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POST-WAR RECONSTRUCTION OF UKRAINIAN ROADS: SEARCH FOR EFFECTIVE SOLUTIONS

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Problem statement. The post-war restoration and development of the road network, an important component of the country's transport infrastructure, is a prerequisite for the functioning and development of economic sectors and Ukraine's integration into the European Union.

Rebuilding Ukraine's infrastructure is a complex process that requires the best international practices and international investment. Studying the experience of post-war reconstruction in European countries will help in planning these measures.

Analysis of previous studies. Paper [1] discusses the stages of technology development, opportunities, and programs for construction information modeling. Works [2; 3] propose methods of construction information modeling (BIM technologies) in the design and reconstruction of road infrastructure facilities.

The purpose of the study is to review the problem of post-war road reconstruction and find effective design methods.

Presentation of the basic material. The National Recovery Plan [4], presented by the Government of Ukraine at a conference in Lugano on July 4−5, 2022, can be described as a comprehensive document that reflects the main directions of post-war economic recovery and provides a set of initiatives and measures, including changes in legislation.

Ukraine's recovery plan consists of 15 national programs that address the country's main needs in both the wartime and postwar periods. The national

programs are compared to the relevant reconstruction programs of Bosnia and Herzegovina (1997). Among other things, according to the program, the plan for the post-war reconstruction of transport routes of international and national importance is a priority for Ukraine.

According to [5], the length of Ukrainian roads of international importance (I index) is 1 436,2 km, national roads (N index) – 7 177 km, regional roads – 9 046,9 km, and territorial roads (T index) – 21 178,4 km. The total length of roads of national importance in Ukraine is 46 733,4 km. The Plan [4] is part of the National Program for the Reconstruction of Ukraine. Document shows the approximate length of damaged roads as a result of hostilities [6].

Table

Damage to Ukrainian roads as a result of hostilities

Region	Length of roads, km	Index
Kyiv	14 023,3	I / N /R / T
Chernihiv	1 512,0	I / N / R
Sumy	1 584,6	I / N
Poltava	63,0	M
Donetsk	2 695,2	I / N / R / T
Luhansk	2 959,4	I / N / R / T
Kherson	3 940,0	I / N / T
Mykolaiv	1 809,4	I / N / P
Zaporizhzhya	3 872,3	I / N / T
Dnipropetrovska	75,0	I
Kharkiv	3 890,8	I / N / R / T
Odesa	0,256	I
Total	3 6474,5	

The table was compiled by the authors based on an interactive map of Ukraine showing the destruction as of March 1, 2023.

According to [6], more than 36 thousand kilometers of the road network need to be rebuilt, which will accelerate the restoration of civil and industrial facilities, engineering infrastructure, and ensure the connection of settlements with district and regional centers, as well as the delivery of humanitarian aid and other goods. The restoration and development of the road network should be implemented with due regard for the state's priorities to ensure its defense capability and regional development, increase in traffic intensity and integration of the Ukrainian road network into the European one, introduction of modern technologies and road safety requirements to promote the development of the Ukrainian economy [7].

To solve this problem, it is first and foremost necessary to conduct surveys and engineering surveys of roads, including those damaged as a result of hostilities, in order to determine the necessary scope of reconstruction work to ensure the smooth functioning of the road network in the near future and to obtain baseline data for planning further activities and design work, and to form a unified information base of road conditions.

The use of computer-aided design systems can increase the productivity of the road design process, the quality and reliability of design solutions. The integrated use of computer-aided design programs and geographic information systems will allow to implement the principle of variant design and choose the most rational solutions according to the established criteria.

Changing design approaches will improve road safety, reduce the number of road accidents and the severity of their consequences.

It is proposed to implement the best international practices in the design and construction of roads. Experience shows that construction information modeling technology (BIM technology) is effective, and the concept of its implementation has been approved by the Cabinet of Ministers of Ukraine [8]. This requires, among other things, research activities to systematize experience, forecast and evaluate results, study programs and train specialists, and develop relevant standards and regulations. Construction information modeling technology involves the development and use of a digital three-dimensional model of road infrastructure (virtual prototype) as an integrated information system or a separate engineering structure that reflects the geometric, physical and functional parameters of the object, on the basis of which working and executive documentation can be developed for the relevant life cycles of the object - during design, construction, rehabilitation (overhaul, reconstruction) and operation.

Conclusions. The search for effective solutions in the post-war reconstruction of Ukrainian roads lies in the application of construction information modeling technologies at the design stage. This will significantly improve the quality of projects and, accordingly, the quality and speed of reconstruction.

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