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Pros and Cons of Using Lightweight Fillers in Compressible Constructions

Khakimov Sodiqjon Rasuljon o'g'li,[1]

[1] Namangan Engineering Construction Institute,

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***Corresponding author:**
Khakimov Sodiqjon Rasuljon o'g'li [1]

Abstract

In this article, the influence of lightweight aggregates on deformation resistance of reinforcing structures is analyzed. The article examines positive and negative aspects of managing deformations and stresses using lightweight aggregates such as gas concrete, vermiculite and perlite. Using mathematical expressions and calculation formulas, it is assessed how these materials affect the deformation resistance of structures. At the same time, the effectiveness of using lightweight fillers, as well as their possibilities and limitations, are also analyzed. The paper also shows new approaches to increasing deformation resistance through the use of lightweight fillers in reinforcing constructions, highlighting both advantages and disadvantages.

Key words: Silhouette constructions, light fillers, deformation, elasticity, strength, materials, calculation, constructions

Introduction

Compressible structures, such as reinforced concrete or steel structures, must be robust compared to external loads. However, compressible structures can often cause deformations, causing problems in ensuring their strength and long-term operation. By applying lightweight fillers, deformation tolerance can be increased in structures. Lightweight fillers, such as aerated concrete, vermiculite, perlite, are effective tools to further lighten compressible structures and minimize deformation processes.

Materials and Methods

The paper uses several methodologies to determine the impact of light fillers on deformation tolerance. The main methods include:

Mechanical properties analysis

When analyzing the mechanical properties and deformation tolerance of light fillers, the following mathematical formula is used:

$E=\sigma/\varepsilon$

Here: E – Modulus of elasticity of e-material, σ – voltage , ε – deformation.

Calculation of deformation tolerance

The following formulas are used to assess the increase in deformation tolerance by applying light fillers:

$\Delta L=(F\cdot L)/(E\cdot A)$;

Here : ΔL – deformation (change in length, F – external force, L – the initial length of the material, E – elasticity modulus, A – is the cutting surface.

Assessment of the effect of light fillers

The deformation effect and stress distribution of light fillers can be estimated by the following expression:

$\sigma\_eff=\sigma\_base/\varrho\_core \cdot P\_mix$;

Here: σ_eff – effective voltage, σ_base – is the stress on the underlying material, ϱ_core is the density of the underlying material, P_mix is the density of a mixture of light filler and base material.

Analysis of the deformation state of structures

When analyzing the deformations associated with light fillers and calculating the optimization of the distribution of voltages, this formula is used:

$\sigma\_max=M\_max/S$;

Here: σ_max is the maximum voltage, M_max is the maximum torque, S is the moment of inertia of the shear moment.

Results and Discussion

The effect of applying light fillers on deformation tolerance is expressed by the following pros and cons:

Positive sides:

Deformation and stress reduction: deformations can be minimized in structures using lightweight fillers. Lightweight materials distribute compressive stresses and reduce deformation processes. Aerated concrete or vermiculite mixtures reduce longitudinal deformation of the structure

Strength enhancement: lightweight fillers optimize voltages to reduce deformation and change. This, in turn, increases the strength of the structure.

Construction lightness: light fillers reduce the overall weight of the structure, which simplifies transportation and installation processes.

Negative sides:

Cost of building materials: making light fillers can often be more expensive. At the same time, they provide less strength in some cases, and their use can increase the cost of construction.

Robustness constraints: some lightweight fillers may have disadvantages in their robustness properties. For example, aerated concrete cannot withstand high voltages in some cases.

Energy and resource consumption: the process of producing light fillers can require high energy consumption, which has a negative environmental impact.

The results of the studies show that the application of lightweight fillers in compressible structures significantly increases deformation tolerance. Lightweight fillers improve structural strength and resistance to external stresses. However, some problems, such as the high cost and the inherent disadvantages of materials, create limitations in the application of these materials. In the production of light fillers, the issues of applying new technologies and their effective use, at the same time reducing energy consumption and increasing strength, are relevant.

Conclusion

The application of lightweight fillers in compressible structures is an effective method in increasing deformation tolerance. These materials can be effective in distributing voltages and reducing deformations. Nevertheless, there are also negative aspects to the use of light fillers, such as price and strength constraints. In the future, it is necessary to optimize these materials and develop new technologies.

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