

Using of geosynthetic reinforcing interlayer in road construction

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Abstract. The relevance of this work stems from the need to improve the durability and reliability of road surfaces, which are subject to intense loads, particularly from heavy vehicles, leading to the development of deformations and damage, such as cracks. This necessitates the use of reinforcement for road structure layers. The aim of this study was to determine the most effective placement of a reinforcing geosynthetic layer in the road structure to reduce the stress-strain state and increase its load-bearing capacity. Analytical methods were used for the calculations, as well as finite element numerical modelling to study the stress distribution in the layers for different reinforcing layer placement patterns. Numerical modelling revealed that geogrid reinforcement significantly reduces tensile stress in the road surface layers. The most effective placement of the geogrid is between the second and third layers of the road pavement, which, despite its primary purpose of preventing crack propagation, significantly reduces tensile stresses. The study showed that this arrangement reduces tensile stresses from 1,207 Pa to 1,011.6 Pa, representing a 20% decrease. At the same time, the use of the geogrid in the first layer increases shear stresses by 2.9%, and between the first and second layers, tensile stresses increase by almost 5%. However, overall, geosynthetics enhance the strength and durability of road pavements. Analysis of the resulting graphs confirmed that the optimal placement of the reinforcing layer corresponds precisely to the maximum tensile stress concentration, which improves structural strength, reduces deformation, and extends the service life of the pavement. The practical value of this work lies in the formulation of sound recommendations for the design of reinforced pavements, which will minimise material consumption and extend the service life of highways

Keywords: asphalt coating; reinforcement; geogrid; bonding; stress concentration; stress-strain state; cracks

Introduction

The strength and durability of the pavement structure are largely determined by the intensity of traffic loads and the influence of climatic conditions. The rapid increase in the number of heavy-duty vehicles on roads leads to

higher axle loads on the pavement and contributes to the development of deformations and distress in asphalt concrete surfaces, as noted by M. Wismans *et al.* (2024) and P. Li *et al.* (2025). The works of S.A. Baran *et al.* (2021) and

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A. Raffaniello *et al.* (2022) stated, that the most common types of pavement deformations and distresses include the formation of transverse and longitudinal cracks caused by extreme tensile stresses at low sub-zero temperatures, under conditions that prevent free contraction of the upper layers. To mitigate this effect, apply transverse thermal (unloading) joints and reinforcement (longitudinal, meshes, etc.) are incorporated into the pavement structure, as emphasised by V.I. Gulyayev *et al.* (2022). Geosynthetics have recently become increasingly popular in road construction. Carbon, boron, glass, organic, ceramic, metallic, and other materials can be used as fibres. Reinforcing elements also come in various forms, including tapes, threads, strands, and meshes. Of significant practical interest is not only the selection of geosynthetic material parameters but also the placement of the reinforcing mesh to strengthen the road structure and reduce tensile stresses localised in areas adjacent to the zone of application of external distributed pressure. Therefore, it is relevant and advisable to study the integration of geosynthetics into road pavement structures, their impact on the overall strength of road structures, and the determination of the optimal geogrid placement to reduce stress and strain concentrators and increase the durability of the system.

The use of geotextile materials in the construction of road pavements and subgrades has increasingly become the subject of both international and domestic research publications. In particular, the following forms of geosynthetics for road pavements are considered: geotextiles, geogrids, geocomposites, geo-elements, geopins, and geobags (Alimohammadi *et al.*, 2020; Al-Barqawi *et al.*, 2021). Z. Yin *et al.* (2022) presented a numerical study of a geotextile-reinforced flexible pavement under static loading to evaluate the improvement due to reinforcement based on three criteria: rutting performance, placement of geosynthetic materials, and reduction in the thickness of the base layer. V.M. Pershakov *et al.* (2020) conducted an analysis of theoretical and experimental data concerning the reinforcing functions of geosynthetic interlayers and their functional interaction with other layers within the pavement structure. The study by S. Banerjee *et al.* (2024) presented the results of full-scale model tests and numerical analyses of reinforced and unreinforced pavement sections. The inclusion of geocell elements within the base layer demonstrated a significant reduction in both residual deformation and subgrade stress concentration compared with unreinforced sections across all pavement configurations. Based on the finite element method, the

study by M. Huang *et al.* (2025) analysed the effect of a stress-absorbing layer on the durability of semi-rigid asphalt pavement. Thus, the analysis of recent studies and publications has demonstrated that the use of geosynthetic materials in pavement design enhances drainage properties and provides a reinforcing effect, thereby slowing down the process of crack formation. In this regard, it is highly advisable to continue research on the application of geosynthetic reinforcing layers in road construction. This study sought to identify the optimal location of a geosynthetic reinforcement layer within a pavement structure in order to minimise stress-strain responses and enhance its load-bearing performance.

Materials and Methods

To study the effect of geogrid reinforcement on the stress-strain state of the road surface, the finite element method was used. The use of numerical modelling was justified by the need to accurately reproduce the layered structure of the road and the conditions of interaction between the layers and the reinforcing element to identify zones of maximum tensile stress. Analytical methods for deriving elastic equilibrium equations and boundary conditions were additionally used. For the finite element analysis of these issues, a layered pavement structure was selected, the schematic of which is shown in Figure 1.

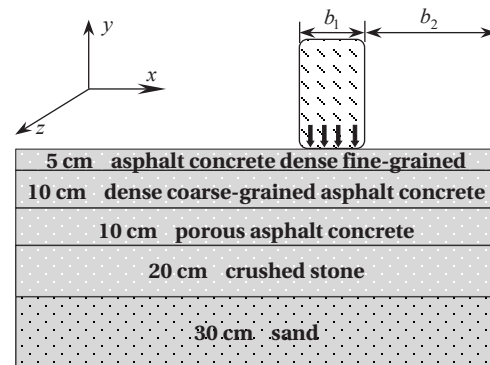


Figure 1. Structural diagram of the road surface
Source: developed by the authors

Figure 1 showed the structural layout of the road surface, illustrating the various layers of materials used in the pavement structure, including asphalt concrete, dense coarse-grained asphalt concrete, porous asphalt concrete, crushed stone, and sand. The values of the structural and mechanical parameters of the system are presented in Table 1.

Table 1. The value of the structural and mechanical parameters of the system

Number <i>i</i> layer	h_i , (m)	E_p , (Pa)	ν
I layer	0.05	$5 \cdot 10^9$	0.2
II layer	0.1	$1.4 \cdot 10^9$	0.25
III layer	0.2	$0.1 \cdot 10^9$	0.3
IV layer	0.2	$0.1 \cdot 10^9$	0.3
V layer	0.3	$0.1 \cdot 10^9$	0.35
Geogrid	0.003	$1.4 \cdot 10^{10}$	0.25

Source: developed by the authors

The data presented in Table 1 indicate a multilayer pavement structure characterised by a gradual decrease in elastic modulus from the upper layer ($5 \cdot 10^9$ Pa) to the lower layers ($0.1 \cdot 10^9$ Pa), ensuring effective stress distribution with depth. The geogrid, despite its small thickness (0.003 m), exhibits a significantly higher modulus of elasticity ($1.4 \cdot 10^{10}$ Pa), confirming its high tensile stiffness and reinforcing potential within the system. A two-dimensional formulation of the problem is considered, in which a vertical load with an intensity of $p = 1,000$ Pa is distributed over a section with a width of $b_1 = 0.48$ m (tire contact patch width), located at a distance of $b_2 = 0.96$ m from the edge of the road. It is assumed that the road structure consists of four layers resting on a soil foundation. Within each segment of the road, the equations of elastic equilibrium are satisfied:

$$\begin{aligned} \frac{\partial \sigma_x}{\partial x} + \frac{\partial \tau_{xy}}{\partial y} + \frac{\partial \tau_{xz}}{\partial z} &= 0, \\ \frac{\partial \tau_{yz}}{\partial x} + \frac{\partial \sigma_y}{\partial y} + \frac{\partial \tau_{yz}}{\partial z} &= 0, \\ \frac{\partial \tau_{zx}}{\partial x} + \frac{\partial \tau_{zy}}{\partial y} + \frac{\partial \sigma_z}{\partial z} &= 0, \end{aligned} \tag{1}$$

where $\sigma_x, \sigma_y, \sigma_z$ are the corresponding normal stresses, and $\tau_{xy}, \tau_{yz}, \tau_{zx}$ are the shear stresses, calculated from the following equations:

$$\begin{aligned} \sigma_i &= \lambda \Delta + 2G \varepsilon_i, \\ \tau_{ij} &= \tau_{ji} = G \gamma_{ij} = G \gamma_{ji}. \end{aligned} \tag{2}$$

The Lamé constants λ and G are expressed through the modulus of elasticity E and Poisson's ratio ν by the following formulas:

$$\begin{aligned} \lambda &= \frac{\mu E}{(1 + \mu)(1 - 2\mu)}, \\ G &= \frac{E}{2(1 + \mu)}. \end{aligned} \tag{3}$$

The symbols used in equations (2) are defined by the following expressions:

$$\begin{aligned} \Delta &= \frac{\partial u_x}{\partial x} + \frac{\partial u_y}{\partial y} + \frac{\partial u_z}{\partial z}, \\ \gamma_{ij} &= \frac{\partial u_i}{\partial i} + \frac{\partial u_j}{\partial j}, \\ \varepsilon_i &= \frac{\partial u_i}{\partial i}, \end{aligned} \tag{4}$$

where $i, j = x, y, z$.

The boundary conditions of zero normal and shear stresses specified on the free surfaces of the first layer and the soil mass are expressed as follows:

$$\begin{aligned} \sigma_y &= 0, \\ \tau_{yx} &= \tau_{yz} = 0. \end{aligned} \tag{5}$$

Within the contact interaction, the stress σ_y is equal to the tire pressure p , therefore:

$$\sigma_y = -p. \tag{6}$$

The displacement continuity conditions at the interfaces of adjacent layers, as well as between

the fourth layer and the soil foundation, are expressed as follows:

$$\begin{aligned} u_{i-1} &= u_i, v_{i-1} = v_i, \\ w_{i-1} &= w_i \quad (i = 2, 3, \dots, 5). \end{aligned} \tag{7}$$

The finite element method was used to solve the problem. The layered system selected for the calculations was divided into three-dimensional finite elements, and the system of differential equations was replaced by a system of algebraic finite element equations formed taking into account the boundary conditions (5)-(7):

$$[K_u]\{u\} = \{q\}, \tag{8}$$

where $[K_u]$ is the stiffness matrix of the finite element model of the entire elastic body, $\{u\}$ is the vector of nodal displacements, and $\{q\}$ is the load vector.

The validity of the model is confirmed through experimental results from laboratory and in-situ testing, with findings from M.R. Sharbaf & N. Ghafouri (2021) and M. Zakarka *et al.* (2023) providing strong corroboration of the theoretical predictions regarding the reinforcing effectiveness of geogrids. It is assumed that the structural configuration of the geogrid consists of square cells formed by fibres whose modulus of elasticity and strength significantly exceed those of the materials in the pavement layers. It is also assumed that the cell dimensions are much smaller than the characteristic dimensions of the layers. Therefore, for the purpose of a qualitative analysis of the problem, the geogrid can be approximately modelled as a continuous thin elastic layer whose averaged modulus of elasticity and strength correspond to the averaged mechanical properties of the actual geogrid. By placing this equivalent layer at different positions within the layered structure, the mechanical behaviour of the reinforced pavement under a given load can be studied. For this analysis, a geogrid was selected with averaged parameter values listed in Table 1. During the simulations, the geogrid was placed within and between the upper layers, and the configuration that resulted in the minimum tensile stress at the bottom of the second layer was determined. The finite element model of the system consists of 213,236 finite elements and 319,137 nodes.

Results and Discussion

In practice, reinforcing layers in the form of synthetic materials, so-called geogrids, are used for reinforcement. They are intended for reinforcing the road base, as a bearing layer for sections located on weak soils (Fig. 2). Their correct use turns the coating into a durable, stable structure and helps to redistribute stresses in the soil mass. Figure 2 demonstrates how the geogrid, placed beneath the crushed stone layer, helps redistribute stresses in the soil, thereby enhancing the stability and durability of the road, particularly when constructed on weak soils. Geosynthetics have been used in road construction in France since the 1960s and became more widely used in the 1980s in the United States, Canada, Israel,

Belgium, Spain, the Czech Republic and Germany (Giroud *et al.*, 1985). They are consistently used in road construction in Ukraine. The use of geosynthetic materials in severely cracked road surfaces improves drainage properties and has a reinforcing effect, slowing down the crack formation process (Gaidaichuk *et al.*, 2021; Gulyayev *et al.*, 2022). Geogrid is a type of synthetic material that is heat-resistant, frost-resistant, elastic, and resistant to mechanical damage. Polyester, polypropylene, fiberglass, and high-grade polyethylene are used for its production. Geogrid modules are stacked on top of each other, and the niches are filled with crushed stone or sand with layer-by-layer compaction, after which they are covered with asphalt concrete. At the same time, the walls of the gratings prevent the displacement of the material placed in it, giving it new properties. The holes of the geogrid and the particles they are filled with form an intermediate layer that acts as a stretched membrane. This effect reduces the concentration of the concentrated vertical load from the car wheel from the base layer and distributes it inside the intermediate layer (Fig. 3). This increases the resistance to displacement and limits lateral deformations in the main layer (Kashif *et al.*, 2024). Geogrids have a wide range of applications, including the construction of road surfaces on soft and shifting soils, the stabilisation of road surfaces on roads, highways, and bridge decks, as well as the reconstruction and widening of roadways. Geogrids are also used to reinforce asphalt concrete pavements during the construction of retaining walls and soil slopes, to

restore road surfaces after repairing underground utilities, and to construct and reinforce airport runways. The use of geogrids offers a range of technological and economic advantages, including the ability to reduce the thickness of asphalt concrete pavements and save money on soil improvements. Reinforcement increases the bearing capacity of weak foundations, evenly distributes mechanical loads, and prevents the propagation of thermal and fatigue cracks and the occurrence of shear deformations in pavements. These factors lead to a threefold or more increase in the service life of the pavement, a two- to threefold increase in the time between repairs, and a reduction in road surface maintenance and repair costs by more than 40%, while significantly simplifying road construction and embankment stabilisation.

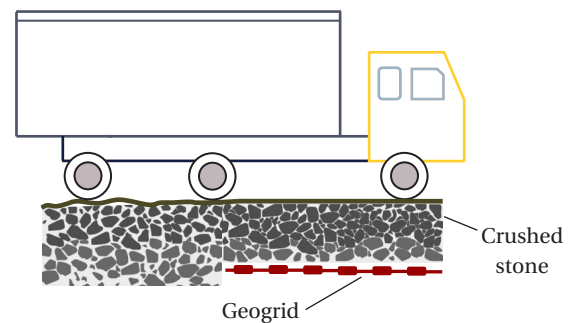


Figure 2. Geometric layout of the geogrid
Source: developed by the authors

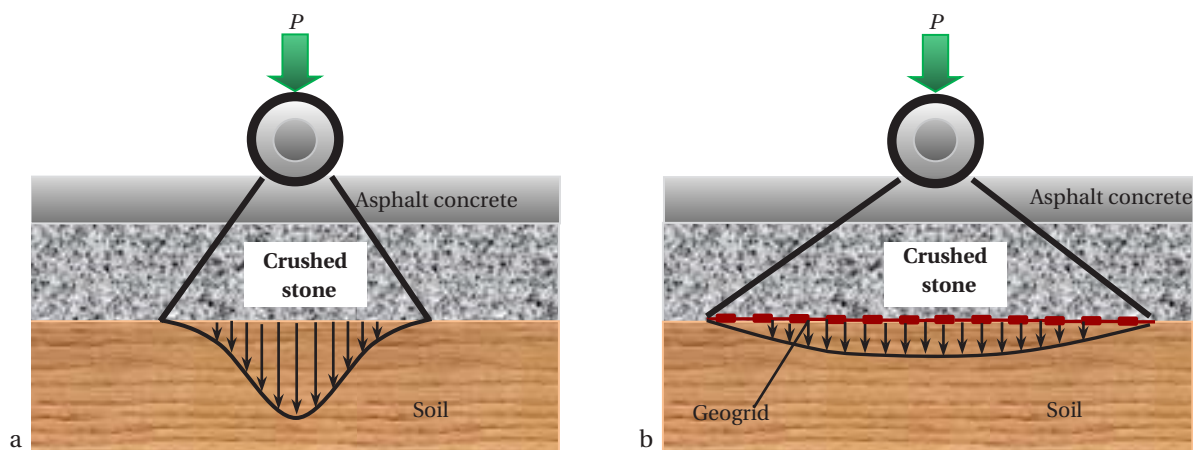


Figure 3. Concentration of concentrated vertical load from a car wheel

Note: a – without geogrid; b – with geogrid

Source: developed by the authors based on M. Al Qurishee (2017)

Depending on the type of repair work, different geogrid placement patterns are used in the pavement structure. When repairing a road section with minor cracks, a geogrid is laid to reinforce the top layer of the pavement. It is placed between the existing asphalt concrete without a levelling course and the new asphalt concrete, creating a preservative effect and absorbing horizontal stresses and deformations, thereby preventing the propagation of existing cracks into the newly laid pavement layer. To

repair a road section with ruts and potholes, a geogrid is placed between the levelling course of the existing asphalt concrete and the new pavement layer. Redistributing vertical loads over a larger base area eliminates or reduces paths and potholes. When reinforcing asphalt concrete pavements on highways or airport runways, geogrids are placed between the asphalt concrete levelling layer and the cement concrete pavement. They act as a binder layer and prevent cracks due to the difference in thermal

expansion coefficients between these layers. Reinforcing asphalt concrete pavements is critical at the junction of sections, as it prevents cracks from developing in the top layer. Geogrids are used to widen road surfaces at junctions, as well as to reinforce road sections after repairs to underground utilities to ensure the integrity of the roadway is restored and improve its reliability.

Using the proposed methodology, a simulation of the pavement structure depicted in Figure 3 was conducted, employing the parameter values listed in Table 1. The calculation results are shown in Figure 4 in the form of graphs of the functions $\sigma_x(y)$, $\sigma_y(y)$, $\sigma_z(y)$, $\sigma_{xy}(y)$ in a vertical section passing through $x = const$ the centre of the load application area. Apparently, the greatest stress $\sigma_x = -5,770$ Pa occurs on the border surface of the upper layer. However, it cannot be considered the most

dangerous, since it is compressed. Therefore, the tensile load $\sigma_x = 1,207$ Pa, arising on the contact edge of the second and third layers, can be considered more dangerous. The remaining components of the stress tensor have much smaller values. In connection with the noted, when reinforcing the structure, it is desirable to select such a location of the geogrid as to reduce the tensile stress σ_x on the contact surface of the second and third layers. Figure 4 shows the graphs of the functions $\sigma_x(y)$, $\sigma_y(y)$, $\sigma_z(y)$, $\sigma_{xy}(y)$ for the case when the geogrid is installed inside the first pavement layer. Such a grid arrangement even has a negative effect, since the maximum tensile stress in the lower plane of the second layer even increased from 1,207 Pa to 1,243 Pa. At the same time, such a design scheme led to a decrease in the compressive forces in the upper layer, which were not dangerous anyway.

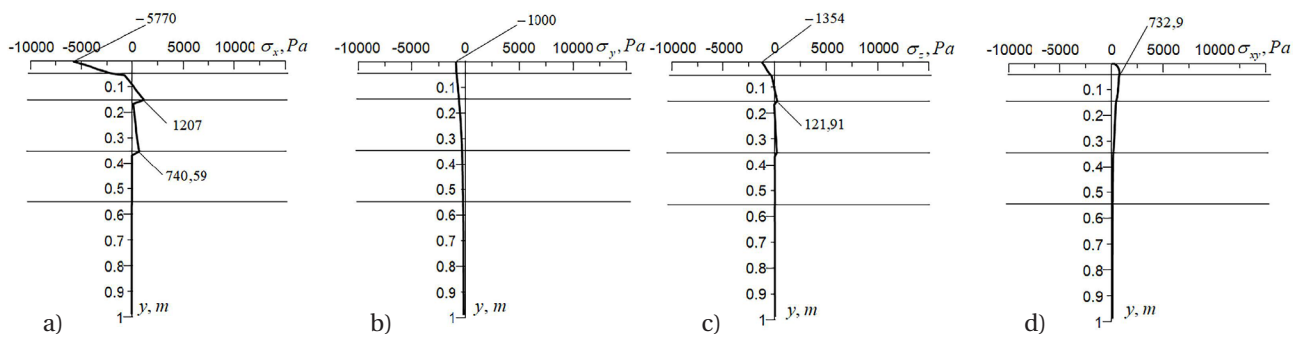


Figure 4. Graphs of stress changes (a), (b), (c), (d) in an unreinforced road structure

Source: developed by the authors

It should be noted that the stresses in the reinforcing layer significantly exceed those in the asphalt concrete. However, this does not pose a threat, as the strength of the geogrid considerably surpasses that of asphalt concrete. The case where the geogrid is located between the first and second layers is shown in Figure 5. This scheme

cannot be considered rational, since the tensile stresses at the bottom of the second layer have again increased from $\sigma_x = 1,207$ Pa (without the grid) to $\sigma_x = 1,260.3$ Pa (with the grid). The geogrid placement inside the second layer has a positive effect on the lower limit of the second layer. It dropped to $\sigma_x = 1,156.2$ Pa.

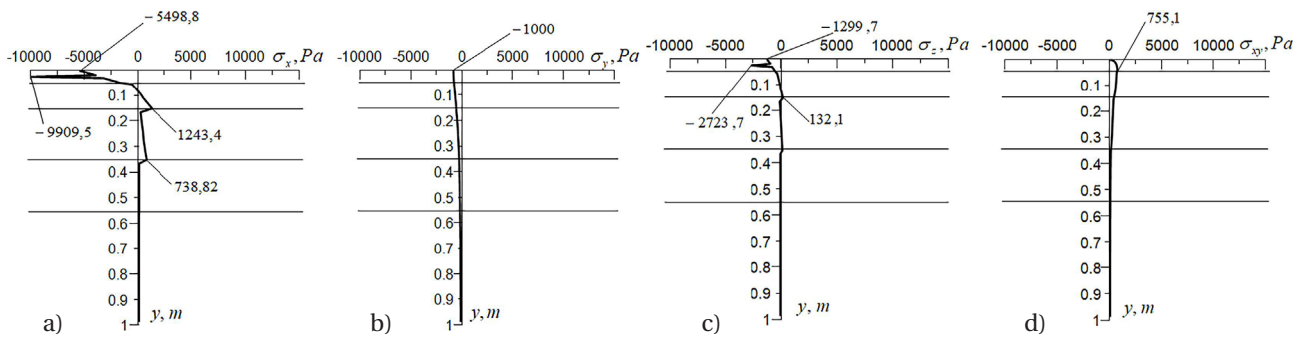


Figure 5. Graphs of changes in stresses (a), (b), (c), (d) in the road cross-section under load when the geogrid is located inside the first layer

Source: developed by the authors

Here the stress σ_x decreased from $\sigma_x = 1,207$ Pa to $\sigma_x = 938.3$ Pa. The installation of a geogrid inside the lower (third) layer also resulted in a decrease in the level of the highest tensile stresses (from 1,260.3 Pa to 1,011.6 Pa), but it was not as significant. Structural schemes were also an-

alysed in which the geogrid was installed even lower (in the fourth layer). However, calculations showed that in this case the influence of the geogrid on the stress-strain state of the system is even less significant. Therefore, the calculation results for such a scheme are not presented

here. As a conclusion to this study, it can be noted that the most rational geogrid arrangement for this structure and this stress can be considered its arrangement between the second and third layers. It should also be emphasised that although the introduction of the geogrid into the coating structure did not result (as expected) in a significant decrease in tensile stresses in the critical

zones of the system, its effect on the overall strength of the coating remains important, as the geogrid, even in a closed state, prevents further crack growth and structural failure in the described area. The graphs of changes in stresses in the road cross-section under load when the geogrid is located between the first and second layers are shown in Figure 6.

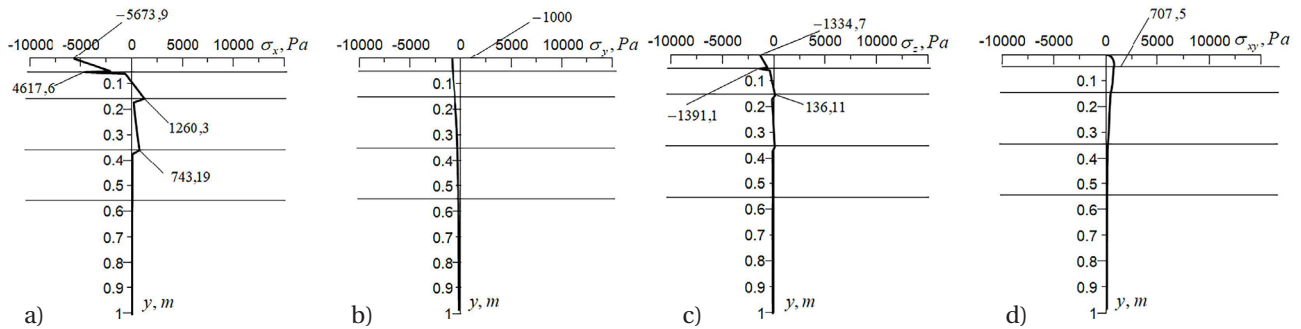


Figure 6. Graphs of changes in stresses (a), (b), (c), (d) in the road cross-section under load when the geogrid is located between the first and second layers

Source: developed by the authors

An analysis of various geogrid-reinforced road pavement designs allowed for determination the most efficient geogrid placement to minimise the most dangerous stress. When reinforcement is placed within the first layer and between the first and second layers, an

increase in the critical tensile stress at the bottom of the second layer by 36-53.3 Pa is observed (Figs. 5-6). The most favourable case was when the geogrid was located in the place of maximum stress σ_x between the second and third layers (Fig. 7).

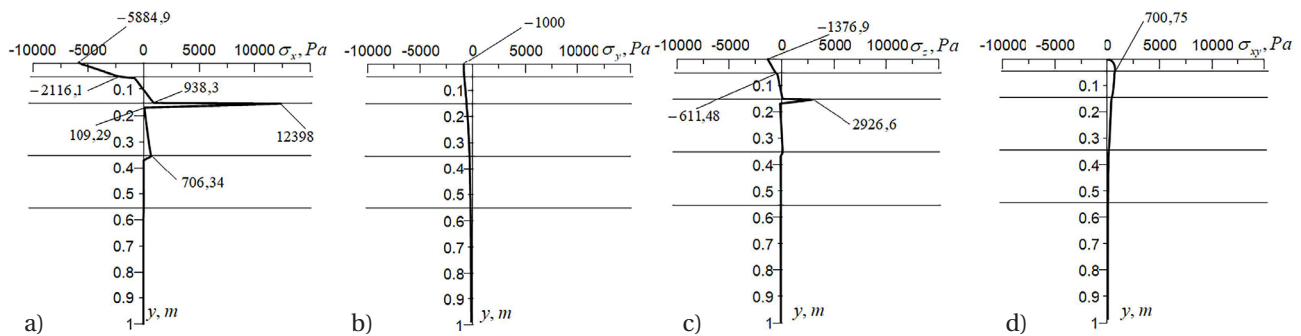


Figure 7. Graphs of changes in stresses (a), (b), (c), (d) in the road cross-section under load when the geogrid is located between the second and third layers

Source: developed by the authors

Indicating a negative impact of this placement on the overall durability of the structure. From the middle of the second layer to the middle of the third layer, a reduction in stress by 50.8 Pa to 195.4 Pa is observed compared with the critical stress value $\sigma_x = 1,207$ Pa. The maximum positive effect is achieved when the geogrid is placed directly in the zone of maximum tensile stress between the second and third layers. Therefore, the study clearly demonstrates the effectiveness of road pavement reinforcement, which is directly dependent on the precise placement of the geogrid in the zone where the greatest tensile stress occurs.

Previous studies confirmed the effectiveness of geosynthetic materials in improving pavement durability. In particular, the use of geogrids has been shown to reduce

rutting and tensile stresses and to allow a significant reduction (20-40%) in base-layer thickness without compromising load-bearing capacity (Al Qurishee, 2017). The results obtained in the present study demonstrate that geogrid reinforcement leads to a decrease in critical stress levels, which is consistent with the findings reported by B. Hill *et al.* (2018). The authors highlighted that the inclusion of recycled materials like reclaimed asphalt pavement (RAP) in pavement construction has led to reduced performance at low temperatures, causing thermal cracking. Their previous research demonstrated that bio-binders from swine manure could mitigate the effects of RAP while enhancing the low-temperature properties of asphalt mixtures. The results of the present analysis are also consistent with the

findings of P. Vishwakarma & S.R. Karumanchi (2023), who emphasised the critical importance of selecting an appropriate geogrid stiffness within the asphalt concrete layer and choosing suitable subgrade materials to optimise pavement performance and service life. Their study highlighted that maintaining the geogrid stiffness within a specific range, particularly between 100 kN/m and 400 kN/m, markedly reduces rutting depth, especially in pavements with lower subgrade modulus, thereby ensuring improved long-term performance. Compared with subgrade reinforcement approaches, the results confirm that optimal depth-wise placement of the geogrid effectively mitigates crack initiation and propagation in high-stress zones, thereby serving as a key factor in extending pavement service life. In contrast to the predominantly theoretical review presented by M. Farhan & K. Murari (2024), the present study employs finite element modelling to systematically investigate and determine the optimal depth-wise placement of geosynthetic reinforcement within the pavement structure. The results are further corroborated by the studies of M.R. Sharbaf & N. Ghafouri (2021) and M. Zakarka *et al.* (2023), providing additional evidence of the effectiveness of geosynthetic materials in enhancing pavement strength. X. Ding *et al.* (2022) demonstrated that the inclusion of geogrid reinforcement significantly improves the strength and alters the deformation behaviour of calcareous sand in maritime geotechnical structures. Their consolidated drained triaxial tests revealed that geogrid-reinforced calcareous sand (GRCS) exhibits higher strength, a shift in the deviatoric stress-strain response from slight softening to hardening, and reduced shearing dilatancy compared to unreinforced sand. D. Nie *et al.* (2023) focused on fatigue performance, the present study specifically determines that placing the geogrid between the second and third pavement layers is the most rational solution. M. Huang *et al.* (2025) demonstrated the results of a comprehensive full-scale investigation into the effectiveness of composite stabilised bases reinforced with geogrids and geotextiles in pavement structures. The findings showed that seasonal freeze-thaw cycles contribute to increased roadbed settlement. Overall, the findings of the present study, supported by previous research, confirm that geogrid reinforcement – when optimally selected in terms of stiffness and strategically placed within the pavement layers – significantly enhances

structural strength, reduces critical stresses and rutting, and effectively mitigates crack initiation, thereby improving the durability and service life of pavement systems.

🌀 Conclusions

The study investigated the deformation behaviour of layered pavement structures with respect to the placement of geosynthetic reinforcement layers. It was demonstrated that the strategic incorporation of geogrid reinforcement, with optimal stiffness and depth placement, significantly enhances pavement strength, mitigates stress concentrations and rutting, and improves the overall durability and service life of the structure. The findings indicated that the most effective geogrid placement is between the second and third layers of the pavement. In this case, the tensile stress decreased from 1,207 Pa (in the unreinforced configuration) to 1,011.6 Pa, representing a significant reduction of approximately 20% in critical stress levels. In contrast, placing the reinforcing layer within the first layer of the road structure or between the first and second layers resulted in negative outcomes. When applied in the first layer, the shear stress increased by 2.9%, and when placed between the first and second layers, the tensile stresses increased by nearly 5%. Therefore, it can be concluded that the use of geosynthetic materials in pavement design is an effective method for improving the overall strength, increasing the durability, and reducing maintenance costs of road structures. It should also be emphasised that although the introduction of the geogrid into the pavement structure did not lead (as initially expected) to a substantial reduction of tensile stresses in the critical zones, its influence on the overall strength of the pavement should be considered important. Even under near-critical conditions, the geogrid prevents further crack propagation and structural failure at the affected location.

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None.

🌀 Conflict of Interest

None.

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Використання геосинтетичних армуючих прошарків у дорожньому будівництві

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🌀 **Анотація.** Актуальність роботи обумовлена необхідністю підвищення довговічності та надійності дорожніх покриттів, які зазнають інтенсивних навантажень, зокрема від вантажного транспорту, що призводить до розвитку деформацій та ушкоджень, таких як тріщини. Це зумовлює потребу у використанні армування для шарів дорожньої конструкції. Метою дослідження було визначення найефективнішого розташування армуючого геосинтетичного шару у конструкції дороги для зменшення напружено-деформованого стану та підвищення несучої здатності покриття. Для розрахунків використовувалися аналітичні методи, а також чисельне моделювання методом кінцевих елементів для вивчення розподілу напружень у шарах при різних схемах розташування армуючого шару. Чисельне моделювання показало, що армування георешіткою значно зменшує розтягуючі напруження у шарах дорожнього покриття. Найефективніше розташування георешітки – між другим і третім шарами дорожнього полотна, що, незважаючи на основну мету запобігання поширенню тріщин, суттєво знижує розтягуючі напруження. Дослідження показало, що така конфігурація зменшує розтягуючі напруження з 1207 Па до 1011,6 Па, що становить 20 % зниження. Водночас використання георешітки в першому шарі збільшує зсувні напруження на 2,9 %, а між першим і другим шарами розтягуючі напруження зростають майже на 5 %. Однак загалом геосинтетичні матеріали підвищують міцність і довговічність дорожніх покриттів. Аналіз отриманих графіків підтвердив, що оптимальне розташування армуючого шару точно відповідає зоні максимальної концентрації розтягуючих напружень, що покращує конструкційну міцність, зменшує деформації та подовжує експлуатаційний ресурс покриття. Практичне значення роботи полягає у формулюванні обґрунтованих рекомендацій щодо проектування армованих покриттів, що дозволяє мінімізувати витрати матеріалів і подовжити термін служби автомобільних доріг

🌀 **Ключові слова:** асфальтобетонне покриття; армування; георешітка; сцеплення; концентрація напружень; напружено-деформований стан; тріщини