

## **Universal Space in Dwelling – the Room for All Living Needs**

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### **ABSTRACT**

Composition and spatial organization of the dwelling can vary due to the multiple factors, such as economical, climatic and cultural, but the functional organization of dwelling is defined by basic human activities. Universal dwelling can be based on principle – every space inside can easily change its function. As soon as dwelling is observed through its inhabitant, it is important to evaluate, how the structure is corresponding towards his constantly changing needs, and how to find the most effective and reasonable way for adaptation. Construction of the universal dwelling brings it to the other level of sustainability – dwelling spaces can be used more effectively by the users, and new living activity will not need significant additional material, time and financial resources. The study starts from the listing of all the variety of living actions, which are mentioned in dwelling space standards of 31 European countries and 7 regions. The frequency of reference of the monofunctional and multifunctional habitable rooms is evaluated. The universality of the room depends on the number of different activities, which can be performed in it without changing of its physical properties. The outcome of the work is the set of three criteria, which define the universality of the dwelling and its parts. Universality in use is directly connected with the size of the given space, which means, that the biggest required size for the living activity is the minimal size of the room to become universal. The width of the room is the second key factor, which defines the universality in use. The maximal width is required for the living room, which establishes the minimal width of the space to be universal. Access to the room is a third factor and rooms with one point of access are considered to be universal.

**KEYWORDS:** universality, housing, living activities

### **1 INTRODUCTION**

For every single society housing space standards vary in size. Different importance is given to one or several factors, such as the density of the dwelling occupation, cultural regulations, sanitary and health standards, economical and technological efficiency, sustainability and climatic conditions. Amos Rapoport stated, that in general on the level of the whole society the house form is not a result of an individualistic desire of a person, but it is a product of the common goals and values (Rapoport, 1969). The averaged and socially approved house becomes the formalized mechanism of a social control of the lifestyle of the individual. The dwelling process is very conservative, and basic physiological living needs are not changing, or changing slowly.

According to Chowdhury, space standards can be expressed in a certain units and forms of measurements, such as sizes of a dwelling and a single room, room proportions and minimal width, relation of the size of dwelling and the number of habitable rooms to the number of inhabitants (Chowdhury, 1985). The level of comfort of dwelling or its overcrowding are measured consequently by lack or exceed of the extra space. The norms are different in each region and express the level of national

wealth. Despite that the standards are the direct product of representation of basic human needs, in different cultures people may require different levels of privacy, different arrangements of rooms, insulation, heating and ventilation conditions.

The main method of the research is the analysis and evaluation of the set of legislation documents regulating the process of project and construction of dwelling in Europe. The paper deals with the general information on the housing design methods, which is established as a set of rules and guidelines on the level of the government of each country. Research aims to find the general trends of the minimal space standards in Europe and to identify the properties of the room, which can host all basic living activities without significant changes of it.

## **2 DWELLING SPACE AND THE LIVING ACTIVITIES**

There are several theoretical preassumptions regarding to the minimal size of the room. For the monofunctional place the attempt to define it was done in 1950 by Le Corbusier. He proposed a living unit with dimensions 2.26x2.26x2.26m, which holded only one function – bed, table, kitchen etc. Those containers could be attached to each other in order to create infinite number of layouts (Corbusier, 1955). According to B. Leupen minimal dimensions for the social space in house are 4x4 m (Leupen, The Polyvalent Dwelling, 2006). Bernard Leupen proposes 6 basic activities: working, sleeping, eating, cooking, bathing and getting together. Each of these functions requires a specific space and also has different importance for the human life.

In the “Timeless Way of Building” Christopher Alexander explains, that the quality of the place depends on the pattern of events that can happen there (Alexander, 1979). In house the room is an agent of the living pattern. The quality of building depends on the usual everyday activities, and the more events can happen, the more livable the place becomes.

H. Hertzberger, B. Leupen, J. Habraken formulated the concept of the adaptable space with fixed/permanent borders and neutral or changeable in use infill. H. Hertzberger defined the polyvalency as one of the types of flexibility, where the built system can offer the neutral solution for specific problems, which can occur with changes (Hertzberger, 2001). The form itself in such system is static, and it can be put into different uses without any changes itself. The study on the polyvalence was continued by B. Leupen, where he tried to measure “the degree of polyvalence” of dwelling, which is directly related with the number of activities, which can be performed in it (Leupen, Polyvalence, a concept for the sustainable dwelling, 2006). The key factors, defining it, are the size of the rooms, the amount of big rooms in dwelling and the relationship between the rooms. J. Habraken divides within the building two categories – support and infill. Support is a permanent part of the building, which can be occupied differently (Habraken, 1988). The infill is the part of building, which can be changeable and substitutable; it is a product of the current occupant and has no relation to the building structure. On the level of room the support elements are the perimeter walls, and infill – the furniture and appliances.

B. Manum examined the potential usability of dwelling by definition of the level of its generality or specificity (Manum, 2005). Generality is the ability of dwelling to accommodate the variety of demands without making any physical changes in it. Specificity is the opposing strategy and aims to respond precisely to needs and demands of the inhabitant, to follow the detailed requests. B. Manum formulates two groups of the key factors affecting generality. The first one refers to the physical properties of the room such as size and shape of the room, daylight conditions and technical equipment. The second group examines the context of the room such as accessibility and the function of the surrounding rooms.

## **3 RESEARCH PROCEEDINGS**

For the present research it is assumed, that the room is universal, if it may host any of the basic living actions – cooking, getting together, dining, sleeping, working (Leupen, The Polyvalent Dwelling, 2006). The activity of washing is intentionally omitted in the research due to the short time and episodic

performance; also due to the high technical requirements towards the place where the activity can take place (bathroom or toilet).

Research is based on the housing standards of 31 European countries and regions including Austria (Salzburg, Niederosterreich, Oberosterreich, Wien), Belorussia, Belgium, Bulgaria, Bosnia and Herzegovina, Croatia, Czech Republic, Denmark, Finland, France, Germany, Great Britain (London, Northern Ireland, Scotland, Wales), Ireland, Italy, Macedonia, Moldova, Netherlands, Norway, Poland, Portugal, Russia (state and Moscow), Serbia, Slovakia, Slovenia, Spain, Sweden, Switzeland (Zurich), Ukraine. The studied documents were established during the period of 1968 – 2012 years. For each document it is extracted the general information, such as region, the minimal size of the apartment according to the number of inhabitants, the minimal size of the kitchen, double and single bedroom, living room and integrated living space.

Further analysis of the dwelling standards proceeds towards the study on the minimal size of the apartment. The study illustrates the consequent growth in size from 1-room to 6-room apartment. Research proceeds with the analysis of the habitable rooms, which are corresponding with the set of living activities. For the evaluation of the universality the two key factors, such as size of the room and its connection with the surrounding rooms, proposed by B. Manum (Manum, 2005) are used. It is assumed, that the universality of the room depends on its physical properties, such as area and width, and has some cultural regulators, such as privacy and accessibility. The standards are the source of information regarding the minimal limits of habitable rooms. It is consequently analyzed the minimal area and the minimal width of the kitchen, living room, integrated living space, double and single bedroom. The width of the room is derived from the size of the furniture and following circulation space, which is defined by anthropomorphic measures. The guidelines on the accessibility are the result of qualitative research on the restriction and limitations stated in standards.

The outcome of the chapter is the theoretical set of criteria, which define the universality of the dwelling and its parts.

### 3.1 Analysis of the minimal size of dwelling depending on the number of inhabitants

The following graph represents the analysis of the 31 state European and 7 regional European dwelling standards regarding the relation of the dwelling size and the number of habitable rooms. The brief outlook at the official regulations shows that among 31 countries only in 2 of them (Poland and Slovenia) there are no prescriptions regarding the minimal size of dwelling and its parts. In addition 14 countries and regions (Austrian regions, Belorussia, Belgium, Bulgaria, Czech Republic, Great Britain regions, Macedonia, France, Netherlands, Slovakia, Spain, Switzerland) give the partial regulation of one or two habitable rooms, but don't have the overall standard of the dwelling minimal size. For the rest, the information is accessible in a range of minimum 1 and maximum 6 room dwellings. For the cases where it is given the recommended maximal and minimal size of dwelling (Germany, Moldova, Russia, Ukraine) it is taken the average size.

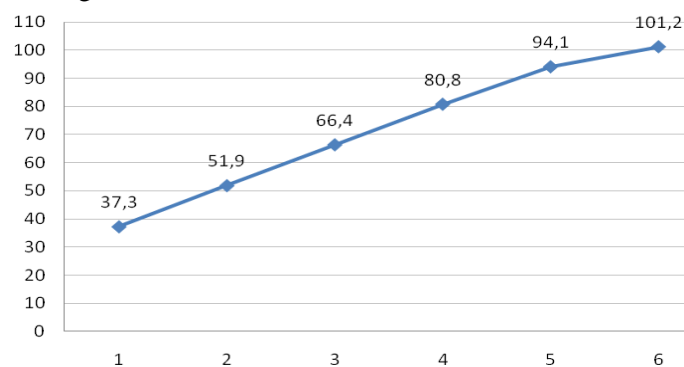


Figure 1 Average size of the dwelling established by housing standards in Europe (sq.m) and the number of inhabitants

For the apartments with 1-5 rooms the growth of area with the increasing of the number of rooms is stable and stays between 13.4 and 14.4 sq.m.

### 3.2 Analysis of the minimal size of habitable rooms

In the following part minimal areas of the rooms, which are typical for every standard – kitchen, living room, single and double bedroom and “aggregate living space” - the combination of living room, dining and kitchen – are defined. Some standards provide information regarding the different size of spaces, which is supposed to be used by one, two and more inhabitants at the same time, which is reflected in the following diagram. Dining and working room, even being mentioned by standards consequently 17 and 8 times don't have any special restrictions by area.

Size of the kitchen as separate habitable room is defined in 15 dwelling standards. Kitchen space integrated with living room, such as built-in kitchen or kitchenette, is not taken in to account. The data is presented for the one-inhabitant kitchen. The average area of the kitchen is 6.2 sq.m.

Functional space of living room is mentioned in 26 housing standards, and in 13 it is given different minimal area of the living room for one and two inhabitants or in other cases – the minimal area of the living room. In addition 8 countries provide requirements for the bigger number of dwellers. The average size of living room for one inhabitant is 15.4 sq.m and for two – 16.4 sq.m.

Bedroom takes a third place by the frequency of mentioning in standards. For the accuracy of evaluation it is important to distinguish and group different types of bedrooms. Some regulations establish Single and Double bedrooms, meanwhile the others could define first and second bedroom, or Parents and Children's bedroom. For the following analysis all spaces are divided according to the number of users – for one (single and minor bedroom) or for two (double and major bedroom) inhabitants. Some regulations establish the standard of any “bedroom”, which by default is related to the double bedroom. As functional space double bedroom is mentioned in 30 housing standards, and single – in 32. There is evident difference in sizes between double and single bedroom, which reaches 2-3.8 sq.m. The average size of a single bedroom is 8 sq.m and of double bedroom – 11.2 sq.m.

Size of the aggregate living space as habitable room, which unites cooking, dining and living areas, is defined in 24 dwelling standards. In 16 it is given different minimal area of the integrated living space for one and two inhabitants, in other cases – only the minimal area of it. The difference in area of the space for one and two inhabitants is 1.3-2.5 sq.m. The average size of aggregate living space for one person is 19.6 sq.m and for two – 21.9 sq.m.

Given below diagram is showing the average size of the most common habitable rooms.

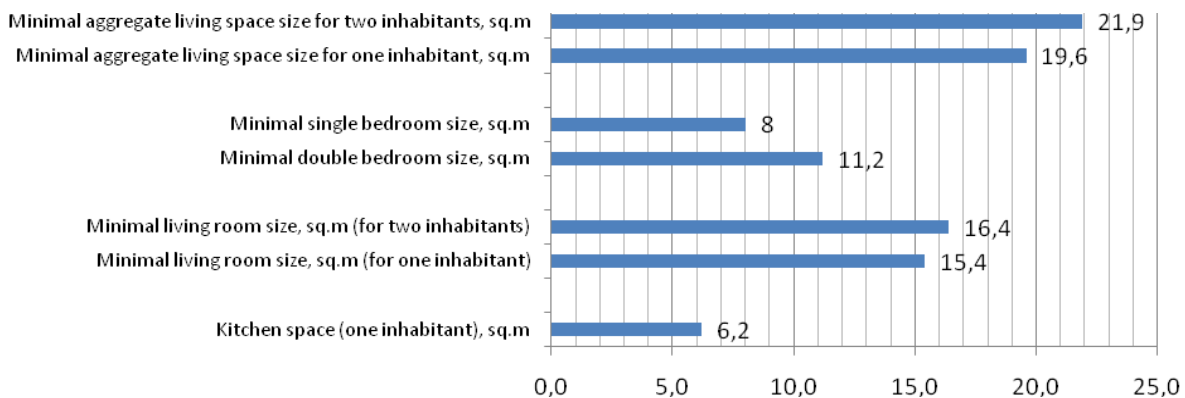


Figure 2 Comparison of the minimal areas of the living spaces for one and two inhabitants established by housing standards in Europe, sq.m

The clear difference in areas of habitable rooms is a result of the high specialization of them. The areas reflect the importance of each space in society and culture. Kitchen has the minimal area, which is based on the understanding of it as highly specialized room with the main utility function. Bedroom is the second by area, despite the fact, that human spends there approximately one third of his day. For the future research double and single bedroom are assumed to be different types of habitable rooms. The main social importance is given to the living room as a place of social interaction and communication. The aggregate living space approximately is the result of simple sum of the living room and kitchen. In order to evaluate universality of a room by area, it is necessary to check, how many uses the analyzed room potentially could have.

### 3.3 Analysis of the minimal width of the habitable rooms

Minimal width of the room is the other parameter defining its universality in use. It is assumed, that the minimal width of the room derived from the physical dimension of the furniture and equipments associating with each type of the habitable space, therefore, cannot be an influence of climate and economical factors to this parameter. The condition of the minimal width is established in 15 housing standards with a clear distinction of the width of a living room, kitchen, double and single bedroom. Minimal width of the living room is defined by 10 standards, single bedroom – by 14, double bedroom – by 12, kitchen – by 10. The resulting diagram shows the comparison of the average minimal width of four habitable spaces:

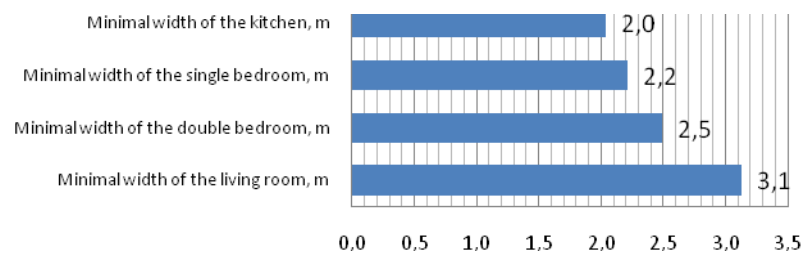


Figure 3 Average width of the kitchen, living room, double and single bedroom, m

Clear difference in values shows the supposed functional specialization of each of the analyzed rooms. The average width of the living room is 3.1 m, of the double bedroom – 2.5 m, single bedroom – 2.2 m and kitchen – 2 m. In order to be universal and accommodate all four living actions, the minimal width of the room should be 3.1 m.

### 3.4 Analysis of the accessibility restrictions of the habitable rooms

Several housing regulations provide certain rules of access to the habitable rooms as soon as the possible combination of the nearby situated spaces. The dependence of the internal arrangement of the habitable space from the local cultures and traditions was studied primarily by A. Rapoport in “House Form and Culture”. He had examined the connection between the use of the space and its position within the dwelling and interconnection with the other spaces (Rapoport, 1969). Privacy, as one of the basic human needs, requires the clear separation between spaces, and from the other side the space for social interaction allow multiple interconnection with other spaces. As a general tendency in dwelling standards all habitable rooms are divided into two groups – public and private spaces. Public spaces are generally the living rooms with their interconnection with kitchen and dining area. For this type of spaces regulations offer some possibilities for the union, for creation of the integrated multifunctional spaces, for possible join with the transition spaces, such as halls and corridors. For the private areas, such as bedrooms and the living rooms, which are intended to have a sleeping place, the regulations establish some restrictions. The bedroom acts as the most private and the most protected place of the house, and it

should be isolated from another rooms and accessed through the corridor, or through the living room. In all the cases bedrooms should not be used as transitions to the other habitable room, but at the same time it may be accepted the access from bedroom to the private service space, such as storage or private bathroom.

Habitable rooms in dwelling can be divided into four groups by accessibility and the possibility of transition:

1. Rooms accessed through one point
  - 1.1. From the corridor. The room can accommodate any of the living action and can be considered universal
  - 1.2. From another habitable room. There are minor restrictions for this room depending primarily on the number of the rooms in dwelling and consequently from the number of inhabitants. The main condition of use in this case is the function of the neighboring room – such combination is possible if that room is not used for sleeping.
  - 1.3. Room with access to the private bathroom or storage can be considered as room with one point of access. The service room is supposed to be used only by the inhabitant of the room, which wouldn't disrupt the requirements of privacy.
2. Rooms with two points of access. Rooms with transition. This room can be partially universal. It is not allowed in most of the standards to be used as bedroom, but it could accommodate kitchen, dining or living room.
3. Rooms with three points of access. Living room may have connection with dining, cooking or working rooms and is some cases bedroom; the kitchen may have access to the dining room and living room.
4. Room with four or more points of access. Only living room may have connection with some other – dining, cooking, working rooms, bedrooms, so it may accommodate just one function and cannot be universal.

#### **4 CRITERIA OF UNIVERSALITY OF DWELLING AND ITS HABITABLE ROOMS**

Almost every housing standard is based on the definition of the minimal size of the 4 monofunctional rooms, such as living room, kitchen, double and single bedroom. Dining room, guest room, working room and abstract habitable room are mentioned in very few cases. The analysis of the standards is showing the current situation regarding the dwelling spatial content and size. This allows to define the size of the room associated with each living activity and to understand the relation between monofunctional and multifunctional spaces. Universality in use is directly connected with the size of the given room, which means, that the biggest required size for the activity getting together, which is represented by living room is the minimal size of the room to become universal. Yet, some regulations directly or indirectly prohibit the functional combination within one space, meanwhile the others encourage it. The width of the room is the second key factor, which defines the universality in use. Minimal width is established for the living room, kitchen and bedrooms and may vary according to the number of inhabitants. The maximal width is required for the living room, which established the minimal width of the room to be universal. Access to the room is a third factor, and the highest restriction by access is applied for bedrooms. From this side of view rooms with just one points of access are considered to be universal.

The universality of the dwelling can be evaluated by applying the following guidelines:

- Dwelling should have at least two habitable rooms. This condition is derived from the statement, that to be universal, the room should accommodate any of the living actions and allow possibility of changing the room's function with time.
- Dwelling is universal, if all the rooms of it are universal
- Dwelling is partially universal, if at least two rooms of it are universal
- Dwelling is partially universal, if at least two living actions can be accommodated in each room
- Dwelling is not universal, if its rooms are specialized

Universality of room is a result of the evaluation of it by three criteria: the area of the room, the width of the room and accessibility. The degree of universality is defined by the number of functions, which the room can host.

Evaluation of the universality of the room by size:

- Room is universal, if its size (area) is more, than 15.4-16.4 sq.m
- Room is partially universal and may accommodate 3 living activities, if its area is between 15.4 – 11.2 sq.m
- Room is partially universal and may accommodate 2 living activities, if its area is between 11.2 - 8 sq.m
- Room is specialized, if its area is less, than 8 sq.m

Evaluation of the universality of the room by width:

- Room is universal, if its width is more than 3.1 m
- Room is partially universal and may accommodate 3 living activities, if its width is between 3.1 – 2.5 m
- Room is partially universal and may accommodate 2 living activities, if its width is between 2.5 – 2.2 m
- Room is specialized, if its width is less, than 2.2 m

Evaluation of the universality of the room by accessibility:

- Room is universal, if it has one point of access
- Room is partially universal and may accommodate 3 living activities, if it has two points of access
- Room is partially universal and may accommodate 2 living activities, if it has three points of access
- Room is specialized, if it has four and more points of access

## 5 CONCLUSION

The outcome of the paper is a set of spatial and volumetric criteria, which can be used as a guideline for the planning of the internal layout of dwelling. In the majority of European countries dwelling standards regulate either, minimal sizes and proportions of the habitable rooms or the whole apartments. The study presents all these parameters, such as apartment area, minimal area of the living room, kitchen and bedrooms and minimal width of spaces. For the development of the numerical criteria of universality of space, the research focuses on the statement of Chowdhury, that the dwelling standard can be expressed in certain units and measurements (Chowdhury, 1985). The outcome of the study is a set of dimensions characterizing the main habitable rooms, which can be taken as average and further specified for different regions. The regulations of universality are derived from the minimal dwelling standards. Majority of built dwellings are constructed with the overpass of minimal area, which gives the presumption of universality of these dwelling through the proper internal planning of the dwelling unit.

The practical impact of the work is a set of guidelines, which can encourage design of dwelling with consideration on its universality in use. Application of the concept of universal dwelling on the stage of architectural project may reduce future expenses determined by the reconstruction and re-planning of the dwelling unit by inhabitant according to his individual needs further reducing the conflict of individualization of the apartment. Construction of dwelling, which is based on the principles of universality, may reduce the costs of dwelling and make the usage of space more effective while improving the social and environmental sustainability. The “habitable room” without any specialization is mentioned in several housing standard, and the current research defines the physical properties of this space. The theoretical findings of the research can go together in the corresponding parts of the housing regulations, which are responsible for the overall sustainability and the quality of design.

Due to the character of studied topic and the limitations of its implication, the following research directions can be explored within the framework of the theme:

- The research on the dwelling standards was performed in the European region. The future study can be broadened in order to evaluate the dwelling strategy in different world regions

- The research was focused on the evaluation of minimal space standards declared by legislation of countries and regions. Similar research can be performed for the statistics characterizing the actual properties of the recently built dwellings
- The study was concentrated on the influence of the size and shape of the room and its interconnection with the other spaces to its universality. The other factors, such as technical equipment and the daylight conditions can be added in the future research

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