Canton of Zurich Building
Department
Office for Spatial Development
Spatial Planning

Recalculation of floor space reserves

1.0
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Contents

Abbreviations used

AG Degree of development
ARE Office for Spatial Development
AV Official Surveying
AZ Utilisation ratio
BMZ Building volume index
DOM Digital surface model
DTM Digital terrain model
GFB Floor space inventory
GFR Floor space reserves
LiDAR Light Detection and Ranging (remote measurement using laser) Max. GF Maximum possible floor area
ÖREB Cadastre of public law restrictions ROK ZH
Spatial planning concept of the Canton of Zurich
UbEs Development and infrastructure status
ÜZ Development index
QEZ Neighbourhood preservation zone

1. Foreword

1.1. Introduction

Due to various circumstances, the calculation models for floor space reserves have been comprehensively revised over the past two years by the Federal Office for Spatial Development (ARE) in collaboration with the Seiler&Seiler office. The main objective was to obtain the most accurate and uniform determination of floor space reserves possible while ensuring a high degree of automation in the processes.

The reasons for the remodelling were, on the one hand, the added value compensation, for which some of the models form a basis, and, on the other hand, the adaptation to new building standards (such as floor heights) and new or amended norms (such as the harmonisation of building terms). On the other hand, new data sources are now available that allow for even more accurate evaluation than before. This makes it possible to better meet the desire for an appropriate representation of reality in terms of existing and maximum possible floor space per property.

The high level of complexity and the sometimes significant statistical changes led the ARE to decide to provide this documentation as a tool to make the effects more tangible and to show how the ARE proceeded in recalculating the existing floor space, the maximum possible floor space, the floor space reserves and the degree of development.

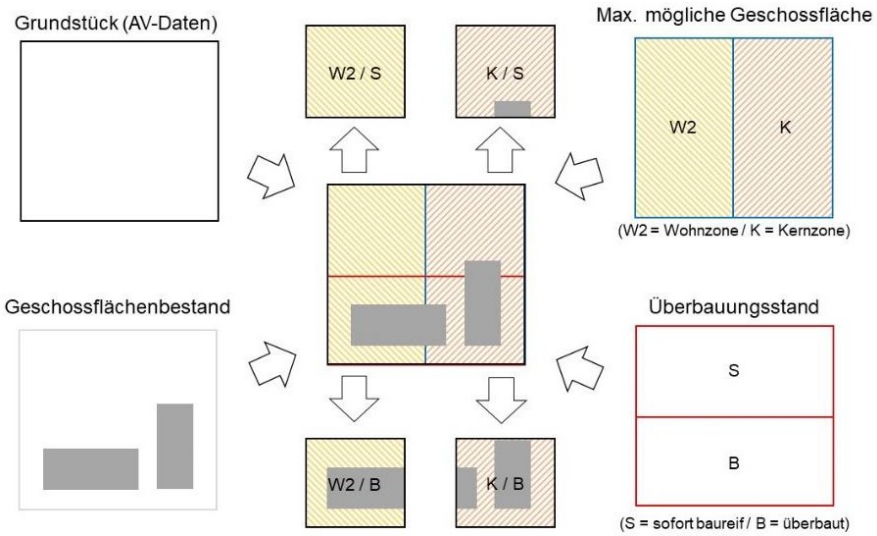

Illustration: Combination of the models "floor space inventory" and "maximum possible floor space" at the level of property – zoning – development status with a view to the subsequent calculation of floor space reserves at the municipal level

1.2. Significance in everyday planning

The floor space reserves (FSR) and degree of development indicators are particularly important tools for local planning. They can be used to determine the theoretical construction potential that exists in a municipality.

The new statistics show that in certain municipalities, the calculated floor space reserves and thus the degree of development (AG) have risen or fallen significantly.
This can lead to uncertainty, for example with regard to what this means for the ARE's assessment of local planning. In this regard, we would like to point out that the ARE does not review plans purely on the basis of calculations. Rather, the guidelines for spatial development in the municipalities (in particular the spatial development concept of the cantonal structure plan – ROK ZH) are decisive. Municipalities in which the statistics have changed significantly can address the changed values in a differentiated manner in their planning reports. The present documentation offers assistance in this regard. The so-called local planning discussions are a good opportunity to reflect on the new statistical findings together with the ARE. If you require an appointment, please contact our regional planning and land use planning advisors.

Data analysis has shown that a large number of factors, some acting alone and some in combination, are responsible for the statistical changes. At the municipal level, it is therefore no longer easy to provide a clear explanation for these changes. Nevertheless, there are certain valid indicators or patterns that could make it easier to understand the changes. Viewed in isolation, these can be summarised as follows:

- In municipalities with a high proportion of core zones and neighbourhood preservation zones, the GFR decreases and the AG increases.
- In more urban municipalities or those with a higher proportion of building zones in the high-rise segment, the GFR increases in the vast majority of cases and the AG decreases accordingly.
- In municipalities along Lake Zurich, which are characterised by pronounced slopes (influence of the basement, see below), the GFR increases and the AG decreases.
- In municipalities with a building volume index and a low maximum number of full storeys, the GFR increases in the vast majority of cases and the AG decreases.

The above points alone cannot conclusively explain the statistical changes. We therefore refer you to the following explanations. If you have any questions, please contact our specialists atraumbeobachtung@bd.zh.ch , who will be happy to assist you. We would also like to refer you to the answers to frequently asked questions (FAQ), which can be found in a separate document.

We would like to note that, for technical reasons, no statistics on floor space, floor space reserves and the degree of development will be published for 2020. We will make this clear in the documents provided (fact sheets/Excel tables). Thank you for your understanding.

2. Recalculation of "floor space reserves"

Floor space reserves (FSR) show how much floor space can theoretically still be realised in accordance with the applicable building regulations in the building zones (residential zones, mixed zones, industrial and employment zones) in the municipalities of the Canton of Zurich, taking into account the existing floor space. Of course, each property must be examined on a case-by-case basis to determine the feasibility of the GFR. In practice, there are structural, topographical and other challenges (such as land hoarding and the like). Since the GFR model does not do justice to individual cases but offers a good approximation on a larger scale (from neighbourhood level upwards), the data is published in tabular form for each municipality, zone type and development status. Data visualisation at neighbourhood level is carried out in the GIS browser (neighbourhood analysis).

2.1. Methodology and effects

The floor space reserves of the canton of Zurich are collected in a complex process within the ARE. In simplified terms, the calculation is as follows:

Step 1: Spatial intersection of the data sets on the development and infrastructure status (UbEs) and the maximum possible floor space (including AV data).

Step 2: The resulting data set is spatially linked to that of the existing floor space in order to obtain the individual values per property unit required for the calculation of the GFR for each property, which may be further subdivided into different zone types depending on the situation.

Step 3: Subtract the maximum possible floor area from the existing floor area per plot of land.

Step 4: Negative values of a difference (i.e. in the case of overuse of a plot unit) are set to 0.

What has changed specifically and what effects can be deduced:

- The **underlying models** (see following chapters) have been comprehensively revised and thus have a decisive influence on the recalculation of the GFR. Depending on the municipality, the new data from the two models can either cumulatively reinforce their effects or, in individual cases, cancel each other out.
- Within the calculation, the **allocation of the individual zone types** to the subcategories of residential, mixed-use and industrial zones (WMI) has been partially revised based on the ÖREB zone codes. This has resulted in deviations within these categories, but without affecting the overall result. Examples include the

neighbourhood preservation zones (QEZ) and residential zones with noise sensitivity levels III, which were previously classified as mixed zones in the data set and have now been reassigned to the residential zone category.

- As negative values (**overused plots** or plot units) are now set to 0 at plot unit level and no longer at zone level for each municipality, as was previously the case, overused plots are less significant overall. This tends to increase the GFR substantially, depending on the municipality.
- Given that GFR data is being collected again after a one-year hiatus, the **changes** that have taken place in the meantime **in building and zoning regulations**, particularly with regard to the harmonisation of building terms, as well as the construction activity that has taken place during this period (demolition/new buildings) must be taken into account when comparing data (statistics for 2019 and 2021).

2.2. New calculation model for "maximum possible floor space"

The data on maximum possible floor space (max. GF) has not been made public to date. In the neighbourhood analysis (map in the cantonal GIS browser), the data is aggregated and presented at neighbourhood level with an appropriate degree of accuracy.

2.2.1. Model definition

The max. GF refers to the floor area that would be possible if all plots of land were redeveloped today with the maximum possible density in accordance with building and zoning regulations, using the currently applicable building standards (floor heights according to use, roof shape).

2.2.2. Methodology and effects

The exact calculation method can be found in the documentation "Model for calculating the maximum permissible floor area per plot in the canton of Zurich". The following list is a rough summary of the calculation steps:

Step 1: Calculation of the eligible plot area

- The previous flat-rate deduction of 15% with regard to the **eligible land area** has now been replaced by a deduction for development in accordance with the categories of roads, railways, pavements and traffic islands in the official land survey. For municipalities with a high or low proportion of **zoned development areas (**such as roads, railway tracks, etc.), the eligible land area will become smaller or larger in some cases, as the new values differ from the previous flat-rate deduction.
- For municipalities that have not yet completed the **harmonisation of building terms**, forest buffer zones and open water bodies are also deducted from the eligible area.

Step 2: Multiplying the utilisation figures by the eligible land area

- In order to reduce the manual recording effort, **overlaps** in land use (such as design plans) are no longer included or evaluated. This may result in the actual maximum GF being underestimated.
- In principle, the utilisation figure from the ÖREB cadastre is used. For zones with **no utilisation figure,** the median of the utilisation figures for all similar zones within the canton is now used instead of an individual assumption.
- Since the focus in **neighbourhood preservation zones** (QEZ) and **core zones** is on preserving the structure, it was simplified for QEZs to assume that there are no floor space reserves, i.e. that the maximum floor space corresponds to the existing stock. In core zones, a reserve is only assumed for undeveloped and severely underutilised plots; for the remaining plots, the same assumption applies as for QEZ. The previous model shows significantly higher reserves, which corresponds to an optimistic assumption, while the new assumptions are rather conservative. Overall

, the new model is certainly more accurate, but in individual cases it may underestimate the maximum floor area.

Step 3: Conversion of values into maximum floor area

- In the new model, **floor space** is redefined so that the main usable area, i.e. the floor space that can be used for living and working, is represented as accurately as possible. The following adjustments and effects are worth mentioning in this context:
    - The new model uses a different **basis** (building footprint) for converting usage figures into floor space than the previous model (above-ground building volume).
    - **External walls** are no longer taken into account in the new model. Viewed in isolation, this leads to a reduction in the maximum GF, especially in the presence of a BMZ or an ÜZ. In the old model, external walls were not included in the AZ calculation, which is why the results of the new and old models for the AZ are similar. With regard to the calculation of floor space reserves, it should be noted that the deduction of external walls is also made for existing buildings.
    - In addition to the full storeys and an attic, half a **basement** is included. This is a compromise solution, as it is not possible to build a basement on certain slopes, while elsewhere a full basement can be built without any problems. Viewed in isolation, the new assumption leads to an increase in the maximum GF. In percentage terms, this has a greater impact on a lower maximum number of full storeys (e.g. in W1 and W2 zones).
    - With the exception of buildings in the core zone, buildings with **flat roofs and attic floors** are assumed instead of pitched roofs. With the new model, the attic floor area is generally slightly lower due to the flat assumption that takes into account the facade distances of the attic floor, but this is likely to be more accurate than assuming a pitched roof.
- The **conversion** of **the floor area ratio** (FAR), the **building volume ratio** (BVR) and the **development ratio** (DR) into floor space is partly based on a new calculation method and new assumptions, including those relating to floor heights. The latter are only used in the BVR in the new model. In zones with **BMZ**, the maximum GF increases significantly when viewed in isolation due to the new assumptions regarding **floor heights** in residential zones and residential zones with commercial concessions, and decreases significantly in industrial and commercial zones.

2.3. New calculation model for "floor space stock"

The model for calculating existing floor space (GFB), which has been in use in the canton of Zurich for several years, has been thoroughly revised with the new model. The newly available data sources (including LiDAR) have the potential to improve the accuracy of the results. The floor space inventory data has been available annually in recent years and this is expected to continue. No data will be released for 2020.

2.3.1. Model definition

The model surveys the built floor space. It is calculated including main usable space, ancillary usable space, traffic areas and interior walls, but excluding exterior walls. This ensures comparability with the model of maximum possible floor space presented in section 2.1.

2.3.2. Methodology and effects

The exact calculation method can be found in the documentation "Model for calculating the existing floor area per property in the Canton of Zurich". The following list is a rough summary of the calculation steps:

Step 1: Linking the data to the building footprint from the official survey

- In contrast to the previous model, which used only data from the Zurich Cantonal Building Insurance (GVZ), a new **cascade-type approach** is now being used, taking into account the availability of **different data sources** (including LiDAR). This new approach leads to greater accuracy than before, but also to deviations from the previous model.
- The model is now more accurate because it only takes into account buildings that also have a building footprint in the **land cover of the official survey (AV)**. Underground buildings such as underground car parks, cellars, civil defence facilities, etc., as well as planned buildings, are no longer included in this approach. The new model relies on high data quality in the AV data set, including building identities for clean linking with other data sets. Errors or inconsistencies can lead to deviations in individual cases.
- The exclusion **of underground buildings** from the new model reduces the GFA significantly in some cases. In percentage terms, this is most evident in municipalities with a relatively high proportion of underground buildings (such as large underground car parks) and zones with a low number of storeys.

Step 2: Calculation of the average building height

Step 3: Derivation of the number of storeys

- For the majority of buildings (currently 65%), the above-ground building volume is now calculated from the difference between the high-resolution **digital surface and terrain models** (DOM/DTM). In addition, when analysing the usability of (inhabited) attics, the lighting is checked, using the **solar cadastre**, among other things. The new use of DOM/DTM and the solar cadastre has shown that there are deviations from the GVZ data set for various reasons. For example, the GVZ volumes were recorded manually by different people at different times. As a result, the values vary significantly over decades depending on the year of construction or recording. However, deviations can also be attributed to different construction practices in past construction periods. For example, the proportion of underground car parks and basements has increased since the 1960s, and attics were previously used more as ancillary areas, which is why they were only partially included in the GVZ volumes, depending on their use. Despite the accuracy of the data collection, errors can also occur in DOM/DTM, for example when trees from the underlying LiDAR data are incorrectly classified as buildings.
- For the remaining buildings, the number of storeys is either taken from the **Building and Dwelling Register (GWR)** (currently 33%) or a fixed number of storeys (currently 1%) is assumed based on the building use (e.g. barn, multi-purpose hall, church). For the remaining buildings (currently 1%), the GVZ building volume is used and converted as in the previous model.
- The assumption of **floor heights** now depends on the building use (including consideration of raised ground floors) and no longer on zoning. Although these new assumptions are more differentiated than before, there is a risk of error if uses are incorrectly classified in the underlying data sets (GVZ, GWR). The exact effects of the new assumptions regarding floor heights are ultimately difficult to determine, as zoning was decisive for floor height in the previous model and building use is decisive in the new model. Roughly speaking, it can be said that the changed assumptions regarding floor heights lead to an increase in floor space in the residential, core and neighbourhood maintenance zones. The increase decreases with the number of full storeys.

Step 4: Calculation of floor area (including deduction of exterior walls)

- In line with the model for maximum floor area (section 2.3) and with regard to the calculation of floor area reserves (section 2.1), **external walls** are no longer taken into account. This consistent deduction results in a lower floor area than with the previous model.

2.4. Degree of development

The degree of development (AG) is derived from the floor area reserves (GFR) and the existing floor area (GFB) and shows the percentage of the construction potential within a defined area unit in the built-up zone that has been realised. Conversely, the AG shows what reserves still exist in the built-up building zones in proportionate terms.

The method of calculating the AG itself has not changed and is simplified as follows:

$$\left[\frac{\text{GFB in the built-up zone}}{\text{GFB in the built-up area + GFR in the built-up area}} \right] * 100$$

As the GFR and the underlying sub-models, such as those for the GFB, are being recalculated, the AG data is also changing. For example, in municipalities where the GFR has increased, the AG decreases accordingly. The effects are most pronounced in rural municipalities with a high proportion of core zones. There, the AG tends to increase significantly. In municipalities with building density ratios, especially those along Lake Zurich, the AG decreases and more reserves are set aside than before.

The level of development and infrastructure (UbEs) also has a significant influence on changes in the AG. In contrast to the GFR, the AG is only allocated to developed areas. With the first digital or online recording of the UbEs by the municipalities for the year 2021, significantly more developed areas were allocated than in previous years. On the one hand, this is due to the new digital recording methodology, which has made recording more dynamic than in previous years with paper plans. On the other hand, the ARE has used GIS analysis to suggest areas to the municipalities that would now have to be classified as "built-up" according to uniform practice (such as railway tracks and similar areas). This, combined with the fact that, under the new practice, hamlet centres are no longer considered building zones, led to significant changes in the building zone statistics, which is ultimately also reflected in the AG in terms of the built-up building zone.