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NEW TYPE OF RESIDENTIAL BUILDING CONFIGURATION

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Abstract. *A good typology, corresponding to the contemporary requirements of housing can contribute to better quality solutions in this field. Theoretical considerations concerning building configuration have defined the types of residential buildings configurations in their basic form, producing hybrid solutions when combined. Current solutions of residential buildings in densely populated urban areas of developed Western European countries have brought another additional type of residential building configuration to the foreground.*
In order to achieve high density it is necessary to build high residential buildings, which suggests the use of the tower building form as one of adequate solutions.
In their response to the current complex building construction requirements, from urban to technological, urban planners and architects conclude that a residential building in the form of a tower must have a substantial plinth. Only this will allow for a quality product – a marketable apartment that meets all standards of a complex locations in the cities. That is how a new type of residential building configuration was born.
Improved configuration typology of residential buildings will expose current issues more clearly and reveal better solutions for housing in urban areas.

Key words: *residential building configuration, housing, typology, dwelling, apartment, building density*

1. INTRODUCTION

Technical and technological development of apartments, more rigorous urban and other requirements for the construction of dwellings, as well as the pursuit of a high density in intensive urban tissues created the need for tools with which to resolve current issues related to housing. One such tool is a typology of residential buildings configurations. This sort of typologies are already in use in architectural practice in developed countries. For the purposes of this study an advanced experience of the Dutch housing will be used.

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In the current practice of the Dutch housing a specific type of configuration of residential buildings has begun to appear more frequently, which, according to the current typologies, has been ignored and, even if mentioned, it has unfairly been omitted from the category of basic types.

The aim of this paper is to analyze the current trends in the Dutch housing practice and review the possibilities for improvement of the existing typology of residential buildings configurations as well as to update the categories of the basic types of building configurations.

Most relevant scientific methods used in the preparation of this paper were observation, case study, content analysis and comparative method.

In this study, research information was obtained from different sources, mainly on-site inspection, architectural bureaus, investors and real estate agencies.

2. RESIDENTIAL BUILDING CONFIGURATION

Typological classification of residential building configurations is becoming increasingly more relevant for solving complex housing-related issues, especially in the current conditions in highly urbanized areas. Following the theoretical considerations of prominent theorists Quatremère de Quincy, Giulio Carlo Argan and Aldo Rossi, explaining the necessity of typology in architecture, Roger Sherwood highlights the role of the typology of forms in the course of clarifying architectural issues and defining solutions. As Sherwood explains the benefits of use of prototypes in housing he defines the types of housing units according to their orientation and the types of residential buildings according to access to dwelling units, [1].

Inspired by these works and by the emergence of new forms of residential buildings, noting the problems of urban growth at the expense of natural resources, a group of researchers at the Faculty of Architecture of the Delft University of Technology, consisting of architects of the NEXT Architects bureau, led by Bart Reuser and professor Rudy Uytenhaak, performed a study during 2004 - 2007 entitled *Density and Spatial Quality*, [2]. The aim of this study was to gain new knowledge in the field of spatial density, and find better ways to exploit existing urban areas by implementing higher density with increasing the quality of housing. This study is of a particular importance for the reconstruction of already developed city tissue. The most prominent aspect of the study was to ensure sufficient daylight and airflow, along with access, view and privacy for housing units in a quality (semi-) private public space.

The result of this research carried out at Delft University of Technology was the creation of blocks library (*de Blokkenbibliotheek*), a typology of forms of residential buildings that facilitates solution-finding in construction performed in urban areas.

The foundation of this solution is a three dimensional matrix in which building volumes are arranged in relation to one another, starting with the smallest unit 5x5m, 3m or 5m in height respectively, and incrementally enlarged by 5x5m, reaching the largest volume of 50x50x50m. When these volumes are arranged in a clear three dimensional matrix, familiar forms are easily discerned, [3].

These basic volumes still do not constitute a building. In the following step the basic volume is cut and perforated in order to provide sufficient daylight to individual dwelling units. Perforations differ relative to the size and form of the basic volume. The next step is to define access to dwelling units, which is inherent to each individual volume, [4].

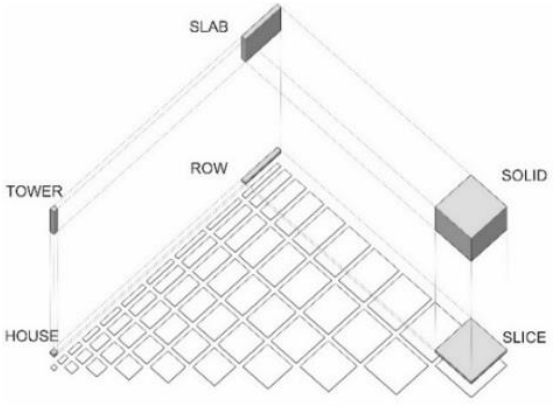

Fig. 1 Basic elements of the blocks library on a horizontal matrix surface, illustration based on published examples of building density studies. [2, 3, 4]

When testing this typology, the authors made a comparison between several buildings, built by the 2006 and inter alia concluded that some new types of residential buildings have emerged in practice which are beyond the standard frame of urban planners. Examples of these new types are the super block on Java Island in Amsterdam, patio types on Borneo Island in Amsterdam, high-patio block in Amsterdam (Funen) and the massive tower on Mullerpier in Rotterdam, [5].

Fig. 2 Massive towers, Mullerpier, Rotterdam: massive tower Hollandia (left) in Sint-Jobskade street, built in 2006; massive tower Mercurius (right) in Mullerkade street, built in 2014. Both towers are entirely residential-type buildings. Hollandia tower shares an underground parking garage with the neighboring lower buildings (which are designed by Architecten Cie.). Mercurius tower has its own parking garage in two underground levels. Both towers have a small plinth in the shape of the foot with two floors above ground level. Both massive towers are designed by Neutelings Riedijk Architects. Photos by Mirko Todorović, 2015.

Tackling a comprehensive approach to the housing problem, Bernard Leupen and Harald Mooij, lecturers and researchers at the Faculty of Architecture of the TU Delft, explain how various linking and stacking of dwelling units produces a configuration of a

shared volume that constitutes a residential building. By studying the configuration of residential buildings Leupen and Mooij have established a typology that entails nine categories of configuration of residential buildings:

- Detached House
- Clustered Low-Rise
- Row
- Mat
- Urban Villa
- Infill
- Slab
- Block
- Tower

This typology of residential building configuration is explaining how wide-wise linking configurations of the simplest type of detached houses creates linear and plain forms horizontally at ground level; and further, adding vertical combinations creates linear, plain and block forms of a stacked housing units. The form and dimension of the residential building configuration are practically determined by contextual and aesthetic aspects, and within each form dwelling units are formed in the most appropriate manner.[6]

In order to simplify the process of typological categorization, Leupen and Mooij also defined abstract forms of residential building categories, which are used as icons in the creation of the Dwellingbase (database of dwelling units) at the Faculty of Architecture of the TU Delft and for the purposes of publishing of professional literature in the field of housing. These abstract icons have very practical application because they define in a very simple manner the typology of the building according to configuration and provide efficient insight into the basic features of the building being studied.

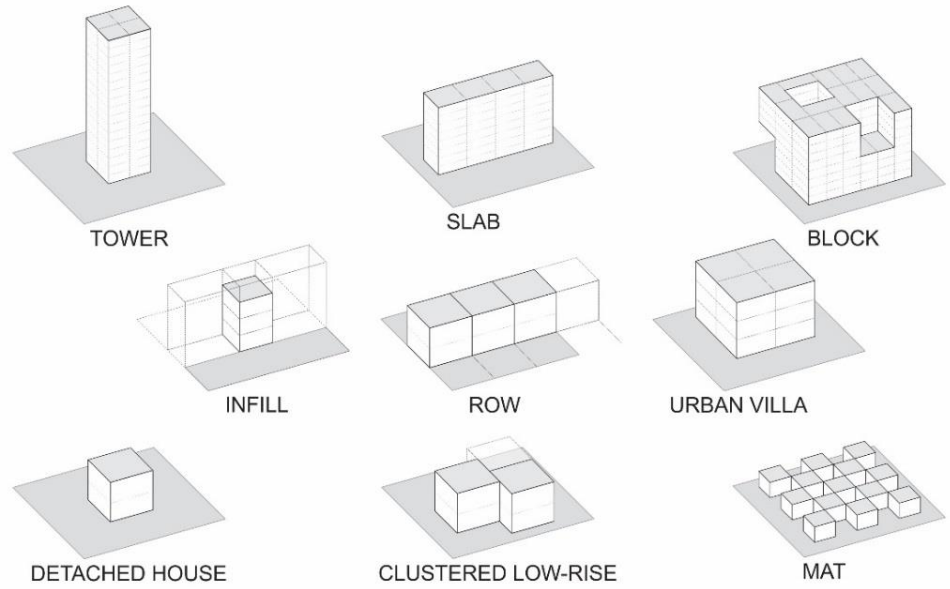

Fig. 3 Abstract icons of residential building configurations based on icons defined by Leupen and Mooij [6] in an order that approximately corresponds to the position of the basic volume of the matrix blocks library in Fig. 1.

In his analysis of configurations of the new and "classical" residential buildings, Jasper van Zwol used the same abstract icons and identified nine groups:

- Closed Blocks
- Perforated Blocks
- Groundscrapers and Mats
- Slabs and Walls
- Ensembles
- Urban Villas
- Towers
- Stepped Blocks
- Complexed Section Blocks

This typology is based on further diversification of a block, as a type from which four new types of building configuration were created, and usage of identical abstract icons for all different types of block. For buildings belonging to different groups, group affiliation was determined based on higher relevance, [7].

For better understanding of the types of buildings, the categorization based on configuration of residential buildings should be accompanied by the categorization based on access to dwelling units, as these are closely related. Shape and configuration of a building affect the means of access to dwelling units and vice versa. Each configuration form of a building is assigned a suitable and appropriate access to dwelling units. In certain configurations most efficient access to a dwelling unit is obvious, while other configuration forms provide more options of access solution.

Defining the manner of access to a dwelling unit is crucial for understanding building configuration. Residential building configuration corresponds to a specific geometric shape that can be seen in the blocks library - the building typology matrix. And vice versa, by piercing or slicing away parts of volumes, basic geometric volumes of the blocks library can produce forms that correspond to a specific category of the building configuration.

3. CURRENT TRENDS IN DUTCH HOUSING

Increasing the housing density in city tissues imposes the use of building towers and large blocks in order to fit as many dwelling units as possible. Here we will review a few examples of residential buildings built in the last ten years.

3.1. Harbour Edge residential building, Lloydstraat, Lloydpier, Rotterdam, built in 2007, designed by AWG architects, investor Leyten & partners

The thirty-five meter high residential building in the form of a tower is located between an old warehouse renovated into a residential building with commercial space on the ground floor (the building of St. Job, renovation by Mei architects) and world-renowned school building of the Shipping and Transport College (designed by Neutelings Riedijk architects).

The building has thirty-nine apartments and commercial space, with its entrance side facing the street and the opposite side facing a body of water. After the construction of the school building, the remaining space left for the building was relatively small and did not leave the possibility to extend the building volume on lower levels.

Due to a relatively small base of the building and high-level underground waters it was technically difficult and irrational to build multi-level underground parking garage, imposing the solution to place the garage on four lower levels above ground. This was done at the expense of favorable positions for additional dwelling units.

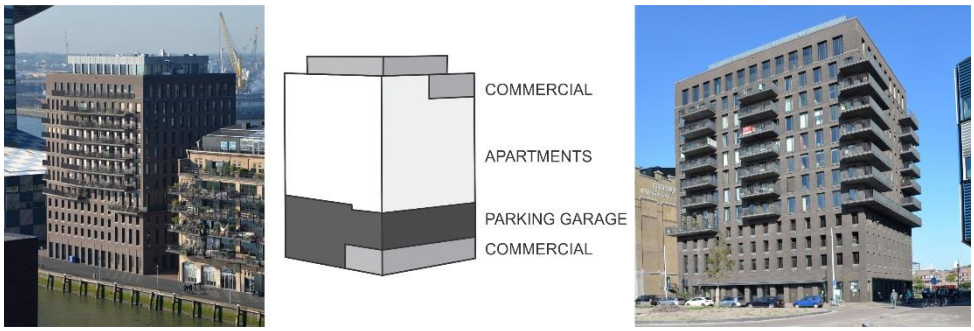

Fig. 4 Harbour Edge residential building in Rotterdam.
Photos and building configuration sketch by Mirko Todorović, 2015.

There are thirteen floors above ground, four of which are reserved for parking garage. Commercial space occupies a part of the ground level and the part of the eleventh floor, and twelfth floor, which is recessed in relation to the façade of the main volume. Access to apartments is provided via vertical circulation core with elevators and stairways. There are five or six apartments on a typical floor. Technical and other auxiliary spaces are on the ground level. Entrance to the residential part of the building is small and inconspicuous, somewhat hidden behind wide columns.

Due to its closed appearance, largely caused by the parking garage occupying several levels above ground, the building was poorly received by the general public, some even referring to it as a "bunker". Without a proper plinth the building appears as if it has collapsed into the ground. Parking space was the greatest challenge for the architects and this example shows that it is very difficult to correctly solve the problem of parking within the tower footprint volume, especially with adverse circumstances in underground levels.

3.2. Crescendo residential building, Mullerkade, Mullerpier in Rotterdam, built in 2007, designed by Frits van Dongen, van Dongen Koschuch achitects, then Architecten Cie., investor Blauwhoed

Residential building Crescendo is located between residential buildings and a body of water, consisting of two volumes: a fifty-meter high tower and a block-form plinth approximately ten meters high. The position of the tower block was conditioned by the positions and volumes of the surrounding buildings.

The tower block volume hosts sixteen floors above ground with one underground level under the central part of the building. The low volume block of the building accommodates a parking garage on one underground and three above-ground levels, and six three-story dwelling units with entrances directly from the street. Duplex apartments below the tower volume also have direct street access. Access to other apartments in the tower is provided by means of a vertical core with elevators and stairways.

Typical floor in the tower has four apartments while the top three floors have three apartments. The tower block has entrances on two sides, one facing the street and the water surface and the other at the opposite side of the building. Technical areas are located at the ground level of the building and the building has a total of sixty-three residential units.

Fig. 5 Crescendo residential building in Rotterdam.
Photos and building configuration sketch by Mirko Todorović, 2015.

This example of a combined volume provides sufficient space for a parking garage of required capacity. Exclusive apartments on the upper floors of the tower have double parking spaces.

Large glass surfaces on the facade, a well sized two-sided entrance to the building for tower apartments, and individual entrances to residential units on the ground level have opened the building to its surrounding. Here, the design brief was much easier. There was enough volume space to allow for very functional, practical and proper solutions.

In environments with less advanced architectural and urban practice, where parameters such as access, daylight, views, and privacy are less important than securing maximum financial return to investors, it would be implemented the configuration of a large block in order to provide more housing units.

This example gives us better and higher quality solutions in every aspect, revealing a different basic configuration type of the residential building.

3.3. *100hoog* residential building, Wijnstraat, Rotterdam, built in 2014, designed by Klunder architects

Residential building *100hoog* (100-high) is located in the city center at a site where old structures were previously demolished, as a part of the city reconstruction project. Building configuration consists of a hundred meter high tower volume, placed on a thirty meter-high horizontal block volume.

One building entrance serves one hundred fifteen apartments in the tower and forty apartments in the block-form plinth. Here, too, the plinth was used to accommodate a parking garage, as well as the technical areas. Commercial space occupies a part of the ground floor of the plinth.

Access to tower apartments is provided by means of a vertical core with elevators and stairways, which also provides connection to the horizontal part of the building with access to the apartments by way of the external corridor.

Without a horizontal volume it would be impossible to provide space for technical facilities and the necessary number of parking spaces for this residential building, because the tower volume base is relatively small. The final result is a very attractive building, with a variety of apartments in terms of configuration and size.

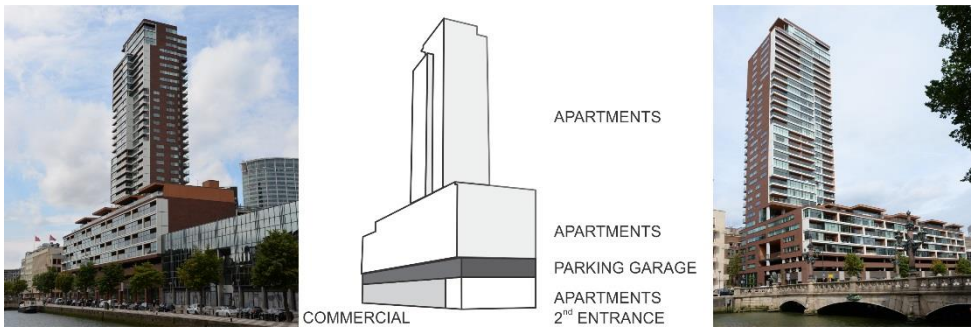

Fig. 6 *100hoog* residential building in Rotterdam.
Photos and building configuration sketch by Mirko Todorović, 2015.

In attractive locations such as this, any investor would certainly insist on fitting in even more apartments. However, compliance with zoning and housing rules produced extremely favorable results. All dwelling units are airy, with plenty of daylight and privacy, excellent access, with mandatory parking space.

3.4. Other examples

In the current practice of advanced housing, there are only few examples of residential building configurations that could be categorized as towers. Several rare examples in Dutch housing with smaller plinth in relation to the tower include residential buildings such as Witte Keizer (Rotterdam, Visserdijk; designed by KCAP architects, 2005) and Scheepmakerstoren (Rotterdam, Scheepmakerskade, Jufferstraat; designed by Taco Pino Architecture, 2008). In both of these examples residential buildings are configured as towers with a smaller plinth and fully automated underground parking garage. Automated garage, where a computer-controlled elevator takes a vehicle without a driver and passengers to a free space on the car 'shelf', occupies the least volume, which is why that solution was implemented in these buildings. Despite the automated parking system, ground level and underground levels could not remain within the perimeter of the tower base, so low plinth volumes had to be added.

In the case of the Coopveart residential tower (Rotterdam, Blaak, designed by Dam & Partners Architects, 2008) plinth could not be build and parking had to be placed in the neighboring building, which is connected to the tower by a pedestrian bridge above the street, since the construction of underground parking garage of the required capacity would have been too expensive.

There is a far greater number of residential building configurations where tower volumes stem from low horizontal block volumes. Some examples of this type of residential buildings are Red Apple (Rotterdam, Wijnhaveneiland, Wijnbrugstraat; designed by KCAP Architects&Planners, 2009), Wijnhaeve (Rotterdam, Wijnhaven; designed by KOW Architects, 2009), Montevideo (Rotterdam, Wilheminapier, Landverhuizersplein; Mecanoo, 2005), Hooge Heren (Rotterdam, Zalmhaven; designed by Wiel Arets architects, 2000), Kabelhof (Rotterdam, Katendrecht, 2e Katendrechtshaven; designed by DKV architects, 2003), De Kroon (Den Haag, Wijhavenkwartier, Turfmarkt; designed by Rapp+Rapp Architects, 2011), Lloydtoren (Rotterdam, Lloydpier; designed by De Zwarte

Fig. 7 De Ruyter residential building (Rotterdam, St. Jobskade; designed by F. Van Dongen), built in 2003, was first named Big Foot for its configuration in the form of a tower with distinct low block volume. The low block was created to accommodate additional dwelling units, outside storage areas and enough space for two-level underground parking garage. Photos by Mirko Todorović, 2015.

Hond, 2011), New Orleans (Wijnhaven, Rotterdam; designed by Alvaro Siza and ADP, 2011), De Admiraal (Rotterdam, Admiraliteitskade; designed by Frits van Dongen, 2003). Apart from parking garages and dwelling units, low volume block offers other facilities for a more well-rounded living, such as swimming pools and fitness facilities (either shared commonly or used privately by the tenants), as well as commercial space for different purposes, such as restaurants, movie theatres, grocery stores etc., which complement the living environment.

4. Categorization of the Residential Tower Block Form Situated on a Low Block Volume

Configuration typologies of residential buildings are defined according to the manner in which several basic dwelling units are connected. More complex configurations can be achieved by combining pre-defined configurations.

In practice, within the contextual, technical and aesthetic aspects, the final form and configuration of a building is achieved by the use of the basic volume or by stripping away volumes from that basic volume of the building so as to achieve natural light, ventilation, views, privacy and access to dwelling units.

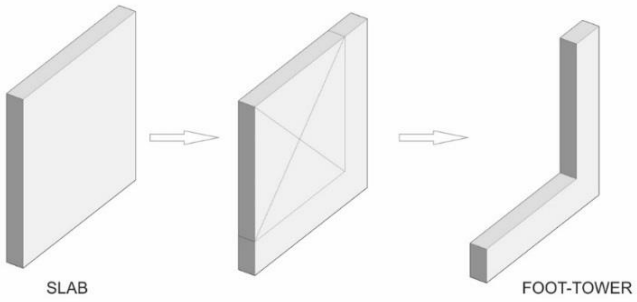

Fig. 8 Analysis of the residential building configuration in the L-form as a result of transformation of basic volume of residential building typology matrix from the Faculty of Architecture of the TU Delft. Author Mirko Todorović, 2015.

For example, cutting out parts of the volume from the basic *slice* form, another form is created in which we recognize the *mat* configuration category; or by cutting out parts of the volume from the basic *solid* form, various other forms are created in which we can recognize the *block* configuration category.

Cutting out volumes from the *slab* basic form produces an L-shaped form, which cannot be with certainty classified to any of already defined categories of residential building configurations. It is clear that this is a new type of configuration category which corresponds to the examples of residential buildings analyzed and mentioned in this paper. The most suitable name for this configuration category is the *Foot-Tower*.

Since residential buildings of this form are usually found in densely built city tissues, a decision which volume to remove is made following the position of the neighboring buildings. Naturally, when deciding on the position of the tower part, the least impact on the surrounding buildings and best positions for dwelling units of analyzing form are decisive.

The logic behind the decision on access to dwelling units in this building configuration form leads to a combination of vertical access for the high segment of the form and horizontal access for the horizontal segment. Horizontal access to dwelling units in the low part of the form can be solved within the form (example - *100hoog* residential building) or outside the form, from external space (example - *Crescendo* and *De Ruyter* residential buildings).

Creating an abstract icon for each category of residential buildings is significant because it allows easier understanding of categories. Icons used by the Dutch theorists are acceptable and applicable, even desirable in practice.

Sometimes it is difficult to discern and classify a building as a specific category. Numerous variations of the pre-defined types of residential building configurations are well-known in practice. Each building configuration category occurring through a deviation of the basic configuration corresponds to one icon representing basic initial configuration. This approach is also used by van Zwol, who, despite recognizing different configuration categories in the block form uses one icon for all those categories. Massive towers, defined by Reuser and Uytenhaak as the new type of residential building form, belong to the tower category, whose abstract icon has already been defined.

Residential building configuration examined in this paper imposes the need to create a new abstract icon since this building category does not fall into the tower or block form. Following the basic principles practiced by Leupen and Mooij when creating abstract icons for residential building configuration categories, the *Foot-Tower* category icon was created, shown in Fig. 9, which can be added to the table shown in Fig. 3.

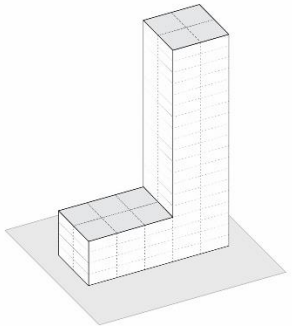

Fig. 9 Abstract icon of the *Foot-Tower* residential building configuration category, according the proposal made by Leupen and Mooij. Author Mirko Todorović, 2015.

5. CONCLUSION

Using the typologies that comprise only basic building forms is not sufficient to enable urban planners and architects to achieve high quality results. Analyses of forms and configurations of residential buildings bring a better perspective and help in finding better solutions in the current housing.

Harbour Edge residential tower is a good example of how the absence of a wider lower volume merged with the tower volume cannot respond well to urban and other standards in current housing. Other examples show that lower block volume is becoming *conditio sine qua non* in the housing for residential towers category. In the current conditions of construction of tall buildings belonging to the tower category it is necessary to provide more space i.e. volume in lower levels. That lower volume is always in the block form and merged with the tower volume. Analyzing these forms and configurations of residential buildings and observing the manner of access to dwelling units brought about the establishment of a new category: *Foot Tower*.

Various solutions and combinations of the types of access to dwelling units in this configuration open numerous possibilities for the implementation of this residential building category. *Foot Tower* configuration category is an important complement to the tools used by urban planners and architects and allows better understanding of issues and finding quality solutions in densely populated urban areas. Implementation of this new type of residential building configuration allows construction of higher-quality apartments in complex urban conditions

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NOVI TIP KONFIGURACIJE STAMBENE ZGRADE

Dobra tipologija, usklađena sa savremenim zahtevima stanogradnje može doprineti kvalitativno boljim rešenjima u toj oblasti. Teorijskim razmatranjima konfiguracije zgrade definisani su tipovi konfiguracije stambenih zgrada u njihovom osnovnom obliku, koji međusobnom kombinacijom daju hibridna rešenja. Aktuelna rešenja stambenih zgrada u gusto naseljenim gradskim područjima razvijenih zapadnoevropskih država u prvi plan stavljaju još jedan dodatni tip konfiguracije stambene zgrade.

Da bi se postigla visoka gustina naseljenosti neophodno je graditi visoke stambene zgrade, što upućuje na upotrebu forme tornja kao adekvatno rešenje. Ali, urbanistički planeri i arhitekti, odgovarajući na kompleksne aktuelne uslove stanogradnje, od urbanističkih do tehničko-tehnoloških, zaključuju da stambena zgrada u formi tornja mora dobiti značajan postament. Tek na taj način moguće je na kompleksnoj lokaciji užeg gradskog jezgra realizovati kvalitetan produkt – stan, koji će zadovoljiti sve standarde i biti privlačan tržištu. Tako je rođen novi tip konfiguracije stambene zgrade.

Poboljšanjem tipologije konfiguracije stambenih zgrada jasnije će se videti aktuelni problemi i kvalitetnija rešenja stanogradnje u gradskim celinama.

Ključne reči: *konfiguracija stambene zgrade, stanogradnja, tipologija, stambena jedinica, stan, gustina izgrađenosti*