INTERNATIONAL JOURNAL FOR INNOVATIVE RESEARCH IN MULTIDISCIPLINARY FIELD ISSN: 2455-0620 Volume - 5, Issue - 8, Aug – 2019
Monthly, Peer-Reviewed, Refereed, Indexed Journal with IC Value: 86.87 Impact Factor: 6.497
Received Date: 13/08/2019 Acceptance Date: 22/08/2019 Publication Date: 31/08/2019

DESIGNING ARCHITECTURAL-SPATIAL STRUCTURE OF SMALL-STOREY RESIDENTIAL BUILDINGS WITH SUNNY HEATING

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Abstract: *The article provides the basics of designing energy-efficient low-rise residential buildings with a passive solar heating system in Uzbekistan.*

Key Words: *helio houses, solar house, ayvan, energy-efficient, temperature.*

1. INTRODUCTION:

One of the main factors in the rational design of the architectural and spatial composition of a solar house is to ensure the desired angle and tilt of the solar system, allowing maximum use of its heat generating abilities. However, when choosing one or another volumetric solution, taking into account the placement options for solar installations, one should pay attention to the fact that solar receivers can simultaneously play the role of effective thermal insulation of a building [1, 2].

2. LITERATURE REVIEW:

Due to the high temperature created inside the heat receiver during the period of exposure to direct sunlight, heat losses through those sections of the building that come into contact with the solar receiver are zero. In cloudy weather and at night, the process must be considered as heat loss through protected unheated rooms.

3. MATERIALS:

Glazed ayvan plays the role of a buffer zone, significantly reducing the heat loss of the building. Calculations show that at night the amount of heat lost by the building is protected by a solar receiver, the surface of the wall structure is about 2 times less than the unprotected area. This was confirmed by an experimental study. When the average ambient temperature was equal to 1,0 ^{0}C, and in the room it was 20,0 ^{0}C, in the winter garden, which played the role of a gelio receiver, the temperature was within 10 ^{0}C of heat, that is, the average value between the external and internal air, which is two times reduces heat loss through living quarters. Thus, the effectiveness of one or another volumetric solution of a solar house is determined by two factors: ensuring the optimal angle of inclination and orientation of the solar receiver in terms of maximum capture of solar energy and the magnitude of reducing heat loss in buildings by additional thermal insulation of the solar receiver.

4. METHOD:

At this stage of the research, we obtained positive results of solar heating with a single-row arrangement of rooms. At the same time, each room has direct access to the "sunny ayvan" Fig-1. A single-row arrangement of the premises is characteristic of historically developed public housing for many regions of the territories of Uzbekistan. Solar engineering requirements to ensure optimal southern orientation of glazed ayvans-low-temperature solar receivers impose special conditions for the placement of the building on the site, the development of solar houses in different directions of the streets [3, 4].

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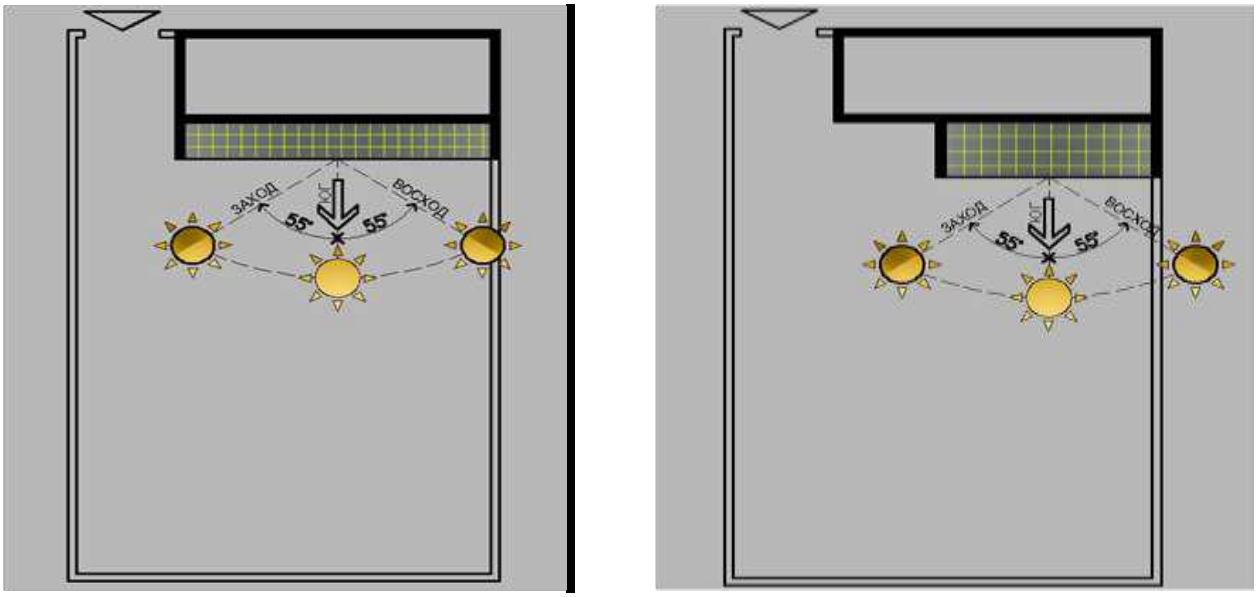

Fig-1. Spatial structure of helio houses on the south side latitudinal street. Solar Low Temperature – Glazed ayvan occupies the entire southern facade -1 and its part-2.

The most acceptable options for the spatial structure of low-rise solar houses with the latitudinal direction of the streets are shown in Fig-2.

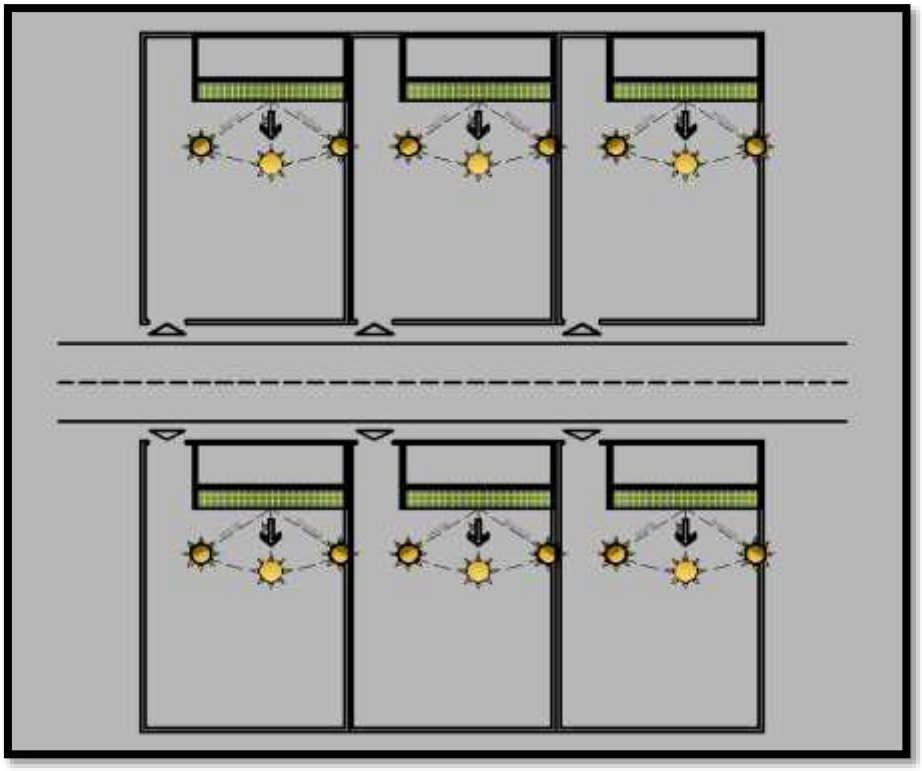

Fig-2. Helio building houses in the latitudinal direction of the streets

5. DISCUSSION:

On the south side of latitudinal street, houses must be located in the back of the plot, which is also widely practiced in the construction of public housing.

With the diagonal direction of the streets, the residential building takes on a “G” shaped shape with the location of a triangular-shaped ayvan-solar collector in the inner corner of the house Fig-3. Such a spatial structure provides the optimal orientation of the ayvan to the south and its relationship with residential premises.

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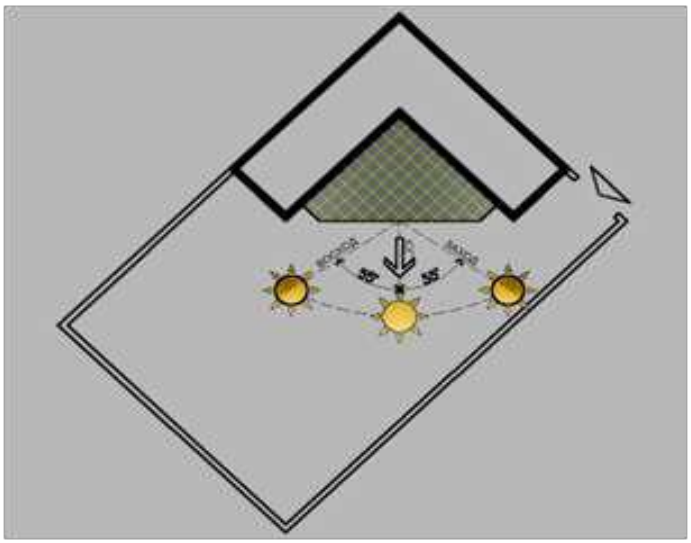

Fig-3. "G" shaped plan of the gelio-house diagonal direction streets.

Such a spatial structure of the solar house makes it possible to obtain planning schemes for building in the direction of the streets from the north-east to the south-west and in the perpendicular direction from the north-west to south-east Fig-4.

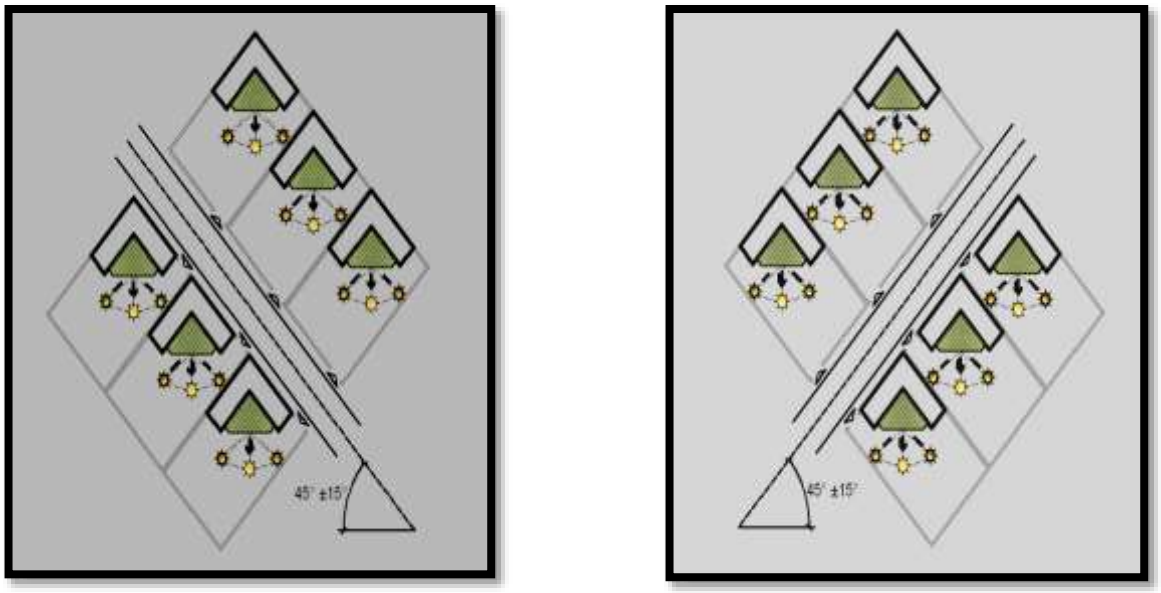

Figure 4. Building with helio houses in the diagonal direction of the streets.

6. SUMMARY:

The above are possible variations in the spatial structure of solar houses and fragments of their development, taking into account the permissible deviations of the solar installation from the southern orientation, which makes it possible to obtain acceptable building schemes for almost any urban planning situations.

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