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# Apartments in Skyscrapers: Innovations and Perspectives of their Typology Development



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## Abstract

*The paper proposes to reflect on the questions: what does the typology of apartments in contemporary high-rise construction mean and whether it is consistent with the high-rise buildings of the future? What impact do demographic, economic, social, climatic, national and other factors have on the structure of apartments? The research is based on the analysis of more than 100 high-rise residential and mixed-use buildings that have been completed in the past 10 years and the buildings under construction in different parts of the world now. A number of trends in the typology and functional planning organization of apartments in high-rise buildings were identified and examined in order to determine the applications of these trends in the advanced model of high-rise construction development.*

**Keywords: Architectural/Design, Social Issues**

The number of high-rise buildings in the world is steadily increasing year after year. Having analyzed high-rise buildings of 150m and higher completed in the past 10 years, including the buildings currently under construction now, it is worth noting that the proportion of residential high-rise buildings is on the rise, currently comprising 45% of the global total. Unfortunately, single function high-rise buildings are still the most common building typology. The shift to mixed-use has been slow and can be traced more perceptibly in future projections. The comparative analysis shows the percentage of mixed-use high-rise buildings in five-year periods: completed in 2005-2009: residential – 52 %, office – 28 %, mixed-use – 17 %; completed and under construction in 2015-2019: residential – 36 %, office – 32 %, mixed-use – 28 %. The decrease in the percentage of residential high-rise buildings does not equate to reduced interest in them, but rather a gradual shift in building function from residential and office to mixed-use high-rise buildings. Touching upon a social factor it can be said that apartments in high-rise buildings are both luxury commercial housing and more affordable economy class and public housing. As high-rise residential housing is of great interest there comes up an acute question of the trends and prospects of their typology development. It is required to rethink the role of high-rise housing as an element of a complex modern city that involves different levels of living environments – “city,” “house,” and “apartment.” The given research focuses on the apartment as an important link defining the standard of living and environment on different interrelated levels of human habitation.

Nowadays, more active research is being conducted regarding new innovations in high-rise construction. Is the process reflected in the evolution of apartment design? It is well known that innovations or new developments should provide quality increase and conceptually new consumer attitudes to the given product. It is to be noted that not all new developments should be regarded as an innovation, but only the development that increases the effectiveness of the existing system considerably. In this regard the present day apartment typologies for high-rise housing are of great interest.

More than 100 high-rise buildings in different parts of the world were chosen for the research. The research focuses on high-rise buildings completed in the past 10 years, the buildings that are under construction, or at the design level now. Maximum diversity was the main selection criteria. This includes not only supertall buildings, but those that don't take part in the “vertical race,” residential and mixed-use buildings. They have different social and climatic conditions on the construction site. Similarities and differences have been searched for and the most interesting innovations in the typology of apartments have been observed.

The paper outlines the following trends:

1. Architectural planning of residential buildings on the principle of a full-floor apartment.
2. Penthouses as the element of luxury residence.
3. Loft units.
4. Studio apartments.
5. Innovative (exclusive) planning concepts.



Figure 1. One Madison Park, USA, New York (Source: David Sunberg c/o Esto Photography/CTBUH)



Figure 3. Orchard Suites, Singapore (Source: www.worldarchitecturefestival.com)

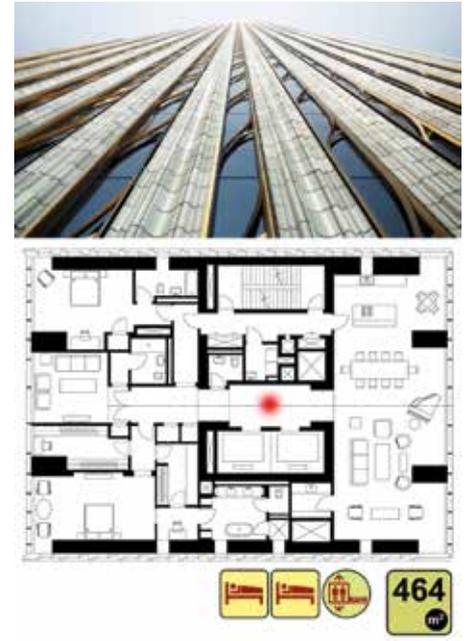


Figure 4. 111 West 57th Street, USA, New York (Source: SHoP Architects, <http://www.shoparc.com/project/111-WEST-57TH-STREET>)

### Trend 1. Full-floor Apartments

This trend is common in many high-rise buildings, and is of special interest for research. This type of apartments is becoming a new typological element in the classification of elite apartments that makes us reconsider the role of penthouses. There are some reasons explaining the existence of such buildings, including their relatively smaller floor-plate, the desire to meet the needs of the most sophisticated residents who look for solitude and privacy in apartment space, and struggle for a panoramic view of the horizon for the maximum number of residential units. In most cases all the above mentioned reasons should be embraced. The following skyscrapers can be given as examples.

The 60-storey residential tower One Madison Park built in New York in 2010 houses 69 units. The key design element was the full-floor apartment. The full-floor apartments have various planning options, i.e. a three-bedroom apartment of 307.5 m<sup>2</sup>, a 253 m<sup>2</sup> apartment with a terrace of 54 m<sup>2</sup> (see Figure 1). A 615 m<sup>2</sup> duplex penthouse on the 55th and 56th floors, and finally, there is a 650.32 m<sup>2</sup> triplex penthouse located on the 55th, 56th and 60th floors.

The residential complex Cliveden@Grange Road was built in Singapore in 2011. While designing the project there was no problem with the lack of site area. Four cylinder towers occupy a spacious site with various public infrastructure facilities- sports fields and playgrounds, a swimming pool, a green space, etc. Moreover, three out of four towers have one round apartment on each floor.

The round apartment offers a panoramic view. Three towers have 63 four-bedroom apartments of 264 m<sup>2</sup> (see Figure 2).

The development of this type of high-rise building has continued, including the design of the residential complex Orchard Suites in Singapore. It is an example of the effective use of a very small area. The residential tower has only 22 apartments. There is only one three-bedroom apartment of 117 m<sup>2</sup> on each floor. The entrance to the apartment is via a private lift lobby and an additional entrance from the stairwell that leads to the kitchen. The tower has an innovative wavy building envelope fixed on the orthogonal grid. The building envelope acts as the ecological filter, protects the apartments from overheating, provides natural air-conditioning and lets the building breath (see Figure 3).



Figure 2. Cliveden@Grange Road, Singapore (Photo source: Elena Generalova, floor plan source: <http://www.condoexpert.sg/cliveden-grange>)

The 77-storey (427 m) residential complex 111 West 57th Street in New York is scheduled for completion in 2017. The building refers to the so called super skinny new Manhattan skyscrapers. Its size in the design plan is only 18.29 x 24.38 m. A 465 m<sup>2</sup> full-floor apartment has distinct functional zoning. The staircase-elevator section separates a kitchen/ dining/ living area from three bedrooms (see Figure 4).

### Trend 2. Penthouses as the Pinnacle of Luxury Residence

The analysis shows that penthouses can be found in nearly every luxury residence. They are the most exclusive and expensive portion of the urban housing market. Having generalized the definitions of the concept

“penthouse”, it can be characterized as a luxurious apartment located on one or several top floors of a residential building. It is an integral part of a luxury residential high-rise building, for one of the major features of any penthouse is the all-round view that is not blocked by any built area. A spectacular view, large floor area, big outdoor terraces, private elevators among other elements make it the symbol of prestige and luxury that emphasizes the high status of its owner. However, the introduction of “full-floor apartments” makes it necessary to rethink the design features of penthouses in order to meet the requirements of a unique residence-“piece goods”.

It should be mentioned that a large floor area is one of the most important features of any penthouse. The analysis demonstrates that the average area of such a residential apartment is 300 – 500 m<sup>2</sup> but sometimes real giants can be found. For instance, the area of a duplex penthouse in 50 United Nations Plaza in New York is just under 1000 m<sup>2</sup>. Another New York duplex penthouse located on the 55th and 56th floors of the high-rise building W New York Downtown Hotel and Residences has the area of 1,115 m<sup>2</sup>. The area of the triplex penthouse The Residence in the high-rise building House on Mosfilmovskaya (Moscow, Russia) is about 2,000 m<sup>2</sup>. There is some information about a luxurious penthouse of 3,300 m<sup>2</sup> that occupies 5 floors in the 49-storey Tour Odeon in Monaco. These are all examples of multi-level penthouses, and it is this typology that should be developed. It is the most expensive kind of apartments on the real estate market, and the demand for them is closely connected with their maximum exclusive living comfort. The comfort level is determined by the following criteria:

- main entrance to the apartment is via a private elevator lobby;
- convenient vertical connection between the floors-not only stairs but private elevators as well;
- well organized service area, private entrance to the apartment for the service staff, a staff bedroom, a laundry, a wet kitchen and dry kitchen area, etc.;
- enlarged number of facilities for a master bedroom: a bedroom, a study room, a mini living room, a dressing room, a walk-in closet, a large bathroom, etc.;
- double floor height area in the living/dining area;
- additional facilities: a fireplace room, a music room, a home-theatre room,



Figure 5. Helios Residences, Singapore (Photo source: Elena Generalova, floor plan source: [http://www.yongtai-dichan.com/pdf/helios\\_ebrochure.pdf](http://www.yongtai-dichan.com/pdf/helios_ebrochure.pdf))

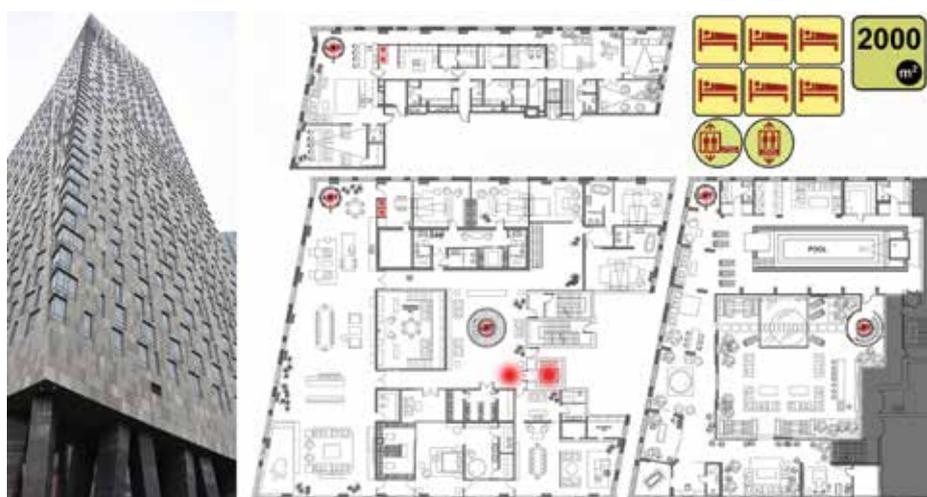


Figure 6. House on Mosfilmovskaya, Russia, Moscow. Penthouse The Residence (Photo source: Elena Generalova, floor plan source: <http://topdonstroy.ru>)

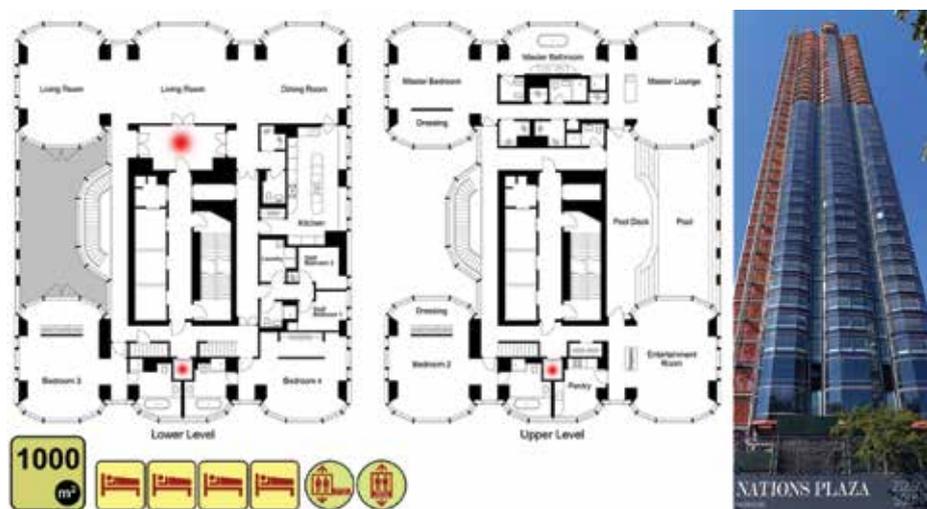


Figure 7. 50 United Nations Plaza, USA, New York (Source: John W. Cahill/CTBUH)

a spa-zone with an exercise pool, a fitness room, an entertainment room, outdoor terraces, etc.

Some of the above mentioned high-level living environment facilities are suitable for some other types of apartments but they are absolutely necessary for multi-level penthouses. The following examples can be given to illustrate the criteria.

**Example 1.** A triplex four-bedroom penthouse in Singapore residential complex Helios Residences of 363 m<sup>2</sup> is a perfect example of well-designed planning structure for high-level comfortable living. Residents get into the apartment via private lift lobby. Despite the rather small area by penthouse standards, the apartment has a special staff zone with an additional entrance, a double floor height area in the living room, a master bedroom that opens onto a terrace with a Jacuzzi, and a spacious outdoor terrace. Vertical connection between the levels should be noted. The private elevator does not occupy the apartment area for it is located on the façade as a cantilever element (see Figure 5).

**Example 2.** The design of a 2,000 m<sup>2</sup> triplex penthouse The Residence in a high-rise building House on Mosfilmovskaya (Moscow, Russia) is of special interest (see Figure 6). The middle level is occupied by the following facilities:

- the entrance zone with a private elevator and a walk-in closet divided into three parts: a clothing store-room, a fridge for fur clothes, and a room for bags;
- six bedrooms: a master bedroom with an attached home office, two bedrooms for children, a nurse bedroom, and two bedrooms for guests;
- a well developed living/dining area with a kitchen, a breakfast area, a great dining hall, a bar, a "soft zone" in the living room, a "music" podium, and a library/fireplace room.

The link between different penthouse levels is provided not only by stairs but by two elevators that are placed inside the apartment. Cooking is done in the kitchen on the low level. Dishes are brought from it by the elevator to a satellite kitchen upstairs. The satellite kitchen is attached to the breakfast area. On the lower level there are utility and service rooms including a service staff room, store-rooms and fridges for foodstuff, a laundry and so on. There is also a home theatre with

a recreational area and bar. The home theatre is linked with the children area by the gallery. The children area consists of a children home theatre, a classroom and a playing room. The upper level of the penthouse represents the recreation and entertainment space with a dance floor, an exercise pool, Jacuzzi, 'soft zones', fitness and massage rooms.

**Example 3.** A 1,000 m<sup>2</sup> duplex penthouse is located in the 44-storey residential tower 50 United Nations Plaza in New York. The luxury apartment is located on the 42nd and 43d floors (see Figure 7). The master bedroom has some interesting elements; in addition to a dressing room, walk-in closets and a large bathroom, the master bedroom has a living room. From the living room one can get to a 10-meter Outdoor Pool & Deck and then to an entertainment room with a fireplace. The penthouse is equipped with a private elevator. It has a service area with a laundry room and two staff bedrooms.

### Trend 3. Loft Units

A special feature of any loft unit is the double height space where a living/dining area is located whereas the bedroom area is on the mezzanine floor. The analysis revealed that, unfortunately, loft units are not widely used in high-rise buildings although they have a great potential for development and variant use. It is notable that a loft unit can represent not only a large area luxury apartment in elite residential complexes, but also a cost-efficient type of residence as well.

Examining the example of loft units as luxury apartments we can take the residential complex SkyPark @ SOMERSET located in Singapore's fashionable district not far from the downtown core. It stands out for its unique and innovative design among other high-rise residential complexes. The idea aimed at creating "a bungalow in the sky" converting the tower façade into a system of open terraces, or "sky gardens". The solution is good for the hot and humid Singapore climate. It is also a simple way to provide ecological sustainability. The 33-storey tower has only 29 luxury apartments designed as loft units. There are three-bedroom loft units of 297 m<sup>2</sup> and four-bedroom loft units of 311m<sup>2</sup> in the tower. A master bedroom with the exit to a spacious terrace with Jacuzzi is on the second floor. Its cantilevered structure with a kitchen underneath extends into a double-height living room space (see Figure 8).

The next two examples refer to commercially cost-effective housing in Singapore. Loft units in these complexes are almost three

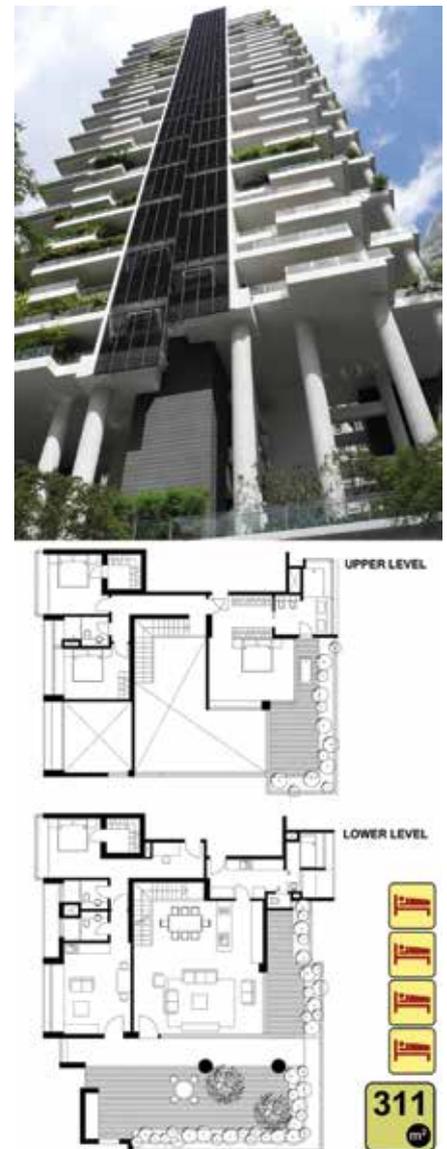


Figure 8. SkyPark @ Somerset, Singapore (Photo source: Elena Generalova, floor plan source: <http://condo.singaporeexpats.com/condo/2659/SKYPARK@-SOMERSET>)



Figure 9. Icon Loft, Singapore (Photo source: Elena Generalova, floor plan source: <http://condo.singaporeexpats.com/condo/923/ICON>)

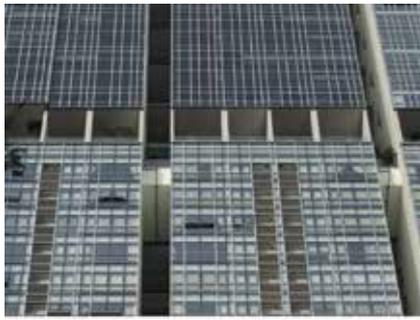


Figure 10. The Clift, Singapore (Photo source: Elena Generalova, floor plan source: <http://www.fareast.com.sg/en/Residential/For-Sale/Properties-By-Name/The-Clift.aspx>)

times smaller than the lofts in SkyPark. The residential complex Icon Loft consists of two 41-storey and 46-storey towers respectively. The complex is in the city business centre and has 646 units; some of them are loft units of 97-100m<sup>2</sup> with a double-height living/dining area, floor-to-ceiling windows and a spectacular view of the city and the sea (see Figure 9).

The residential complex The Clift is an impressive 43-storey tower located in the centre of the Singaporean business district. The design of the building represents a new conceptual idea of contemporary high-density urban living. The condominium comprises 312 apartments with one or two bedrooms. 240 rather small one-level one-bedroom apartments of 44-49 m<sup>2</sup> are located from the 11th up to the 30th floors. All the apartments located above the 31st floor are loft units; 60 one-bedroom apartments of 70-77 m<sup>2</sup> and 12 two-bedroom apartments of 100 m<sup>2</sup>. The planning concept was aimed at creating the possibility for spacial redevelopment, as all internal partitions can be changed (see Figure 10).

#### Trend 4. Studio Apartments

A studio apartment, also called "a studio flat", "an efficiency apartment" or "a bachelor apartment" is a type of a residential apartment that's major feature is the absence of a load-bearing wall between a bed-sitting room and a kitchen. It is a rather small apartment with the combined functions of a living room, a bedroom and a kitchen and a separate bathroom. There occur some unit variations where a bed-place is arranged

in an alcove or it is separated from a living room by a sliding partition.

Nowadays this type of apartment has not lost its relevance. Moreover, the number of different unit variations is growing. It has been found that they are widely used in high-rise residential complexes. Studio apartments are offered in different residential building types within real estate markets:

- public housing (e.g. HDB's Studio Apartments – SA in Singapore for elderly residents and studio apartments in Hong Kong public housing);
- commercial housing of economy class designed for customers who make their first purchase on the real estate market (e.g. the residential complex 235 Van Buren in Chicago);
- elite housing located in a city center or in highly-urbanized city environment that requires high density development (e.g. The Sail @ Marina Bay and Scotts Square in Singapore, One Central Park in Sydney).

It is interesting that despite their size, studio apartments encourage structural designers to seek new ways of improving the living comfort. Functionality and ergonomics of space must be paid careful attention to in such apartments. Innovative solutions are looked for in different directions:

- in planning (in room proportions and interaction of functional areas);
- in engineering equipment;
- in new structures, technologies and materials;
- in functional design (sliding partitions, transforming and built-in furniture, etc.).



Figure 11. Modular Flat Design. Choi Tak Estate, Hong Kong (Photo source: Elena Generalova, floor plan source: <http://www.legco.gov.hk/yr12-13/english/panels/hg/papers/hg0702cb1-1391-1-e.pdf>)

B2 tower at Atlantic Yards in Brooklyn can be taken as an example of an innovative modular construction solution. It will be the tallest modular building in the world. The 32-storey residential tower has 363 units. Pacific Park is the new name of the project. 41 percent of units are studios, and every apartment is a variation of either 25 m<sup>2</sup> and 32 m<sup>2</sup> floor plates, and the ceiling of 2.74 m and 3.0 m high that enables to arrange a loft space of about 5m long for storage. This project should satisfy the increased demand for small apartments meant for one or two residents in the city with limited space for development. 50 percent of units will be affordable to low, moderate and middle-income households.

Public mass housing development in Hong Kong is another example that reflects how



Figure 12. Studio apartment. 1 - Skysuites @ Anson, Singapore; 2 - SkySuites 17, Singapore; 3 - Scotts Square, Singapore; 4 - The Sail @ Marina Bay, Singapore; 5 - Conciera Nishi-Shinjuku Tower's West, Japan, Tokyo; 6, 7 - Shibaura Island Bloom Tower, Japan, Tokyo; 8 - One Central Park, Australia, Sydney; 9 - 235 Van Buren, USA, Chicago (Source: Elena Generalova)

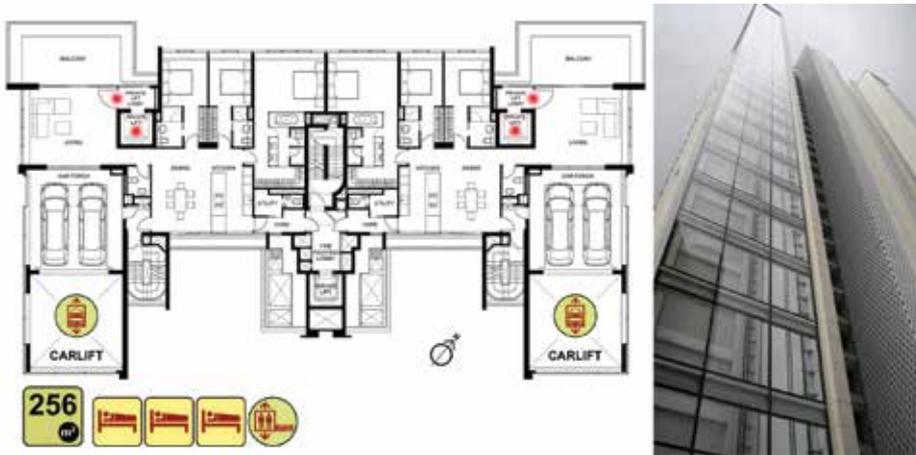


Figure 13. "Sky garage" - Hamilton Scotts, Singapore (Photo source: Elena Generalova, floor plan source: <http://www.hamiltonscotts.com/en/residences/plans>)

modern effective structural solutions are linked to apartment design. Prefabricated building construction systems are extensively used here. While erecting 40-storey residential buildings, prefabricated components of various difficulty levels are used, including precast facades, semi-precast slabs, precast staircases, volumetric bathrooms and kitchens, garbage chutes, elevator shafts, etc. Standard units also feature newly developed and applied engineering systems, including the gas and water supply systems, as well as sewerage installed on the building's façade. In order to optimize the number of standard structural elements modular flat design has been used for the last decade. Four types of modular apartments have been developed. Two types of them are studios, one type of 14.1 – 14.5 m<sup>2</sup> is for one or two residents, one type of

21.4 – 22.0 m<sup>2</sup> is for two or three residents (see Figure 11).

Despite great diversity of studio apartments they can be arranged according to the following features (see Figure 12):

1. Kitchen equipment location:
  - in a small partly isolated area;
  - in a living room;
  - in the hallway at the entrance.
2. Isolation degree of a bed place:
  - the possibility of isolation into a separate area using a sliding partition;
  - a zone in the common room;
  - a space in the back of an apartment without natural lightning or with double-height space lightning;

- a sofa in a common room that can be transformed into a bed place.
3. Arrangement of rooms against the light-front:
- development along the light-front;
  - development to the back of the building.

### Trend 5. Innovative (Exclusive) Planning Concepts

Whereas a private lift lobby in elite housing, especially penthouses, does not surprise anybody, the function of a 'Sky garage' for every apartment in the design of high-rise buildings certainly does. The unique 30-storey residential tower Hamilton Scotts was built in Singapore in 2012. The apartment was designed for very wealthy people who really like their luxurious cars and would like to admire them constantly. For this purpose the residential tower has two special elevators (Multiparker 720), produced by Wöhr, that bring cars up to the height of 100 m to the apartments' owners. There is a special "car porch" designed for two cars in every apartment. The penthouse residents have a "car porch" for four cars (see Figure 13).

Apartments in SkyBridge structures are another interesting trend. The residential complex One Shenton can be taken as an example. The complex consists of two 50-storey and 42-storey towers constructed in Singapore's high-density central urban environment. Besides the duplex penthouses, Sky Villas, of 620-844 m<sup>2</sup> on the top floors of the towers, the residential complex has something exclusive. There are six Sky Suites that constitute two-level "bridges" interconnecting the towers on the 16th-17th, 26th-27th and 33d-34th floors. Their area varies from 483m<sup>2</sup> to 565m<sup>2</sup>.

Another Skybridge design one can observe is in the residential complex Gate Towers in Abu Dhabi. There are three towers supporting the plate that combines them into one composition. Twenty one duplex penthouses of 371.6 m<sup>2</sup> are designed in The Penthouse Bridge which is 300m long. Sixteen of them have private exercise pools.

The construction of the residential complex Versis will be completed in Moscow soon. A bridge structure is used as the support for the residential gallery. Three such galleries are designed on the 9th, 17th and 22nd floors. Every gallery has three or four apartments of 160 m<sup>2</sup>-266 m<sup>2</sup> with three bedrooms. The first floor of the gallery is engineering, while the

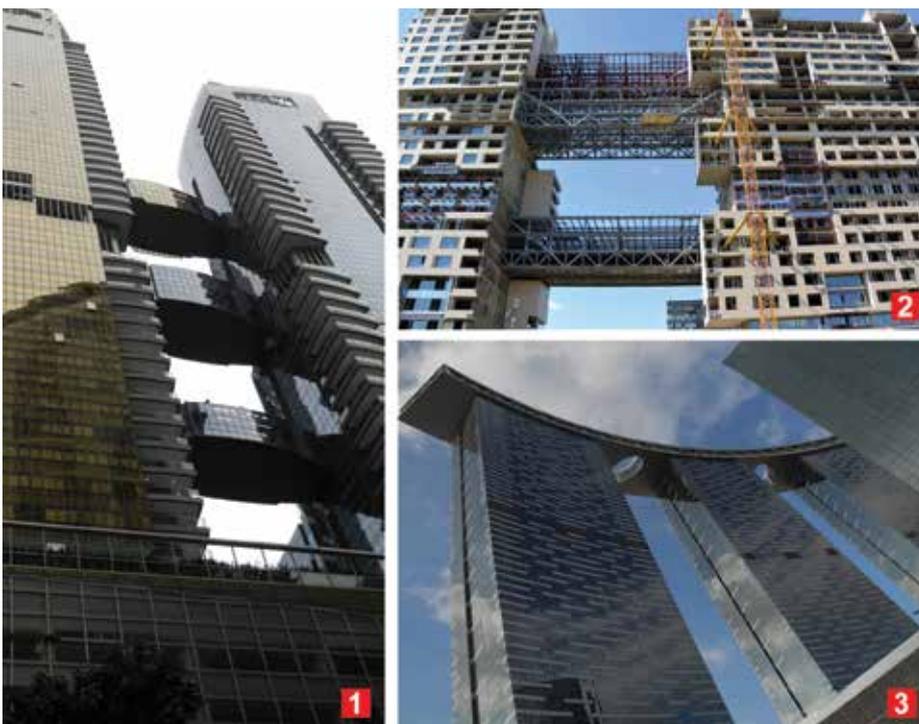


Figure 14. «Skybridge». 1 - One Shenton, Singapore; 2 - Versis, Russia, Moscow; 3 - Gate Towers, Abu-Dhabi (Source: Elena Generalova)



Figure 15. The Marq on Paterson Hill, Singapore (Elena Generalova)

second and the third ones are residential (see Figure 14).

It should be noted that the exclusive design of apartments in high-rise residential complexes is greatly influenced by the existence of swimming or exercise pools in their structure. As a rule it can be realized in penthouses, on the top floors of buildings. However, there exist some other solutions. It can be found in the residential complex The Marq on Paterson Hill which is one of the most expensive in the world. It is unique because not only penthouses but all the apartments of 575.5 m<sup>2</sup> are provided with a 15-meter exercise pool located on the console outdoor terrace (see Figure 15).

## Conclusions

Nowadays building technologies and materials, as well as structural and engineering systems used in high-rise construction are being improved at a rapid rate. It is of primary importance to make sure apartment design solutions also keep pace with or even surpass this process in the future.

A residential skyscraper as an object closed in itself and consisting of apartments and service facilities for residents should be left in the past. Looking to the future we would like to support the idea expressed by Anthony Wood (Wood, A. Rethinking the Skyscraper in the Ecological Age: Design Principles for a New High-Rise Vernacular) at Shanghai Conference in 2014, "Each tall building would thus become considered as a vital element in an overall, three-dimensional urban framework, rather than as a stand-alone icon superimposed on a two-dimensional urban plan".

When making a model of an urban skyscraper as a fragment of the overall urban environment, it is necessary to speak about a residential function in its structure with the maximum diversity in the apartment typology. The apartments should be involved in the harmonious whole in a certain percentage which depends upon the needs of the specific location.

It should be stressed that the types of apartments described in this paper and their planning features represent not only progressive but contradictory trends as well. The analysis was based on the high-rise

buildings existing in different political, socio-economic, climatic, cultural and national conditions. Herewith, we observe more similarities than differences in the typology of apartments. This is due to the fact that in the information age mankind faces the process of globalization which is reflected in its architecture. There is a risk of losing national and regional identity. The result is the spread of "anonymous" architecture. To be viable it should be flexible enough in order to adapt to regional features, new design and construction methods, and the development of new techniques to facilitate the search for new architectural forms. It is necessary to study the experience and draw out innovative design techniques. The techniques should not become a cliché. It is essential to search for new solutions and always maintain standard of living criteria with the latest trends in contemporary society.

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