Bulgarian Journal of Agricultural Science, 26 (No 6) 2020, 1151–1157

Floor orchards and small fruit- stores located in the lower floor of maisonette houses of a skyscraper

Yanko Aleksandrov

University of Structural Engineering and Architecture "Lyuben Karavelov", 1373 Sofia, Bulgaria
E-mail: yanko.aleksandrov@live.com

Abstract

Aleksandrov, Y. (2020). Floor orchards and small fruit- stores located in the lower floor of maisonette houses of a skyscraper. *Bulg. J. Agric. Sci., 26 (6)*, 1151–1157

The article discusses the creation of agricultural complexes related to the cultivation of local fruits and vegetables in tall buildings, such as skyscrapers. A combination of multi-storey orchards and small orchards located on the lower floor of the penthouses of these tall buildings is proposed. The processing of fruits and vegetables can take place in one or two of the technical floors of the skyscraper structure. In the lower floors of the skyscraper there are also larger fruit storages for storing the excess products intended for transportation to the local markets.

It is especially important for the occupants to provide spaces for premises that will be used for a second purpose for medical purposes - for example for forced quarantine isolation in epidemics and pandemics (such as Corona virus), threatening the health and lives of the occupants. In this regard, the skyscraper was designed in Kun Ming, China. The structure of this skyscraper also integrates modern innovative technologies for energy maintenance of the building (photovoltaic coatings, greenhouse effect, steam generator), collection and use of rainwater.

Keywords: new solution; multi-storey orchards; small home orchards; lower floor; penthouses; skyscraper

Introduction

The economic situation significantly affects the food security of the inhabitants (Hendrarini et al., 2018). In case of crises, this food security is directly dependent on the possibilities for self-sufficiency in home-grown fruits and vegetables. It can be carried out in:

– floor gardens for tall species with a height of 2-3 floors;

– in containers, as part of their spaces are intended for growing soft fruits and vegetables, and another part - for storing them at a certain positive temperature;

– in the space of its own balconies and terraces;

– in internal green partition walls;

– on roofs that are adapted for greenhouses;

– in the inter-block spaces.

The methods of collection, processing and storage of agricultural products are essential for high quality, which gives high competitiveness in offering excess quantities of items on the market. Agricultural complexes for growing fruits and vegetables (Vlasarev, 2014) are particularly suitable for feeding the occupants of high-rise buildings. Biodiversity in agriculture and economic productivity of the yards is essential for feeding the population in Arguni Bava, Cayman District, West Papua Province, Indonesia (Antoh et al., 2019). Similar yards in the form of multi-storey orchards can be arranged to feed the occupants of tall skyscrapers).

Material and Methods

The experimental activity is aimed at proving the effect of combining functionally useful features with building spaces (for example, growing orchards in tall buildings and local storage of fruits in small storey fruit stores located in each penthouse). By shifting the signs characteristic of the

Table 1. Indonesian fruit production in 2017 (p. 35, Hendrarini, H., et al., 2020)

№	Fruits Production	Total (ton)	Comparative analysis of fruit production in Indonesia for 2017
1.	Banana	7,008	
2.	Mango	2,464	Mango production is 2.8441558 times less than banana production!
3.	Orange	1,999	The production of oranges is 3.5057528 times less than the production of bananas!
4.	Soursop	1,874	Soursop's production is 3.7395944 times less than banana production!
5.	Salak	1,036	Salak's production is 6.7644787 times less than banana production!
6.	Durian	856	Durian production is 8.1869158 times less than banana production!
7.	Papaya	830	Papaya production is 8.4433734 times less than banana production!
8.	Rambutan	733	Rambutan production is 9.5607094 times less than banana production!
9.	Avocado	306	Avocado production is 22.90196 times less than banana production!
10.	Mangosteen (p. 35)	111	Mangosteen's production is 63.135135 times less than banana production!

task - fruit trees located on floors and forming orchards, accompanied by technical solutions of its own infrastructure needed for drip irrigation, heating of the root system, harvesting, processing and more, a positive effect greater than the world level is achieved.

There are combinations between orchards and building spaces. It should be borne in mind that the cultivation of fruits and vegetables in high-rise buildings is associated with local and traditional preferences of residents and residents. For example, in Indonesia, the consumption of different varieties of bananas occupies a significant place. For consumers of these bananas are important: fruit defects, taste, availability, color, and price (Hendrarini et al., 2020).

Table 1 show that in Indonesia the production of Avocado is 22.90196 times less than the production of bananas! For example, the market price in Bulgaria for 1 kg of bananas is about 2 BGN, and the price for 1 piece of avocado is 1 BGN[1]. It is obvious that the production of avocado should increase, once due to the price and secondly due to the demand for this product on the world markets in connection with its taste and health qualities. In mega-urban structures, the production of scarce fruit items, as well as other ones with preferred consumption, should be developed in agricultural complexes located in the so-called archeological skyscrapers.

Possible practices

The cultivation of soft fruits and vegetables in containers, located next to dwellings also by containers, is given in a tall skyscraper type building; Mumbai, India; (Aleksandrov, 2018b); (Figure 1); (innovation conceptual design, Aleksandrov & Michailova, 2015). The solution is suitable for soft fruits and vegetables intended for own consumption.

Positive temperature chambers and containers are housed in horseshoe-shaped elements located outside a skyscraper

Fig. 1. Container Skyscraper, Mumbai, India

for Hong Kong; (Aleksandrov, 2018a); innovation conceptual design Aleksandrov and Kirilov, 2013) (Figure 2).

Soft fruits and vegetables are grown outside the structure of the skyscraper, but the principle «next to us, but not with us»). Multi-storey garden is served by trained staff who care about the quality of fruit items. The finished product is for the inhabitants, and another part is available on the market.

Innovation design proposed by the author

Innovative solutions with an inventive step of chambers for fruits and vegetables of the author are discussed in detail in the chapter "New design solutions with an inventive step for the chambers of fruit and vegetable warehouses (Aleksandrov, 2018c). As a new solution with an inventive step are the chambers for positive temperatures of the fruit storages, filled with elastic protection of their walls; (Aleksandrov,

[1] 1 BGN = 0.51 EUR

Fig. 2. Arcology skyscraper, Hong Kong

2017a). Using solar panels located on containers or chambers is an opportunity to maintain a positive temperature in them. The participation of transparent elements in the walls and roof of these containers and chambers is another opportunity to achieve a positive temperature through the greenhouse effect formed in sunny weather (Aleksandrov, 2017b). A fruit storehouse of chambers for growing and storing soft fruits and vegetables is planned on a floor included in the structure of a bamboo skyscraper, Singapore (Aleksandrov, 2019).

Volume planning modules

(innovation conceptual design, Aleksandrov Yanko, student Meriam Iuzeirova). Schools; (Figure 3).

The relatively small area of the containers requires the search for other solutions, such as modules with increased usable area and with water containers for storing rainwater for watering soft fruits and vegetables grown in these modules. The modules are located on the roof and top floor of the skyscraper (Figure 3).

Cassette cultivation on the upper level with the help of practical devices (hydraulic devices) and storage of the harvest in individual containers on the lower level is a new way to increase the yield of soft fruits and vegetables in tall buildings.

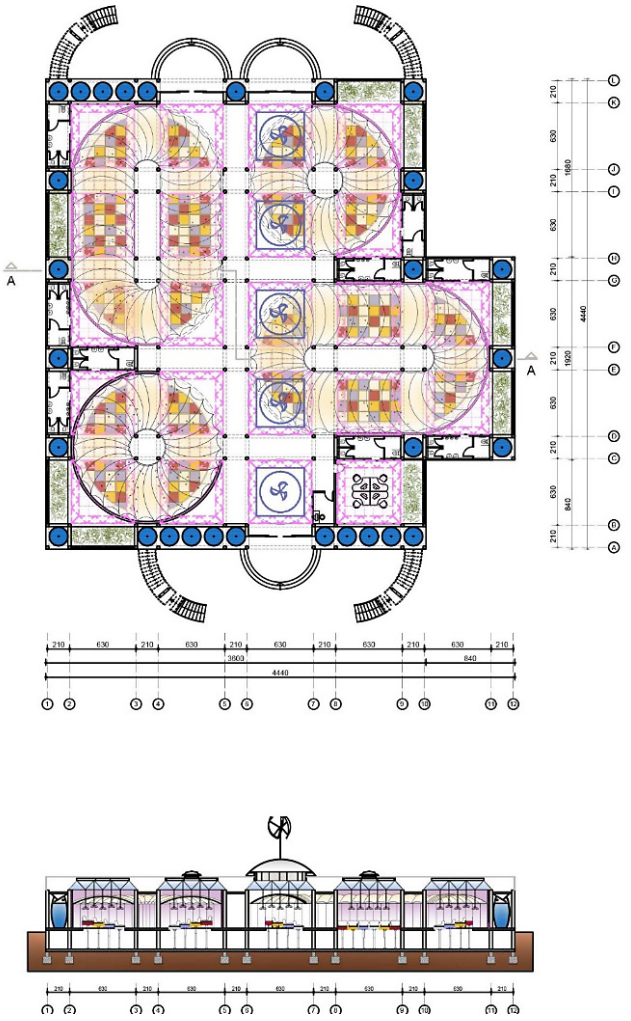

Fig. 3. Two- storey modules for integration into the structure of tall buildings

Results and Discussion

Growing fruits in floor gardens. Skyscraper in Kun Min

(innovation conceptual design, Aleksandrov Yanko, Aleksandrova Liudmila, student Kostadinov Viktor, 2015); (Figures 4-13)

In the heart of the skyscraper are orchards with a height of two penthouses, serving the needs of those living in them (Figure 5). The orchards are surrounded by galleries or corridors on the side of the penthouses. On the first floor of these penthouses are located small home fruit stores, storing fruit products intended for consumption by the inhabitants. On the second floor, above these orchards are the offices of their inhabitants.

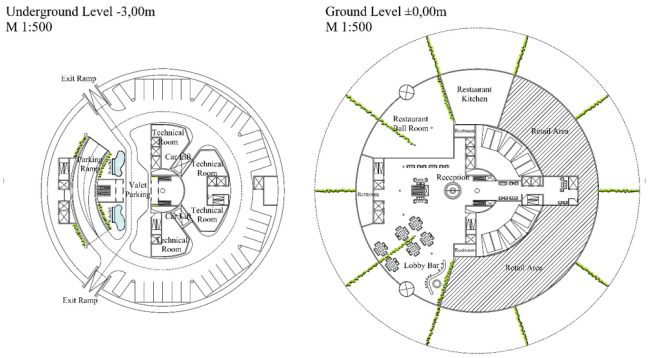

Fig. 4. Level plan -3.00 m (left) and level plan + - 0.00 m (right)

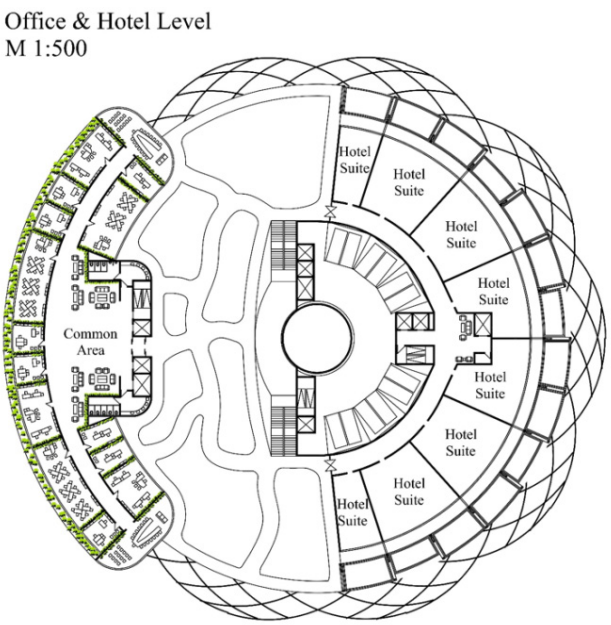

Fig. 5. Vertical green walls are located between the common areas, and green areas - on their balconies

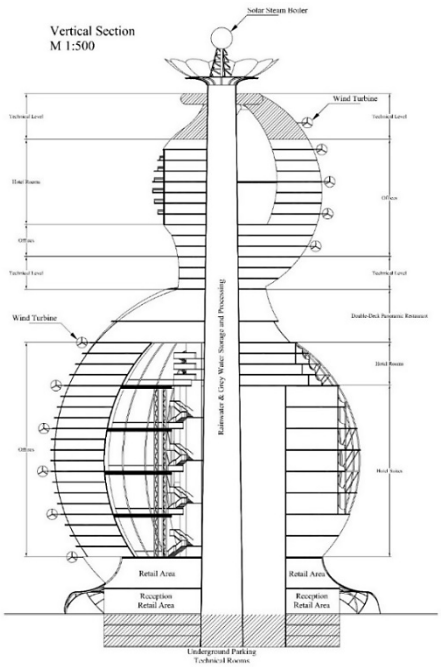

Fig. 6. Section

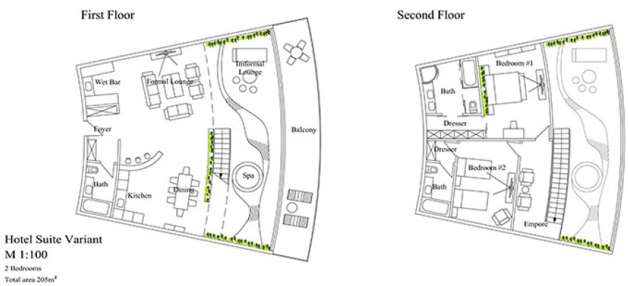

Fig. 7. Vertical green walls are located inside the apartment

The fruit stores are accessible once from the galleries or corridors, and the second time - from an internal corridor, through which one enters the first floor for each penthouse. The work offices are accessible directly from the second floor of the penthouse or from another internal corridor or gallery (Figure 7).

On the balconies of the maisonettes there are gardens for growing soft fruits and vegetables. Irrigation of the gardens is drip, with filtered rainwater that collects in water vessels. Their collection is on the roof and more, from their flow on the spherical parts of the skyscraper in channels located in the lowest balconies of these parts. If necessary, the root system is heated by radiant water heating. A steam generator for energy production is located on the roof. The water in the generator evaporates from the sun's rays reflected by parabolic reflectors (Figure 8). Two green arched walls mark the car ramp at the level of -3.00 m (left). Radial vertical gardens, longer and shorter, are located at level 0.00 (right). Retail space occupies a significant place in the plan. 6+6 cameras store the production of fruits and vegetables produced in orchards and vegetable gardens (Figure 4).

Fig. 8. General view of the skyscraper in Kun Min

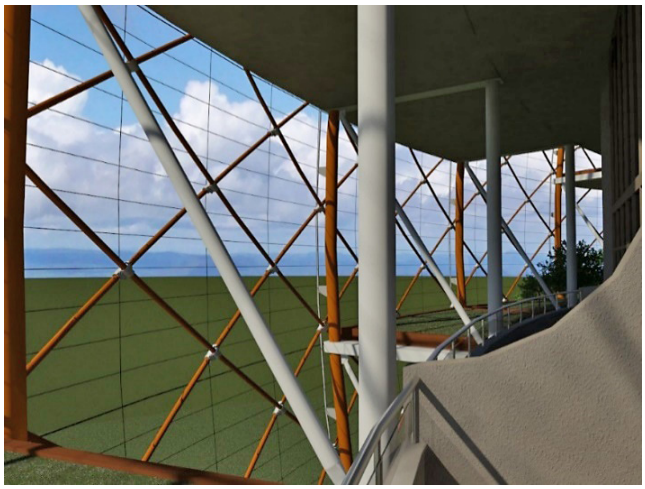

Fig. 9. Facade casing made of polyketone with a rectangular mesh is stretched on a grill of bamboo rods

Use of part of the technical areas for second purpose for medical purposes (Aleksandrova, 2009); (Aleksandrova, 2016)

The spread of pandemics and epidemics in the human environment obliges us in high-rise buildings to look for suitable solutions for secondary use of premises for medical purposes (isolation of patients, carriers, such as the Crown virus), in isolators. In this case, some of the technical rooms can be adapted for these purposes in case of extreme situations. For the same purposes, the premises of the small fruit stores located on the lower floor of the maisonette dwellings may be used (for example, to remain under forced quarantine of a family member) (Figures 6, 8, 12).

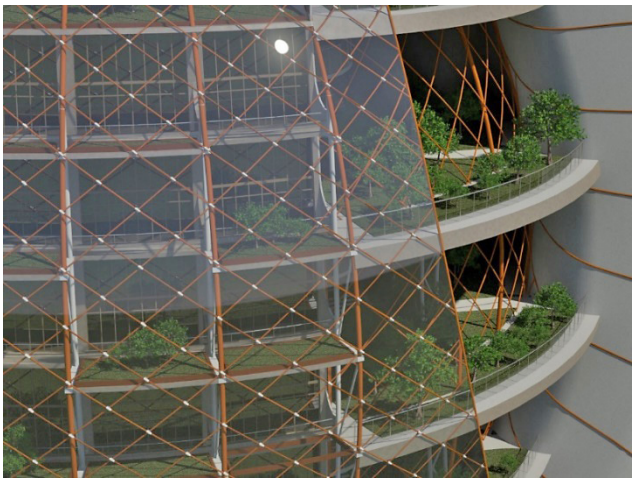

Fig. 10. Fragment of two floors of the floor gardens

Fig. 11. Fragment of the fifth garden

Fig. 12. General view with wind turbines located on both sides of the two convex solid parts of the skyscraper

Fig. 13. Fragment of the skyscraper project in Kun Min, China

Rainwater is stored in water containers located in technical floors just below the crown of the roof of the building, constituting the highest technical level of the section (Figure 6). Three other technical floors are located in the neck of the building.

The outer transparent shell of the balconies is made of polyketone reinforced with transparent carbon fibers. This ensures the greenhouse effect. When the balcony doors are opened, heat exchange takes place inside the premises and the air in them is heated indirectly (Figure 9).

Floor gardens for growing, for example, bananas are located in the heart of the skyscraper. The transparent polyketone cover transmits the sun's rays and provides a greenhouse effect on the spaces of the balconies located behind them (Figure 10).

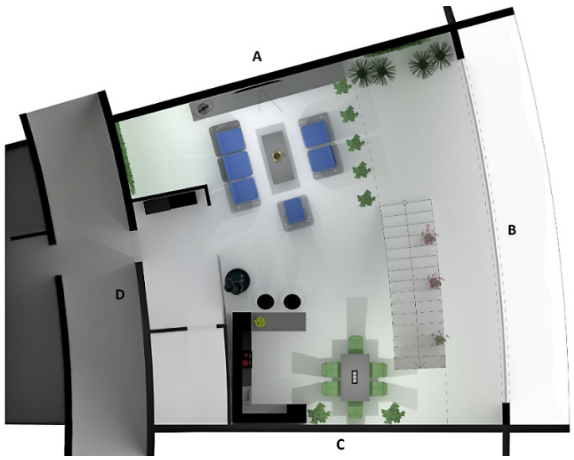

Fig. 14. Sample plan of habitable space; to the left of the corridor is the fruit and vegetable store

The fifth floor of the orchard is provided with a height equal to the height of 4 floors or two maisonettes with two floors, for species with a higher natural height. For the development of their root system, upgraded formations with earth mass are provided on the floor structure (Figure 11) (innovation conceptual design, Aleksandrov et al., 2015).

The wind turbines are located on dense parts, crossing the neck of the skyscraper and reaching the bottom of the crown, forming the end of the roof (Figure 12). In the center, above the crown, is a water vessel, which is heated by the sun's rays reflected by parabolic reflectors. The generated steam is directed to a steam generator, a source of energy (Figure 13). Water vessels for rainwater collection are located in the technical floors. The two-sided orientation of the orchards allows their direct ventilation.

To the left of Corridor D is the fruit storehouse of the dwelling, which is located to the right of the plan. Above it, on the second floor is the office of the occupants. The access for external visitors to these offices is from a corridor located between the inner orchard and the penthouse itself (Figure 14) (innovation conceptual design, Aleksandrov & Doncheva, 2017).

Conclusions

Production is influenced by consumption, consumer taste, areas, product quality, price, exports. In high-rise buildings it is advisable to plant orchards with scarce and more expensive items on the market: Durian, Papaya; Rambutan; Avocado, Mangosteen, which are also in demand on world markets. The height of the spaces for the orchards is in accordance with the height of the listed items in order to

ensure their natural growth. The fruits for own consumption are stored in local fruit storages at the respective floor level

The overproduction, intended for the market or for export, is stored in fruit stores in containers located on the ground floor of the skyscraper. Modern innovative technologies are an integral part of the formation of the tall building in Kun Ming. Steam generators for obtaining energy from the sun's rays, which are reflected by parabolic screens forming the crown of the roof, photovoltaic coatings, wind generators, located on both sides of the two protruding parts of the building, are located harmoniously in the structure of the skyscraper.

References

Aleksandrov, Y. (2018a). New solution – cultivation of soft fruits and vegetables in a super skyscraper in Hong Kong. *Bulgarian Journal of Agricultural Science*, *24(1),* 151–157.

Aleksandrov, Y. (2018b). New solution – cultivation and storage of soft fruits and vegetables in chambers of the "containers" type with positive temperatures (Container Skyscraper, Mumbai, India). *Bulgarian Journal of Agricultural Science*, *24(2),* 326–334.

Aleksandrov, Y. (2018c). New design solutions with an inventive step for the chambers of fruit and vegetable warehouses. In: *Fruit and Vegetable Consumption and Health: New Research, Nova Science Publishers Inc.,* 199–240.

Aleksandrova, L. (2016). Exploitation of medical modules and sub-modules in extreme situations. National Library "Cyrill and Metodii", National library St. St. "Cyrill and Methodius", Sofia, ISBN: 978-954-331-068-5, p. 180 (Bg).

Aleksandrova, L. (2008). Adaptation of the chambers of fruit storehouses and refrigeration warehouses for use for medical purposes in extreme situations. Dissertation, UASG, Sofia, 178 (Bg).

Antoh, A. A., Arifin, N., Chozin, M. A. & Arifin, H.S. (2019). Short communication: Agricultural biodiversity and economic productivity of the yards in Arguni Bawah, Kaimana District, West Papua Province, Indonesia. *Biodiversitas, 20(4),* 1020-1026.

Hendrarini, H., Sunarsono, R. J., Soedarto, T., Nurhadi, E., Kusnandar & Rahayu, E. S. (2018). The effect of charity attitude and economic condition on the farmers' household food security. *Bulgarian Journal of Agriculture Science, 24(2),* 206-212.

Hendrarini, H., Sunarsono, R. J., Erviyanti, Y. & Soedarto, T. (2020). The identification of ready-to-eat banana's superior attributes through the fishbein multi-attribute approach. *Bulg. J. Agric. Sci., 26 (1)*, 34–42.

Vlasarev, D. (2014). Construction of territories for buildings and complexes for storage and production of plant and animal products. Ph Thesis, Varna Free University "Chernorizets Hrabar", Varna, ISBN - COBISS.BG-ID - 1282387940, p. 315 (Bg).

Received: November, 24, 2019; *Accepted:* August, 14, 2020; *Published:* December, 31, 2020