Creation and Operation of Recreational Footpath System

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Abstract. The concept of "recreational footpath" is introduced as comfortable linear recreational facilities for mass pedestrian tourism, as element of path network of recreational areas. Proposals to improve the regulatory and methodological support for the creation and operation of a system of recreational footpaths have been developed. The definition of ecological footpath is proposed as a form of recreational footpath designed for eco-tourism. The classification of recreational footpath and their technical characteristics are proposed.

1. Introduction
Reproduction of labour resources of the population depends on the quality of recreational services. The development and rational use of the recreational potential of the territory of our country can improve the quality and volume of recreational services, which allows, on the one hand, to meet the needs of the population in recreational services, on the other hand, to develop the domestic recreational industry.

Recreational potential of the territory with rational and careful use is a renewable resource. However, sustainable development of recreational potential requires a science-based approach to the organization of its rational use and regeneration.

Rational improvement of the recreational area can reduce the negative anthropogenic impact of the flow of visitors to the natural environment. In the present work the part of complex improvement of the recreational territory \cite{2, section 9} – the system of recreational footpaths, including ecological paths for recreational and educational purposes is considered.

The aim of the work is to develop methodological approaches to ensuring standards and quality of service, including the implementation of the necessary requirements for human safety, on recreational footpath, as well as the preservation of the tourist and natural potential of the recreational area.

2. Materials and Methods
Various definitions of the concepts of "recreational footpath" and "ecological footpath" in the scientific and legal literature are considered.

Ecological footpath is a specially equipped route passing through various ecological systems and other natural objects, architectural monuments having aesthetic, nature protection and historical value, on which walking (walking, tourists, etc.) receive oral (with the help of a guide) or written (stands, notices, etc.) information about these objects. \cite{1}

Ecological footpath functions:
1. informative and educational (acquaintance with the local flora and fauna, the study of different ecosystems and identifying the ecological relationships between plants, animals and the environment;

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analysis of the impact of human activities on ecosystems; familiarity with scientific methods in the study of natural objects and the acquisition of skills of self-education and research;
2. developing (development of such cognitive processes as: attention, memory, thinking, perception, observation, creativity);
3. educational (development of ecological culture);
4. health-recreational (combination of mental work and physical activity with outdoor recreation).

Thus, both in its content and functions, the ecological footpath is a special object. It is designed to give the visitor new, interesting information about the natural or cultural environment for education in it "ecological" (i.e. careful) attitude to it. And the way to perform this dual task should be the assimilation of the necessary information in the process of moderate physical activity in the form of walking on rough natural or urban areas surrounded by favourable natural factors. I. e. information and education is carried out using the method of recreation – a system of restoring normal health and human performance. Moreover, if we are talking about the education of respect for the natural complexes of its territory, or nature in General, the best object for the creation of ecological footpath are recreational areas, i.e. areas adapted for recreation of the population whose ecosystem is protected by legal acts and preserved in kind, and therefore can serve as the most complete and visual aid for environmental education.

The other side of the ecological footpath is that it is an anthropogenic object. Even when it comes to urban routes, which represent the direction of movement on existing urban footpaths, they should be equipped with convenient viewing platforms, places of rest, facilities for sanitary stops, etc. The purpose of the investment is to make the object convenient for the function of showing the tourist. Actually, the footpath itself is a set of facilities for excursion activities – from convenient road surface to information stands, special devices for those who have health restrictions, etc.

The authors believe that where there are financial investments of the state or individuals there is always a question of social effect (mass character of visit) or economic profitability (self-sufficiency and even profitability) of the operated object. As a rule, if there are no special restrictions in the operation of the facility in the selected areas, issues of social and economic efficiency of investments in the field of environmental education are due to the creation of conditions for the implementation of multi-tasking, the created object. The more functions the equipment and environmental conditions of the ecological footpath will perform (from those listed above), the greater the social and/or economic impact will have its operation.

Apparently, the greatest number of tourists and visitors will be involved in the passage of the ecological footpath and the objects of its display, if initially it will perform the function of rest and entertainment, if its visit (of course, in compliance with all the requirements for careful and responsible behaviour in the process of finding it) will contribute to rest, distraction, recuperation, interesting pastime of different groups of the population and, especially, families with children. The creation of conditions for recreation "according to interests" for different age members of family groups in the process of visiting the ecological footpath can create conditions for its special popularity. Family education requires periodic stay of all family members on a joint vacation, in nature, the joint implementation of a common task in a useful environment for children and adults. If this is implemented in the process of visiting the ecological footpath, the latter in full accordance with its main function will carry out environmental education of the population in an interesting and healthy way.

Thus, the formation of the ecological footpath should be started as a recreational footpath – a footpath that attracts visitors by the method of rest and recovery, with its further improvement for environmental information and education. In this case, the creation of ecological footpath should be carried out in accordance with the requirements for the formation of recreational footpath.

Recreational footpaths are part of the system of improvement of recreational areas. The system of recreational footpath is advisable to design as part of the sections of improvement of recreational areas [2,3]. Depending on what areas have recreational footpath, different regulatory documents describing recreational footpath or similar concepts.

In the standard "eco-tourism" [4] given the definition:
"Ecotourist route: a tourist route developed in accordance with the program of the ecological tour, including visits to various natural landscapes and objects in order to maximize knowledge of nature and its preservation.

Ecological tourist footpath: equipped and specially protected ecotourist routes created for the purpose of environmental education of the population through the signs of tourist navigation installed along the route, for example information stands.

Note – as a rule, ecological footpaths are laid on the zones of organized tourism: national parks, landscape reserves."[4]

The definition of ecological footpath [4] mixes the concepts of ecological footpath and ecological route, which can lead to logical errors and requires clarification of the definition.

A footpath is a physical object (a narrow footpath trodden in a forest, in a field, etc.). A route is an information object (description of the object's line of motion from the start point to the end point).

Arrangement or improvement can be performed in relation to the physical object – footpath) - the device cover, fences, information stands, navigation signs and pointers, etc.

Several routes can be made along the same footpath. The route can pass sequentially along several footpaths.

A recreational footpath can be used as an ecological footpath if it is accompanied by environmental education and awareness-raising (for example, with the help of a guide and/or information stands).

In this paper we propose the definition of ecological footpath as a type of recreational footpath designed for eco-tourism (tourism to promote environmental protection, environmental education and upbringing).

Classification of recreational footpaths on the territory of the passage:

Urban design is regulated by SP 42.13330-2016 "SNiP 2.07.01-89* Urban development. Planning and development of urban and rural settlements" [2], section 9 "Recreational Areas. Areas of specially protected areas".

In a protected area governed by federal law 33-FZ "About specially protected natural territories" [5].

It is proposed to apply by analogy to recreational footpaths, their objects of visit and zones of influence federal law 73-FZ "About objects of cultural heritage" [6].

Approaches to the design of the recreational areas and the system of recreational footpaths it is recommended to use federal law 132-FZ "About bases of tourist activity in the Russian Federation" [7].

3. Recreational Footpath Definition and Characteristics

Recreational footpath is a well-arranged linear recreational facility for mass pedestrian recreational tourism. The ecological recreational footpath is a recreational footpath for mass pedestrian ecological tourism. The level and degree of improvement depends on the intensity of anthropogenic impact (pedestrian flows), the value of the visited area and the level of difficulty of the route.

This definition uses the terminology of geographic information systems (GIS). (Not to be confused with types of capital construction projects).

The length of recreational footpath is more than two orders of magnitude greater than its width, so a linear type of object is recommended to indicate recreational footpath. A linear object is an object whose length is more than an order of magnitude greater than its width. The length of recreational footpath is a more indicative characteristic than the area. Geographically, recreational footpath is characterized by the position of its axis and category (typical width and/or degree of improvement).

The ecological recreational footpath in most cases appear as a result of improvement of the existing trails passing on especially protected natural territories or territories with limited economic use (recreational territories) on which construction or economic activity is forbidden.

In this paper, the principles of formation of the ecological recreational footpaths are proposed:

The ecological recreational footpath is not an object of construction, does not allow the construction of foundations and artificial structures with foundations, does not allow the use of construction equipment in the process of improvement, except when their use allows you to save the environment and display objects.
The ecological recreational footpath is not intended for sports tourism, does not require special equipment or training.

The ecological recreational footpath is not an object of transport infrastructure. It prohibits the movement of all modes of transport. Only pedestrian traffic is allowed.

4. Proposals to Improve the Regulatory and Methodological Support for the Creation and Operation of Recreational Footpath System

It is proposed to create a Set of Rules «Recreational footpaths. Rules of design and improvement».

The purpose of recreational footpaths is to ensure the recreation of visitors (in the process of walking along the footpaths or the availability of recreants to the objects of visit or display).

The purpose of the design and improvement of recreational footpaths is to reduce the harmful anthropogenic impact on the environment and display objects in the conditions of increasing the pedestrian flow of visitors (recreants) along the recreational footpaths to the calculated intensity.

In the design, improvement and operation of recreational footpaths priority is the preservation of the natural environment, the preservation of display objects in the area of visual accessibility of recreational footpaths, as well as the preservation of recreational potential (attractiveness) of the recreational footpath and its visual accessibility zone.

Recreational footpaths should be designed as elements of the system of improvement of recreational areas. At the same time, the planning should be aimed at determining the designation of territories in the planning documents [8] based on the natural resource potential of the territory, the totality of social, economic, environmental and other factors in order to ensure sustainable development and rational use of recreational potential, taking into account the interests of citizens.

Recreational areas (objects of visit with recreational purposes) depending on the design capacity for the estimated period authors are divided into groups in accordance with table 1.

Table 1. Classification of recreational facilities by design capacity.

| Group Name | The design capacity of recreation area / object of visit (thousand people per year) |
|------------|---------------------------------------------------------------------------------|
| Largest    | Over 1000                                                                        |
| Large      | from 250 to 1000                                                                 |
| Big        | from 50 to 250                                                                   |
| Average    | from 10 to 50                                                                    |
| Small *    | from 1 to 10                                                                      |

* In the group of small objects included informal sites.

Group named analogically [2, table 4.1]. The design capacity is determined by the author by multiplying the flow of visitors to analogous objects by the duration of the peak season and the coefficient of annual unevenness.

The design capacity should be determined for the estimated period on the basis of data on the prospects of development of the object in the settlement system [9], taking into account the demographic forecast of natural and mechanical population growth in the transport accessibility zone (gravity zone). Prospects of development of the recreational territory shall be defined on the basis of schemes of territorial planning of municipal areas, master plans of settlements in coordination with formation of a recreational complex, and also taking into account placement of other objects of gravitation.

4.1. Recreational Footpath System

When planning the development of recreational areas, it is necessary to ensure a balanced development of the recreational area and the recreational footpath system. The recreational footpath network should be planned in the form of a single system in conjunction with the planning structure of
the recreational area, the placement of objects of visit, public transport stops and parking of individual transport, providing convenient and safe foot access to visitors to all areas of the recreational area, objects of visit, located in the recreational area from public transport stops and parking of individual transport. The structure of the recreational footpath network should provide the possibility of alternative routes in this direction.

The time spent by visitors for walking to the nearest place of rest (one way) should not exceed: for large and largest objects of visit – 30 minutes; for big – 45 minutes; for medium – 60 minutes; for small – 120 minutes.

The capacity of the recreational footpath network, the required number of parking spaces for cars of visitors to the recreational area should be determined based on the recreational capacity of the served recreational area.

The recreational footpath network should be designed as a continuous system taking into account the functional purpose of the footpath, the intensity of pedestrian traffic, the planning organization of the territory and the nature of the objects visited. In this paper, a classification of recreational footpaths by category (table 2), according to which it is proposed to allocate the main footpaths (walkways) and distribution footpaths as part of the recreational footpath network. Categories of recreational footpaths are proposed to be determined in accordance with their purpose in table 2.

Table 2. Classification of recreational footpaths by category.

| Recreational footpath category | The main purpose of the recreational footpath |
|-------------------------------|---------------------------------------------|
| The main walkway              | Pedestrian communication in the largest and large recreational areas from the exits to public transport stops, large Parking of individual transport on the borders of recreational areas to the main objects of visit and exits to the system of main and distribution recreational footpaths. It has a hard surface and a high level of improvement. |
| The main footpath             | Pedestrian communication in big and medium-sized recreational areas from the exits to public transport stops, large Parking of individual transport at the borders of recreational areas to the main objects of visit and exits to the system of distribution recreational footpaths. |
| Pedestrian communication in the largest and large recreational areas from the main walkways to secondary sites of visits and exits to the system of distribution recreational footpaths. It has a solid or transitional coating and high or medium level of improvement. |
| The distribution (local) footpath | Pedestrian communication in big and medium-sized recreational areas from the main footpaths to secondary sites of visit. |
| Pedestrian communication in the largest and large recreational areas from the main footpaths to secondary sites of visit. It has a transitional coating or uncoated, medium or low level of improvement. |

\* Depending on the size and planning structure of recreational areas, the volume of visits to these categories of recreational footpaths supplemented or used their incomplete composition.

\* In the conditions of reconstruction, as well as for complex or constrained conditions, it is allowed to apply the parameters of the recreational footpath one category below.

4.2. Technical characteristics of recreational footpaths

The design geometric parameters of recreational footpaths are proposed in table 3:

\( b \) – width of the pedestrian traffic lane,
\( n \) – number of lanes (total in two directions),
$i_{\text{max}}$ – maximum longitudinal gradient,

$j_{\text{max}}$ – maximum crossfall,

$B_{\text{min}}$ – minimum width of the pedestrian part.

**Table 3.** The design geometric parameters of recreational footpaths.

| Recreational footpath category | $b$ (m) | $n$ | $i_{\text{max}}$ (‰) | $j_{\text{max}}$ (‰) | $B_{\text{min}}$ (m) |
|-------------------------------|---------|-----|------------------------|------------------------|---------------------|
| The main walkway              | 0,75    | 4   | 80                     | 30                     | 3                   |
| The main footpath             | 0,75    | 2 – 4 | 120                   | 60                     | 1,5                 |
| The distribution (local) footpath | 0,75    | 1 – 2 | 120                   | 60                     | 0,75                |

*a SP 42.13330-2016 [2] p.9.16

*b The ratio of the width of the pedestrian part to the width of the pedestrian traffic lane

*c SP 42.13330-2016 [2] p.9.16 or table 11.6

*d Expert evaluation. Analogue in VSN 7-89 [10] p.1.8

*e Expert evaluation. Analogue in Recommendations for the design of city streets and roads [11], p.4.2, table 1

*f Expert evaluation. Analogue in SP 34.13330-2012 [12] p.5.4, table 5.3 with notes

*g In case of increasing the crossfall of the footpath more than 60 ‰, it is required to cut the shelf in the ground to the width of the footpath cover.

*h In rough or difficult terrain conditions, the longitudinal gradient may exceed 120 ‰ with steps (ladders).

Notes for Table 3 made by analogy [2, table 11.2]:

1. The width of the pedestrian paths is determined by calculation depending on the intensity of pedestrian traffic, the composition of disposed within the transverse profile of the elements of improvement (urns, benches, green spaces, etc.), taking into account sanitary and hygienic requirements and safety requirements of visitors.

2. The width of the pedestrian part of the footpath should be taken depending on the function of the footpath and the conditions of the footpath on the relief. When designing new footpath in an unoccupied area, it is recommended to take maximum widths. When designing footpath in cramped conditions or in difficult terrain conditions, smaller of the specified width values may be taken in order to reduce the amount of excavation or reduce damage to the natural environment. It is not allowed to increase the width of the footpath if it leads to a decrease in the recreational value of the territory, damage to specially protected natural areas or monuments of nature, history or culture.

3. In climatic sub-districts IA, IB and IG [13] the largest longitudinal and transverse slopes of the footpath should be reduced by 10‰.

4. The width of the pedestrian part of the footpath does not include the areas necessary for the placement of urns, benches, etc.

5. In cramped conditions of the design of footpath with parameters on one category below is allowed.

6. At direct adjunction of footpaths to vertical barriers, retaining walls or fencings it is necessary to increase their width not less than on 0,5 m (except the constrained conditions).

When creating a new recreational footpath and the lack of data on the intensity of pedestrian traffic recommended width – 1.5 m (2 lanes of pedestrian traffic). The geometric parameters of the recreational footpath are recommended to be determined taking into account the conditions of the footpath according to table 4.

**Table 4.** Conditions of recreational footpath.

| Parameter of the footpath | Conditions |
|--------------------------|------------|
|                          | free | limited | difficult |
| Footpath width (m)       | 1.5 – 3 | 0.75 – 1.5 | 0.75 |
| The slope of the terrain | less than 12 % | some areas with a slope of more than 12 % | more than 12 % |
If the slope of the terrain is more than 12% (limited or difficult conditions for laying the footpath), it is recommended to lay the footpath at an angle to the slope in order to reduce the longitudinal gradient of the footpath.

The longitudinal gradient of the recreational footpath, as a rule, corresponds to the slope of the existing terrain. When the longitudinal gradient of the footpath more than 12% arranged steps (stairs).

The crossfall of the footpath cover is recommended from 1 to 2%.

4.3. Capacity of recreational footpath

The capacity of the recreational footpath is the number of visitors per hour, which it can serve with the standard quality of service and without damage to the environment, display objects and elements of its improvement.

In this paper we propose as the normative parameters of the capacity of the pedestrian traffic lane on the recreational footpath (table 5). The capacity of recreational footpath is determined depending on the types of service received by the recreants during its visit (passing).

**Table 5.** Capacity of the pedestrian traffic lane on the recreational footpath, pers. / hour ².

| Type (mode) of service | Level of improvement |   |   |
|------------------------|----------------------|---|---|
|                        | low  | average | high |
| Pedestrian traffic in one direction without stopping | 150  | 225  | 300  |
| Pedestrian traffic in one direction with stops     | 100  | 150  | 200  |
| Pedestrian traffic in two directions                 | 50   | 75   | 100  |

² Expert evaluation. Analogue in Recommendations for the design of city streets and roads [11], p.4.30, table 9.

The high level of improvement of the recreational footpath: the width of the footpath 1.5 – 3 m, covering of the footpath is hard and smooth (eg, concrete).

The average level of improvement – the width of the footpath 0.75 m with a solid and smooth surface, or the width of the footpath 1.5 m with a transitional coating (loose non-wetting materials).

Low level of improvement – lack of coverage or transitional coverage with a width of 0.75 m footpath.

4.4. Improvement of recreational footpath

Improvement of recreational footpath is a set of measures to maintain the territory of the zone of anthropogenic impact of the recreational footpath, as well as the design and placement of elements of improvement aimed at ensuring and improving the comfort of visitors, maintaining and improving the sanitary [14] and aesthetic condition of the object.

The project of improvement of recreational footpath is a technical documentation on its territory (the area of anthropogenic influence), which determines the complex of measures on its improvement.

The level and degree of improvement depends on the intensity of anthropogenic impact (pedestrian flows), the value of the visited area and the level of danger of the route. The higher intensity of anthropogenic impact needs the higher level of improvement of recreational footpath.

Improvement elements include covering footpaths, platforms (mating) for recreation with benches, tables (perhaps sheds), fire pits or braziers, places for waste collection. Possible elements of landscape design and small architectural forms.

Types of coating:

1. Hard coating – concrete. It is required when the intensity of pedestrian traffic more than 50 people / hour.
2. Transitional coating – topping footpath by non-wetting the bulk material, increasing the ease of pedestrian traffic along the footpath (fine gravel). It is required when the intensity of pedestrian traffic more than 10 people / hour.

3. Uncoated – dirt footpath. When the intensity of pedestrian traffic is less than 10 people / hour.

Every 2 hours walk (after 5 km) landscaped areas for recreation and food, toilets, fireplaces, benches, tables, sheds, organized garbage collection.

If the length of the footpath is more than 20 km, then every 20 km places of overnight stay (camp site, camping) are provided.

Places of spending the night (camp site), public catering or trade are not elements of improvement of a recreational footpath, and are independent objects of design.

4.5. Safety of recreational footpath
The recreational footpath can take place in mountainous areas or near water bodies.

Fencing of the recreational footpath is required if it is necessary to prevent the visitor from leaving the footpath:
- if the footpath is bordered by a cliff, water body or other sources of increased danger,
- if it is required to prevent anthropogenic impact directly on the monument, nature, history or culture.

Water obstacles are overcome on the bridge (possibly rope or suspension). The operating organization carries out periodic inspection of safety of the bridge, if necessary carries out repair.

The footpath may not pass through ice or snow.

When snow falls, the hard surface is cleaned and the transition surface is closed to pedestrian traffic. The monitoring of the landscaping and safety of the recreational footpath have been attributed to the organization operating this footpath.

5. Conclusion
In the article introduced the concept of "recreational footpath" as comfortable linear recreational facilities for mass pedestrian tourism, as element of path network of recreational areas. Proposed definition of environmental footpath as a form of recreational footpath designed for eco-tourism. The classification of recreational footpath and their technical characteristics are proposed. Proposals to improve the regulatory and methodological support for the creation and operation of a system of recreational footpath have been developed.

The system of recreational footpaths is part of the improvement of recreational areas and is planned as part of the scheme of recreational resources in the region in accordance with the developed proposals.

Parameters of recreational footpath are determined by the recreational capacity of the served area (object of visit) and the calculated intensity of pedestrian traffic.

6. References
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