Light Guardian

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The paper is of the school study type (a kind of scientific expertise of a feasibility study), which refers to the identification of the optimal way to achieve the darkening of a space with the destination of a festive hall, in which natural light enters through a pyramidal skylight, located in the ceiling of the room. Our work steps were as follows:

Stage I- Construction of a virtual space model. For this, the ArchiCAD 23 program was used and based on it, the model of the amphitheater and the central body of the college was built.

Stage II- Identify a way to simulate the movement of the sun in the sky and to dynamically position this movement over the space model. Unifying the two stages, it was very clear that the old building only covers the pyramid to a small extent and the problem of finding solutions to reduce the flow of light or darkening is not solved naturally.

Stage III- Calculate/measure the illumination of different regions of the pyramid for a few moments belonging to different seasons. This was done using the physics lab's experimental kit, which includes a light sensor. It was found that the area under the pyramid is extremely bright, due to the lens effect of the windows, which under the action of their own weight were noticeably curved.

Stage IV- Identify solutions for darkening the amphitheater-type space, feasible and cost-acceptable solutions.

IV. 1) The use of a mirror-like layer, which is a foil with a special inner composition, can be mounted on the inner or outer face of the pyramid and achieves a constructive interference for the reflected light, decreasing the luminous flux of the transmitted light.

IV. 2) The use of an anti-transmissive layer, which works in destructive interference for the transmitted light.

IV. 3) Use of a polarizer+analyzer system. A polarizing layer is mounted on the outside of the pyramid and a grid of rectangular polarizing foils is mounted on the inside. The grille is mechanically or electrically malleable and allows the rectangular foils to be tilted at an angle that allows a desired amount of light to pass through. At least in theory, the method allows for the darkening of space. We obtained a 60% efficiency of the method.

IV. 4) Use of an electrically switchable layer, which already exists on the market. It is especially interesting from a scientific point of view, because it is based on the orientation of molecular dipoles in the electric field, which makes the switchable layer go from transparent to opaque. A disadvantage is the high price.

IV. 5) Using a light-spreading layer is an original idea. Many problems, which appeared in the case of the previously made solutions, would be solved if small spheres of different sizes were placed on the surface of the glass, so that there would always be rays perpendicular to different parts of them. They will behave like reflective slats, with variable thicknesses. It would be ideal for the glass spheres to be of different refractive indices (made of glass of different qualities). to enhance the light reflected by different colors, and the transmitted light to remain transparent.

Stage V- Testing the proposed solutions, measuring their efficiency, concluding on the best way to solve the problem.