

12th International Conference "Organization and Traffic Safety Management in Large Cities",  
SPbOTSIC-2016, 28-30 September 2016, St. Petersburg, Russia

## Criteria for Substantiation of Rational Pavement Design as Bases of Traffic Safety throughout Life Cycle of Transport Structures

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### Abstract

Presently used conventional Russian pavements including macadam base asphalt covering loses its advantages under the current conditions of heavy and high traffic. In this regard, for the development of the country's economy and transport infrastructure, a rational pavement design is developed, which is presented in rigid fragmented asphalt bedding course. It provides high homogeneity and uniform strength of coating with low variation factors resulting in increase of the pavement life time and service life. The rational pavement design with a fragmented base layer compared to the conventional one has a higher resistance to formation of ruts and cracks that improves safety and reduces the risk of an accident.

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Peer-review under responsibility of the organizing committee of the 12th International Conference "Organization and Traffic Safety Management in large cities"

*Keywords:* Reliability, cement concrete, thin asphalt concrete layer, fragmented concrete bedding course, combined structures, crack strength, ruts resistance, smoothness, life time, traffic safety.

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### 1. Introduction

Currently, the highway system of the Russian Federation and its production facilities are in the state that does not actually meet the economic, social and defense requirements [Shumeyko (2007)].

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Outdated technical policy focused only on flexible pavement, inappropriate outdated regulatory structure, single use of old pavement designs in the form of multi-layer asphalt concrete pavement with their growing "incomplete repair" due to low service time restraint the transition to new functional-process solutions. In addition, modern equipment (plants to construct concrete roads) is not available as well as the road concrete production base, experience and highly qualified construction personnel were lost. Therefore there is a major lag behind the developed countries in terms of effective design solutions and modern cement-and-concrete production technologies.

Asphalt concrete pavement with a low-quality bitumen based on basement of macadam, was widely spread thanks to many years experience and the positive technical characteristics in the conditions of light, low-intensity traffic but they are losing their advantages in view of nowadays traffic and heavy conditions.

The solution of modern road network problems includes the pavements construction with the use of cement concrete in its structures. This is confirmed by the world experience which analysis makes it clear that the cement concrete is universal and often more cost-efficient material in comparison with the conventional asphalt. In addition, actual service life of the concrete coating corresponds to the calculated figures (20-25 years), or exceeds them, whereas for asphalt concrete the service life is only 5-8, according to the FSBI Russian Roads R&D Establishment (RosDorNII) and even less according to the Federal Road Agency, while the estimated period is 12-18 years [Federal Road Agency (2016)].

All developed countries without exception have an extensive network of roads with concrete coating and basements, and continue to construct them in significant scopes. For example, in Western Europe countries and in the USA roads network with concrete coating and basement vary from 30 to 40% of the total road network length (in Russia less than 2%) [Federal Road Agency (2016)]. Such Federal highways ensure reliable and year-round connection between the major urban conglomerates. Therefore users of the transport routes are able to quickly and safely move around the entire territory of the country, and road control authorities are able to direct funds allocated by the Government not only to maintain roads in proper operating condition, but also to develop the system.

Intensive economic development of our country requires durable high-quality network of roads and cement concrete pavements shall be used in construction thereof. This idea is supported by a variety of publications in various sources [Shumeyko (2007), Nosov (2011)], including, the shorthand report of the meeting of the State Council Presidium on the improvement of the road network, which was held in Novosibirsk on 10.08.2014 [President of the Russian Federation (2016)].

As is known, the task of doubling the volume of construction and reconstruction of public roads in the Russian Federation will increase the number of cement-concrete roads significantly by 2022. However, in view of all the realities of the present time, namely the double-quick increase in the intensity and freight traffic density on the roads; taking into account individual advantages and disadvantages of asphalt concrete and cement concrete, urgent task now is to develop a new combined economical and efficient road clothes with the use of these two materials, and to research and study methods of design, calculation and construction thereof.

In a broad sense, the concept is conditioned by the need to create a high bearing capacity layer, capable of carrying heavy loads and neutralize the pressure on the basement. To maintain the structure uniformity and to control cracking it is expedient to transit on fragmented carrier layers of concrete blocks of efficient dimensions and shapes tied into a single layer.

Paper objective: to explain use of road clothes of unconventional design and technological solutions in concrete load-bearing layers in the form of fragmentation reached by cuts and fractures (including seams and joints) to control the stress-strain state (SSS) of the structure and to reduce influence transport and natural factors dynamic impact.

The developed design of road pavement is efficient for use in all regions of the world: in northern latitudes (prefabricated option that allows performing continuous and year-round works of pavements construction, since it is possible to use the basement as a standalone coating for the time of structure stabilization (settlement) or until a season of construction of asphalt concrete coatings); in southern latitudes (significant reduction of wheel tracking and cracking by reducing accumulation of residual deformations in the currently used thick layers of asphalt).

Use of combined structures with concrete load-bearing layers, fragmented cuts, fractures, reduce the cost of motor roads at the stages of design, construction and operation, therefore lifetime of road of pavements and traffic safety will improve (number of road accidents – an accident will reduce). High stability and strength properties, reduction

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