Received: 08/24/2021, Revised: 10/22/2021, Accepted: 11/24/2021

UKRAINIAN JOURNAL OF FOREST AND WOOD SCIENCE

Journal homepage: https://forestscience.com.ua/en
Ukrainian Journal of Forest and Wood Science, 12(4), 41-49

UDC 712.253(23)(477.411)
https://doi.org/10.31548/forest2021.04.004

Relief geoplastics as a means of shaping the perception of landscape compositions using the example of the Pechersk Landscape Park in Kyiv

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Abstract. Geoplastics as a method of vertical planning is becoming increasingly popular among landscape architects because this method gives the landscape aesthetic unity, expressiveness, and a peculiar feature. The study considers the influence of geoplastic changes in the terrain on the viewer's perception of the environment. These factors are extremely important in the creation and design of the park, allow presenting key elements, while creating harmonious combinations of composition in the space, which can cause admiration and thereby contribute to increasing the number of visitors to the landscape object. Pechersk Landscape Park is located on the picturesque slopes of the Dnipro River in the city of Kyiv, has a landscape type of layout, which is characterised by large areas of lawns with groups of bushes and trees, lack of symmetry in the placement of alleys and other elements of open planning. The park itself covers an area of 32.92 hectares. The location in difficult terrain conditions contributes to the use of geoplastics, which can be utilised to improve and develop the park space. The highlighted studies are based on the analogy method, which transfers analogue elements of geoplastics to the results obtained during a full-scale survey of a park area in difficult terrain conditions. Graphic materials were developed using the ArchiCad 21 software suite based on the original map data. A detailed analysis of the problematic aspects of the Pechersk Landscape Park outlined the main task of determining the adaptability of the territory for the needs of visitors, in the context of improving the comfort of stay, improving the natural landscape, and arranging natural areas of the park terrain. Techniques and methods were used to improve the territory, such as terracing of slopes, creating eco-chairs, and using artificial relief on playgrounds. The impact of these changes on visitors' stay and the environment in general was summarised and predicted. The use of geoplastics in the context of the perception of landscape compositions would provide a solution to the problematic relief and exposition aspects of the Pechersk Landscape Park, which would increase its recreational potential

Keywords: vertical layout, landscape, urbanisation, terracing, landforms

Suggested Citation:

Matviychuk, V.L., Pikhalo, O., Minder, V., & Sydorenko, I. (2021). Relief geoplastics as a means of shaping the perception of landscape compositions using the example of the Pechersk Landscape Park in Kyiv. *Ukrainian Journal of Forest and Wood Science*, 12(4), 41-49.

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Introduction

Relief is a particularly significant factor for the art of landscape design. Urbanisation determines the need for a special attitude to the land fund. Therefore, some territories that are not intended for construction are used for landscape objects. Parks with difficult terrain conditions are mostly dangerous areas, according to the municipal organisation Institute of the General Plan of Kyiv City (Eco urban planning forecast). This information confirms the special status of such territories, the danger of which is manifested in existing erosion processes, the possibility of landslides and mudslides (Minder & Sidorenko, 2014). Therefore, the organisation of safety in recreational areas, within difficult terrain, is an integral part of design and executive work. The use of anthropogenic landforms in landscape design is also relevant as a means of creating vivid emotions in the viewer (Bondarenko, Kokhan, Gonchar & Bondarenko, 2019).

Pechersk Landscape Park in the city of Kyiv is an example of using a territory with complex terrain for landscaping. Due to the processes of urbanisation and a good location on the banks of the Dnipro River, the recreational load on this park increases, which serves both for the recreation of residents and guests of the city, and for holding mass events (concerts, festivals, exhibitions). Therefore, there is a need to adjust the park to the needs of society, adapt hard-to-reach areas of the territory, increase the comfort of staying in the park space and improve the natural landscape, which will favourably affect the psychological state of a person in a megalopolis. Since many exhibition events are held in the Pechersk Landscape Park, it is important to arrange certain areas of the park terrain for the convenience of viewing landscape and exhibition compositions. Vertical planning of the area is part of any green area project and is carried out during the initial period of both design and construction (Sokhnych, 2010; Pikhalo & Omelianchuk, 2017).

A large number of visitors come to exhibitions and festivals in the Pechersk Landscape Park every year, which significantly increases the recreational potential of the park. It is this park that has become a traditional venue for exhibitions and festivals due to the fact that the complex terrain contributes to the placement of compositions on the slopes, which can be viewed from different angles, revealing to the observer the fullness of three-dimensional and flat landscape paintings. Given the importance of these events and the annual increase in interest in them as a result of urbanisation processes, there is a need for compositional enrichment of the park, expansion and arrangement of recreation areas, which will create more comfortable conditions for staying on the territory of a landscape object. Geoplastics as a tool for artificial terrain change allows improving the park area, enhancing the view of exhibition elements and the general perception of space by creating new and improving existing landforms, and establishing modern recreation areas.

Analysis of recent studies and publications. Complex terrain conditions are an important factor in organising the landscape of a park area, in particular, dividing the surface into separate forms, each of which becomes a separate element of the composition. In addition, the nature of the terrain is an important compositional condition that determines the emotional perception of the park area (Starke & Simonds, 2013).

The visual quality of urban recreational areas is a factor that directly affects the requirements of users of these territories. Polat & Akay (2015) have identified the relationship between the visual quality of the landscape and the structural design of territories, and between the aesthetics and functional requirements of visitors.

Pieczara (2019) noted the importance of shaping the landscape based on its visual qualities. This approach reflects the importance of all visible features of the territory in terms of their aesthetic appeal, which is often used in landscape research. The potential for measuring visual phenomena, which are often the subject of intuitive and experimental design, is considered by Nijhuis (2011). The main activity of landscape architecture is the establish-

ment of open and closed spaces. The visible form, which also acts as a relief, is crucial, since it provides movement through its formations and areas, through its spatial orientation, and causes an emotional impact with visual composition. Quite important in landscape perception is the observer's point of view and programming of visual impressions based on the theory of dynamic visual perception (Xiaogang, Xiaogang & Hui, 2021).

Understanding the visual quality of urban park landscapes in complex terrain conditions requires a comprehensive approach to its study. The urban park area under study belongs in its form of relief to parks on a hill, which have a significant impact on the development of the urban landscape, create a peculiar silhouette of the city, serve as landmarks in the spatial organisation of development, and determine the scale of various structural parts of the urban organism (Sydorenko & Minder, 2018).

The purpose of the study is to develop project proposals to improve the perception of the territory of the Pechersk Landscape Park using terrain geoplastics techniques.

Materials and Methods

During the research, the method of analogy of selection and transfer of analogous elements of artificial geoplastics to the results of a full-scale survey of the park territory was used. The synthesis determined the factors of influence of landforms, both natural and artificial, on the landscape planning organisation of the territory, which outlined the locations of the proposed geoplastics techniques. The study and analysis of the territory was carried out by the cartographic method based on a topographic survey of Kyiv city on a scale of 1:2,000 (Topographic maps). The master plan was developed using the ArchiCad 21 graphics software suite.

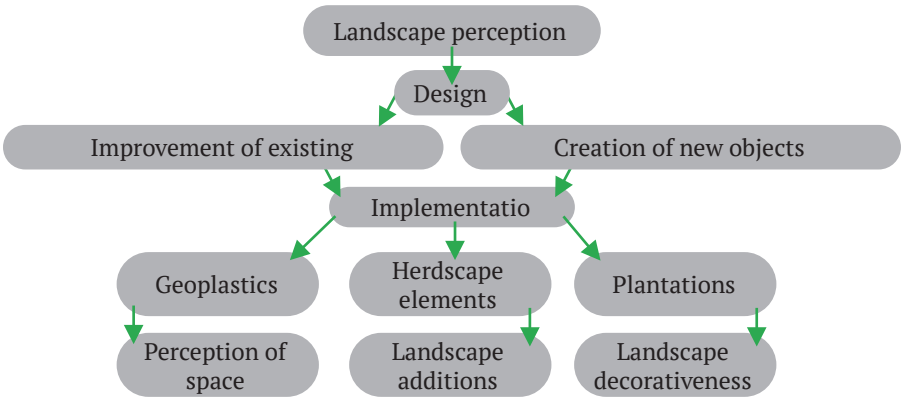
The object of research is the formation of artificial terrain as the main means in the perception of landscape compositions. The subject of the research is the territory of the Pechersk Landscape Park in Kyiv.

Results and Discussion

Geoplastics are used to improve existing or create new forms, to restore natural landforms, etc. The advantage of geoplastics is that despite the artificial method of changing the terrain, objects have a natural appearance. To achieve this result, it is important to work through each stage, starting from the design and ending with the direct implementation of the project. Earthworks are difficult, as it is necessary to create harmonious proportions without disturbing the natural outlines of the terrain (Kuznecova, 2011).

Human perception of the landscape is one of the main goals in designing and creating a park. Each element should make a special impression on the person. This can be achieved with various landscape techniques that depend on the goal and task. Certain objects can be hidden from view, and some need to be opened in a timely manner so that the viewer gets the strongest possible impression.

Having revealed all the landscapes and secrets to the viewer at once, the park loses its sense of mystery and begins to disappoint. The task of forming the perception of the environment can be handled



by the features of the terrain and the location of various types of plantings on the territory (Fig. 1).

Figure 1. Design scheme of park space perception

For example, positive landforms affect a person's perception of park space from a certain viewpoint. They can be used to "gradually reveal" the view or play the role of a screen, hiding unwanted elements, technical park structures, etc. Relief affects the perception of space and human perception. Smooth landforms can promote relaxation, it is an ideal terrain for rest, since it does not require energy consumption for movement, it is comfortable for sitting, but a terrain with a height difference helps to excite the nervous system. Similarly, the slope of a surface affects spatial perception. A person feels more protected when standing on a flat surface. At the same time, the sloping landscape encourages movement.

This property of the human psyche can be used to encourage visitors to move in certain directions (Norman, 1979). The gradual disclosure of the exposition elements of the exhibitions of the Pechersk Landscape Park can be ensured by shaping the movement of visitors in difficult terrain conditions.

The overall configuration of the park area is compact. The height difference of the terrain is 80 m. The lowest absolute mark (100 m) is located in the north-eastern part of the park, and the highest (180 m) is located in the north-western part of the park. The southern part of the park has a hilly rise with a natural height difference of 50 m (Sydorenko & Minder, 2018).

To provide the viewer with the maximum view of the territory, it is necessary to raise it higher above the element or area on which the accent is made. The steeper the slope, the larger the external space is felt. Hilly terrain is used to create spatial boundaries of park areas, to divide it into functional zones.

The openness of the gentle terrain allows visually combining the elements of the park and observing them for a long time without interference. However, the disadvantage of the flat area is the lack of protection from wind, sun, and the impossibility of privacy of park visitors, resulting in a feeling of "nudity" (Bauer, 2011).

Vertical terrain elements help in spatial definition and contribute to the comfort of visitors. Hills on both sides set the edges of personal space (Lynnik, 2004). Placing objects on hilltops creates a sense of its importance and focuses the visitor's attention on it.

Artificial terrain can be used to direct attention to certain objects along the lines of least resistance to open space. By creating artificial hills, it is possible to control the sunlight during the day. This aspect should be considered when holding exhibitions, since natural light affects the perception of compositions. Depending on what time the events are held, it is possible to determine on which side of the slope the exhibition elements should be placed or to plan the placement of the stage so that sunlight does not interfere with the visitor's observation and even helps in the overview (Bakurova & Efimov, 2015).

The conducted studies on the influence of the existing terrain on the nature of illumination of the territory of the Pechersk Landscape Park in the cardinal directions during the day established the following features of their expositions:

- west side: indirect illumination by morning sun; illumination by hot sun in the afternoon;
- east side: illumination in the morning; indirect illumination in the afternoon;
- south side: all-day illumination; aggressive direct sunlight at noon;
- north side: in summer, illumination is only in the morning and evening; in winter, there is no direct illumination during the day.

The principles of relief changes are outlined, and the nature of illumination of the territory is considered in the project proposals for improving the park environment. As noted, the Pechersk Landscape Park is a popular venue for exhibitions. For such open-air events, it is a very good solution to place the exhibition on the surface of the slope, the view of which opens from below. Such a surface can be formed by geoplastics methods. To do this, the site is raised using an embankment of earth using a frame made of geoplastic materials and fixed with a

retaining wall. The resulting "canvas" will serve for the subsequent creation of various compositions, such as flower arrangements, the review of which would become more convenient and better perceived by the viewer.

To reveal new angles on the compositional elements of the annual flower exhibitions on the territory of the Pechersk Landscape Park, a relief solution using geoplastics can be used. An example is the terracing of the slopes of the eastern exposition of the central part of the park, combined with a road network along the edge of the terraces. This would allow visitors not only to contemplate flower arrangements from the bottom up, but also to walk between them (Fig. 2).

Figure 2. Terracing of slopes with paths along the edge of terraces: *a* – analogue image (http://surl.li/axskp); *b* – suggested location within the park

One of the options for the compositional solution is terracing with retaining walls of various shapes. The use of vegetation on architecturally terraced slopes (Pikhalo, Bagatskaya & Kudrenko, 2019) will ensure the establishment of space in difficult terrain conditions. This solution is proposed to be used on the slopes of the southern and western expositions of the central part of the Pechersk Landscape Park (Fig. 3), due to which it is possible to provide different intensity of illumination of this territory and create new compositional accents.

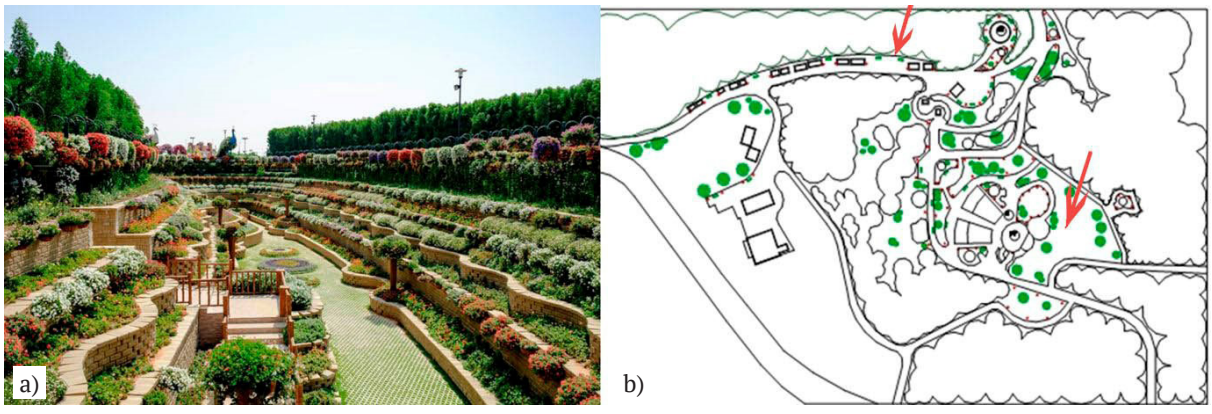


Figure 3. Terracing with retaining walls of various shapes: *a* – analogue image (http://surl.li/axsnw); *b* – suggested location within the park

For a comfortable rest of visitors, it is advisable to install eco-chairs in quiet recreation areas, which are created using geoplastics (Fig. 4). This does not require much effort, it is quite economical, since secondary raw materials can be used for the

frame of the eco-chair. The cavities of the frame are filled with a mixture of uncompressed soil and sown with lawn grass seeds. The creation of such green furniture lasts about two months. Artificially created eco-style with its smooth lines harmoniously fits into the landscape and does not look alien. Within the park, it is proposed to place eco-chairs on the highest positive points of the terrain, which would allow visitors to observe the panorama of flower exhibitions.

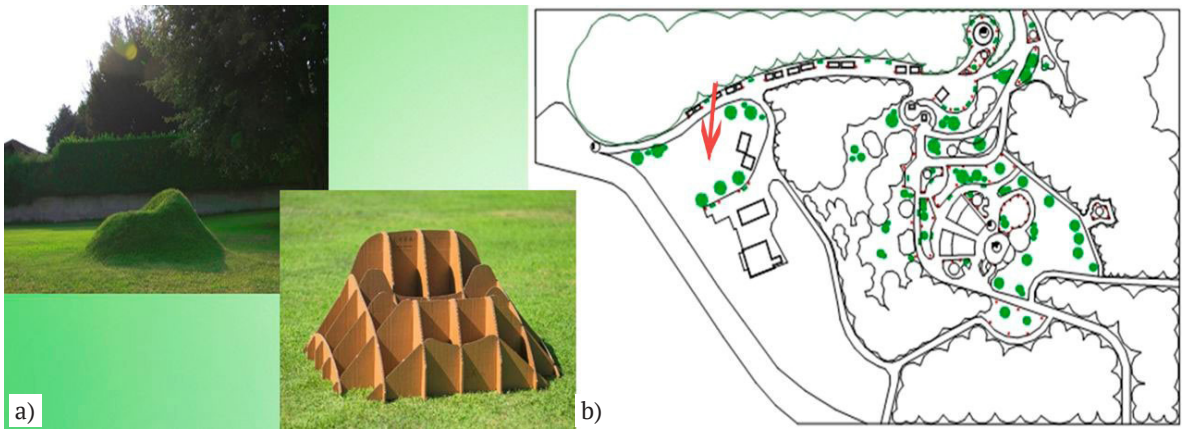
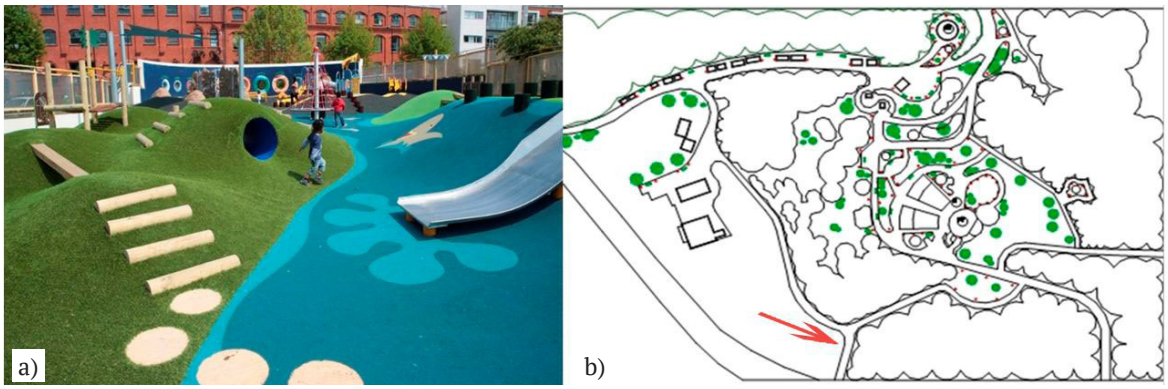


Figure 4. Eco-chairs: *a* – analogue image (http://surl.li/axsql); *b* – suggested location within the park

The upper parts of the slope of the northern exposition of the Pechersk Landscape Park, which are not occupied by exhibition flower arrangements, are proposed to be used to create playgrounds (Fig. 5). This relief is ideal for children's slides, which in combination with natural materials of the site will create a sense of unity with nature. At the same time, the relief changes will be insignificant: the organisation of smooth lines of the slope and the platform at its base will contribute to the safe descent of children from the slide.

Figure 5. Children's playgrounds: *a* – analogue image (http://surl.li/axsvm); *b* – suggested location within the park

Another interesting solution may be to create artificial hills on playgrounds for children. Tunnels can be laid in them, bridges and ladders can be created between hills, which would develop the spatial



orientation of children. For a site of this type, which has a non-standard appearance, it is proposed to place harmoniously integrated artificial hills in the existing relief from the additional entrance from Lavrska Street on the slope of the north-eastern exposition (Fig. 6).

Figure 6. Artificial hills on playgrounds for children:
a – analogue image (http://juegos1.rockthefashions.com/);
b – suggested location within the park

Imitating the elements and topography of natural landscapes, architects and designers rely on the needs of the citizen – to make their childhood more natural and close to the natural landscape.

Conclusions

Geoplastics, as a method of creating a completely new terrain or improving an existing one, is gaining wide popularity among landscape architects, because this method gives the landscape originality and expressiveness and at the same time makes it durable.

Having carried out a detailed analysis of the problematic aspects of the Pechersk Landscape Park in the city of Kyiv, the main areas for improving the perception of landscape compositions were identified: adapting the territory to the needs of society, increasing the comfort of stay, improving the natural landscape, arranging the forms of the existing terrain. Nature, with its smooth, iridescent lines, is the main tool of inspiration when creating geoplastic objects. Solutions to problematic relief and exposure aspects are proposed to increase the recreational potential of the area under study with the help of geoplastics and considering the illumination at the cardinal directions during daylight hours. The main techniques and methods for improving the aesthetics of the park environment and comfortable rest for visitors selected: terracing of slopes in combination with a road and trail network and with the help of retaining walls of various shapes in combination with vegetation; creation of eco-chairs as geoplastic elements; use of existing terrain and creation of artificial hills on playgrounds. The impact of these changes on visitors' stay in the park and on the overall environment is summarised and predicted.

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Геопластика рельєфу як засіб формування сприйняття ландшафтних композицій на прикладі Печерського ландшафтного парку у місті Києві

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Анотація. Геопластика як метод вертикального планування набуває все більшої популярності у ландшафтних архітекторів, адже цей метод надає ландшафту естетичної єдності, виразності, своєрідної особливості. У роботі розглянуто вплив геопластичних змін рельєфу на людину, сприйняття глядачем навколишнього середовища. Ці фактори є надзвичайно важливими при створенні та проєктуванні парку, дають змогу подати ключові елементи, при цьому створивши гармонійні поєднання композиції у просторі, які здатні викликати захоплення і тим самим сприяти збільшенню кількості відвідувачів ландшафтного об'єкта. Печерський ландшафтний парк розташований на мальовничих схилах Дніпра в місті Києві, має ландшафтний тип планування, для якого характерні великі площі газонів із групами кущів та дерев, відсутність симетрії в розміщенні алей та інших елементів вільного планування. Безпосередньо паркова зона займає площу 32,92 га. Розташування в умовах складного рельєфу сприяє застосуванню засобів геопластики, які можна використати для вдосконалення і розвитку паркового простору. Висвітлені дослідження базуються на методі аналогії, за допомогою якого перенесено аналогові елементи геопластики на отримані результати під час натурного обстеження паркової території в умовах складного рельєфу. Графічні матеріали розроблено за допомогою програмного пакета ArchiCad 21 на основі вихідних картографічних даних. Проведений детальний аналіз проблемних аспектів Печерського ландшафтного парку окреслив основне завдання щодо визначення пристосованості території для потреб відвідувачів, у розрізі підвищення комфорту перебування, покращення природного пейзажу, облаштування природних зон паркового рельєфу. Застосовано прийоми та методи щодо покращення території, такі як: терасування схилів, створення екостільців, використання штучного рельєфу на дитячих майданчиках. Узагальнено та спрогнозовано вплив цих змін на перебування відвідувачів і на середовище загалом. Використання геопластики в розрізі сприйняття ландшафтних композицій забезпечить вирішення проблемних рельєфних та експозиційних аспектів Печерського ландшафтного парку, що підвищить його рекреаційний потенціал

Ключові слова: вертикальне планування, ландшафт, урбанізація, терасування, форми рельєфу