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Contents

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URBAN PLANNING AND ECOLOGICAL ASPECTS IN THE FORMATION OF THE NATURAL LANDSCAPE ENVIRONMENT OF UZBEKISTAN

Asilbek Jo‘raboyev

A B S T R A C T

This article describes the factors affecting the organization of recreation centers in the mountainous regions of Uzbekistan. The effectiveness of recreation, the ease of use of the resort area and facilities, relief features, and the flow of winds were analyzed and recommendations were made to the wellness complexes. Climategeographical factors affecting the organization of resort settlements are analyzed in depth and their specific aspects are highlighted. Rest areas in the mountainous regions of Uzbekistan were analyzed based on their functional use and natural conditions, and recommendations were made. This article can effectively benefit architects, especially landscape architects in their design and scientific work.

Keywords: Recreational facilities, Aeration, Katabatic winds, air isotherms, winter sports, ski area

1. Introduction

Today, great importance is attached to the healthy lifestyle of the population of our Republic and its rapid improvement. In this regard, along with the large-scale reforms being carried out in our country, the attention paid to the recreation sector of the population is certainly gratifying. Formation of services in recreation and its sectors (ecological, agro, historical, extreme) in our republic, increasing the number of multidisciplinary spa resorts, taking into account the natural and socio-economic potential of the regions, research on their specialization and improvement of the territorial structure its inadequacy prompted work on the topic "Urban planning and ecological aspects in the formation of the natural landscape environment of Uzbekistan".

Uzbekistan is a heavenly country. Every corner of it gives a person a special charm with its pleasant nature. Fergana region, which is considered the "Jewel of the East" and has received special recognition in our country for its unique nature, is distinguished from other regions by its unique scenery formed by mountains and riverbeds, and various landforms. These aspects attract the attention of any visitor and tourist [5].

The results of the study of the recreational potential of Fergana region show that the favorable conditions of Fergana are very favorable for the development of recreational activities. Especially the shores of the Syrdarya, the green areas around it, the plants scattered in the adjacent areas, the ornamental trees stretching to the sky, the medicinal herbs growing along the mountain slopes, the groves, the natural Getting to know forests, fishing farms, protected wildlife, and various natural monuments attracts not only residents of our republic, but also foreign tourists.

2. Materials and Methods

The location of Shahimardan village in the mountainous area of Fergana region and the specific features of the orography determine the difference in the aeration regimes of individual parts of Shahimardan region. The relief, which characterizes the plasticity of the earth's surface, affects the speed and direction of wind currents in the surface layer of the atmosphere. The coefficients of wind speed change depending on the shape of the relief were used to assess the wind regime in relation to the relief (slopes, influence of the slopes on the base points, relative position of individual sections of the slopes, etc.).

The considered morphological features have a great influence on the change of the initial wind speed recorded in the data of the meteorological station. The above-mentioned katabatic winds of the foothills formed in deep mountain areas with the cleanest air of alpine landscapes "flow" from the slopes to the valley in the early morning under the influence of mountainvalley circulation. This process can be compared to the special "rivers" of cool, clean air moistened in summer, which is important in the hot-dry climate of a number of mountain valleys in Central Asia. These "rivers" have the best disinfection properties, but this type of wind flow is easily dispersed (destroyed, fragmented) under the influence of various orographic and landscape barriers.

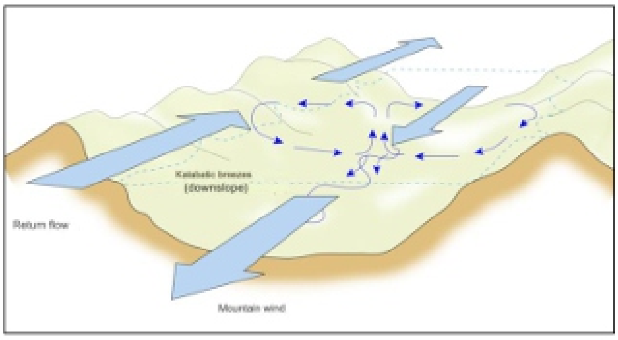

Figure 1. The scheme of movement of the katabatic wind

The territory of Shahimardan of Fergana region and its surroundings are characterized by katabatic mountain flow in the southern and southwestern directions:

- the katabatic wind is like a water current: if the slope of the earth's surface is less than 2-3%, its speed decreases sharply, so cold air "lakes" appear in the central part of Shahimardon and the southern parts of Fergana region;
- decrease of wind speed in the central part of the region due to morphological conditions occurs as a result of an increase in the length of the air mass flow line;
- the extension of the flow path contributes to the increase in the physical size of the flowing air masses, which leads to an increase in the probability of stagnation processes at the bottom of the slope along the trajectory of the wind flow in the south and southeast directions [4].

In the daily cycle, there is a significant concentration of air pollution and temperatureorographic inversions, a weak variable air layer with stable characteristics, which is clearly expressed under the influence of periodic changes of winds in opposite directions (mountain-valley circulation phenomenon). It was formed over the central area of the city (its western part). This phenomenon is later called “thermal core", its formation is caused by:

- placement of new commercial and communal warehouses in the western part of the city, which will help to increase the amount of harmful waste from automobile transport;
- a significant increase in the flow of passengers in the area of the western bus station of the city;
- features of the morphology of the studied area, which contribute to the passage of the katabatic flow of the greatest length along the slope of the northwest direction, increase the probability of stable processes in the atmosphere and the movement of the "thermal core". longer parts of the flow trajectory due to a decrease in the physical volume of the polluted air mass;
- the slope of the relief surface is less than 2%, which causes a decrease in the speed of the katabatic flow and the formation of inversion processes. It should be noted that in recent years, the location of this thermal core has shifted to a certain extent from east to west, as well as the physical volume of the polluted air mass in the core itself has been reduced to a certain extent by the following factors:
- partial, and in some cases, complete shutdown of a number of industrial enterprises that emit harmful waste in the central and eastern industrial zones of the city;
- beautification of the eastern part of the central zone of the city and increase the level of greenery due to the placement of embassies, company offices, banks, offices and other prestigious state and private institutions here.

The study of atmospheric processes over the considered area revealed the phenomenon of temperature-orographic inversion. Inversions prevent vertical movement of atmospheric air, which creates a high potential for air pollution, and frequent calms and low (2-3 m/s) air speeds help inversions to persist. Aeration of the urban area and the study of the interaction of wind currents with the plasticity of the relief surface in the main dominant directions:

- the location of the city in the foothills and the uniqueness of the orography determines the difference in aeration regimes in some parts of the city;
- The most favorable ventilation conditions are created on high ground with a slope of about 3% (in the southern and southeastern regions of the city). In these places with relatively good air circulation, inversion and accumulation of pollution in the surface layer of air occur to a lesser extent, because there is less stagnation in the atmosphere.
- In the central part of the city, morphological features prevent self-purification of the atmosphere. Here, the greatest decrease in the speed of wind currents is observed, which leads to stagnation in the surface layer of air and an increase in the probability of occurrence of inversions.
- The northern, northwestern and western zones of the city are characterized by orographic conditions

that do not significantly affect the winds of the western direction, but prevent the entry of the most favorable winds of the southern directions. Inversion phenomena are often observed in these areas of the city, especially in winter.

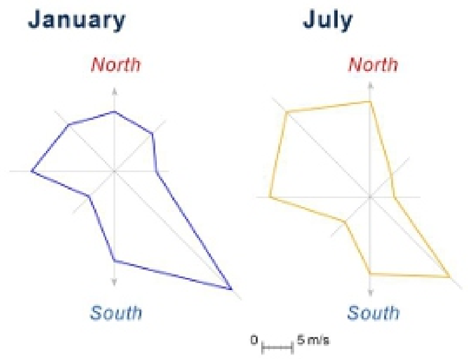

Figure 2. Architecture and climate passport of regions of Fergana region

Aeration and other climatic and ecological factors were taken into account in the development of the architectural-climatic (ecological) passport of the city (Fig. 2). This document specifies the climate and orography of the study area that should be taken into account when making urban planning, architectural planning and design decisions to improve the environment, as well as a list of climate and landscape factors, including:

- architectural climate analysis;

-engineering and physical calculations of individual climate factors;

-basic urban planning and environmental recommendations. The basis for the development of this passport was climate-ecological characteristics processed by appropriate methods, including long-term stationary observations of the city weather station, route research data, calculations and graphic-analytical constructions. A comprehensive climate-ecological assessment of individual areas of the city based on relief conditions, aeration schemes and types of development, a differentiated approach to the development of urban development solutions and planning restrictions should be the basis for the development and beautification of urban areas for different purposes for the city of Fergana.

3. Results

Based on the research materials of recent years, the revised document has developed recommendations on the use of urban planning tools in order to improve the urban development and ecological condition of the natural landscape environment in the Fergana region and its suburbs. The central region of Fergana region is located on low-slope, almost flat lands; it is most sensitive to the phenomena of stagnation processes in the surface layer of the air with the largest number of inversions against the background of radiation cooling in the winter period of the year; With the presence of a "thermal core", excessive pollution of atmospheric air and soil, the weakest wind activity and other negative environmental factors make the area unfavorable for the placement of residential structures.

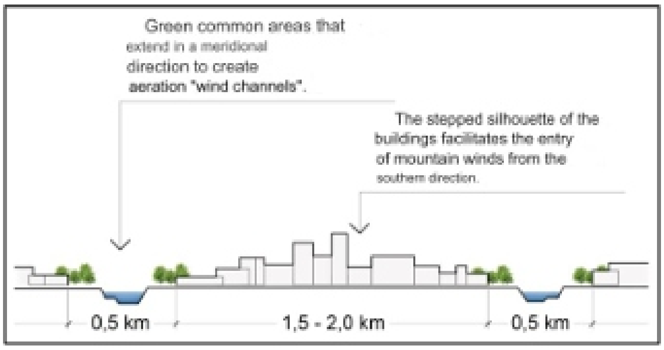

Figure 3. Scheme of linear park structures and wind channels in the meridional direction

In connection with the status of the administrative center of this area, which is considered one of the major cities of the republic, it is appropriate to place mainly business center objects: administrative, entertainment, commercial and household buildings and their complexes in its territory.

In the area where the influence of the katabatic mountain flow of the considered area is practically not manifested, it is preferable to use planning methods that encourage the movement of the wind in relation to the flows in the north and northwest direction, including:

- maximum opening of inner city spaces to the west and north-west sides of the horizon;
- increase the width of highways and wide streets on red lines to the maximum values allowed by the standards;
- development of green spaces for general use in the latitude direction, as well as along the diagonal axis "northwest, southeast".

Figure 4. Schemes of carrying out climatic studies of Fergana city area

The following are recommended for the selection of urban planning solutions in all considered areas of the city:

- replacement of residential and green areas with the recommended ratio of the width of green (0.5-1 km) and built-up (1.5 - 3 km) areas (Figure 2.3); It is recommended to give the role of wind corridors to lowrise buildings with well-equipped cottages with landscaping and water supply.

-taking into account the direction of the opposite winds prevailing at a height of more than 50 m when locating industrial areas and reconstructing existing industrial areas; it is not recommended to place industrial facilities with harmful waste on the same width area as large residential buildings.

5. Conclusions

The interaction of favorable winds and structural elements of the environment in the placement of settlements within the framework of the plasticity of landscape and architectural planning structures located in mountain valleys, in cases where environmental disasters (landslides, floods, etc.) do not threaten the consequences of aeration flows the principle of the most convenient passage was formed. Not only the Fergana region, but also the principles of architectural and aesthetic organization of urban development structures in the formation of cities similar to natural landscape conditions, from the appropriate models for formalizing the relief of territories and directing the "channels" of air currents flowing along the slopes. it is recommended to use it when forming all the cities of the republic.

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PREFABRICATED MONOLITHIC GAS BLOCK SYSTEM

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A B S T R A C T

The article presents an analysis of prefabricated monolithic ceilings (PMC) of various manufacturers, which have received the most widespread use. The task of reducing the weight of building structures while maintaining the bearing capacity is relevant in modern construction. Prefabricated monolithic construction systems correspond to modern trends, but require special attention and study. The article presents an analysis of the advantages and disadvantages of prefabricated-monolithic slab structures, identified and identified problems of use that require further detailed study to ensure the reasonable use of SMP structures in the construction of buildings and structures.

Keywords: prefabricated monolithic floors, structural elements, energy efficiency, foam block, gas block, concrete mix, reinforcement, formwork, analysis

1. Introduction

Reducing the weight of construction structures, reducing the consumption of materials, as well as achieving a significant economic effect by ensuring their load-bearing capacity is a constant issue for designers and builders. Wall, frame, frame-wall and frame-core structural systems are used in our country and in the design and construction of monolithic buildings.

Load-bearing reinforced concrete is widely used in heavy concrete and masonry systems, increasing the mass of structures and buildings. One of the efforts to solve this problem is the emergence of porous media and roofing sheets. Such plates are much lighter than prefabricated and monolithic composite panels. exempted from the labor-intensive technological process of making and removing coatings, special lifting techniques are not involved, and they also have other additional benefits [1]. The main part Reinforced concrete structures. The most widely used type of scaffolding in construction is reinforced concrete flat scaffolding. According to the construction technology, they are divided into: - monolithic, - assembled - assembled -monolithic types.

The next step in lightening the constructions was the use of prefabricated monolithic iron bars. When designing them, all the positive and negative aspects of composite and monolithic media are taken into account.

In the countries of the European Union, the weight of the use of monolithic composites ranges from 20% to 35%, in the Russian Federation they have been used in small quantities since 2008, and in the conditions of Uzbekistan they have not been used until now. The relative weight of monolithic composite panels is low, they have high heat and sound protection, they are exempted from the labor-intensive technological process of making and removing coatings, special lifting techniques are not involved, and they also have other additional benefits [1].

The main part

Reinforced concrete structures.

The most widely used type of scaffolding in construction is reinforced concrete flat scaffolding. According to the construction technology, they are divided into:

- monolithic,
- assembled
- assembled
-monolithic types.

Monolithic media.

The technology of building the construction site itself, without joints connecting the structures, is called "monolithic reinforced concrete construction" Monolithic reinforced concrete frames belong to this category and are among reliable and universal constructions. Their advantages are durability, the ability to give the desired shape, fire resistance, the possibility of using local raw materials, saving steel, while their disadvantages are high specific weight, laborious installation of roofs and coatings that do not meet modern construction trends, high labor consumption, etc. [2]. In addition, monolithic construction depends on climate and weather conditions. For example, the preparation of monolithic reinforced concrete structures at temperatures below +5ºC and above +30 0C dramatically increases the cost of the process, as it requires different heating-cooling methods and equipment.

All this requires the development of other new types of media structures. Cumulative averages. Precast reinforced concrete structures are built from reinforced concrete slabs prepared in enterprises. They are made in specialized enterprises from concrete not lower than V15 class and prestressed or unstressed steel reinforcement. One of their advantages is that there is no need for separate calculations due to the fact that the maximum loads on the bearings are calculated during production. In the process of designing, it is necessary to select the required size and loads from the catalog of reinforced concrete structures [3,4]. The most common types of composite panels are:

- non-porous reinforced concrete slabs, rectangular in shape, thickness from 100 to 160 mm.;
- porous steel concrete slabs, the cut of pores is circle, square, oval, circle diameter is 140 and 160 mm, slab thickness is 160, 220, 260 and 300 mm, the most common ones are 220 mm thick and 160 mm in diameter, length is up to 2-8 m.
- reinforced concrete slabs with ribs are reinforced with additional ribs, have a large load-bearing capacity, are used in the construction of infrastructure and industrial buildings, are 1.5 and 3.0 m wide, and 6 and 12 m long. Compared to cast monolithic partitions, the advantages of precast reinforced

concrete partitions are as follows: - increased heat and sound insulation when porous composite plates are used; the speed of installation of structures in place; inviolability of installation work to climatic conditions.

Precast reinforced concrete in relation to the construction process of cast structures assembly of constructions is quite light, but requires special lifting equipment. Therefore, searching for lightweight structural solutions that require minimal labor instead of prefabricated reinforced concrete structures is one of the urgent issues [5,6].

Stacked monolithic media (SMM).

These types of concrete slabs, which include both monolithic and composite concrete slabs, are composed of a lightweight block and various filler blocks. At the construction site, monolithic concrete is filled and a surface layer is formed. In recent years, due to the changes in the construction industry, the division of construction organizations and changes in specialization, a number of new requirements have been imposed. One of them is the preparation of separate, relatively small and light constructions in the object itself during the restoration of buildings. One of such solutions is called monolithic media systems. These systems maintain a good balance with aerated concrete, foam concrete, expanded clay concrete, expanded polystyrene concrete, thermoblocks, porous bricks and insoluble monolithic coatings. Among the main problems during the design and construction period, in addition to the choice of structural solutions, it is necessary to develop and improve the methods of calculating the averages, and to take into account how they behave under loads [7,8]. The measures taken will help to take into account as accurately as possible the load-carrying capacity of the selected class of media, and will be compared to other existing technological solutions. If we look at and analyze the tomyopma and oraiopma, which are widely used in practice, they have different structural forms and are made of different materials. For reinforced concrete structures, along with walls, a lot of material consumption is required. Approximately 20% of the weight of the building under construction corresponds to the averages, and in the buildings to be reconstructed, this figure reaches 50-60%. This situation means to us that it is important to choose the intermediate structure in the buildings under construction, taking into account the features such as accuracy, uniformity and economic efficiency from the point of view of preparation technology. The work done in favor of the practice of prefabricated monolithic frame construction in Koyi is also the literature published in the world and in our country. We present the analysis. We will try to justify the possibility of using this technology in complex climatic and seismically active conditions, along with the introduction of architectural content, giving detailed classification and descriptions. In addition, the reasons why we prefer this particular technology are given. It is based on the fact that the prefabricated monolithic frame of the building works as a half-frame system and has the same positive qualities as a fully prefabricated frame. One of the urgent issues today is to reduce the cost of construction. The solution to such a problem can be implemented due to the industrialization of construction. In the case of monolithic construction, the construction period is doubled compared to prefabricated or prefabricated-monolithic construction. For the purpose of industrialization of construction, the relevance of using monolithic constructions in complex conditions, including seismic effects on a large scale [9] has been justified.

In construction, characteristics such as uniformity, durability, noise isolation, and heat resistance, which ensure the required quality of the building, are also of great importance. Precast-monolithic ribbed partitions, the space between the ribbed wall blocks is filled with autoclaved aerated concrete. In this type of environment, aerated concrete serves not only as a filler, but also as a coating at the same time. In a number of articles, the construction of monolithic constructions in the presence of a lifting support structure of industrial and civil buildings, their constructive structures, fields of application, advantages and disadvantages are shown. For the normal development of science in the field of construction, optimal types of constructions that save time and money, as well as having good durability indicators are necessary. In the listed articles, it can be seen that the main indicators and descriptions of composite-monolithic media are processed and summarized with a wide review, analysis and existing information about them.

Calculation methods

Stresses in statically indeterminate structures are usually determined using the method of strapping systems in structural mechanics. In this method, the calculation is carried out assuming the ideal elasticity of the material and the invariable integrity of the structure. The performance of structures in buckling consists of a linear relationship between stress and displacement as the load increases. However, reinforced concrete structures can exhibit elastic and inelastic deformations, i.e. plastic state. With the distribution of the given force, elastic deformations disappear, plastic deformations remain. Elastic deformations are based on displacements that bring atoms back to the equilibrium state, and plastic deformations are based on non-return to the initial equilibrium state. With the appearance of cracks in reinforced concrete structures, uniformity changes, the correct proportionality of forces and loads is disturbed, that is, internal forces are redistributed. In other words, as the load increases, the ratio between the internal forces in different sections of the structure changes. It follows that the results obtained in the calculation of statically uncertain reinforced concrete systems according to the strap stage do not correspond to the actual bearing capacity of such systems.

Therefore, today, the “limit balance method” is widely used in the calculation of static uncertain structures [1]. The method takes into account plastic deformation of materials and redistribution of forces caused by other factors. According to the content of the method. At a certain value of the load, the cracks in the mild steel tensile reinforcement reach the yield strength. Plastic deformations in steel increase, and a zone of local large deformations occurs in the elongated reinforcement in reinforced concrete structures. This zone is called "plastic hinge". The difference between a plastic hinge and an ideal hinge is that it has a constant moment equal to the limiting value:

$$M = R_s \cdot A_s \cdot z \quad (1)$$

where, R_s is the calculated resistance of the reinforcement in the plastic joint to stretching,

As – the area of the extended armature in the plastic hinge,

z – the shoulder of the internal couple force in the plastic joint is found by the following formula:

$$z = h_0 - 0{,}5 \cdot x \quad (2)$$

this on the ground x – the height of the compressed zone in the plastic hinge. As the load decreases, it freezes. Real with plastic properties constructions shows multiple static nonionic systems. Therefore, all structures will have an additional bearing capacity reserve. In contrast to static definite systems, static indeterminate systems can carry additional loads due to internal forces when the stresses reach the yield point in the most dangerous sections. The moment of the structure immediately before failure is considered, that is, the moment when the conditions for the balance of internal and external forces reaching the limit values are still fulfilled. This is the reason why the calculation method is called "Limited equilibrium method".

$M_{ex.} \leq 0.5 \cdot M_{is.} + M_{if.} + 0.5 \cdot M_{is.}$ (3)

Mex –external standard load moment;

Mis –internal stresses at the support moment;

Mif –moment of internal stresses in the medium.

It can be seen from the equation that the load carrying capacity of a statically indeterminate structure does not depend on the value of the relationship between the base and intermediate moments and the sequence of plastic hinges. The sequence can beMex –external standard load moment; (3) Mis –internal stresses at the support moment; Mif –moment of internal stresses in the medium. It can be seen from the equation that the loadcarrying capacity of a statically indeterminate structure does not depend on the value of the relationship between the base and intermediate moments and the sequence of plastic hinges. The sequence can be defined freely, it is only necessary to observe the equilibrium equation. When considering a statically defined, freely supported beam close to failure, the reinforcement of which has reached the yield limit, a branch with large local deformation – a plastic hinge – appears in it. The number of such branches can be different, for example, in a beam that is tightly clamped on both sides, they can be three – on both supports and in the span. This means that the bearing capacity of the beam is completely exhausted, that is, the given system breaks down. The value of the force generated by the plastic hinge in the beam is called the limiting force.

With a plastic hinge attached to the beam clamped at the supports, it is precisely this clamping that prevents the turning of its parts. Therefore, as long as the load continues to increase, that is, until plastic branches appear and excess connections are broken, the plastic joint does not break. In a statically uncertain system, the appearance of a plastic hinge is redundant is equal to and means that the static uncertainty of the system decreases by one level [10].

Loss of geometrical invariance of the system can occur only with the appearance of those three plastic hinges – both at the base and in the span. We can see the sequence of redistribution of bending moments under the influence of force F0 (in the figure shown P- load) in the example of a beam with two supports (Fig. 1).

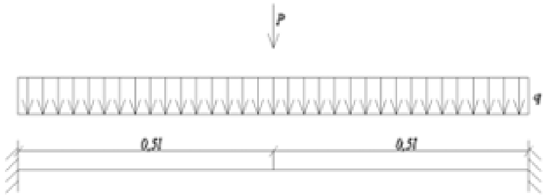

Figure 1. The calculation scheme of the beam with an external load.

We must not forget that the calculation using the limit equilibrium method can be applied only to structural elements made of plastic materials that allow plastic deformations at the most stressed points. This method is also used to calculate the bearing capacity of the element in terms of fire resistance.

Since the light block precast concrete perimeter in question usually rests on the walls, which are made of studs and other materials, it is necessary to make a reinforced concrete belt around the perimeter. During the construction of the inter-floor partition, this belt is protected from twisting by loading with the walls of the next floor. This means that the torsion of the crosssection of the beam and the direct beam in the supporting zones is equal to zero, and its edges are locked together [11].

The loads used in the calculation were obtained based on KMK 20.13330.2016 [4]:

1. Constant loads :

weight of floor / roof coverings (floor covering , warm floor and roof – 3 options); average weight (t/b bulk weight and gas block weight);

2. Short-term loads (long-term):

transverse curtain walls (150 mm); longitudinal curtain walls (100, 120, 150 mm);

3. Short-term loads (short-term):

temporary loads evenly distributed among the spaces (attic rooms: apartments, offices, corridors, halls).

Test-experimental work was carried out by making changes to the types of structures presented for use in the conditions of Uzbekistan. Figure 2 shows the state of the prefabricated monolithic construction type that we propose and called "KOSON-N" before pouring concrete.

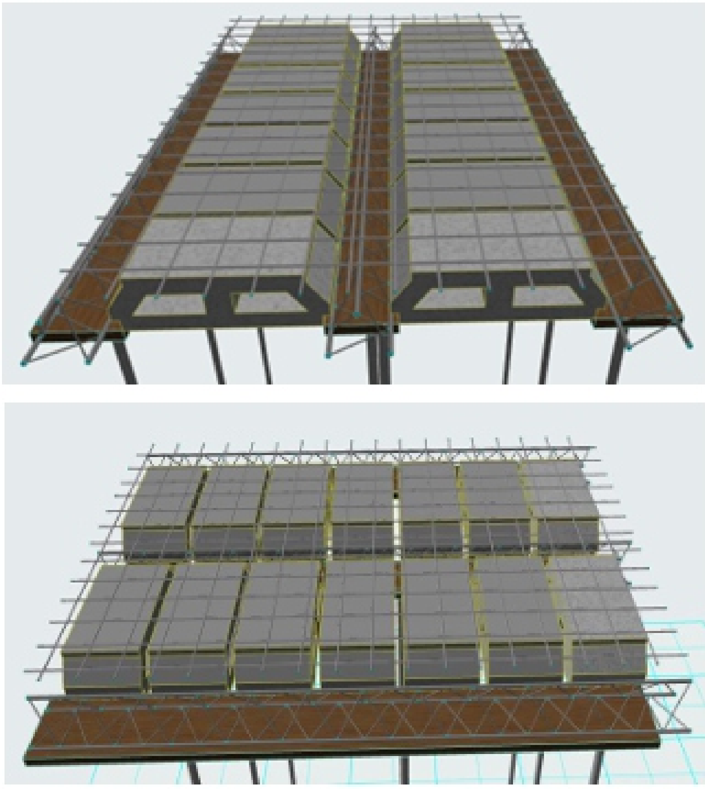

Figure 2. "KOSON-N" intermediate view before concrete placement.

When calculating the "KOSON-N" spacer system, we applied and tested the above-mentioned limit equilibrium method in the conditions of formation of plastic hinges between supports and spacers [5-8]. The result of the test showed us that if the standard load on the media is not less than 600 kg/m2, it was 850 kg/m2 in our experience.

3. Conclusions

Today, prefabricated monolithic types of structures are being developed and used in the world: Photoderm (Austria), Teriva (Poland), Rektolight (France), Ytong (Sweden), Mapko-Econ 1, MarkoStandard 2, Marko-Universal 3, IJ-670 (Russia). In Uzbekistan, it is possible to close complex geometric shapes in conditions of increasing weight of prefabricated monolithic construction, without partitions resorting to during excessive construction technologies for assembly. This makes it convenient to replace such structures not only in new construction, but also in weakened wooden and other partitions of buildings that have served their service life. Most often, prefabricated monolithic partitions in halls serve as the best option for use in the reconstruction of buildings, including the restoration of historical structures.

Prefabricated monolithic spans are a constructive type in new construction, providing high indicators of load-bearing capacity, impact resistance, sound insulation and thermal conductivity of spans. The factors constraining the widespread use of prefabricated monolithic superstructures are that these structures have not yet been sufficiently studied and design standards for them are collapsing. Strength tests and necessary calculations are performed to develop a method for calculating prefabricated monolithic supports.

Calculation methods for prefabricated monolithic formwork are based on deformation models, it should be borne in mind that the structural material is heterogeneous, deformability is physically heterogeneous, work with cracks, subsidence and displacement of reinforced concrete. The criteria for fire resistance of prefabricated monolithic formwork require clarification by conducting special experiments.

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NUMERICAL STUDY OF FLOW AFTER NASA 0012 AERODYNAMIC PROFILE BASED ON THE SST TURBULENCE MODEL

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A B S T R A C T

The article presents a study of the SST turbulence model in the Comsol Multiphysics software package for the problem of subsonic flow around a NACA0012 profile with angles of attack from 0 to 15 degrees, respectively. In this work, the finite element method is used for the numerical implementation of the turbulence equations. To stabilize the discretized equations, stabilization using the Galerkin least squares method was used. The results obtained are compared with the results of experimental data. The results showed good convergence of the SST turbulence model with experimental data.

Key words: Navier–Stokes equations, separated flow, SST model, Comsol Multiphysics, NASA.

1. Introduction

Aerodynamic research is an important part of aircraft development and optimization. One widely used airfoil is the NASA 0012. Numerical methods such as computational fluid dynamics (CFD) provide an effective means to study the flow around a given airfoil and determine its aerodynamic characteristics. Review of numerical methods: CFD Simulation: CFD studies allow you to conduct virtual experiments by simulating flow around an airfoil under different conditions. Solving the Navier-Stokes equations and the turbulence equations using various approaches (for example, k-ε, k-ω models) allows one to estimate aerodynamic parameters. Profile geometric characteristics: Analyzing the thickness and camber in different sections of the chord allows us to understand how geometric features affect aerodynamic properties. Pressure distribution: Studying the pressure distribution along the airfoil surface helps to identify high and low pressure zones, which is important for understanding the lift force generated. Lift and drag: Evaluation of lift and drag at different angles of attack allows us to determine the optimal conditions for using the profile. Border Effects: The study of the influence of the proximity of the profile to a solid surface on the aerodynamic characteristics, as well as the effects of the wing tip, is intended to more accurately take into account the conditions of real application. Computational Fluid Dynamics, or CFD (Computational Fluid Dynamics), is the science of numerically solving systems of equations that describe the movement of liquids and gases. This discipline finds application in modeling a variety of hydrodynamic processes, such as aerodynamic flows around aircraft, turbulent flows, heat transfer, mixing of fluids and many others. The basis of CFD is the Navier-Stokes equations, which describe the conservation of mass, momentum and energy in a liquid or gas. Direct analytical solution of the Navier-Stokes equations is possible only for simple geometric objects and flows. In most cases, a division of space into a grid and a numerical solution at each node of this grid are required. Numerical CFD methods, such as finite difference, finite element or finite volume methods, can solve the Navier-Stokes equations over the entire domain, taking into account the boundary and initial conditions.

The use of CFD in various engineering fields allows the design and analysis of systems, taking into account the physical laws of the operation of liquids and gases. For example, in the aviation industry, CFD can optimize the shape of a wing or fuselage, reduce drag, and improve aerodynamic efficiency. CFD capabilities have also been successfully applied in the design of automobiles, ships, turbines, air conditioning systems and other areas. Thus, CFD is an important discipline in engineering, enabling more efficient design and analysis of a variety of systems associated with the movement of liquids and gases [12]. The Navier-Stokes equations are a system of differential equations that describe the motion of an incompressible fluid:

$$\begin{cases} \frac{\partial \mathbf{v}}{\partial t} + \mathbf{v}\nabla\mathbf{v} = -\frac{\nabla p}{\rho} + \nu\nabla^2\mathbf{v} + \mathbf{F} \\ \nabla\mathbf{v} = 0 \end{cases} \quad (1)$$

where:

v is the fluid velocity vector,

t - time,

p - pressure,

ρ - density,

ν - kinematic viscosity,

F - external force acting on the fluid,

∇ is the nabla operator that determines the

gradient and divergence of the vector field. The first equation - the Navier-Stokes equation of motion - describes the change in fluid velocity over time, under the influence of external forces, viscosity and pressure. The second equation - the continuity equation - guarantees the conservation of the mass of the liquid.

The Navier-Stokes equations are nonlinear equations and are difficult to solve. They are used, for example, to simulate fluid flows in various fields of science and technology, such as aerodynamics, hydrodynamics, oceanography, etc. The NavierStokes equation is a mathematical model of laminar flow. Very many flows are turbulent, so it is necessary to model the Navier-Stokes equation so that this equation has a turbulent character [5–13]. NASA Airfoil 0012 is an airfoil that was developed by the US National Aerospace Administration (NASA). This profile is widely used in aerodynamic research and engineering calculations. Here, "0012" denotes the profile designation format, where the first digit (0) indicates no angle of attack (zero angle of attack), and the last three digits (012) represent the profile shape characteristics. The main parameters of the NASA 0012 profile include thickness, camber (camber) and distribution of the profile along the chord (the longitudinal line running from tip to tail). In this case, the thickness of the profile increases evenly from the front edge to the rear, and the camber characterizes the bend of the profile. An important property of an airfoil is its ability to produce lift at atmospheric pressure, which is especially important in aviation and aerospace applications. A graphical representation of a NASA 0012 airfoil typically includes characteristics such as thickness and camber distribution along the chord, as well as plots of lift, drag, and moment about the rotation point (usually relative to the leading edge of the airfoil). If you have specific questions about NASA Profile 0012 or if you need any specific data, please clarify your request and I will try to provide more detailed information.

The purpose of this article is to study the SST turbulence model for problems of turbulent flow around the NASA 0012 airfoil. The obtained numerical results are compared with known experimental data, which are presented on the NASA Turbulence Modeling Resource (TMR) website [14].

2. SST turbulence model.

Menter's shear stress transfer (SST) model [5-6] is a combination of the k-ε and k-ω models. For the wall layer, k-ω is used, for the outer region - k-ε. This model is currently very popular and is included in many CFD packages.

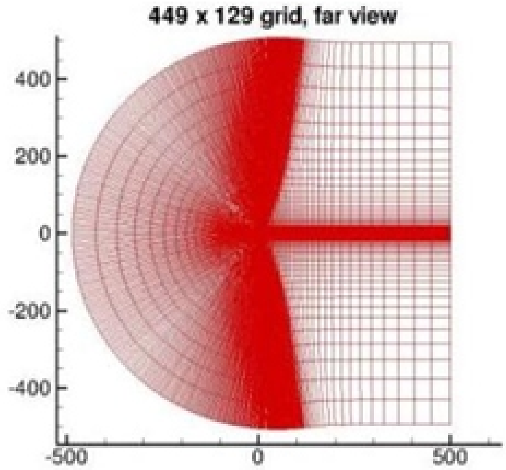
$$\begin{cases} (\mathbf{U}\cdot\nabla)k = \nabla\left[(v+\sigma_k v_t)\nabla k\right] + P - \beta^* \omega k, \\ (\mathbf{U}\cdot\nabla)\omega = \nabla\left[(v+\sigma_\omega v_t)\nabla \omega\right] + \frac{\gamma}{v_t} P - \beta\omega^2 + 2(1-F_1)\frac{\sigma_{\omega 2}}{\omega}\nabla\omega\nabla k. \end{cases} \quad (1)$$

Here k is the specific turbulent kinetic energy ($m^2 s^{-2}$), ω is the specific rate of turbulent dissipation (s−1). Other values are presented in works [5-6].

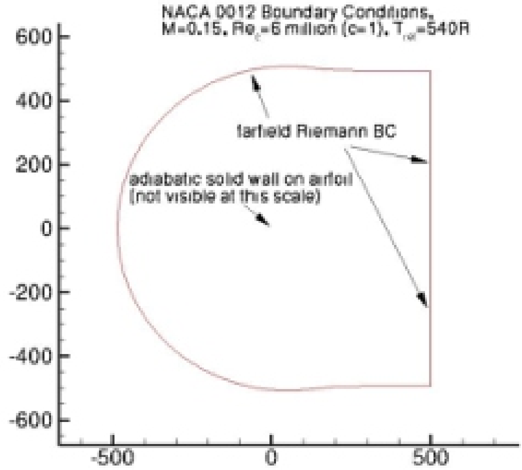
3. Solution method

Standard COMSOL Multiphysics solvers were used for the standard SST turbulence model.

The NACA 0012 turbulent airfoil must be operated under virtually incompressible conditions (recommended here to use M = 0.15 in compressible CFD codes). Reynolds number per chord Re = 6 million. The boundary layers should be completely turbulent over most of the profile of Figure 1. The inflow conditions for the turbulence variables should be specified[14].



a)



b)

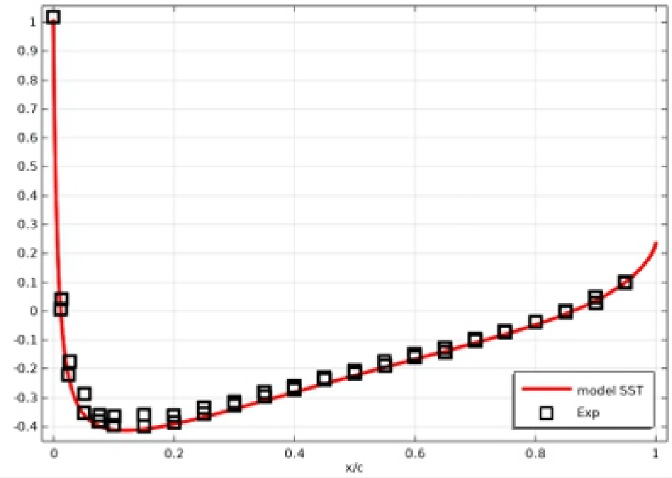
Fig. 1. 2D NACA 0012 Airfoil. a) computational mesh and b) boundary conditions.

The distribution of the surface pressure coefficient on the channel wall is characterized by a change in pressure on its surface depending on the distance from a certain point.

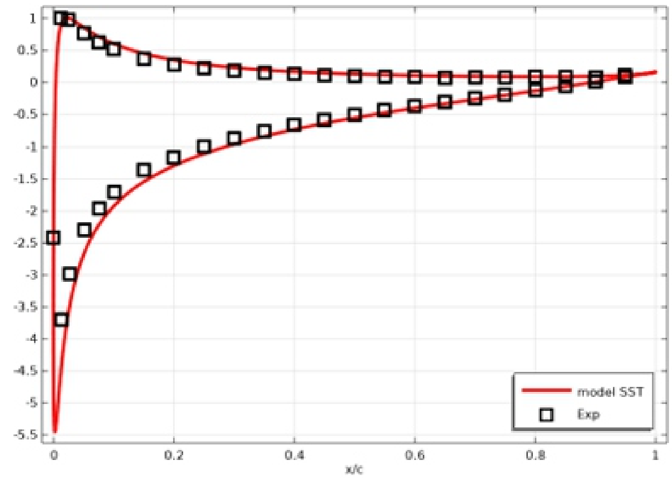
$$C_p = \frac{p - p_\infty}{0.5\rho U_0^2}$$

where p is the pressure at a point on the surface of the profile, P∞ is the pressure of the free flow, ρ is the density of the free flow, U0 is the speed of the free flow.

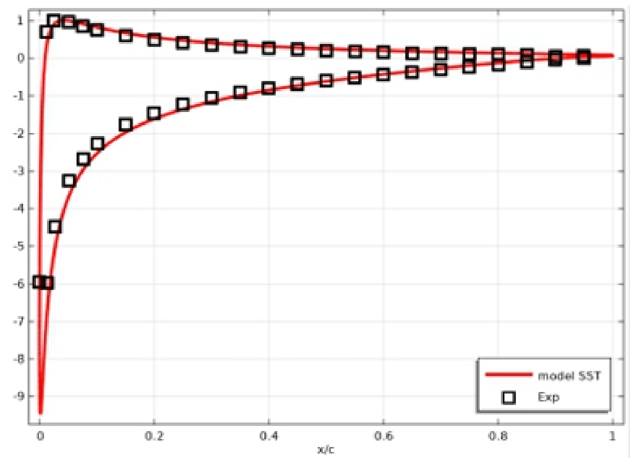
Below are comparisons of the obtained numerical results with known experimental data. Figure 2 shows the pressure coefficient at different angles of attack of the surface profiles as well as the experimental results.



α=0



α=10



α=15

Fig.2 Pressure coefficient at different angles of attack of surface profiles.

Figure 3 shows the effect of angles of attack on lift coefficients.

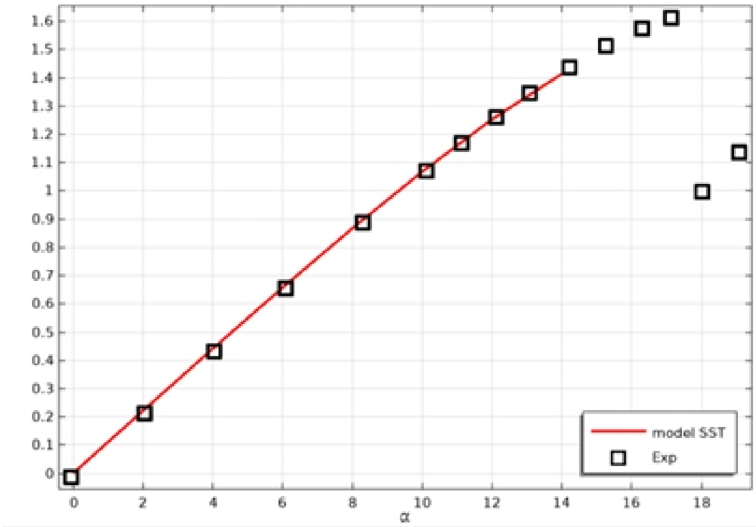
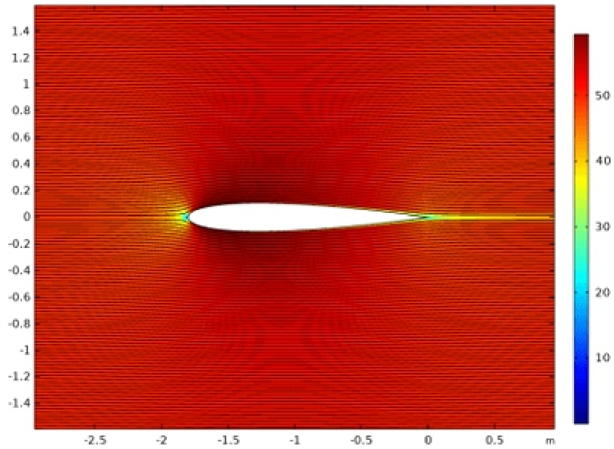
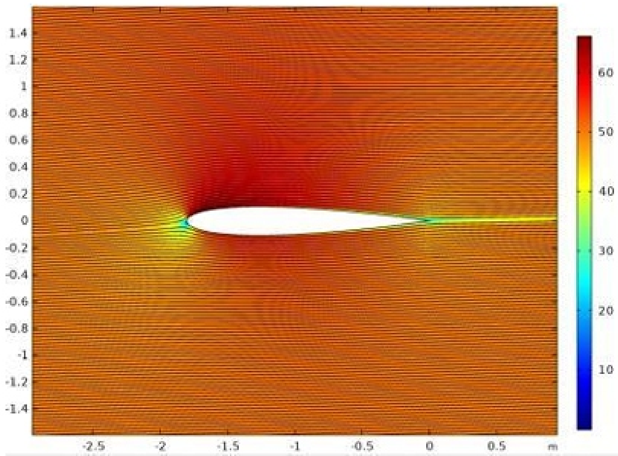


Fig. 3. The influence of angles of attack on lift coefficients.

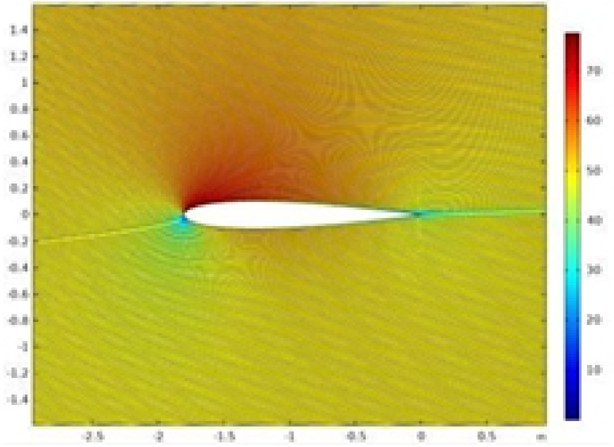
As can be seen from Figures 2-3, the results of the SST model are close to the experimental results. In Fig. Figure 4 shows isolines of the flow velocity at different angles of attack.



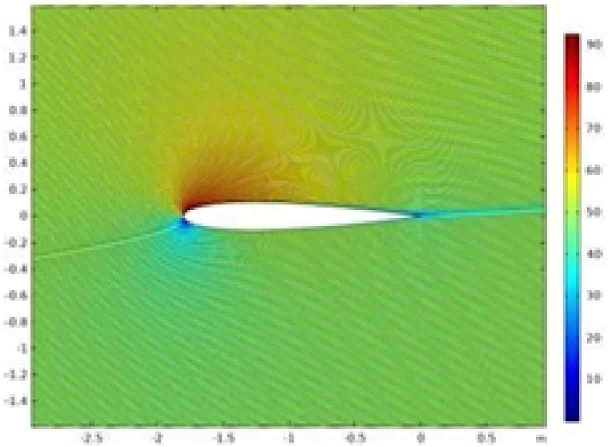
α=0



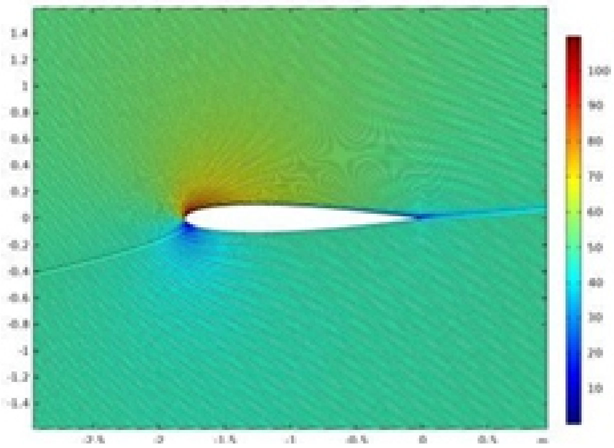
α=2



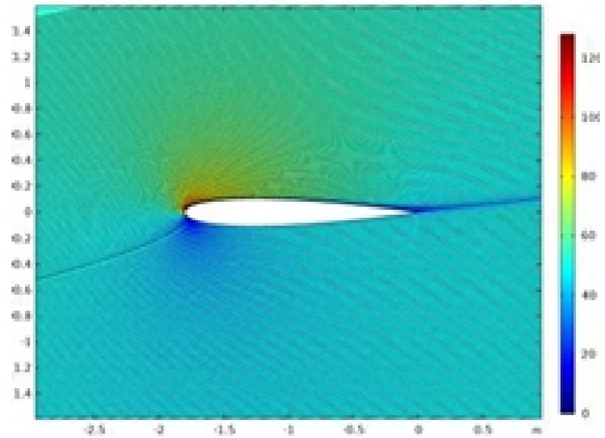
α=4



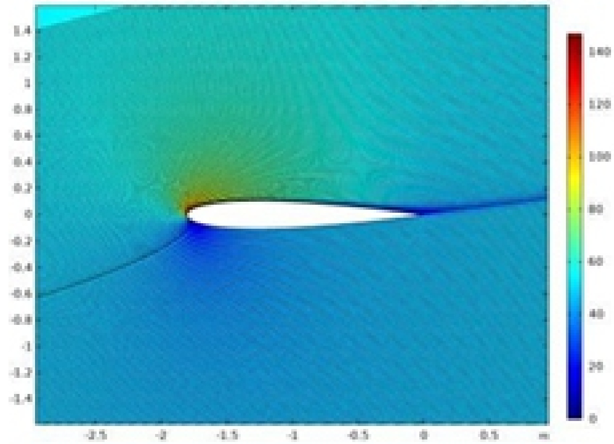
α=6



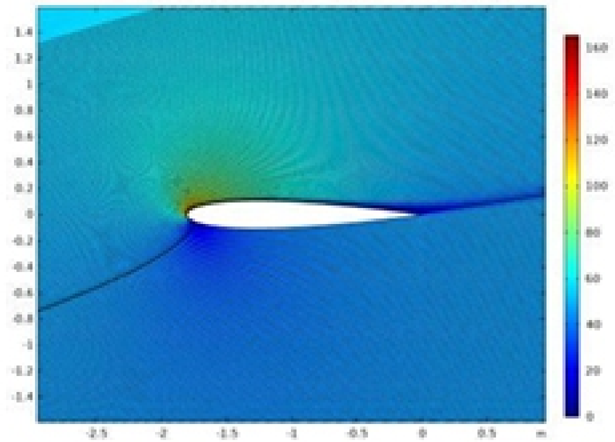
α=8



α=10



α=12



α=15

The SST turbulence model is considered to be the best semi-empirical model available today.

5. Conclusions

A numerical study of the flow around the NASA 0012 airfoil using CFD techniques provides valuable data for engineers and designers. The results obtained can be used to optimize the profile shape, improve aerodynamic efficiency and develop more efficient aircraft. Understanding the aerodynamic characteristics of an airfoil at the level of numerical simulation contributes to the development of advanced technologies in the field of aviation and aerospace.

This article shows the results of a standard SST turbulence model in the Comsol Multiphysics software package, which uses the finite element method. To validate the SST model, the problems of flow around the NASA 0012 airfoil were considered. From the results obtained, it is clear that the SST model has high accuracy for this problem.

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A METHOD OF INCREASING DRAINAGE FLOW TRANSPORTABILITY IN A DRAINAGE PIPELINE

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2Tajik Technical University named after Academician M.S.Osimi

ABSTRACT

The article delves into an examination of the factors influencing the conveyance of water flow in drainage pipes within irrigated regions. It also details research efforts aimed at augmenting the volume of water flow. The study's outcomes revealed that arranging drainage pipes in a sequential manner, with increasing diameters, can significantly amplify flow conveyance compared to conventional pipe setups. The findings underscore the potential for substantial enhancement in flow transportability by employing a series of drainage pipes with incrementally larger diameters. This approach capitalizes on the capacity of larger pipes to accommodate greater water flow, thereby minimizing the likelihood of blockages and obstructions.

Keywords: drainage pipe, ditch, flow transportability, sediments, water flow rate, flow capacity

1. Introduction

In recent years, consistent reforms have been carried out on effective use of land and water resources, improvement of the water resources management system, modernization and development of water management facilities. At the same time, due to global climate change, the growth of the population and economic sectors, and their demand for water is increasing year by year, the shortage of water resources is increasing year by year. The average annual amount of water used was 51-53 billion cubic meters, including 97.2 percent from rivers and streams, 1.9 percent from collector networks, and 0.9 percent from underground, reducing by 20 percent compared to the allocated water intake limit.

In the republic, in 2020-2030, it is necessary to provide the population and all sectors of the economy with water, to improve the reclamation of irrigated lands, to widely introduce market principles and mechanisms and digital technologies to water management, and to ensure the reliable operation of water management facilities. Different reforms are being implemented by the government in order to ensure and improve the efficiency of land and water resource use[1].

In drainage networks, drainage flow transportability refers to the ability to efficiently transport water or other liquids through the pipe system. This is an important aspect of drainage design and is essential for long-term effective maintenance of drainage systems.

The main purpose of drainage network design is to collect excess water in the area, prevent waterlogging and potential damage to existing structures or landscapes. Good drainage ensures that water is efficiently removed from the area, reducing the risk of flooding or waterlogging.

Several factors affect the flow transportabilty of pipes in drainage systems, including pipe diameter, slope, material, and the presence of any local resistances. The diameter of the pipe determines the volume of water that the existing system can hold, larger diameter pipes have a higher flow capacity. The slope of the pipe also has a very significant effect on the flow rate, with steeper slopes allowing for faster flow. The pipe material used in the design of drainage systems can also affect the flow transportability. Smooth and corrosionresistant materials such as PVC (polyvinyl chloride) or HDPE (high-density polyethylene) differ from traditional pipes in that they reduce friction and minimize the accumulation of sediment, and promote better drainage flow.

Local resistance in the drainage pipe, for example, the accumulation of sediments, can significantly impede the movement of the flow. In order to ensure optimal drainage flow, it will be necessary to identify and remove any obstructions and constantly monitor through observation wells.

In an irrigated area, proper design and installation of drainage system pipeline is critical to achieving good drainage. When designing a drainage system, engineers and designers consider factors such as expected water volume, topography of the area, and required flow volume. Proper pipe dimensions, proper slope, and use of appropriate materials are essential to ensure optimal flow.

In conclusion, it can be said that the transportability of the flow in the drainage pipes is very important in preventing the swamping of the area caused by the inefficient use of water and the flood caused by a sharp increase in the volume of atmospheric precipitation, that is, in effectively removing excess water from the area. Various factors such as pipe diameter, slope, material, resistances or lack thereof play an important role in achieving optimum flow transportability.

Water balance equations in irrigated areas, the movement of underground seepage water, determination of the critical depth value, and researches conducted in such scientific areas as the basis of collector-storage types are carried out on the scale of the Commonwealth of Independent States. A.N.Kostyakov, S.F.Averyanov, A.P.Vavilov, L.Prozov V.A.Kovda, N.A.Besednov, K.Mirzajanov, V.A.Dukhovniy, H.Yakubov, H.A.Ahmedov, F.M.Rakhimbayev, F.A.Barayev, Sh.Kh.Rakhimov, B.S.Serikbayev, R.K.Ikramov, It was reflected in the work of MXXamidov, A.T.Salokhiddinov, A.G.Sherov, R.A.Murodov, A.Kh.Karimov, M.Y.Otakhonov and others, and certain positive results were achieved. From the scientific research carried out in recent years at the world level, it can be analyzed that the flow transportability of drainage systems is affected by various factors, for example, the installation of pipes connected at a certain angle, the change of the flow direction, and hydraulic resistance. does [2,6]. In addition, drainage flow transportability is affected by the technical condition of the drainage system and the increase in hydraulic resistance along the drainage section [3]. In addition, the transportability of drainage pipe systems can decrease with the increase of flow velocity, and the change of flow direction at the points of connection of the drainage pipe significantly affects it in the drainage system [7]. In addition, the regional flow transportability of drainage systems is affected by factors such as contributing strength and sub-system resources and interregional flow potential [10]. It is very important that the drainage layers have good drainage properties, sufficient layer thickness and anti-clogging properties at the points where groundwater enters or joins the drainage pipe. Maintaining the design parameters of the drainage pipe system for many years of service life is important[5]. The hydraulic properties of drainage systems, including water carrying capacity and permeability, are very important for their efficiency [4]. In addition, the continuity of unsteady flow in soil movement can affect drainage efficiency, and pavement permeability plays an important role in evaluating drainage flow transportability [8,9]. Increasing water transportability in drainage pipeline system is important for several reasons: An efficient drainage system: Water with good flowability moves through drainage pipes without obstruction or accumulation. This helps prevent or prevent clogging of the drainage pipe, allows water to flow efficiently, and prevents unexpected flooding or ponding in flood or irrigated areas. Maintenance and cost savings: Good water flow permeability in the drainage pipe will reduce the cost of frequent maintenance and opening and reconstruction of drainage pipes. This, in turn, helps to minimize the accumulation of particles, sediment in the drain pipe that impede flow.

Extending the service life of pipes: If the water stream does not flow smoothly due to improper flow transportability, pressure changes and turbulence will occur, which will cause stress on the pipe walls, and over time, this stress can cause the pipe to fail.

Optimizing the flow transportability helps to achieve a stable and controlled flow, reduces the stress on the pipes and extends their service life. Optimum system performance: Effective flow transport allows drainage pipe systems to function optimally. This ensures that wastewater and rainwater reach the desired destination, i.e. collectors, efficiently. This results in improved overall system performance and functionality.

Pipe design, size, slope and regular maintenance play an important role in increasing the flow transportability. Proper design and installation of pipes, regular cleaning of sediments inside the drainage pipes and minimization of interruptions in the flow are the main factors to achieve smooth and portable flow through the drainage pipes.

One of the current challenges with drainage flow portability is the limited availability of mobile and user-friendly software tools for drainage flow analysis and visualization. Most existing software solutions are advanced and require high technical skills, while the lack of experts or practitioners involved in basic drainage flow analysis makes the process somewhat difficult.

In addition, there is a great need to improve the accuracy and reliability of drainage flow prediction. In some cases, existing models and algorithms used to study drainage flow do not adequately reflect the complex interactions and dynamics of water movement across different terrains and land uses. This leads to inaccurate forecasts and unreliable results, and affects decision-making processes related to drainage infrastructure planning and management. At the same time, the issue of data privacy and

2. Materials and Methods

One potential solution to increase drainage flow transportability is to change the diameter of the drainage pipe along its length.(d1=63 mm, d2=90 mm, d3=110 mm, l1=150 m, l2=100 m, l3=50 m, Figure 1).

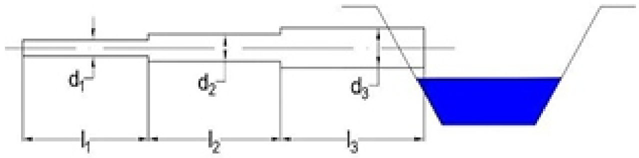

Figure 1. Drainage line with three different diameters.

Changing the diameter of the pipe helps to control the volume of flow passing through the movement section per unit of time, which allows controlling the passage of a certain volume of water and particles through this section. This reduces the risk of sediment accumulation along the length of the drainage pipe and as a result it causes to increase the Coefficient of Performance (the COP) of the drainage system.

A larger pipe diameter can also reduce flow velocity, which adversely affects particle transport in the flow. Also, a lower flow velocity increases the possibility of sediment settling and does not allow the particles in the flow to move together with it as a single body. In the case of a small pipe diameter, the opposite situation occurs, in this case, due to the increase in the flow velocity, high transportability can be achieved, but hydraulic elements that guarantee a steady flow cannot be achieved. Therefore, the optimal diameter of the drainage pipe, which ensures the transportation of particles in the water flow, should be chosen in such a way that, as a result, the movement of the water flow in this drainage pipe will cause the drainage system to work correctly and efficiently for many years and fully perform its function.

If the ditch networks are placed in the direction of the installation network and side by side, then the irrigation network must be equipped with a special coating against water wastage, or the ditch network is designed to be waterpermeable only (closed and the drainage pipes are visible without holes). Hydraulic calculation of closed ditches, water flow rate of ditches (Q3), when the slope (i) and the pipe's roughness coefficient (n) are known, the diameter of the ditch pipe (d), the actual depth of the water in the ditch (h0) and actual speed values (Th 0) is to determine.

The characteristic value of water flow rate in drainage:

$$K = \frac{Q_3}{\sqrt{i}} \qquad (1)$$

According to the graph in Figure 2, the diameter of the drainage pipe is determined from the relationship K=f (d), and it is the standard diameter dSt is brought to dSt through K=f (d) and S=f (d) from graphs of mutual functional dependence0 and S0 values are determined.

When the drainage pipeline is full of water, its transportability to carry particles in water flow rate (Qt)and the velocity of water in it (ϑt) will be as follows.

$$Q_t = K_0 \cdot \sqrt{i} \tag{2}$$

$$\vartheta t = S0 \cdot \sqrt{i} \tag{3}$$

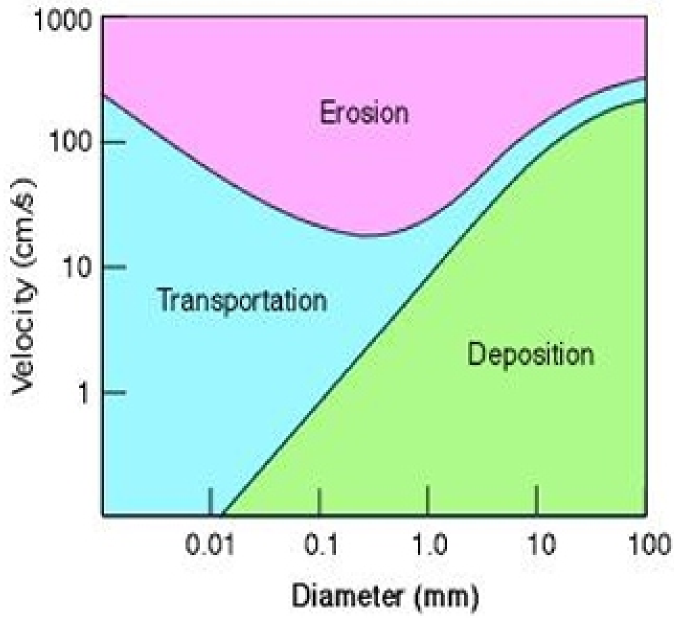

Figure 2. A graph of the relationship between the velocity and the diameter of the sediment - $\vartheta = f\ (d)$.

The real depth of water in drainage pipe (h_0) and the real velocity (Th_0) will be:

$$h_0 = \alpha \cdot dSt \tag{4}$$

$$\vartheta 0 = \beta \cdot \vartheta t \tag{5}$$

where: α and β are values $A = \frac{Q_z}{Q_t}$ is derived from data by value.

Table 1. A table for determining α and β by value

A	α	β	A	α	β
1,0	1,06	1,0	0,5	0,5	1,0
1,07	0,95	1,1	0,414	0,45	0,94
1,068	0,9	1,150	0,332	0,4	0,84
1,068	0,85	1,157	0,256	0,35	0,81
0,994	0,8	1,157	0,188	0,30	0,74
0,927	0,75	1,152	0,124	0,23	0,635
0,830	0,7	1,137	0,080	0,20	0,550
0,750	0,65	1,115	0,045	0,15	0,435
0,678	0,6	1,074	0,020	0,10	0,338
0,583	0,55	1,045	0,004	0,05	0,180

3. Results

In the design of closed ditches, it is important to evaluate the transportability of the flow. When evaluating the transportability of flow, it is necessary to take into account the flow velocity, hydraulic radius, sediment size. Nowadays, several formulas for determining the transportability of the flow have been recommended. The results of the theoretical research revealed that the formula recommended by A.M. Arifzhanov is suitable for determining the transportability in drainage pipe. Because this formula includes almost all the hydraulic elements of the flow:

$$S = \alpha \frac{{\vartheta_{min}}^3}{g \cdot R \cdot W} \tag{6}$$

where: S-flow transportability, *Vmin* – minimum permissible velocity, g-free fall acceleration, hydraulic radius, W-hydraulic quantity in the equation:

$$\alpha = \left(\frac{d_0}{d_i}\right)^3 \tag{7}$$

where: d0-optimal diameter, that is, the diameter of the sediment whose velocity is equal to the current velocity of water flow, di-the average diameter of the sediments in the flow.

In contrast to existing methods, α is a variable quantity in the equation, the value of which changes depending on the regime of motion and energy state of the particles in the flow. In the drainage pipe, as a result of similar processes, that is, as a result of the addition of seepage water from cultivated fields and underground to the water flow in the riverbed, the regime of motion and energy status of the flow changes. From the equation (3) given above, we can base the average velocity of the flow in the drainage pipe being designed.

$$\vartheta_{min} = \alpha_0 \sqrt[3]{S \cdot g \cdot R \cdot W} \quad (8)$$

where:

$$\alpha_0 = \frac{1}{\alpha}$$

Table 2. Calculated sediment transportability for three different diameters

63 mm		90 mm		110 mm	
W, m/s	S, kg/m³	W, m/s	S, kg/m³	W, m/s	S, kg/m³
0.0005	2.09	0.0005	3.5	0.0005	4.85
0.001	0.89	0.001	1.49	0.001	2.06
0.0015	0.53	0.0015	0.89	0.0015	1.24
0.002	0.37	0.002	0.62	0.002	0.87

From the relationship graph in Figure 3 illustrated by the results of Table 2, we can see that if 3 different diameter drainage pipelines are placed in series in order of increasing diameters, the increase of the sediment transportability S will be greater than that of a drainage pipeline with a constant diameter. it will be several times higher.

4. Discussion

However, changing the diameter requires re-updating the existing drainage infrastructure, such as adapting wells to the existing system or adjusting connections. In addition, changes in the volume of water flowing through the system will require modification of open ditches downstream of the outlet pipe to handle existing flow events in the future.

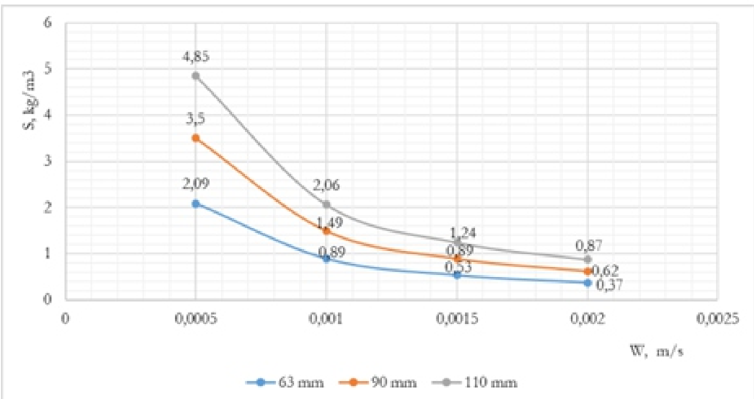

Figure 3. A graph of the relationship for pipes of three different diameters $S = f\ (W)$

Before making any changes, it is recommended that a thorough analysis and hydraulic modeling be conducted to assess the likely impact and feasibility of changing the pipe diameter. Factors such as available flow velocity, sediment characteristics, and overall capacity of the drainage system should be considered in this analysis.

5. Conclusions

To sum up, the essence of the method we recommend is that the drainage pipeline line is divided into 3 sections, taking into account the variability of the water flow rate in the drainage pipeline along the length of the drainage pipeline. At the beginning of the drainage line, a pipe with a diameter of 63 mm, a pipe of 90 mm in the middle and a pipe of 110 mm at the end are laid, that is, the rate of water flow at the beginning of the drainage pipe is less due to infiltration, and in the case of laying a drainage pipe with a small diameter, the velocity of the water flow increases relatively, as a result, the transportability increases and the risk of silting is reduced. Changing the diameter of the drain pipe can be a potential solution to increase the flow transportability of the drain. However, to ensure the effectiveness and sustainability of the drainage system, careful assessment of hydraulic and hydrological factors is essential before any changes are made.

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