UDC 625.72:629.79:314.44:574.2

Lytvynenko T., PhD, Assistant Professor
Ivasenko V., post-graduate
Poltava National Technical Yuri Kondratyuk University

STREET AND ROAD NETWORK'S PLANNING PRINCIPLES FOR NEEDS OF PERSONS WITH DISABILITIES

The development and improvement problem of principles and receptions of street-travelling network planning and also facilities of their providing, that would take into account the necessities of all users an environment, is in-process investigated, especially people with different disability nosologies and other categories of people with limited mobility. Distinguished basic groups of principles in relation to planning of environment. Analysed basic principles of planning of street-travelling network for conditioning for unimpeded motion by the community of all participants of traffic participants: functional integration, functional differentiation, compactness, town-planning integrating, microdistricts creation, construction of optimal street-travelling network, functional zoning, non-conflictual, modernisation, aesthetic attractiveness, visual perception, sequentialization, design of spatial corridor, universal design, availability, comfort, informing, unconcern, «smart adaptation», social, social adaptation, participating in public life, labour employment.

Keywords: *street and road network, people with limited mobility (PLM), transport accessibility, mobility, transport infrastructure, design principles.*

Литвиненко Т.П., к.т.н., доцент
Івасенко В.В., аспірант
Полтавський національний технічний університет імені Юрія Кондратюка

ПРИНЦИПИ ПРОЕКТУВАННЯ ВУЛИЧНО-ШЛЯХОВОЇ МЕРЕЖІ З УРАХУВАННЯМ ПОТРЕБ МАЛОМОБІЛЬНИХ ГРУП НАСЕЛЕННЯ

Досліджено проблему вдосконалення проектування та реконструкції вулично-шляхової мережі з визначенням принципів і прийомів, а також засобів їх забезпечення, які враховували б потреби всіх користувачів навколишнім середовищем, особливо людей з різними нозологіями інвалідності та інших маломобільних категорій. Виділено і проаналізовано основні принципи проектування вулично-шляхової мережі для створення умов для безперешкодного руху населеним пунктом усіх учасників дорожнього руху: функціональної інтеграції, функціональної диференціації, компактності, містобудівної інтегрованості, мікрорайонування, побудови оптимальної вулично-шляхової мережі, функціонального зонування, неконфліктності, модернізації, естетичної привабливості, візуального сприйняття, композиційності, моделювання просторового коридору, універсального дизайну, доступності, комфортності, інформативності, безпечності, «розумного пристосування», соціальної ефективності, соціальної адаптації, участі у громадському житті, трудової зайнятості.

Ключові слова: *вулично-шляхова мережа, маломобільні групи населення, транспортна доступність, мобільність, транспортна інфраструктура, принципи проектування.*

Introduction. Due to increased level of the life quality and population growth, the number of people with limited abilities and special needs has increased as well. While the vehicles expand dramatically on our roads and streets, the need for a special transport-distribution system has arisen so that all the participants of the street traffic, along with groups of population with limited mobility, will have access to existing street and road network and to the other elements of the infrastructure. People with limited mobility (PLM) are the people, who have difficulties with self-transportation and space-orientation, and who lack in appropriate services and information. They consist of disabled persons, persons with temporal loss of productivity and health, old people, pregnant women, persons with child's cart etc. They consist of disabled persons, persons with temporal loss of productivity and health, old people, pregnant women, persons with child's cart etc.

Increased mobility of modern world and stimulation of people to live active life have caused a huge demand for functional transformation city streets so that the needs of the GPLM would be taken into consideration.

Analysis of the latest sources of researches and publications. City traffic safety is the topic of researches of O.V. Tolok, Y.O. Reitsen. M.V. Sholukh raises an issue of rehabilitation environment of industrial city. O.V. Stelmakh emphasizes problem of parking spots for cars in the biggest cities of Ukraine. Principles of organization of rehabilitation centers for disabled people and other GPLM are under research of O.V. Prokopenko, V.V. Kutsevych. I.O. Danchak investigates the principles of ergonomic architecture for disabled persons. Foreign scientists who explore problems of street traffic for disabled are the following: L.-P. Grosbois (France), E. Rossman (Poland), J. Geil (Denmark) and others.

Unsolved parts of the common problems. While developing the community and changing its appearance, communication structure becomes less effective in terms of bandwidth lines, differentiation of movement types, and in terms of comfort for people who use it . The main purpose of urban space is creating conditions for a safe, comfortable, accessible traffic for all the users, including the most vulnerable people with limited mobility. Thus in the formation of existing and new transit space based on scientific principles, methods and techniques of urban transformation, we must consider the needs of people with special requirements, help them to move freely in the urban environment, including street and road network. Therefore, we must investigate needs of the people with limited mobility, identify measures to improve development of street and road network and implement this measures.

Purpose of research – improvement and development of the new principles and methods of designing street and road network to the needs of people with limited mobility.

Basic material and results. It was discovered the following group of principles, architectural and planning; technical and socioeconomic while exploring and analyzing the development of domestic and foreign scientists for the design environment (Fig.1).

The group of architectural and planning principles include: functional integration, functional differentiation, compactness, urban integration, zoning, building optimum street and road network, functional zoning, non-conflictual, upgradable, aesthetic appeal, visual perception, compositionality, modeling spatial corridor [2 – 13].

The technical group refers principles: universal design, accessibility, comfort, information, safety, «reasonable adaptation» [14 – 16].

Socio-economic group includes next principles: social efficiency principle, social adaptation principle, principle of participation in public life, employment principle (Fig. 2).

Let's analyze each principle and a system of methods and tools in details.

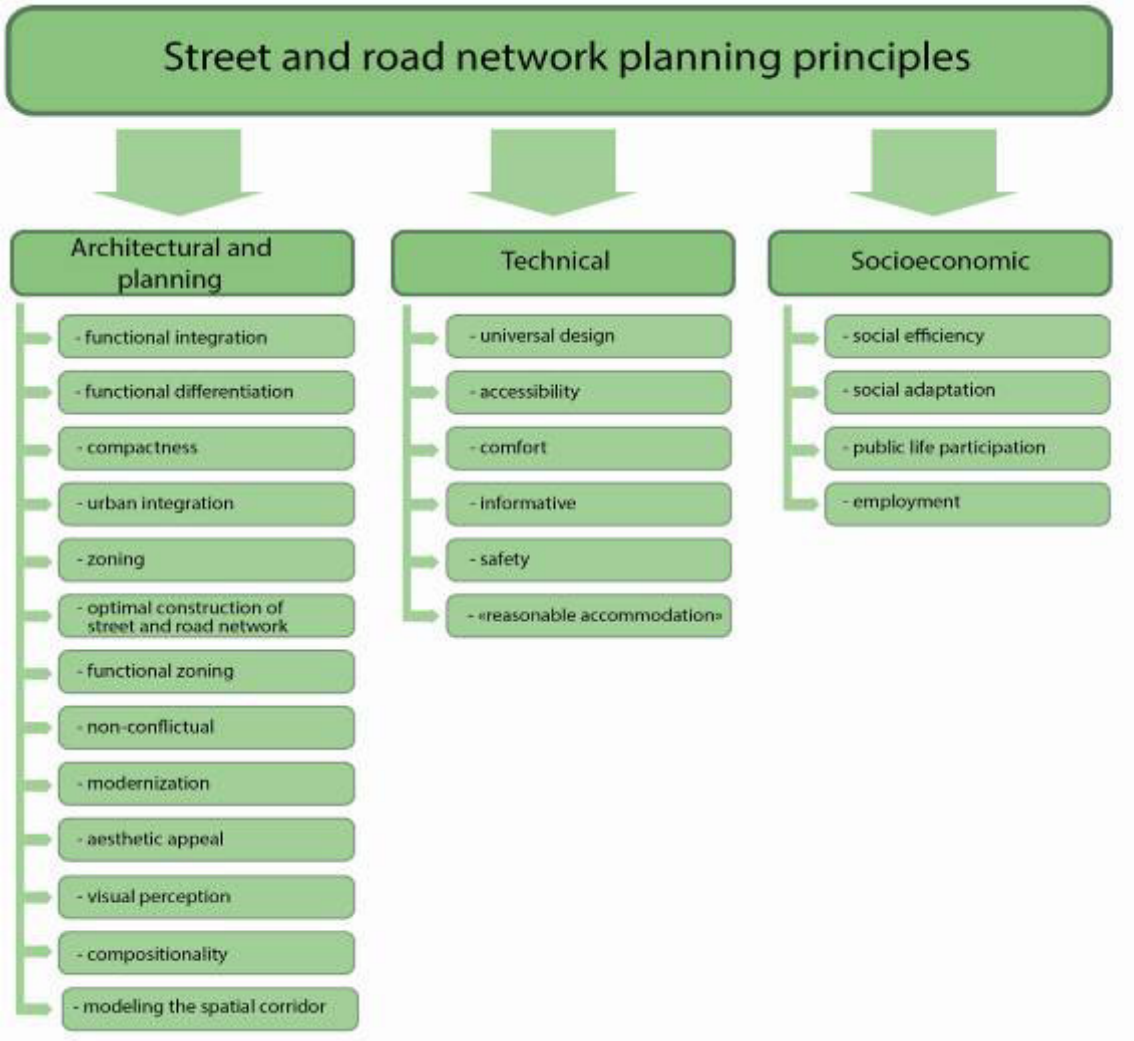

Figure 1 – Groups of street and road network design principles for needs of people with limited mobility

The principle of functional integration is aimed at adapting existing street and road network for persons with disabilities needs without capital construction activities and can be implemented by:

– allocation of separate lanes;

– the speed limit on the streets and roads;

– construction and arrangement of recreational areas.

The principle of functional differentiation is based on separation of road space functional areas and is aimed at future development of streets, roads and communities and include:

– designing the other roads that can be combined with bicycle's roads (this applies only to people who are moved by specialized vehicles);

– designing independent routes and associated facilities street and road network that take into account the needs of people with limited mobility.

The principle of compactness is to create conditions for people with limited mobility to move fast and freely on town or microdistrict, which are characterized by a relatively high density, so this will reduce the cost of construction.

The principle of integration of urban planning takes into account the optimal objects placement in the street and road network of the community and the rational distribution of certain elements of transport infrastructure. Also determines the availability of favorable conditions for street and road network.

The principle of zoning is based on the unity of residential buildings formations around daily service buildings; forming of sustainable community («neighborhoods»); a safe and comfortable environment; designing mainly pedestrian environment.

The principle of optimal street building and road network consists of a shortest community's network design; identifying additional nodal points and links; finding an effective solution to the problem of optimal street and road network, which would be convenient for of people with limited mobility. In designing visual diagram showing shortest connecting networks of roads, assesses the cost-effectiveness of building each street individually and the entire network as a whole

The basis *for the principle of functional zoning* is a logical sequence «Life-work-rest» in the design of the surrounding space that means a clear demarcation of functions and processes in as a result of new methods of living space and transport and walking.

On the basis of the undertaken research it is proposed a *principle of non-conflict* that analyzes conflicts that could arise in the interaction between traffic and pedestrian flows in order to eliminate conflicts between different flows of people; demarcation of traffic and pedestrian flows. This principle focuses on the maximum segmentation level of these flows.

The principle of modernization aimed at reconstruction of the existing street and road network with current technology and full or partial reconstruction of the overall community system to accelerate of development of community.

The principle of aesthetic appealing aims to preserve the architectural and compositional unity of all the objects of a street and road space - lighting, landscaping, proper arrangement of small architectural forms, check the cleanliness and serviceability of all elements of street and road network, etc. while considering this principle in the design environment scientists from different countries didn't take into account the features of some groups of people with limited mobility (people with mental disabilities, the blind, people with hearing impairment), so it is proposed to extend this principle taking into account the peculiarities of perception.

The compositional principle is based on the perception of the environment, a sense of human in space; sensation when driving vehicles; fixing the most favorable terms to understand such elements as scale, rhythm, contrast, nuance, symmetry and asymmetry.

The principle of spatial corridor modeling integrates with hierarchical sequence location of certain elements of improvement. This principle allows design checking by volumetric modeling after the test facility and allows for quality decisions control.

Principle of the universal design were developed by a group of architects headed by Ron Maise [14]. The main ideas of the principle are: to provide even access to usage; usage flexibility; y usage simplicit; free access to the provided information; mistakes tolerance; little physical efforts; free space necessity, and appropriate size. Those features are provided by means of: usage equity for all the categories of users, so that additional available special devices do not put some visitors in a worse position; simplicity, so that an action does not demand special knowledge, skills, or language understanding; usage flexibility, so that the same device could be easily operated by many groups of people; signal perception easiness by blind, deaf people, or people with lower level of attention, mentally ill people; mistakes safety, so that accidental, unintentional action will not create a dangerous situation somehow; minimum effort, so that a continual usage of a device causes minimal fatigue; or single action takes very small effort; necessary space for special devices that people use, and proper size and zones of access for different people.

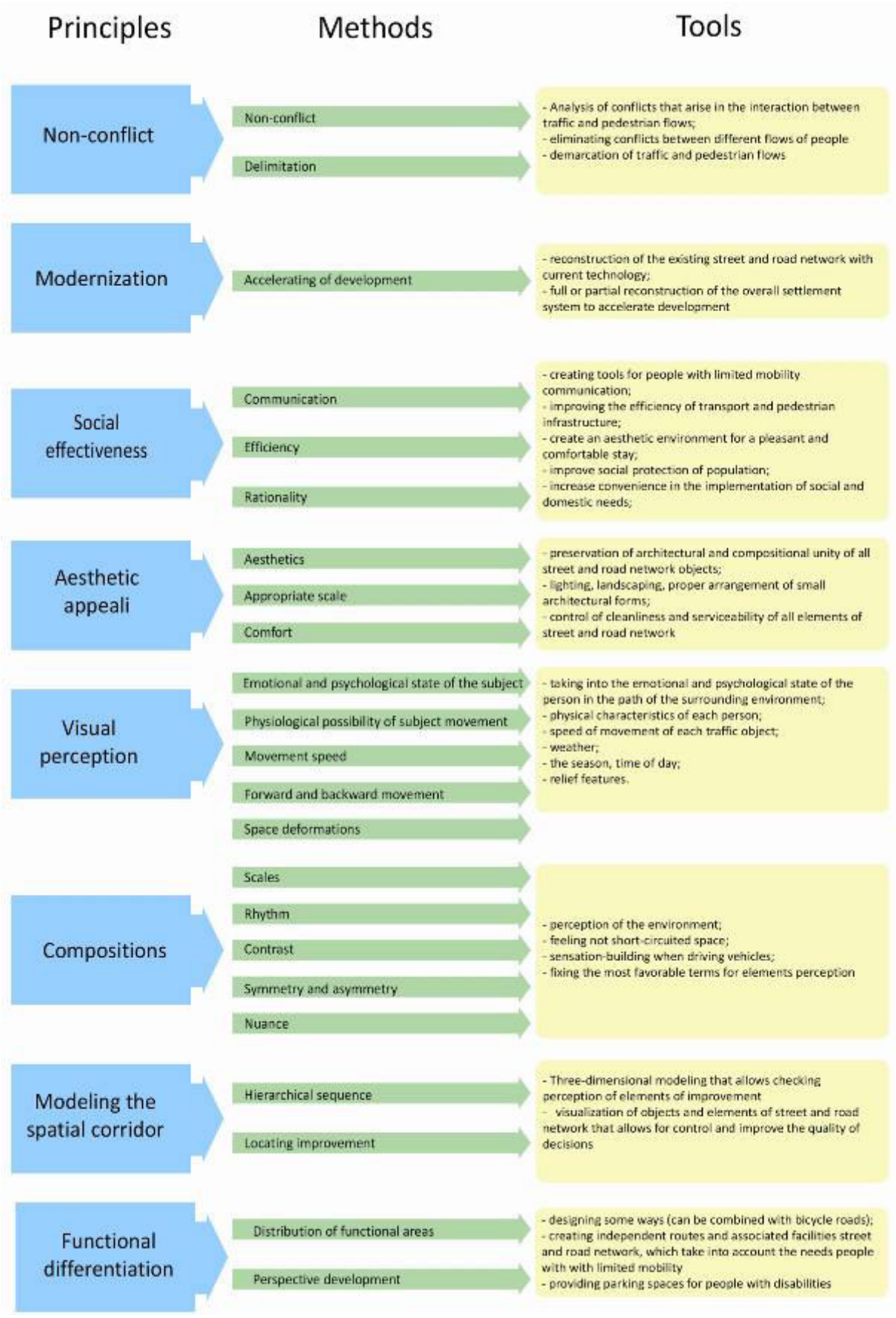

Figure 2 – Principles, methods and designing barrier-free street and road network

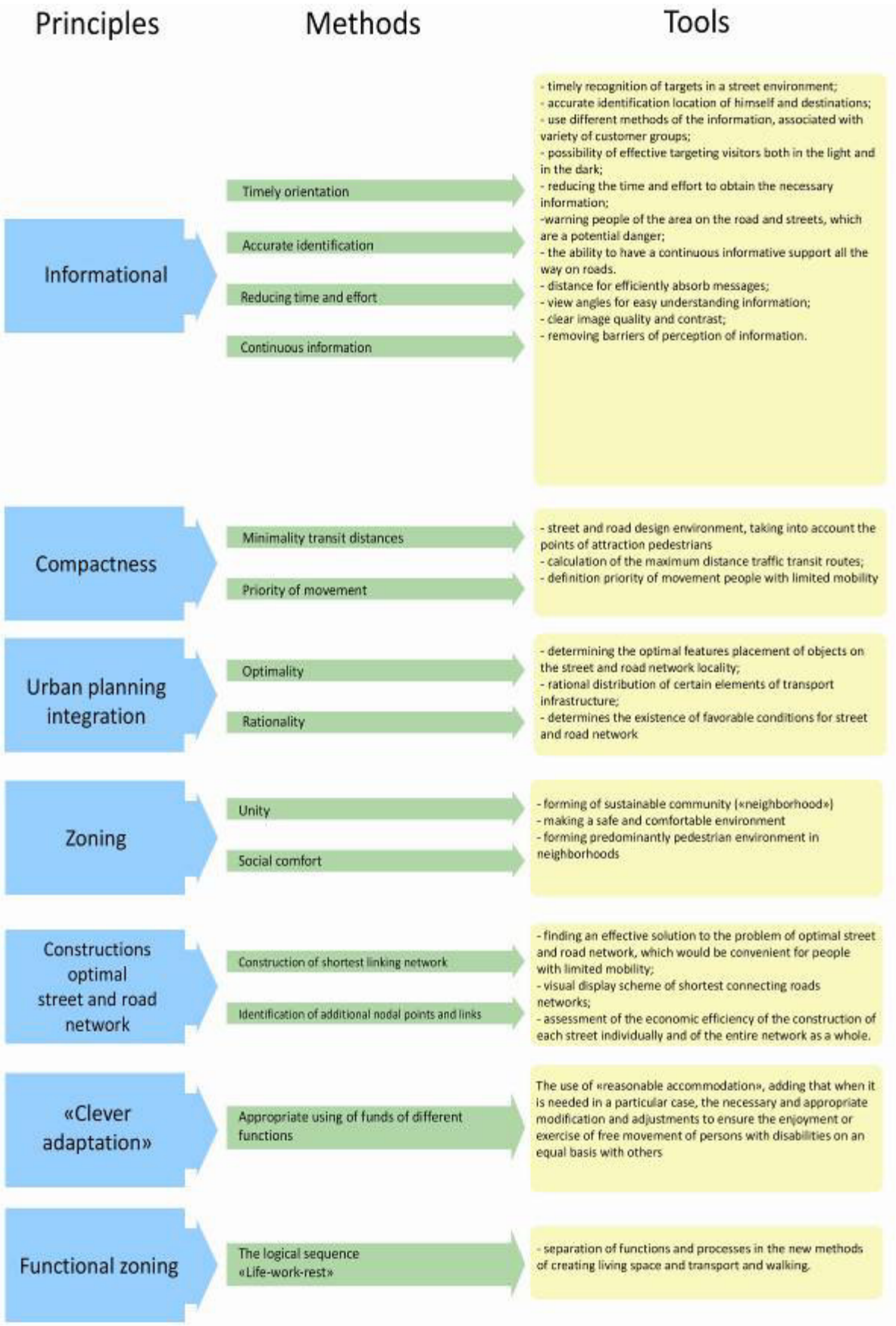

Figure 2 – Principles, methods and designing barrier-free street and road network (continuance)

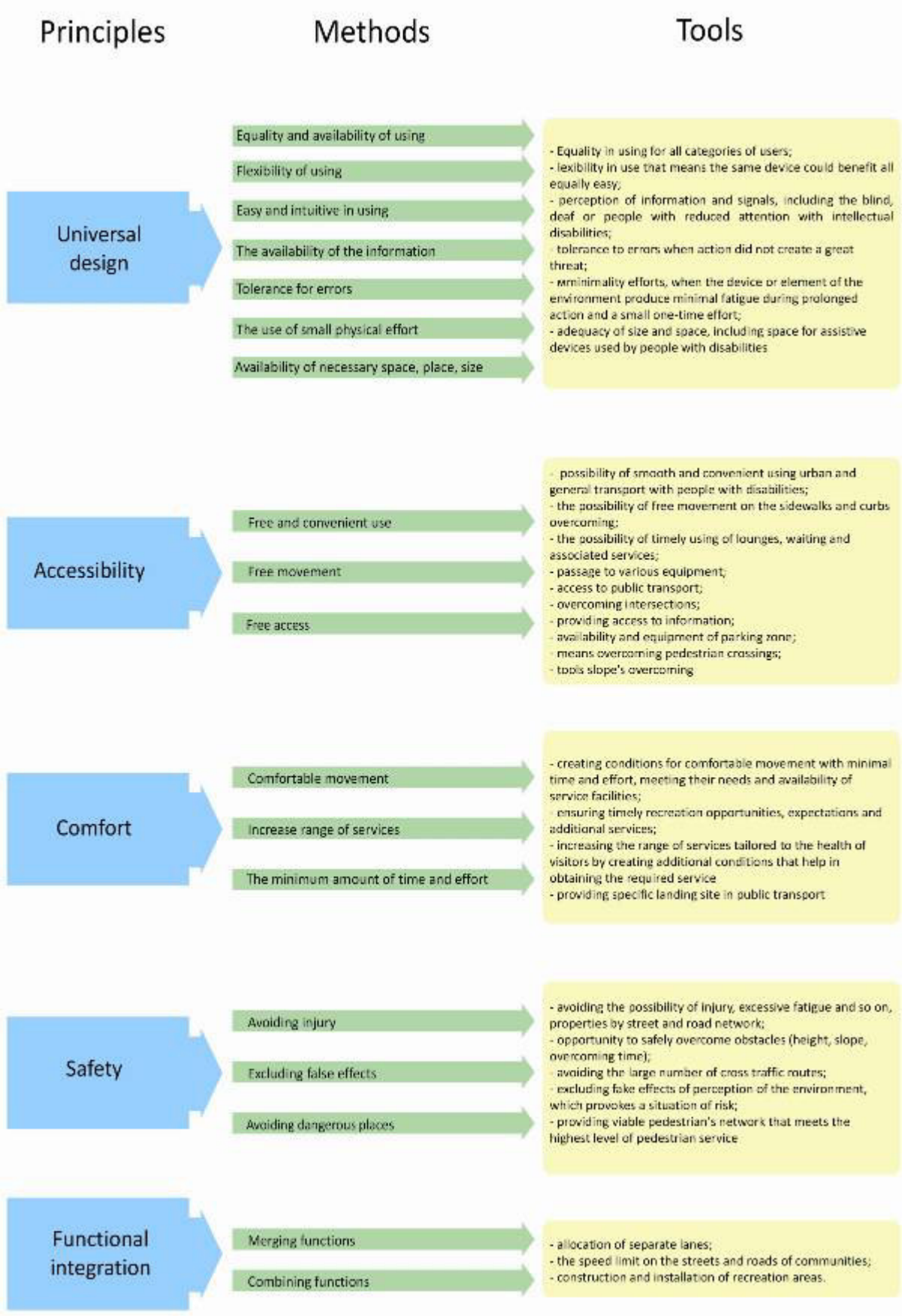

Figure 2 – Principles, methods and designing barrier-free street and road network (continuance)

Free space and access principle means that person has an ability to move in a space without any limitations and with maximum comfort; he/she has free access to devices and facilities, public and private transportation; he/she have an ability to move easily by sidewalk, use apparels without any help of other people; he/she has available parking spot, devices for crossing the street at crosswalks.

Comfort principle includes: conditions creation for comfortable transportation through a city; increasing number of services; minimal time waste; minimal efforts; availability for rest, comfortable waiting, and additional service.

Safety principle is intended to protect from traumas, dangerous places; decrease risks in the places of intersection of many directions traffic; help to deal with constraints (height, inclination, time); eliminate possibly misunderstandable signals and effects of environment, which increase risks

Informativeness principle helps orient in the space in a timely manner; gives precise identification of location; decreases efforts and optimizes time of a person; provides with continuous information while moving in traffic, no matter what the physical abilities or level of intelligence a person has.

Principle of the reasonable adaptation means that the need of modifications and improvements of particular special devices are properly investigated and evaluated, so that any excessive expenses risks and enormous efforts are being eliminated. Idea: «Make changes where it is needed, not where it is possible».

Taking into consideration United Nations convention and foreign best practices in designing non-barrier street and road environment, it can be defined another principle - *principle of social effectiveness*. This principle creates communication environment for the people with various levels of disabilities, gives an opportunity to freely move and be among the other people, to socialize and communicate, take part in public life, be employed and socially protected.

Conclusions. Street and road network design needs a lots of improvements and renovations to meet a special demands of people with limited mobility. Principles and methods of designing street and road infrastructure that were covered in the article, need a development of the calculation particular parameters methodology (width, inclination, speed of a stream, time, needed to crosswalk the street, zone of observation), which will allow improve PLM quality of life, increase their life standards, involve them in public activities, and increase a chance of their participation in social life along with all its members.

References

1. *ДБН В.2.2-17-2006. Будинки і споруди. Доступність будинків і споруд для маломобільних груп населення [Чинний від 2007-05-01]. – К. : Мінрегіонбуд України, 2007. – 20 с. – (Державні будівельні норми України).*
   DBN V.2.2-17-2006. Budinki i sporudi. Dostupnist budinkiv i sporud dlya malomobilnih grup naselennya. [Chinniy vid 2007-05-01]. – K. : Minregionbud Ukrayini, 2007. – 20 s. – (Derzhavni budivelni normi Ukrayini).
2. *McIntosh R. P. The Background of Ecology: Concept and Theory / Robert P. McIntosh // Cambridge University Press. – London, N.-Y., New Rochelle, Sydney, Melbourne, 1985. – 383 p.*
3. *Досвід та перспективи розвитку міст України // Проектно-планувальні аспекти містобудування: зб. наук. пр. – К. : Ін-т Діпроміcто, 2004. – Вип. 7. – 188 с.*
   Dosvid ta perspektivi rozvitku mist Ukrayini // Proektno-planuvalni aspekti mistobuduvannya: zb. nauk. pr. – K. : In-t Dipromisto, 2004. – Vip. 7. – 188 s.
4. *Клюшниченко Є. Є. Соціально-економічні основи планування та забудови міст / Є. Є. Клюшниченко. – К. : Укр. акад. архіт., 1999. – 348 с.*
   Klyushnichenko E. E. Sotsialno-ekonomichni osnovi planuvannya ta zabudovi mist / E. E. Klyushnichenko. – K. : Ukr. akad. arhit., 1999. – 348 s.

5. *Сардаров А. С. Архитектура автомобильных дорог / А. С. Сардаров. – М. : Транспорт, 1993. – 269 с.*
Sardarov A. S. Arhitektura avtomobilnyh dorog / A. S. Sardarov. – M. : Transport, 1993. – 269 s.
6. *Габрель М. М. Просторова організація містобудівних систем: монографія / М. М. Габрель. – К. : АСС, 2004. – 399 с.*
Gabrel M. M. Prostorova organizatsiya mistobudivnih sistem: monografiya / M. M. Gabrel. – K. : ASS, 2004. – 399 s.
7. *Дёмин Н. М. Управление развитием градостроительных систем / Н. М. Дёмин. – К. : Будівельник, 1991. – 184 с.*
Demin N. M. Upravlenie razvitiem gradostroitelnyh sistem / N. M. Demin. – K. : Budivelnik, 1991. – 184 s.
8. *Manual Of Uniform Traffic Control Devices / FHWA. – The US Acces Board, 2004. – 864 p.*
9. *Piverkova A. Spatial analysis for detection of places in a city with a high riskiness or handicapped persons: master thesis / A. Piverkova . – University of Pardubice, 2008. – 161 p.*
10. *Dufour D. Практична довідка PRESTO. Велосипедисти і пішоходи. Українська версія / D. Dufour, Ligtermoet&Partners. – Нідерланди, 2010. – 8 с.*
11. *Иодо И. А. Основы градостроительства. Теория и методология / И. А. Иодо – Минск, 1983. – 199 с.*
Iodo I. A. Osnovy gradostroitelstva. Teoriya i metodologiya / I. A. Iodo – Minsk, 1983. – 199 s.
12. *Лобанов Е. М. Транспортная планировка городов / Е. М. Лобанов. – М. : Транспорт, 1990. – 240 с.*
Lobanov E. M. Transportnaya planirovka gorodov / E. M. Lobanov. – M. : Transport, 1990. – 240 s.
13. *Ткаченко І. В. Принципи розміщення елементів благоустрою автомобільних доріг: автореф. дис. на здобуття наук. ступеня канд. техн. наук: 05.22.11 – автомобільні шляхи та аеродроми / Ткаченко І. В. – Київ, 2013. – 20 с.*
Tkachenko I. V. Printsipi rozmishchennya elementiv blagoustroyu avtomobilnih dorig: avtoref. dis. na zdobuttya nauk. stupenya kand. tehn. nauk: 05.22.11 – avtomobilni shlyahi ta aerodromi / Tkachenko I. V. – Kiyiv, 2013. – 20 s.
14. *Mace R. What is Universal Design [Electronic resource] / Ronald Mace. – Access mode: http://universaldesign.ie/what-is-universal-design/the-7-principles/the-7-principles.html.*
15. *Доступність до об'єктів житлового та громадського призначення для людей з особливими потребами інвалідністю: методичний посібник. / ВГСПО «Національна Асамблея інвалідів України»: Я. Грибальський, В. Куцевич, К. Іванова, О. Полозюк, О. Журбенко. – К., 2007. – 138 с.*
Dostupnist do ob'ektiv zhitlovogo ta gromadskogo priznachennya dlya lyudey z osoblivimi potrebami invalidnistyu: metodichniy posibnik. / VGSPO «Natsionalna Asambleya invalidiv Ukrayini»: Ya. Gribalskiy, V. Kutsevich, K. Ivanova, O. Polozyuk, O. Zhurbenko. – K., 2007. – 138 s.
16. *Офіційний сайт Організації Об'єднаних Націй (ООН). [Електронний ресурс]. – Режим доступу: http://www.un.org.*
Ofitsiyniy sayt OON. [Electronic resource]. – Access mode: http://www.un.org.

Received 12.04.2016