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Energy Efficient Building Materials for External Walls of Residential Buildings Physical Properties of Heat

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Abstract:
This article presents the results of theoretical and experimental full-scale thermophysical studies in models of external walls made of fixed formwork from expanded polystyrene.

Determination of heat transfer resistance, coefficient, thermal conductivity, temperature distribution in the thickness of experimental samples, humidity of the regime and heat resistance of external walls erected from non-removable formwork from expanded polystyrene. In addition, the calculation of the humidity regime of the external walls erected from the fixed formwork made of expanded polystyrene was carried out.

Keywords:
exterior, barrier structures, wall, thermal physics, condensation, thermal conductivity, expanded polystyrene, optimal thickness, humidity

1. Introduction. To design energy-efficient buildings, they and the external barrier structures must have a thermal-physical theoretical basis. To do this, the initial thermal-physical calculations of the building and its external barrier structures are performed. In addition, the choice of energy-efficient building materials and devices is made as a result of thermal-physical calculations. As a result of heat-physical calculations, the following can be obtained:

1. A normative microclimate environment is created for people in the rooms of the building;
2. Energy-efficient building materials are selected for the external barrier construction of the building;
3. The thermal insulation layer of the external barrier structure is determined by the physical, optimal thickness of the heat;
4. Energy efficient residential design is achieved;
5. As a result of thermal physical calculations it is determined how much heat energy is saved for heating buildings;
6. The resistance of the external barrier structure of residential buildings to heat transfer is increased;
7. It is determined whether condensate moisture is formed in the layers of the outer barrier structure.

It is clear from the above considerations that, first of all, the climatic conditions of the construction site are taken into account in order to create a normative microclimate for people, especially in residential buildings. The climatic parameters of the construction site affect the following indicators in the rooms of the residential building:

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a. On the surfaces of the external barrier structure and the main of the room the temperature of the parts;
b. relative and absolute humidity of the air in the room;
c. Sanitary and hygienic condition (quality) of air in the room;
d. whether condensate moisture is formed on the inner surface of the external barrier structure of the room;
e. thermal-physical improvement of the structure to increase the thermal protection of the external barrier structure of the room;
f. Whether the indoor air environment is aggressive or progressive towards the barrier structure.

The air temperature depends on whether the barrier is aggressive or progressive towards the structure, not only whether the air contains chemical compounds, but also the temperature and humidity of the air environment.

The minimum and maximum (maximum) calculated values of temperature and humidity are of great importance even in the design of barrier structures, as they change the seasons over the years and are an environment that affects people inside the building. During the design process, average values of temperature and humidity in the rooms of the building are often adopted. These indicators are hygienically responsible for the lower part of the building (room), depending on the type of building fit for purpose, in which moderate temperature and humidity environments are established. Due to the small amount of heat released in almost all residential buildings, they are heated to create a temperate climate. The amount of heat consumed to heat a building also depends on the climatic characteristics of the construction site.

The above figures do not cover all climate effects. We will get acquainted with the main climatic indicators used for the design of external barrier structures.

To determine the estimated time of air movement, the width of the daily temperature change, the level of humidity, the parameters of the outside air, the direction and speed of the wind, the amount of precipitation and other indicators. QMQ 2.01.01 - 94 use Tables 1 – 13

To perform thermal-physical calculations of external barrier structures, the coldest and hottest of the construction sites, the duration of the air temperature, the return are taken into account. Heat - When selecting the outside air temperature for physical calculations, the average weather of the 8 coldest winters recorded at the meteorological stations for the next 50 years is taken. In the climatic zones, we map the boundaries determined by QMQ 2.01.01-94 based on the data in Table 14. As you can see from the QMQ, Samarkand region is located in the 4th climatic zone.

Heat is taken as the coldest average temperature of the outside air on certain days, for physical calculations. The accepted temperature includes the following. Average coldest day temperature - t_{T}^{c}; average coldest five-day temperature - t_{T}^{5}; The average coldest three-day temperature - t_{T}^{3}. To accept one of these parameters, it is necessary to calculate the thermal inertia of the external barrier structures. We determine the thermal inertia by the following

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formula.

$$D = R_1 \times S_1 + R_2 \times S_2 + ... + R_n \times S_n \qquad (1.1)$$

where $R_1, R_2,...R_n$ is the thermal heat transfer resistance of the separate layers of the barrier structure, 0s / W;

$S_1, S_2..., S_n$ - heat absorption coefficients of separate layers of the barrier structure, Вт/($м^{2°} c$); Accepted from QMQ 2.01.04 - 97 * is done

Thermal resistance of multilayer barrier structures, as well as homogeneous barrier structures, R_1, $м^2$ ^{0}c /Вт; following determined using the formula.

$$R = \frac{\delta}{\lambda} \qquad (1.2)$$

where δ is the thickness of the structure, m;

λ is the thermal conductivity of the material, Вт/ $м^2$ ^{0}c.. QMQ is accepted from 2.01.04 - 97 *.

Atmospheric air always contains a certain amount of moisture in the form of water vapor, which is called air humidity. Humidity barrier affects the thermal-physical properties of the structure.

The higher the air temperature, the greater the saturated pressure of water vapor. The temperature dependence of the saturated pressure (elasticity) of water vapor is given in the appendix.

The absolute humidity of the air is determined from the following formula.

$$f = \frac{1{,}058 \times e}{1 + \frac{t}{273}} \qquad (1.3)$$

where t is the air temperature, ^0c; e is the true elasticity of water vapor, mm.sim.ust. Often heat - relative humidity is used in physical calculations.

Relative humidity is the ratio of the elasticity of real water vapor to the maximum elasticity of saturated water vapor, which is determined by the following formula.

$$\varphi = \frac{e}{E} \times 100\% \qquad (1.4).$$

If the temperature of the air rises, its relative humidity decreases, because as the temperature rises, the pressure of saturated water vapor also rises. Conversely, as the air temperature

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decreases, the elasticity of water vapor does not change, and the humidity of the air rises due to the decrease in the elasticity of saturated water vapor.

2. The main part. There are the following methods of thermophysical improvement of the structural material of external building envelopes:

1. By increasing the thermal protection of the external building envelope;
2. Choosing energy efficient building materials for the erection of the external fence of the building;
3. Due to the effective constructive solution of the external building envelope.

Various energy-saving constructive solutions are currently being used as external barrier structures to save natural energy resources and to design energy-saving buildings around the world, including Germany, Denmark, Sweden, USA, Russia and other countries [20] . For example, by applying a layer of thermal insulation to the inner surface of the barrier in order to enhance the thermal protection of the outer barrier structure. In addition to the positive side of this constructive solution, the main disadvantage is the following. That is, if a thermal insulation material with a very high thermal conductivity resistance is built from the inner surface of the outer wall, condensate moisture is likely to form at the boundary between the thermal insulation layer and the outer wall. This situation has been observed in practice and theoretical research. To prevent such a situation, it is recommended to build a layer of thermal insulation on the outer surface of the external barrier structure. In this case, the external barrier creates a state of humidity and heat as long as it meets regulatory requirements.

Such constructive solutions are presented in the following schemes.

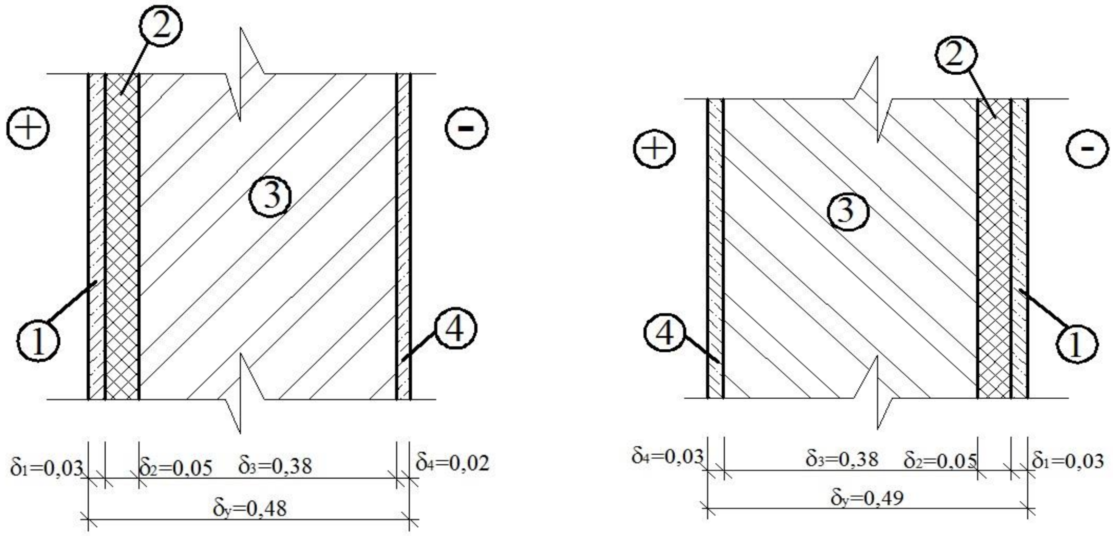

Figure 1.1. Thermal protection schemes embedded on the inner and outer surfaces of a brick wall.

1- 4 - cement - sandy plaster; 2 - heat insulating layer; 3 - brick wall.

A multi-layer structural solution that increases the thermal protection of the outer wall is also being used in practice. Such a constructive solution consists mainly of three layers:

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- thermal insulation layer - this layer consists of a mineral plate, polystyrene foam or other with very low thermal conductivity;
- a layer of alkali-resistant wire mesh glued with a special glue;
- A layer of protective makeup plaster.

"Clinker" tile or natural stone can be used as this layer.

Such a constructive solution is shown in Figure 1.2.

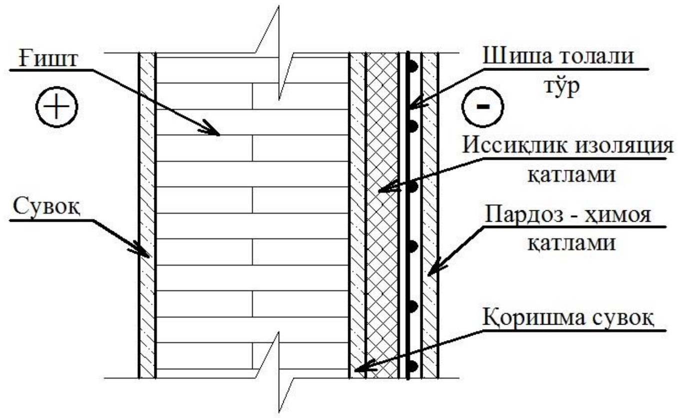
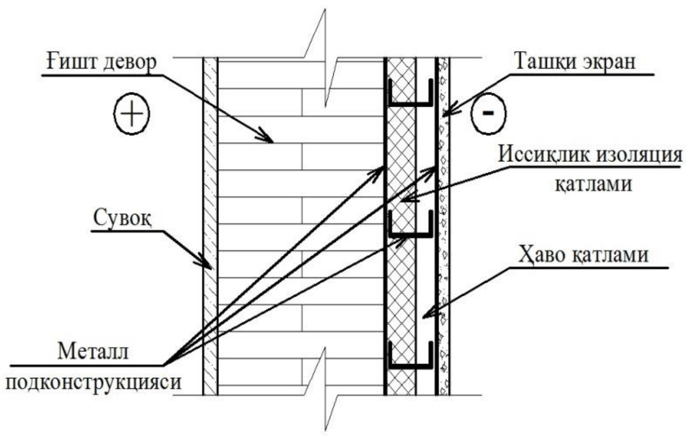


Figure 1.2. A constructive solution of a multi-storey wall with increased thermal insulation.

At present, a constructive solution equipped with various plates, leaving an air exchange space in the facade of the building, is widely used in practice . This constructive solution consists of the following layers. A metal frame is attached to the outer surface of the outer wall and equipped with a screen made of plates or sheets. The distance between the screen and the outer wall surface should be assumed to be such that a gap of 40 mm to 100 mm is required between the heat insulating plate and the plate.

The thickness of the thermal insulation layer installed on the outer surface of the wall is determined by thermal-physical calculations. A schematic of this constructive solution is shown in Figures 1.3 and 1.4.



1.3 - picture. A constructive solution with a ventilated air layer built into the outer surface of the wall.

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Figure 1.4. Constructive solution for the facade of the ventilated air gap of the PAROC system.

Condensate moisture practically does not form in the layers of such structures.

Such a constructive solution increases the effectiveness of thermal protection of external barrier structures of buildings.

In addition to the positive aspects of the constructive solutions of the above walls, there are also negative aspects. These include:

1. It takes a lot of labor to implement such constructive solutions;

2. The cost of such constructive solutions is very high, from 1 to 40-50 US dollars;

3. Most of the materials used in this constructive solution are imported;

3. The final part. At present, the thermal and physical properties of some local building materials have not been fully studied. Therefore, the more accurately the thermal-physical properties of building materials are accepted, the more accurate the thermal-physical calculations will be.

The calculated thermal and physical properties of various building materials, structures and thermal insulation materials are given in QMQ 2.01.04 - 97 *. These properties include: a) thermal conductivity; b) specific heat capacity; c) coefficient of thermal conductivity of the material in the dry state; g) coefficient of heat absorption during the use of the material; e) vapor absorption coefficient, etc.

In addition to the indicators listed above, thermal physics the calculations use the relative humidity of the air and the material, the density of the construction or material in it during use, and so on.

Thermal conductivity is the property of a building material to remove a certain amount of heat from its own body.

The thermal conductivity is represented by the thermal conductivity λ of this material.

To determine the coefficient of thermal conductivity, if the surface is F, $1\,м^2$ and the thickness is δ meters, $t_1 > t_2$, the amount of constant heat (kcal) passing through the wall for Z hours is determined according to the following formula.

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$$Q = (t_1 - t_2) \times F \times Z \times \frac{\lambda}{\delta} \quad (1.5).$$

If the amount of heat Q is known, the thermal conductivity can be determined using the following formula.

$$\lambda = \frac{Q \times \delta}{(t_1 - t_2) \times F \times Z} . \quad (1.6).$$

If we take δ = 1m, F=1 $м^2$, $(t_1 - t_2)$=1 $м^2$ and Z = 1 hour, $\lambda = Q$,, we will have. From the above formula it is possible to determine the unit of measurement of thermal conductivity, ie λ, Вт/м·^{0}C or ккал/(м·hours·^{0}C).

Thermal conductivity of building materials λ = 0.029 (polystyrene foam) to λ = 3.49 Вт/(м·^{0}C) (granite)

The thermal conductivity of the metal is even higher. For example, λ = 58 Вт/(м·^{0}C) for steel, λ = 221 Вт/(м·^{0}C) for aluminum, and λ = 407 Вт/(м·^{0}C) for copper.

The magnitude of the thermal conductivity is not constant for the same material, it changes with the direction of heat flow, density and humidity of the material.

Heat capacity is the heat-absorbing property of a material as the temperature rises. Heat capacity indicator - the specific heat capacity of a material is expressed by C.

The amount of specific heat capacity is measured in Wt (kcal.) Of the amount of heat expended to raise the temperature of a kg of material mass to 1^{0}C.

The dependence of the specific heat capacity on the moisture content of the material is determined by the following formula.

$$C_\omega = \frac{C_0 + 0{,}01 \cdot \omega_н}{1 + 0{,}01 \cdot \omega_н} \quad (1.7)$$

where C_ω is the specific heat capacity of the material in the wet ($\omega_н$) state;

C_0 is the specific heat capacity of this material in the dry state;

$\omega_н$ is the relative humidity of the material,%.

If the external barrier structure consists of several different building materials, its specific heat capacity is determined using the following formula.

$$C = \frac{C_1 . P_1 + C_2 \cdot P_2 + \cdots\cdots + C_n \cdot P_n}{P_1 + P_2 + \cdots\cdots + Pn} \quad (1.8)$$

where, C_1, C_2, ... C_n is the specific heat capacity of each of the building materials that make up the structure;

P_1, P_2, ... P_n - the relative amount of these materials in relation to the structure.

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Heat absorption coefficient, Z of the material over time depending on the coefficient of thermal conductivity, heat capacity and density, it is determined using the following formula.

$$S = \sqrt{\frac{2\pi \cdot \lambda \cdot C \cdot \gamma}{Z}} \qquad (1.9).$$

In particular, if Z = 24 hours, formula takes the following form.

$$S = 0{,}51\sqrt{\lambda_\omega \cdot C_\omega \cdot \gamma_\omega} \qquad (1.10)$$

γ_ω - density of the material used in each layer of the external barrier structure during operation, kg / m3; this is determined using the following formula

$$\gamma_\omega = \gamma_0 \cdot \left(1 + \frac{\omega}{100}\right) \qquad (1.11)$$

γ_0 - density of the material in the dry state, kg / m3;

ω - relative humidity of the layer material during use, (%);

C_ω is the heat capacity during operation of a separate layer of the external barrier structure.

λ_ω is the thermal conductivity of the outer barrier structure during the use of each layer of material

coefficient is taken from QMQ 2.01.04 - 97 *.

According to the law of thermal conductivity, the amount of water vapor diffusion in a flat wall of homogeneous material under constant (stationary) conditions is determined using the following formula:

$$P = (e_u - e_T)F \cdot Z\frac{\mu}{\delta} \qquad (1.12)$$

where P is the amount of water vapor passing through the structure during the diffusion process, г; $e_и$ and $e_т$ - elasticity of water vapor on the inside and outside of the barrier structure, mm.sim.ust .; μ is the vapor absorption coefficient, мг/(м.с.Па).

Formula (1.12) can be used without water vapor condensation on the wall. The water vapor absorption coefficient of a material depends on its physical properties, which reflect the water vapor permeability property by self-diffusion.

Water vapor passing through the layer of material through diffusion encounters a certain resistance. This resistance is called the water vapor absorption resistance of the material layer and is expressed using the following formula

determined:

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$$R_Б = \frac{\delta}{\mu} \qquad (1.13)$$

where, δ is the thickness of the construction material or layer, m.

The thermal-physical properties of the building materials analyzed above differ from the thermal-physical properties often determined in practical experiments. Therefore, it is expedient to conduct thermal-physical studies on a sample of non-cast wall made of thermophysically improved polystyrene foam and compare the results with the calculated values.

4. Conclusion. It is known that in the current era, the design, construction and repair of energy efficient buildings is important. The design, construction and repair of energy efficient buildings are carried out as a result of their thermal physical research and engineering thermal physical calculations.

Recently, construction of residential buildings according to standard designs has been widely used in the country.

However, today, practically in all buildings during construction and renovation, energy efficiency is not given due attention. Therefore, our goal is to select and recommend modern building materials and structures to improve energy efficiency in the construction of public and residential buildings.

References

1. ҚМК-2.01.01-94. Лойиҳалаш учун иқлимий ва физикавий-геологик маълумотлар. Ўзбекистон Республикаси Давлат Архитектура ва Қурилиш Қўмитаси. Тошкент. 1994 й.

2. ҚМҚ 2.01.04-97*. Қурилиш иссиқлик техникаси. Ўзбекистон Республикаси Давлат Архитектура ва Қурилиш Қўмитаси. Тошкент. 2011 й.

3. СП 23-101-2004. Проектирование тепловой защиты зданий. Москва. 2004.

4. В.Файст. Основные положения по проектированию пассивных домов. Издательство Ассоциации строительных вузов. 2008.

5. Тулаков Э.С., Бўронов Ҳ., Матёқубов Б.П., Абдуллаева С. А.. Кам қаватли турар-жой бинолари ертўла деворларининг иссиқлик изоляция қатлами қалинлигини ҳисоблаш. //Me'morchilik va qurilish muammolari Проблемы архитектуры и строительства.Samarqand 2020. №2. -С.41-45.

6. Тулаков Э.С., Иноятов Д., Курбонов А.С., Матёқубов Б.П.. Бинолар-нинг ертўла деворларини иссиқлик изоляциялаш ва унинг қалинлигини ҳисоблаш. //Me'morchilik va qurilish muammolari Проблемы архитектуры и строительства.Samarqand 2020. №4.(2-қисм) -С.29-32.

7. Тулаков Э.С., Матёқубов Б.П.. Thermal Insulation Of The Foundation Walls Of Buildings And Calculation Of ItsThickness. THE AMERICAN JOURNAL OF ENGINEERING AND TECHNOLOGY (TAJET) SJIF-5.705 DOI-10.37547/tajet Volume 3 Issue 04, 2021 ISSN 2689-0984 The USA Journals, USA www.usajournalshub.com/inde x.php/tajet -С.70-78

International Journal of Culture and Modernity
ISSN 2697-2131, **Volume 9**
https://ijcm.academicjournal.io/index.php/ijcm

8. Melikov Zarshed Jamshedovich. (2021). RULES FOR INSPECTION OF THE TECHNICAL CONDITION OF THE BUILDING DURING RECONSTRUCTION. European Scholar Journal, 2(5), 118-121. https://doi.org/10.17605/OSF.IO/J7WMV
9. Melikov Zarshed Jamshedovich, & Abdurakhmon Akhunjanov. (2021). SAFETY RULES WHEN CHECKING THE TECHNICAL CONDITION OF A BUILDING DURING RECONSTRUCTION. European Journal of Humanities and Educational Advancements, 2(6), 56-59. https://doi.org/10.17605/OSF.IO/7V35B
10. Atamurodov, B., Sirozhiddinov, U., & Kamolov, A. Investigation of Alkali Cements and Concrete Based on Local Raw Materials. JournalNX, 359-364.
11. Qizi, Y. Z. S. (2021). Determination of pressure in the plunger during the operation of oil wells by submersible pumps. ACADEMICIA: An International Multidisciplinary Research Journal, 11(3), 159-163.
12. Sirojiddinov, U. S., & Shodiyev, K. (2021). ALKALINEACTIVATED OIL-WELL CEMENTS AND SOLUTIONS ON THE BATE OF LOCAL ACTIVE MINERAL SUBSTANCES AND WASTES OF PRODUCTION. Oriental renaissance: Innovative, educational, natural and social sciences, 1(5), 486-491.
13. Shodiyev, K. (2021). FEATURES OF STATE REGULATION OF DEVELOPMENT OF TOURISM IN UZBEKISTAN. Oriental renaissance: Innovative, educational, natural and social sciences, 1(5), 492-497.
14. Shodiyev, K. (2021). Contribution of ict to the tourism sector development in Uzbekistan. ACADEMICIA: AN INTERNATIONAL MULTIDISCIPLINARY RESEARCH JOURNAL, 11 (2), 457-461.
15. Shodiyev, K. (2021). The Contribution of ICT to the Development of Tourism in Uzbekistan. Academic Journal of Digital Economics and Stability, 9, 38-42.
16. Shodiyev, K. (2021). THE USE OF ECONOMIC AND MATHEMATICAL METHODS WHEN ANALYZING THE ACTIVITIES OF ENTERPRISES. Scientific progress, 2(3), 108-118.
17. Shodiyev, K. (2021). THE USE OF ECONOMIC AND MATHEMATICAL METHODS WHEN ANALYZING THE ACTIVITIES OF ENTERPRISES. Scientific progress, 2(3), 108-118.
18. Shodiev, T., Turayey, B., & Shodiyev, K. (2021). ICT and Economic Growth Nexus: Case of Central Asian Countries. Procedia of Social Sciences and Humanities, 1.
19. Shodiyev, K. (2021). Contribution of ict to the tourism sector development in Uzbekistan. ACADEMICIA: AN INTERNATIONAL MULTIDISCIPLINARY RESEARCH JOURNAL, 11(2), 457-461.
20. Шодиев, К. (2021). ТУРИСТИК СОҲАДА КЛАСТЕР ВА ДАВЛАТ ХУСУСИЙ ШЕРИКЧИЛИГИ АСОСИДА ТАДБИРКОРЛИКНИ РИВОЖЛАНТИРИШ. Scientific progress, 1(6), 857-864.
21. Shodiyev, K. (2021). OPTIMIZATION OF PRODUCTION ACTIVITY OF THE TOURIST ENTERPRISE. Academic Journal of Digital Economics and Stability, 6, 106-114.

International Journal of Culture and Modernity
ISSN 2697-2131, **Volume 9**
https://ijcm.academicjournal.io/index.php/ijcm

22. Shodiev, K. (2021). THE ENTREPRENEURSHIP DEVELOPMENT ON THE BASIS OF GOVERNMENT–PRIVATE PARTNERSHIP AND CLUSTERING IN THE TOURISTIC SPHERE. ResearchJet Journal of Analysis and Inventions, 2(04), 177-183.
23. Sirojiddinov, U. S., & Shodiyev, K. (2021). Investigation of Alkali Cements and Concrete Based on Local Raw Materials. International Engineering Journal For Research & Development, 6(3), 1-16.
24. Tulakov Elmurad Salomovich, Matyokubov Bobur Pulatovich. Thermal Insulation Of The Foundation Walls Of Buildings And Calculation Of ItsThickness. THE AMERICAN JOURNAL OF ENGINEERING AND TECHNOLOGY (TAJET) SJIF-5.705 DOI-10.37547/tajet Volume 3 Issue 04, 2021 ISSN 2689-0984 The USA Journals, USA www.usajournalshub.com/inde x.php/tajet -C.70-78
25. Goyibov Oybek Inatillayevich, Matyokubov Bobur Pulatovich. Analysis of Underground Projects of Energy Efficient Low-Rise Residential Buildings Built on Highly Flooded Soilshttps://doi.org/10.31149/ijie.v4i9.2156 Copyright (c) 2021 Author (s). This is an open-access article distributed under the terms of Creative Commons Attribution License (CC BY).To view a copy of this license, visit https://creativecommons.org/licenses/by/4.0/