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New solution – a skyscraper with integrated floor gardens, multi-storey panoramic elevators and aquariums filled with fluorescent algae

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Abstract

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The healthy way of life in skyscrapers requires the everyday availability of fresh fruits and vegetables to the inhabitants. It is even more convenient when the produce is cultivated on-site, whereas its production can be realised in close proximity to the individual residences or offices. Furthermore, these internal gardens can be easily connected to storage facilities which are available inside the skyscrapers. To implement this, multi-storey panoramic elevators, equipped with smaller internal elevators and aquariums filled with fluorescent algae can be built. These aquariums can be situated near the shafts of the panoramic elevators. Such a solution is covered by patent application № BG111889 of 17.12.2014. "Multi-storey panoramic elevator" (Aleksandrov et al., 2014).

Keywords: new solution; cultivation; fruits; vegetables; floor gardens; multi-storey; panoramic elevators; skyscraper

Introduction

The reviewed new solution allows the cultivation, transportation and storage of fruits and vegetables, which are cultivated in gardens, situated in direct proximity to the residential apartments and offices in the building. They all are planted in one- or two-storey gardens, according to the height of the respective species. Floor gardens for cultivation of fruits and vegetables are situated inside of horseshoe-shaped volumes, which are situated outside of the main volume of a skyscraper, designed for Hong Kong (Aleksandrov, 2018a). The skyscraper has been designed by combining objective features of form (by positioning horseshoe-shaped elements under varying angle) and the means for their aesthetic organisation (geometric resemblance of horseshoe-like shapes, where the floor gardens are integrated) (Aleksandrov, 2017a), whereby the proportions of construction material are of utmost importance in this form-shaping (Ching, 2014). The cultivation of fruits and vegetables is realised in containers with transparent elements in the project "Container Skyscraper" designed for Mumbai, India (Aleksandrov, 2018 b), whereas the design solution has been achieved as a result of unexpected combinations of well-known and new technical indicators with inventive step (Aleksandrov, 2017b). For the cultivation of fruits and vegetables are designed chambers with a double function (for their cultivation and for their storage). Therefore, the chambers are equipped with two spaces – a bigger one for cultivation under higher temperatures and a smaller one – for storage under lower temperatures (Aleksandrov, 2013a, Aleksandrov, 2013b).

The fruits and vegetables can also be stored in other chambers, which are placed on service floors where a special storehouse is situated (Aleksandrov, 2002). The fruits and vegetables are transported in special sections of the panoramic passenger elevators (Aleksandrov et al., 2014). The main characteristics of fruit storehouses are reviewed in detail in "Chapter 2.2.1. Storehouses for fruits and vegetables, vegetable depots, vegetational structures, etc. in the mono-

graph "Constructional and technological structures for the nutritional industry" (Vlasarev, 2014, p. 67), whereas these characteristics are also applicable in the design of fruit storehouse for skyscrapers. The cultivation of fluorescent algae makes an inseparable part of the complexes of aquacultures which have been reviewed in "Regional localization of complexes of aquaculture" (Vlasarev, 2013). The chambers of the fruit storehouses in skyscrapers could as well be used for medical purposes in extreme situations (Aleksandrova, 2009) and (Aleksandrova, 2016). In critical situations the spaces of the chambers can be adapted for use as operation rooms and operation blocks (Aleksandrova, 2008). Unexpected combinations between well-known and new technical indicators have been applied in Patent BG66192 (B1) (Aleksandrova, 2011). Basing on the Theory of inventive steps of the author (Aleksandrov et al., 2014), unexpected combinations between well-known natural phenomena (gardens, fluorescent algae), well-known technical indicators (elevators, aquariums) and new technical indicators (multi-storey elevators with integrated aquariums for cultivation of fluorescent algae) have been created. These unexpected combinations make an inseparable part of the patent claims of patent application № BG111889 of 17.12.2014. "Multi-storey panoramic elevator" (Aleksandrov, 2014).

Exemplary Design Schemes of Floors with Gardens

The floors have a central core where an elevator shaft for a multi-storey panoramic elevator is situated, whereas there are smaller internal elevators integrated in the multi-storey panoramic elevator. Other features of the design are the aquariums for cultivation of fluorescent algae, additional high-speed elevators as well as one- and two-storey gardens situated in close proximity to the residential apartments and offices (Fig. 1 and Fig. 2).

An exemplary design scheme with four gardens with a height of two floors for fruit trees, a panoramic elevator with three smaller internal elevators and a staircase (3 + 2 + 2 + 2) and external multi-storey elevators (high-speed and panoramic) is presented on Fig. 1. Part of the high-speed elevators can be used for automated transportation of fruits and vegetables, situated on the lower floors of the skyscraper (Fig.1 and Fig.2).

A complex construction of tubes and soft tubular connections is used to create a facade system for solar heating of water. The heated water can be used to warm up the root system of soft fruits and vegetables on all floors (Fig. 3). A part of the floors of the skyscraper can accommodate a vertical

Fig. 1. Plan of the floor with one capsule – there are three internal elevators and nine external elevators (Aleksandrov et al., 2014)

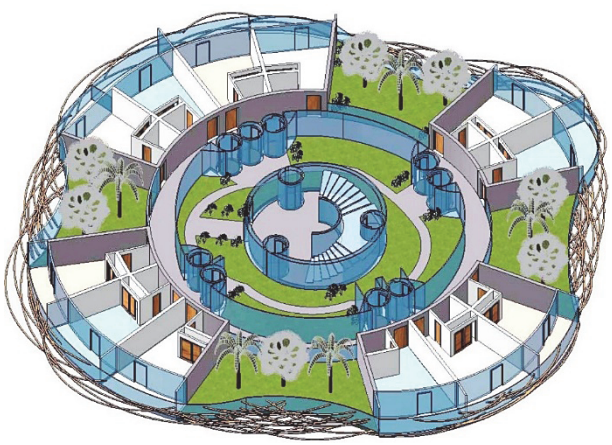


Fig. 2. View of the floor with three internal elevators and nine external elevators (Aleksandrov et al., 2014)

park with several fruit and vegetable gardens, walking paths and cycling alleys, which contributes to the improvement of sport and recreational activities of the inhabitants (Fig. 4).

Several floors are designed as zones for relaxation and free-time activities. The park environment can be reached by both the high-speed elevators and the panoramic elevator. The height of the floors is designed according to the height of the plant species. Transparent and semi-transparent car-

Fig. 3. Façade (Aleksandrov et al., 2014)

Fig. 4. Four floors with one transparent elevator capsule (Aleksandrov et al., 2014)

rying walls shape the enclosing construction of the recreational floors. The multi-storey panoramic elevator and part of the rooftop garden are protected by a transparent dome.

Fig. 5. Fragment of the roof with a transparent dome (Aleksandrov et al., 2014)

The rooftop garden offers excellent conditions for recreation (Fig. 5).

New Generation Panoramic Elevators

Variants (Aleksandrov Y., 2014)

The panoramic elevators are designed in several variants:

- Multi-storey panoramic elevators without integrated aquariums (Table 1 and Table 2.1);
- With internal aquariums, situated inside the panoramic elevator (Table 2.2);
- With external aquariums, situated on the floors of the skyscraper (Table 2.3 and Table 2.4);
- Plan schemes of the floor gardens, situated in skyscrapers (Fig. 4 and Fig. 5).

Advantages

The advantages of the reviewed solutions are the following:

– the fruit and vegetable gardens are placed in direct proximity to the residences or offices;

– collected produce (fruits and vegetables) can be easily transported to the internal storehouse by using special sections inside the panoramic elevators;

– improved functionality of the elevators – they can transport passengers and freight simultaneously, there is no need for an additional fright elevator shaft;

– inside the panoramic elevator are placed aquariums for cultivation of fluorescent algae; the movement of the capsule provokes vibrations which stimulate their growth;

Table 1. Multi-storey panoramic elevators

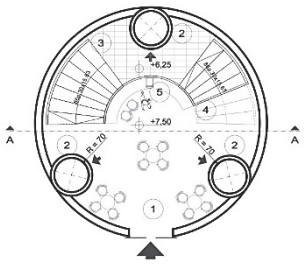
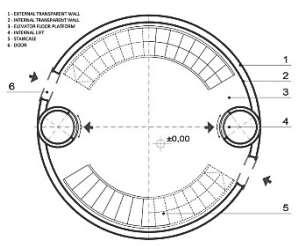
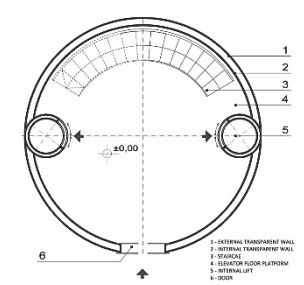
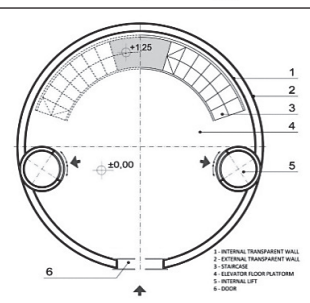
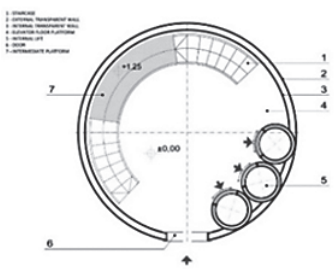
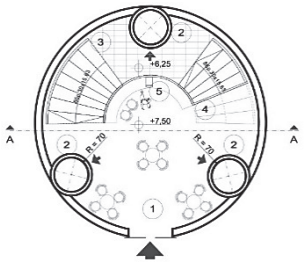
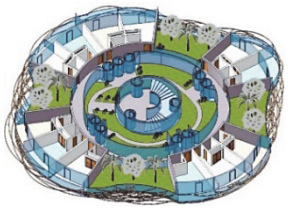
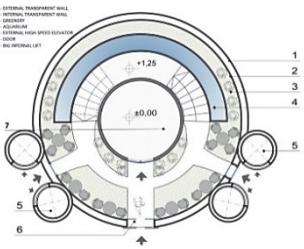
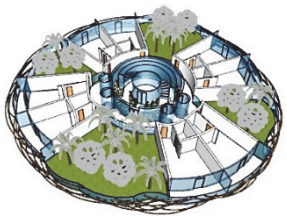
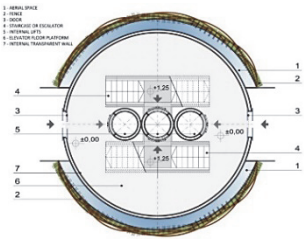
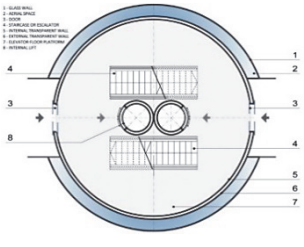
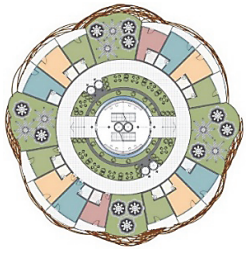
№	Description of the elevator	Plan figures	Radius	Diam-eter	Area m^2	Floors	Elevator height m	Volume m^3
Multi-storey panoramic elevators without integrated aquariums								
1	A multi-storey panoramic elevator with **three** peripheral internal lifts and **two** curved escalators or **two** curved staircases, transparent double external walls, vending machines and tables; **dimensions 5.40 x 5.40 meters**.		**2.70**	**5.40**	**22.89**	**3**	**12.50**	**286.13**
2			2.25	4.50	15.89	3	12.50	198.625
3			1.95	3.90	11.94	3	12.50	149.25
4	A panoramic vertical elevator with **two** peripheral internal lifts and **two** curved escalators or **two** curved staircases, transparent double external walls, vending machines and tables; **dimensions 5.40 x 5.40 meters.**		2.40	4.80	18.09	3	12.50	226.125
5			2.55	5.10	20.417	3	12.50	255.21
6			**2.70**	**5.40**	**22.89**	**3**	**12.50**	**286.13**
7	A panoramic vertical elevator with **two** peripheral internal lifts and **one** curved escalator or **one** curved staircase, transparent double external walls, vending machines and tables; **dimensions 5.40 x 5.40 meters.**		2.40	4.80	18.09	3	12.50	226.125
8			2.55	5.10	20.417	3	12.50	255.21
9			**2.70**	**5.40**	**22.89**	**3**	**12.50**	**286.13**
10	A panoramic vertical elevator with **two** peripheral internal lifts and **two** curved escalators or **two** curved staircases, transparent double external walls, vending machines and tables; **dimensions 5.40 x 5.40 meters.**		2.40	4.80	18.09	3	12.50	226.125
11			2.55	5.10	20.417	3	12.50	255.21
12			**2.70**	**5.40**	**22.89**	**3**	**12.50**	**286.13**
13	A panoramic vertical elevator with **three** peripheral internal lifts and **two** curved escalators or **two** curved staircases, transparent double external walls, vending machines and tables; **dimensions 5.40 x 5.40 meters.**		2.40	4.80	18.09	3	12.50	226.125
14			2.55	5.10	204.17	3	12.50	255.21
15			**2.70**	**5.40**	**22.89**	**3**	**12.50**	**286.13**

Table 2. Organisation of the internal space of the floor gardens an the panoramic elevators

№	Description of the elevator	Plan figures	View	Note
	Plan schemes of the floors, situated in skyscrapers			Description of the note
1				Multi-storey panoramic elevators without integrated aquariums
With three internal elevators		9 high-speed elevators, situated outside of the panoramic elevator		12 rooms and 4 gardens
2				With internal aquariums, situated inside the transparent elevator with fluorescent algae
With one internal central elevator, situated in the multi-storey panoramic elevator and one aquarium with fluorescent algae		4 high-speed elevators, situated outside of the panoramic elevator		8 rooms and 4 gardens
3				With external aquariums, situated on the floors of the skyscraper with fluorescent algae
With three adjacent internal elevators, situated in the multi-storey panoramic elevator and one aquarium with fluorescent algae		4 high-speed elevators, diagonally located in groups of 2, situated outside of the panoramic elevator		14 rooms and 4 gardens
4				With external aquariums, situated on the floors of the skyscraper with fluorescent algae
With two adjacent internal elevators, situated in the multi-storey panoramic elevator and one aquarium with fluorescent algae		4 high-speed elevators, diagonally located in groups of 2, situated outside of the panoramic elevator		14 rooms and 4 gardens

– in the elevator shafts are situated smaller capsules where rainwater is stored in tanks, which serve for irrigation of the floor gardens and represent an important element of the fire extinguishing system;

– increased flexibility of use of the floor space of the elevator capsule as its floors are interconnected by a ladder and smaller internal elevators which ensure an improved maintenance.

Plan Schemes of the Multi-Storey Panoramic Elevator

In the first scheme, the multi-storey elevator has three smaller internal elevators inside. The middle elevator can be accessed via the intermediate ground, which is situated between the two stairways. The lower floor level of the elevator can be used for transportation of collected produce to all floors of the skyscraper (Fig. 6).

In the second scheme, the panoramic elevator has two smaller internal elevators. There is enough space for loading and unloading of freight (collected produce, i.e. fruits and vegetables). The curved staircase features an intermediate ground. The space of the elevator can be accessed via a big sliding door (Fig. 7).

In this scheme, the panoramic elevator has two entrances, two smaller internal elevators and two staircases/two escalators. In front of the two internal elevators and between the two curved staircases there is a plenty of space for loading and unloading of freight (fruits and vegetables). Both staircases have no intermediate ground (Fig. 8).

In this case, the multi-storey elevator has the maximum possible usable area for transportation of passengers and freight to all floors (Fig. 9).

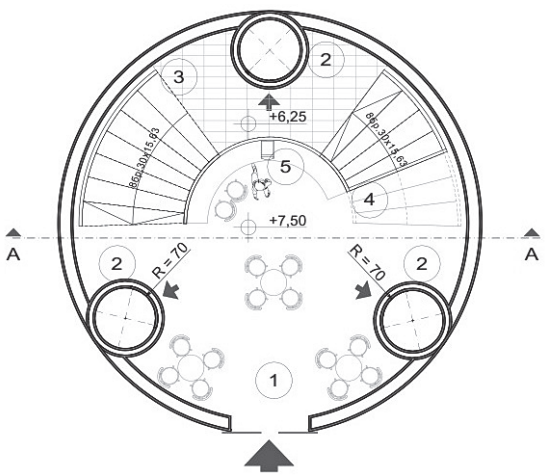


Fig. 6. A panoramic vertical elevator with three peripheral internal lifts and two curved escalators or two curved staircases, transparent double external walls, vending machines and tables; dimensions 5.40 x 5.40 meters (Aleksandrov et al., 2014)

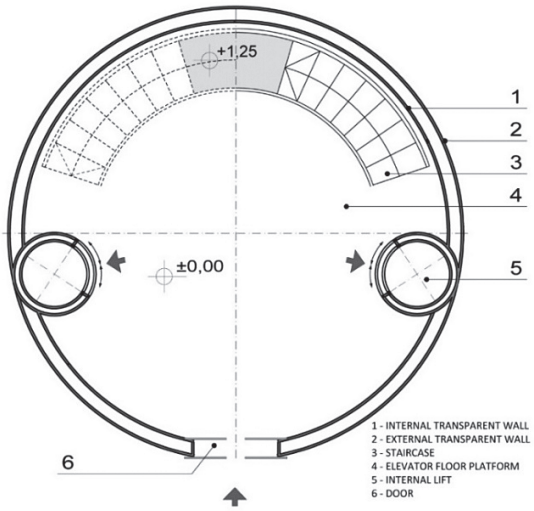


Fig. 7. A panoramic vertical elevator with two peripheral internal lifts and two curved escalators or two curved staircases, transparent double external walls, vending machines and tables; dimensions 5.40 x 5.40 meters (Aleksandrov et al., 2014)

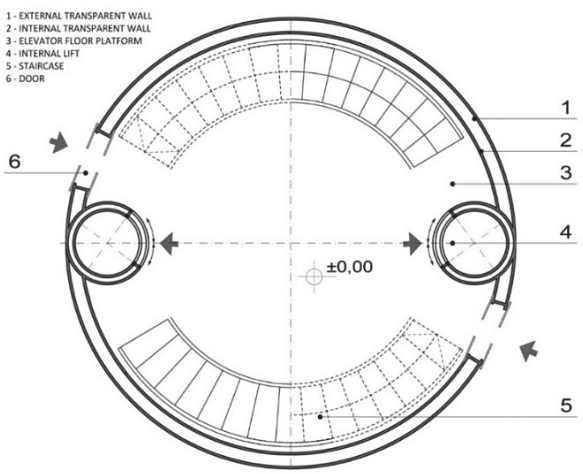


Fig. 8. A panoramic vertical elevator with two peripheral internal lifts and two curved escalators or two curved staircases, transparent double external walls, vending machines and tables; dimensions 5.40 x 5.40 meters (Aleksandrov et al., 2014)

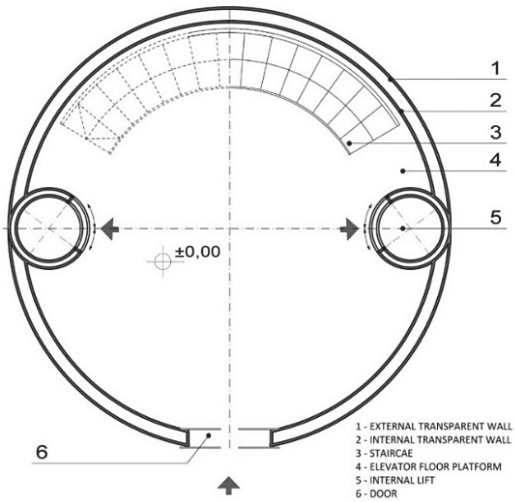


Fig. 9. A panoramic vertical elevator with two peripheral internal lifts and one curved escalator or one curved staircase, transparent double external walls, vending machines and tables; dimensions 5.40 x 5.40 meters (Aleksandrov et al., 2014)

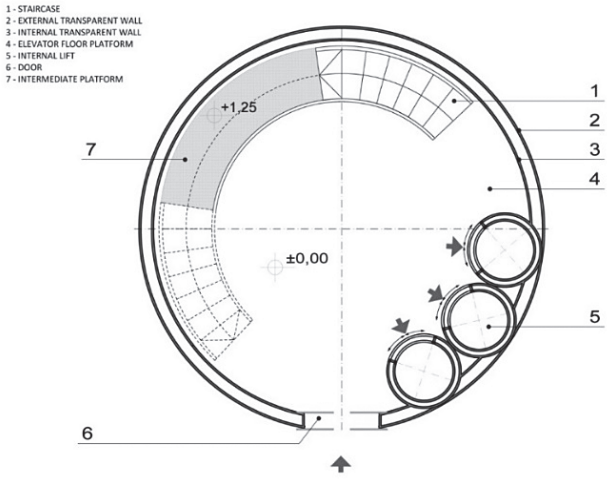


Fig. 10. A panoramic vertical elevator with three peripheral internal lifts and two curved escalators or two curved staircase, transparent double external walls, vending machines and tables; dimensions of 5.40 x 5.40 meters (Aleksandrov et al., 2014)

The multi-storey elevator has an enlarged intermediate ground or there is a combination of two escalators and a moving pathway between them. Between the staircase and the three internal elevators, there is a ground for transportation the freight (produce, i.e. fruits and vegetables) to the lowest level of the elevator. The elevator can be accessed via a large two-winged door (Fig. 10).

In Table 1 are described 5 planning solutions of a panoramic elevator, whereas each of them has three dimension types (Tables 1.1-1.15): – a symmetrical plan with three elevators, situated at equal distance from each other and one curved staircase with an intermediate ground, and one elevator door (Table 1 – 1,2,3); – a symmetrical plan with two elevators, two curved staircase and two elevator doors (Table 1 – 4,5,6); – a symmetrical plan with two elevators, one curved staircase without an intermediate ground and one door (Table 1 – 7,8,9); – a symmetrical plan with two elevators, one curved staircase with a small intermediate ground and one door (Table 1-10,11,12); – an asymmetrical plan with three elevators, one curved staircase and an enlarged intermediate ground with one door (Table 1-13,14,15).

The integration of three internal elevators increases the comfort of the passengers (Table 1-1,2,3) and (Table 1-13,14,15). The different plan versions of the multi-storey panoramic elevator feature also escalators and curved staircases (with or without an intermediate ground). The multi-storey elevator can be accessed via one or two doors depending on the planning solution.

Table 2 indicates the 4 different types for organisation of the internal space of the floor gardens and the multi- storey panoramic elevators.

The first type includes a kernel made of the multi-storey elevator, combined with three internal elevators, nine high-speed elevators, 12 rooms and 4 gardens (Table 2.1).

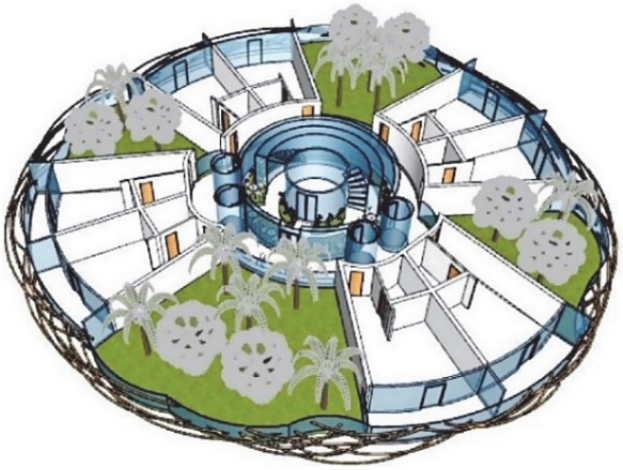


Fig. 11. View of the floor with one central internal elevator and four high-speed external elevators (Aleksandrov et al., 2014)

Fig. 12. View of the floor with three internal elevators and four external elevators (Aleksandrov et al., 2014)

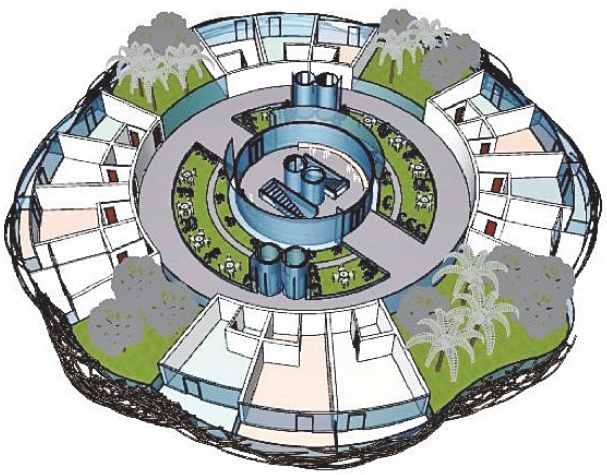


Fig. 13. View of the floor with two internal elevators and four external elevators (Aleksandrov et al., 2014)

The second type includes one smaller central elevator and an aquarium with fluorescent algae situated inside the multi-storey panoramic elevator, four independent high-speed elevators situated outside the panoramic elevator, 8 rooms and 4 gardens (Table 2.2).

The third type has three adjacent internal elevators and two internal aquariums with fluorescent algae situated in the multi-storey panoramic elevator, four high-speed elevators, diagonally located in groups of two, 14 rooms and 4 gardens (Table 2.3).

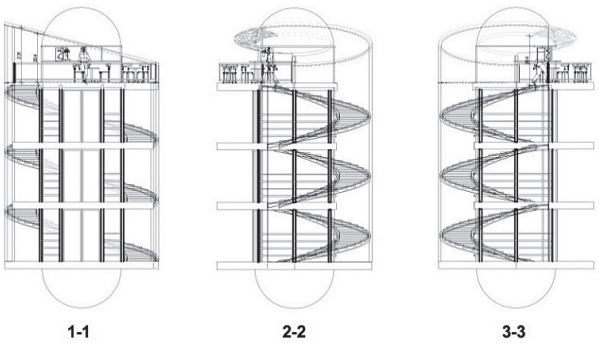


Fig. 14. Three variants of the elevator capsules (Aleksandrov et al., 2014)

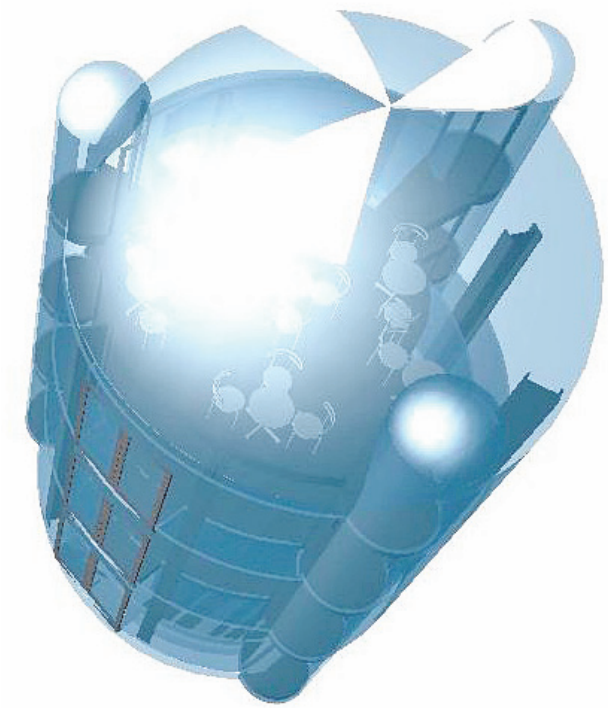


Fig. 15. View of the elevator capsule (Aleksandrov et al., 2014)

The fourth type features two adjacent internal elevators and two internal aquariums with fluorescent algae situated in the multi-storey panoramic elevator, four high-speed elevators, diagonally located in groups of two, 14 rooms and 4 gardens (Table 2.4).

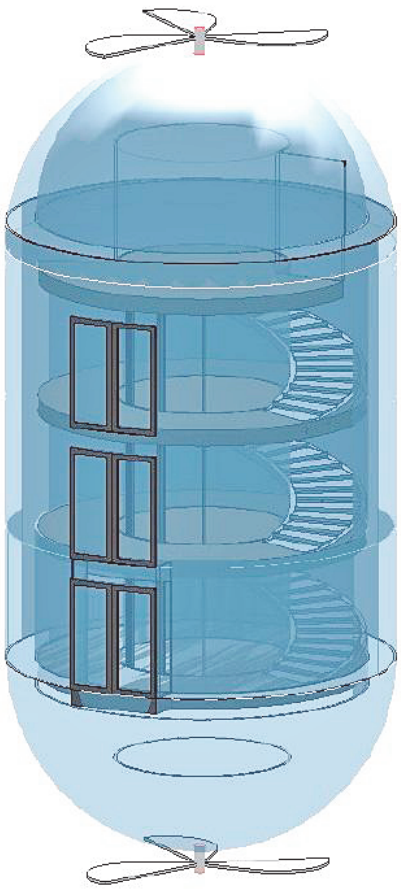


Fig. 16. Frontal view of the capsule (Aleksandrov et al., 2014)

Four fruit and vegetable gardens with a height of two floors and green areas in the multi-storey panoramic elevator are an inseparable part of the green ecosystem of the skyscraper (Fig. 11).

Four fruit and vegetable gardens are complimented by an internal garden, situated in direct proximity to the multi-storey panoramic elevator. Here the fruits and vegetables are cultivated vertically along the internal walls and fences (Fig. 12).

In one of the variants four fruit and vegetable gardens and two green areas are situated direct direct proximity to the panoramic elevator, four high-speed elevators and one multi-storey panoramic elevator with two staircases and two internal elevators (Fig. 13).

All three variants of the capsule feature a panoramic terrace (Fig .14).

The capsule is equipped with three smaller peripheral elevators (Fig. 15). Wind generators, situated above and under the elevator capsule generate additional energy when the capsule is in motion (Fig. 16).

Conclusions

The cultivation of fruits and vegetables is realised in individual gardens, meant for exploitation by the inhabitants. These gardens are situated in direct proximity to the residential apartments (or the offices) on every floor of a skyscraper, whereas their height can vary from one to two, even three floors. The choice of height of the gardens is pre-defined by the height of the plants and the fruit trees. If the gardens are situated in direct proximity to the working space of the offices, the personnel can spend some of their working time in the garden. The selection of new species can facilitate the cultivation of soft fruits and vegetables in hanging gardens. The harvested produce is transported by panoramic elevators to service floors inside the skyscraper where it is stored in fruit warehouses.

The cultivation of fluorescent algae in aquariums improves the options for application of aquacultures in high-rise buildings. The unexpected combinations between well-known and new technical indicators lead to an increased **positive technological effect** – the simultaneous transportation of passengers to every floor as well as the transportation of freight (fruits and vegetables) from the floor gardens to the storehouses on different floors by using multi-storey elevators (a new technical indicator) and to an **original aesthetic effect** – an attractive system for lighting using fluorescent algae as a source of light.

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