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Modular Approach to Solving Public Spaces and Medical Complexes - Synthesis of Nature and Technology

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Abstract

The article considers the integration of modular solutions of therapeutic landscapes and interactive public spaces with a high degree of digitalization into the infrastructure of the city and special-purpose facilities, medical complexes and institutions. The article examines the role of the therapeutic function of therapeutic landscapes using a modular approach as a response to the challenges of time. It is important to combine growing technological capabilities with landscaping components. It is in this synthesis that the author sees the future development of the urban environment and the landscape of medical facilities.

Keyword: pattern; urban morphology; integrity; development; BIM for landscape; unique design; simulation algorithm; identity; utilities; technologies; innovations; design of alternatives; construction; competitive ability; potential; innovative development; municipal economy; community economy; urban semiotics; residential yards and gardens; county level; digital public spaces; neurorehabilitation; formation of man of today; scenario approach

Introduction

Over the past few decades, more than 150 studies have been conducted on the healing and restorative effect of contemplating nature. The universal conclusion is that contemplation and contact with nature provides significant emotional and physiological benefits. A proven fact is the therapeutic effect of the landscape and green infrastructure in the city and special-purpose facilities, such as hospitals, sanatoriums, educational institutions, etc.

Moreover, extensive research has shown, that even small green planted areas influence on the microclimate alleviating the temperature and relative humidity of the air on the territory and allow to testify that the rational plantation is able to reduce the acoustic level and provide a proper treating-preventive regimen in the hospital.

At the same time, modern public spaces represent a tool for transforming identities and principles of social interaction. The advanced modular simulation technologies allow us to shape design concepts for our surroundings and source solutions for all kinds of landscapes. The experience of implementing architectural and design solutions for public spaces landscaping (Villosi, Leningrad Region, Russia), created in 2018-2020 under the guidance of architect Svetlana Danilova, describes the modular simulation algorithm and theoretical research as a highly promising tool, used also by St. Petersburg State University of Architecture and Civil Engineering Department of Architectural Landscape Design, and has many examples of integrating different kinds of fill based on function, scale, position in urban design and surrounding landscape. It is important to combine growing technological capabilities with landscaping components. It is in this synthesis that the author sees the future development of the urban environment and the land-scape of medical facilities.

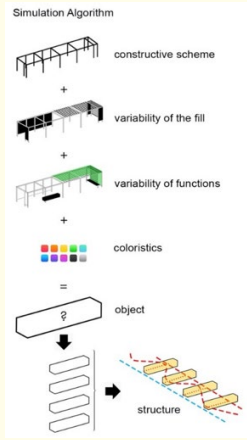

Figure 1: Simulation algorithm by S. Danilova.

Modular solutions allow the use of vertical and container gardening, increase the number of green spaces in conditions of growing urbanization and rapidly changing reality.

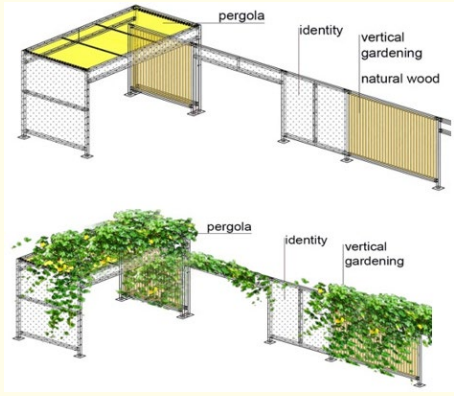

Figure 2: Structural frame (top) and vertical gardening as a possible fill solution (bottom). Villosi Village, Leningrad Region, Russia. Author: S. Danilova.

Importantly, modular simulation allows to create authentic, identics-based solutions with due consideration of the budget and with strong focus on detail enhancement.

Figure 3: Implementing the elements of integrated masterplan and design code for Villosi Village landscaping (Leningrad Region, Russia). Design developer: St. Petersburg State University of Architecture and Civil Engineering. Chief architect: S. Danilova. Design team: E. Kuznechikova, A. Yegorova, A. Soshnikova, A. Popova, E. Shcherbakova.

Using sets of standard modules and shared design code, it is possible to model all kinds of facilities – early development and rehabilitation centers, information stands, co-livings, medical offices, playgrounds in kindergartens and schools, recreation centers, sports and wellness facilities. With digital analysis systems continuing to develop rapidly, we have more possibilities for planning the processes to form individual development paths.

In the context of the pandemic and unprecedented tense geopolitical situation in the world, integrating digital and modular technologies into landscaping offers solutions to some of the challenges of our time. Contact with Nature and involvement in interactive processes provides an opportunity for the formation of a versatile developed personality and the restoration of lost resources of psycho-physical health of citizens. Harmonization of tools for working with the population is possible with the consolidation of the efforts of various government departments, such as sports, healthcare, art, smart city, security, etc.

Materials and Methods

In this regard, research and design are interdisciplinary and occur at the intersection of landscape architecture, cognitive urbanism, medicine and digital information technologies.

The scientific and informational kernel of the study relies on the following system modules:

- 3D learning;
- Augmented reality;
- Sensory-motor integration and neurodynamic gymnastics;
- Neurocognitive capacity building;
- Enhanced physical conditions;
- Interactive communications.
- Green module-garden.

At the level of more specialized work with children, patients and elderly citizens, a research-based framework has been designed that uses the modules targeting better neurorehabilitation and academic performance:

Sensory (tactile, proprioceptive, acoustic) development. Sensory playgrounds engage a child's touch and muscular sensations and allow to experiment with sound recognition. They offer activities that appeal to vestibular senses to develop behaviors based on how children move and position their body in space.

Coordination. Coordination playgrounds offer activities designed to develop balance and coordination.

Cognitive development. Playgrounds can benefit children by developing behaviors based on core notions of shape, color, number, volume, more-less, back-ground-foreground, through fascinating journeys into recognition and interpretation.

Relay race. Relay races appeal to complex forms of attention and help to stimulate planning skills and self-control. They motivate families to be more active.

Civilization. Civilization module introduces children to the main achievements of civilizations in the field of culture, arts, architecture, technology and much more.

Provided that the above five modules use the prescribed protocols, they can provide the highest possible level of child development. The same is true about working with the elderly as these facilities can slow down the aging process in the brain, and patients of specialized healthcare facilities in need of rehabilitation.

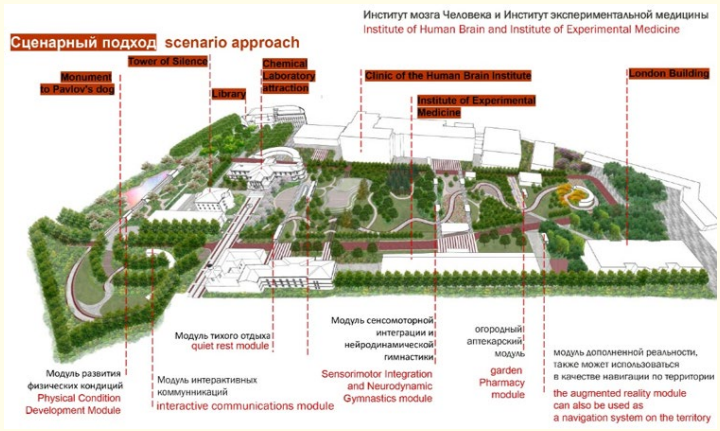

Figure 4: Scenario approach in action: modular elements layout and landscaping solution for the Institute of Human Brain and the Institute of Experimental Medicine (St. Petersburg). Scheme: S. Danilova. Graduation thesis by A. Weitzer (research supervisors: S. Danilova, N. Kerimova, V. Gomozov V., 2021).

Another area of implementation of the modular approach is the integration of planning elements – modular gardens with the function of treatment, recreation and rehabilitation - at the master plan level. Elements can be replaced taking into account the event, the need for repair and updating, changes in user needs during the year. The composition of landscaping can be varied depending on the function, climate, aesthetics and therapeutic effect. For example, a garden of fragrant shrubs, where aromatherapy procedures can be carried out, may include perennial flowering plants and ornamental shrubs. It is worth noting that the effectiveness of aromatherapy healing has been confirmed in almost all components of some modern studies. The results of in-depth examinations and analysis of rhinocytograms allowed us to conclude that there was a significant improvement in the condition of the nasopharyngeal mucosa and an increase in the effectiveness of local immune protection in children against the background of aromatherapy.

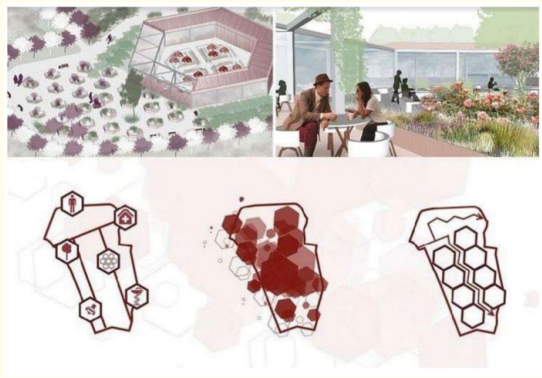

Figure 5: Modular solutions. A garden of fragrant shrubs. Placement of modular gardens on the master plan. Materials of the thesis of E. Stasovoy (hands. Danilova S. B.,Gomozov V. I., Keri-mova N. A.). The project of landscaping the territory of the Institute of Experimental Medicine and the Institute of the Human Brain (DIPLOMA OF the 1st DEGREE of the competition Saint-Petersburg State Forestry Universityin the nomination "Project of a modern object of land-scape architecture", 2021).

Depending on the desired therapeutic, aesthetic and aromatic effect, the following breeds can be used in landscape solutions: rose, rosemary, sage, lavender, mint, fennel, nasturtium, azalea, carnation, elder, clover, heliotrope, honeysuckle, hawthorn, barberry, geranium, hyacinth, magnolia, individual varieties of honey-suckle, peony, iris, sweet peas, lilac, wisteria. Also, the function of the pharmacy garden is gaining more and more popularity among the population, when children and adults can take care of plants, increasing physical activity, improving their mental health and strengthening social communication skills. It is important not to forget about the conditions for the staff. As an example, an example of the device of a modular garden for the recreation of hospital workers is given. Varieties with a predominance of coniferous species were used: verbena, mountain pine, spirea, maiden grapes, barberry, thuja, juniper.

Figure 6: Modular garden for staff on the territory of the Mariinsky Hospital, St. Petersburg. Ma-terials of A. Maksimova's thesis, 2021, SPbGASU. (hands. Danilova S. B., Gomozov V. I., Keri-mova N. A.).

Results

As a result of the work, solutions were found that will provide solutions to the issues of the effectiveness of various public spaces and elements. It is necessary to develop a strategy for the introduction of modular elements into public spaces and the landscape of special-purpose facilities for the development of children, rehabilitation of patients, creation of conditions for leisure and recreation. The introduction of such modular elements into the green infrastructure of cities will improve the health of citizens.

One more important line of research is offered by scenario approach to the architecture of hybrid spaces. This study defines *hybrid spaces* as fusions of physical territories, landscape solutions and augmented reality-assisted 3D planning. Such spaces should be solved using the *scenario approach*. On the one hand, the scenario approach to landscaping relies on a combination of techniques, elements and natural components of a given territory with account of the specifics of functional purpose, urban planning, compositional aspects, thematic content, existing and future biocenoses, ecosystem forecasting and sustainable development principles designed to achieve harmonious coexistence of man and environment. On the other hand, the efforts to build an environment conducive to comprehensive child development and rehabilitation of patients of different age groups, should seek to create the spatial-temporal patterns that would be interconnected by paths and information content consistent with their functional purpose and seasonal or all-year-round activity/event agendas. That said, in conditions of the pandemic, which means these spatial-temporal patterns are subject to rapidly changing requirements to their use and operation, it is important to be able to operate flexible solutions for adjusting to real-life situations. The scenario approach and modular simulation algorithm stands as a modern response to the challenges of the time. It allows for a variety of behaviors in accordance with individual learning, rehabilitation, recreation, sporting and leisure paths. In a world with rapidly changing social and economic conditions, to the foreground comes personal development and social acumen.

Thus, the scenario approach to hybrid spaces uses the following core principles:

- Forecasting.
- Social interaction and identity transformation.
- Architectural design planning at micro-, meso- and macro-levels of environment.
- Multifunctionality with focus on facility's specific features.
- Harmonization.
- Routing.
- Unlocking the landscape potential and integrating natural components.
- Identity and authenticity enhancement.
- Technology integration. Digital analysis systems offer more possibilities for planning the processes to form individual development paths.
- Modularity and optimized problem-solving.
- Flexibility of use.
- Institutional consolidation and cross-disciplinary communication.

Discussion

When developing solutions for hybrid spaces of healthcare and other facilities, it is very important that sufficient attention is paid to the basic age-specific motor skills, sensory abilities, and sensorimotor integration taking into account the climate.

Achieving progress in conditions of swiftly advancing technologies is possible only by integrating the flexible digital and electronic solutions into landscape environment.

Thanks to the advanced technologies, the active and passive interaction patterns can be combined with augmented reality technologies as a way to support the individual paths to recreation, physical health improvement, physical and neuro-cognitive development in the landscape.

Notably, the issues of development and developmental problems in citizens of different ages have been seriously addressed for more than 80 years, but it is only now, with the advent of newest generation digital and electronic solutions, as well as research on the impact of a green landscape on health, that the achievements of these years can be used to the maximum benefit, increasing the availability of tools created by large research centers and clinics available to every yard, social space and landscape for higher interactivity and monitoring of each process.

Conclusions

The study has shown that the development of integration of modular solutions with a high degree of digitalization, and modern advanced technologies, including dendrology, will effectively use the accumulated knowledge and technological re-sources to organize the landscape of medical complexes and institutions in an urban environment.

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