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Graphic Reconstruction of the Late 17th Century Building "Madreseyi Dor Ush-Shifo" In the City of Bukhara

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Abstract: The article provides information on the history of the formation of madrasas in Central Asia, identifies the design methodology of 17th-century Bukhara architects, and based on this, a graphic reconstruction of the medical center "Madreseyi dor ush-shifo," built by the Bukhara Khan Subhankuli Khan in the 17th century, was developed. The original parameters of this building were determined in modern length measurements, and the proportional system of architectural shapes was identified.

Keywords: Bukhara, 17th century, public hospitals, design methodology, modular grid, graphic restoration, proportionality of building dimensions.

It is known that in the Middle Ages, in all major cities of the Islamic world, along with other public buildings, public hospitals were also built. In addition to hospitals, the healing class of public buildings included pharmacies, baths, buildings constructed over thermal springs (garmoba), and steam baths (obzan). Sometimes, medical centers were formed based on public hospitals, mainly consisting of hospital buildings, a madrasa, a library, and a bath. If public hospitals were called "bemoristan" or "dor ush-shifo," then medical treatment centers were called "madresayi dor ush-shifo." One such center was established at the end of the 17th century in Bukhara by Bukhara Emir Subhankuli Khan (1680-1702). Subhankuli Khan was enlightened, had good medical knowledge, treated patients himself, and wrote the book "Ikhyo at-tibbi Subkhoniy" (Subhankuli Khan's Medicine), which was repeatedly published and translated into European languages. His medical center was located at the main gates of the Bukhara Ark, on the right side of the Bukhara Registan (Fig.1). In addition to "dor ush-shifo," Subhankuli Khan built many other civil buildings not only in Bukhara but also in Balkh. Among them were madrasas, mosques, caravanserais, pools, and charbagh gardens.

In the photograph (Fig.1), taken in the second half of the 19th century by Russian missionaries, part of this center is clearly visible on the left side. In Fig.2, we see "Madreseyi dor ush-shifo" and the Ark of the Bukhara citadel in the Registan, surrounded by other public buildings.

(Figures and captions omitted for brevity)

In photographs (Figs. 3 and 4), fragmentary images of Dor ush-shifo are visible. The first shows a top view of the building, taken from the Bukhara Ark. We see the inner courtyard and domes of the buildings. The other shows a perspective of Dor ush-shifo. These photographs were taken in the 1930s when the building had fallen into disrepair and was in a semi-ruined state.

The medical center of Subhankuli Khan most likely functioned until the beginning of the conquest of Bukhara by the Russian Imperial troops. It may have partially continued functioning

later. However, it is known that in the 1930s, the building of "Madreseyi dor ush-shifo" was completely demolished during the clearing of the Bukhara Registan area. I managed to find a plan of the building without any dimensions or scale (Fig.5).

The drawing shows that the building had a courtyard-centered symmetrical facade composition with end towers, which is also characteristic of other madrasas in Bukhara.

(Figure captions omitted for brevity)

Unlike other civil buildings, this structure has a very interesting courtyard composition. The corners of the courtyard are dissected by halls allowing entry to the interior deep rooms. This plan composition is rarely seen in Central Asia and can occasionally be found in madrasa buildings of the Near and Middle East.

The Bukhara medical center included rooms such as classrooms, which were represented as large semi-open summer iwans, a library, a pharmacy, an outpatient clinic, a reception room, wards, a kitchen, rooms for doctors, and premises for medical staff. In the courtyard, a sardoba (covered water reservoir) was located.

It is known that Subhankuli Khan visited this medical center weekly and was aware of the situation in the madrasa.

Based on existing old photographs and a schematic plan of "Dor ush-shifo," we attempted a graphic reconstruction of this interesting 17th-century building using modern computer graphic programs.

Our goal was not to recreate an already existing building plan scheme but to clarify its original parameters and establish the proportional system of all parts of the building, i.e., to seek the harmony of its architectural forms. Only in this way, in our opinion, can a correct graphic reconstruction of the medical center building be created. To do this, I first aimed to understand the design methodology used by the architect of this building in the 17th century.

The key to solving this issue was a scroll of drawings discovered by Prof. N. Baklanov in the archive of a 16th-century Bukhara architect. These drawings depicted architectural designs of buildings that were most commonly constructed at that time: caravanserais, rabats (inns), khanakas, and sardobas. There were eight such drawings in the scroll. After studying them, N. Baklanov concluded that these documents reflected the architectural design methodology of the 16th-century Bukhara master.

The essence of this method was that before imagining the plan of the future building, the architect drew a grid on paper, which consisted of a modular mesh. Figure 6 shows a copy of one of the Bukhara master's drawings – a plan of a khanaka (Sufi building). The architectural form was constructed based on a modular system that defined the proportions of plans, facades, and interiors, as well as the proportionality of parts and whole in the development of architectural details.

The module was taken as the size of an important or main element of the building plan. Usually, this was the span of the portal arch or the internal dimensions of the main room. For facades, half the span of the portal vault was often used. The function of the module in Central Asia was fulfilled by the medieval measure of length (g'az), which was usually a multiple of the enlarged module. Numerical proportions based on simple whole numbers allowed for easy and reliable proportional relationships, which was the perfection of this architectural method.

In reconstructing the plan of the 17th-century "Madreseyi dor ush-shifo," I relied on this historical method and determined that the Bukhara architect used the modular grid not only to define the composition of the building plan but also to harmonize the architectural forms of the facade and its individual details. For plan development, a main module M was used, equal to half the span of the "dor ush-shifo" portal vault (Fig.7). For harmonizing and proportioning the plan and facade elements, a smaller module equal to one-quarter of the main module was also used.

Additionally, for construction and setting dimensions in g'az, an intermediate module M1/2 equal to half the main module was applied. The average Bukhara g'az was 60–62 cm. Also used was the Shah's g'az – 120–124 cm, i.e., double the Sharia g'az. The most widespread unit of length was half the Sharia g'az (30–31 cm). On construction sites, a measuring rod of 180–186 cm, divided into six parts of 30–31 cm each and further into four strands ("tutam"), was used. The measuring rod was a universal tool at construction sites. The drawing, i.e., the modular grid, was executed at any scale, but the architect knew exactly how many units each module contained; thus, dimensions were not marked on the drawings. When detailing the plan and facade elements, their proportionality was adjusted using the small module and g'az grid. The length of the g'az generally corresponded to the width of one or more fired bricks.

(Figure 7 and 8 captions omitted)

Thus, based on the above units in g'az and the modular system characteristic of medieval Bukhara architecture, we determined that the proportionality of the building plan sides of the "dor ush-shifo" is 16:22 (Fig.8), which is very close to the golden ratio.

If this is converted to modern length measurements, it equals 29.76 by 40.92 m, or approximately 30x41 m. The proportions of the inner courtyard along the axes are 8:13, which is also close to the golden ratio and equals 15x24 m in meters. The proportion of the portal height to its width in the intermediate module is 8:12, again close to the golden ratio. The ratio of the two side parts of the facade to the length of the portal is 9:4:9.

Thus, our studies allowed us to clarify the original parameters of the "dor ush-shifo" building in modern length measurements and to establish the proportional system of all parts of the building. Based on this, a complete graphic reconstruction of the Bukhara "dor ush-shifo" was developed, including its axonometric view (Fig.9) on a computer.

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