

INTRODUCTION

CHAPTER I

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(Housing involves many concepts. A house could be just a shelter, which is a roof above one's head and a house also mean a home which reflects one's identity and creates a base to develop relationships with others. It is a space where one expects to live with peace, security and dignity.

If we explore these concepts in the context of a woman, it is true she has a shelter above her head. But, physical amenities and designing of her house are not always planned as per her needs of health, security, and work place comfort. "Every day in our life, we use some physical facilities that have some relationship to our basic physical features and dimensions. Work space must get considerable attention in the designing of the layout" (Charles, 1976). The normal and maximum work areas, for a worker are important. A worker should not have to travel or reach farther than the maximum work area. Most of his/her motions should be within the normal work area.)

(The work areas are determined by the limitations of the human body. Thus, it becomes necessary to study the anthropometric parameters of a large cross-section of

various age groups to provide a complete picture of the diversity in size and shape of women.) This could be used as a reference data for planning ergonomically sound work place layouts, while evaluating area specifications to determine work surface heights, clearances, reach dimensions, zones of comfortable reach and postural demands during work performance. Thus, it help in enhancing operability, safety, convenience and comfort to woman while performing domestic tasks.

"Facilities such as work place, chairs, tables, storage etc, have some relationship to our physical features and dimensions. The comfort, physical welfare and performance of people can be influenced for better or worse by the extent to which such facilities 'fit' the people".

(McCormic, 1976)

(According to Saha (1990) housing is a major health problem in our age of industrialisation. Hence, this is a major field where much improvement could be achieved by considering more fully the human factors involved. Ergonomics has wider applications in the domestic field. The principles of erogonomics can also be applied to the disciplines placed under non-industrial category such as housing, biomedical engineering etc. It is appropriate to regard the domestic kitchen in specific and the work performed by the housewife in the kitchen as

a work situation.) Just as an industrial situation requires application of some ergonomic principles to govern environmental conditions, equipment design and work place layout, domestic kitchen also requires the same. (For the majority of accidents reported occurring in homes, kitchen is the site, it is the accident prone zone in the home.) Both in India and United Kingdom, the information published indicated that, accounting for 1,50,000 accidents per year 26 per cent (India) and 24 per cent (U.K) of all domestic accidents like fall, burns etc occur in one place i.e., the kitchen (Varghese et. al., 1989 ; Ward, 1974). There are two separate groups of ergonomic problems which arise in the field of building. They are related to the needs of the future occupants and to the actual physical task of erecting buildings (Page, 1960). This however is handicapped by the fact that the available literature on ergonomic principles is widely scattered and not easily accessible to the architectural profession. It is, therefore, suggested that it would be useful if the ergonomic research society and other related fields provide the ergonomic material to the building designers. (According to Dhesi and Devadas (1975) the development and evaluation of the design of the houses need to be based

on criteria such as anthropometric measurement, physiological factors, activity patterns, thermal factors and non-thermal factors.

Ergonomics is the scientific study of man in relation to his/her work and work environment, primarily aiming at increasing efficiency and productivity with emphasis on promotion of health and well being of man at work.) The International Labour Organisation has defined it as "the application of human biological sciences in conjunction with engineering sciences to the worker and his working environment so as to obtain the maximum satisfaction for the worker which at the same time enhance productivity". According to Rodger and Cavanagh (1962) it attempts to 'fit' the job to the man rather than to 'fit' the man to the job. But, ergonomics of the home is the science of analysing the normal operations of the human body under domestic conditions. Its purpose is to define human needs, so that buildings, rooms, structures and fitments can be designed to suit them (Grandjean, 1973).

Anthropometry is one of the six disciplines in ergonomics. It deals with measurements of physical features of the human body. These may include body

dimensions such as linear dimensions, range of motion of the parts of the body, muscle strength, weight and volume. Reliable anthropometric data based entirely on the human body dimensions provide a tool and guide line to the architects for designing of all building. It is also a very useful tool specially for designing of work surfaces, storage spaces and other fixtures. It also helps in establishing the maximum and minimum levels of working planes and in the organization of storage and placement of equipment (Le. Corbusier, 1951; McCormic, 1970; Dhesi and Devadas, 1976).

Static anthropometric measurements provide necessary information about the range of body dimensions. Functional measurements are essential to define the boundaries for location of controls. However in addition to taking functional arm reach measurements, various static measurements are also essential because of their apparent relationship to functional arm reach.

Anthropometry, bio-mechanics and work study are the disciplines which contribute greatly to the field of housing. They help to establish the principles and standards for designing of equipment, functional house plan, work space etc, bringing them into harmony with

size, shape, mobility and structure of human body. Human beings vary from group to group and from culture to culture. Differences in age, sex and race are obvious but are more critical causes of physical variations. Therefore, it is not enough to design to suit an average person. It must cater to a wider range of operator size (Daftuar, 1972; Bullock, 1974; Grandjean, 1988). But no design can be optimal for all people, therefore adjustable work places, equipment etc. which accommodate individual differences are very desirable. Most work places require attention to more than one anthropometric characteristics (Reinhold, 1983).

The inter-relationships between human dimensions and the house design, equipment design etc. can be said to be ideal when it costs least to the human body while performing the task. Measurement of the personal cost of work requires not only a broad concept of the human costs, but also the use of knowledge about two other dimensions i.e., the work and the working environment. During recent years there has been considerable interest in the application of ergonomics to the domestic situation (Berglund, 1960; Bouweentum, 1963; Ministry of housing and local government, 1965). Some describe only overall space requirements in the kitchen,

while others (Bateson and Whyte, 1953 and the council for scientific management in the home, 1961), are largely concerned with the provision of adequate work surfaces of appropriate form and size placed in proper relation to each other to facilitate work in the kitchen. It is evident that an ergonomic approach can improve safety and posture. This is done mainly in two ways i.e., by improving the design and layout and training people to use correct posture.)

(In the occupation of homemaking, women perform variety of tasks, duties and responsibilities. But the study of homemaker's work is almost a neglected area. The research in this aspect calls for a series of purposes viz., use of human resources in accomplishing work, requirement of user in the work place and the ergonomic background to guide the functional design, placement, and arrangement of work place. The physical cost of the work of the home is to be thought in terms of effects on all systems of the body that function during work. Steidl and Bratton (1968) say that movement made during work performance may constitute beneficial exercise or they can even subject parts of the body to stresses if work place is not planned well.)

(Homemaking is still a full time occupation of many Indian women. They spend a large proportion of their time in the kitchen. Studies indicate that women spend 5-6 hours a day in the kitchen. According to Sangel (1959), a kitchen is a place of work in the house where day long activities of the housewife go on. A well planned kitchen can reduce the demand upon the time and energy of a housewife and can avoid fatigue and frustration caused to her. Therefore, it is very desirable that great thought should be given while planning the kitchen. Review of literature indicates that kitchen activities demand a high degree of physical effort leading to fatigue. The major causative factors responsible for this are the static muscular effort and adopting unnatural postures, mainly resulting from poor design of the kitchen layout and storage shelves.) With the bad designs of kitchen and storage layout even normal persons without primary anatomical or physiological defects develop degenerative tissue changes and functional defects in the musculo-skeletal system due to the stresses induced by long enforced postures. In the area of ergonomics much effort has been made to perfect tools and equipment for their efficient use. However, one aspect of research is obviously missing i.e., the

measurement of the dimensions of work space and work place in the designing of kitchen and storage relative to the human scale specially in Indian homes. (Thus, domestic kitchen and its storage facility stress the need and requirement of application of ergonomic principles that are applied to industrial situation. Nickel and Dorsey (1960) have stressed the importance of easy reaches while working in the kitchen. According to them "the height of the working surface should be given careful attention because comfortable height suited to the worker permits good working posture. Good standing position is possible only when the height of the working surface is built to the physique of the worker". The vertical and horizontal distances that people can reach are of considerable importance. Woman's vertical reach is of critical significance for the layout of cupboard space and shelves, as well as placement of fittings such as the switches, watertaps or electric sockets (Grandjean, 1973).) Further the author has suggested some factors for the design of cupboards, shelves and storage surfaces. The factors are :

- The vertical reach as determined anatomically.
- The most comfortable and maximum height that can be reached when standing free or hindered.

- Access in relation to the depth of the storage surfaces and their height above ground.

For this, body measurements are helpful in indicating the ranges that need to be considered in planning the heights, widths and depths for storage units and work surface in the kitchen.

Homemakers frequently or sometimes perform the tasks for a long period on work surface. But, the body mechanics of working in this position has had surprisingly little and only superficial attention in spite of its importance to the work of the home.

"There is no single posture which is correct for every one. Good posture should be comfortable, easy to maintain for long periods and not produce strain".

(Herald of health, 1984).

Due to bad posture the muscles can not relax properly and sustained tension in the muscle becomes habitual. This results in impairment of circulation which hampers nourishment and causes accumulation of waste materials. In the more severe cases actual discomfort may develop when the condition is referred to as 'fibrositis' or 'rheumatism'.

The action of the muscles in maintaining body balance is affected by bad posture. When there is a danger of the body being unbalanced, the muscles of the lower limbs contract to make the limbs more efficient and provide them with prop. It is for this reason the correct posture adjustment of the lower limbs is essential when doing different types of jobs. If they are parallel when bending or lifting, the lower limbs stiffen automatically so that no further assistance is obtained from their contraction and the movements are limited to the arms and upper part of the body causing more strain on them. Incorrect posture will increase energy consumption of the task and it also will lead to permanent changes in the body resulting in diseases and infirmity. Postural strain has more profound effect on the body as a whole when associated with a 'doubled up' position; in this way the action of heart, lungs and digestive organs are restricted. At the same time depression of the spinal column retards the blood circulation in the nerve centres of the brain and spinal cord and further lowers the general vitality. The importance of correct posture at work is directly related with efficiency, safety, good health and well being of workers.

So, a correct posture for work is "a posture which does not impede breathing, hamper circulation, interfere with proper muscular activity and hinder functioning of internal organs" (Chakraborty, 1974). Therefore, in order to maintain good posture at work and at rest it is important to check the suitability of working height and seating height for each individual. Although the idea of the physical size of the person is somehow related to his/her ability to work is accepted, this concept is neglected in every day thought and designing of work place. Hence, design of functional plan and work place requires anthropometric data which are appropriate to the population of users for whom the plan is intended.

A review of existing literature on 'ergonomics at home' indicates that Indian architects and product designers rely on conversion of Western standards. The architect and client rarely meet face-to-face to identify the client's needs and preferences and also to discuss the design solutions. Since the individual architect does not have time to undertake a full assessment of the user needs, he/she makes many apparently common sense assumptions which may or may not fit in with the actual requirement. For the design of dwellings, each

person/agency has its own set of standards which have been formulated by its decision making officials based on their experience and intuition. These standards considerably vary in the provision of work spaces and areas for the same category (Tyagi, 1979). Therefore, he needs a systematic body of knowledge or a list of standards of user's requirements. With these informations he can blend it with his technical knowledge and create an environment which is more functional, economical and to the satisfaction of the users.

A. RATIONALE FOR THE STUDY

Design of the functional plan and work place requires anthropometric data which are appropriate to the population of users for whom the plan is intended. According to Bhavnani's observations (1965), the shelves for kitchen storage were too high for homemakers to reach. The counters for working were built at a very low height which caused stooping and straining. In some houses depth of the counters was too narrow or too wide. Documentation of data both in India and abroad reveal that many sources of variables cause differential pattern in anthropometric data. This clearly indicates specifications of work place layout based on anthropometric measurements of one region may not be ideal to people of other region. So,

generation of specifications of work place layout specially for kitchen and storage based on body measurement is essential. Regionwise anthropometric data and ergonomic implications will facilitate to formulate the standards or norms at national level for housing construction.

Although many houses are being constructed privately and through mass housing schemes, the problem of functional design is not solved. Khanna (1968) and Sokhey (1968) evaluated the house plans and studied the expressed satisfactions in Chandigarh. They found low mean satisfaction scores for kitchen evaluation when compared with other aspects of house plan viz., circulation, landscape, site and flexibility. Ogale (1975) investigated the housing values and satisfaction of homemakers living in co-operative ownership (owners) housing, Baroda. Her findings indicated that the occupant homemakers were satisfied with respect to several aspects of housing such as privacy, economy, protection, sanitation, circulation, flexibility. However, large number of families were dissatisfied with the storage facility in general but, with respect to adequacy of kitchen storage many were satisfied. Katwala (1976) evaluated the co-operative ownership housing societies in

Baroda, to see whether the house plans are suitably designed to fulfil the needs of families. She found that the selected features of the house plan viz., floor plan, built up area, number of rooms, size of doors and windows, base cabinets, were not found to be satisfactory when evaluated on the basis of the specified standards.

In designing of the house, kitchen and storage areas need special consideration of anatomical measurements of the users. Hedberg et. al., (1981) insist that the dimensions of the working place should suit the worker, since incorrect design can cause physical and psychological discomfort. Swamy (1966) studied the attitudes of homemakers towards storage areas in their homes at Roorkeela, Orissa. Most of the homemakers were dissatisfied with the location, width, height and depth of the storage units. Nadvi (1971) developed guides for setting up storage cabinets for tools, utensils, containers at cooking and preparation centres for L-shape kitchen. Her guidelines were restricted to specific number of tools, utensils and for containers, under laboratory condition. Varghese et. al., (1989) studied the existing kitchen design in Bombay city. They found that due to lack of adequate space and disorganised work centres and storage areas in small kitchen houses, storage

was kept outside the kitchen. Work counters were unsatisfactory and not convenient in majority of the houses. Maximum storage in small kitchens was found to be at a higher level requiring a stool to reach the supplies. Patel (1971), Gupta and Dhesi (1975) suggested special space requirement for some selected activities viz., washing dhal, vegetable, rolling, cutting, churning, kneading dough, grinding spices, frying vegetable and puffing chapatti. They found space requirement differed for all activities. This is because of body-type, requirements of tools and equipment for different activities and elbow extension. Tyagi (1979), recommended space standards for economically weaker sections, keeping in view the user's capacity to adopt. He says, each dwelling unit must have a living space (not less than 9 sq. mt.), multipurpose room (small, not less than 5.0 sq. mt. and large, not less than 6.0 sq. mt.). Toilet and bathroom may be combined or separated : if it is combined not less than 2.2 sq. mt., if separated, bath, not less than 1.4 sq. mt. and toilet, not less than 1.1 sq. mt.

(Thus, under Indian conditions although the attempt has been made for data documentation on various aspects of housing, ergonomic implication for domestic

condition has been ignored to a greater extent and relationship between body dimensions and the design of working place in the kitchen and storage has not been given importance.) Although the incidences of ergonomic application in kitchen and storage designing is available, it is scanty and in piece-meal. Pheasant (1982) reported that, the anthropometric characteristics of any population are dependent upon the large number of biological, social and demographic variables and hence location of suitable data is essential. So, this indicates that there is a dire need for technical guides based on anthropometric data and user study data for space, work place planning. It is very important to know one's easy reaches while working in the kitchen which will enable the worker to do kitchen tasks with minimum effort by storing all tools, supplies and equipment within easy reach in order to reduce shoulder lifting. According to Nickell and Dorsey (1960), good standing position is possible only when the height of working surface is built to fit the physique of the worker. If the work surface height is high the shoulder must frequently be lifted up, which may lead to painful cramps in the neck and shoulder. If it is too low also it causes backache. It is also necessary to have

details of arm reach in order to decide positioning of the shelves, control switches etc.

The above discussion justifies that designing of work surface height and depth, storage shelves height and depth require standards based on anthropometric data. But there is inadequate information regarding this aspect for Indian homemakers of various regions. There is a strongly felt need for such valuable information, hence it becomes necessary to study the anthropometric parameters of a large cross-section of people to provide a complete picture of the diversity in size and shape among women which could be used as a reference data in planning work place layouts in the house. The present study with the following objectives will fill the existing lacuna in the planning of functional kitchen and storage.

B. OBJECTIVES OF THE STUDY

Broad Objectives :

1. To collect the anthropometric data for the selected bodily dimensions of women of Northern Karnataka state for the purpose of work space and storage design in the kitchen.

2. To frame the standards for work surface height and depth and storage height and depth reaches of women of Northern Karnataka State.

Specific Objectives :

1. To record the various anthropometric measurements of a large cross-section of women residing in Dharwad City of Northern Karnataka state.
2. To study the normal and maximum vertical and horizontal reaches of women in standing position.
3. To investigate the convenient reach of shelf height and depth in standing position with and without obstacle.
4. To traverse the diversity in anthropometric characteristics of the sample, due to background variables.
5. To examine the interrelationship of selected anthropometric parameters.
6. To establish the standards for designing of fixing of vertical fixtures, work counter and storage shelves in the kitchen.
7. To assess the existing measurements of work surface, shelf height and depth, in the kitchen and storage areas of selected subsample households and to compare them with the standards evolved from the study.

8. To suggest the design of work surface and storage based on standards evolved.

C. ASSUMPTION OF THE STUDY

The present study was undertaken with the following assumption.

1. Women of Dharwad City of Northern Karnataka state differ in their vertical and horizontal (standing) reaches according to their body measurements.

2. The existing work surface and storage shelf dimensions in the households of Dharwad City are not suitable to the body measurements of the users.

D. HYPOTHESES :

The following specific null hypotheses were framed to assess the relationship between the variables under the study:

1. There is no association between the anthropometric characteristics and the following background variables :

- (a) Age of the respondent
- (b) Marital status of the respondent
- (c) Number of children
- (d) Food habit

2. There exists no significant interrelationship among various standing heights, sitting heights and circumferential measurements while standing.

3. The existing work surface and storage measurements in the kitchen do not differ from the standards evolved.

E. DELIMITATION:

The study was limited to :

1. Dharwad city of Northern Karnataka state.
2. Women belonging to middle income families and in the age group of 18-50 years without any physical deformity excluding the pregnant and lactating women.
3. The houses having facilities of standing work counter and storage shelves in the kitchen.