

06.09 Urban Structural Density (2019 Edition)

Overview

The maps "Actual Use of Built-Up Areas" (06.01), "Actual Use" (06.01.1), "Inventory of Green and Open Spaces" (06.02), "Actual Use and Vegetation Cover" (06.02.1) and "Urban Structure" (06.07) and "Urban Structure - Area Types Differentiated" (06.08) detail the types of land use in the Berlin municipal area. When it comes to the **degree of structural use** only indirect conclusions can be drawn from these maps, however.

The degree of structural use is essential for determining the urban structural density and the intensity of use, and therefore, in addition to the supply of facilities and open space, the urban structural quality of a residential area.

Thus, for the first time, the degree of structural use is presented at block and block segment level for the entire city in these maps, represented by the site occupancy index (SOI) and the floor space index (FSI). The Maps "*Floor Space Index (FSI)*" (06.09.1) and "*Site Occupancy Index (SOI)*" (06.09.2) provide a detailed **overview of urban structural density in Berlin**.

The two parameters site occupancy index and floor space index are planning values under construction law which describe the extent to which lots are used. The regulations of the Land Use Ordinance (BauNVO) of 2017 provide the basis for the calculations. The regulations of the Land Use Ordinance of 1962, 1968, 1977 and 1990 have not been considered, since they do not significantly contribute to the representation of urban structural density.

The **site occupancy index (SOI)** indicates the share of the area covered with structural facilities, as compared to the size of the lot (cf. Article 19, Para. 1, BauNVO).

The **floor space index (FSI)** is a parameter which describes the intensity of use of an area. It indicates how many square metres of floor space are available per square metre of property area, and is calculated based on the external dimensions of all full storeys of the buildings (cf. Article 20, Para. 2 & 3, BauNVO).

The maps refer to the definitions of the Land Use Ordinance (BauNVO), and show the key values of urban structural density at the level of individual **blocks and block segments**, since a representation at the level of lots would not be suitable for a general map. For this investigation, the **existing inventory (actual)** was ascertained for these two planning parameters. The maps thus show the current intensity of use for all built-up areas containing buildings.

The analyses are designed to permit a comparison of the actual use of built-up areas with the stipulations and descriptions of the Berlin development plans (land use plans, building use plans and local development plans), and thus to facilitate the localisation of areas that are over- or underused. Hence, the threshold values of the presentation and the class boundaries were defined with reference to those of the building use plans and the land use plans. To be able to draw more differentiated conclusions on densely built up areas with pre-First World War buildings, additional classes were developed for floor space indices of above 1.5.

Statistical Base

To calculate the site occupancy index and the floor space index, the geometries of the buildings in the Official Property Cadastre Information System (ALKIS) were merged with the Block Map of the Urban and Environmental Information System, 1 : 5,000.

For this purpose, the following data bases were consulted:

- Block map 1 : 5,000 (ISU5) of the Urban and Environmental Information System (ISU5, as of December 31, 2015)
- Population Density, as of December 31, 2017 (cf. Environmental Atlas [map 06.06, Edition 2018](#))
- buildings and building components of the Official Property Cadastre Information System (ALKIS), as of March 13, 2019

as well as the appropriate factual data

- number of storeys of buildings and building components
- building function, building component type
- land use of blocks/ block segments
- urban structural type/ area type of blocks/ block segments.

With the aid of these data bases, the site occupancy index (SOI) and the floor space index (FSI) were ascertained for a total of 24,722 blocks and block segments.

Methodology

Ascertaining the Number of Storeys in Buildings

The number of storeys of a building was adopted from the Official Property Cadastre Information System (ALKIS). If a building features special or varied properties, the relevant data is subdivided and documented under 'building components'. If a building has a 'vertical structure', i.e. a varied number of storeys, these are modelled as 'building components'. This allows for a very fine differentiation of a structured building.

To derive the storey structure at 'building component' level, **building parts with the following specifications** were used:

- Low-rise part of building
- Part of building with a greater number of storeys (not high-rise)
- High-rise part of a building
- Basement
- Arcade
- Storeys that protrude/ are set back
- Other

All buildings without data concerning their number of storeys (number of above-ground floors = 0 and number of underground floors = 0) were automatically assigned a value of one above-ground floor. Components without a floor specification were not considered (except for the building type 'basement'). Figure 1 presents an example of a building differentiation by components.

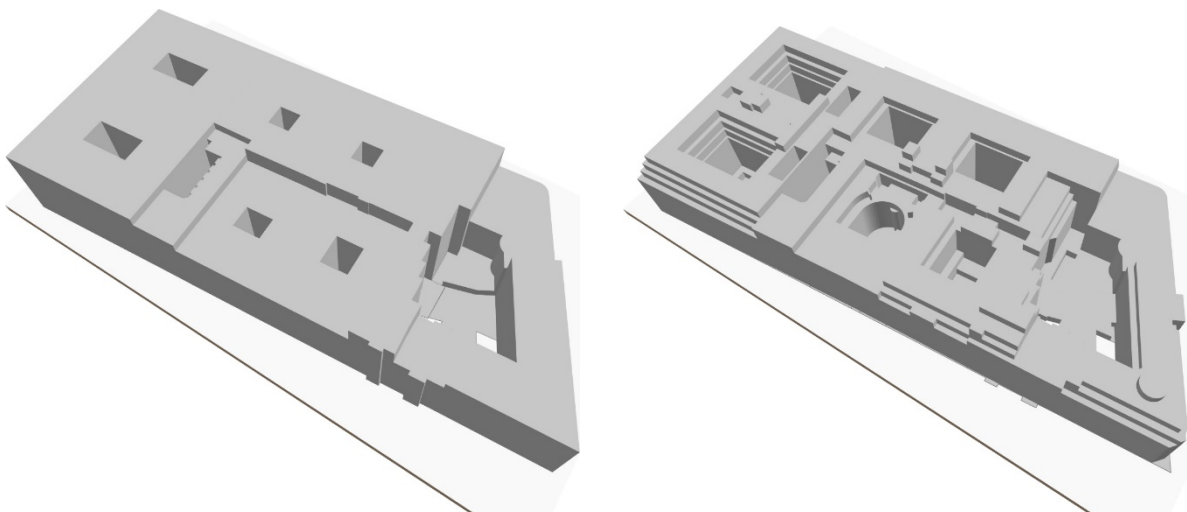


Fig. 1: Differentiation into the ALKIS object types 'building' and 'building component'; left: block with buildings and right: block with buildings and building components.

Ascertaining the Site Occupancy Index

The **site occupancy index (SOI)** states the built-up proportion of a lot. The SOI is a decimal number with one or two fractional digits.

Thus, the formula to calculate the SOI used to prepare the present map is derived as follows: the sum of all built-up areas on a lot - here, the block or block segment area - is divided by the total area.

Since the building areas do not correspond to the block area boundaries, only the proportions of those building areas that actually lie within the block area boundaries were summed. To achieve this, the building boundaries were intersected with the block areas of Block Map 1 : 5,000 (ISU5). Building parts located outside of block areas, e.g. on traffic areas (road surfaces), were not considered.

Ascertaining the Floor Space Index

The **floor space index (FSI)** indicates the number of square metres of floor area per square metre of lot area, here at block or block segment area.

For ascertaining the FSI, the following applies:

The sum of all floor spaces of the main buildings and building components (cf. Fig. 1) located on a block or block segment area is divided by the block size. The floor area of a building is thus calculated by summing the areas of all full storeys. (Generally, this means: number of full storeys multiplied by the floor area of the building).

Consideration of Structural Facilities as per Article 19, Para. 4, BauNVO in ascertaining the Site Occupancy Index (SOI)

BauNVO defines two different parameters to calculate the site occupancy index. They differ in whether ancillary structures are included in the calculation.

According to **Article 19, Para. 4, BauNVO**, garages and carports, including their driveways and ancillary and structural facilities, are part of the floor area (cf. Tab. 1).

As a first step in the calculation, the "main facilities" as per Article 19, Para. 2, BauNVO, were ascertained. As a second step, the floor areas of garages, carports, underground car parks and ancillary structures listed in the ALKIS were added. The buildings of the types shown in Table 1 were categorised as ancillary structures if they had less than two storeys. As per Article 14, BauNVO, ancillary structures are not considered in the determination of floor space.

In cases where above-ground and underground structures overlap, the above-ground structures were cut out of the underground structures (e.g. in the case of an underground car park in a building).

To determine the site occupancy indices (SOI) presented in the **map**, only the main facilities as per Article 19, Para. 2, BauNVO were ascertained, **disregarding ancillary structures**. The map therefore does not display values **including ancillary structures**, i.e. garages, sheds etc. (Article 19, Para. 4, BauNVO), but these numbers were determined and can be accessed through the **factual data display**.

Key	Number	Type
2074	72	Camping site building
2463	80810	Garage
1313	4107	Garden house
2723	22847	Shed
3281	19	Refuge
2465	4731	Underground garage (if all storeys are underground)
2612	350	Toilet facility
2523	2502	Converter
2412	82	Waiting hall
2513	28	Water tank

2000	151	Basement as a building component (incl. one storey above ground)
x	771	Other buildings/ building components completely underground

Tab 1: Building functions and component types categorised as ancillary structures

Depending on whether Para. 2 or Para. 4 of Article 19 of BauNVO is referred to, slightly different urban structural density numbers emerge per block. Figure 2 shows the distribution amongst the selected SOI density classes for both calculation methods.

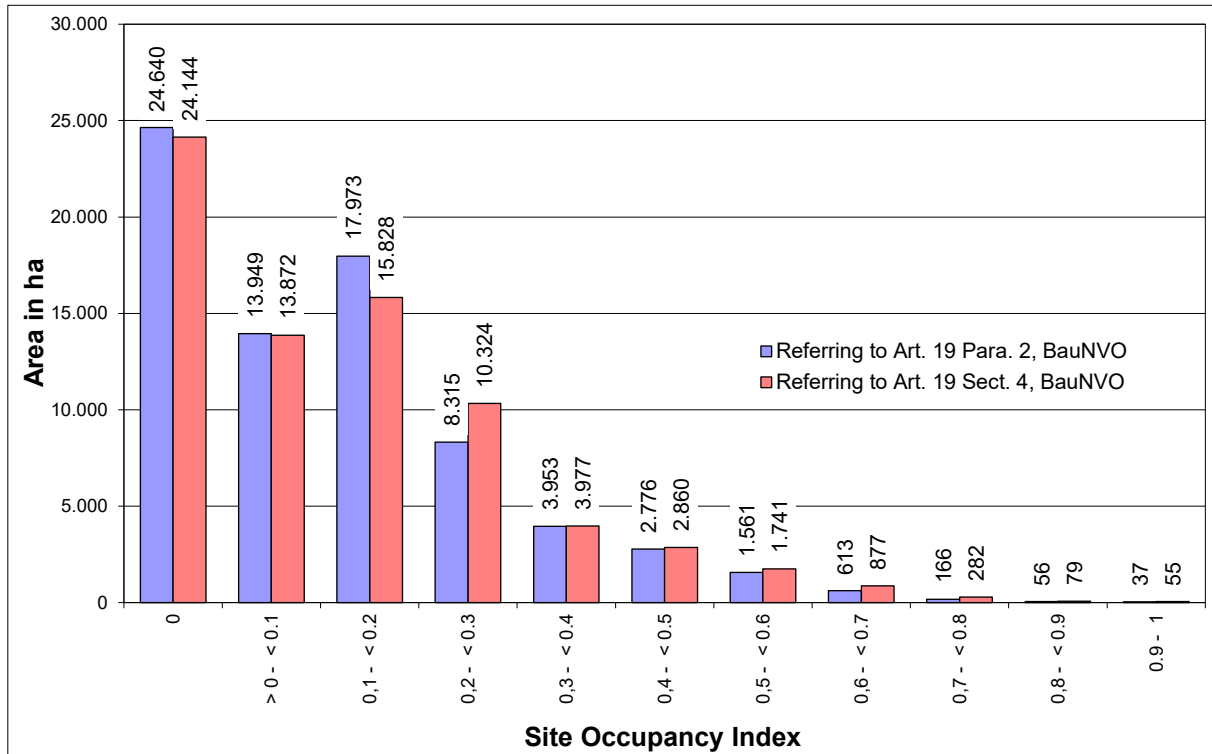


Fig. 2: The distribution of the site occupancy index (SOI) referring to Article 19, Para. 2, BauNVO or Article 19 Para. 4, BauNVO (excl. streets and bodies of water, area-weighted calculation), ALKIS building stock, March 2019.

Hereinafter, SOI always refers to the SOI based on Article 19 Para. 2 of BauNVO.

Overall, however, it turns out that this difference in considering ancillary structures only slightly affects the final presentation of the SOI.

Map Description

Values determined for the FSI and SOI maps are classified based on the **classification** of the land use plan (FNP) and the building use plan (BNP). Areas with negligible levels of development were assigned to the undeveloped areas and presented with them. These are areas with a site occupancy index (SOI) of below 0.1 or a floor space index (FSI) of below 0.05. These are usually forest areas or similar open spaces containing only one or a few buildings, typically outbuildings.

As expected, the maps generally depict a largely concentric staggering of the degree of structural use in the municipal area and, to a large extent, a strong link with the Environmental Atlas Map "[Building Age in Residential Development](#)" (06.12). The more densely built-up areas are easily recognisable by their dark red and dark blue colouring. Today's **inner-city area** within the City Rail Circle Line, built as the "Wilhelminian tenement belt" around the old centre of Berlin, has the highest structural density even today, with FSIs of between 2 and 4. This is also true of the "new city centre" at Potsdamer Platz and the core areas of the boroughs of Spandau, Reinickendorf, Köpenick, Hellersdorf and Zehlendorf.

On the **periphery of the inner city**, including many residential areas of the Weimar period, most areas have an FSI of 1.0 to 1.2. In the **outer parts of the city**, single-family homes prevail, with low floor space indices of less than 0.5 predominating. The large housing estates of the '60s and '70s, and older built-up areas along the main radial traffic routes stand out clearly, as they use their grounds to a

greater extent. In particular cases, a high density of development of individual blocks can be seen even in the peripheral areas of the city. This usually involves large public service complexes, such as the hospital complex in Berlin Buch.

The considerably higher density figures of the numerous **local centres** also show the polycentric structure of Berlin with its core area uses.

The maps may be used to locate building land reserves in built-up blocks in which the actual degree of structural use is less than what is permissible under building law. These reserves play an important role in urban development discussions about the densification of the inner city.

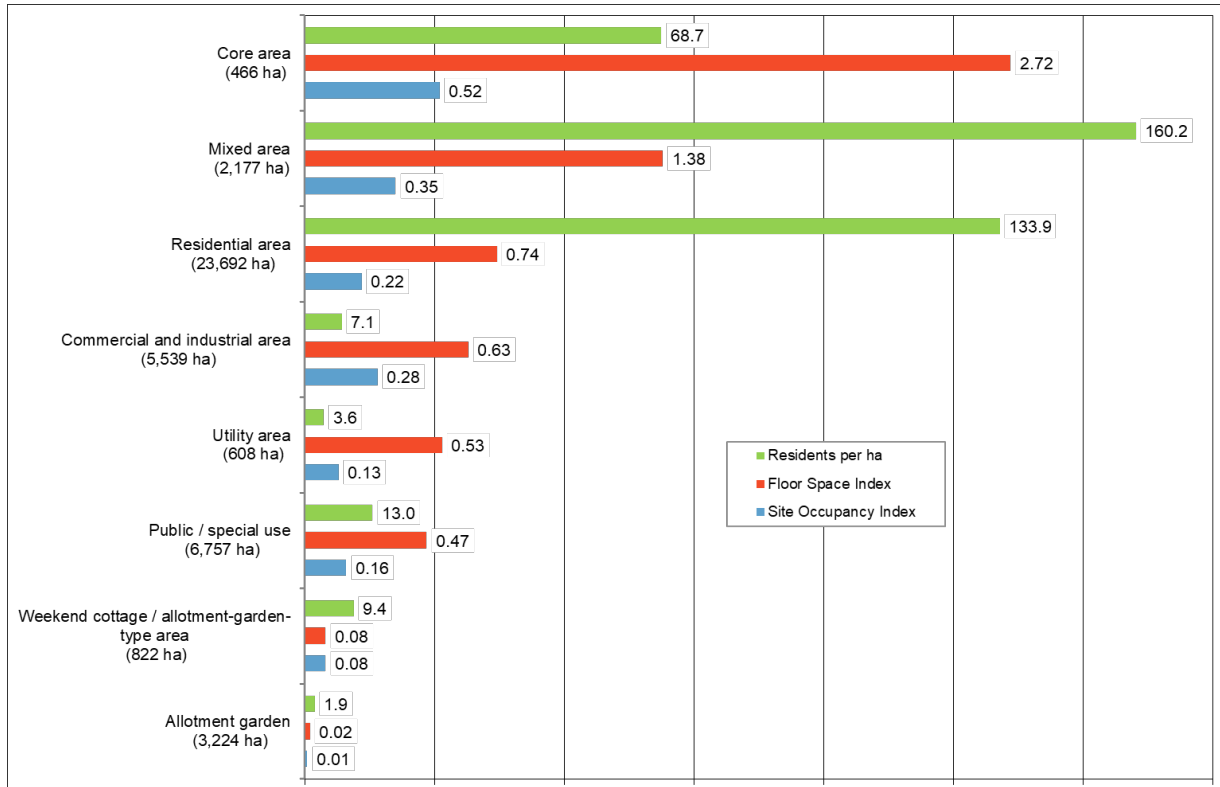


Fig. 3: Population density, FSI and SOI of select use categories in comparison (area-weighted calculation), ALKIS building stock, March 2019.

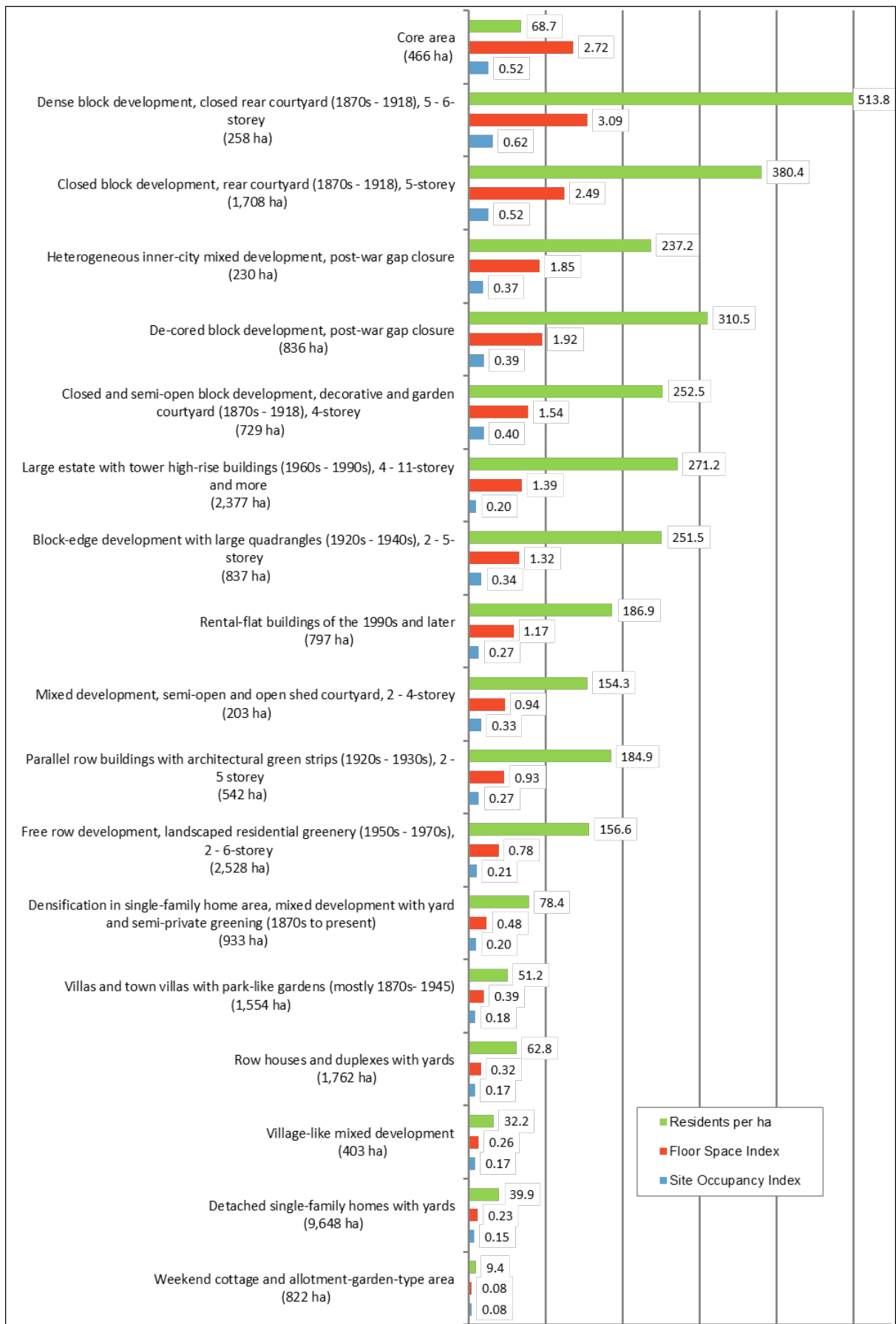


Fig. 4: Population density, FSI and SOI of the different urban structure types in comparison (area-weighted calculation), ALKIS building stock, March 2019.

Figures 3 and 4 show the average FSIs and SOIs for select use categories and urban structure types, and contrast them with the average population densities. When comparing the population density with the two parameters “site occupancy index” and “floor space index”, it is clear that the greatest population densities combined with the highest urban structural densities, remain in the neighbourhoods with Wilhelminian block developments (cf. Fig. 4). Satellite towns and high-rise complexes, on the other hand, tend to be in the mid-range due to large undeveloped spaces between individual buildings.

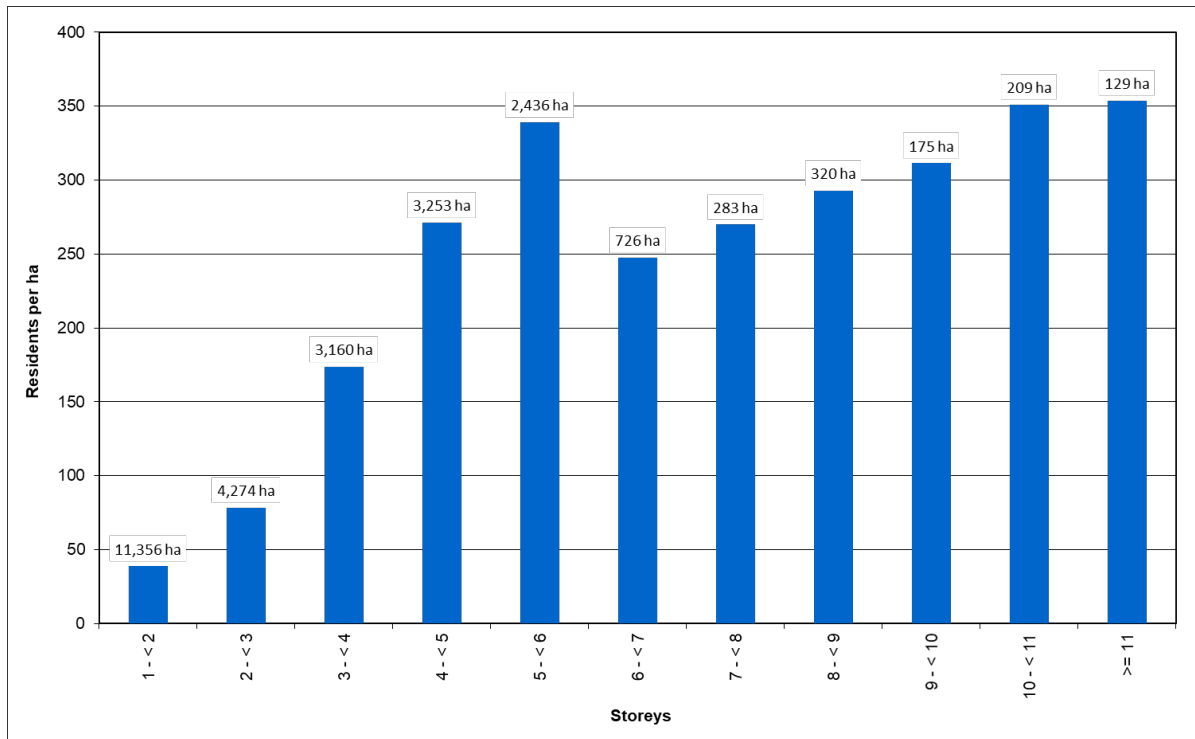


Fig. 5: Population density in proportion to the average number of storeys per block (only blocks with residential use, area-weighted calculation), ALKIS building stock, as of March 2019.

Fig. 5 shows the ratio between the number of storeys and population density of the 12,614 blocks identified as residential areas, core areas, or mixed areas, according to the use categories of the Environmental Atlas maps “Actual Use of Built-up Areas” (06.01) and “Inventory of Green and Open Spaces” (06.02). Ultimately, due to its high building density of 340 residents per hectare, the structure type representing the 5 - 6-storey block development of the Wilhelminian period with wings and rear buildings, stands out. This value is only exceeded by areas with tower high-rises of more than 10 storeys in the sequence presented. In the structure type “post-war high-rise development”, the large undeveloped spaces between the buildings are compensated by the high number of residents per building.

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