ANALYSIS OF SELECTED STANDARDS OF FLOOR AREA MEASUREMENTS ON THE EXAMPLE OF OFFICE PREMISES

Robert Łuczyński, Ph.D.
Faculty of Geodesy and Cartography
Warsaw University of Technology
Warsaw, Poland
e-mail: r.luczynski@gik.pw.edu.pl - contact person

Paulina Kotarba, M.Sc.
Faculty of Geodesy and Cartography
Warsaw University of Technology
Warsaw, Poland
e-mail: paulina_kotarba_92@wp.pl

Abstract

Definition of floor area is known not only in cadastre but is also commonly interpreted as area of residential or commercial premises that is suitable to be developed accordingly with requirements of premises owner/tenant. Nevertheless it turns out that this common belief is not always true and the definition of floor area despite being defined in Polish legislature can be interpreted in few ways. Different views according to floor area are result of the fact that in Polish law there is no obligation of performing measurements of floor area according to one actual standard for all purposes. There are many existing standards and differences between them are so significant that this same area measured in compliance with various standards might vary by few meters. Property owners and managers, landlords and tenants often are not aware of the fact of existing many standards of measurements and their lack of knowledge in this area is cause of ignorance of consequences of choosing particular standards.

The purpose of this thesis was to introduce the topic of floor area measurements standards used for office premises: PN-70/B-02365, PN-ISO 9836:1997, ANSI/BOMA Z65.1-2010, TEGOVA, GIF and IPMS.

In practical part of the thesis, on the base of measurements conducted in one of Warsaw office buildings, the sections of measured area were prepared accordingly to standards described in the thesis. Moreover, the comparison of standards was performed.

Essential part of the thesis represents description of results of choosing particular standards by landlord and by tenant.

Key words: *floor area, standards of floor area measurements, premises, PN-70/B-02365, PN-ISO 9836:1997, ANSI/BOMA, TEGOVA, GIF, IPMS*

Introduction

The usable floor area is defined by three Acts of the Polish law. The first one, the Inheritance and Donation Act, defines the usable floor area in a somewhat general way as the *area measured along the inner side of room walls at all (underground and overground) storeys of the building, except for cellars, stair wells, and lift wells* [the Act, 1983]. The second one, the Local Taxes and Fees Act, says that the *usable floor area of a building or its part is the area measured along the inner side of room walls at all storeys of the building, except for stair wells and lift wells; underground garages, cellars, basements, and usable attics are also considered as storeys* [the Act, 1991]. This definition may seem very similar to the first one but the difference is that it defines cellars as rooms whose area must be included in the usable floor area. This, however, runs counter with the third law, the Tenants Rights, Municipal Housing Stock, and the Civil Code Amendment Act, which reads that the *usable floor area is the area of all the spaces in a building, in particular, the rooms, kitchens, pantries, lobbies, alcoves, halls, corridors, bathrooms and other rooms used for residential and housekeeping needs of the tenant, whatever their actual purpose or way of use; the usable floor area does not include the area of balconies, terraces, loggias, entresols, wardrobes, recessed wall cubbies, laundry rooms, drying rooms, baby carriage rooms, attics, cellars, and fuel storage rooms* [the Act, 2001]. Moreover, the same law says that the measurement of usable floor area is done along the inner side of plastered walls and the area of spaces or their parts with headroom of more than 2.2 metres must be in 100% included in the floor area; spaces with headroom of 1.40-2.20 metres—in 50%; and those with

headroom of less than 1.40 metres are not included in the usable floor area at all. Apart from the question of including vault space into the usable floor area, all these definitions clearly say what must be measured. But the question is: how to do the measurement? A surveyor measuring the usable floor area must decide whether to include niches or not, whether to make the measurement between plastered or unplastered wall surfaces, how to qualify pillars and various types of wall protrusions, which measuring height to choose, and must take many other factors under consideration. The answer to these questions depends on which floor area calculation standard is chosen.

Research results

Table 1 shows the rules of measuring floor area according to six selected standards: PN-70/B-02365, PN-ISO 9836:1997, ANSI/BOMA Z65.1-2010, TEGOVA, GIF and IPMS. The PN-ISO 9836:1997, adopted by the Polish Committee for Standardisation in 1997, is a Polish translation of the English-language version of the international standard ISO 9836:1992.

Table1. The floor area measurement rules

Measurement rules	**PN-70/B**	**ISO 9836**	**BOMA**	**TEGOVA**	**GIF**	**IMPS**
Object from which measurement is made	unplastered walls	plastered walls	dominant portion	wall or window (facade domination rule)	wall or window (depending on facade type)	dominant portion
Measuring height	1 m above floor	at floor level	at dominant portion level	1.5 m above floor	at floor level	at dominant portion level
Construction walls	not included in usable floor area	not included in usable floor area	included in usable floor area	included in usable floor area, if their area is smaller than 1 m^2	not included in usable floor area	not included in usable floor area
Partition walls	not included in usable floor area	not included in usable floor area	included in usable floor area	included in usable floor area	included in usable floor area	included in usable floor area
Structural columns	not included in usable floor area	not included in usable floor area	included in usable floor area	included in usable floor area, if their area is smaller than 1 m^2	not included in usable floor area	not included in usable floor area
Niches	wall niches up to 0.1 m^2 in area are not included in usable floor area; wall niches over 0.1 m^2 in area are included in usable floor area	niches are not included in usable floor area	no reference in the standard	no reference in the standard	no reference in the standard	no reference in the standard

Wall protrusions	wall protrusions up to 0.1 m^2 in area are not deducted from the usable floor area; wall protrusions over 0.1 m^2 in area are deducted from the usable floor area;	wall protrusions are not deducted from the usable floor area;	no reference in the standard	no reference in the standard	no reference in the standard	no reference in the standard
Add-on factor	none	none	add-on factor (for storey and building)	none	none	none
Headroom-related area reduction	headroom over 2.2 m— area calculated in 100%; headroom from 1.40 to 2.20 m— area calculated in 50%; headroom less than 1.40 m— area not calculated at all	area divided into two parts: - -part with headroom 1.90 m and more-part with headroom less than 1.90 m	area not reduced but areas with headroom less than 1.52 must be shown separately	none	area not reduced but areas with headroom less than 1.52 must be shown separately	area not reduced but areas with smaller headroom (depending on local law) must be shown separately
Measurement precision	0.01 m	0.01 m	0.01 m	0.01 m	0.01 m	0.01 m
Calculation precision	0.1 m^2	0.1 m^2	0.1 m^2	0.1 m^2	0.1 m^2	0.1 m^2

Source: Own study based on the data from: PKN [1997], PKN [1970], MF-G [2004], Kubica [2006], ANSI/BOMA [2010], Ebing [2011], Standards [2012], Standards [2014].

A reflectorless total station Leica, model TSO6, and a hand-held laser meter DISTO, model DLE40 were used to measure the area of an office room. Apart from the office area, the lift lobby, corridors, toilets, and stair cases were also measured at each storey. Measuring these spaces of the storey was done to present all the different types of area present there and to classify them according to the standards discussed. Since the measured space was quite vast (more than 700 m^2) the measurement had to be done from several stations and that required setting up a measurement network. To do this, the investigators used cross of lines as a survey mark put up on the walls which closed the measured area. The measurement using space resection method was done from 21 stations.

Processing of the measurement results consisted in making projections of the usable floor area which showed the different types of area referred to in the respective standards and it also included a descriptive comparison of the standards applied. Storey projections were made in CAD environment. Apart from the directly measured objects, the presentation also included such parts of the building as lifts and cable ducts inaccessible for measurement. These objects were plotted on the projections of storeys based on the architectural drawings.

This work led to making room projections. Fig. 1 shows a fragment of room projection done according to ISO 9836:1997.

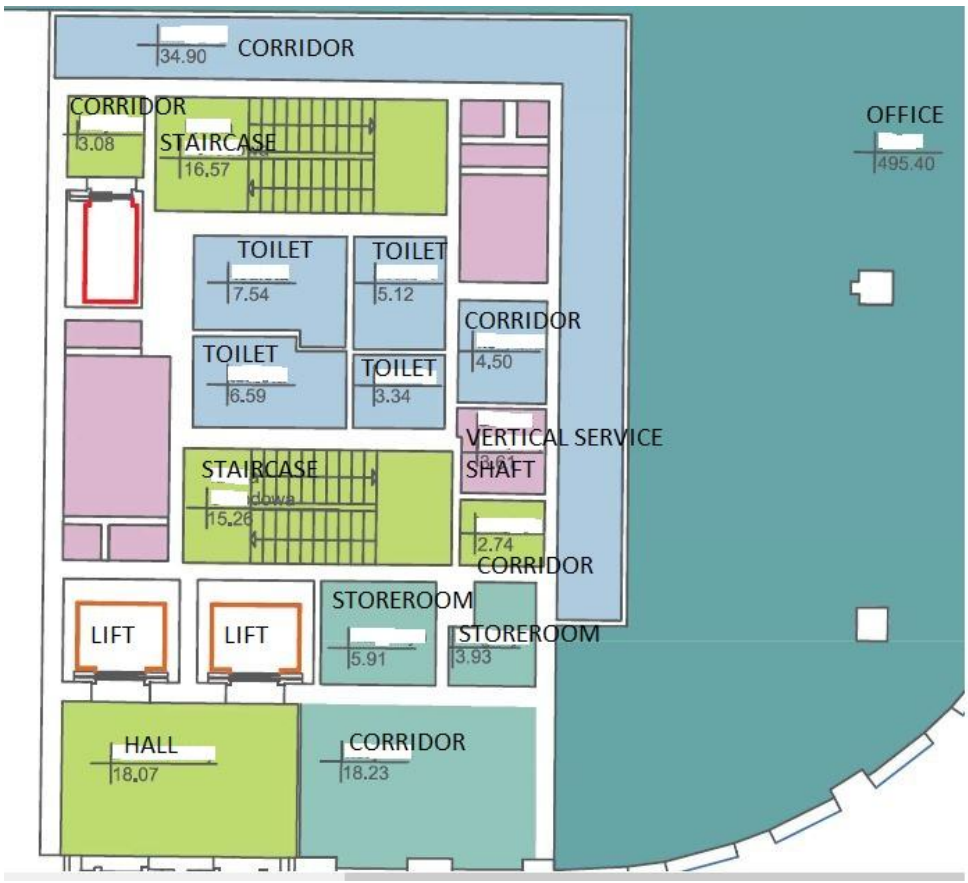

Fig. 1. Room projection according to standard PN – ISO 9836:1997. *Source: own elaboration*

Floor area measurement (Fig. 1.) was done to the inner face of plastered walls at the floor level without including the baseboards. The leasable area at the particular storeys was included in the basic usable floor area. Because of the building's character, this is an office area. The basic usable floor area also included a corridor and two storage rooms which were offered for rent too. In the case of the measured area, the corridor may do the function of, e.g., a tenant's reception area and it differs from the corridor included in the auxiliary usable area because it may be used only by the tenant who rents the measured office area. Pillars were not included in the usable floor area. The auxiliary area is made of rooms which do not meet the basic needs planned for a building of this type. At the measured storey, it included toilets and corridors leading to them. These areas are found at the given storey and can be used by all tenants who occupy it. Traffic area is another group of areas shown in the projection. This includes such rooms as the lift well, stair cases, and two small corridors leading to the stairs. The traffic area is obviously meant to carry the building's internal circulation. Like the auxiliary areas, these components of this space are used by all tenants of the given storey. Utility system service area is the last area type shown in the projection done to the standard PN–ISO. This area carries technical installations and equipment. It was inaccessible to direct measurement on the building used in this study. These spaces were plotted on the storey projection based on the architectural drawings. The total of the (basic and auxiliary) usable floor area, the traffic area, and the utility system service area is what we get as the net floor area of the measured storey.

Fig. 2 shows a fragment of room projection done according to BOMA.

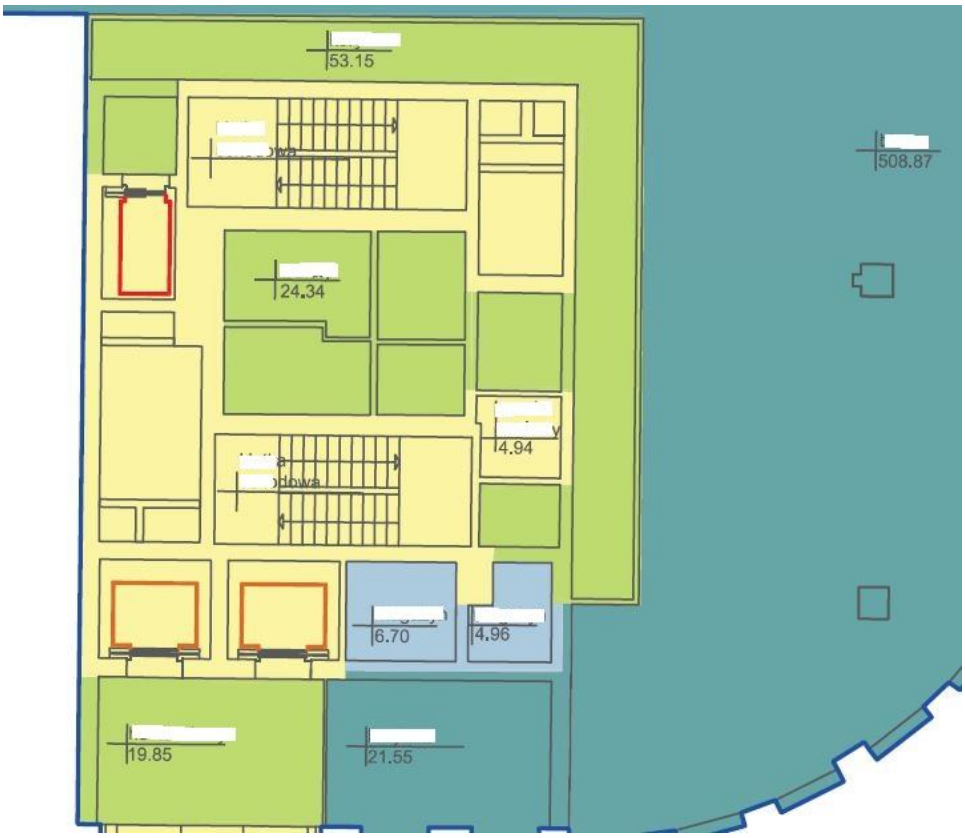

Fig. 2. Room projection according to BOMA. *Source: own elaboration*

This area measurement (Fig. 2) was done at the dominant portion level. The storey projection was made in a special process. The first task was to identify the Interior Gross Area (IGA). Then, other areas were classified within IGA boundaries and totalled as the interior gross area. The definition of boundaries between the particular area types was done according to the standard rules. The boundary between adjacent equivalent areas ran along the axes of the walls between these areas. But in the case of adjoining areas of different types, the wall separating the rooms was included into the area qualified for a higher rank in the BOMA standard. This grading of measured spaces can be shown in the following way, starting from the superior area: Major Vertical Penetration (MVP), Floor Service Area (FSA) and, at the end, the equivalent Occupant Area OA and Occupant Storage OS. This means that whenever an MVP-type area adjoins an FSA-type area, the separating wall is included into Major Vertical Penetration MVP; when the adjacent spaces belong to the categories of floor service area FSA and occupant storage OA, the wall is included in FSA, but when OA adjoins OS, the boundary between them runs along the axis of the separating wall (half of the wall area is included in the tenant's area, and the other half—in the storage area; this situation would also occur in the case of two adjacent spaces held by two different tenants. Apart from the walls, pillars are also included in the leasable area. This categorisation of the spaces was followed by calculation of their size. The last stage of data processing according to BOMA was a calculation of the Rentable/Usable Ratio (R/U Ratio). The R/U Ratio is a special BOMA feature that distinguishes it from among the other standards and is handy in calculating the proportion of common areas per particular tenants. This allocation is done proportionately to the rented leasable area which—multiplied by the respective coefficient—usually produces an area entered in the contract for which the landlord calculates the due rent.

Fig. 3 shows a fragment of room projection done according to TEGOVA.

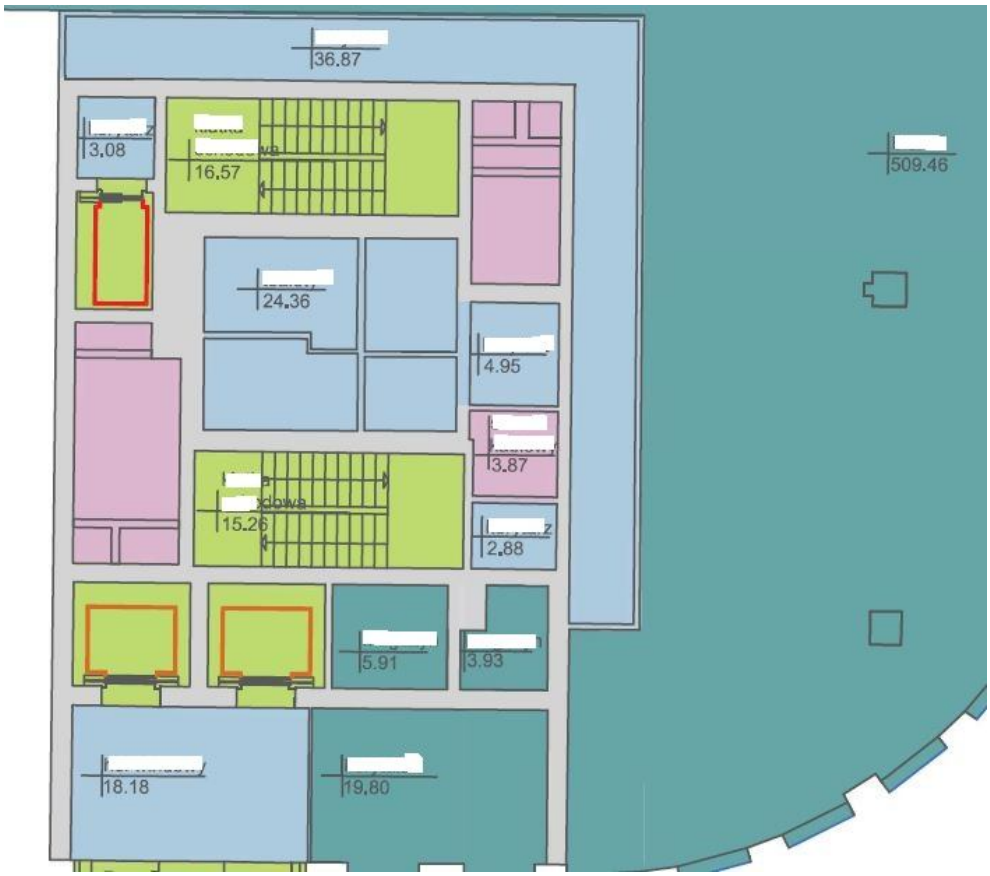

Fig. 3. Room projection according to TEGOVA. *Source: own elaboration*

This area (Fig. 3.) was measured to the external glass panels of the building because windows made up a dominating part of the facade area. Internal construction walls of the building and partition walls of an area over 1 m² were included in the Interior Construction Area (ICA). Pillars present in the interior leasable area were not included because none of them covered an area larger than 1 m². The circulation zone consists of space used for the building internal traffic. It includes the area of the stair cases and lift wells. The common traffic area at the measured storey comprised the the lift lobby, corridors, and toilets. The tenant's area is the area to let. Since TEGOVA does not define storage rooms as a different type of area, the investigators included in that space the office, the corridor, and the storage rooms used by the tenant only. The investigators did not exclude pillars from the leasable area because they did not cover more than 1 m². The total of the above-described areas, that is, the Interior Construction Area, the Circulation Area, the Technical Services Area, the Common Traffic Area, and the Occupant Area altogether makes up the gross Internal Floor Area. The Net Floor Area is equal to the Gross Area less the Construction Area, the Communication Area, and the Technical Services Area.

Fig. 4 shows a fragment of room projection done according to GIF.

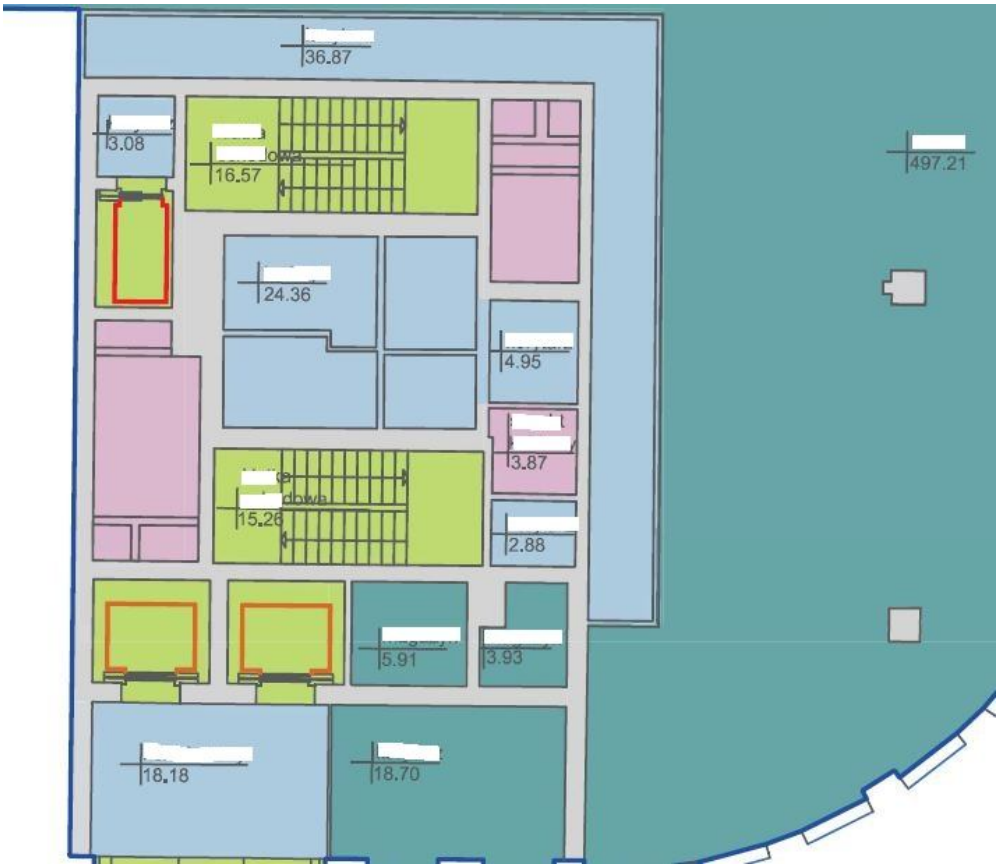

Fig. 4. Room projection according to GIF. *Source: own elaboration*

Boundaries of the areas (Fig. 4) were marked by the inner edges of the walls. The Leasable Area (MF-G) is the total of usable area occupied exclusively and the common areas found at a given storey. In the measured space, the exclusively used area (MF-G1) comprises the office, the corridor, and the store rooms to be used only by the tenant. The other spaces, that is, the lift lobby, the corridors, and the toilets were included in the common area (MF-G2).

Fig. 5 shows a fragment of room projection done according to IPMS 2-Office.

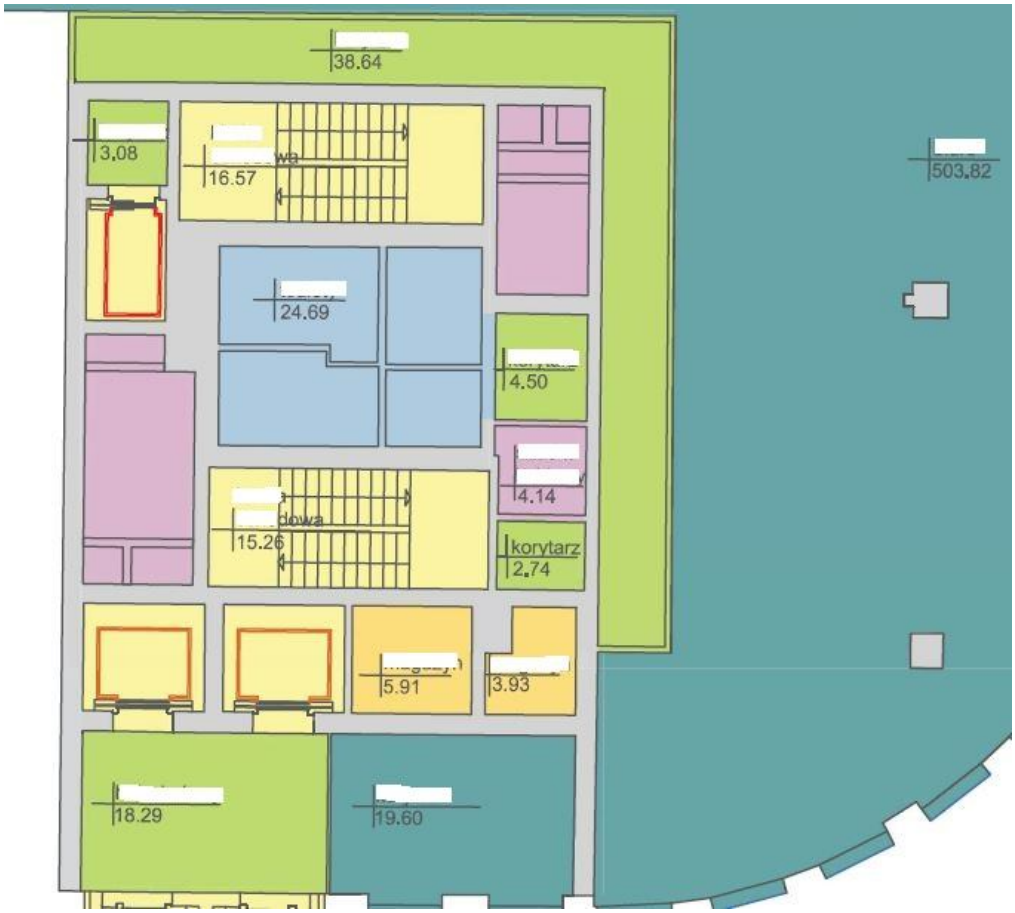

Fig. 5. Room projection according to IPMS 2-Office. *Source: own elaboration*

The area measurement (Fig. 5.) was made, like in the BOMA standard, to the dominant portion but due to the IPMS-specified area types, a projection of the storey made according to this standard is more similar to that following TEGOVA rules. Under the IPMS standard, many more area types can be identified at the measured storey than under any of the above-discussed standards.

The projections were used to define areas available for lease. To enable a comparison of areas obtained from measurements done by the rules of the different standards, the investigators included the same rooms into the leasable area. These rooms were: the office space, the corridor, and two storage rooms destined for an exclusive use of the tenant. Table 2 shows the result of measuring the areas discussed, which have seen given in Figs 1-5, and it specifies the area types recognized by the particular standards.

Table2. Area measurement results

ISO 9836		BOMA		TEGOVA		GIF		IPMS 2	
The type of surface	[m²]	The type of surface	[m²]	The type of surface	[m²]	The type of surface	[m²]	The type of surface	[m²]
Net Usable Area	663.00	Interior Gross Area (IGA)	761,70	Interior Construction Area (ICA)	43.90	Mechanical Building Area (TF)	23.90	Component A - Vertical Penetrations	64.48
Basic usable floor area	**523.47**	Major Vertical Penetration (MVP)	122.28	Circulation Area 1 (CA)	64.48	Traffic area (VF)	64.48	Component B -Structural Elements	47.87
Auxiliary usable floor area	61.99	**Occupant Area (OA)**	**530.42**	Technical Services Area (TA)	23.90	Structural Building Area (KGF)	47.87	Component C -Technical Elements	24.16
Traffic area	55.72	**Occupant Storage (OS)**	**11.66**	Circulation Area 2 (CA)	90.32	**Leasable area used by tenant only (MF-G1)**	**525.75**	Component D -Hygiene Areas	24.69
Utility systems service area	21.82	Floor Service Area (FSA)	97.34	**Occupant Area (OA)**	**539.10**	Common leasable area (MG-G2)	90.32	Component E – Circulation Areas	67.25
		R/U Ratio	1.18	Internal Floor Area (IFA)	761.70	Gross floor area (BGF)	752.32	Component F - Amenities	0.00
				Net Floor Area (NFA)	629.42			**Component G - Workspace**	**523.42**
								Component H – Other Areas	**9.84**

Source: own elaboration

The measurement results show that the largest leasable area can be obtained by using the BOMA standard. BOMA measurement always produces a larger area than any other standard, whatever the building finishing, proportion of walls and pillars, facade type, or size of the windows. This feature explains why the per-cent proportion of leasable area should be calculated also according to standards other than BOMA.

If we assume that the leasable area defined according to BOMA is 100%, we will find that TEGOVA measurement produces the second-largest area and the third-largest one can be obtained by using the IPMS standard.

An analysis of the per-cent proportion of leasable area according to these standards in relation to the BOMA-calculated area was done for two cases:

a) without calculating the R/U Ratio—Table 3

b) with the R/U Ratio included—Table 4.

Table 3. Results of measurement of usable floor area based on selected standards and an analysis of its per-cent proportion without taking the R/U Ratio into consideration

	ISO 9836	BOMA	TEGOVA	GIF	IPMS 2
Area to let [m^2]	523.47	542.08	539.1	525.75	533.26
Per-cent proportion vs. BOMA	96.57%	100.00%	99.45%	96.99%	98.37%

Source: own elaboration

Table 4. Results of measurement of usable floor area based on selected standards and an analysis of its per-cent proportion with the R/U Ratio included in the calculation

	ISO 9836	BOMA	TEGOVA	GIF	IPMS 2
Area to let [m^2]	523.47	639.65	539.1	525.75	533.26
Per-cent proportion vs. BOMA	81.84%	100.00%	84.28%	82.19%	83.37%

Source: own elaboration

Analysis 1 (Table 3.) does not look at the R/U Ratio and offers a more realistic insight into differences between the particular standards which show up in surveying practice. It should be noted, however, that only BOMA offers a method of calculating the shared area factor for a storey. Under the other standards discussed here, this ratio can be calculated in a way proposed by the principal who has ordered the measurements or by the surveyor himself. The fact that BOMA provides a method for the calculation of the shared area at a storey and in a building is a major advantage because it rules out bias.

Analysis 2 (Table 4.) which includes the R/U Ratio, is intended to demonstrate how different may the obtained leasable areas be when the shared area factor is or is not taken into consideration.

These analyses prove that areas calculated according to the different standards are different too. The choice between floor area measurement standards may lead to the building owner's considerable financial benefit or loss.

Taking into account unit price for 1 m2 space of premise, which is at level 7000 PLN (1750 EUR), one should ask question if they are neglected or not. Below, an example of way of computing such area, resulting differences reaching 3%, that is 1.8 m2 . It corresponds to 12600 PLN (3150 EUR). Area computed according to PN-70/B is 53.6 m2, and according to z ISO 9836 is 51.8 m2 [BIEDA et al., 2014].

Maximum rent income is very important to owners of commercial buildings present on the leased property market. Rent hikes, which may seem the easiest thing to do to maximise rent income, is not always possible because of the current price level on the market and rather high competition. Many landlords, therefore, go the other way, that is, they try to "enlarge" their leasable area. This, it is important to commission building measurements according to a carefully selected standard and then to declare the obtained result when offering the leasable area to the market. Table 5 shows an analysis of profits that can be gained by changing the floor area measurement standard.

Table 5. Analysis of rent profit generated by changing the usable floor area measurement standard when the rent rate stands at EUR15/m^2

	ISO 9836	BOMA	TEGOVA	GIF	IPMS 2
Leasable area [m^2]	523.47	542.08	539.1	525.75	533.26
Monthly rent at unit rate of EUR15/m^2	€7,852.05	€8,131.20	€8,086.50	€7, 886.25	€7, 998.90
Difference in rent paid for a leased area per area measured with PN-ISO	€0.00	+€279.15	+2€34.45	+€34.20	+€146.85
Per-cent difference in rent paid for a leased area per area measured with PN-ISO	0.00%	+3.56%	+2.99%	+0.44%	+1.87%

Source: own elaboration

ISO 9836 was adopted here as the basic area and EUR15.00/m^2—as the unit rent rate. Calculations given in Table 5 make it clear that from the landlord's perspective, a change of the leasable area size from one calculated with the ISO 9836 standard into an area size obtained from the BOMA standard, when the area under study is about 550 m^2, the monthly profit increase may be ca EUR280. Suppose the landlord has a building of 10,000 m^2, his monthly profit will reach around EUR5,000. During a year, his profit will total EUR60,000. This profit may be even higher when the leased building has many partition or construction walls. This explains why BOMA is the landlords' most favoured floor area measurement standard.

Potential gains on the sale of a building is another consequence of the choice of a floor area measurement standard. This is because these standards can be chosen freely when it comes to pricing a building put on the market. Surely, the seller and the buyer must be well versed in the rules of the measurement standards because one of them wants to ask the maximum price and the other wants to pay the lowest possible price. There is no doubt that the expert who actually puts a price on a sold property must be very familiar with those rules too. A property valuation survey should, therefore, identify which standard was used to measure the floor area because it is part of the building value and a larger leasable floor area generates a higher rent profit. A potential buyer should understand that income to be generated by a building may change after re-calculating the rent rates using a usable floor area size which is different than one stated in the property valuation survey.

Conclusions

The term "usable floor area" can have more than one meaning and it can be interpreted in a number of ways. Having studied several different standards of area measurement, we found that the usable floor area of the same room may vary depending on the actual standard employed. On the property market, where any method of determining the size of area to let is allowed, several standards are in common use and their selection depends on the personal preference of the principal who commissions the measurements. To solve this situation, the IPMS standard was introduced with the intention to have an international and globally binding standard that would make the area measurement rules identical all over the world. However, the leasable area calculated with IPMS is usually smaller than area obtained by employing the standard ANSI/BOMA Z65.1-2010. This is why BOMA is better for the landlords who will certainly be reluctant to discard their preferred methods of measuring the area of their property. We should, therefore, expect BOMA to retain its leading position as a measurement standard. After all, whichever standard is used in the measurements, it is important for both, the landlords and the tenants to understand the rules of measurement they have chosen. The result of floor area measurement always translates into financial proceeds to be gained by the landlords. The tenants, when signing a lease contract, should make sure that the measurement standard named in the contract and the attached projections are consistent and that the landlord has made no modifications in them to enlarge the area to let. As a matter of fact, modification of the measurement standards is legally acceptable so long as the tenant is duly informed about it because, as has been mentioned before, the law does not indicate any particular standard as mandatory in measuring the usable floor area.

The study discussed here has shown that the floor area measurement standard ANSI/BOMA Z65.1-2010 is most convenient to owners of commercial property, the second-most advantageous is TEGOVA, third—IPMS, and GIF is the fourth, while the least advantageous for them is the standard ISO 9836. However, it is not enough to have the floor area measured only with the one most preferred standard because the usable floor area which must be declared for tax purposes is different than the area measured with international standards and different than the area required for valuation, technical purposes, or safety requirements.

References

PKN [1970] - Polski Komitet Normalizacyjny, Polska Norma PN-70/B-02365, Powierzchnia budynków. Podział określenia i zasady obmiaru, czerwiec 1970

PKN [1997] - Polski Komitet Normalizacyjny, Polska Norma PN-ISO 9836:1997, Właściwości użytkowe w budownictwie - Określanie i obliczanie wskaźników powierzchniowych i kubaturowych, październik 1997

Ustawa z dnia 28 lipca 1983 roku o podatku od spadków i darowizn

Ustawa z dnia 12 stycznia 1991 roku o podatkach i opłatach lokalnych

Ustawa z dnia 21 czerwca 2001 roku o ochronie praw lokatorów, mieszkaniowym zasobie gminy i zmianie Kodeksu Cywilnego

MF-G [2004] - Gesellschaft für Immobilienwirtschaftliche Forschung e.V., Dyrektywa w sprawie obliczania powierzchni najmu pomieszczenia dla celów zarobkowych (MF-G), tłumaczenie z języka niemieckiego, listopad 2004

KUBICA J. *Metoda weryfikacji powierzchni inwentaryzowanych obiektów budowlanych*, Nieruchomości C. H. Beck, grudzień 2006, nr 12, s. 39-42

Building Owners and Managers Association International, Office Buildings: Standard Methods of Measurement (ANSI/BOMA Z65.1 – 2010), 2010

Standards [2012] - The European Group of Valuers' Associations, European Valuation Standards 2012, Belgium, 2012

EBING J. *Obliczanie powierzchni i kubatury obiektów o różnym przeznaczeniu*. *Poradnik specjalisty ds. nieruchomości.* Wydanie II , Wydawnictwo Verlag Dashöfer Sp. z o.o., Warszawa, 2011

Standards [2014] - Koalicja Międzynarodowych Standardów Pomiaru Nieruchomości, Międzynarodowe Standardy Pomiaru Nieruchomości: Budynki biurowe, listopad 2014

BIEDA A., HANUS P., JASIŃSKA E., PREWEDA E. "*Accuracy of determination of real estate area*", "ENVIRONMENTAL ENGINEERING", eISSN 2029-7092/eISBN 978-609-457-640-9, Lithuania, 2014.