ECOLOGICAL MEANS OF FORMING ARCHITECTURAL ENVIRONMENT FOR MULTI-STOREY PARKING GARAGE IN LARGE CITIES

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Abstract

This paper examines the ecological aspects of forming of architectural environment for multi-storey parking garages in large cities using landscape and ecological means. We describe modern methods of applying biotic and abiotic natural elements of urban design in forming architectural environment of multi-storey parking garages. Also we give recommendations for using these techniques. These aspects are not resolved in today`s modern architecture practice.

Keywords: multi-storey parking garage, landscape and ecological resources, landscape planning, architectural environment, large city

ЛАНДШАФТНО-ЭКОЛОГИЧЕСКИЕ СРЕДСТВА ФОРМИРОВАНИЯ АРХИТЕКТУРНОЙ СРЕДЫ МНОГОЭТАЖНЫХ АВТОСТОЯНОК В КРУПНЕЙШИХ ГОРОДАХ

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Аннотация

В статье рассматриваются экологический и эстетический аспекты формирования архитектурной среды многоэтажных автостоянок в крупнейших городах с помощью ландшафтно-экологических средств. Описаны современные приемы использования форм живой и неживой природы, элементы городского дизайна в формировании архитектурной среды многоэтажных автостоянок.

Ключевые слова: многоэтажная автостоянка, ландшафтно-экологические средства, архитектурная среда, крупнейший город

Importance of ecological and aesthetic factors in regards to forming architectural environment for multi-storey parking garages was explored in works of two Russian authors. E. Golubeva [1] approached this problem in relation to structure of the entire city and M. Fakki [2] approached it in relation to high-rise apartment complexes.

External appearance of multi-storey parking garages has particular influence on the surrounding architectural environment. In this case, improvement of ecological sustainability happens by reducing negative impact of personal transport on the surrounding area [3].

The problem of storing personal vehicles clearly cannot be solved with technical and space-planning means alone. Ecological component is just as important, which points to multifaceted nature of interaction between a man and his surroundings. Not enough attention at the present stage of design is paid to art, esthetic, environmental and psychological problems of organization of the architectural environment of multi-storey parking garages. Ecological problems of organizing architectural environment for multi-storey parking garages currently don't receive as much attention as they deserve [4].

The purpose of this paper is to reveal importance of ecological and aesthetic aspects of forming architectural environment for multi-storey parking garages in large cities using landscape, ecological and visual means.

Problem statement

Multi-storey parking garages are closely connected with our living environment. They are placed close to residential and recreational areas, workplaces etc. Therefore architectural environment of multi-storey parking garages that are located in residential and public spaces must be paid just as much attention as for buildings with other functionalities. This is because all multi-storey parking garages have impact on forming opinion about an area, estate or public zone where they are located.

Ecological and aesthetic factors are very significant in forming architectural environment around multi-storey parking garages. Ecological approach is focused on realizing aesthetic potential of the territory by correlation of artificial and natural components in the urban environment. This reduces adverse impact on the architectural environment around multi-storey parking garages.

Landscape and ecological methods are focused on improving aesthetic potential of an area by combining artificial and natural urban environment components. This helps to reduce negative effects of building upkeep on the surrounding architectural environment.

Following methods can be used: placing plants on the exterior, interior, façades, roofs of multi-storey parking garages, creating a sanitary green belt around multi-storey parking garages.

Also, ecological means of multi-storey parking garages architectural environment forming are: noise reduction (placing multi-storey parking garages on edges of residential areas protects residents from traffic noises) and creating sanitary protection green areas around multi-storey parking garages.

Landscape planning means of multi-storey parking garages architectural environment forming are: placing plants, site landscaping, terrain profiling, plant sculptures, roof gardens, vertical facade gardens, combination of linear and volumetric forms of plants, marking multi-storey parking garages boundaries with plant containers, terraced slopes with plants, artificial hills, coverage with grass areas and multi-storey parking garages combined with roads and located on steep terrain [5,6].

Therefore ecological approaches can be categorised as landscape methods of forming architectural environment around multi-storey parking garage (Fig. 1).

For architectural environment of *ground multi-storey parking garages* following methods are used: placing plants, site landscaping, combination of linear and volumetric forms of plants, terrain profiling of territory (creating terraced slopes with static plants) (Fig. 2B). And for ground multi-storey parking garage *buildings* following methods are used: vertical facade gardens; roof gardens (Fig. 2A).

For architectural *environment* of *semi-underground multi-storey parking garages* (Fig. 2C) following methods are used: placing elements of pavements with grass areas and marking borders of multi-storey parking garage territory with potted plants. And for *semi-underground*

building of multi-storey parking garage same methods as for the ground building of multi-storey parking garage are used (Fig. 2A).

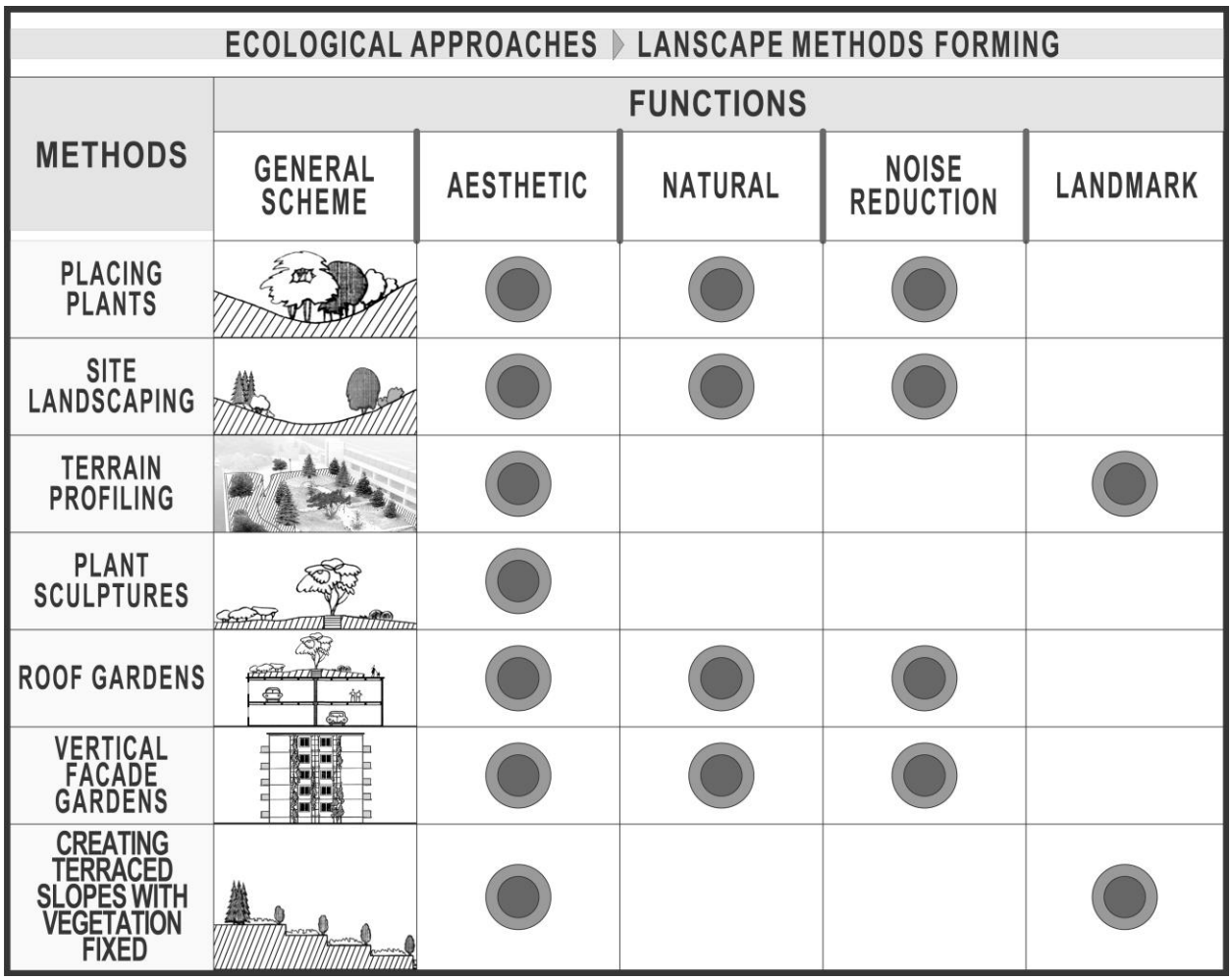


Fig. 1. Ecological approaches categorised as landscape methods of forming architectural environment around multi-storey parking garages (Grey circles show types of functions)

Usually plants are the main focus of creating architectural environment around multi-storey *parking garages*, because it offers following benefits:

- aesthetics function;
- natural function – it improves external ecology and internal ecology. Chemical composition of air in the area is improved.
- noise reduction.

Planting methods for *multi-storey parking garages* are: ground greenery, green roofs and vertical green walls (Fig. 3).

Ground greenery. External ground greenery is the most effective strategy of protecting against heat build-up and control ambient temperatures on macro level. External landscaping on ground level can be done using trees, palms, shrubs and turfing. Landscaping plans of multi-storey *parking garages* sometimes include waterbodies such as fountains to add «blue architecture» to overall «green» effect of the development.

Landscape elements (trees, shrubs, lawns, flower beds, ponds) combine elements with different functions located near multi-storey parking garages. *Figure 4* shows an example of trees planted in line in front of a Santa Monica Place Mall multi-storey parking garage. Adding a green

buffer makes a monotonous building facade more expressive. This method can be used to demarcate buildings that vary in functionality, including areas around multi-storey parking garages. Trees in a transport space composition are a factor of ecological stabilization [7].

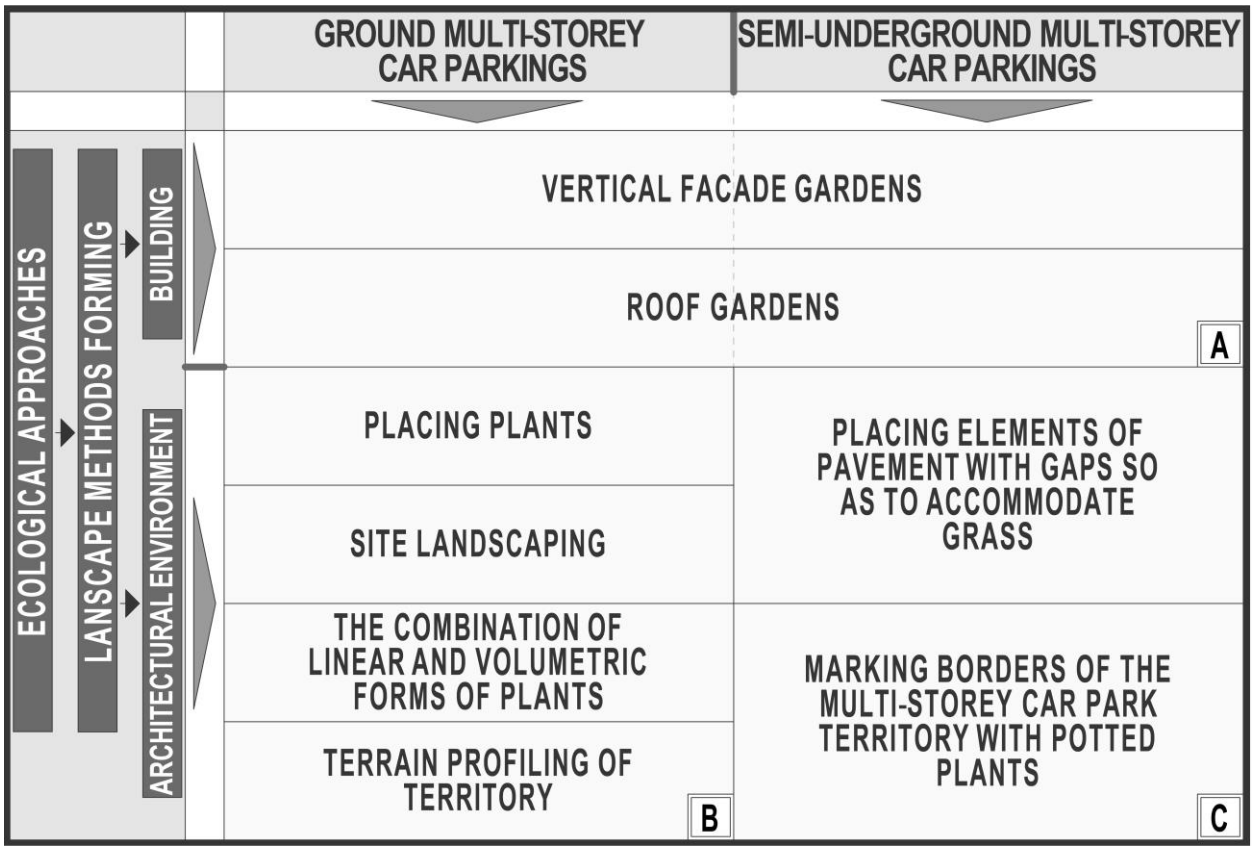


Fig. 2. Ecological approaches in forming architecture of multi-storey parking garages in large cities

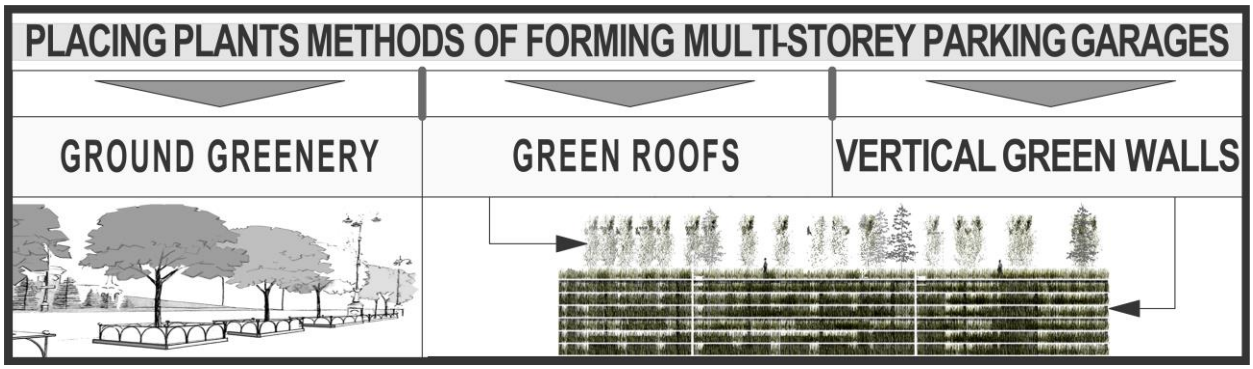
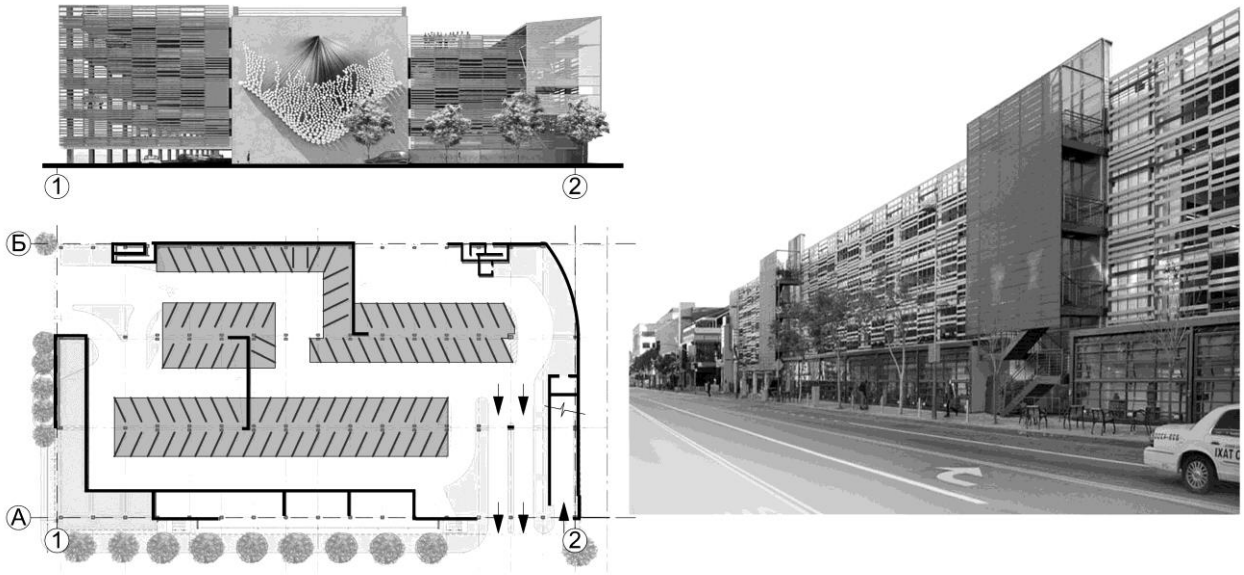


Fig. 3. Landscape and ecological means of forming architectural environment around multi-storey parking garages

Vertical green walls. Vertical facade gardens are important for forming architectural environment of multi-storey parking garages.

As multi-storey parking garages grow higher, facade area also increases. Placing plants on external walls not only reduces heat transmission inside, especially if installed on east and west facades but also protects the facade from weathering and express creativity. Planning for vertical green walls requires early consideration of maintenance, structural safety, irrigation and long-term durability of the backing wall [8].

Open grid paving tile that allow plants should be considered for ground multi-storey parking garages. This allows grass to grow over as well as surface rainwater runoff to infiltrate into the ground. Both reduce heat build-up in the hard surface.



a) b)

Fig. 4 (a,b). A green buffer along the facade of an MCP. Multi-storey parking garage at Santa Monica Place Mall. «Brooks + Scarpa», Santa Monica, USA, 2011:
a) façade 1 – 2, typical floor plan; b) general view

Architectural structure of a typical multi-storey parking garage is a suitable support for vining plants. This method not only serves for an aesthetic purpose, but also for natural and noise reduction purposes. A good example is Blackrock Hospital Garage in Dublin (Fig. 5) and Shinjuku Gardens in Tokyo (Fig. 6).

Vegetation helps reduce solar heat gain and improve the microclimate within any interior or exterior space. The incorporation of plants into multi-storey parking garages is a popular feature in bio-climatic design. Plants can mitigate the effect of urban heat islands, and may also reduce the energy demand of multi-storey parking garages. A new trend in urban greenery is the creation of urban farms – using green areas in buildings to grow crops and vegetables. Semi-outdoor spaces with vertical green screens can also provide shading from the sun and contribute to the garden ambience. Also, transpiration by plants extracts heat from the surrounding air and lowers the surrounding air temperature.

This not only helps to divide road surface into zones with different functions but also reintroduce elements of nature. Adding plants inside of buildings used for temporary or permanent personal vehicle storage may create a connection between nature and the building. A good example is 18 Kowloon East (Fig. 7). Division of facade elements contrasts well with scenic beauty of plants.

Green roofs. The greatest benefit of green roofs of multi-storey parking garages is that it provides thermal insulation to interior spaces below and also becomes a habitable space for people and animals, thereby promoting biodiversity. This also helps to slow down stormwater runoff and improve its quality. Creating a roof garden requires careful planning since roof space is traditionally also a highly sought-after location to for different services such as water tanks, cooling towers, plant rooms, etc [9].

Green roofs offer environmental and ecological benefits. In addition, green roofs also increase the thermal resistance of the roofs thereby reducing heat flux through the roof and into the spaces below. Roof top gardens have been measured to reduce surface temperatures of roof by more than 10°C.

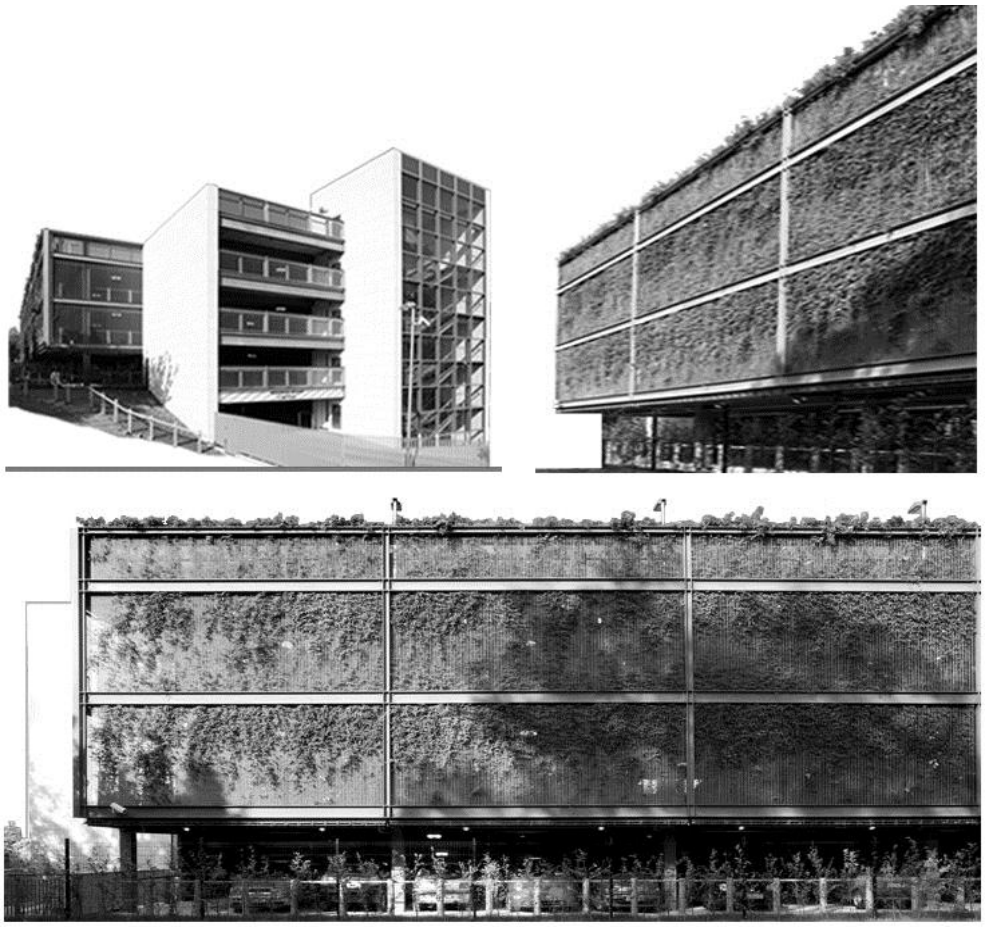


Fig. 5. Blackrock Hospital multi-storey parking garage, Rock Rd, Blackrock, Co Dublin, 2005 – 2008

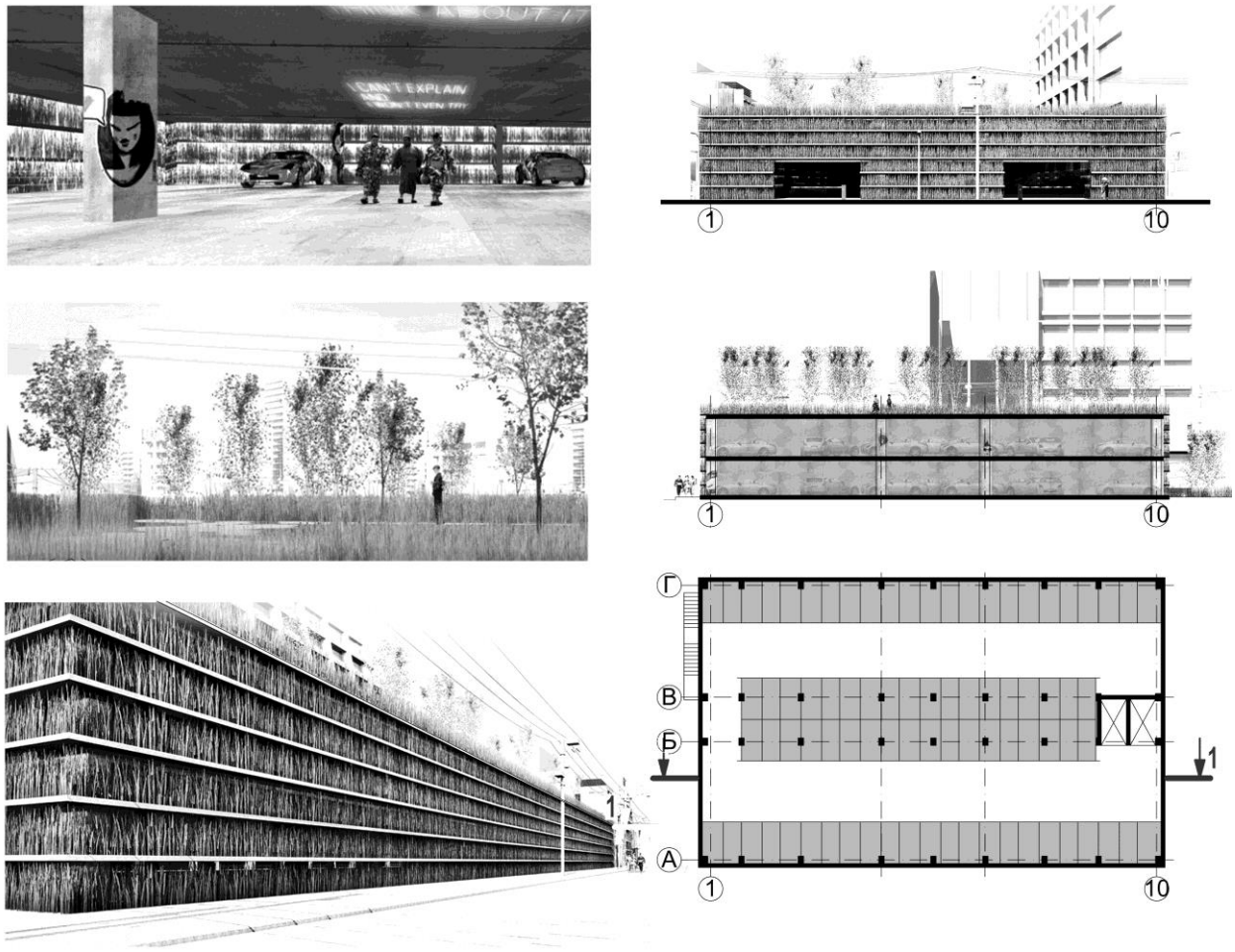
Traditional turfing on concrete flooring is enhanced by placing high plants and flower beds in multi-storey parking garages. It`s not going against technical roof operations. By creating offsetting nature landscape elements for architectural multi-storey parking garage, we reproduce the lost balance between natural and artificial components of the environment.

An example of geoplastics usage and relief profiling in architectural environment of multi-storey parking garage is Pomona college parking (Fig. 1.8), which is placed on the roof of a stadium, and the whole area near is demarcated with decorative coating combined with plants.

The idea of enhancement of composite space culminating points visual impact using plants, including changes in the geometry of relief, plastic and color modeling of plants, construction of water devices and surfaces, leads to possibility of management of space in multi-storey parking garages [10].

Landscape and environmental resources can include natural elements into the interior, making multi-storey parking garages more ecological. Landscape and ecological resources are binding elements of spatial management in architectural environment of multi-storey parking garages and urban structure as a whole. They are a guarantor of environmental wellbeing [11].

Environment sustainability increasing and its aesthetic improvement in projects of multi-storey parking garages using landscape and ecological resources happens due to reduction and minimization of negative impact of transport on the inner circle of human habitat.



a) b)

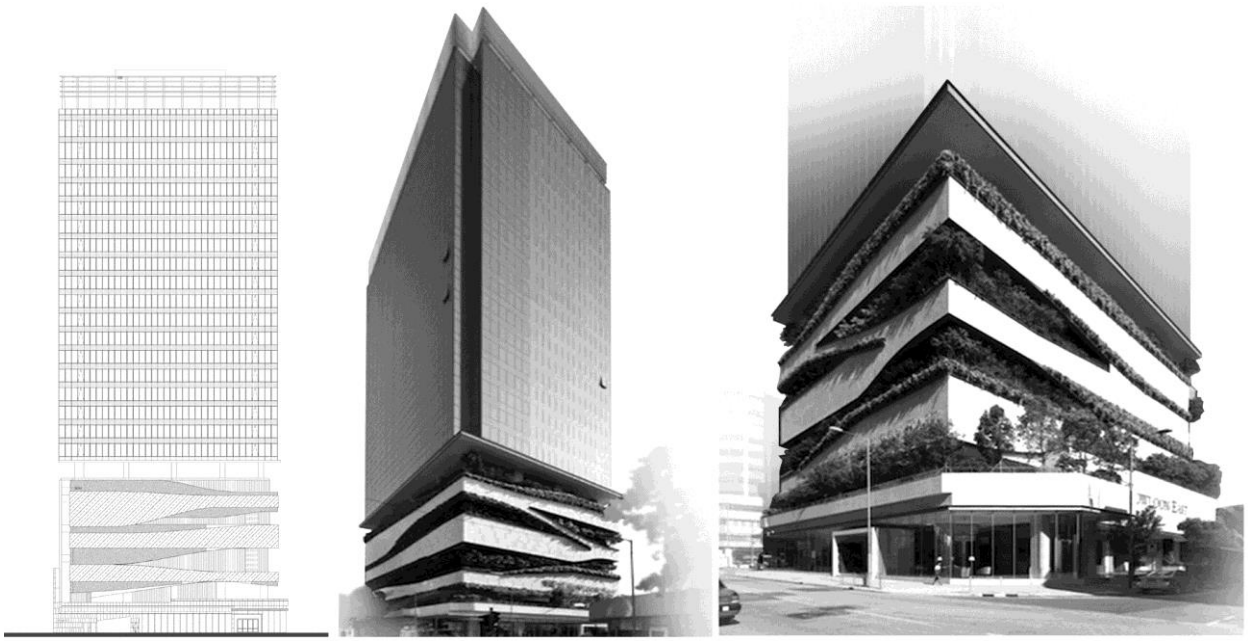
Fig. 6 (a,b). «Shinjuku Gardens», open multi-storey parking garage, Christoph Vogl, Tokyo, 2010: a) interior, green roofs, general view; b) façade 1 – 10, section 1-1, typical floor plan

In addition, environment wellbeing elements can change microclimate, protect multi-storey parking garages from noise, dust and gases that vehicles produce.

Conclusions. Global experience of multi-storey parking garages building and usage provides a set of methods, including landscape-ecological ones, for forming architectural environment of the parking garages from convenience point of view.

Forming of multi-storey parking garages architectural environment must correspond to modern aesthetical and ecological requirements and help to extend views of a modern man about comfortable habitat.

Multi-storey parking garages must be orientated on special approaches to landscape, ecological and visual methods of expression. Greening is the most important one.



a) b) c)

Fig. 7(a-c). 18 Kowloon East multi-storey parking garage, Aedas, Kowloon Bay, Hong Kong, 2010: a) main facade; b) general view; c) detail

Fig. 8. Pomona College multi-storey car park, 2008, USA. General view

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