Building of clusters of energy-efficient roadside and road safety

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Abstract. Listed basic energy saving techniques by implementing them in the practice of design and construction roadside recreation cluster. When designing roadside clusters to the implementation of innovative energy-saving technologies and energy-efficient materials and designs. Particularly relevant these activities in remote areas of the North and East. The article discusses methods of saving for their implementation in the practice of design and construction of roadside clusters. The use of alternative sources of heating and energy supply enhances the competitive advantages of the projected cluster. At the design stage it is necessary to substantially upgrade the engineering services cluster objects, implementing innovations and applying the sources of heating and energy supply capable of replacing the traditional. It is recommended that the introduction of innovative measures for energy conservation include work on "the intellectualization of buildings" and for the automatic control of life support systems. Automated monitoring and management of all life-support systems of the cluster includes the control of separate elements of systems of life support objects. A significant effect of energy conservation will give the rational use of presence sensors, people (for temperature, lighting, operation of ventilation and air-conditioning and other comfort parameters of microclimate). The result of research is a study on the development of conceptual models for clusters of automobile tourism, the introduction of innovative measures for energy conservation in the design of objects in the cluster, introducing sources of heat and power can replace traditional (organic) sources, using modern energy efficient materials and designs.

1. Introduction

The objects of road service designed and developed in our country. It is not only the architectural facilities of technical purposes: petrol station, car wash, car maintenance center, garages, parking, transport hubs and bus stations. It is also architectural objects, the function of which is aimed at meeting the basic physical (rest, nutrition, sleep, medical care) and mental needs of the driver and passengers, to their service and relaxation. All that is usually called recreation. In the real design many of objects with technical and social amenities functions are combined in one or several closely spaced buildings. The totality of these objects are usually referred to as roadside complexes because of their multifunctionality and complexity. Including horizontal regional ties of roadside complexes with
territorial production complexes, and individual under consideration objects, obtain a new urban education - a roadside recreation and tourism cluster (PPH).

The Government of the Russian Federation from October 3rd, 2013 approved the program "Improving road safety in 2013 - 2020". The total funding of this program in the 2013 - 2020 years is about 36 000 million rubles, including from the federal budget over - 16 000 million rubles. These funds should be focused on applied research and experimental development performed under the contracts, as well as to conduct research, development and engineering works on the improvement of road infrastructure and road safety. Construction of roadside recreational clusters (CPR) is an important aspect of the implementation of the program - "Improving road safety in 2013 - 2020".

2. The concept of roadside recreational-tourism cluster

Creating a cluster ensures:
1) providing emergency medical assistance to victims (various accident).
2) provision of emergency measures in case of emergency situations and elimination of consequences of natural disasters (snow drifts highways, hypothermia, overheating)
3) rapid response of a police officers on the criminal situation on the roads,
4) legal advice on a variety of difficult situations on the road,
5) a quick meeting with an attorney, the agent of the insurance company, lawyer and appraiser.

The Option of hypothetical model roadside cluster, see on Figure 1. The system approach in the design of roadside cluster is to apply to the development of the territory from the point of building it on the highest possible density of activity and the maximum long value chain. Such clusters are generally referred to as synergistic or diversified, they crossed a lot of technological chains, activities and areas of expertise. These chains should support each other.
Only in this case turns out not simply the sum of the direct by adding them but some progression. «These clusters are called innovation, we are dealing with technological innovations, woven into the traditional production chain, as well as to the economy of knowledge», [1,2,19].

The policy decision "Improving road safety in 2013 - 2020 years" stated: "... Recommend executive authorities of the Russian Federation while adopting in the 2013 - 2020 years of regional programs aimed at improving road safety, take into account the provisions of the program approved this Resolution ... 'This will make the executive authorities of subjects of the Russian Federation to begin work on the creation of clusters of CPR. Architectural clustering CPR will benefit road safety on the roads of Russia.

The basis of the methodology for the design of roadside recreational facilities in the related aggregate in the form of clusters, is a systematic approach and the development of the architectural typology of buildings, [6,9,10]. Cluster CPR is seen as a dynamic open system, which includes a set of the following subsystems: landscape and urban environment CPR, structural-functional zones of CPR territory, the architecture of individual buildings and structures belonging to the CPR. All these subsystems make up the levels of the object necessary for its typological study. «It must be remembered that the CPR is a single territorial and compositional unit, analyzed by the typological and architectural requirement» [4,5].

When organize the CPR Roadside space it divided into three main zones:
Zone - 1 traffic artery area, communication area;
Zone - 2 vehicle service area and transport communication;
Zone - 3 service area of roadside recreational facilities, objects of a relaxation and other facilities required for the cluster CPR functional purpose (see Figure 2.).

\[
P_{sr} = \sum_{i=1}^{n} P_i
\]

The main architectural elements that make up a cluster of CPR: buildings and structures (basic infrastructure), developed territory, natural landscape, small architectural forms, the synthesis of the decorative arts, lighting design. The attractiveness of a cluster of CPR or the main consumer properties are closely connected not only with the level of service and comfort of the buildings but also with roadside landscape and the level of its potential.

Overall capacity of the cluster environment – Rsr (its main consumer properties) are made up of individual "elementary" Pi potential environment where - a single "elementary" potential of the medium should be assessed taking into account the forecast of its change.

"Elementary" components of building components CPR environment are the following capabilities of the region or place: environmental, climatic, social, cultural, historical and economic, aesthetic.
The overall level of the recreational potential of the medium CPR Rsr (its main recreational properties) are made up of individual "elementary" recreational potential factors.

\[ R_{sr} = \sum_{i=1}^{n} R_i \]  

(2)

Where \( R_i \) – is a single "elementary" factor influencing the recreational potential of the medium taking into account the forecast of its change.

"Elementary" components of recreational potential factors CPR cluster environment are the following features of the region or place:

transport communications and sustainable linkages, availability of beds or leisure travelers, the security level of the communication link and the reliability of the object, ecological and climatic features of the region at the moment, social, cultural and historical feature of the region at the moment, as well as the aesthetic perception of the environment and economic level of development of the region.

In determining the potential level using a scale of 0-10 points. Total (total) score is selected by points dialed.

Main zones when placing the CPR cluster objects along functional and ecological range of factors that affect the planning of the PPH and their relation to transport communications:

A1 - communication zone – zone of artery traffic - \((R1)\);

A2 - vehicle service area and transport communication - \((R2 = R1 + 50m)\), Where the vehicle maintenance facilities (stations, petrol stations, etc.) and space for emergency and temporary parking of vehicles, for construction of the protection from the adverse environmental impacts of transport and sanitary-protective planting of trees and shrubs;

A3 - area roadside recreational facilities \((R3 = R2 + 50)\), where the objects of prime necessity: power facilities, temporary accommodation, medical facilities ambulance; Area recreational activities \((R3 = R2 + 100)\), where the object of increased living comfort traveling, sports and recreation facilities, objects of relaxation and other objects cluster CPR on a functional purpose;

A4 -zone impact of transport communications \((R4 = R3 + K1x50km.)\), Where all the residential and industrial formation fall under the maintenance of the highway;

K1 - regional coefficient received from 0.1 to 10, in inverse proportion to the physical density of the population (FPN). For the Far Eastern and East Siberian region \(K1 = 7\), for the central and north-western region of K1 ranges from 0.1 to 1.0. - See table. 1.

An important aspect of the design and operation of PPH is the demographic situation of the region. Physical population density of Russia's federal districts varies from 1.2 to 410.3 persons / Sq km.

3. Physical population density (FPN) of the RF economic regions

| No | Name economic areas | Area, thous. km² | Population, million people. | Percent RF territory | Article II. | FPN | Article III. | K1 |
|----|---------------------|-----------------|-----------------------------|---------------------|------------|-----|--------------|----|
| 1  | Northwestern        | 21.2            | 8.7                         | 0.18                | 410.3      | 0.1-1.0 |              |    |
| 2  | Center              | 485.0           | 30.0                        | 3.1                 | 61.8       | 0.1-1.0 |              |    |
| 3  | Volgo-              | 265.4           | 8.5                         | 1.6                 | 32.0       | 0.2-5.2 |              |    |
| 4  | Vyatskyi            | 167.7           | 7.8                         | 1.1                 | 46.5       | 0.3-1.8 |              |    |
| 5  | Center              | 335.1           | 17.6                        | 2.0                 | 52.5       | 2.0-7.0 |              |    |
| 6  | Chernozemnyy        | 536.6           | 17.0                        | 3.3                 | 31.7       | 0.2-5.0 |              |    |
| 7  | North aucasus       | 824.0           | 20.5                        | 4.9                 | 24.6       | 0.1-4.0 |              |    |
| 8  | Povolzhskiy         | 2.4             | 15.5                        | 14.1                | 6.5        | 5.0-8.5 |              |    |
| 9  | Uralian             | 4122.8          | 9.2                         | 24.1                | 2.2        | 7.0-10  |              |    |
| 10 | West Siberian       | 6215.9          | 7.5                         | 36.4                | 1.2        | 8.0-10  |              |    |
Note - for trunk highways 1st categories K1 have to take on the larger value.

Based on the selection of a tourist cluster features can transform a typical cluster structure, described by M. Porter, in a structure that takes into account the existing tourist resources and their disposition, specialized infrastructure and the location of its elements. Architectural elements of the regional recreational CPR and matrix optimization of architectural elements of the regional CPR are shown in Figure 3.

![Diagram](image)

**Figure 3.** Arrangement of interaction of the environment cluster and cluster management.

4. Energy efficiency and conservation of CPR

The perimeter residential quarter is a significant obstacle to air flows at the meso level. A closed perimeter with narrow aeration streets (the space between the ends of buildings) causes considerable turbulence in the flows at a high speed, which provides protection against strong winds carrying sand and dust from deserts. Ricci A., Kalkman I. M., Blocken B., Repetto M. P., Burlando M., & Freda A. demonstrated that at lower heights the wind profiles are strongly modified by the buildings, and the different degrees of precision of their geometry turn out to have a large effect on the flow, especially inside the narrow street and canal [2]. The proportions of the aeration streets allow a limited amount of air mass to pass only when their longitudinal axis coincides with the approximate direction of the wind. An angle of approximately 90 degrees between the horizontal airflow vector and the horizontal axis of the aeration street creates a detached flow at the corner of the building with jet-boundary breaks outside the perimeter and along the contour of the block. This ensures the local formation of several streams in the entrance space to the aeration street and high turbulence of these flows, which prevents the penetration of air masses deeper into the aeration street and the courtyard. The described aerodynamic effects allow creating a comfortable environment in the building with different wind directions.

The sides of the perimeter building are parallel and perpendicular to the vector of the wind before building in the winter and summer periods. Therefore, the amount of air flowing through the aeration streets between the buildings (Figure 1) of the building sides 1 and 2 is much larger than through the
spaces between the buildings on the sides 3 and 4 of the building. Perimeter density (according to Ratter) and wind speed in the yard will be overestimated.

When designing the cluster must introduce the innovative of energy-saving technologies and energy-efficient materials and designs.

Particularly relevant in the design of these activities objects cluster in the remote areas of the north and east of the RF energy conservation methods for their implementation in practice of designing and constructing the CPR is following:

1. Saving energy using rational planning decisions on the location of CPR facilities taking into account climatic conditions of the region.
2. Energy conservation by applying rational space-planning and designs of objects CPR, considering the climatic characteristics of the region.
3. Energy savings for buildings and CPR using modern technology, including the use of renewable energy sources.
4. The use of automated systems engineering management and energy-saving equipment at the facilities of CPR.
5. Efficient use of materials and structures for buildings and CPR.

Using objects on the territory of CPR innovative sources of heat and power will improve the competitive edge of the cluster project. At the design stage there should be some substantially updated engineering services cluster of objects, introducing innovations and applying heat and power sources capable of replacing traditional.

The use of solar collectors, photovoltaic panels, wind turbines, power generators of sea and river currents, waves, tides provides not only energy-efficient solution, but also creates new architectural dominant among the objects projected cluster, which also increases the interest of the sleeper to the data objects.

Additional energy can be obtained from:
- the ground heat exchangers;
- 2) low-grade geothermal heat;
- 3) thermal energy from low-grade sources;
- 4) sewage (industrial) runoff;
- 5) natural and artificial reservoirs;
- 6) outside air, as well as other non-traditional sources of heat and power, biofuels, fuel cells, etc.

Innovative measures to conserve energy include work on "intelligence building" and automatic control of building management.

Automated monitoring and control of all building management includes the control of the individual elements of the building life support systems with: room controllers; thermostatic valves (without setting room controllers); ambient light sensor; carbon dioxide concentration sensor; occupancy sensors.

5. Conclusions
It should be noted that the interest in the development of caravanning has increased significantly in many countries. There has been significant growth of automobile tourism in the European and Asian continent. Annual car sales continue to rise, the level of car ownership in Russia by 2020 will reach 400 cars per 1000 inhabitants. For the owners of the vehicles create conditions for travelling and move around the territory of the Russian Federation, which connects the two continents of Europe and Asia.

"On the territory of Russia enough attractors create conditions for the organization and development of roadside clusters" [7,8,9,16].

Statistical reports reflect the positive dynamics of development of automobile tourism and an increasing interest in it among our and foreign citizens. This is facilitated by motorization, as well as the state interest in caravanning, as evidenced by a dedicated part of the Federal Target Program "Development of domestic tourism in the Russian Federation (2011-2020)" the structuring direction - the formation of CPR on highways in Russia. «All of this confirms the need for the design and
construction of clusters in a roadside environment» [10,11,12]. When designing the cluster must be the introduction of innovative energy-saving technologies and energy-efficient materials and designs. Particularly relevant in the design of these activities objects cluster in the remote areas of the Russian North and the East. «You must use the latest energy-saving methods in the practice of designing and constructing the CPR» [20, 21].

The above determines the relevance of the chosen topic, and requires the development of conceptual models for clusters of automobile tourism. It is also necessary to clarify used in theory and practice, conceptual, terminological and methodological apparatus, justify approaches to the definition of automobile tourism's contribution to the economy of destinations and tourist areas of the region.

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