Western European Journal of Modern Experiments and Scientific Methods
Volume 3, Issue 12, December 2025
https://westerneuropeanstudies.com/index.php/1
ISSN (E): 2942-1896 Open Access| Peer Reviewed


# AGRICULTURAL INFRASTRUCTURE FACILITIES IN SEISMIC AREAS WITH SALINE SOIL

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**Introduction.** Agricultural buildings and structures play an important role in ensuring food security and developing the agrarian sector of the economy. The production, storage and processing of agricultural products depend on their reliable and uninterrupted operation. Ensuring the safety and stability of underground facilities is of particular importance in areas with widespread seismic activity and saline soils. Earthquakes are a serious natural hazard that can cause significant damage to buildings and structures, economic losses, disruption of production processes and, most importantly, a threat to human life. Saline soils are characterized by complex physical and mechanical properties that negatively affect the foundations of buildings and structures, increasing the problems of seismic resistance [1-5].

Saline soils are a special type of soil containing a large amount of light, medium and poorly soluble salts in water, and have a number of specific properties that negatively affect the foundations of buildings and structures. It is recommended to divide them into the following groups according to their properties and the effect they have on the strength of engineering structures[12] **:**

1-Chloride salts: $NaCl$ , $CaCl_2$ and $MgCl_2$ . These salts have the property of solubility. Soils containing chloride salts have the property of retaining a certain amount of moisture, which creates good conditions for their compaction even in the dry season of the year. Chloride salts do not increase in volume even when crystallized in solution.

2- Sulfate and magnesium salts: $Na_2SO_4$ and $MgSO_4$ . These salts have the property of binding a certain number of water molecules to themselves. Sodium sulfate binds 10 molecules of water. At a temperature of $32.4\,^{o}C$ , $Na_2SO_4 \cdot 10N_2O$ passes into an anhydrous form. In the conditions of Uzbekistan, when the air temperature changes from 50 to 40 $^{o}$C, the bonds between soil particles are broken, resulting in the formation of "fluff".

3- Sodium carbonate salts: $NaNCO_3$ and $Na_2CO_3$ . These salts are relatively rare in the composition of the soil. The aqueous solution of soda has an alkaline reaction, which allows for maximum dispersion of clay-colloidal fractions in the soil.

4- sulfate and sodium carbonate salts. Their content in soil can range from 2% to 60% and more.

As is known, there are a number of features in terms of seismic safety for agricultural buildings and structures, which are characterized by large areas, lightweight structures and specific technological processes. First, the roofs and walls of such buildings with large dimensions increase the total area affected by seismic forces. Second, lightweight structures, although they reduce inertial seismic loads, may be more vulnerable to deformation and damage, especially joints and nodes. Third, technological processes associated with the storage of large volumes of products in agricultural structures, the presence of livestock complexes or greenhouses require special attention to ensure the continuity of work, the prevention of

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emergency situations during and after an earthquake. For example, the destruction of a granary or livestock complex as a result of an earthquake can cause significant economic losses, as well as negative social consequences [6-15].
In seismically active and saline soil areas, pile foundations have several advantages over traditional shallow foundations[6,7,8]. In particular, piles allow the transfer of loads from the building to stronger and denser layers of soil at depth. This ensures the stability of the building even in water-saturated soils and reduces the possibility of uneven settlement of the building, which may occur.

**Results.** When designing pile foundations in seismically hazardous areas, we take into account additional factors related to the dynamic nature of seismic effects. This includes inertial forces arising in the "pile foundation - building" system, as well as the interaction of piles with the surrounding soil during seismic vibrations **.**

Ensuring the seismic resistance of agricultural buildings and structures with pile foundations in the arid regions is associated with a thorough study of the engineering and geological conditions of the construction site, assessment of seismic hazard and properties of saline soils, prediction of changes in soil properties under time and seismic influences, and the use of corrosion-protected reinforced concrete piles resting on a solid layer rather than a saline loose soil layer. High concentrations of salts in saline soils and in the composition of seepage waters lead to corrosion of reinforced concrete piles, reducing their load-bearing capacity. Special protective measures can be taken to prevent corrosion, taking into account the possibility of changes in the physical and mechanical properties of the soil over time [15-20].
The pile calculation is assumed as a multi-span beam (Winkler model [10] ) supported on the soil at infinite points, and the soil properties are expressed by a variable shear coefficient $C(x_k)$ . When determining the shear coefficient at the nodes corresponding to the calculation scheme, the settlement moduli *($E_s$) of the soil under natural ($E_{tab}$)* , short-term moistened *($E_{nam}$)* and long-term moistened and desalinated under the influence of suffocation (Fig. 1 *, a* ) and the corresponding values of the loads on the supports ( *Fig. 1, b* ) are taken into account.

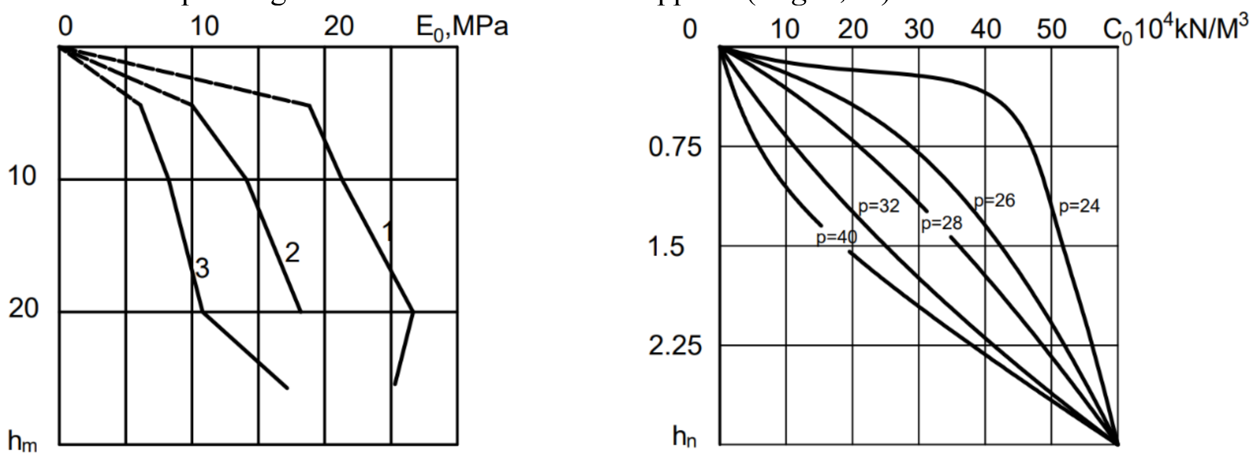


*Figure 2. Variation of the modulus of subsidence with depth (a) and the stiffness of the supports under the action of loads $C(x_k)$ coefficients. 1,2,3 - natural, partially and completely desalinated soil conditions, respectively (pile length 3.0m, cross-section 20x20cm) (Central Fergana).*
In this case, based on the study of the change in the soil settlement modulus with increasing loads on a vertically or horizontally loaded stamp, its variability along the length of the pile was assumed [10,11]:

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$$E_i(x_k) = E_0 Z^n \qquad (1)$$

Here: $E_0$ – soil subsidence modulus at a depth of *1m* , kPa;
z – depth of the layer along the length of the pile, m;
*n* -coefficient, with its change, the distribution diagram of the slump modulus $E_0(x_k)$ can be continuous (n = 0), convex parabola (n<1<1), triangular (n=1) and concave parabola (n>I).
Based on experimental data and (1), we assume a nonlinear variation of the birefringence coefficient $C(x_k)$ :

$$C(x_k) = \frac{K_0 E_i(X_k)(\frac{z}{z_0})^n}{[1 - M_0^2(X_k)]\sqrt{F}\cdot\omega} \qquad (2)$$

In this case, the parameter *tr n* can be considered as a function of the displacements $V_0$ of the pile head under the action of various loads .

Based on the data obtained, in regions with severe and moderate site conditions [1,7], the design of pile foundations for horizontal loads arising from seismic effects is affected by corrosion effects and wetting and salinization of the soil around the pile.

**Discussion.** Ensuring the seismic resistance of agricultural buildings and structures on piles in saline soils is a complex and multifaceted task, requiring an integrated approach and taking into account all factors affecting the reliability and safety of objects. In this case, the use of modern dynamic analysis methods, numerical modeling, and software complexes such as Lira, SKAD, PLAXIS, and ABAQUS, taking into account the variability of saline soils under the influence of moisture (2), as well as the organization of a system for monitoring and controlling the condition of the building and foundation during construction and operation, including monitoring deformations, stresses, corrosion processes, and other parameters affecting seismic resistance, allows for the adoption of effective design solutions. To successfully solve this problem, joint efforts of geologists, designers, builders, and operational specialists are necessary. Accordingly, special attention is paid to the analysis of factors affecting seismic resistance, consideration of modern methods and technologies used to increase the reliability and safety of such structures. Further research in this area should be focused on the development of new, more effective and economical methods and technologies for ensuring the seismic resistance of agricultural buildings and structures in complex engineering and geological conditions, including the development of new materials, designs, calculation and monitoring methods. The development of a regulatory framework and standards in the field of earthquake-resistant construction of agricultural buildings and structures in aggressive environments is also an important research area that serves to increase the safety and stability of the agrarian sector of the economy [21-29].

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ISSN (E): 2942-1896 Open Access| Peer Reviewed


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