

## Research Article

# Technical standards in the construction and repair of the Azerbaijani kamancha: An organological study

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| Article Info                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Abstract                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
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| <p><b>Submitted:</b> 11 October 2025<br/><b>Accepted:</b> 26 December 2025<br/><b>Online:</b> 20 March 2025</p> <p><b>Keywords</b><br/>Azerbaijani kamancha<br/>Musical instruments<br/>Instrument selection<br/>Recognition of instruments<br/>Organology</p> <p>3023-7890/ © 2026 JTO<br/>Published by Genç Bilge (Young Wise)<br/>Pub.Ltd. This is an open access article<br/>under the CC BY-NC-ND license.</p>  | <p>This study presents a systematic organological examination of the professional Azerbaijani kamancha, detailing its structural components, construction principles, and acoustic functions. The analysis demonstrates that each part of the instrument including the mulberry-wood bowl, the neck and pegbox configuration, the tension-bearing spike, the simgir anchoring system, the fish-skin membrane, and the dual-bridge structure plays a critical role in ensuring tonal stability and performance quality. The findings show that precise material selection, proportional measurements, and balanced tension distribution are essential, as even small deviations in wall thickness, bridge height, or neck alignment can significantly affect resonance, timbre, and playability. By documenting the kamancha's construction parameters in a standardized and replicable format, this research contributes to the preservation of traditional craftsmanship and provides a technical foundation for future restoration and reconstruction efforts. The study ultimately highlights how traditional luthiery integrates craftsmanship, acoustic reasoning, and empirical observation to maintain the cultural and sonic identity of the instrument.</p> |

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## Introduction

The kemençe (Azerbaijani kamancha) is one of the most deeply rooted and characteristic bowed instruments of the Caucasian and Near Eastern musical cultures. Throughout cultural history, it has been an integral part of both musical expression and social rituals; with its timbre, technical structure, and performance style, it has played a fundamental role in shaping regional musical identity (Hacıbəyli, 1985). Due to its tone color, closeness to the human voice, and emotional permeability, the kemençe occupies a central position particularly in mugham performance. Moreover, since the geographical spread of the instrument extends from Asia Minor to the Caucasus, and from Iran to Central Asia, it also holds international significance from an organological perspective. The kamancha is one of the oldest and most beloved musical instruments of the Azerbaijani people. It has an extremely soft, delicate, and captivating sound. Its tone is very close to the human voice and, when performed, it draws the listener into contemplation and the world of imagination.

## Azerbaijani kemençe

Uzeyir Hajibeyli stated the following about the kamancha: “The kamancha is the musical instrument with the most melodic sound among Azerbaijani instruments.” The kamancha is also known by similar names in many countries. For

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example, it is known as *kamanqa* in the Caucasus, Iran, and Afghanistan, as *kamanqa* in Egypt, as *ıklığ* in Türkiye, and as *ıklık* in Central Asia. Research shows that the distribution area of the kamancha instrument covers Asia Minor, the Caucasus, the Near East, and Central Asia.

The word “kamancha” is formed by the combination of *kaman*, meaning bow, and the suffix “-ça,” derived from the verb “to play,” which indicates that the instrument is played with a bow. According to some researchers, the kamancha evolved from instruments that were formerly played with a plectrum. Instead of a plectrum, this instrument uses a bow approximately 70 cm long, made from horsehair.

Although many studies exist on kemençe performance and repertoire, research that technically presents the instrument’s construction measurements, material standards, acoustic balances, and repair principles remains limited. Since much of the knowledge transmitted through master practices is based on oral tradition, placing construction and restoration knowledge within a scientific framework emerges as an important necessity in the field of organology (Memmedov, 2024; Salimian Rizi, 2024). As emphasized by Zeller (2019), systematically documenting the technical parameters of traditional instrument making is a critical step both for preserving cultural heritage and for enabling scientific examination of acoustic performance.

This study examines in detail the structural characteristics of the professional kemençe, its measurements and proportions, material selection criteria, membrane, bridge, neck, and bow systems, acoustic interactions, and repair processes. In addition, parameters such as the moisture content of the wood types used in kemençe making, membrane tension, skewer and *simgir* structures, bridge height, and neck geometry, and their effects on sound production, are technically evaluated. In this way, the applied knowledge of master instrument makers has been documented in written form, and a reference model aimed at standardization in the field of organology has been presented.

Recent studies published in the *Turkish Journal of Organology* also point to the necessity of systematically documenting the construction knowledge of traditional instruments in the region. Memmedov’s (2024) study on tar construction and restoration reveals the effect of the functional integrity of components on acoustic quality, while Ramadani’s research on Albanian craftsmanship emphasizes the importance of master knowledge in terms of cultural transmission. Çalkap and Çiftçi’s (2025) study on the Unified Kanun model demonstrates the need for innovative approaches in organology, while Salimian Rizi’s (2025) applied examination of Iranian tar and setar construction highlights the contemporary value of placing traditional instrument knowledge within a scientific framework. The common aspect of these studies is their emphasis on the necessity of systematically documenting measurements, materials, and technical stages in traditional instrument making.

## Research Problem

The lack of standardization in the measurements used in traditional kemençe construction, variations in material selection from one master to another, and the absence of scientific criteria in repair processes lead to inconsistencies in the acoustic quality of the instrument. This study aims to address these technical deficiencies by developing a detailed, systematic, and measurable framework for the construction and maintenance processes of the kemençe.

## Method

This study was conducted using an applied organology method; the structural components of the kemençe were directly measured, and the stages of the construction process were analyzed together with master practices. Technical processes such as wood carving, membrane placement, adjustment of bridge and neck angles, assembly of *simgir* and skewer components, bow making, and rosin application were documented through both observational analysis and applied examination.

## Findings

The bowl of the kamancha is made of walnut wood. The diameter of the bowl is 215–220 mm, the diameter of the opening is 120 mm, and the height is 165 mm.



Photo 1. Professional kamancha

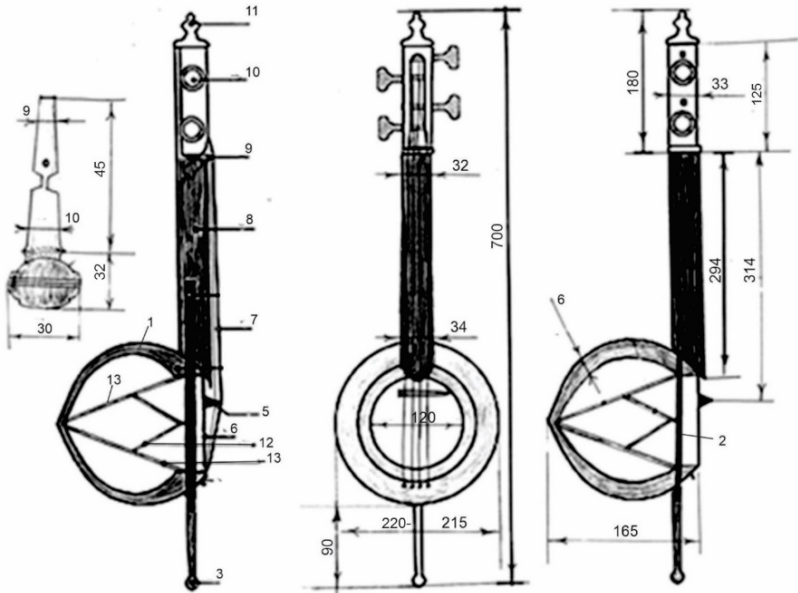


Figure 1. Measurements of the professional kamancha

Table 1. Names of the parts of the professional kamancha

| № Parts of the Professional Kamancha |                                      |
|--------------------------------------|--------------------------------------|
| 1                                    | Bowl                                 |
| 2                                    | Skewer (internal bowl support)       |
| 3                                    | Support skewer (knee support)        |
| 4                                    | Simgir (string hook)                 |
| 5                                    | Body bridge                          |
| 6                                    | Skin stretched over the body surface |
| 7                                    | Strings (4 pieces)                   |
| 8                                    | Neck                                 |
| 9                                    | Nut                                  |
| 10                                   | Bridges (4 pieces)                   |
| 11                                   | Crown                                |
| 12                                   | Internal plectrum                    |
| 13                                   | Resonator                            |
| 14                                   | Knee support                         |

**Table 2.** Measurements of the professional kamancha

| Nº | Names of the parts of the instrument     | Measurement of the parts of the kamancha |
|----|------------------------------------------|------------------------------------------|
| 1  | Bowl opening diameter                    | 120                                      |
| 2  | Bowl diameter                            | 215-220                                  |
| 3  | Bowl height                              | 165                                      |
| 4  | Scale length                             | 314                                      |
| 5  | Neck length                              | 294                                      |
| 6  | Total length                             | 700                                      |
| 7  | Length of the pegbox including the crown | 180                                      |
| 8  | Diameter of the neck at the body joint   | 34                                       |
| 9  | Length of the neck at the pegbox section | 32                                       |
| 10 | Wall thickness of the bowl               | 6                                        |
| 11 | Pegbox diameter                          | 33                                       |
| 12 | Diameter of the bridge (aşık) socket     | 30                                       |
| 13 | Bridge cone                              | 9-10                                     |
| 14 | Length of the knee support spike         | 90-100                                   |

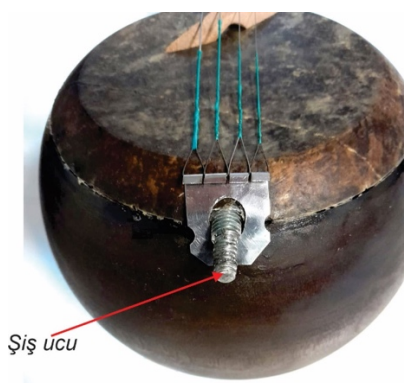
The bowl is carved from a walnut log. The log must be green; otherwise, when dry, carving the inner and outer surfaces of the bowl on the lathe becomes extremely difficult. The wall thickness of the bowl should be approximately 6–7 mm. At the rim, however, the thickness should be greater, around 15–16 mm. The reason for this is that the spike of the kamancha passes through the rim area of the bowl, and the tension force of the strings applies pressure to the bowl at this point. In order to withstand this pressure, the wall in this area must be thick.

Different methods are also applied in the bowl to balance the tension force of the strings. For example, the sections where the spike passes through the bowl should be glued so that all the pressure is borne by the spike.

**Spike.** The function of the spike is to connect the bowl to the neck. At the same time, a protrusion is left on the back side of the bowl to carry the *şimgir* and to attach the knee support spike. The knee support spike is attached to this protrusion (Photo 2).

It should be noted that when the bowl is carved in a green state, it should be carved 5–6 mm larger than the specified measurements. This is because, once the bowl dries, the measurements should correspond to the final dimensions shown in Figure 1. After carving the bowl in a green state, a protrusion with a thickness of 60–70 mm and a length of 50–60 mm is left on the back side. This allows the inner and outer surfaces to be sanded to an ideal form after the bowl has completely dried.

After the bowl is varnished, it is painted with a walnut-colored water-based stain. Once dry, a transparent filler varnish is applied. After the filler dries, it is lightly sanded. Finally, a transparent lacquer is applied to achieve a completely smooth surface.

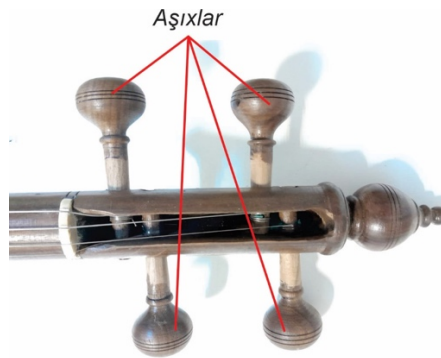
**Photo 2.** Spike

**Neck.** The neck is carved on the lathe together with the pegbox. The total length of the neck (neck + pegbox + crown together) is 475 mm (Photo 3). The length of the crown section may be 55 mm or longer; this varies according to the maker's preference.



**Photo 3.** Neck

The measurements of the neck are given in Figure 2. The neck is carved entirely from fully dried walnut wood. During preparation, the diameter at the pegbox section should be smaller than the diameter at the point where the neck connects to the body. The surface of the neck must be completely smooth. The pegbox and crown sections may be painted in the same manner as the bowl; however, oiling the neck section with walnut oil is more appropriate. In some cases, an ebonite plate is placed on the surface of the neck where it comes into contact with the strings. This allows the fingers to slide more comfortably and freely over the strings. The bridges (*aşıklar*) of the kamancha are also made of walnut wood.



**Photo 4.** Tuning pegs (*aşıklar*)

The measurements of the tuning pegs (*aşıklar*) are shown in Photo 4. It is recommended that the color of the pegs be compatible with the color of the kamancha and the pegbox section.

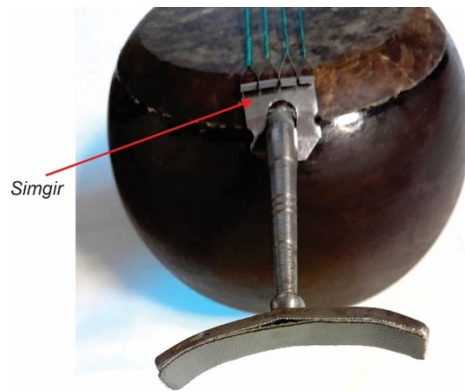
**Knee support spike:** Its length may be 9–10 mm or longer. This measurement can be adjusted to be longer or shorter depending on the performer's height and sitting posture.



**Photo 5.** Knee support spike (*şiş*)

It is recommended that the part resting on the knee be oval in shape. This form allows the spike to sit more firmly on the knee and prevents the kamancha from slipping off the knee during performance.

**Simgir:** As its name suggests, the simgir is the part placed on the back of the bowl to hold and secure the strings.



**Photo 6.** Simgir

The element that carries and holds the simgir in place is the spike. The simgir is mounted onto the spike. The strings emerging from the simgir first pass over the bridge on the bowl, then over the bridge on the neck, and are finally wound onto the tuning pegs (aşıqlar). The function of the tuning pegs is to tune the strings and keep them in tune. See Photo 6.

### **Membrane (fish skin)**

The membrane of the kamancha is made of fish skin (generally salmon or catfish). After the fish is caught, its body is gently struck with a thin stick to soften it so that the skin can be easily separated, and the skin is then carefully removed. After the skin is peeled off, the inner surface is completely cleaned of oils and dried in a place away from direct sunlight.



**Foto 7.** Fish skin

The dried skin is re-soaked before being stretched onto the kamancha body (the surface of the bowl), preferably for two days. After it becomes wet and flexible, it is placed tightly over the bowl. The skin is fixed to the edge of the bowl using PVA adhesive. The width of the bonded area between the skin and the bowl should be approximately 20–25 mm.

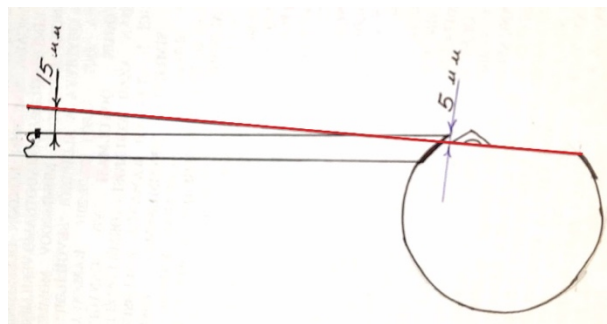
### **Bridge (Xərək):**

The bridge placed on the bowl is made of walnut wood. Its length is 60 mm and its height is 15 mm.

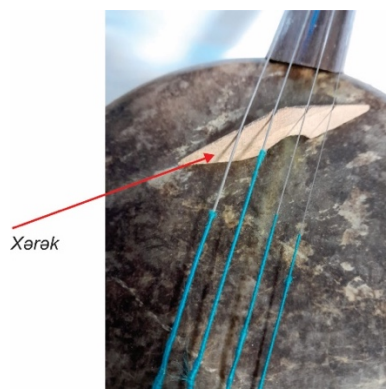


**Photo 8.** Bonded area between the skin and the bowl

The distance between the neck plane and the bowl plane (Figure 2) is 15 mm. Depending on variations in this distance, the height of the bridge may vary (Photo 9).

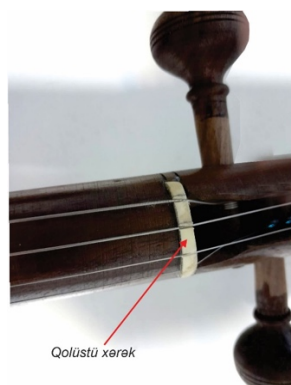


**Figure 2.** Distance between the neck plane and the bowl plane



**Photo 9.** Bridge

**Nut:** The nut is made of bovine bone. Its function is to correctly regulate the spacing between the strings and to adjust the height between the strings and the neck (Photo 10).



**Photo 10.** Nut

The distance between the neck and the string should be 1 mm. Depending on the performer's habit, this distance may be slightly smaller or larger; however, a greater distance is not recommended. When the distance increases, the string cuts into the finger, the finger exerts more force during performance, and tuning instabilities occur.

**Bow (violin bow / kaman):** The bow of the kamancha is made from a rod (wooden stick) with a length of 70 cm. Cylindrical pieces made of copper or aluminum are placed at both ends of the rod. The horsehair strings are attached to the rod by means of square metal rings.



**Photo 11.** Bow

A strap is attached to the part held by hand; by means of this strap, it is possible to tension the hairs (strings). The thickness of the bow stick may be 0.7, 0.8, 0.9, or 1 cm. This diameter is uniform along the entire length of the stick.

The thickness of the hairs used in the kamancha bow is approximately four times greater than that of the hairs used in a violin bow.

The hairs of the kamancha bow may be white or dark chestnut in color.

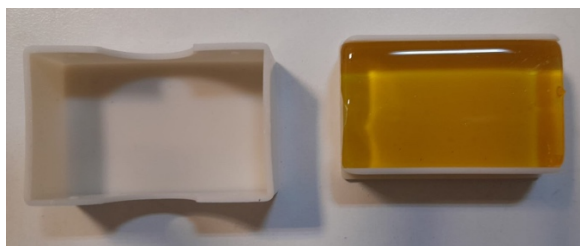


**Photo 11.** Bow

A strap (belt) is attached to the part held by hand; by means of this strap, it becomes possible to tension the strings (hairs). The thickness of the rod may be 0.7, 0.8, 0.9, or 1 cm. This diameter is uniform along the entire length of the rod.

The thickness of the hairs of the kemençe bow is approximately four times greater than that of the hairs of a violin bow.

The kemençe hair may be white or dark chestnut in color.



**Photo 12.** Rosin (Colophony)

More precisely, rosin creates an adhesive contact surface between the string and the hair, increasing friction and thereby enabling sound production.

## Conclusion

This study has systematically presented the construction and restoration processes of the professional Azerbaijani kemençe within an organological framework and has documented in detail the fundamental technical parameters that determine the acoustic character of the instrument. The findings demonstrate that all components of the kemençe, including the body (bowl), neck, spike, simgir, membrane, bridge, and bow, are shaped not only according to aesthetic considerations but also in accordance with functional and acoustic logic. Structural details such as carving the bowl from green walnut wood, increasing wall thickness in the rim area, positioning the spike to withstand string tension, and applying the membrane at the correct moisture level are of critical importance for both the durability and sound quality of the instrument.

As emphasized by Memmedov (2024) in his technical study on tar construction, each component of traditional string instruments serves a specific function, and correct understanding of these functions directly affects acoustic balance. The findings of this study show that details such as bridge height, the distance between the neck and bowl planes, the positioning of the strings on the neck, and the thickness of the bow hairs determine both playing comfort and timbral stability in the kemençe. Similarly, the applied study conducted by Salimian Rizi (2024) on the Iranian tar highlights the effects of wood dryness, membrane tension, and neck geometry on sound production, and this study confirms that similar technical principles apply to the kemençe.

Zeller's (2019) methodological approach to traditional instrument reconstruction argues that construction processes should rely not only on historical transmission but also on engineering, material science, and experimental acoustics. By analyzing the structural systems of the kemençe in detail, this study has transformed knowledge transmitted through

oral master-apprentice tradition into a measurable, comparable, and standardizable form, thus presenting a model fully consistent with the scientific framework proposed by Zeller.

In conclusion, this research makes a significant contribution by presenting the technical construction characteristics of the Azerbaijani kemençe in an applied and systematic manner, supporting both the preservation of cultural heritage and the establishment of a scientific basis for modern construction and restoration practices. The study serves as a strong reference for future organological analyses, acoustic optimization studies, and instrument standardization initiatives. Moreover, the detailed documentation of the kemençe construction process enables technical knowledge that might otherwise be lost through oral transmission to be transformed into a permanent and accessible scientific resource.

### Acknowledgement

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### Biodata of Author



Dr. **Mamedali Mirali Mamedov**, music researcher and musical instrument restorer. Since 2010, he has been working as the head of the “Improvement of National Musical Instruments” (*Milli Musiqi Alətlərinin Təkmilləşdirilməsi*) research laboratory at the Azerbaijan National Conservatory (*Azərbaycan Milli Konservatoriyası*). Over the years, 64 of Mamedali Mamedov’s scientific works have been registered with the Copyright and Intellectual Property Agency (*Müəllif Hüquqları və İntellektual Mülkiyyət Agentliyi*), and dozens of scientific articles and conference materials have been published. The ensemble “In the Footsteps of Time” (*Zamanların İzində*), consisting of ancient musical instruments, was founded by Mamedali. Mamedali Mamedov has created a four-cornered drum (*dördguşəli nağara*), a square drum (*kvadrat nağara*), and a “chovgan” (*çovqan*, conductor’s baton) for the National Military Band (*Milli Hərbi Orkestr*). In addition, he has developed new musical instruments that produce sounds at different registers and registered them in the database of Azerbaijani musical instruments in collaboration with the Copyright Agency. In 2018, the book “Improvement of Azerbaijani Folk Musical Instruments” (*Azərbaycan Xalq Musiqi Alətlərinin Təkmilləşdirilməsi*) was published.

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