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APARTMENT GROSS AREA: DEFINITION AND POTENTIAL IMPLICATIONS ON HOUSING SUSTAINABILITY

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Abstract

Apartment Gross Area is a term that has never officially incorporated into the legislative framework in Serbia and become part of any regulation. Nevertheless, it is occasionally employed within the architectural and real estate sectors. Its purpose is to signify the total functional area of an apartment, ensuring that any modifications or reconstructions within this area do not encroach upon the property rights of other occupants within the building. The principal aim of this research is to scrutinize the nuanced interpretations of related terms such as 'apartment gross area' in the field of architecture. The study delves into the distinctive characteristics and specific applications of this concept while seeking to establish a precise definition. Additionally, the research endeavors to dispel uncertainties surrounding the definition of 'apartment gross area' and to furnish clear guidelines for its practical implementation. The focus of the study is a reevaluation of the assumed definition, which posits that the apartment gross area encompasses the entirety of the living space as delineated by the inner perimeter of the external walls of the apartment. This definition includes all modifiable construction elements (such as partition walls) while excluding fixed structural components (like walls and columns) and enclosed installations that are collectively used. Open areas, such as terraces and balconies, with specific usage protocols, are also part of this calculation. Notably, this definition implies the total area of the apartment under the ownership of residents, emphasizing adaptability without impinging upon common areas, elements, and ownership of other residents. Methodologically, this research involved an extensive review of existing literature on the term 'apartment gross area' within architecture and related disciplines. It also encompassed an examination of various definitions, interpretations, and applications of this term across different contexts and geographical regions. Through a comparative analysis of divergent interpretations, the study aimed to refine the definition and explore avenues for its broader application within the professional domain. The research findings suggest that integrating the concept of apartment gross area into design, construction, and registration processes can significantly enhance the sustainability of residential

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spaces. This can be achieved through more effective resource allocation, heightened flexibility and achieving energy efficiency.

Key words: *Gross floor area, net floor area, adaptability, space efficiency, sustainability.*

The concept of Gross and Net Area in architecture

The area of a building can be measured in various ways, and it is crucial to clearly specify which method is being used, for example, in the design of architectural structures, space lease negotiations, real estate sales, value assessments for taxation, and similar purposes. [1] The term "Gross Area" (GA) can be confusing, as it has different meanings around the world, with variations in interpretations even within some countries (Table 1).

Table 1. Comparative overview of characteristic interpretations of the term "Gross Area" worldwide

Interpretation of the term "Gross Area"	Source (country or community)
„Gross Floor Area is sum of all areas on all floors of a building included within the outside faces of its exterior walls, including all vertical penetration areas, for circulation and shaft areas that connect one floor to another."	***. (2006). The Postsecondary Education Facilities Inventory and Classification Manual (FICM), Washington: The Institute of Education Sciences (IES). [2]
„Gross Internal Area is defined as the total floor space measured between the internal faces of perimeter walls that enclose the dwelling. This includes partitions, structural elements, cupboards, ducts, flights of stairs and voids above stairs."	***. (2015). Technical housing standards – nationally described space standard. London: Department for Communities and Local Government. [3]
„Gross Internal Area is the area of a building measured to the internal face of the perimeter walls at each floor level. The Gross Internal Area includes floor area of habitable and non-habitable rooms plus circulation, plus area taken up by internal partitions. It does not include the area of external private amenity space."	***. (2010). London Housing Design Guide, Interim Edition. London: London Development Agency. [4]
„Gross Floor Area is the total area of a space determined by the external measurements of the final finished building elements that form it (such as facade walls, fences, etc.)."	***. (2002). Izračunavanje površina objekata u oblasti visokogradnje, SRPS U.C2. 100:2002. (eng. Calculation of Building Areas in the Field of High-Rise Construction, SRPS U.C2. 100:2002) [5]
„Gross floor area of a building shall be the area contained within the external walls of the building measured at each floor level (including any floor below the level of the ground), together with the area of each balcony in the building, which shall be calculated from the overall dimensions of the balcony (including the thickness of the sides thereof), and the thickness of the external walls of the building."	***. (2012). Building (Planning) Regulations. Hong Kong: Hong Kong law, Chapter 123. [6]
„Gross floor area is the total area of covered floor space, including the half thickness of external walls or other building facade elements (e.g. windows, railings, curtain walls), but excluding voids."	***. (2023). Handbook on Gross Floor Area. Singapore: Urban Development Authority. [7]

By conducting a comparative analysis of the mentioned interpretations, it can be observed that the term "Gross Area" has different interpretations worldwide, ranging from its name to the explanation of boundary areas and elements included in the entirety. Taking these interpretations into account, it can be noted that gross area in certain situations is calculated up to the outer edge of the facade walls, the middle line, or the inner contour of the facade walls. On the other hand, it may also encompass the complete area up to the outer boundary or a reduced value by the sum of the areas of all openings in the intermediate ceiling. Without delving further into the analysis and interpretation of the reasons for these differences globally, for the further course of the research, we will opt for a formulation that we believe comprehensively integrates the most significant characteristics from the mentioned interpretations:

Gross Area (of a building floor) is the total area of space defined by the external measurements of the finished building elements that form it (facade walls, planters, railings, etc.), excluding voids in the intermediate floor structure (atriums, skylights, utility shafts, elevator shafts, etc.).

The reason for this interpretation lies in the fact that the term Gross area refers to the area of a floor of a designed or constructed building, which does not include the voids within it (as they are not built), hence all openings are excluded from the area calculation, while the area is calculated solely up to the outer contour, encompassing all designed and constructed elements on a specific floor of the building within it.

In relation to Gross area, the term Net Area is somewhat clearer; however, it also presents numerous variations in interpretations (Table 2). The basic interpretation of net area generally refers to the sum of all usable areas on a single level of a building, considered between building elements. However, there are many differences in interpretations regarding what the net area includes in its entirety, i.e., what should be subtracted from the basic net area.

Table 2. Comparative overview of characteristic interpretations of the term "Net Area" worldwide

Interpretation of the term „Net Area"	**Source (country or community)**
„Net Usable Area is sum of all areas on all floors of a building assigned to, or available for assignment to, an occupant or specific use."	***. (2006). The Postsecondary Education Facilities Inventory and Classification Manual (FICM), Washington: The Institute of Education Sciences (IES). [2]
„Unit net area –The area of a unit that is bounded by the inside finished surface of the perimeter walls of that unit."	***. (2010). Multi-Unit Residential Buildings: Standard Methods of Measurement. Washington: Building Owners and Managers Association International. [8]
„The Net Floor Area of a level is the sum of the areas of polygons whose edges are formed by the visible internal faces of construction features: façade walls, party walls, internal walls and screens, columns and fixed partitions."	***. (2019). Measurement Code: Applicable to the buildings of the institutions and other bodies of the European Union, Ver. 01. European Commission. [9]
„Net Internal Area is the usable area within a building measured to the internal face of the perimeter walls at each floor level."	***. (2015). Code of measuring practice: RICS professional

Interpretation of the term „Net Area"	Source (country or community)
	standards and guidance, Global. London: Royal Institution of Chartered Surveyors (RICS). [10]
„The Net Floor Area refers to the surface area of all spaces between walls and partitions. It consists of: a) usable area, b) area under installations, and c) circulation area. Usable area comprises "parts of the net floor area that serve the purpose and function of the building," area under installations is determined by "parts of the net floor area where technical installations of the building are located," while circulation areas consist of "parts of the net floor area that serve for movement within the building."	***. (2002). Izračunavanje površina objekata u oblasti visokogradnje, SRPS U.C2. 100:2002. (eng. Calculation of Building Areas in the Field of High-Rise Construction, SRPS U.C2. 100:2002) [5]

In Serbia, according to the "Rulebook on Conditions and Norms for Designing Residential Buildings and Apartments" (*Pravilnik o uslovima i normativima za projektovanje stambenih zgrada i stanova*), "the size of an apartment is determined by the net usable area of the apartment calculated according to the SRPS.U.C2.100:2002 standard." [11] The same Rulebook defines the following types of areas in architecture: a) construction gross area, b) net area, and c) area under construction elements.

A- The term "construction gross area" refers to "the area of space defined by the external measurements of the finished building elements that form it (facade walls, railings, etc.)."

B- The term "net area" refers to "the area of all spaces between walls and partitions," comprising: a) usable area, b) area under installations, and c) area for communication. The usable area consists of "parts of the net area that correspond to the purpose and function of the building." The area under installations is defined by "parts of the net area where the building's technical installations are located," while areas for communication comprise "parts of the net area that serve for movement within the building."

C- The term "area under construction elements" is defined by the standard as "the area within the construction gross area of the floor and refers to the area (horizontal cross-section at floor level) of the construction elements that form the space (external and internal walls, columns, chimneys, etc.)."

From the above, it is clear that A=B+C, i.e., the construction gross area equals the sum of the net area and the area under construction elements. However, this classification of areas applies only to the entire building complex. When it comes to the apartment level, it is determined solely by the net area.

What is significant for the further course of the research is the interpretation of the net area, which is defined by the internal measurements between the walls that delimit the closed and open spaces. For calculating the net area of a floor, the measurements between the finished walls are used, not considering the measurements of skirting boards, baseboards, etc. The usable area is considered relevant from the aspect of the apartment's utility value and is recorded in the cadastre during the registration of the constructed apartment. Consequently, the usable area becomes the primary parameter that shows the amount of residential space the owner possesses, but also affects the

perception of the property's value and the apartment's utility value. However, what happens to the usable area during the adaptation or reconstruction of residential space?

Variability of usable area

According to the aforementioned rulebook, "an apartment is a spatial unit, or a set of spaces and rooms that form a separate functional entity providing conditions for living and staying in it." [6, 11] Given that the same rulebook does not mention any variability of residential space, i.e., adaptability or flexibility, it can be stated that an apartment is legally viewed as a static system, which it actually is not in reality. One of the prominent Yugoslav researchers of residential architecture, Mihailo Čanak, explicitly states in his scientific papers that an apartment is a variable system because "over time, the status of a family changes - the number of members decreases or increases, social, health, and age status evolves." Consequently, there arise needs for changes in the physical structure of the apartment. [12] Any change in the physical structure of the apartment also changes the usable area, which can lead to misunderstandings and potential problems during the potential sale of the apartment, as the altered usable area differs from the registered area.

In the research by P. Femenias and F. Geromel, the authors highlight that in the sample they studied, an open plan was observed in 50% of the apartments during subsequent adaptations, and that for 30% of the surveyed users, the internal openness of the plan was one of the most desirable aspects of the apartment. [13] Their research indicates that internal plan openness has become a widespread trend because users have become aware of the advantages of an open plan in housing. Tokazhanov and his team share a similar opinion, recognizing the sustainable nature of open-plan apartments and emphasizing the importance of achieving privacy in such spaces. [14] Numerous authors have addressed aspects of variability in residential areas, and from their research, a general conclusion can be drawn that adaptability is highly desirable in housing and that there should be various possibilities for modifying the apartment structure in each building to meet the needs of the users. [15, 16, 17, 18, etc.]

From the mentioned research, we can conclude that after the construction of the building, during the exploitation phase, multiple adaptations of the residential space are frequently present, sometimes involving a radical adjustment of the same apartment to the needs of new generations of users. This topic was also addressed in the dissertation by Dalia Dukanac, who interprets the usability value of the apartment as a dialectical process and highlights the need for its constant reconceptualization. [19]

When constructing an apartment in Serbia, the net area of the built residential space is entered into the real estate cadastre when the ownership rights of the first occupant are registered. During each subsequent adaptation or reconstruction that changes the physical structure of the apartment, according to the "Rulebook on Cadastral Survey and Real Estate Cadastre" (*Pravilnik o katastarskom premeru i katastru nepokretnosti*), "the change in usage is determined based on the report on the inspection conducted during

the process of geodetic determination of changes on the ground." [20] This practically means that with every change of a partition or structural wall in the apartment, the net area in the real estate cadastre should be updated, which in practice is rarely done due to the complex and lengthy procedure. [21] When selling a modified apartment, the usable area can vary by several percent compared to the registered area, especially if more partition walls have been removed (open plan concept) compared to the original segregated scheme. From all the aforementioned, the question arises whether there is a specific size that would remain unchanged during multiple adaptations, which could serve as a constant measure for determining ownership of the residential space.

Gross Apartment Area and space efficiency

An analysis of the literature reveals that the gross area of an apartment is typically used in situations where the "efficiency" of a design solution needs to be demonstrated. If a relationship is established between the usable (net) area and the gross area of the space, the resulting ratio indicates the functional value of the space, i.e., how much of the usable area is utilized in relation to the maximum possible area that could be adapted for use. [22, 23, 24, 25, 26] The term "space efficiency" is usually used to describe how efficiently a space is utilized, meaning how functional and useful it is in relation to its total area. The formula used to express the efficiency of residential space can be represented as the ratio of usable area (UA) to gross area (GA) of the apartment, i.e., the mathematical expression UA/GA x 100%, where the usable area is divided by the gross area, and the result is multiplied by 100 to obtain the percentage of space utilization. The presented sources highlight the role and significance of the gross area of residential space, but how is it determined and measured?
The terms closely related to the gross area of an apartment are "Gross Internal Area" (GIA) in the United Kingdom and "Gross Living Area" (GLA) in the United States. The Gross Internal Area is defined as "the total floor area measured between the internal surfaces of perimeter walls that enclose the living space. This includes partitions, structural elements, cupboards, ducts, staircases, and voids above staircases." [182] [3] On the other hand, the Gross Living Area is defined as "the total area of finished, above-ground residential space; a measurement standard used to determine the amount of space in residential properties." [183] [27] From both definitions, it is key that the gross area of residential space includes the entire area that belongs to one unit. However, it is evident that this area also includes some elements that are not adaptable, such as structural elements and ducts, which do not belong solely to the owner of one apartment but also to other residents above or below the unit. Moreover, it is characteristic of these measurements that they do not include the areas of terraces

[182] „The Gross Internal Area of a dwelling is defined as the total floor space measured between the internal faces of perimeter walls1 that enclose the dwelling. This includes partitions, structural elements, cupboards, ducts, flights of stairs and voids above stairs."
[183] „Gross living area is the total area of finished and above-grade residential space; the standard of measurement used for determining the amount of space in residential properties.")

or loggias, as open spaces are considered an addition to the residential space. [10, 28] In Serbia, according to the "Housing and Building Maintenance Law" (*Zakon o stanovanju i održavanju zgrada*), elements that belong to the facade of the building (terraces and loggias) "are considered common parts of the building, with the owner of that specific part of the building having the right to use that part without the right to alter its physical properties." [29] Therefore, in order to adopt the gross area of an apartment as the maximum adaptable area that belongs to the user, it is necessary to exclude non-changeable elements from the definition, i.e., structural walls, columns, and common installations, as the user must not alter these since they are part of the common elements in the building [29], and to include open spaces with an appropriate usage regime. If we summarize the aforementioned, we can conclude (Fig. 1):
The apartment gross area encompasses the total residential space determined by the internal contour (perimeter) of the external walls surrounding the apartment. This includes all the construction elements that form it and are adaptable (partition walls), excluding unchangeable structural parts (walls and columns) and built-in installations that are commonly used, as well as open spaces (terraces, loggias) that have a special usage regime.

Figure 1: Net Usable Area and Apartment Gross Area
Source: Author's sketch

Discussion

The application of gross apartment area in the phases of design, construction, and registration can have a positive impact on the sustainability of residential space for several reasons. First, considering the gross area motivates designers and owners to make better use of every part of the space. Instead of focusing solely on usable areas,

which emphasize rooms used for daily activities, the gross area includes the potential for actively utilizing other parts of the apartment such as hallways and areas beneath partition walls. This opens up possibilities for a more creative approach to design and space organization, aiming for a higher level of efficiency in solutions. As a result, a more flexible room layout can be applied, or the space can be organized as multifunctional, where the same room can have different functions under various usage scenarios. For example, a room that functions as an office during the day can be converted into a bedroom at night or serve as a social space when guests are present. This approach allows for better utilization of space, which is crucial for sustainability, as it reduces the need for larger residential areas. Moreover, more efficient use of space can lead to a reduced need for building materials and resources. This can have a dual positive effect on the sustainability of residential space. First, reducing material consumption lowers the overall construction costs, which can be financially beneficial for owners and investors. Second, lower material consumption means a reduced environmental impact, lessening the emission of harmful gases and waste generated during construction activities. Flexible space design also facilitates the implementation of energy-efficient solutions. For example, when space can be adapted to different needs, it is easier to utilize natural lighting and ventilation, reducing the consumption of electricity for lighting and climate control. This directly contributes to the sustainability of residential space by decreasing energy consumption and negative environmental impacts. In summary, the application of gross apartment area can encourage more efficient use of space, striving for flexibility and multifunctionality, reducing material and resource consumption in construction, and facilitating the implementation of energy-efficient solutions.

Based on the analysis of literature and relevant definitions, it is concluded that the gross area of an apartment encompasses the total area of the residential space enclosed by the inner contour of the exterior walls surrounding the apartment. However, issues arise in situations where there is an existing mezzanine or the potential for creating one in apartments with greater height. In such cases, the mezzanine area should be included in the gross area of the apartment to accurately determine the total area available for functional use. It is important to note that regulations, standards, and local laws may vary in the definition and measurement of the gross area of an apartment. Therefore, it is necessary to consider the specific guidelines and standards applicable in a given geographical or legislative context to correctly apply the definition of the gross area in practice.

Conclusion

In this study, the concepts of gross and net floor areas in architecture, as well as their variations in interpretation worldwide, were analyzed and defined. The findings highlight the importance of precise definitions and interpretations of these concepts in design, real estate transactions, and other architectural activities. Further research could focus on the standardization of the definition of the gross floor area of an apartment, primarily at the national level but also internationally. This would

facilitate consistent application in architecture, as the lack of a unified, internationally accepted practice for measuring floor area can lead to insufficiently precise identification of the total value of that area. Additionally, research could investigate the impact of the applied definition of gross floor area on the sustainability of housing solutions. This would include an analysis of potential energy savings and the possibility of using renewable energy sources as part of efficient space utilization. Another potential direction could be exploring how the applied definition of gross floor area affects the adaptability and flexibility of space over time. This includes issues of legality and ownership of additional residential space created during adaptations.

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