


The Science of Palace Architecture



Injong Hall in Changdok Palace was used for important celebrations and ceremonies, and official receptions were held in the forecourt. The forecourt is of particular interest, as it was clearly built to maximize the quality of the acoustics. Both the eaves of the building which overlook the forecourt and the granite paving slabs of the floor make use of the principle of 'diffuse reflection' to ensure even distribution of sound, similar in respects to techniques used in modern theatres. The cloisters which surround the forecourt served to amplify and extend the sound to improve the quality still further. The paving stones also distributed light evenly, making the interior of the forecourt unusually bright. Even the soil beneath the slabs was chosen carefully to ensure efficient drainage of rainwater

Changdok Palace was one of the five palaces of the Choson royal family, and is famous for its beautiful garden. The most important building in the palace was Injong Hall, which served as an audience chamber, and was used to hold important national events such as coronations and royal celebrations. Foreign envoys and delegations were officially received in the forecourt of the hall. At such events, civil officials stood by their rank stone³⁶ on the eastern side, and military officials on the western side. Recent studies have shown that the Injong Hall and its forecourt were designed with great care, specifically with such events in mind.

It was very important for the entire audience to be able to hear the proceedings, and very difficult to ensure this in the days before amplifying speakers. In his paper "Acoustics of the Injong Hall's Forecourt," Professor Chon Chin-yong notes that the eaves of the Hall are ideally designed for diffuse reflection³⁷, and as a result sound spreads well in the courtyard below. Seen from its side, the Hall's eaves extend some way beyond the wall, and curve upwards slightly at the end. This not only has the effect of reflecting the voice of a person speaking at the front of the Hall back to the speaker, but also 'scatters' it throughout the yard. The roof of the Injong Hall is in many ways similar to the acoustic shell found in modern-day theaters, which helps amplify the sound of stage performers for the benefit of the audience and the performers themselves.³⁸



■ Sound reflection ■ Light reflection

The paving stones in the courtyard also played an important acoustic role. The forecourt is covered with large, thin stone panels, cut from granite. Because granite is very solid, it reflects sound well, and its rough surface ensures that sound is diffused in all directions.

Professor Chon also examined the cloisters around the Hall, which are lined with columns on the inside. When the sound from the speaker's platform reached the cloisters, some of it was reflected back into the yard by the columns, and the sound that traveled through the gaps was reflected by the outer wall, and returned to the yard as well. The cloisters therefore act as a two-stage reflector, having a lengthening effect on the sound. In addition, the eaves of the cloister roofs are designed like the



37. Diffuse reflection is the means whereby light or sound is reflected from an uneven or rough surface and scatters or diffuses in a number of directions.

38. Malga Kim, "Secrets of Changdok Palace," Donga Science, February 2007, 104-109

underside of a balcony in a modern theater, amplifying the reflected sounds and making them converge in the forecourt. In terms of structure, Injong is akin to a huge concert hall.

The designers also approached the issue of lighting with wisdom. The Hall appears brighter than usual, because of the granite stone panels used in the forecourt. Of the different minerals comprising granite, white mica gives it a shiny appearance, while quartz (a major component of glass) gives it transparency. The white component of granite reflects light of every wave length, making the Hall appear even brighter.

As with sound, the natural lighting of the Injong Hall is enhanced by the rough surface of the granite stones. Movies can be seen from any seat in a cinema because the cinema screens are based on the principle of diffuse reflection – if one touches the screen, one can feel that it is uneven. Similarly, in the courtyard, light is reflected at uneven angles and spreads out in all directions, meaning

that it is distributed evenly at every point in the Hall.

Another notable feature of the palace architecture is its efficient drainage system. Beneath the thin granite floor panels, there is a layer of decomposed granite soil. As Professor Yi Chae-gun of Sangmyong University explains, “Decomposed granite soil is white clay without any viscosity, and because it consists of large particles, it absorbs and releases water well. It is therefore used in the drainage facilities of modern buildings.”³⁹

In the Injong courtyard, the granite soil draws away the rainwater, and to prevent the soil itself being washed away or causing dust, granite panels were laid over the top, leaving an adequate distance in between for drainage. When it rained, the water would travel down from the Hall’s roof, pass underground via the granite soil, gather at the catch-pit and pass along the subterranean stone waterways, out of the Palace grounds. In every corner of this traditional work of Korean architecture, hidden wonders can be found.

39. Ibid.

Source: Excerpt from “Fifty Wonders of Korea” Vol. 2 Science and Technology, Korean Spirit & Culture Promotion Project

