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# RATED STRUCTURE AND FROST RESISTANCE OF CONCRETE

**Mirzajanov Mamujan Alimovich**
*Docent of Ferghana Polytechnic Institute, "Production of building materials, products and constructions" department, Ferghana, Uzbekistan*

**Otaqulov Bahromjon Adhamovich**
*Docent of Ferghana Polytechnic Institute, "Production of building materials, products and constructions" department, Ferghana, Uzbekistan*

**Salimjonov Jasurbek Xalimjon o'gli**
*Assistant of Ferghana Polytechnic Institute, "Production of building materials, products and constructions" department, Ferghana, Uzbekistan*

**ABSTRACT**
***The influence of the parameters of the pore structure on the frost resistance of concrete is considered. A mathematical equation of the dependence of the frost resistance of fine-grained concrete on the parameters of its pore structure is given.***
**KEY WORDS**: ***pore structure, frost resistance, fine-grained concrete, cement paste, correlation, regression coefficient***

## INTRODUCTION

Among the indicators that determine the quality of building materials, including cement concretes, their frost resistance is of particular importance. The importance and complexity of the problem of ensuring the required frost resistance of concrete used in the climate of the Republic of Central Asia is indicated by the fact that the annual damage caused to the national economy from the premature destruction of concrete and reinforced concrete structures as a result of exposure to low or high temperatures and variable humidity is calculated tens of millions of dollars. Therefore, the study of the factors affecting the frost resistance of concrete is one of the urgent tasks of modern concrete science.[1, 2]

The mechanism of concrete destruction from the combined effect of water and frost is complex, and on this issue there are many different hypotheses (crystallization pressure of ice, hydraulic pressure in capillaries when water is squeezed out of the freezing zone, hydraulic pressure in pores and capillaries, difference in the coefficients of linear difference between ice and skeleton placeholders, etc.) [1, 3, 4]. Discussions about the validity of one or another hypothesis about the causes of concrete destruction during freezing and thawing continue and it is not yet possible to give preference to any of them.

The purpose of this work was to study the relationship between frost resistance of fine-grained concrete and the parameters of its pore structure.

## OBJECTIVES

In the studies, Portland cement grade M-400 D0 of Kuvasaycement JSC (GOST 10178-85) was used as a binder. Concrete mixtures were prepared from fine-grained crushed stone of the Faizabad quarry (Uzbekistan). The research was carried out on sample cubes with an edge of 10 cm, made of fine-grained concrete mixture with a volumetric concentration of cement paste of 0.35; 0.4 and 1.0 and a water-cement ratio of 0.30; 0.35; 0.40 and 0.45. The volumetric concentration of cement paste in concrete mixtures was set taking into account the

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water demand of the sand according to the IISS method [5].

## METHODOLOGY

Tests of samples for frost resistance were carried out in accordance with UzRST 10060-95 [2]. At the same time on identical samples were determined: the volume of total and open pores, indicators of the average pore size and uniformity of pores in size [6].

In addition, to assess the volume of "reserve" pores, the pore closure coefficient (Kzp) was used, which was defined as the ratio of concrete open porosity to its total porosity.

## STATISTICAL DESIGN

The mathematical processing of the data obtained by the least squares method showed that the dependence of the frost resistance of concrete on the parameters of its pore structure obeys linear and parabolic laws and is approximated by the equations presented in the table-1.

**Table-1.**
**Equation of dependence of concrete frost resistance on the parameters of its pore structure.**

| № | Regression equation | Correlation coefficient |
|---|---|---|
| 1. | $F = a + bC_{цк} - (C+dC_{цк})\,П_{общ}$ | 0,572 |
| 2. | $F = a + bC_{цк} - (C+dC_{цк})\,П_{отк}$ | 0,689 |
| 3. | $F = a + bC_{цк} - (C+dC_{цк})\,К_{зп}$ | 0,761 |
| 4. | $F = C_{цк}\,10^{a\lg\alpha+b-(C+d\alpha)\lambda}$ | 0,873 |
| 5. | $F = C_{цк}\,10^{a\lg\alpha+b-(C+d\alpha)\lambda Кзп}$ | 0,916 |

where F - concrete frost resistance, cycle;
$C_{цк}$ - volumetric concentration of cement paste in concrete mixture;
$П_{общ}$, $П_{отк}$ - total and open porosity;
α, λ - indicators of the average pore size and uniformity of pores in size;
a, b, c, d – regression coefficients.

## RESULTS

Correlation analysis of the obtained dependences found that the weakest are the connections between frost resistance of concrete and its total and open porosity. This indicates that the total and open porosity are not sufficient sensitive indicators that link the frost resistance of concrete with its pore structure. The most sensitive are the indicator of the average pore size, the coefficients of conditional closure and uniformity of pores in size, as well as the volume concentration of the cement paste in the concrete mixture. Taking these indicators into account made it possible to significantly increase the relationship between the frost resistance of concrete and its pore structure, as evidenced by the obtained values of the correlation coefficient.

## CONCLUSION

The revealed close correlation between frost resistance and pore structure parameters makes it possible to accurately predict the frost resistance of concrete.

Based on the research carried out, a method for accelerated prediction of concrete was developed, which is currently used by us in the preparation and publication of "Methodological recommendations for predicting frost resistance of concrete by the parameters of the structure of its pores."

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