

Technical Progress and Ergonomics in Contemporary Domestic Kitchen

Jerzy Charytonowicz and Dzoana Latala-Matysiak

Wroclaw University of Technology, Department of Architecture
53/55 Prusa Street, 50-317 Wroclaw, Poland
jerzy.charytonowicz@pwr.wroc.pl,
dzoanalatala@wp.pl

Abstract. Technical progress, thanks to which the contemporary kitchen achieved the current shape, initiated changes going towards adapting the kitchen equipment to widely understood needs of the user. The whole of current studies concerning the ergonomics of the kitchen area in apartment is insufficient, it doesn't fulfill contemporary designing requirements. Verifying and updating previous research, supplementing them and presenting in the form of designing criteria is essential. Taking into consideration all needs of contemporary family, diverse by age, fitness and agility, it is necessary to provide optimal and widely understood quality of kitchen area.

Keywords: domestic kitchen, technical progress, ergonomics.

1 Introduction

Domestic kitchen has changed during the last thirty years – from a closed work area it has evolved to an open, functionally most important area in apartment.

Small laboratory kitchen, which was invented in 1926, became a standard kitchen solution, especially in a common block of flats, till almost late 80's of 20th century. However, narrow kitchen, limited space and the isolation of a housewife during kitchen works soon met with criticism [1]. That resulted with changes in the functional layout of new and renovated apartments - the outcome was the open kitchen, partly or entirely connected with a living room.

The opening of the kitchen was determined by technical progress as well, among others by inventions like kitchen electric hood [1]. The kitchen area was no longer a neglected, hidden part of the flat. The appearance of contemporary kitchen and its specialized equipment more and more encourages to share kitchen works with family members and to spend time together during preparing and having meals. Technical progress, thanks to which the contemporary kitchen achieved the current shape, initiated changes going towards adapting the equipment to widely understood needs of the user. The lifestyle has changed in many ways – the television promotes collective, family cooking, and it gives impression of participation, satisfying a subconscious and deeply coded (in a man) need to stay in family circle, group of relatives or

friends during the food preparation and dining [1]. The open kitchen model is conducive to social and family integration process, and it's a solution used more and more often as a visible sign of changing image of domestic kitchen, which comes back to the primary central location against a background of the house or apartment – like a prehistoric bonfire or centrally situated hearth in primitive civilizations [2].

2 What the Technical Progress Caused

The technical progress was an unquestionable, contributory cause of changes in the kitchen area. It manifested by bringing into the residential area new equipment and appliances, new technologies, production engineering (in the kitchen it's a food preparation process). So called technical novelties still occur, thanks to whom the domestic kitchen is changing not only by its appearance, but also in relation to functional and applied features. An aspiration for improvement of appearance and quality of kitchen equipment details is an effect of those changes, and implementation of solutions which raise a prestige of a kitchen space, simultaneously increasing the comfort of its everyday usage. The kitchen area is the most intensely used, highly filled with mechanized, electric equipment. It's a multimedial and technologically advanced area, where a lot of dangerous activities connected with food preparation processes take place – it's like a laboratory, where high temperatures, chemical detergents, sharp utensils, electricity and water can cause life hazard [1]. It is necessary to admit that it's a side effect of technical progress, mostly because of electrical equipment and huge variety of chemical substances and materials.

The domestic kitchen has evolved from closed work area to an open and the most important functional area in the apartment. It's more and more often designed as an open kitchen, connected with a living room, creating one multifunctional and united area, which is pro-social and generally ensuring the family comfort of performing kitchen works. The kitchen can also be solved as so called kitchen room – a closed, separated room, which looks, despites of its character, like a representative room: a living room. The kitchen furniture doesn't look like kitchen ones, but more like furnishing of the living room. It doesn't have to be closed area of course, but can be connected with living room, so that is really hard to notice where the kitchen area begins [2].

Technical progress, thanks to which the contemporary kitchen achieved the current shape, initiated changes going towards adapting the equipment to widely understood needs of the user. Therefore the kitchen is more and more often user-friendly, which means it's adapted to individual needs of diverse users, fit and disabled, old and with different level of agility and efficiency [2]. The technical progress caused the entry of mass media into the kitchen area. All kind of equipment connected with the Internet and also devices equipped with response systems, are able to choose and take up previously programmed functions and perform intelligent reactions in specific cases as well. Thanks to so called the intelligent systems, efficient managing of the entire household and controlling the individual devices efficiency is possible [2]. Some innovative kitchen equipment, more frequently used lately, is equipped with devices

such as saving water or electricity, which makes the kitchen ecological. The technical progress takes care of an environment and also reduces overall costs, letting the user to save money. By using the “safe in use” kitchen equipment it is possible to reduce or even eliminate accidents and health hazard. There are lots of kitchen tools and devices equipped with all kinds of security systems, especially childproof. Ergonomic shapes, easy to use and intuitive control panels, are only examples of technical progress influence, connected with amplified care of the user and wide knowledge about consequences that the progress brings into the daily life, and also a need to design with care for the users’ safety with special needs (disabled and advanced in years) [2]. So called the island kitchen, both open and closed, is an attractive solution, ensuring very good conditions for all kitchen works and also conducive to tightening the social and family bounds. The island kitchen is more and more common element of kitchen equipment, and it can establish some kind of border between two areas: the kitchen and the living room, creating one shared multifunctional room. The kitchen island (furniture and equipment) takes most functions of the kitchen line, including with function of equipment and food storage in lower area of the kitchen island body [2]. Enormous variety of kitchen equipment and kitchenware gives unlimited possibility of choice and individualization in the kitchen area, however it’s necessary to be guided by ergonomic criteria of kitchen designing to make this choice optimal.

3 Ergonomics in Domestic Kitchen

Intuitive nature of facilities, which were introduced in the kitchen area from the beginning of mankind till almost 19th century, confirmed the need of conscious shaping the work environment in household, especially in the kitchen area [1]. The progress of ergonomics science took place through a wide range of research conducted by psychologists, physiologists and anthropologists for the military services during the World War II [3]. Discontinuous by warfare research were continued and although a lot of kitchens didn’t fulfill standards of the time, research were aspiring to implementing those standards. Till the end of the first half of 20th century the research were run in a lot of European countries to the wide scale [4]. Soon the ergonomics issues appeared in workplaces, universities and in the industrial design studios. The ergonomics science was developing together with technical progress. Unfortunately the whole of current studies concerning the ergonomics of the kitchen area in apartment is insufficient, it doesn’t fulfill contemporary designing requirements, mainly with regard to sudden technological development of the kitchen equipment and due to secular trend [5]. To sum up the results of previous results of research, relating to domestic kitchen area it is possible to pull the following conclusions out:

- the whole of current studies concerning the ergonomics of the kitchen area in apartment is insufficient, it doesn’t fulfill contemporary designing requirements, mainly with regard to sudden technical progress, which took place at the turn of 20th and 21st century. It is connected with increasing number of technologically and materially advanced kitchen devices

- the efforts of kitchen equipment manufacturers to provide widely understood ergonomic quality of their products are most often confined to specific solutions, but they don't guarantee integrated kitchen equipment; that's conducive to health hazard in the kitchen area
- improper spatial arrangement and limited kitchen area also generates health hazard, limited motor and manipulative space in small kitchen requires special attention and careful arrangement
- existing and still used apartments in blocks of flats built in 70th of XX century need the ergonomic correction in order to adapt to contemporary needs of the users
- with regard to rapid technological development of kitchen equipment, its computerization, introduction of intelligent technologies, multimedia, the Internet, and due to secular trend, the whole of current studies concerning the ergonomics of the kitchen area in apartment is insufficient, it doesn't fulfill contemporary designing requirements

Because of above mentioned, verifying and updating previous research, supplementing them and presenting in the form of designing criteria, fulfilling the present requirements, especially ergonomic directives, is well grounded and necessary.

3.1 Ergonomic Designing Criteria

Among others, the kitchen area is the most intensively used area in apartment. More and more often multifunctional, should be well equipped with devices and furniture which are comfortable and safe to use, in order to carry out the meal preparing process and to facilitate comfortable consumption. As the functional area, which should integrate the family, the kitchen should enable necessary works to all users, regardless of their age, sex and level of psychophysical efficiency. That's why it's so important for the kitchen to be flexible, mobile and possible to adjust to diverse and changeable in time needs of the users. The kitchen area designing should provide for necessary space designed both for equipment and its usage. Equally important issue is to ensure the motion area, which should enable collision-free moving and walking in the kitchen.

3.2 Specific Spatial and Motor Requirements of Individual User

Kitchen designing and optimal selection of comfortable and safe kitchen equipment should be preceded by defining specific spatial and motor requirements of individual user. For designing the kitchen area one should use an anthropometric atlas, however the data concern to phantoms in static positions, without consideration the body position change during movement or free position (not standing on attention); those are closer to natural body positions, typical of man ready to take action. Therefore the anthropometric atlases require widening the range of data. It was proper to analyze particular elements of kitchen equipment and functional areas by means of extreme planar percentile phantoms of man and woman (defined as C5 and C95) in dynamic positions during housework. The motion area (walking path) and maneuver space

should be set according to features and motion possibilities of a high person – by 95 percentile (95C) male phantom, because it enables comfortable walking and working for all kitchen users. The outreach and grasp scope should be set down individually for a very high man (95C) and for a very short woman (5C) [5].

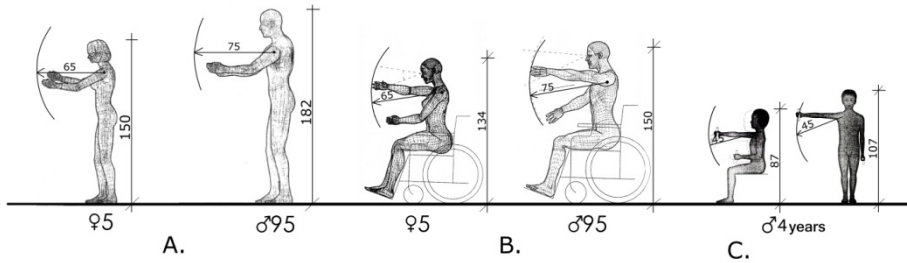


Fig. 1. The comparison of heights and outreach of phantoms: A. a woman 5C and a man 95C, B. a woman on a wheelchair 5C and a man on a wheelchair 95C, C. 4 years old child (Source: own work)

The motion area and maneuver space is different for disabled users. The most space is required for people on wheelchairs with regard for size and the way of wheelchair drives. To take into consideration the sitting position of work - the space of operation and outreach is significantly different (Fig. 2).

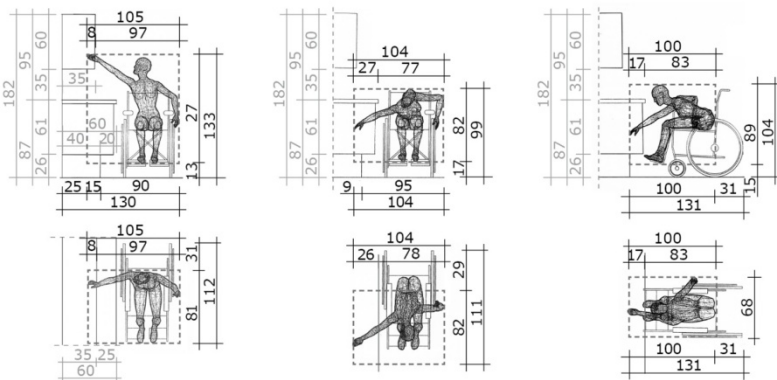


Fig. 2. An example of carried out analysis: the usage of typical kitchen cabinets by disabled wheel-chaired phantom of a very short woman (5C) (Source: own work)

Children also belong to the group of people of temporary limited efficiency (fitness) connected with age – a characteristic reduced body proportion and of course different spatial and motor requirements. It is necessary to pay attention that not every

device should be adapted to children motion requirements, and more - some should be protected against them, preventing the uncontrolled use of those electric and dangerous ones.

3.3 Conclusions

As a result of conducted research – the somatography analysis, among others, following issues were verified:

- depth of working tops – it is suggested to increase it to 80cm, instead of commonly used 60cm
- height of working tops – it is suggested to increase it to 90-95cm
- width of the route along kitchen furniture and equipment – it is suggested to increase it to 165cm.

The research complemented existent recommendations; it has been noticed that, among others:

- raising of devices location level eliminates the necessity of assuming the uncomfortable body positions and also reduces the service area
- the use of all kind of drawers and systems which let to slide out the inside of device (e.g. oven, fridge drawer, lower cabinets drawer) is a solution which reduces the uncomfortable body positions and enhance the visibility
- it is necessary to locate dangerous kitchen equipment aside from the children outreach and to use integrated security systems. It is suggested to relocate all kind of devices deep into the end of working tops (e.g. cooker plates, electric devices and kitchen appliance)

It is strongly recommended to design so called spare area –the area which is enlarged to the functional and motion needs of the user– disabled in wheelchair – especially as the kitchen area adapted to special requirements of disabled, is also comfortable for fit users. Special needs of disabled in wheelchairs concerns outreach limited by sitting position.

4 Kitchen Models

In order to facilitate the design process of new kitchens and the rearrangement of existing ones, the models of kitchen layouts in different quality standards (low, medium or high) were suggested:

- low standard kitchen area – equipped with necessary devices and kitchen equipment, with minimal working and maneuver space, addressed to small family (young childless couple, couple with grown children etc.)
- medium standard kitchen - equipped with standard devices and kitchen equipment, with average working and maneuver space, addressed to a family with three or four members (couple with one or two children etc.)

- high standard kitchen - equipped with all kind of devices and the newest kitchen equipment, with increased working and maneuver space, addressed to a family with three, four or more members (couple with two, three or more children, plus grandparents etc.).

Designed classification of above mentioned kitchen standards follows the assumption about family members (number of the kitchen users). The kitchen standard is also connected with brand and quality of kitchen equipment, which often comes of users finances and their personal preferences. However the dimensions of kitchen devices or furniture, as well as their choice, should be dependent on area and space which they take up. The L-shaped kitchen model scheme in three quality standards shows the main differences in kitchen designing (Fig. 3, 4, 5).

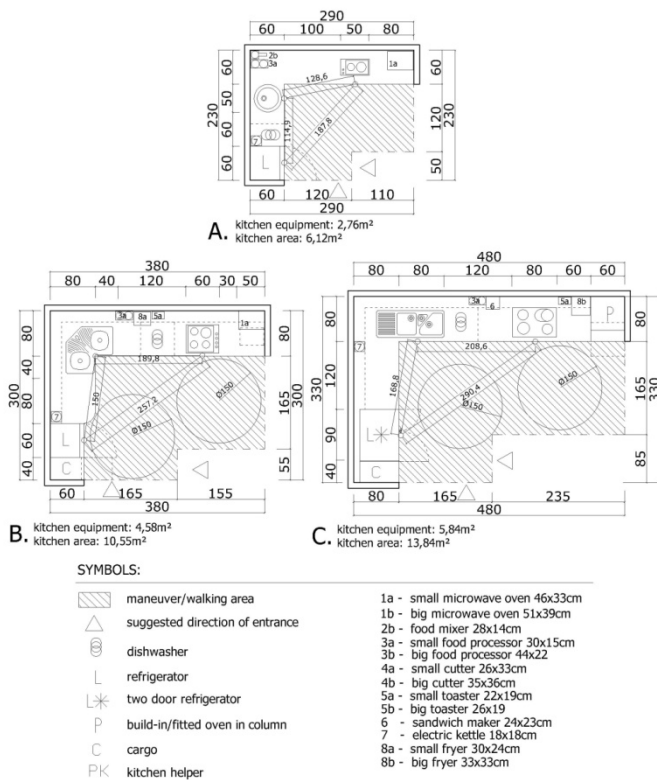


Fig. 3. The L-shaped kitchen in three quality standards: A. Low standard, B. Medium standard, C. High standard (Source: own work)

The conducted spatial and motor analysis were used to prepare twenty four model schemes of kitchen, which can be connected with dining area (in low standard: twenty four combinations). Depending on chosen area standard, the model schemes can be used as well as to design and rearrange kitchen areas. With regard to special requirements of disabled, concerning the dining area, eighteen kitchen models with dining area were proposed.

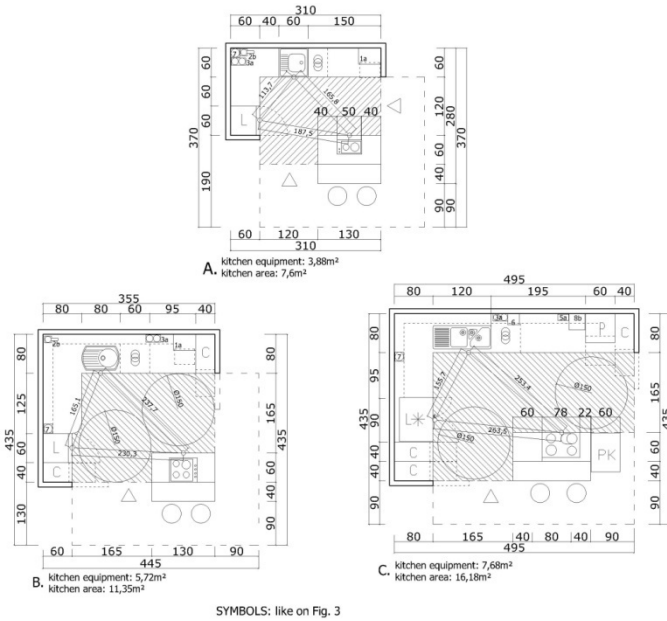


Fig. 4. The L-shaped kitchen with the kitchen island in three quality standards: A. Low standard, B. Medium standard, C. High standard (Source: own work)

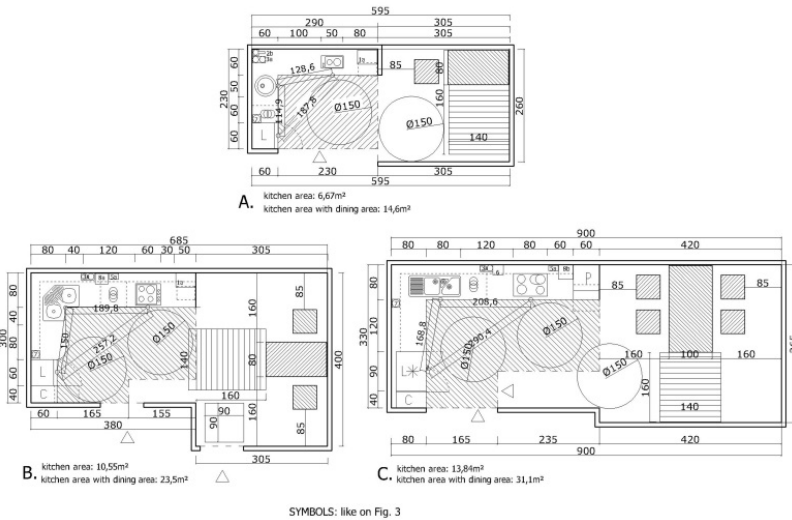


Fig. 5. The L-shaped kitchen with dining area in three quality standards: A. Low standard, B. Medium standard, C. High standard (Source: own work)

The location of dining kitchen area in relation to work kitchen area has an influence on the shape of the whole kitchen. It is necessary to take into consideration that the presence of the kitchen island is not an excuse from obligation to design comfortable dining area – like a table with chairs, at least only for whole family members.

It is possible to connect the kitchen island with the dining table, which can be actually advantageous because of the nearness of the table and the cooker, so that ready meals don't have to be carried from long distance – can be placed directly on the table and served. The kitchen users can accompany or participate in the meal preparing process. It also uplifts the cooking and make it a social event. It is recommended to design the island kitchen which is opened or arranging the multifunctional kitchen area together with the dining area.

The island kitchen connected with the dining area is an optimal solution, which can be regarded as a model (Fig. 6).

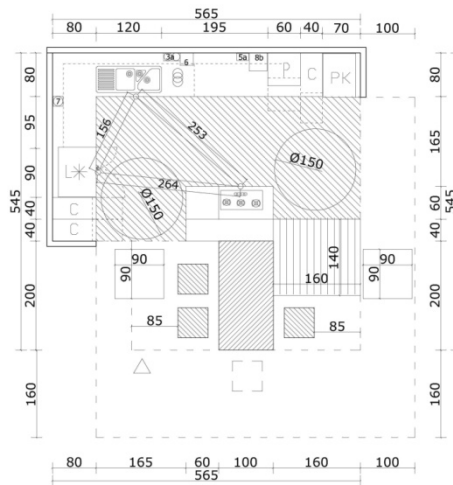


Fig. 6. The L-shaped kitchen with the kitchen island and dining area in high standard (Source: own work)

During the analysis it turned out to be essential to compare the length of individual working triangle sides in those kitchen models, which enabled setting the new recommended lengths between a refrigerator, sink and a stove - on the basis of the spatial-motion requirements of extreme planar percentile phantoms, kitchen equipment dimensions and applied exact area standard (low, medium or high) and particular kitchen layout, previous lengths of working triangle and the length of working tops were verified. The new dimensions are:

- the low standard: fridge – sink 115-181cm, sink - cooker: 125-226cm, cooker - fridge: 132-265cm,
- the medium standard: fridge – sink: 136-167cm, sink - cooker: 170-238cm, cooker - fridge: 197-359cm,

- the high standard: fridge – sink: 156-211cm, sink - cooker: 163-253cm, cooker - fridge: 182-445cm.

The sum of kitchens working triangle sides, regardless of the kitchen standard, comprises between 364-890cm.

5 Summary

The technical and technological progress, which took place in a field of an apartment infrastructure and kitchen equipment, is a continuous process, thereupon in the kitchen some new solutions appear, which require constant verification – that’s why the ergonomic research would be the most appropriate.

The proposed model schemes of kitchen layouts can be used as “ready-to-use” templates of independent kitchen area or the one connected with the dining area, depending on the situation (in existing apartments/houses). The designing process should begin with the introductory arrangement of the kitchen area against a background of the house. Then the choice of proper model scheme, adjusted to the other rooms, should be made. Presented versions of the kitchen area allow to make quick decision about the shape and type of functional layout. The example of high quality kitchen area with kitchen island connected with the dining area, adjusted to requirements of disabled users (especially wheel-chaired), one can consider as optimal solution.

Taking into consideration all needs of contemporary family, users diverse by age, fitness and agility, it is necessary to provide optimal and widely understood quality of kitchen area.

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