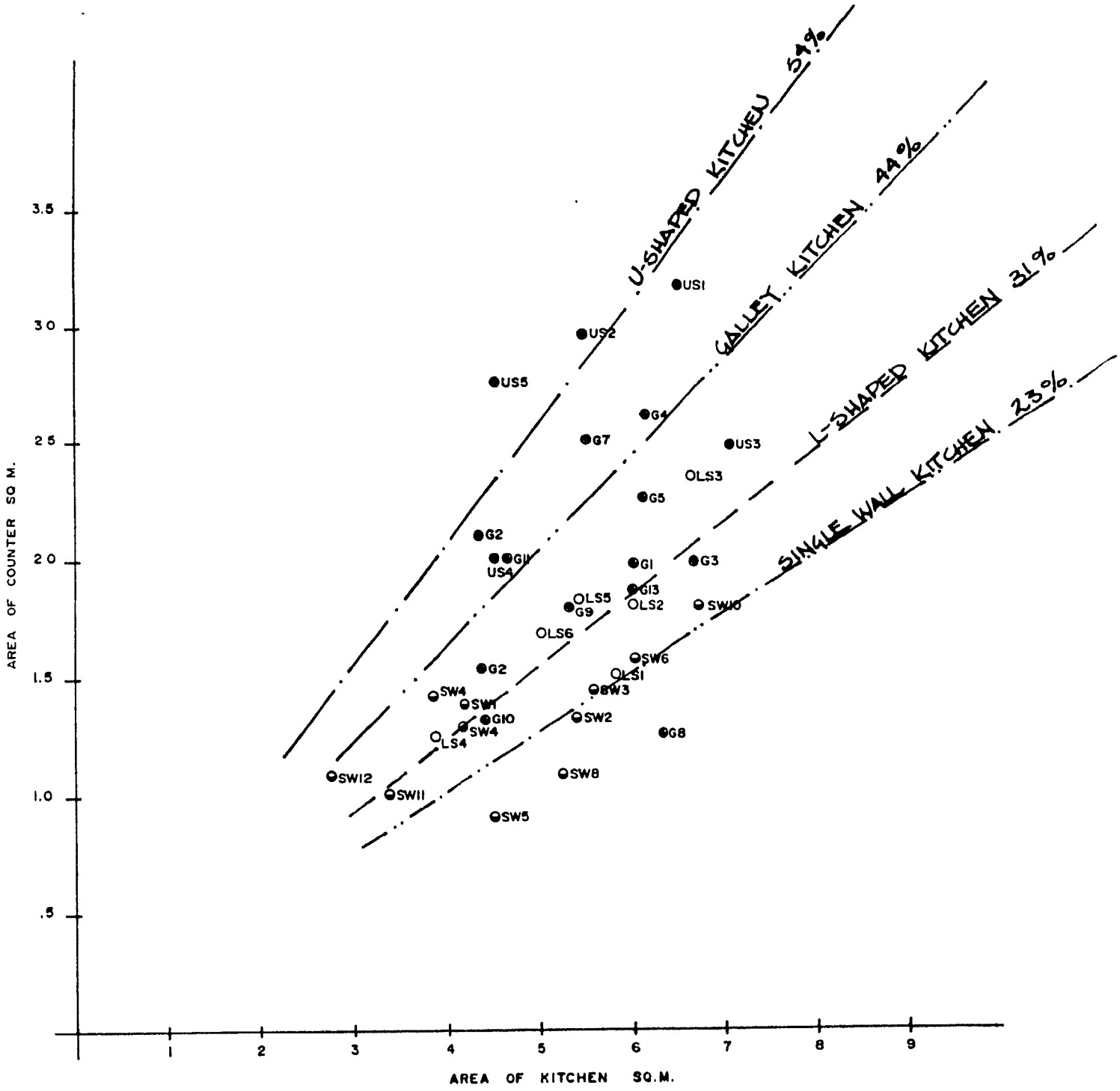
SINGLE WALL KITCHEN LAYOUT

$$\frac{\text{COUNTER TOP AREA}}{\text{TOTAL KITCHEN AREA}} = \frac{140\ X^2}{540\ X^2} = 26\ \%$$

---

* x = 100mm±. Cross-hatched area represents .72 m^2, the area of kitchen appliances, and is subtracted from the counter-top area. Due to configuration of layout types, kitchen areas are similar but not identical.

Figure 24: Comparison of Calculated Work-top Area to Survey Measurements: Work-top Area vs Kitchen Area



3.4.6 Work Triangle

The work triangle is defined as the distance between the three work-centres: the sink, the range and the refrigerator. It is used as a measurement of kitchen efficiency; the smaller the distance the more efficient the layout. The maximum acceptable length for the work triangle is 6-7m; a greater distance than this requires too much travel time to accomplish the task.[8] For an average family kitchen a work triangle of 5.5-6m is considered efficient. In the examples examined the majority were below 5m and ranged from 2.8-5m. In Fig.25 Comparison of Work Triangle Lengths for Four Kitchen Layout Types, all examples below the broken line represent the smallest work triangle for a given kitchen area. The single-wall layout is the most efficient in kitchens with the smallest area, the galley and the L-shaped layouts are most efficient in the midrange of kitchen areas and the U-shaped layout is most efficient in kitchens with the largest area. Although Single-wall layout SW8 is in the midrange of kitchen areas, it has a small work triangle. An examination of the layout SW8 (Appendix #1) shows that the appliances, the refrigerator and range, are not located at either end of the kitchen wall as commonly found but rather are grouped together providing storage space to one side of the range. This layout decreased the length of the work triangle while still providing a greater amount of storage area and kitchen area.

Figure 25: Comparison of Work Triangle Lengths for Four Kitchen Layout Types: Work Triangle Length vs Kitchen Area (A measure of kitchen efficiency)

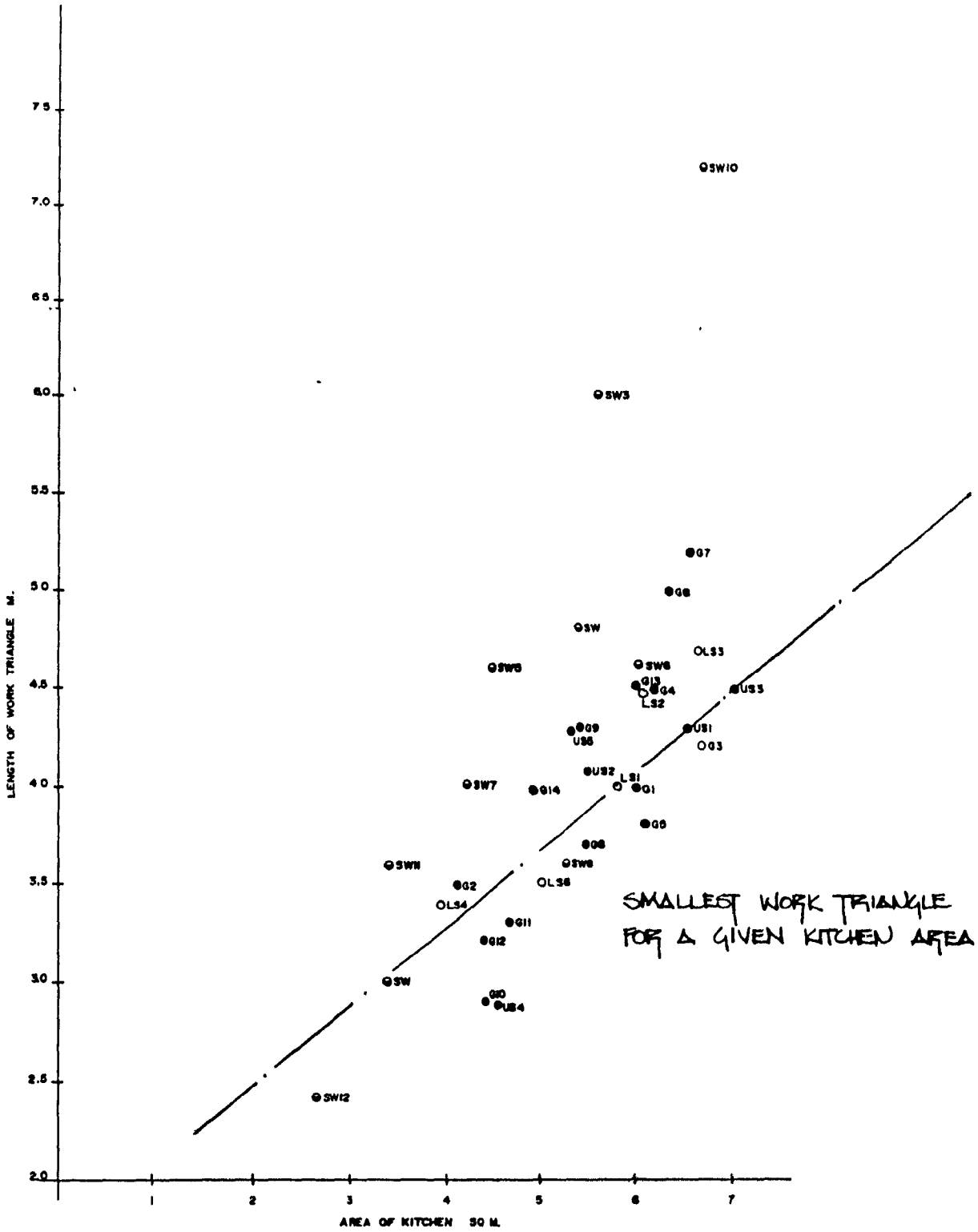
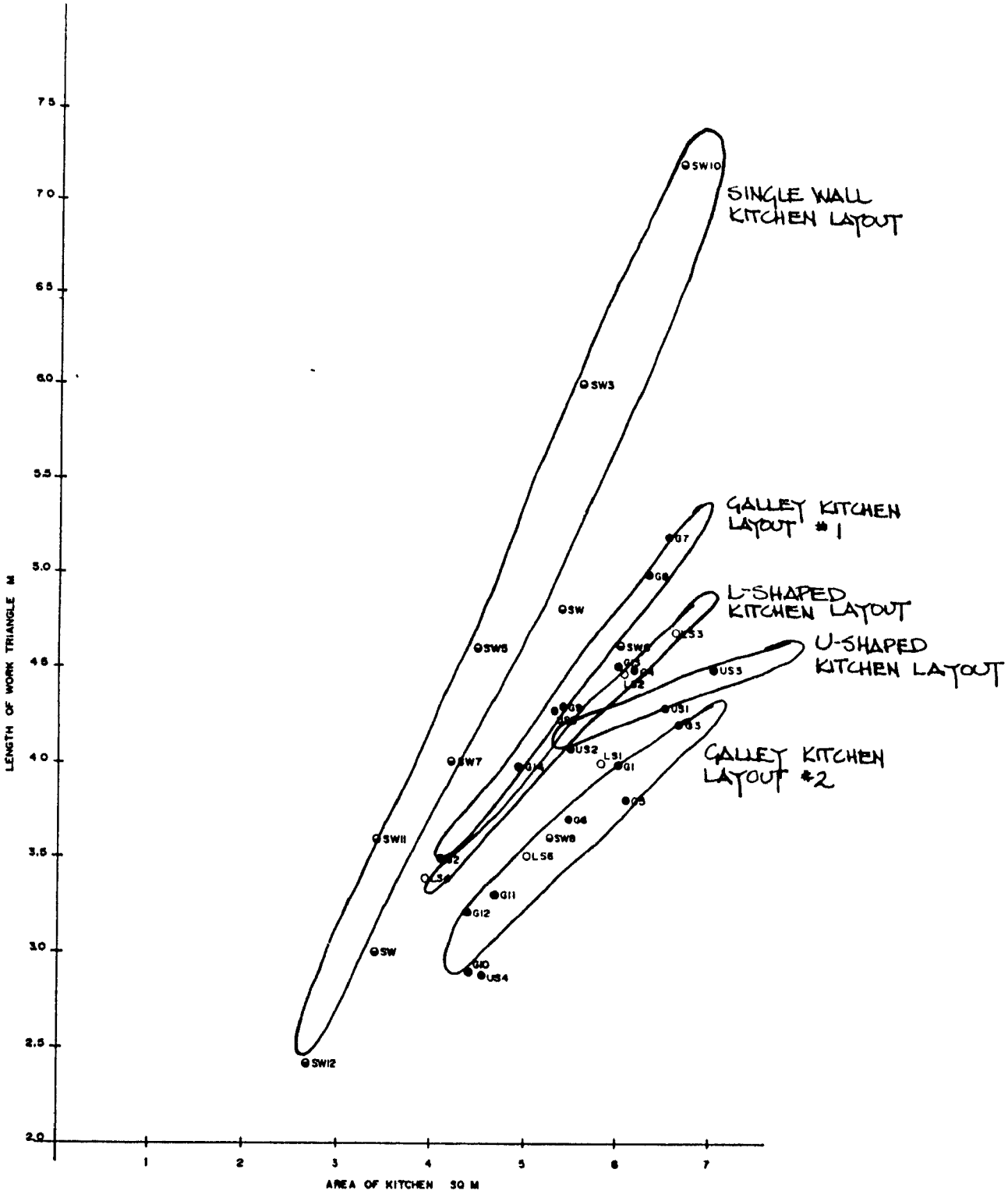


Fig.26 shows two distinct groupings for kitchen triangles in galley layouts. One reason for this is the difference in aisle widths between the two work counters, the larger work triangle having the greater aisle width. Another factor influencing the length of the work triangle was the placement of kitchen appliances. A similar condition influenced work triangle lengths in single-wall layouts.

The length of the work triangle for the U-shaped layout is found within a small range between those of the galley layout. The U-shaped layout normally has one appliance per side, and the distance between appliances is short. The limited range of work triangle distances for the U-shaped layouts suggests the limited area in which they can be efficiently designed. The work triangle of the L-shaped layout was less confined as was the kitchen area. The single-wall layout can adapt much more easily to other influencing factors thus giving us the broad range that was found in the examples.

Figure 26: Work Triangle Patterns According to Kitchen Layout Type



3.5 CONCLUSION

The galley layout and single-wall layout were the most frequently used for compact kitchen layouts. Of the thirty-five kitchens reviewed, 75% were galley or single-wall layouts. These two layouts adapt well to compact dwelling units where the design conditions of the dwelling unit play a role in determining the final configuration of the kitchen layout. A review of the galley and single-wall layouts indicates that the majority of these kitchen layouts are part of larger rooms used for dining and living. U-shaped and L-shaped layouts were commonly combined with an eating area in a separate room from the living room.

An examination of the layout examples shows all were well below the threshold area of $10m^2$ The range in kitchen area was $2.7m^2$ (single-wall SW12) to $7m^2$ (U-shaped US3) with the majority in the range of $4.5\text{-}6.5m^2$ All the layouts reviewed are examples of compact kitchens. Single-wall layouts are found within the entire range of kitchen areas and make up the majority of layouts within the lower range of $2.7\text{-}4.5m^2$ The single-wall layout is the most flexible layout being able to adapt to a variety of kitchen areas. The galley, U-shaped, and L-shaped layouts are only found within the upper area range of $4.5\text{-}\ 7m^2$. These layouts have a lower limit of $4.5m^2$ and cannot be practically adapted to areas smaller than this.

Of the four layout types examined the U-shaped layout has the

greatest storage capacity for a given kitchen area, and is thus the most efficient layout in terms of storage capacity. The ratio of storage area to kitchen area for the U-shaped layout averages 1.8:1 compared to L-shaped layout at 1.4:1, galley layout at 1.1:1, and single-wall layout at 0.9:1. A review of wall-hung cupboard and base cupboard storage indicates that the amount of wall storage found in wall-hung cupboards equals that of base cupboards in all layouts except galley layouts. In the latter wall-hung cupboard storage was between 1/3 and 1/2 the capacity of base cupboard storage. In most galley kitchens wall-hung cupboards were missing from one side of the kitchen. This accounts for the low ratio of storage area to kitchen area in galley layouts. These figures also indicate the large amount of storage found in 300 mm wide wall hung cupboards. Kitchen G8 remedied the problem of low storage capacity in galley layouts by having one entire side of the kitchen made up of 300 mm deep wall hung cupboards resulting in the second highest storage capacity of all examples. While certain kitchen layouts provide smaller amounts of storage than others, this can be remedied by the type of storage provided as indicated in layout G8.

A review of the work-top areas show that the U-shaped layout provides the greatest amount of work-top area to kitchen area. On average work-top area in U-shaped layouts comprises 54% of the total kitchen area

(Fig.23). The U-shaped layout is followed by the galley layout at 44%, the L-shaped layout at 31% and the single-wall layout at 26%. The U-shaped layout requires less circulation area to access counter spaces on three sides of the room (as shown in the diagram of the U-shaped layout in Fig.23). The circulation area of the galley layout serves two work-tops providing more work-top area than the L-shaped and single-wall layout.

The work triangle was used as the measure of efficiency for this study; the shorter the work triangle the more efficient the layout. A sub-group of the galley layout (galley kitchen layouts No.2, Fig.26)is the most efficient, even more efficient than the U-shaped layout. The configuration of the galley layout does not change but the circulation width between counters is reduced thus reducing the length of the work triangle. The examples in the group galley kitchen layouts No.1 have a larger work triangle due to an increase in the width of the circulation between the two counters. As a result, U-shaped and L-shaped layouts both have smaller work triangles than the group galley kitchen layouts No.1. The only layout less efficient is the single-wall layout. To connect the three work-centres in the single-wall layout the work triangle has to double back over itself resulting in the largest work triangle and the least efficient layout.

From the kitchen layouts examined in this section four were chosen for further study in the following section, Simplifying the Kitchen: galley

layout G8, U-shaped layout US1, single-wall layout SW3 and L-shaped layout LS5. The design of galley layout G8 provided the greatest amount of storage area for galley layouts and the third greatest amount out of all layouts examined. The U-shaped layout that provided the greatest amount of storage area is US1. This is the second example chosen. Single-wall layout SW3 shows the standards set by the Ontario Housing Council. This kitchen is the suggested minimum size for a two bedroom unit. The final layout chosen was L-shaped layout LS5, which has the greatest storage capacity for an L-shaped layout of its size.

ENDNOTES

1. "Kitchen Facts." *Builder Magazine*, April, 1990: p. 92.

2. Grandjean, Etienne. *Ergonomics of the Home.* New York: Halsted Press, 1973.

3. Lifshey, Earl. *The Housewares Story.* Chicago: National Housewares Manufacturers Association, 1973.

4. Grandjean, Etienne. *Ergonomics of the Home.* New York: Halsted Press, 1973.

5. Tufte, Edward. *The Visual Display of Quantitative Information.* Cheshire: Graphic Press, 1983.

6. Ibid.

7. "Kitchen Facts." *Builder Magazine*, April, 1990: p. 92.

8. Conran, Terence. *The Kitchen Book.* New York: Crown Publishing, 1977.

4.0 SIMPLIFYING MATERIALS AND ASSEMBLY TECHNIQUES

4.1 INTRODUCTION

This chapter focuses on examining less expensive materials and simpler construction techniques in order to reduce cost in kitchen millwork construction. An examination of materials and their costs is undertaken. Four kitchen examples are used to review and examine the three approaches to cost reduction described in 'Approaches to Cost Reduction'. Finally the total cost for each kitchen example is calculated and used for evaluation.

4.2 RESEARCH METHOD

The method of research used in this chapter is quantitative analysis. It is an appropriate method when a common measure of its cost and benefits can be determined. For the purpose of this study the common measure will be cost; the benefit will be maximum storage capacities within a minimized kitchen area, and efficiency as reviewed in the previous chapter. The following sections explain the procedure for the calculation of material costs for kitchen storage.

4.3 APPROACHES TO COST REDUCTION

Cost reduction through simplification of materials includes alternative construction techniques and materials. It involves an analysis of kitchen storage components, how they are assembled, their materials, and where costs are concentrated. While a number of approaches to simplifying

kitchens were examined, some proved to be less practical because of the difficulty in assembly and the materials used. Three approaches to simplifying the kitchen are detailed in this chapter.

Conventional kitchen cupboard construction consists of modular components arranged to achieve the required configuration and then fitted with a worktop. Doors, drawers and hardware are added according to the function or required storage needed. The *first* approach to simplifying the kitchen eliminates all components which are not essential for the functioning of the kitchen such as doors, drawers and hardware. This approach was considered to be one which required the least amount of change and allowed for the addition of these components at a later point. The *second* approach provides the required storage area in the form of shelves hung from the wall. The three basic components are battens, supports and shelving including the worktop shelf. Its straightforward construction is ideal, allowing consumers to do their own assembly, thus producing further savings. The *third* approach uses industrial metal framing and shelving to provide worktop counter space, base cupboard and wall-hung storage. The system is straightforward in its erection principles and a similar approach could also be taken in wood. All three strategies were evaluated and compared according to the cost of materials. The assembly of materials by the consumer creates a further cost reduction estimated at 25%. Plumbing and appliances are identical for each approach and are included in the total cost.

4.4 SIMPLIFYING THE KITCHEN

In this chapter the kitchen is analyzed in terms of material costs with cost saving in mind. The approaches to simplifying the kitchen units are based on using alternate, less expensive materials and simplified construction assembly techniques while maintaining the same degree of functional integrity found in a conventional kitchen layout. Three approaches for simplifying the kitchen were developed and applied to the layouts chosen. These approaches range from subtle to more radical changes to the construction of a conventional kitchen of reduced area.

The three approaches were applied to each of the four examples and an analysis for each combination was examined and presented in a cost breakdown. The cost of each final product was used in assessing the economic impact of capital costs for each approach.

4.4.1 Modified Modular Unit Approach to Cost Reduction

The first approach for simplifying the kitchen involved using conventional modular kitchen components but removing parts not considered necessary to the functional working of the kitchen such as doors, hardware, drawers and decorative detailing. A cost analysis of the materials determined cost savings could be achieved. After removing the non-essential items, what is left are the outer shells of base and wall cupboards, shelves, counter top and sink.[1] By removing non-essential items on a conventional kitchen unit, cost reduction can be made without redesigning the product; base and wall

cupboards were not altered and the future addition of doors and hardware could be made without major alterations being required (Fig.27-30 show diagrams of plans and elevations of the solutions for this approach).

A survey of suppliers and manufacturers of modular kitchen equipment found Ikea to have one of the lowest prices.[2] Ikea's product was designed for "do it yourself" consumers who could realize further savings by assembling and installing the kitchen equipment themselves. The materials and modules are manufactured by Ikea and the quoted prices are based on their 1991 catalogue prices. Having consumers assemble and install the kitchen equipment themselves results in a saving of approximately 25% of the total cost.[3] Fig.27-30 are diagrams of each of the four layouts chosen; U-shape, galley, L-shape and single wall, indicating the arrangement of modified Ikea modular units. A chart describing each module type, quantities of each module, price of each module and total price for each layout type was prepared (Fig.31-34). The cost breakdown also includes the cost for plumbing fixtures and installation. The breakdown of costs are used for comparison between kitchen layout types and between approaches to simplifying the kitchen.

Figure 27: U-Shaped Kitchen Layout for Modified Modular Unit Approach to Cost Reduction

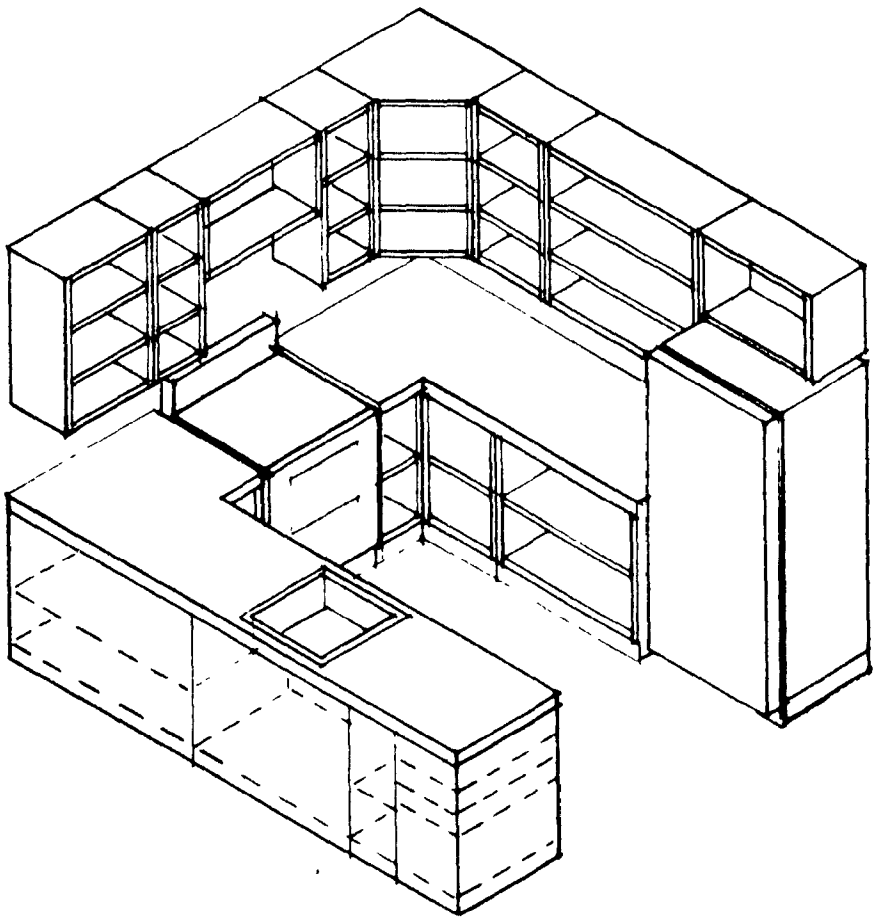


Figure 28: L-Shaped Kitchen Layout for Modified Modular Unit Approach to Cost Reduction

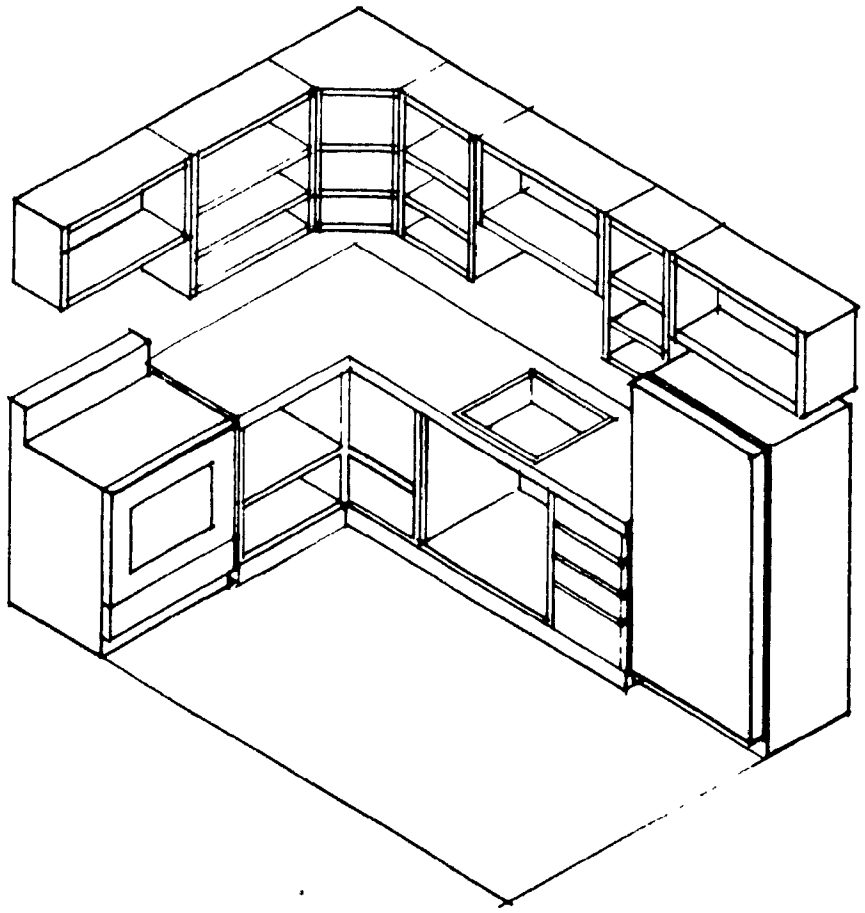


Figure 29: Galley Kitchen Layout for Modified Modular Unit Approach to Cost Reduction

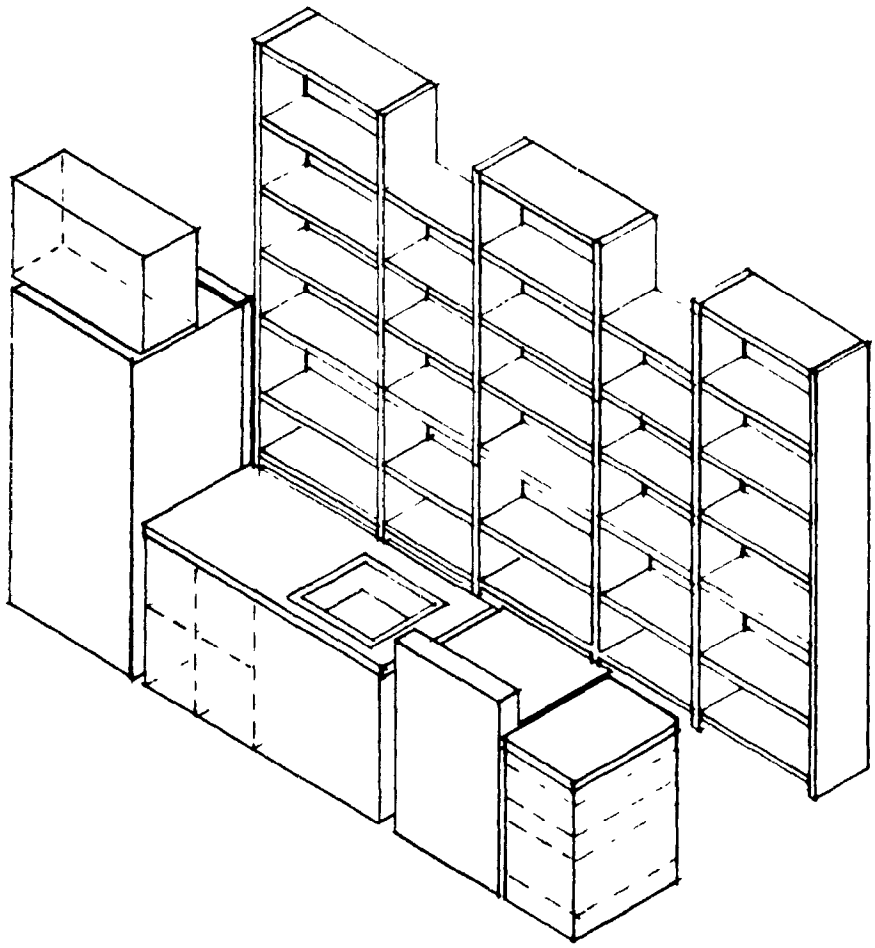


Figure 30: Single-wall Kitchen Layout for Modified Modular Unit Approach to Cost Reduction

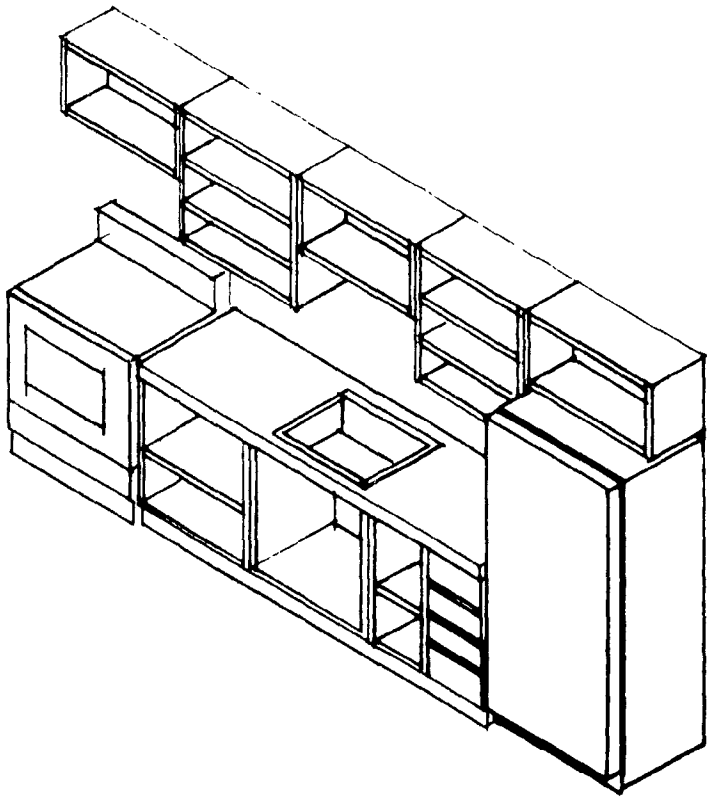


Figure 31: Cost Analysis for U-Shaped Kitchen Layout (Manufacturer: Ikea)

Description of Module	Quantity	Unit Price [$]	Total Price [$]
Base Cabinets:			
-30cm standard	2	70.	140.
-50cm standard	1	80.	80.
-80cm standard	2	90.	180.
-120cm angle	2	135.	270.
Wall Cabinets:			
-30cm standard	2	40.	80.
-60cm standard	2	51.	102.
-60cm angle	1	139.	139.
-80cm standard	1	75.	75.
-80cm special	2	45.	90.
Base Cabinet Shelves:			
-30cm	2	9.	18
-50cm	1	12.5	12.5
-80cm	2	16.5	33.
-corner rotating shelf	4	48.	192.
Wall Cabinet Shelves:			
-30cm	2pack	10.	20.
-60cm	2pack	19.	36.
-80cm	1	23.	23.
-work top			288.
-single sink	1	71.49	71.49
-faucet	1	29.99	29.99
-plumbing	2 hr.	37.00/hr	74.
	materials	25.	25.
TOTAL:			$1,970.98

Figure 32: Cost Analysis for L-Shaped Kitchen Layout (Manufacturer: Ikea)

Description of Module	Quantity	Unit Price [$]	Total Price [$]
Base Cabinets:			
-60cm standard	1	85.	85.
-50cm standard	1	80.	80.
-80cm standard	1	90.	90.
-120cm angle	1	135.	135.
Wall Cabinets:			
-50cm standard	1	47.	47.
-80cm standard	1	75.	75.
-60cm standard	2	51.	102.
-60cm angle	1	139.	139.
-80cm special	2	45.	90.
Base Cabinet Shelves:			
-50cm	1	12.5	12.5
-60cm	1	14	14
-80cm	1	16.5	16.5
-corner rotating shelf	2	48.	96.
Wall Cabinet Shelves:			
-50cm	1	15.	15.
-60cm	2	19.	36.
-80cm	1	23.	23.
-work top			156.
-single sink	1	71.49	71.49
-faucet	1	29.99	29.99
-plumbing	2 hr.	37.00/hr	74.
	materials	25.	25.
TOTAL:			$1,412.48

Figure 33: Cost Analysis for Galley Kitchen Layout (Manufacturer: Ikea)

Description of Module	Quantity	Unit Price [$]	Total price [$]
Base Cabinets:			
-40cm drawers	1	153.	153.
-50cm standard	2	80.	160.
-80cm standard	1	90.	90.
-28cm -210cm high cabinet	3	120.	360.
Wall Cabinets:			
-80cm special	1	45.	45.
Base Cabinet Shelves:			
-50cm	1pack	25.	25.
-80cm	1	16.5	16.5
Wall Cabinet Shelves:			
-60cm	5	19.	95.
-80cm	8	33.	33.
-work top			120.
-single sink	1	71.49	71.49
-faucet	1	29.99	29.99
-plumbing	2 hr.	37.00/hr	74.
	materials	25.	25.
TOTAL:			$1,297.98

Figure 34: Cost Analysis for Single Wall Kitchen Layout (Manufacturer: Ikea)

Description of Module	Quantity	Unit Price [$]	Total Price [$]
Base Cabinets:			
-40cm standard	1	153.	153.
-40cm standard	1	75.	75.
-80cm standard	2	90.	180.
Wall Cabinets:			
-80cm standard	2	75.	150.
-80cm special	3	45.	135.
Base Cabinet Shelves:			
-40cm	1	11.	11.
-80cm	1pack	33.	33.
Wall Cabinet Shelves:			
-80cm	2	23.	46.
-work top			115.
-single sink	1	71.49	71.49
-faucet	1	29.99	29.99
-plumbing	2 hr.	37.00/hr	74.
	materials	25.	25.
TOTAL:		$1,098.48	

4.4.2 Wall Hung Shelf Unit Approach to Cost Reduction

The second approach to simplifying the kitchen involved suspending the entire kitchen unit from the wall. A series of wall standards and brackets, support shelves and counter tops which replace base- and wall-hung cupboards allow shelves to be used for both storage and counter space. Sinks are placed in the counter top but require flexible plumbing connectors to accommodate movement[4] (this was reflected in the plumbing installation price). A diagram of the L-shaped layout was drawn indicating the components and arrangement of parts (Fig.35) The elements of the second approach are: wall standards, brackets, worktop, shelving, sink, and faucet. Standard drawer-sets or wire baskets with runners can also be attached under the work top for alternate storage. The shelf-hung kitchen is supported on adjustable brackets allowing it to be altered to suit changing needs.

A survey of materials was made to determine what was available on the market. Melamine covered particle board proved to be the least expensive option while the plastic laminate covered particle board counter (made by Ikea) proved to be the least expensive solution for the work top. Other materials and manufacturers were indicated in the cost breakdown.

A chart similar to those in the previous section shows materials, prices and quantities and the total price for each layout type (Fig.36-39). The cost breakdown also includes plumbing fixtures and installation. The cost analysis was prepared for each of the four layout types according to the wall hung shelving unit approach to cost reduction. These cost breakdowns were then used for comparison purposes in the analysis.

Figure 35: L-Shaped Kitchen Layout for Wall Hung Shelving Unit Approach to Cost Reduction

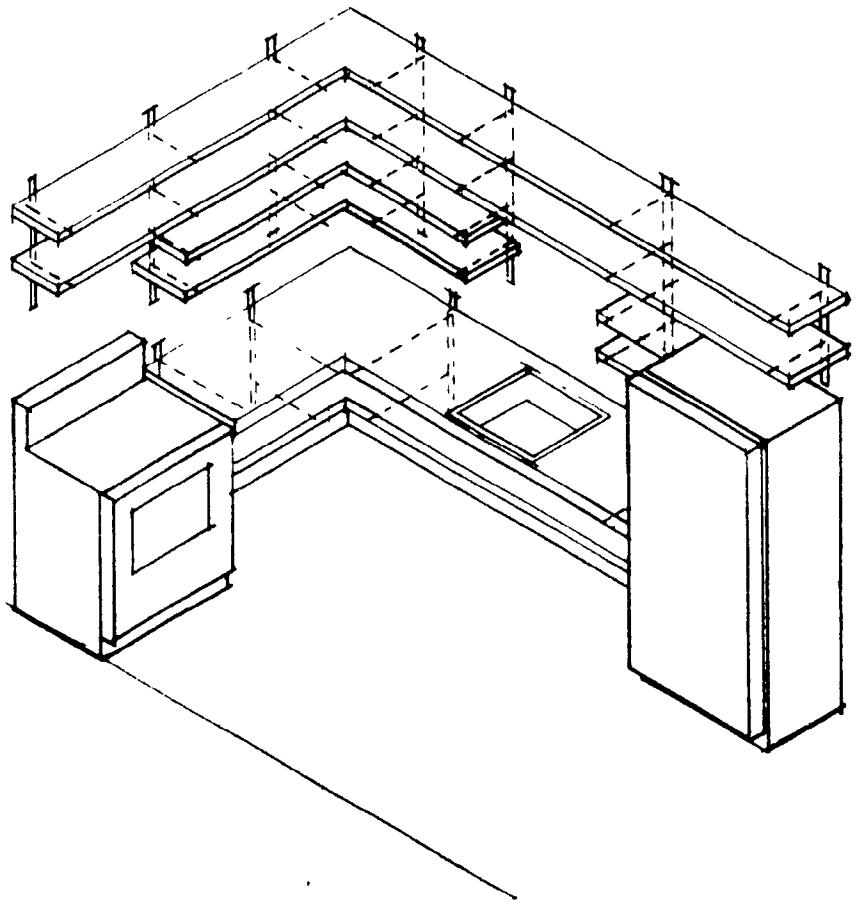


Figure 36: Cost Analysis of Wall Hung Kitchen for U-Shaped Kitchen Layout
(Manufacturer as specified)

Description of Module & Material	Quantity	Unit Price [$]	Total Price [$]
Wall Standards: Knape & Vogt			
-120cm	2	4.69	9.38
-213cm	4	10.37	41.48
Shelf Brackets: Knape & Vogt			
-300mm	30	1.69	50.70
-600mm	7	15.86	111.02
Shelving: Beaver Lumber			
-melamine clad particle board (300mm)	12.4m	2.16/m	26.78
-work top: Ikea	6m		288.
-single sink: Beaver Lumber	1	71.49	71.49
-faucet: Price Club	1	29.99	29.99
-plumbing	2 hr.	37.00/hr	74.
	materials	25.	25.
TOTAL:			$728.64

Figure 37: Cost Analysis of Wall Hung Kitchen for L-Shaped Kitchen Layout
(Manufacturer as specified)

Description of Module & Materials	Quantity	Unit Price [$]	Total Price [$]
Wall Standards: Knape & Vogt			
-122cm	2	4.69	9.38
-213cm	6	10.37	62.22
Shelf Brackets: Knape & Vogt			
-300mm	28	1.69	47.32
-600mm	6	15.86	95.16
Shelving: Beaver Lumber			
-melamine clad particleboard (300mm)	15m	2.16/m	32.40
-work top: Ikea	3m	156.	
-single sink: Beaver Lumber	1	71.49	71.49
-faucet: Price Club	1	29.99	29.99
-plumbing	2 hr.	37.00/hr	74.
	materials	25.	25.
TOTAL:			$602.96

Figure 38: Cost Analysis of Wall Hung Kitchen for Galley Kitchen Layout (Manufacturer as specified)

Description of Module & Material	Quantity	Unit Price [$]	Total Price [$]
Wall Standards: Knape & Vogt			
-122cm	5	4.69	23.45
-213cm	6	10.37	62.22
Shelf Brackets: Knape & Vogt			
-300mm	41	1.69	69.29
-600mm	10	15.86	158.60
Shelving: Beaver Lumber			
-melamine clad particleboard (300mm)	24m	2.16/m	51.84
-work top: Ikea			120.
-single sink: Beaver Lumber	1	71.49	71.49
-faucet: Price Club	1	29.99	29.99
-plumbing	2 hr.	37.00/hr	74.
	materials	25.	25.
TOTAL:			$685.88

Figure 39: Cost Analysis of Wall Hung Kitchen for Single Wall Kitchen Layout (Manufacturer as specified)

Description of Module & Material	Quantity	Unit Price [$]	Total Price [$]
Wall Standards: Knape & Vogt			
-122cm	2	4.69	9.38
-213cm	4	10.37	41.48
Shelf Brackets: Knape & Vogt			
-300mm	20	1.69	33.80
-600mm	8	15.86	126.88
Shelving: Beaver Lumber			
-melamine clad particleboard (300mm)	13.8m	2.16/m	29.80
-work top: Ikea			115.
-single sink: Beaver Lumber	1	71.49	71.49
-faucet: Price Club	1	29.99	29.99
-plumbing	2 hr.	37.00/hr	74.
materials	25.	25.	
TOTAL:			$556.82

4.4.3 Metal Utility Shelf Cost Approach to Reduction

The third approach to simplifying the kitchen used metal shelving components. The utility shelving materials consisting of metal shelves, uprights and corner braces, were applied to the four kitchen types. Fig.40 shows how the metal utility shelving components are combined to form the L-shaped layout. Similar exercises were also conducted on the U-shaped, galley, and single wall layouts. Following this exercise, a cost breakdown identifying and quantifying all components for each layout type was prepared. Fig.41-44 provide a cost analysis for each of the four different layouts. The cost of assembly materials (nuts, bolts, etc.) was included in the cost of components. The prices for the metal shelving components were supplied by Johnson's Furniture and Office Supplies of Ottawa from their 1991 catalogue.

Figure 40: L-Shaped Kitchen Layout for Metal Utility Shelf Approach to Cost Reduction

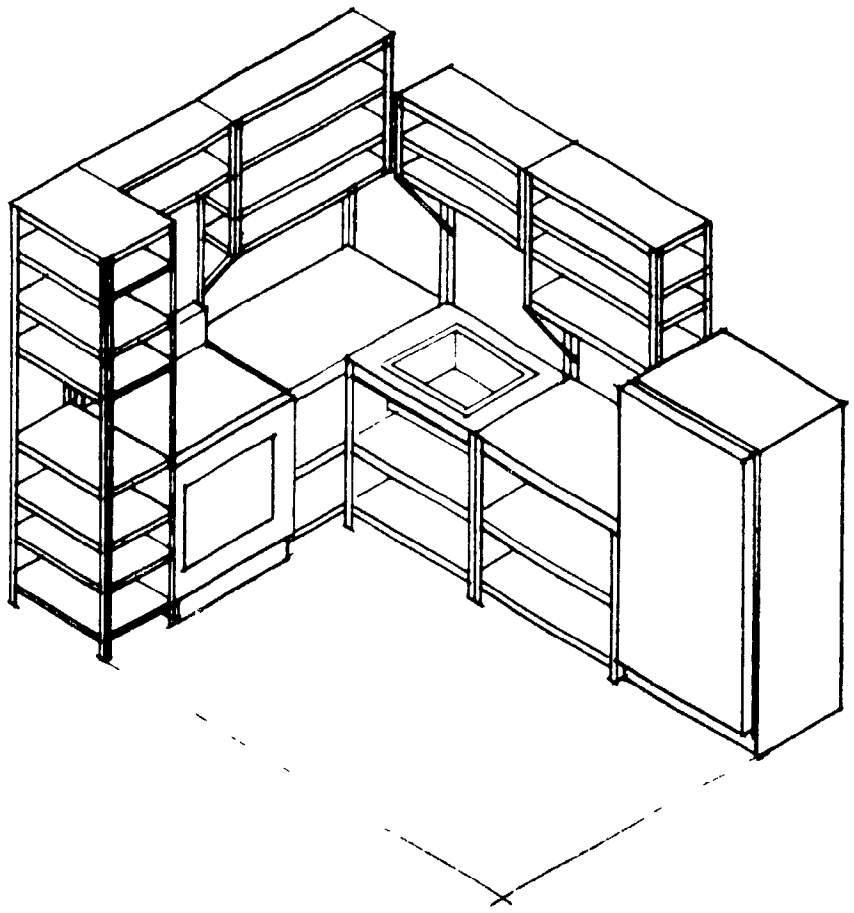


Figure 41: Cost Analysis of Metal Frame Kitchen for U-Shaped Kitchen Layout (Manufacturer as specified)

Description of Module	Quantity	Unit Price [$]	Total Price [$]
Metal Angle Uprights: Johnson's Office Furniture Supply			
-220mm	16	6.30	100.80
Metal Shelves: Johnson's Office Furniture Supply			
-300mm	9	8.25	74.25
-600mm worktop	15	12.90	193.50
-corner brace	4	1.20	4.80
-single sink: Beaver Lumber	1	71.49	71.49
-faucet: Price Club	1	29.99	29.99
-plumbing	2 hr.	37.00/hr	74.
	materials	25.	25.
TOTAL:			$573.83

Figure 42: Cost Analysis of Metal Frame Kitchen for L-Shaped Kitchen Layout (Manufacturer as specified)

Description of Module	Quantity	Unit Price [$]	Total Price [$]
Metal Angle Uprights: Johnson's Office Furniture Supply			
-220cm	16	6.30	100.80
Metal Shelving: Johnson's Office Furniture Supply			
-300mm	11	8.25	90.75
-600mm worktop	12	12.90	154.80
-single sink: Beaver Lumber	1	71.49	71.49
-faucet: Price Club	1	29.99	29.99
-plumbing	2 hr.	37.00/hr	74.
	materials	25.	25.
TOTAL:			$546.83

Figure 43: Cost Analysis of Metal Frame Kitchen for Galley Kitchen Layout
(Manufacturer as specified)

Description of Module	Quantity	Unit Price [$]	Total Price [$]
Metal Angle Uprights: Johnson's Office Furniture Supplies			
-190mm	13	5.45	70.85
Metal Shelves: Johnson's Office Furniture Supplies			
-300mm	26	8.25	214.50
-600mm worktop	5	12.90	64.50
-corner brace	10	1.20	12.00
-single sink: Beaver Lumber	1	71.49	71.49
-faucet: Price Club	1	29.99	29.99
-plumbing	2 hr.	37.00/hr	74.
	materials	25.	25.
TOTAL:			$562.33

Figure 44: Cost Analysis of Metal Frame Kitchen for Single Wall Kitchen Layout (Manufacturer as specified)

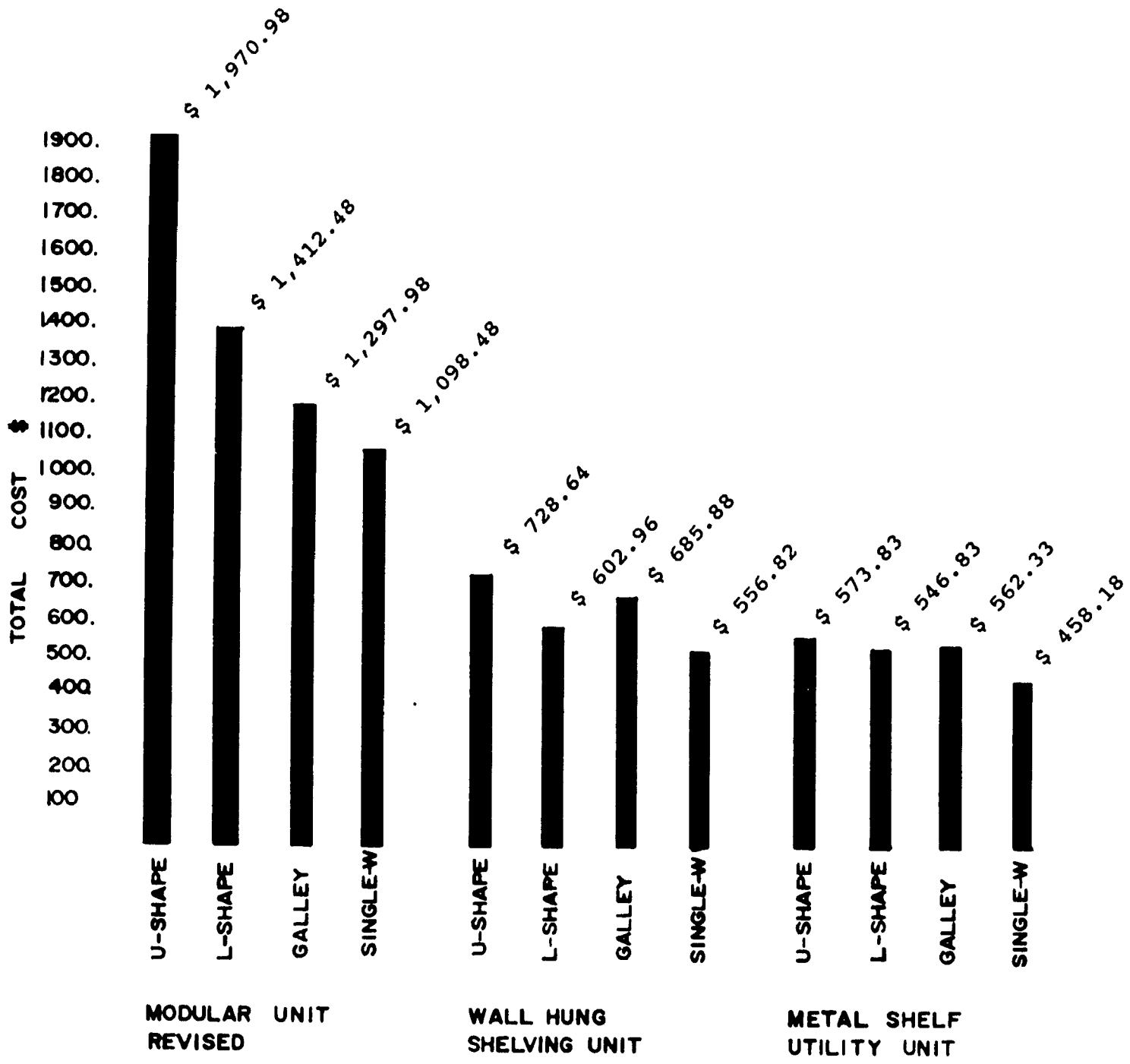
Description of Module & Material	Quantity	Unit Price [$]	Total Price [$]
Metal Angle Uprights: Johnson's Office Furniture Supply			
-220cm	12	6.30	75.60
Metal Shelving: Johnson's Office Furniture Supply			
-300mm	8	8.25	66.00
-600mm worktop	9	12.90	116.10
-single sink: Beaver Lumber	1	71.49	71.49
-faucet: Price Club	1	29.99	29.99
-plumbing	2 hr.	37.00/hr	74.
	materials	25.	25.
TOTAL:			$458.18

Each of the four kitchen layouts was evaluated and priced according to the three approaches to simplifying the kitchen. Twelve total cost breakdowns were tabulated for analysis. These cost breakdowns were placed on a bar graph (Fig.45) for evaluation and analysis.

4.5 ANALYSIS OF APPROACHES TO COST REDUCTION

This section analyzes the cost of the four layouts selected, each example being a compact layout constructed of simplified materials. The cost of materials calculated for each grouping does not include assembly and installation costs as these are considered part of the cost savings as stated earlier. In the case of the modified modular units the cost of assembly and installation was calculated at a 25% saving. The modified modular units, a more detailed approach, are a more expensive final product than the wall hung shelving units and metal utility shelving units both of which are utilitarian approaches and do not vary greatly in price. All three approaches were less expensive than the estimated cost of $17,803.00 for a conventional kitchen.[5] Of that total, 65% ($11,571.95) was for cabinets and fittings, and the labour to install them. The cost saving due to size reduction, simplified materials and labour are described in the following sections.

Figure 45: Cost Comparison of the Approaches to Cost Reduction



4.5.1 Modified Modular Units

Of the three approaches reviewed, the modified modular units had the highest cost. Using modular units allowed for the later addition of hardware and doors to provide a more conventional product. As seen in Fig.45, Cost Comparisons for Three Cost Reduction Strategies, the U-shaped layout has the highest cost ($1970.98) for modified modular units followed by the L-shaped layout ($1,412.48), galley layout ($1,297.98) and the single-wall layout with the lowest cost ($1,098.48). The U-shaped layout costs substantially more than the other three layouts and this cost difference is partially due to the increased materials required to construct it. The cost analysis for the U-shaped layout (Fig.31) indicates the use of special corner modules required for base cupboards and wall hung cupboards totalling $274.00 per corner. These particular units cost more than the standard cupboard units. Similar corner units are required for the L-shaped layout (Fig.32) and, as a result, the materials for the L-shaped layout cost more than the galley layout and single-wall layout, both of which use only standard modules.

4.5.2 Wall Hung Shelving Unit

The second approach to cost saving through simplification of materials is the wall-hung kitchen. In providing for the functional requirements of a kitchen, namely storage and workspace, the wall hung kitchen can be achieved at 1/2 the cost of the modified modular unit and considerably less than the

conventional kitchen cost described above. A review of Fig.36-39 Cost Analysis of Wall-Hung Kitchen Approach shows the U-shaped layout to have the highest cost followed by the galley layout, the L-shaped layout, and finally the single-wall layout. The difference in price between the highest priced U-shaped layout and the lowest priced single-wall layout is less than $200.00. In this strategy the same standard materials are used for all layouts and as a result, the materials for the L-shaped layout ($602.96) cost less than the galley layout ($685.88). This is the opposite of what occurred with the modified modular units. Because the L-shaped layout required the more expensive corner cupboards its total price was greater than the galley layout. The 300mm deep shelves from the floor to ceiling of the galley layout required extra materials and increased the cost, making it more expensive than the L-shaped layout for this approach. The single-wall layout using wall hung shelving units provided the same amount of storage as in the modified modular units. It has the simplest layout, uses the least materials and, as a result, provides the lowest total cost ($556.82). The shelving materials priced are prefinished melamine clad particle board. This material is less expensive than plywood sheathing which is unfinished and has to be cut to the proper width. The melamine clad particle board is substantially less expensive than pine shelves originally considered as an alternative shelving material.

4.5.3 Metal Utility Shelving Unit

The third approach to kitchen cost reduction, using metal utility shelves for a majority of the components, proved to be the least expensive example of the three approaches to simplifying materials. As seen in Fig.45, Cost Comparisons for Three Cost Reduction Strategies, total cost appears to peak at the $550.00 mark. When this level of cost is reached for kitchen materials, differences in price between layouts are minimal. A similar situation occurs in the wall-hung kitchen examples. A review of costs for the four layouts also indicates a similar pattern to what is seen in the other two approaches: the single-wall layout has the lowest cost ($458.18) and the U-shaped layout has the highest cost for materials ($573.83). In between these two layouts are the galley layout ($562.33) followed by the L-shaped layout ($546.83). The metal utility shelf approach has the lowest cost of the three alternatives. The modular nature of the shelving units results in minor adaptations and changes to each of the kitchen layouts. The metal utility shelf components consist of a limited number of standard metal components allowing for only minor alterations to materials, resulting in changes to layouts to accommodate the metal components. These alterations consisted of moving appliances to allow for better use of materials. The result of working with a limited number of modular components (as compared to conventional kitchens which had a greater variety of modules) provided the least expensive solution. The four layouts used identical components and the cost difference between the four varies by only $100.00. In conventional

kitchen construction specialized components are combined with standard modules, while with metal utility shelves standard shelf widths of 600mm and 300mm are used throughout.

4.6 CONCLUSION

The three alternative approaches to cost reduction provided total costs well below those of a conventional kitchen as described in chapter one.[6] The three approaches to material simplification outlined in this chapter took advantage of kitchen areas smaller than those of the conventional kitchen, and consumer assembly and installation to further reduce the total cost of a kitchen layout. In comparing the three alternative approaches it is clear that as the materials are simplified the kitchen layout becomes less expensive. This observation suggests the more radical the approach the greater the cost saving.

The same holds true for the kitchen layouts; as the layout is simplified, the total cost of materials is reduced. The U-shaped layout has the greatest percentage of specialized parts with corner conditions, free standing counters, and custom cupboards over appliances, while the single-wall layout is comprised primarily of simple standard components. The single-wall layouts provide the lowest cost solution and the U-shaped layouts are the highest. When simplifying materials as a way of reducing cost, the materials become standardized and simplified and the total cost of the final

product is reduced. By simplifying the construction materials the difference in cost between kitchen layout types is also reduced.

ENDNOTES:

1. Goldbeck, David. *The Smart Kitchen.* Woodstock: Ceres Press, 1989.

2. A survey of costs for six kitchen suppliers, in the Montreal area, was undertaken in 1991 The test kitchen had an area of 8.9 sq.m. Of the six suppliers four were within 15% of each other, the fifth supplier was 10% higher and the sixth, Ikea, was 25% lower than the first four prices (installation costs were included in the total price for this initial examination only).

3. "Swedish Kitchen Design Reaches New Heights." *Ikea Kitchen* Brown Printing, 1990.

4. Conran, Terence. *The Kitchen Book.* New York: Crown Publishing, 1977.

5. "Kitchen Facts." *Builder Magazine*, April, 1990: p. 92.

6. "Kitchen Facts." Builder Magazine, April, 1992: p92. The estimated cost of $11,571.95 includes only the cost for materials and labour for assembly of kitchen millwork according to 1990 cost estimates.

5.0 FINAL CONCLUSIONS

5.1 INTRODUCTION

The strategies of area minimization and simplification of construction materials for cost reduction examined in the two previous chapters suggest 1) a large variety of kitchen examples exist below the $10m^2$ threshold; and, 2) the more construction materials are simplified, the greater are the savings. The kitchen type with the smallest kitchen area is the single-wall layout, with single-wall kitchen SW12 having an area of $2.7m^2$. An evaluation of alternate construction materials indicates that the modified modular units range in price from $1,098.48 to $1,970.98 while the more simplified metal utility shelving units ranged in price from $458.18 to $573.83, almost one third the price of the modified modular units and substantially less than a conventional kitchen.[1] This chapter will review the results of these two cost reduction strategies highlighting the best examples of each condition, and will draw overall conclusions for the study.

5.2 STRATEGY ONE: KITCHEN AREA MINIMIZATION

Chapter three examined kitchen layouts constructed of standard components but having reduced area, that being an area under $10m^2$. The cost saving is found in the reduced kitchen floor area and the reduced number of componets required in the kitchen. Single-wall layouts were found to have the smallest area (single wall kitchen SW12 has an area of $2.7m^2$). SW12 is defined as a closet kitchen, complete with a fold-down eating table. It is

used primarily in small bachelor units Single-wall layout SW4 and SW11 ($3.4m^2$) also have smaller areas. Both are found in apartments of limited floor area where the single wall layout is the ideal solution

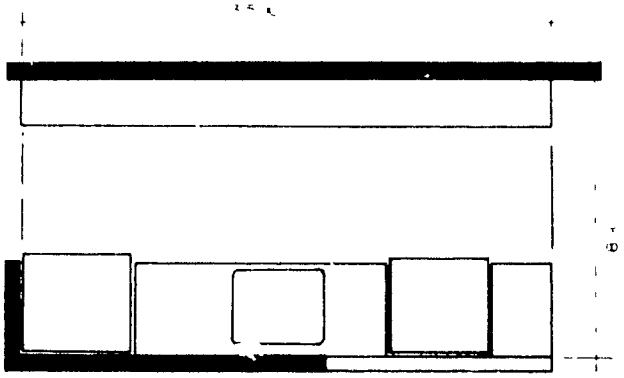
The smallest L-shaped layout LS4, with an area of $3.8m^2$, was built as a study model by CMHC. While the L-shaped layout type has the second smallest kitchen area it is the only example within this range, and appears to be the exception rather than the rule. All other L-shaped layouts along with galley layouts are within the mid-range of areas. The smallest area for a galley kitchen is $4.4m^2$ G2 (a theoretical study), G10 (an apartment) and G12 (a small house). These three examples all emphasize compact planning. While the majority of the U-shaped layouts are within the upper range of areas for the examples examined (5.0-7.0m^2), the smallest U-shaped kitchen, US4 ($4.5m^2$), is within the range of the smallest L-shaped and galley kitchens. This example is found in a renovated house of $60m^2$.

Since the primary function of the kitchen is the storage and preparation of food and associated equipment, the storage area is one of its most important aspects. In general, the greater the storage capacity the more desirable the kitchen becomes. The U-shaped layout provides the largest amount of storage area for a given kitchen area. U-shaped layout US1 provides $10.2m^2$ of storage area, the largest amount of storage area of all the examples studied. Surprisingly, this kitchen does not have the greatest kitchen area; this example takes advantage of its wall-hung cupboard storage potential. Through careful examination it becomes apparent that design

changes to other kitchen layout types can provide greater amounts of storage that meet or exceed that of the U-shaped layout. Galley kitchen G8 (Fig.46) uses one entire wall for storage cupboards and has the second largest amount of storage area. The storage capacity of this layout (and other galley layouts) could have been greater had wall hung cupboards been located above the counter on both sides of the kitchen. As a result of this design condition, found in a majority of galley layouts, the storage capacity of L-shaped layouts surpasses that of galley layouts. Regardless of the kitchen layout the type of storage provided for a given layout, alternative designs, and innovative planning can all lead to greater storage capacities.

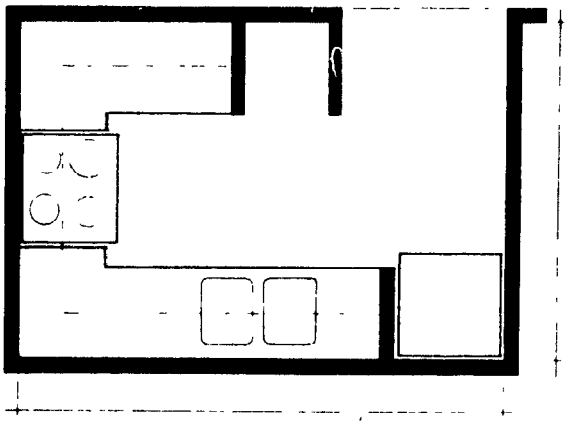
The findings regarding storage volumes are similar to those in kitchen storage area and reinforce the conclusions drawn earlier. U-shaped layouts provide the largest amount of storage volume (Fig.21); US3 (Fig.47) provides the greatest storage volume of all kitchen layouts examined in this study. 4.0m^3. L-shaped layouts provide more storage volume than galley layouts (Fig.48 shows LS-3 with the greatest storage area for L-shaped layouts at 3.0m^3) because wall-hung cupboards are not usually found on one side of the galley kitchen. This suggests the importance of wall-hung cupboards as potential storage. While not as large as base cupboards, wall hung cupboards account for 1/3 of the total kitchen storage volume. In the case of the galley layout G8, wall-hung cupboards account for more than 2/3 of the total storage volume of the kitchen, far surpassing the storage volume of L-shaped layouts.

Figure 46: G-8 Galley Kitchen Layout



G-8

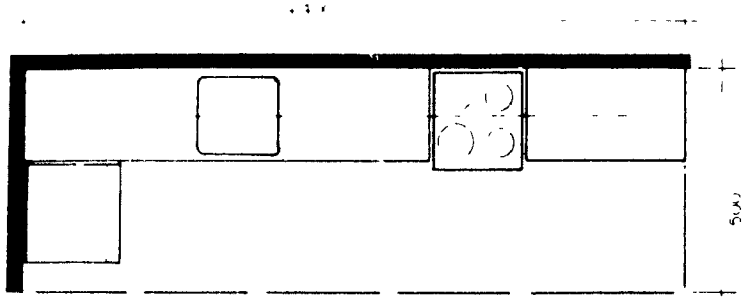
Figure 47: US-3 U-Shaped Kitchen Layout



US-3

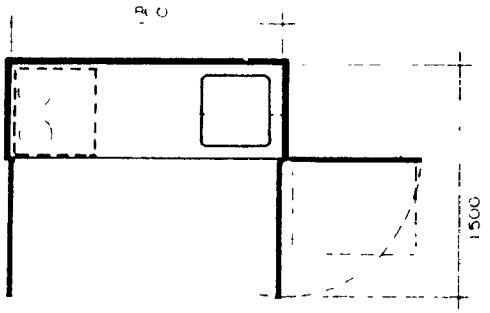
Of the four layout types examined, the U-shaped layout provides the greatest amount of work top area to floor area. Fig.23 indicates that as much as 54% of the U-shaped kitchen area is potentially work top area;

Figure 48 L-3 L-SHAPED KITCHEN LAYOUT



L-3

Figure 49: SW-12 Single-Wall Kitchen Layout



SW-12

Fig.24 corroborates these findings. Both Fig 23 and Fig.24 show that single-wall layouts provide the least amount of work-top area, roughly 23%. It is important to note that while galley layout G8 provides a large amount of storage area and storage volume, this is done at the expense of the worktop area. The average worktop area for galley kitchens is 44% of the kitchen

area, but G8 has a worktop area of only 20%. This figure is below that of the single-wall layout.

Efficiency is measured according to work triangle length with the smallest work triangles having the most efficient layouts. Of the examples examined, the most efficient layouts are galley kitchens having a corridor between counters of less than 1000mm (Fig.26 galley kitchen group 2). The other group of galley layouts identified (galley kitchen group 1), have aisle widths greater than 1000mm increasing the work triangle. The U-shaped layout is the second most efficient kitchen type; US4 has a work triangle length of 2.9m the second smallest of all the layouts studied. SW12 at 2.4m has the smallest work triangle.

The U-shaped layout proves to be the best overall layout of the four kitchen types reviewed. Its storage area is as much as 1.5 times its kitchen area. The L-shaped layout has a storage area approximately equal to that of its kitchen area. The worktop area of the U-shaped layout is 54% of its kitchen area followed by the galley layout with 45%. The efficiency of the U-shaped layout is second to that of galley kitchen group 2. The galley layout and L-shaped layout hold second and third place while the single-wall layout holds fourth place. The single-wall layout, while having examples within the full range of kitchen areas, provides the example with the smallest area SW12 at 2.7m^2 (Fig.49). The majority of the single-wall layouts were smaller than the other kitchen layout types examined.

Through design changes, similar to those discussed above, the galley and the L-shaped layout types can provide greater amounts of storage area, work top area, or efficiency which meet or exceed the measurements of the U-shaped layout. When reviewing all conditions, however, it is the U-shaped layout which shows the best results in all the categories identified above.

5.3 STRATEGY TWO: SIMPLIFICATION

Chapter four examined cost reduction through simplified construction materials and techniques. Using the information on minimization of kitchen area (presented in Chapter three) three approaches to simplification in materials and construction techniques were applied to four layout types of reduced area. Fig.45 shows cost totals of kitchen examples with reduced area, using simplified materials and construction techniques, including savings made through the assembly of units by the consumer. A review of Fig.50, Comparison of Average Costs for Kitchen Millwork, shows that these approaches applied to kitchens of reduced area create less expensive kitchens than those of conventional area and construction. The estimated cost, $11,571.95, includes kitchen storage and labour for assembly according to 1991 cost estimates.[2] While the range in costs between the three approaches is roughly $1,000.00 (average cost as indicated in Fig.50), the difference in cost between the conventional kitchen and the three alternative approaches to cost reduction is over $10,000.00. This difference in cost indicates that the

impact of labour cost in assembly and installation (estimated at $3,500.00 by the American National Kitchen & Bath Association) as well as the impact of reduced kitchen size and simplified materials ($6,500.00) are considerable.

Figure 50: Comparison of Average Costs for Kitchen Millwork

Conventional approach applied to a kitchen of average size as indicated in the 1990 survey by the american National Kitchen and Bathroom Association		Three approaches to cost reduction applied to kitchens of reduced area (excluding labour)
Conventional Kitchen Millwork (including assembly and installation) $11,571.95	Conventional Kitchen Millwork (excluding labour) $8,011.35	Modified Module Unit $1,444.98
		Wall Hung Shelving Unit $643.58
		Metal Shelf Utility Unit $535.00

Of the three approaches reviewed in Fig.45, the highest total cost for a kitchen layout was the U-shaped layout of the modified modular unit. The total cost for materials is $1970.98 (see Fig.31). The modified modular units use similar materials and construction techniques to the conventional kitchen, but the changes made result in significant savings (Of the $17,803.00 over 65% is for materials and construction of millwork resulting in a cost of $11,571.95). These changes include reduction in area, simplification of materials and elimination of labour costs for assembly

To increase savings, a rethinking of kitchen materials had to occur regardless of kitchen layout type and area. All three approaches take this

strategy into account. The wall-hung shelving unit approach shows a dramatic increase in cost savings. In this approach the average cost for a kitchen layout is $650.00 as compared with the modified modular unit which has an average cost of $1,300.00 (see Fig.45), this represents a 50% reduction in cost. The wall-hung shelving unit approach uses standardized materials throughout and a comparison of Fig 31-34 with Fig 36-39 shows the modified modular units to have a larger variety of specialized pieces. Greater cost savings can be attained by using more standardized materials. This is further supported by the third alternative, metal utility shelf units. In this approach the average total cost is $530.00, providing a further 20% saving compared to the wall-hung unit approach.

A comparison of layouts and cost analysis indicates that a simplified kitchen layout will result in greater cost savings. A review of the total costs of the four layout types for the modified modular units in Fig.45 shows the U-shaped layout to have the greatest total cost ($1,970.98) followed by the L-shaped layout, the galley layout and the single-wall layout (which has a total cost of $1,098.48). The total costs, from the most expensive to least expensive, reflect the differences in layouts from highly specialized to the most simplified. The wall-hung shelving unit and the metal utility shelf approach show similar results but the differences in cost are more subtle.

As materials and assembly techniques are simplified and standardized the difference in cost between kitchen layout types becomes marginal. An examination of the wall-hung kitchen and metal utility shelf approaches to

cost reduction, point out that as components become standardized and materials less expensive, the difference in costs between the kitchen layout types decrease. In the wall-hung shelving unit approach the range in price for the four layouts is $171.82. The range in cost in the metal utility shelf approach is $115.65 for the four layout types.

Three conclusions have been drawn from the review and examination of the simplification strategy:

1. Simplifying and standardizing assembly techniques and materials will result in a final product that is less costly.
2. A simplified kitchen layout can produce cost savings.
3. As the materials are simplified and the assembly techniques standardized, the variation in cost between the different kitchen layouts becomes marginal.

This study has shown that it is possible to provide an inexpensive kitchen through a reduction of kitchen size and through the use of alternate materials. It has also shown that:

1. Reduced kitchen size is a feasible alternative (evidence of this is shown in the many practical kitchen examples reviewed).
2. Alternate materials can be used to drastically reduce the price of a kitchen layout.

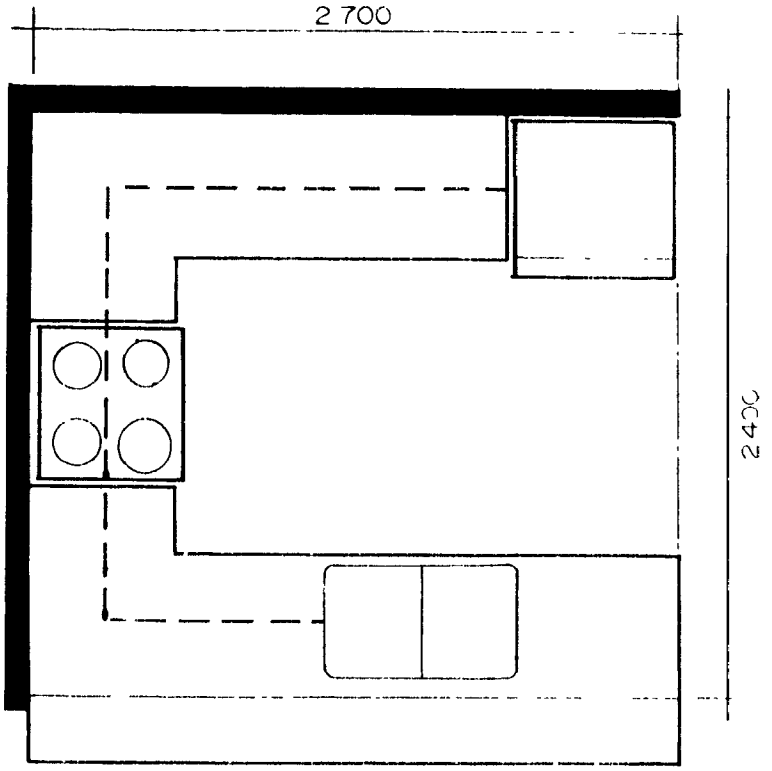
The cost of materials in the more radical strategies did not differ substantially between the four kitchen layout types examined. This suggests that a more elaborate kitchen layout is possible using alternatives in

materials to produce a product with greater advantages in storage and worktop area efficiency at a reduced price.

ENDNOTES:

1. "Kitchen Facts." *Builder Magazine*, April, 1992: p92.
2. "Kitchen Facts." *Builder Magazine*, April 1992: p92.

APPENDIX



- Kitchen floor area	6.48 sq.m.
- Counter top area	3.18 sq.m.
- Base cupboard volume	2.9 cu.m.
- Wall hung cupboard volume	1.06 cu.m.
- Base cupboard shelf area	5.88 sq.m.
- Wall hung cupboard shelf area	4.29 sq.m.
- Work triangle	4.3 m.

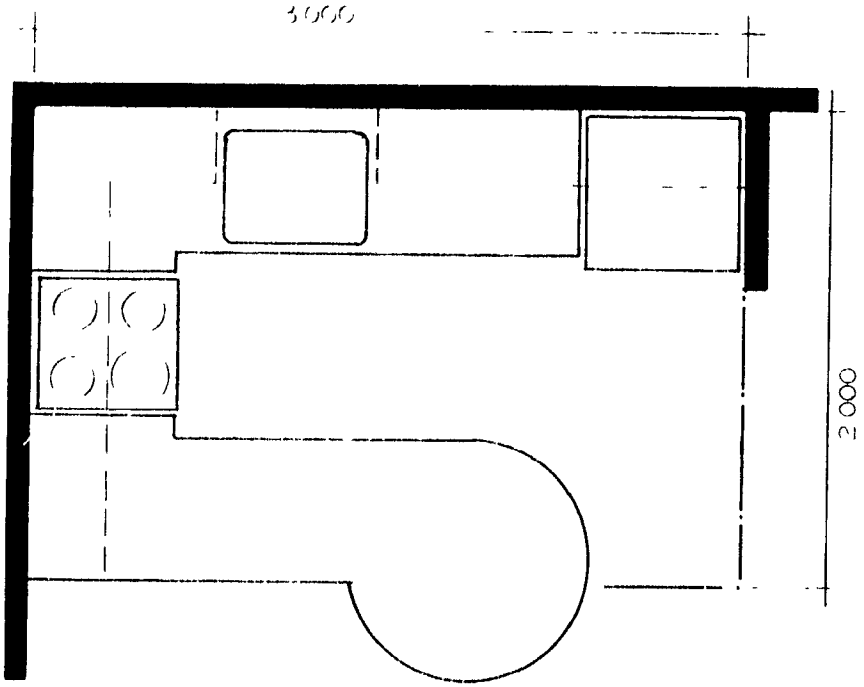
KITCHEN TYPE: U-shape kitchen

CONTEXT:

- Housing plan magazine
- Area of dwelling unit 140 sq.m.
- Canadian Planning book
- Designed to be built

SOURCE:

- Clements, Alec. Canadian Small Homes
  Toronto. Arthurs Publications Ltd. 1963 p. 29



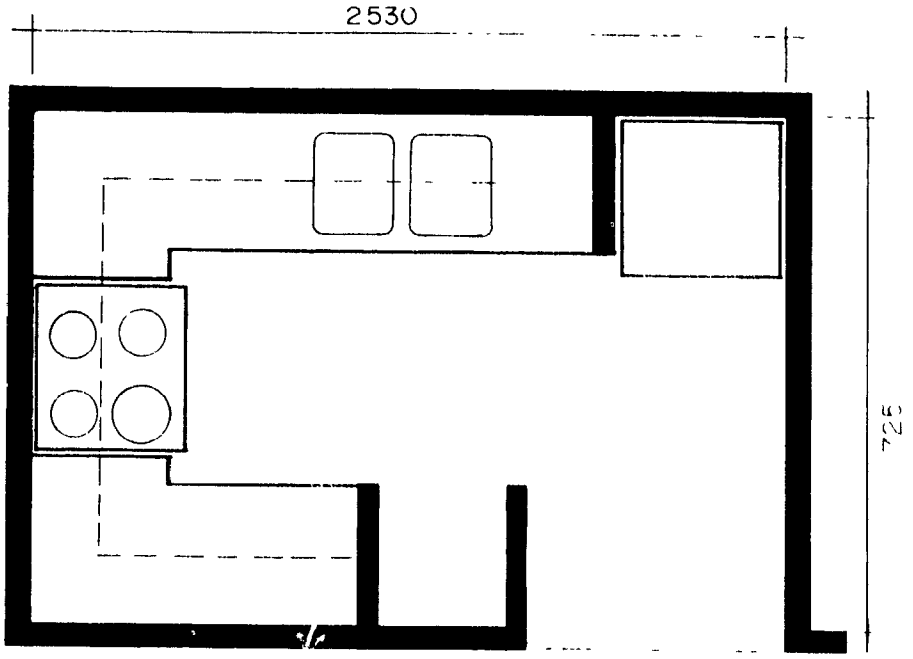
- Kitchen floor area	5.46 sq.m.
- Counter top area	2.94 sq.m.
- Base cupboard volume	2.4 cu.m.
- Wall hung cupboard volume	.78 cu.m.
- Base cupboard shelf area	4.92 sq.m.
- Wall hung cupboard shelf area	3.21 sq.m.
- Work triangle	4.1 m.

KITCHEN TYPE: U-shape kitchen

CONTEXT:
- Built by contractor
- Single detached residence
- Dwelling unit built
- Area of dwelling unit 150 sq.m.
- Location: Yorktown Heights

NOTES:
- Base and cupboards custom made

SOURCE:
- Dickinson, Duo. The Small House
  Toronto : McGraw-Hill Book Company, 1986.



- Kitchen floor area	7.04 sq.m.
- Counter top area	2.46 sq.m.
- Base cupboard volume	2.9 cu.m.
- Wall hung cupboard volume	1.05 cu.m.
- Base cupboard shelf area	4.74 sq.m.
- Wall hung cupboard shelf area	4.26 sq.m
- Work triangle	4.5 m.

KITCHEN TYPE: U-shape kitchen

CONTEXT:

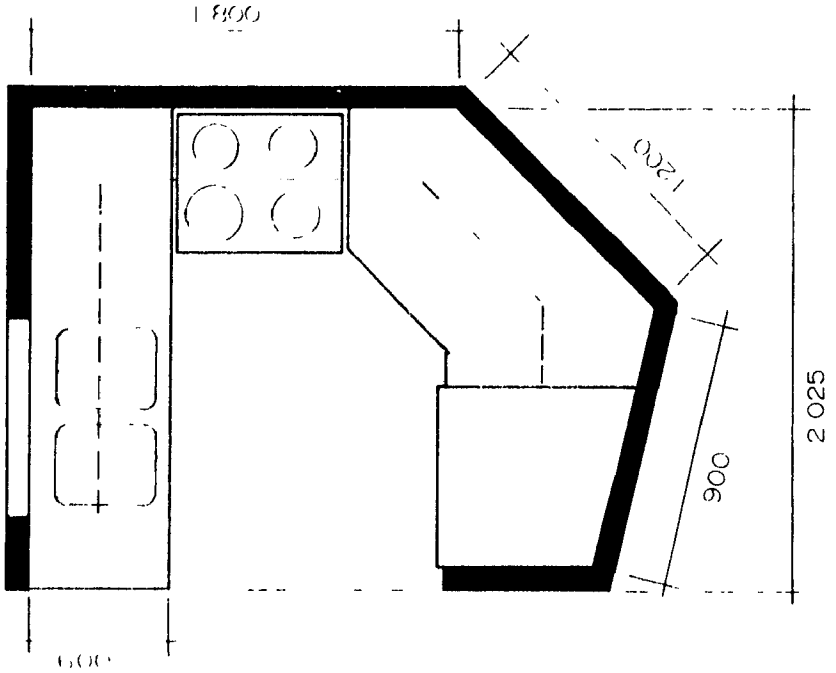
- Single detached dwelling units
- Affordable infill housing
- Area of dwelling unit 75 sq.m.
- Location: Dumas, Arkansas

NOTES:

- Standard cupboards
- Dwelling $35/sq.ft.

SOURCE:

- Ivy, Robert. " Country Living ". Architecture, July, 1990 : 70



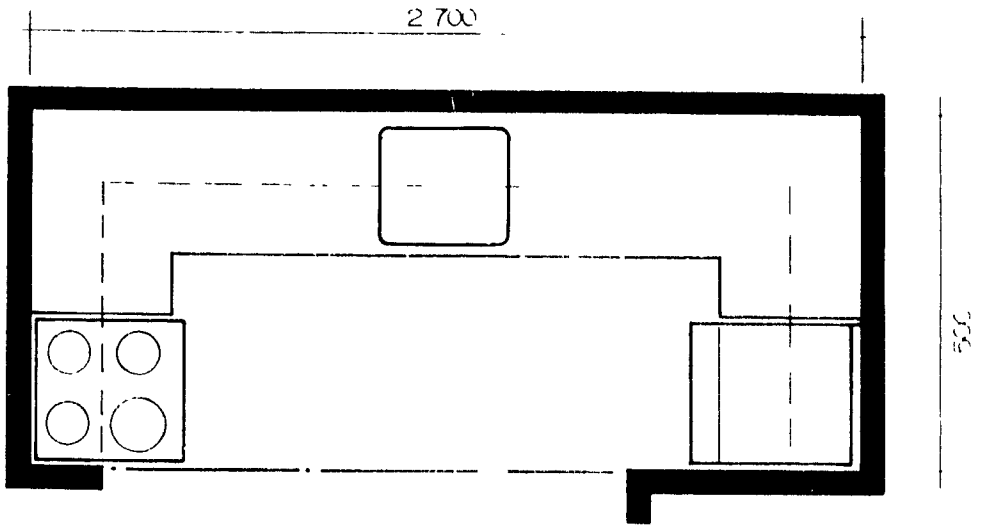
- Kitchen floor area	4.48 sq.m.
- Counter top area	1.99 sq.m.
- Counter frontage	3.68 m.
- Base cupboard volume	1.82 cu.m.
- Wall hung cupboard volume	1.4 cu.m.
- Base cupboard shelf area	2.73 sq.m.
- Wall hung cupboard shelf area	3.46 sq.m.
- Work triangle	2.9 m.

KITCHEN TYPE: U-shape kitchen

CONTEXT:
- Complete renovation of existing shell
- Dwelling unit built by owner
- Area of dwelling unit 60 sq.m.
- Location: Santa Monica, California

NOTES:
- Base and wall cupboards custom made

SOURCE:
- Dickinson, Duo. The Small House
Toronto : McGraw-Hill Book Company, 1986.



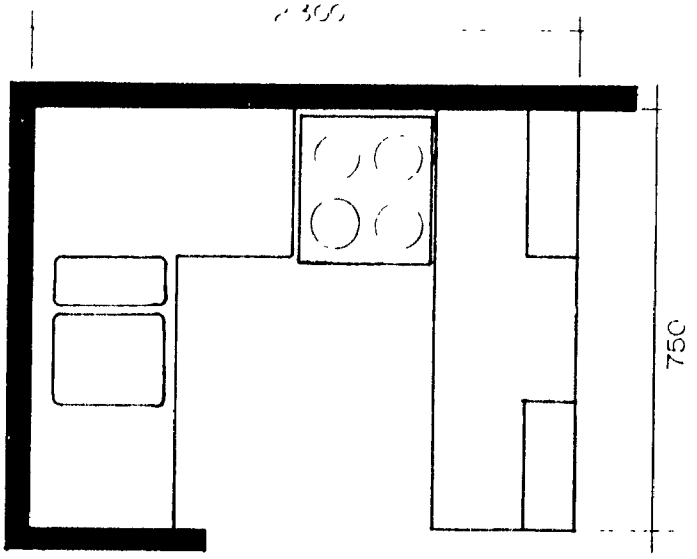
- Kitchen floor area	5.25 sq.m.
- Counter top area	2.4 sq.m.
- Base cupboard volume	2.19 cu.m
- Wall hung cupboard volume	1.18 cu.m
- Base cupboard shelf area	4.44 sq.m
- Wall hung cupboard shelf area	4.74 sq.m.
- Work triangle	4.3 m.

KITCHEN TYPE: U-shape kitchen

CONTEXT:
- Small Lot Infill Housing Competition
- Dwelling unit built
- Option for dishwasher
- Area of dwelling unit 1076 sq.m.
- Location: Winnipeg, Manitoba

NOTES:
- Base and wall cupboards, standard manufactured units

SOURCE:
- Award Winning Designs
  Manitoba Housing and Renewal Corporation 1982



- Kitchen floor area	4.03 sq.m.
- Counter top area	2.6 sq.m.
- Base cupboard volume	
- Wall hung cupboard volume	
- Base cupboard shelf area	3.7 sq.m.
- Wall hung cupboard shelf area	1.5 sq.m.
Work triangle	2.4 m.

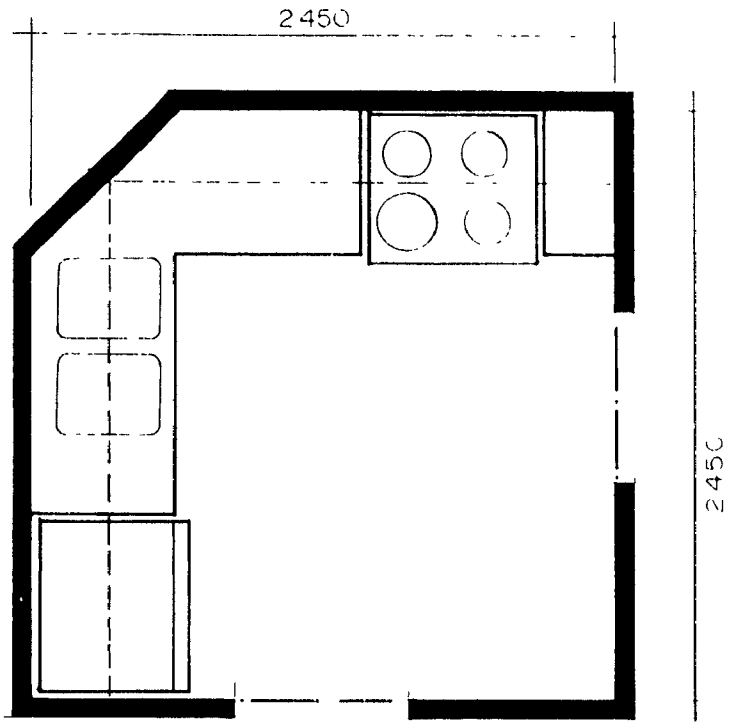
KITCHEN TYPE: U-SHAPED KITCHEN

CONTEXT:
- APARTMENT COMPLEX
- LOCATION - MARSEILLES, FRANCE

NOTES: BASE CUPBOARDS SPECIFICALLY DESIGNED FOR THIS COMPLEX

SOURCE:
- SHERWOOD, RODGER MODERN HOUSING PROTOTYPES. CAMBRIDGE, HARVARD PRESS . 1979.

US-6



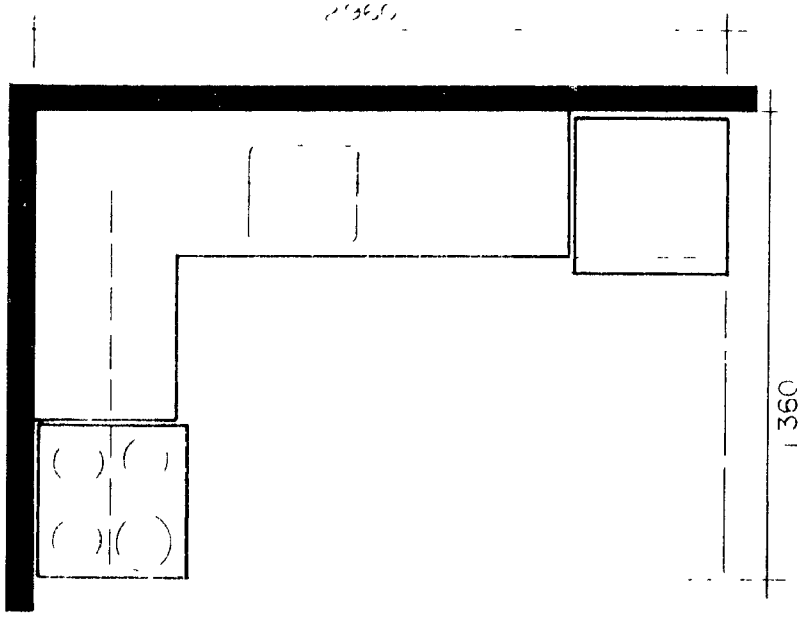
- Kitchen floor area	5 8 sq.m.
- Counter top area	1.5 sq.m.
- Base cupboard volume	1.37 cu.m
- Wall hung cupboard volume	.73 cu.m
- Base cupboard shelf area	2 52 sq.m.
- Wall hung cupboard shelf area	2.94 sq.m.
- Work triangle	4 m.

KITCHEN TYPE: L-shaped kitchen

CONTEXT:
- Low income housing units
- Attached units
- Built as part of a development
- Location: Mountain Home, Arkansas

NOTES:
- Standard manufactured units for base and wall cupboards

SOURCE:
- Ivy, Robert. " Country Living " Architecture July, 1990 : 71



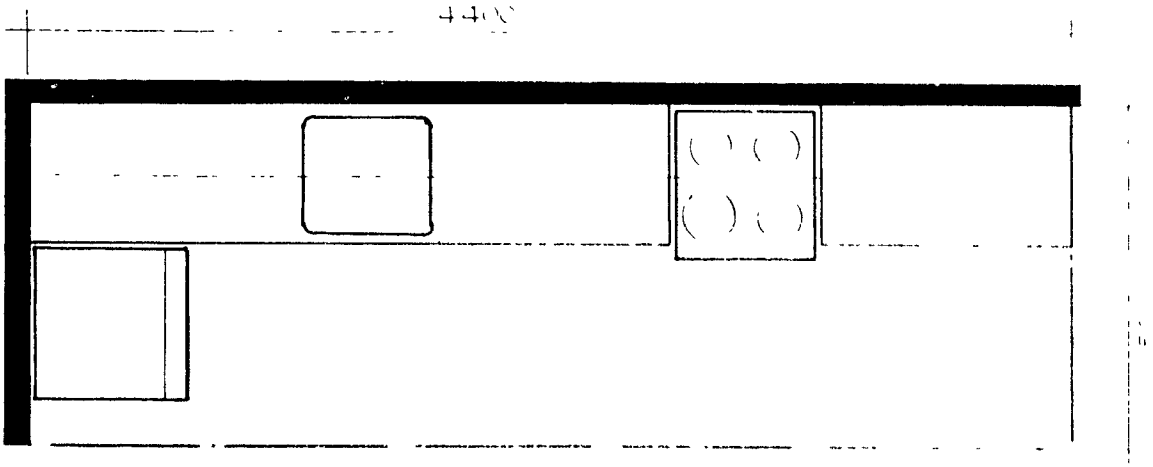
- Kitchen floor area	4 03	sq m.
Counter top area	1 8	sq m
- Counter frontage	3.12	m
- Base cupboard volume	1.65	cu m.
- Wall hung cupboard volume	.81	cu.m
Base cupboard shelf area	3 3	sq m.
Wall hung cupboard shelf area	3.07	sq m
- Ratio of cupboard shelf area to kitchen area	1.58	

KITCHEN TYPE:

CONTEXT:

NOTES:

SOURCE:



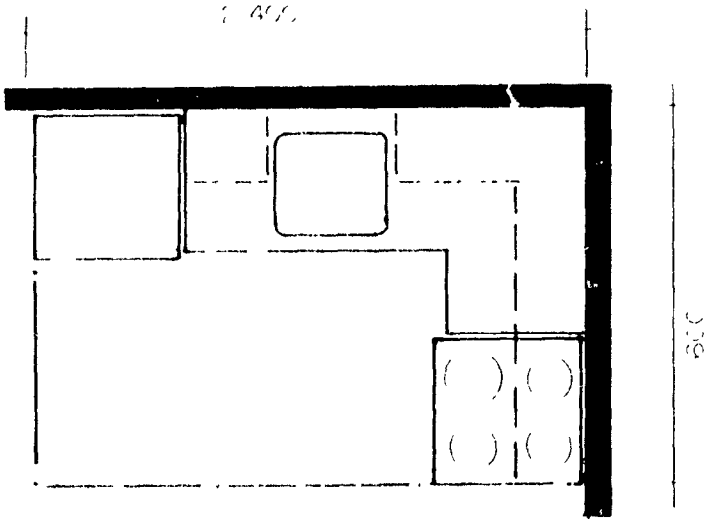
- Kitchen floor area	6.6 sq m
- Counter top area	2.34 sq.m
- Counter frontage	3.7 m.
- Base cupboard volume	2.14 cu.m.
- Wall hung cupboard volume	.88 cu.m.
- Base cupboard shelf area	1 17 sq m
- Wall hung cupboard shelf area	3 6 sq m
- Work triangle	

KITCHEN TYPE: L-shape kitchen

CONTEXT:
- Study kitchen - to produce an inexpensive work centre
- Low tech, do-it-yourself
- Theoretical design

NOTES:
- Shelves and counter hung on to wall by brackets

SOURCE:
- Conran, Terence - The Kitchen Book
  New York : Crown Publishing, 1977.



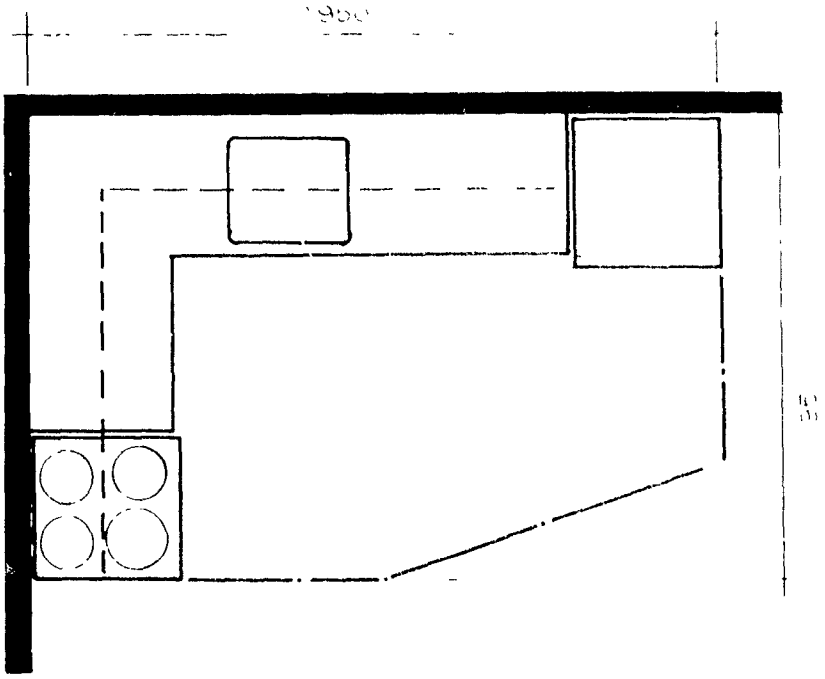
- Kitchen floor area	3.84 sq.m.
- Counter top area	1.25 sq.m.
- Base cupboard volume	1.125 cu.m.
- Wall hung cupboard volume	.54 sq.m.
- Base cupboard shelf area	2.14 sq.m.
- Wall hung cupboard shelf area	2.2 sq.m.
- Kitchen triangle	3.4 m

KITCHEN TYPE: L-shape kitchen

CONTEXT:
- Garden suite
- Dwelling unit built as study model
- Dwelling unit size 50 sq.m.

NOTES:
- Base and wall cupboards standard manufactured unit

SOURCE:
- " Garden Suites "
Canada Mortgage and Housing Corporation: Toronto. 1987:8



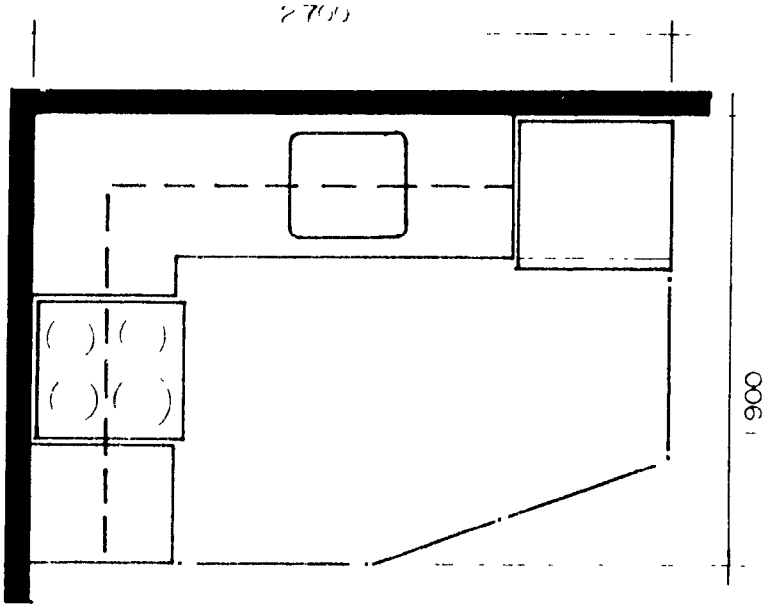
- Kitchen floor area	5 47 sq m
- Counter top area	1.8 sq m
- Counter frontage	4.02 m
- Base cupboard volume	1.62 cu.m
- Wall hung cupboard volume	.83 cu m
- Base cupboard shelf area	3 24 sq.m
- Wall hung cupboard shelf area	3 3 sq m
- Work triangle	

KITCHEN TYPE: L-shape kitchen

CONTEXT: - Design standards for government assisted housing projects

NOTES: - Suggested minimum kitchen counter frontage for two bedroom units

SOURCE: - Ontario Housing Council Guide, Revision No 7 July, 1987 : B5.2.



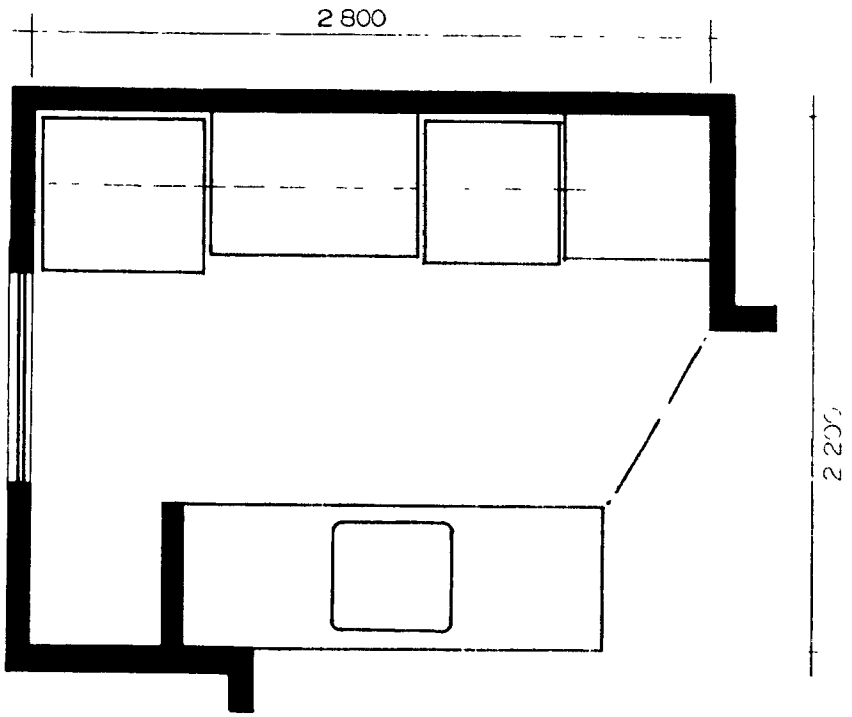
- Kitchen floor area	5 sq.m.
- Counter top area	1.68 sq.m.
- Base cupboard volume	1.5 cu.m.
- Wall hung cupboard volume	.76 cu.m.
- Base cupboard shelf area	3.24 sq.m.
- Wall hung cupboard shelf area	2.7 sq.m.
- Work triangle	3.5 m.

KITCHEN TYPE: L-shaped kitchen

CONTEXT:
- Affordable single dwelling unit
- Dwelling unit built
- Area of dwelling unit 70 sq.m.
- Location: San Francisco, California

NOTES:
- Base and wall cupboards simple construction methods

SOURCE:
- Duff, Jocelyn. " Small is Affordable "
  Canadian Housing Vol. 7 No. 2 1990 : 18



- Kitchen floor area	6 sq m.
- Counter top area	1.98 sq m
- Base cupboard volume	1.8 cu.m
- Wall hung cupboard volume	.51 cu.m.
- Base cupboard shelf area	3.6 sq.m.
- Wall hung cupboard shelf area	2.13 sq.m.
- Work triangle	4 m.

KITCHEN TYPE: Galley kitchen

CONTEXT:

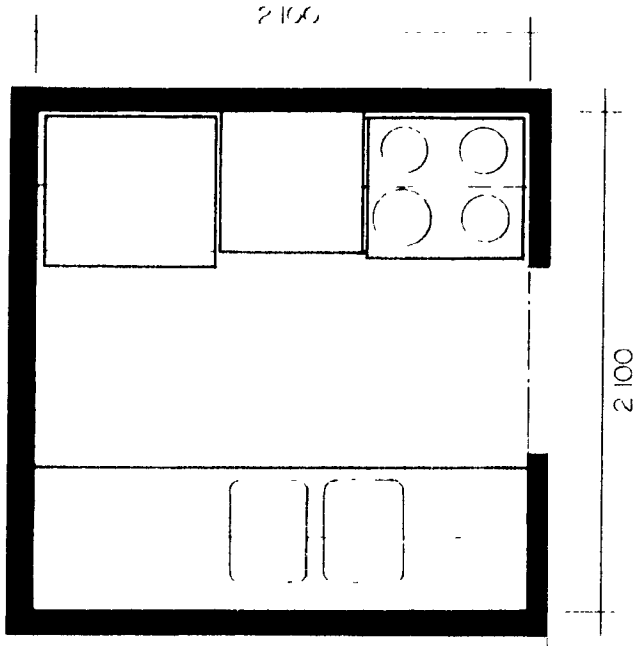
- Back to back rowhouses
- Affordable dwelling units
- Dwelling unit built
- Area of dwelling unit 90 sq.m.
- Location: New Brunswick, New Jersey

NOTES:

- Base and wall cupboard standards

SOURCE:

- Daubilit, Susan " A Venerable Town Pattern Re-emerges " Progressive Architecture August, 1984.

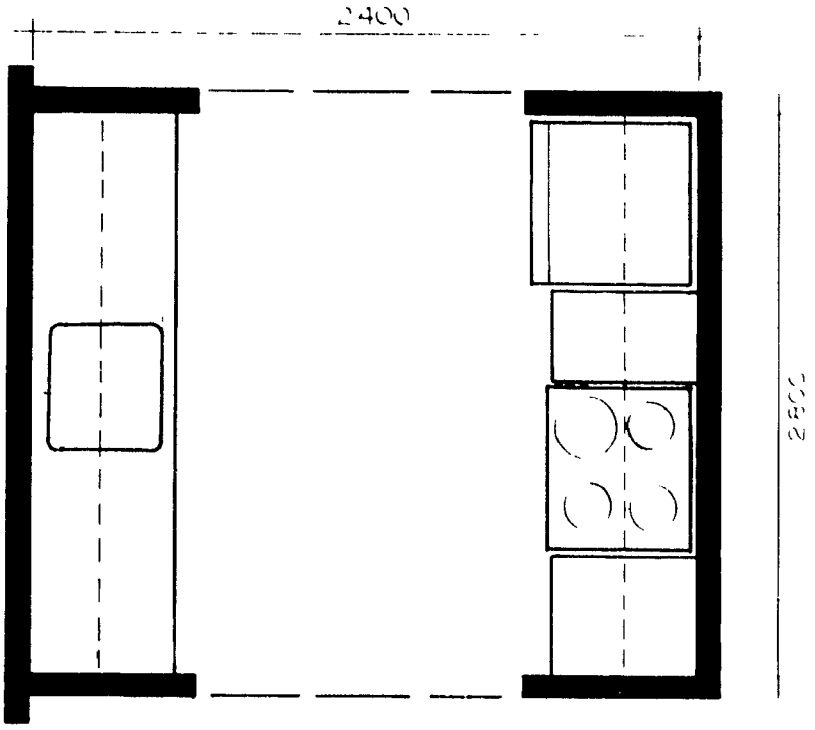


- Kitchen floor area	4.41 sq.m.
- Counter top area	1.62 sq.m.
- Base cupboard volume	1.48 cu.m.
- Wall hung cupboard volume	.77 cu.m.
- Base cupboard shelf area	2.76 sq.m.
- Wall hung cupboard shelf area	3.09 sq.m.
- Work triangle	3.5 m.

KITCHEN TYPE: Galley kitchen

CONTEXT:
- Residential kitchen planning study
- Small kitchen planning
- Theoretical analysis

SOURCE:
- Ramsey, Charles and Sleeper, Harold. Graphic Standards. New York. John Wiley & Sons Inc. 1970 : 22



- Kitchen floor area	6.72 sq m.
- Counter top area	1.92 sq.m.
- Base cupboard volume	1.75 cu m.
- Wall hung cupboard volume	.91 cu.m.
- Base cupboard shelf area	3.54 sq m.
- Wall hung cupboard shelf area	3 69 sq.m.
- Work triangle	4.2 m.

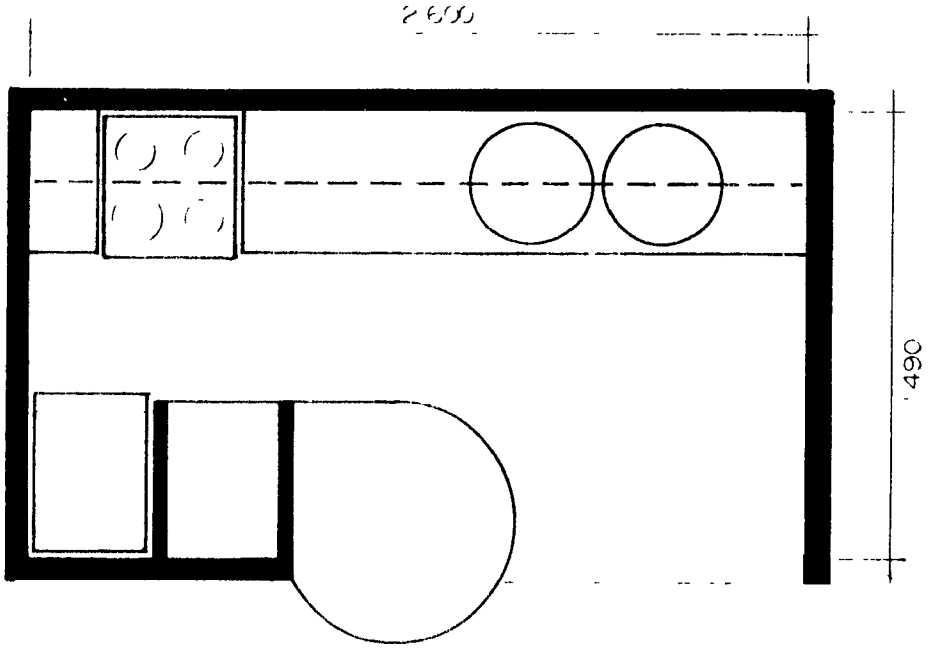
KITCHEN TYPE: Galley kitchen

CONTEXT:

- Affordable two and three storey rowhouses
- Dwelling unit built as part of a larger development
- Location: Boston, Massachusetts

SOURCE:

- Leccese, Michael. " On The Waterfront "
  Architecture July, 1990 : pp 64 - 66



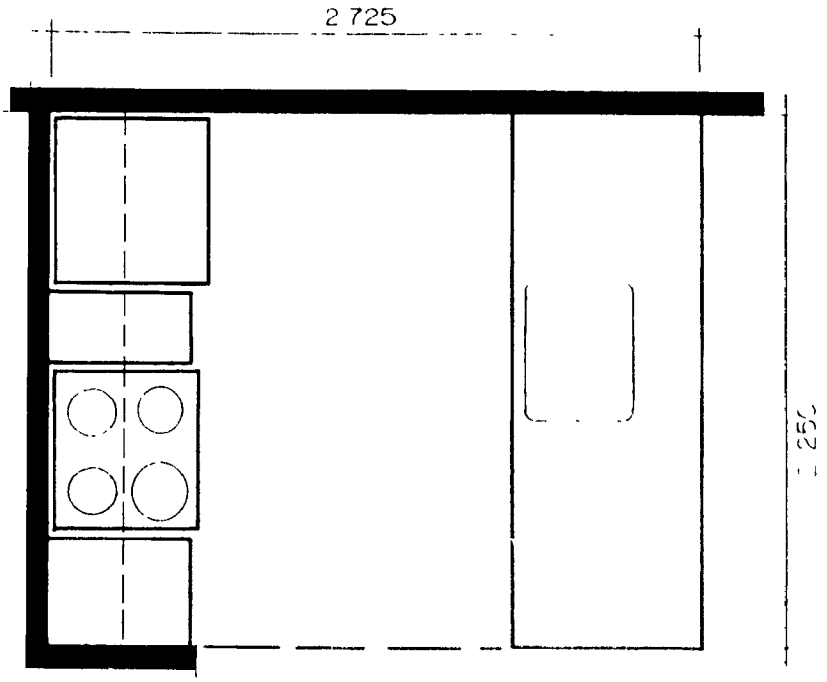
- Kitchen floor area	6.1 sq.m.
- Counter top area	2.62 sq.m.
- Base cupboard volume	2.5 cu.m.
- Wall hung cupboard volume	.62 cu.m.
- Base cupboard shelf area	2.88 sq.m.
- Wall hung cupboard shelf area	2.22 sq.m.
- Work triangle	4.5 m.

KITCHEN TYPE: U-shape kitchen

CONTEXT:
- Open planned house
- Dwelling unit built
- Infill housing
- Efficient functional design
- Owner built
- Location: London, England

NOTES: - Base and wall cupboards, exposed shelving

SOURCE: - " Proper Decorum ". Architectural Record



- Kitchen floor area	6.13 sq.m.
- Counter top area	2.25 sq.m
- Base cupboard volume	1.65 cu.m
- Wall hung cupboard volume	.37 cu.m
- Base cupboard shelf area	3.24 sq.m.
- Wall hung cupboard shelf area	1.58 sq.m.
- Work triangle	3 8 m

KITCHEN TYPE: Galley kitchen

CONTEXT:

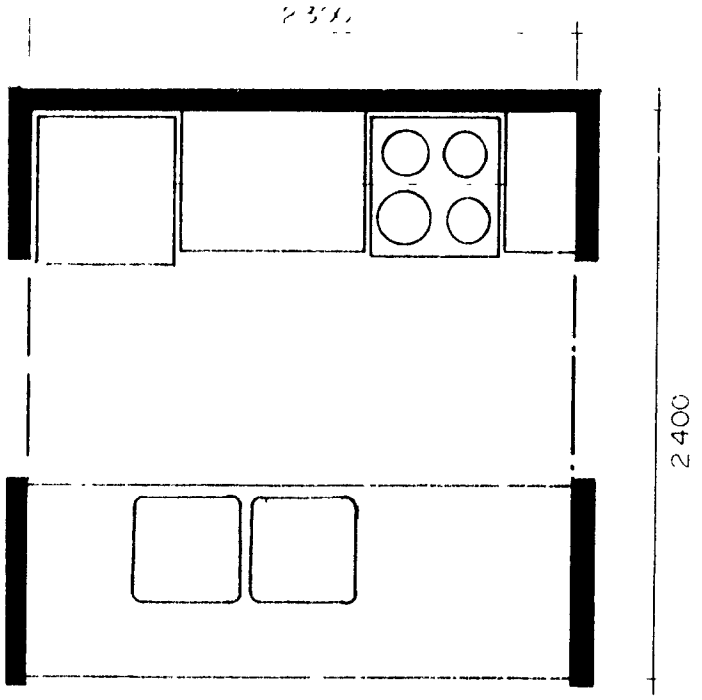
- Affordable condominium units within a larger development of mixed income units
- Dwelling unit built
- Area of dwelling unit 55 sq.m.
- Location: Lincoln, Massachusetts

NOTES:

- Base and wall cupboards standard manufactured units

SOURCE:

- Leccese, Michael. " Front Porch Society " Architecture. New York. BPI Communication July 1990, pp 56 - 59.



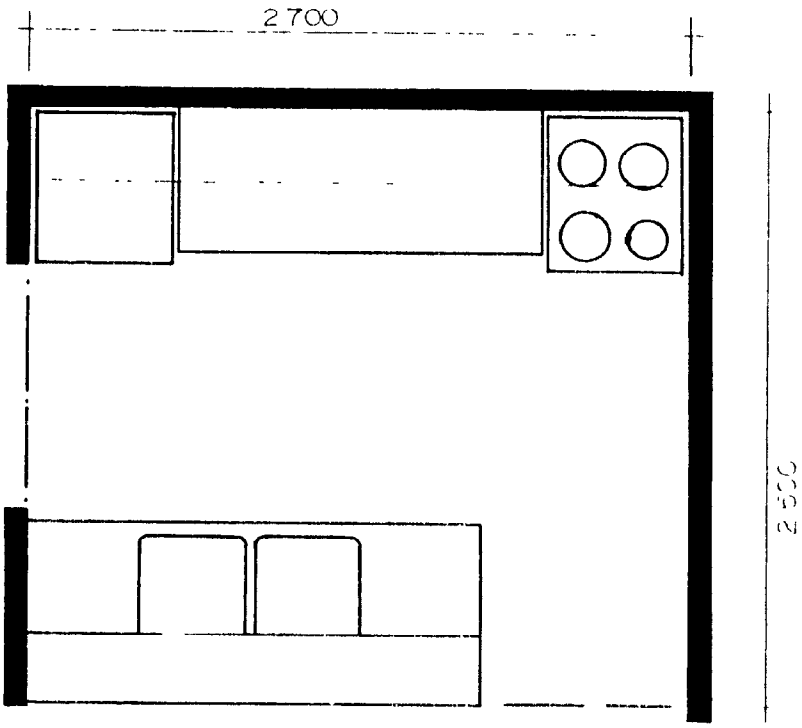
- Kitchen floor area	5.52 sq.m.
- Counter top area	2.5 sq.m.
- Counter frontage	4.6 m.
- Base cupboard volume	1.86 cu.m.
- Wall hung cupboard volume	.41 cu.m.
- Base cupboard shelf area	3.56 sq.m.
- Wall hung cupboard shelf area	1.71 sq.m.
- Work triangle	3.6 m.

KITCHEN TYPE: Galley kitchen

CONTEXT:
- Affordable row housing development
- Infill housing
- Area of dwelling unit 110 sq.m.
- Location: Boston, Massachusetts

NOTES:
- Island sink, attached eating counter

SOURCE:
- Boles, Dolorace. " P/A Inquiry Affordable Housing " Progressive Architecture. February 1987 : pp 86 - 91.



- Kitchen floor area	6.48 sq.m.
- Counter top area	2.42 sq m.
- Counter frontage	4.2 m.
- Base cupboard volume	1.86 cu.m.
- Wall hung cupboard volume	.5 cu.m.
- Base cupboard shelf area	3.48 sq.m
- Wall hung cupboard shelf area	2.07 sq.m
- Work triangle	5.2 m.

KITCHEN TYPE: Island kitchen

CONTEXT:

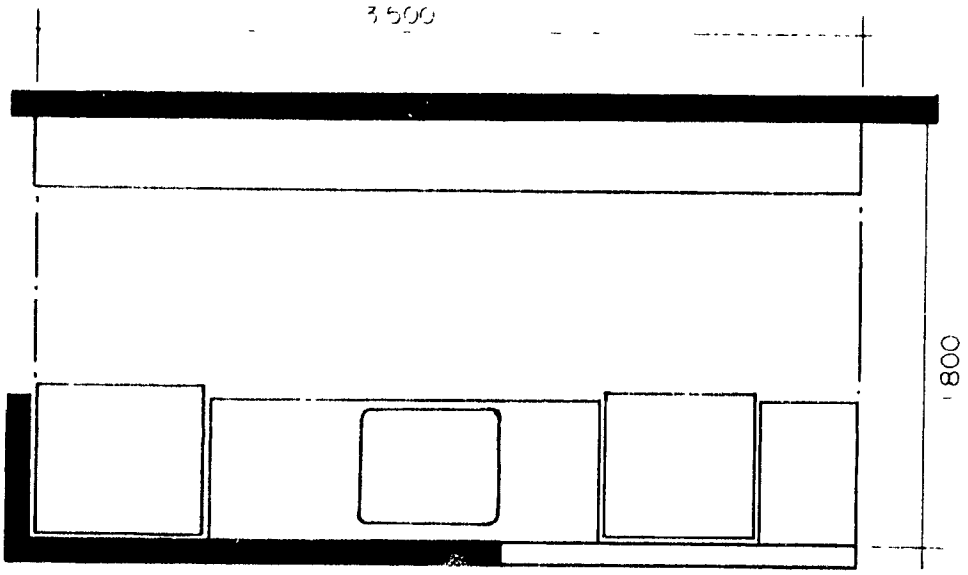
- Small lot infill housing competition
- Dwelling unit built
- Option of built-in dishwasher
- Area of dwelling unit 84 sq.m.
- Location: Winnipeg, Manitoba

NOTES:

- Base and wall cupboards standard manufactured units
- Provision to eating counter

SOURCE:

- " Award Winning Designs "
  Infill Housing Design Competition. Winnipeg
  Manitoba Housing and Renewal Corporation. 1982.



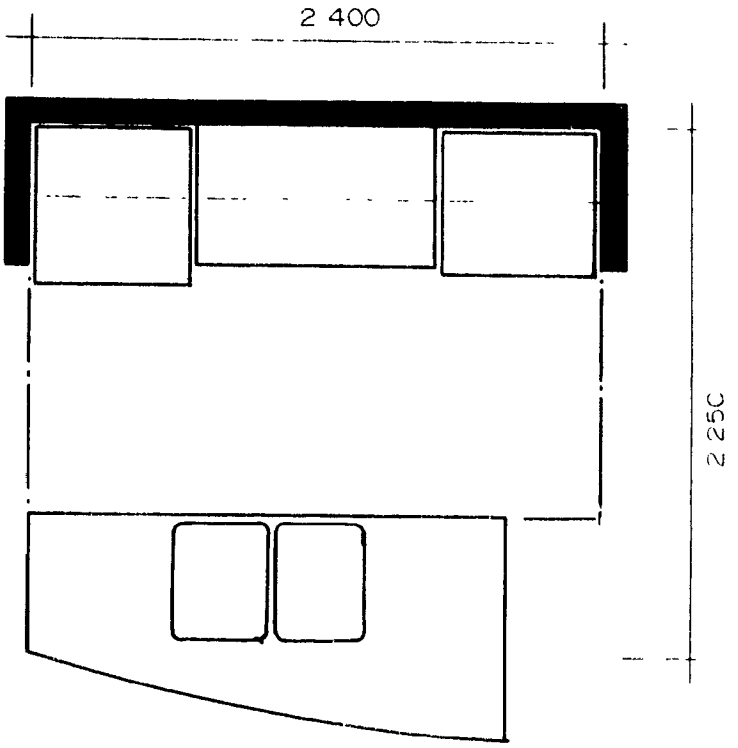
- Kitchen floor area	6.3 sq.m.
- Counter top area	1.26 sq.m.
- Base cupboard volume	1.15 cu.m.
- Wall hung cupboard volume	2.42 cu.m.
- Base cupboard shelf area	2.16 sq.m.
- Wall hung cupboard shelf area	7.35 sq.m.
- Work triangle	5 m.

KITCHEN TYPE: Galley kitchen

CONTEXT:
- Development of low income units
- Absolute minimum costs
- Apartment units
- Area of dwelling unit 70 sq.m.
- Location: Portland, Oregon

NOTES:
- One wall consists of floor to ceiling cupboards

SOURCE:
- Thompson, Elizabeth.
<u>Apartments, Townhouses and Condominiums</u>
Toronto : McGraw-Hill Book Company. 1975.



- Kitchen floor area	5 4 sq.m.
- Counter top area	1 8 sq.m.
- Counter frontage	3.4 m.
- Base cupboard volume	1.65 cu.m.
- Wall hung cupboard volume	.43 cu.m.
- Base cupboard shelf area	3.24 sq.m.
- Wall hung cupboard shelf area	1.5 sq.m.
- Work triangle	4.3 m.

KITCHEN TYPE: Galley kitchen

CONTEXT:

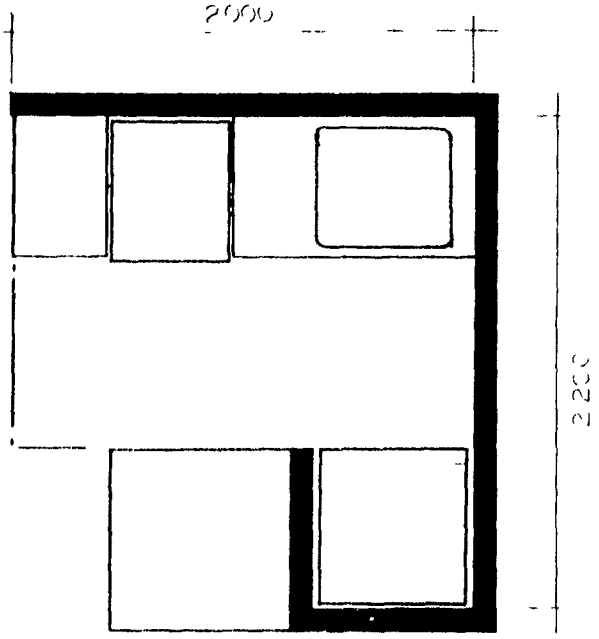
- Compact and affordable single family detached unit
- Dwelling unit for the National Council of the Housing Industry
- Housing prototype of the new American home

NOTES:

- Base and wall cupboards made of standard manufactured units

SOURCE:

- Power, Donald. Modest Mansions. Emmaus : Rodale Press, 1985.



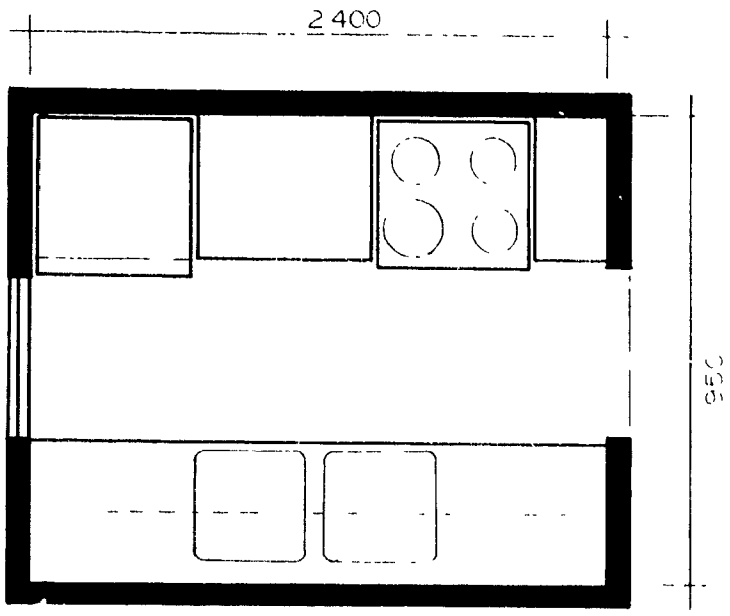
- Kitchen floor area	4.4 sq.m.
- Counter top area	1.32 sq.m.
- Base cupboard volume	1.2 cu.m.
- Wall hung cupboard volume	.4 cu.m.
- Base cupboard shelf area	2.28 sq.m.
- Wall hung cupboard shelf area	1.5 sq.m.
- Work triangle	2.9 m.

KITCHEN TYPE: Galley kitchen

CONTEXT:
- Subsidized housing project
- Renovated warehouse apartment units
- Area of dwelling unit 120 sq.m.
- Location: New York, New York

NOTES:
- Base and wall cupboards made of standard manufactured units

SOURCE:
- Thompson, Elisabeth.
Apartments, Townhouses and Condominiums.
Toronto : McGraw-Hill Book Company, 1975.



- Kitchen floor area	4.68 sq.m.
- Counter top area	2.04 sq.m.
- Base cupboard volume	1.86 cu.m.
- Wall hung cupboard volume	.50 cu.m.
- Base cupboard shelf area	3.48 sq.m.
- Wall hung cupboard shelf area	1.86 sq.m.
- Work triangle	3.3 m

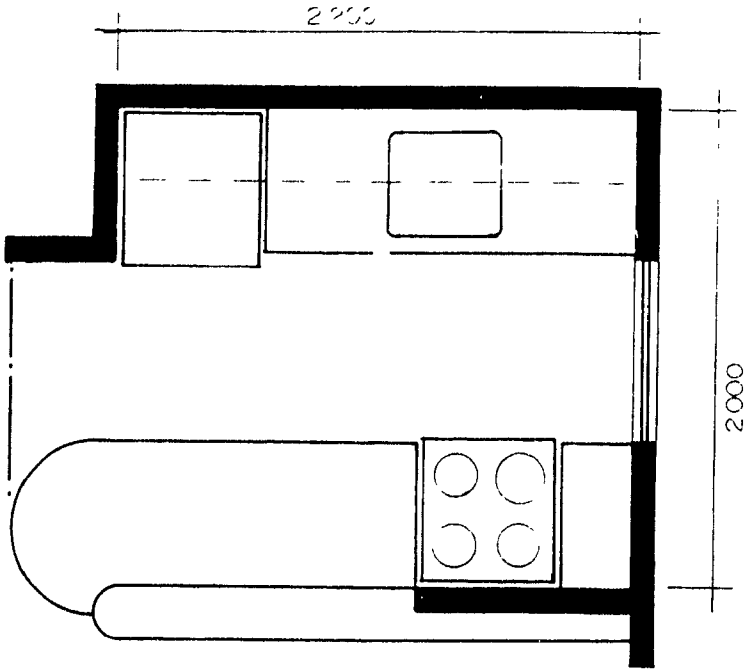
KITCHEN TYPE: Galley kitchen

CONTEXT:

- Kitchen guidelines
- Typical Kitchens and Space Requirements Committee on Kitchen and Other Work Centres of the Presidents Conference on Home Building and Home Ownership

SOURCE:

The Architectural Record January 1932 : 51.



- Kitchen floor area	4.4 sq.m.
- Counter top area	2.1 sq.m.
- Base cupboard volume	1.92 cu.m.
- Wall hung cupboard volume	.36 cu.m.
- Base cupboard shelf area	3.64 sq.m.
- Wall hung cupboard shelf area	1.65 sq.m.
- Work triangle	3.2 m.

KITCHEN TYPE: Galley kitchen

CONTEXT:

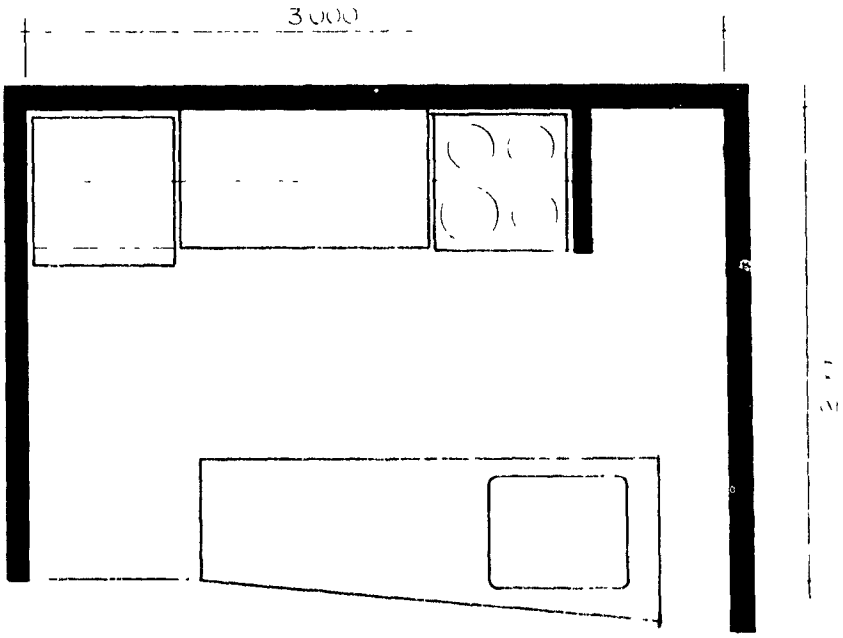
- Compact house - Affordable housing
- Dwelling unit built
- Area of dwelling unit 110 sq.m.
- Location: Madison, Connecticut

NOTES:

- Base and wall cupboards made of simplr standard units

SOURCE:

- Dickinson, Duo. The Small House.
  Toronto : McGraw-Hill Book Company, 1986.



- Kitchen floor area	6 sq.m.
- Counter top area	1 86 sq.m
- Base cupboard volume	1.7 cu m
- Wall hung cupboard volume	.37 cu.m.
- Base cupboard shelf area	3.36 sq.m
- Wall hung cupboard shelf area	1.35 sq m
- Kitchen triangle	4 5 m

KITCHEN TYPE: Island (Galley kitchen)

CONTEXT:

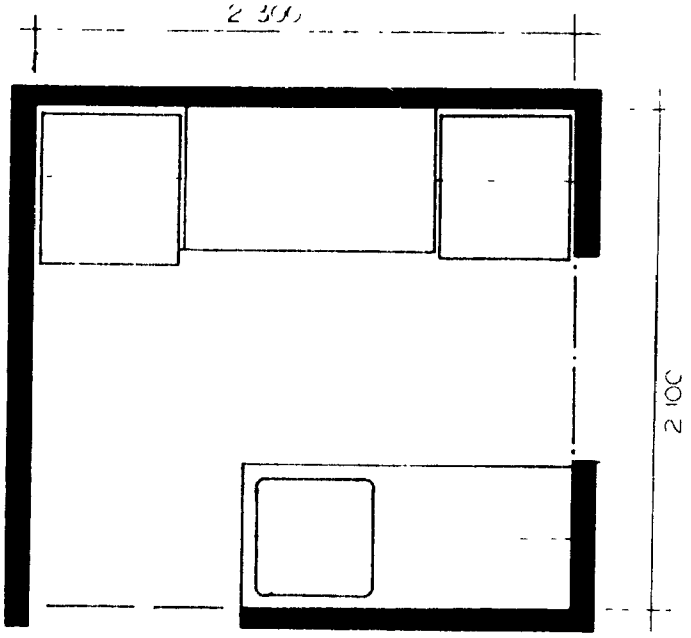
- Architect design
- Affordable compact plan
- Open planning
- Dwelling built
- Area of dwelling unit 140 sq.m.
- Location: Rural Maine

NOTES:

- Open kitchen, wall and base cupboards, exposed shelving

SOURCE:

- Dickinson, Duo. The Small House
  Toronto : McGraw-Hill Book Company 1986.



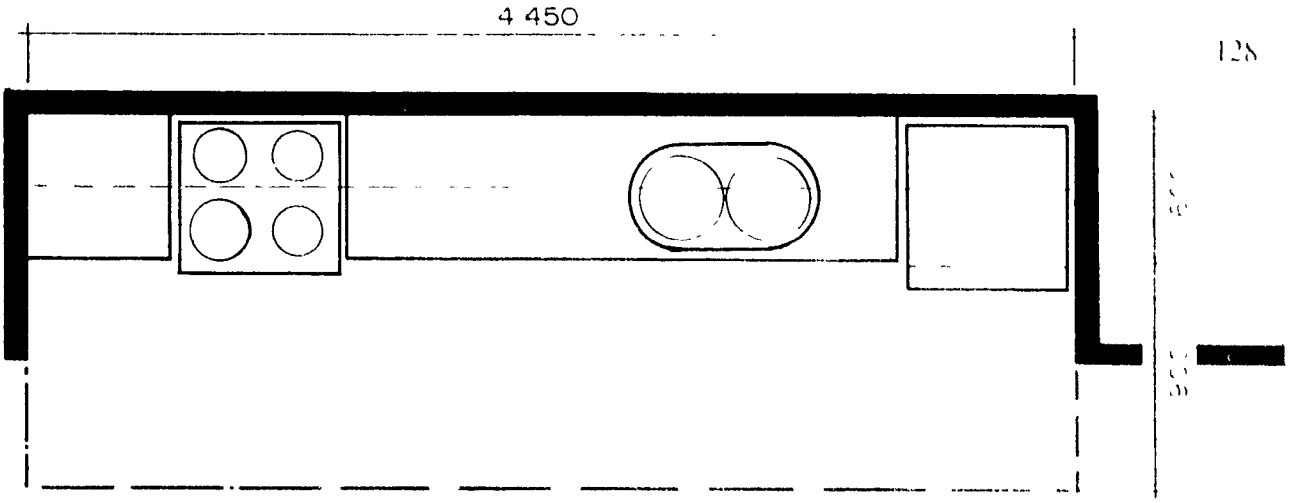
- Kitchen floor area	4.83 sq.m.
- Counter top area	1.5 sq.m.
- Counter frontage	3.7 m.
- Base cupboard volume	1.1 cu.m.
- Wall hung cupboard volume	.7 cu.m.
- Base cupboard shelf area	2.64 sq.m.
- Wall hung cupboard shelf area	2.79 sq.m.
- Work triangle	4 m.

KITCHEN TYPE: Galley kitchen

CONTEXT:
- Back to back rowhouse
- Affordable units
- Dwelling unit built
- Area of dwelling unit 125 sq.m.
- Location: Columbus, Indiana

NOTES:
- Base and wall cupboards, standard manufactured units

SOURCE:
- " Pence Place Family Housing "
Progressive Architecture. March, 1982.



- Kitchen floor area	6.74 sq.m.
- Counter top area	1.77 sq.m.
- Base cupboard volume	1.62 cu.m.
- Wall hung cupboard volume	.83 cu.m.
- Base cupboard shelf area	3.06 sq m.
- Wall hung cupboard shelf area	1.98 sq.m.
- Work triangle	7.2 m.

KITCHEN TYPE: Single wall kitchen

CONTEXT:

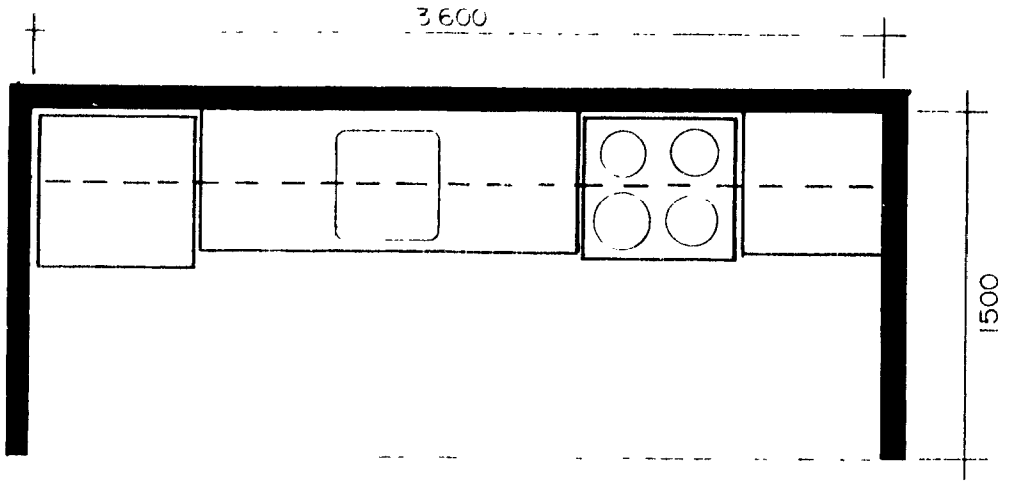
- Affordable infill housing
- Dwelling unit built
- Area of dwelling unit 140 sq.m.
- Location: Halifax, Nova Scotia

NOTES:

- Base and wall cupboards made of standard manufactured units

SOURCE:

- " Housing ". The Canadian Architect. Toronto : Southam Publishing Services. June 1990 : 19



- Kitchen floor area	5.4 sq.m.
- Counter top area	1.32 sq.m.
- Base cupboard volume	1.2 cu.m.
- Wall hung cupboard volume	.52 cu.m.
- Base cupboard shelf area	2.37 sq.m.
- Wall hung cupboard shelf area	2.69 sq.m.
- Work triangle	4.8 m

KITCHEN TYPE

Single wall kitchen

CONTEXT:

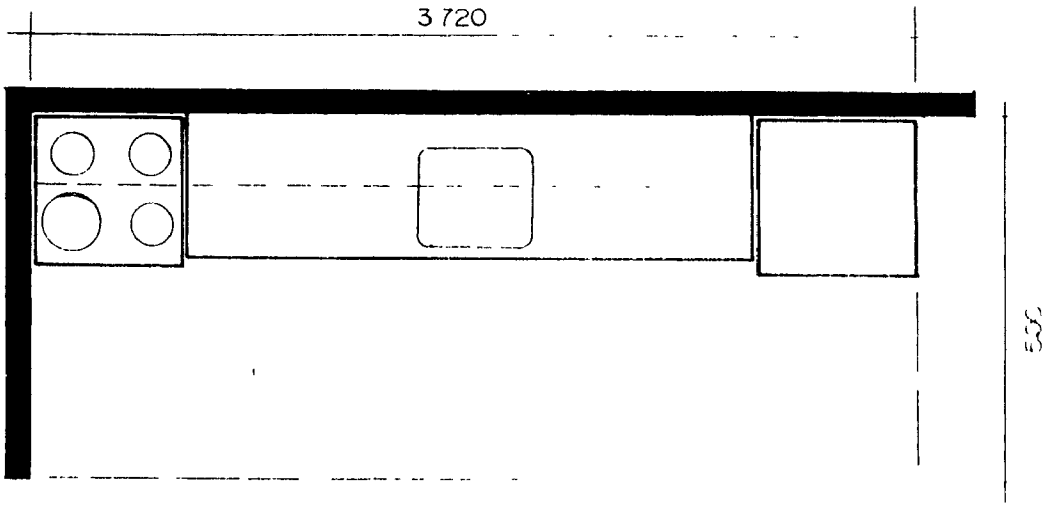
- Attached housing co-operative
- Dwelling units built
- Part of eat-in kitchen
- Area of dwelling unit 90 sq.m.
- Location: Fuglsang Park, Denmark

NOTES:

- Melamine clad particle board cupboards with stainless steel top

SOURCE:

- Fuglsang Park, Architectural Review. Architectural Press. Volume 1095, May 1988.



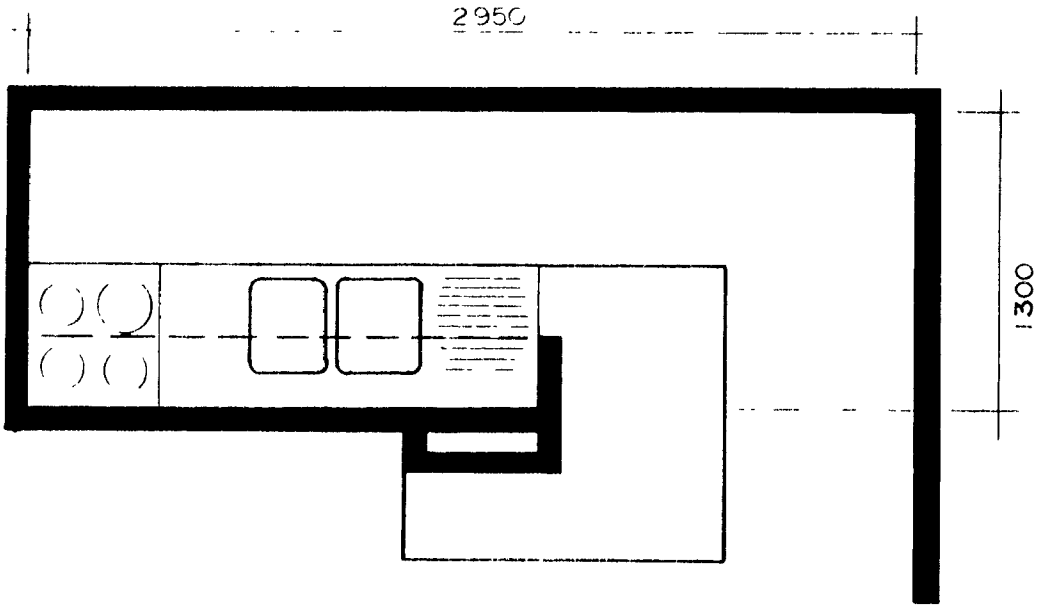
- Kitchen floor area 5.58 sq.m.
- Counter top area 1.44 sq.m.
- Base cupboard volume 1.32 cu.m.
- Wall hung cupboard volume .78 cu.m.
- Base cupboard shelf area 2.58 sq.m.
- Wall hung cupboard shelf area 2.8 sq.m.
- Work triangle 6 m.

KITCHEN TYPE: Single wall kitchen

CONTEXT: - Design standards for government assisted housing projects

NOTES: - Suggested minimum kitchen counter frontage for two bedroom units

SOURCE: - Ontario Housing Council Guide, Revision No. 7 July 1987: P B5.2



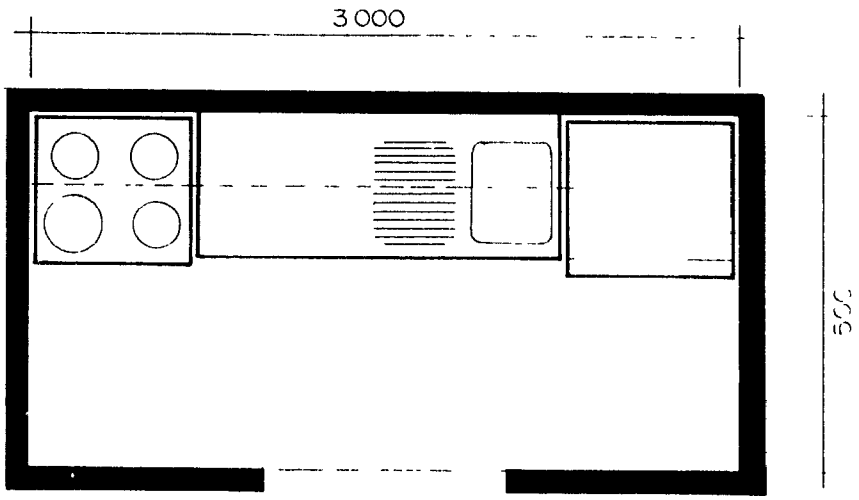
- Kitchen floor area	3.38 sq.m.
- Counter top area	1.41 sq.m.
- Base cupboard volume	1.28 cu.m.
- Wall hung cupboard volume	.39 cu.m.
- Base cupboard shelf area	1.59 sq.m.
- Wall hung cupboard shelf area	1.3 sq.m.
- Work triangle	5.0 m.

KITCHEN TYPE: Single wall kitchen

CONTEXT:
- Apartment dwelling unit
- Renovation to existing unit
- Location: Rome, Italy

NOTES:
- All base and wall cupboards customized
- Refrigerator found under sink

SOURCE:
- Arredare, Come. La Cucina. Milan. Gorlich Editore Spa, 1970 : 13



- Kitchen floor area	4.5 sq.m.
- Counter top area	.9 sq.m.
- Base cupboard volume	.82 cu.m
- Wall hung cupboard volume	.52 cu.m.
- Base cupboard shelf area	1.5 sq.m.
- Wall hung cupboard shelf area	2.1 sq.m.
- Work triangle	4.6 m

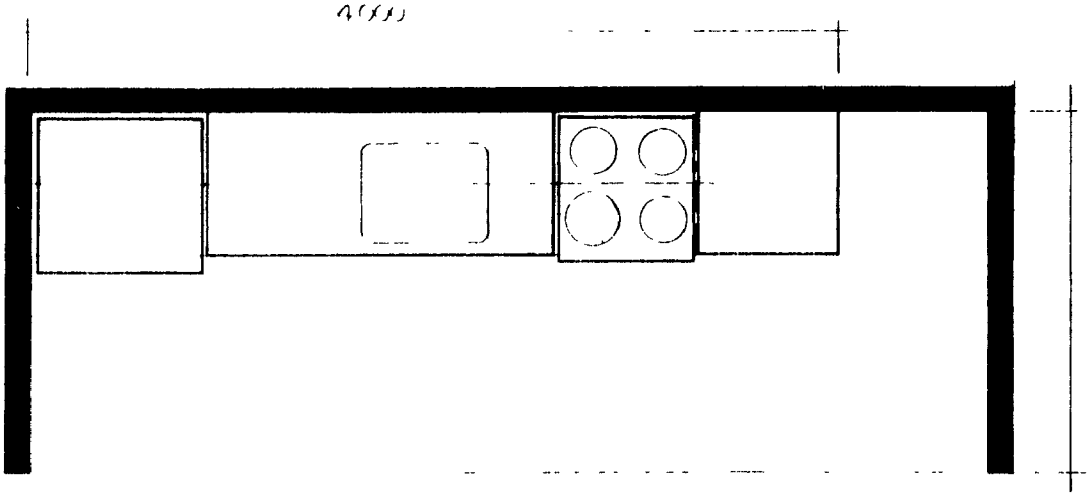
KITCHEN TYPE: Single wall kitchen

CONTEXT:

- Theoretical source of practical guidelines
- Small kitchen planning
- Study not built

SOURCE:

- Ramsey, Charles and Sleeper, Harold. Architectural Graphic Standards. New York. John Wiley and Sons Inc. 1970 : 22.



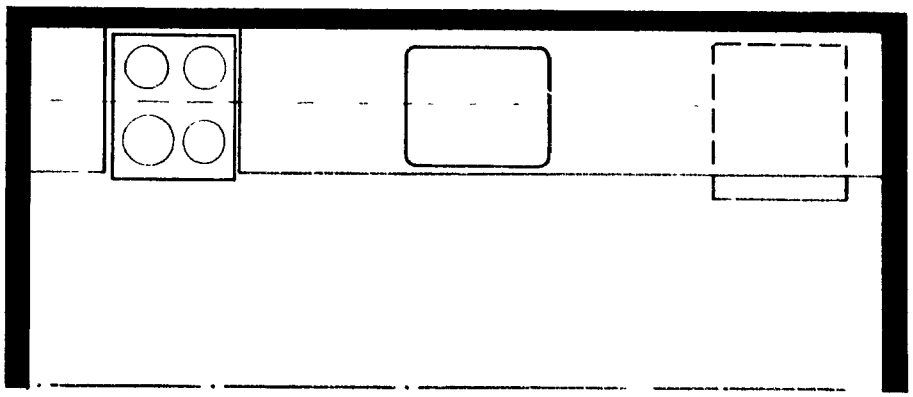
- Kitchen floor area	6 sq.m.
- Counter top area	1.56 sq.m.
- Base cupboard volume	1.43 cu.m.
- Wall hung cupboard volume	.72 cu.m.
- Base cupboard shelf area	2.76 sq.m.
- Wall hung cupboard shelf area	2.7 sq.m.
- Work triangle	4.6 m.

KITCHEN TYPE: Single wall kitchen

CONTEXT:
- Affordable housing unit
- Compact unit
- Dwelling unit built
- Area of dwelling unit 72 sq.m.
- Location: San Fransisco, California

NOTES:
- Cabinets base and wall, open shelves

SOURCE:
- Duff, Jocelyn. " Small is Affordable "
  Canadian Housing Vol 7 No. 2, 1990 : 19



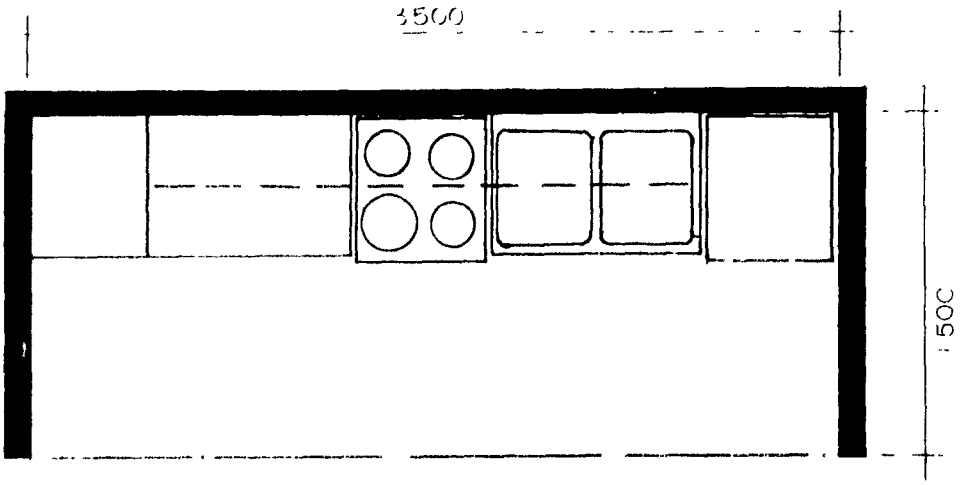
- Kitchen floor area	4.2 sq.m.
- Counter top area	1 38 sq.m
- Base cupboard volume	.99 cu.m.
- Wall hung cupboard volume	.56 cu.m.
- Base cupboard shelf area	2.16 sq.m
- Wall hung cupboard shelf area	2.22 sq.m.
- Work triangle	4 m.

KITCHEN TYPE: Single wall kitchen

CONTEXT:
- Small cottage unit
- Dwelling unit built by owner
- Low tech construction
- Area of dwelling unit 45 sq.m.
- Location: Spokane, Washington

NOTES:
- Base cupboards handmade

SOURCE:
- Walker, Lester. Tiny Houses. Woodstock : The Overlook Press, 1987.



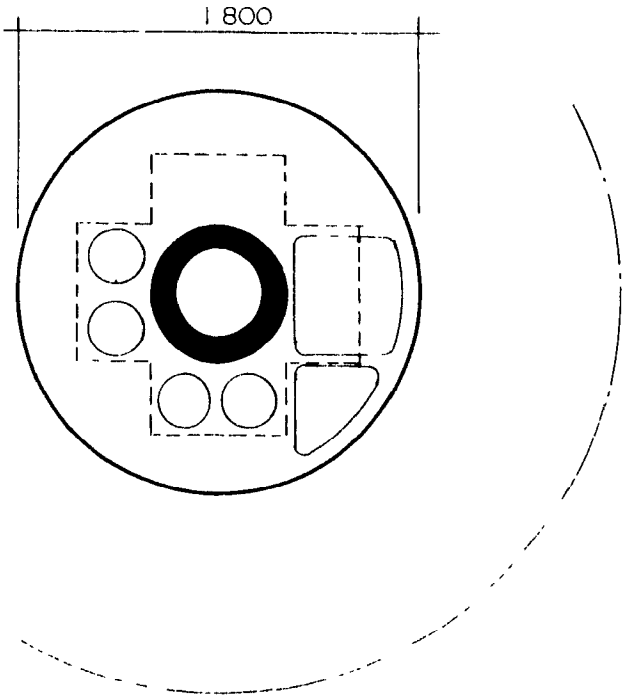
- Kitchen floor area	5.25 sq.m.
- Counter top area	1.08 sq.m.
- Base cupboard volume	.99 cu.m.
- Wall hung cupboard volume	.72 cu.m.
- Base cupboard shelf area	1.62 sq.m.
- Wall hung cupboard shelf area	2.7 sq.m.
- Work triangle	3.6 m.

KITCHEN TYPE: Single wall kitchen

CONTEXT:
- Kitchen work centre study
- Including eating area

NOTES:
- Modular kitchen components, storage and appliances come as a complete unit

SOURCE:
- Arredare, Come. La Cucina
  Milan: Glorlich Editore Spa, 1970 : 20



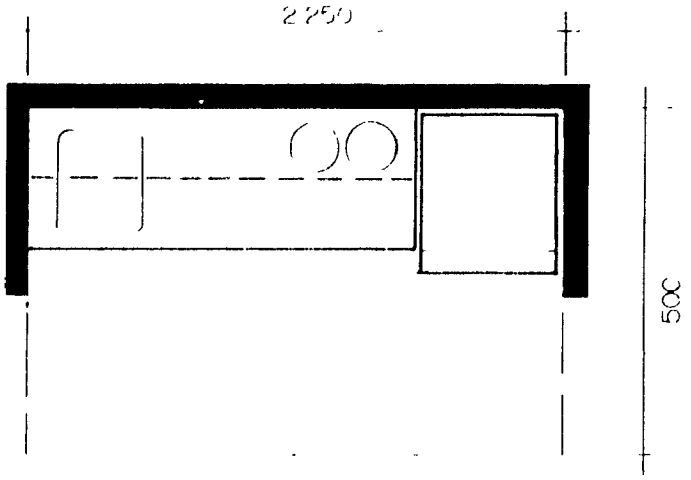
- Kitchen floor area	10 3 sq.m
- Counter top area	2.8 sq.m.
- Base cupboard volume	1.99 cu.m.
- Wall hung cupboard volume	.432 cu.m.
- Base cupboard shelf area	3 sq.m.
- Wall hung cupboard shelf area	1.44 sq m

KITCHEN TYPE: Island kitchen (Single wall kitchen)

CONTEXT:
- Design competition in kitchen planning
- Built example for demonstrations

NOTES:
- Upper and lower cupboards and counter rotate allowing for food preparation without moving
- All appliances built-in, including fridge, freezer, microwave oven and combined dishwasher sink
- Counter stainless steel, cupboards plastic

SOURCE:
- " New Kitchen Ideas for Tomorrow "
  Domus 471 February 1969 : 37



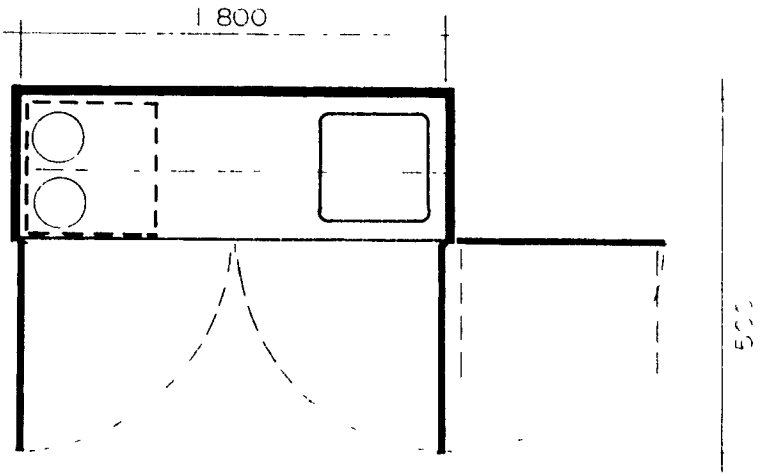
- Kitchen floor area	3.4 sq.m.
- Counter top area	1 sq.m.
- Base cupboard volume	.92 cu.m.
- Wall hung cupboard volume	.29 cu.m.
- Base cupboard shelf area	1.7 sq.m.
- Wall hung cupboard shelf area	1.67 sq.m.
- Work triangle	3.6 m.

KITCHEN TYPE: Single wall kitchen

CONTEXT:
- Low cost housing
- Shelter-transitional housing
- One and two bedroom units
- Area of dwelling unit 40 sq.m.
- Location: Brooklyn, New York

NOTES:
- Kitchen comes as a complete customized unit

SOURCE:
- Mays, Vernon. " Low Cost Housing "
  Progressive Architecture 10 : 1988 : 77.



- Kitchen floor area	2 7 sq.m.
- Counter top area	1.08 sq.m.
- Base cupboard volume	75 cu.m.
- Wall hung cupboard volume	.972 cu.m.
- Base cupboard shelf area	1.62 sq.m.
- Wall hung cupboard shelf area	1.62 sq.m.
- Work triangle	2.4 m.

KITCHEN TYPE: Closet kitchen (Single wall kitchen)

CONTEXT:

- Small bed sit apartment
- Location: London, England

NOTES:

- Base and wall cupboards made of melamine clad particle board
- Fold-out kitchen attached to closet door
- Custom sink, stove and fridge

SOURCE:

- Conran, Terence. The Kitchen Book
  New York : Crown Publishing, 1977

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BIBLIOGRAPHY

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