

DOI:10.32703/2415-7422-2020-10-2-304-314

UDC 72:745:749(091)

Olena Khramova-Baranova

Cherkasy State Technological University

460, Shevchenko Boulevard, Cherkasy, Ukraine, 18006

e-mail: Khramova74@ukr.net

<https://orcid.org/0000-0002-3811-7701>

Formation of the architecture of Ukraine based on longstanding measurement standards

Abstract. *The article, on the basis of a fundamental study of literature and its thorough analysis, highlights the importance of measurements in the cultural aspect of the development of the country and types of art. The analysis of literary sources is carried out, which confirms the influence of the formation of measurement standards on the development of the main types of art. The relevance of the topic is to show the connection between the development of technical thought and the formation of art forms, which has become one of the foundations of the general development of the culture of the state. I. Babenko, M. Bieliaiev, D. Mendelieiev, E. Kamentseva, B. Rybakov and others made a great contribution to the formation and development of measurement standards that influenced the cultural development of the state. In their fundamental works one can find information on the influence of measurement on formation and development of architecture, arts and crafts. But these materials do not give a complete picture of the conceptual significance of the influence of technical thought on art and the cultural development of the state. The purpose of the article is to show the influence of the technical thought development, namely the metrological foundations, on the development of the arts. The centuries-old history of metrology is useful for the development of society, although its origin and development are covered only in scattered sources. One of the fundamental studies of the origin of measures was the works of I. Babenko “Metrology”, M. Bieliaiev “On ancient and modern Russian measures of extension and weight”, and B. Rybakov in his writings presented fathoms as geometric lines of the calculation table of architects (Babylon). The history of measurements is highlighted in the literature and is mainly devoted to the processes on the formation of metrological concepts among the Skifiia, Sarmatiia, the Zarubinets and Cherniakhiv cultures, the Northern Prychornomia, of Kyivska Rus, Moskoviiia and other. Neither in the ancient world, nor in the Middle Ages there was a metrological service, but there is information about the implementation of standards and storage of measures, as well as about the verification of measuring instruments.*



Accurate measurements and calculations allowed the architect to achieve harmony in the creation of architectural monuments.

Keywords: *measurements; ancient architects; metrological concepts; architecture*

Introduction.

The article, based on a fundamental study of literature and its thorough analysis, highlights the importance of measurement in the culturological aspect of the country's development and arts. The analysis of the literature sources where the influence of formation of standards of measurement on development of the basic kinds of art is confirmed has been made. The relevance of the topic is to show the connection between the development of technical thought and the formation of arts, which has become one of the foundations of the overall development of state culture. I. Babenko, M. Bieliaiev, D. Mendelieiev, E. Kamentseva, B. Rybakov and others made a significant contribution to the formation and development of measurement standards that influenced the cultural development of the state. In their thorough works you can find information on the influence of measurement on the formation and development of architecture, decorative arts. But these materials do not give a complete picture of the conceptual significance of the influence of technical thought on art and cultural development of the state. The purpose of the article is to show the impact of the technical thought development, namely metrological foundations on the development of arts.

Research methods.

The research methodology is based on the universal principles of scientific knowledge – historicism and scientific objectivity, as well as on the widespread use of comparative-historical, systematic methods. The comparative-historical method made it possible to study the development of measurement standards in the formation of art, in particular architecture. The system method makes it possible to comprehensively investigate complex systems, such as architecture in general and the impact of measurement standards on its development.

Results and discussion.

The history of measurement is highlighted in the literature up to the twentieth century, which is devoted to the formation of metrological ideas in the Skifiiia, Sarmatiia, Zarubynets and Cherniakhiv cultures, the Northern Prychornomia, Kyivska Rus, Moskoviiia and the Russian Empire and the impact on art. It is established that the development of research in the field of metrology was associated with the publication in 1827 in the article of A. Lamberti «On the origin and current state of the Russian linear measure and weight and the comparison of those with foreign» in the “Military Journal” and in 1849 in the work of F. Petrushevskiyi “General Metrology”, the concepts of which were adopted and further developed (Lamberti, 1827; Petrushevskiy, 1849). The analysis on some aspects of the development of weights and

measures was initiated from the city-states of the Northern Prychornomia and Kyivska Rus, but these were only primitive ideas and it was not a question of settling all kinds of measures. Some information, the first ideas about measures, weights, standards are found in the Ipatiev and Lavrentyi chronicles, “Pravda Ruska”, which testifies to the interest of the state from antiquity to the unification of measures.

In the VIII – VI centuries BC the Great Greek colonization and one of the ways of its development was the development of the Northern Prychornomia. Among the Greek city-states the most famous are: Tira (Bilhorod-Dnistrovsky), Chersonesus (Sevastopol), Pantikapaeum (Kerch) and others. From the first century BC. ancient cities under the influence of Rome fought with nomadic tribes. Crimea is filled with remnants of architecture, remnants of sculptures, amphorae, tiles. The Kerch assembly numbers more than two thousand units, and the most important feature of urban planning was the presence of a colonnade. Cities were surrounded by walls, and quarters of clear form were formed in them, gymnasiums and theaters were also built (Ponomarov, Artiukh, & Betekhtina, 1994).

For example, there were metrological institutes in Chersonesus that monitored the operation of norms in the metrological system of the state. From the end of the IV century BC there was an institute of magistrates, which exercised periodic control over the observance of measures and their regulation. In Chersonesus there were standards for amphorae, tiles of marble and stone. Potters constantly removed from them the dimensional parameters for reproduction in their products. Chersonesus is one of the oldest cities and its construction was carried out according to a strategic plan using standard measures. The blocks for construction were of the same length (orgy – 1.8 m), the quarters were (52.5×52.5) square meters. The width of the streets adjacent to the quarters was 6 meters. The city was divided into quarters by longitudinal and transverse highways according to the Hippodame system. In Chersonesus, the measure “pus” (Greek foot – 29.62 centimeters) was used in construction. For example, Felon Vizantiyskyi pointed out that when building walls in the lowlands of Chersonesus, the norm was a thickness of 10 cubits (4.6 meters) (Belyaev, 1917). The philosopher Vitruvii believed that when building a house, the architect should have paid more attention to compliance with the proportions, and indeed the size of the buildings of Chersonesus meet certain standards. The largest number of houses had dimensions along the masonry axes of (12.4×2.4) square meters; the delimitation of agricultural plots was also carried out according to standards. The land-surveyor broke a grid of squares in the area; the length of the side of the square was 52.5 meters. During the excavations of Chersonesus on some streets, additional walls were added to the walls of the houses, reducing the width of the streets. Archaeologists have long thought about the purpose of these walls, and after making measurements came to the conclusion that in the Roman period the width of the streets was adjusted to their standards. In V – IV centuries BC the construction of temples and altars was widespread, for example, the temple of Apollon Delfinii in Olbia (5th century BC) and the temple in Patikapei (4th

century BC), which had an area of up to 1000 square meters (Kamentseva & Ustyugov, 1975).

Changes in the history of the ancient Slavs took place in the first millennium AD, which is associated with large settlements. The creativity of the ancient Slavs was manifested in the Zarubynets (II century BC – II century AD) and Chernyakhiv (II-V centuries AD) cultures, which were discovered by V. Khvoiko in 1899 – 1901 near the villages of Zarubyntsi and Chernyakhiv in the Kiev region. The Zarubynets culture was spread on the territory of the Prypiat and Dnipro basins, where a moundless burial ground was excavated and bronze fibulae and ceramics of the 3rd century were found. B. C. Zarubynets culture is characterized by dugouts with an area of 18–20 square meters and wooden-frame construction, and the source of heat was an open hearth. Chernyakhiv culture is characterized by finds in the Kaborga cemetery near the village of Osetrivka, Mykolaiv region. In the III – IV centuries. Chernyakhiv culture occupied most of Ukraine, Moldova, and part of Poland, Russia, and Romania. Chernyakhiv culture (II–IV centuries) became the basis of Ukrainian cultural soil. All this was manifested in the nature and type of settlements, the territory of some stretched up to a kilometer, others – up to 200–300 meters. Architectural structures had features of Zarubynets, Skifo-Sarmatska culture. The forest-steppe of Ukraine was characterized by the construction of dugouts and semi-dugouts on the basis of a pillar structure, then these buildings were treated with bushes and clay, and log structures were spread. According to the characteristics of the arts development, it can be determined that measurement standards were not practically used.

The system of ancient Egyptian measures was mastered in Kyivska Rus. For example, the ancient Russian sazhen is 2154 mm, and the ancient Egyptian sazhen is 2160 mm, the ancient Russian yardstick is 718 mm, and the ancient Egyptian yardstick is 720 mm. The measure of elbow length (the distance in a straight line from the elbow bend to the end of the extended middle finger) was first mentioned as a measure of length in Yaroslav the Wise's *Pravda Ruska* and *Pateryk Kyievo-Pecherskyi* (Hrekov, 1947; Kolpakova, 2001). Kyivska Rus traded not only with its nearest neighbors, but also with distant countries. Waterways occupied a significant weight in trade. From the tenth century famous boats made of wood. They were small and could accommodate no more than three people and only some of them reached 20 meters in length (Hanch, 2000). Later, the carrying capacity of the boats began to increase, and printed boats and planks appeared. In Kyivska Rus, various measures were used, which were available to the princes and provided by them for use in trade, construction, and so on. With the advent of exemplary reference measures, they had to be carefully stored. Standards of measures were consecrated and kept in temples and churches.

Ancient Kievans lived in small settlements of 10–15 yards. Representatives of the Zarubynets culture lived in large settlements, where housing was located by groups of families and communities. Families from such a community consisted of large and small patriarchal families. All national features, such as settlements, frame construction of architecture, family structure, indicate on the formation of a developed type of

management within the Kiev culture, which is based on agriculture and livestock. The culture of ancient Kiev became the basis of ethnic traditions. As for measurement, according to chronicles, as well as the results of excavations, we can judge that the old masters were familiar with primitive metrology and measuring instruments. Many measures were of anthropometric origin and were associated with human activities. For example, in Kyivska Rus in everyday life there were introduced the following (Babenko, 1905; Kamentseva, & Ustyugov, 1975):

- a) cream “fingertip” – the length of the index finger;
- b) span from “five”, “five” – the distance between the outstretched thumb and forefinger. Span was mentioned in descriptions of travels of the XII–XVI centuries and was used to determine small lengths;
- c) elbow – a measure of length from elbow to middle finger;
- d) sazhen – from «reach».

Thus, the ancient Russian system of length measures had the following form: 1 verst = 750 sazhens = 2250 cubits = 4500 spans. Folk methods of measuring the area were rectangles measuring 30 by 80 and 40 by 60 sazhens. Folk measures such as tithe, day, lan, morgue, cage were common, which meant either the time for cultivation or the amount of harvest harvested in a certain area.

Neither in the ancient world nor in the Middle Ages there was a metrological service, but there is some information of standards and their storage, as well as checks on measuring instruments. Documents of the Xth century certify the existence of state supervision of measures. For example, the Statute of Volodymyr the Great on ecclesiastical courts (996) emphasized the need to comply with the measures applied in everyday life and trade, and the belt of Volodymyr became the standard length (108 cm). In Great Novhorod in the Church of Ioana Predtechy there was a Chamber of Weights and Measures, which adopted the Charter of Prince Vsevolod of Novhorod “About the court of the church, on people and on measures of trade” (1136) (Prozorovskiy, 1854).

Accurate measurements and calculations made it possible for architects to achieve harmony in the creation of architectural monuments. Next to the Church of St. Sophia in Kiev another church - the Church of the Tithe, built in 989-996. During the excavations of the Church of the Tithe, three furnaces were found for firing plinths (bricks). Near one of them there was found a drawing of a three-nave church, which is the facade of the church, its scale is 1/75 of the actual size of the central part of the church. This was the first drawing found on the construction site. Construction of bridges required great skill from builders. The chronicle “The Tale of Bygone Years” (XI century) mentioned the bridges in the ancient Russian cities of Ovruch and Vasiliev. In 1115, Volodymyr Monomakh, according to the Ipat Chronicle, built a bridge across the Dnipro (Ponomarov, Artiukh, & Betekhtina, 1994). At the same time, different types of fathoms, which were provided for the architects by ancient Russian metrologists and thanks to which they obtained aesthetic architectural proportions were used.

Sazhen was mentioned in the “*Pateryk Kyievo-Pecherskyi*” by the chronicler Nestor, where in 1017 it was reported that Hilarion (a monk) dug a cave for himself in two sazhen (Kolpakova, 2001). To determine the sazhen, the discovery of a stone in the Tmutarakan River near the Kerch Strait was important, on which an inscription was carved that Prince Hlib in 1068 measured the sea on ice in sazhen (10,000 and 4,000 sazhen). Comparison of these measurements of the width of the Kerch Strait and the results obtained by topographers in the first half of the XIX century in measures, almost coincided. M. Ustiuhov (Kamentseva & Ustiuhov, 1975) found a value equal to 142 cm for the ancient sapling. It differed from the one that followed from the value of the verst, so B. Rybakov (Rybakov, 1957; Rybakov, 1984) compared the results of measurements of the width of the Kerch Strait in the time of Prince Hlib with the measurements of topographers from Vizantiia (952) and came to the conclusion that the measurements almost coincided.

The name “pud”, according to D. Prozorovskyi, means weight. In ancient metrology, the pud meant not only a measure of weight but also a device, and when weighing metals, the pud was taken as a unit of measurement. The word “hryvnia” was used to denote both weight and currency (a measure of value), found in “*Pravda Ruska*” (Hrekov, 1947). The hryvnia was the most common measure of weight in trade and crafts, it was used in weighing gold and silver. During the period of feudal fragmentation of Kyivska Rus, specific local measures appeared. But even in this period marks were placed on the measures, which testified to their legitimacy and made it possible to distinguish them (diploma of Bielozerskyi Mykhailo Andriiovych of the XV century) (Prozorovskiy, 1854).

B. Rybakov presented sazhen as geometric lines of the calculation table of architects – “*Vavylons*” (Rybakov, 1957; Rybakov, 1984). Vavylons are tablets with a diagram of proportional relations depicted on them, thanks to which the architects found the necessary proportions for the building. When comparing the Vavylons found with the architecture and system of measures, it turned out that all the ancient measures fit into the schedule of Vavylons with the side in the measured sazhen. Analyzing the architecture, B. Rybakov determined that from the XI to the XVII century there were seven types of sazhen: large sazhen – 1494.6 mm, sazhen without four – 1972 mm, measured sazhen – 1764 mm, oblique sazhen – 2160 mm, straight sazhen – 1527.6 mm, pipe sazhen – 1870.8 mm, sea sazhen – 1830 mm (Rybakov, 1957; Rubakov, 1984). For the construction of temples after the XIV century oblique sazhen were introduced, for which convenient anthropometric methods were introduced. The sazhen is defined as the distance between the outstretched arms. In the XIV-XV centuries oblique sazhen came out of the use of a narrow circle of builders and to the XVI century used in other industries, where it replaced the direct sazhen. In the XVI century oblique sazhen had several types: pipe, bridge, which were fixed by metal standards. B. Rybakov established the relationship between the measures that provided functionality and ease of use. This concept was implemented as a geometric construction of a system of circles and squares inscribed in them. Based on a simple

and flywheel, for each system of measures used the same factor – two. With the help of this system, the dimensions of bridges and supports were determined, which had a considerable height for observing the enemy and firing at him. According to the same system, deep works (wells, underground passages) were determined and used for the construction of temples. These measures were preserved in construction practice in the XI–XVII centuries (with sazhen 152, 176 and 216 cm). The existence of these interconnected measures made it possible to do without fractions, which facilitated the measurement, planning and construction of structures. Proportionality and harmony of architecture was achieved by the use of builders not one system of measures, but two or three, which were in certain proportions. Confirmation of B. Rybakov's hypothesis was the discovery of the Novhorod architectural expedition (1972), when in Novhorod they found fragments of a measuring rod (measure), on which three scales were applied, which testified to the simultaneous use of three different sazhen. However, the notches on the rod, placed at 6, 7 and 8 cm, did not coincide with the known division of sazhen (span, cream) and checking the proportionality of the ratios of these notches showed that they coincide with the straight, measured and large sazhen. So, it was necessary to find out what proportion of sazhen these notches were on the scale and it turned out that they corresponded to $1/21$ of the straight sazhen, $1/21$ of the dimensional sazhen and $1/21$ of half of the large sazhen. Therefore, B. Rybakov suggested that these notches related to the ratio of the length of the circle and the diameter of the circle, if we take the diameter of the circle of sazhen, composed of 21 notches of the scale, the circle will be equal to 66 notches. Therefore, this ratio is equal to $66/21 = 3.14285$, we get an approximation to the number $\pi = 3.1416$. This allowed architects to make circles for arches, curved surfaces of temples and other structures (Rybakov, 1957; Rybakov, 1984). D. Mendelieiev made a significant contribution to the development of measurement and implementation of standards in construction and architecture, which can be observed in his researches in the field of theoretical and applied metrology (Elkin, 2007).

Conclusions.

The first authors, who began to reproduce the emergence and formation of measures, focused their efforts on identifying the origins of measures. These works have become a historiographical phenomenon in the history of weights and measures. The question of the formation of metrology is analyzed in the works of: M. Pauker on the measures of Russia in comparison with the German (1832), D. Prozorovskyi on ancient measures, J. Veks on measures in Greece and Rome (1883), O. Khvolson on the metric system (1884), V. Vulkhauz on national measures, weights and currencies (1890), F. Blumbakh on the verification of weights and measures (1897), M. Yehorov on the Main Chamber of Weights and Measures, etc. The centuries-old history of metrology is useful for the development of society, although its formation is analyzed only in scattered data. Applied metrology studies the practical use of the results of theoretical knowledge in various fields. Literature of the twentieth century in

monographs, textbooks and scientific articles showed the formation and development of metrology after the signing of the International Metric Convention (1875) and was mainly devoted not to the influence of metrology on the development of art, and comparative tables and new measuring instruments. One of the most thorough studies of the origin of measures in this period were the works of I. Babenko “Metrology” (1905), R. Guter on the analysis of comparative tables of measures and weights from around the world (1911), M. Bieliaiev “On ancient and current Russian measures of extension and weight” (1917). Thanks to the fundamental research and thorough analysis of the literature, it was possible to highlight the importance of measurement in the cultural aspect of the development of Ukraine and architecture. The study confirms the influence on the formation of measurement standards on the development of architecture and shows the connection with the arts formation with the development of technical thought of the state.

References

- Babenko, I. P. (1905). *Metrologiya (Merovedeniye) [Metrology (Merology)]*. Sankt-Peterburg: Tipografiya chelovekolyub. obshchestva [in Russian].
- Belyaev, N. T. (1917). O drevnikh i nyneshnikh russkikh merakh protyazheniya i vesa [On ancient and modern Russian measures of extension and weight]. *Seminarium Kondakovianum – Seminarium Kondakovianum*, 1, 258–260 [in Czech].
- Hancho, V. (2000). Sudnobuduvannia v Ukraini: s chasnyi stan standartyzatsii ta sertyfikatsii [Shipbuilding in Ukraine: the current state of standardization and certification]. *Standartyzatsiia, sertyfikatsiia, yakist – Standardization, certification, quality*, 2, 17–19 [in Ukraine].
- Elkin, G. I. (Ed.). (2007). *D. I. Mendeleev i nauka ob izmereniyakh [D.I. Mendelieiev and the Science of Measurements]*. (Vol. 1-3). Sankt-Peterburg: Gumanistika [in Russian].
- Kamentseva, E. I., & Ustyugov, N. V. (1975). *Russkaya metrologiya [Russian metrology]*. Moskva: Vysshaya shkola [in Russian].
- Lamberti, A. I. (1827). O pervonachalnom proiskhozhdenii i nyneshnem sostoyanii rossiyskoy lineynoy mery i vesa i o sravnenii onykh s inostrannymi [About the formation and current state of the Russian linear measure and weight and on their comparison with foreign]. *Voyennyi zhurnal – Military journal*, 3, 108–136 [in Russian].
- Kolpakova, V. M. (Eds.). (2001). *Pateryk Kyievo-Pecherskyi [Pateryk Kyievo-Pecherskyi]*. Kyiv: Lybid [in Ukraine].
- Petrushevskiy, F. (1849). *Obshchaya metrologiya [General metrology]*. Sankt-Peterburg [in Russian].
- Hrekov, B. D. (Eds.). (1947). *Pravda Russkaya: kommentarii [Pravda Ruska: comments]*. Moskva-Leningrad: AN USSR [in Russian].

- Prozorovskiy, D. (1854). Drevnerusskiye mery [Old Russian measures]. *Zhurnal ministerstva narodnogo prosveshcheniya – Journal of the Ministry of Public Education*, 3, 230–268 [in Russian].
- Rybakov, B. A. (1957). Arkhitekturnaya matematika drevnerusskikh zodchikh [Architectural mathematics of ancient Russian architects]. *Sovetskaya arkhеologiya – Soviet archaeology*, 1, 84–113 [in Russian].
- Rybakov, B. A. (1984). *Iz istorii kultury Drevney Rusi: issledovaniya i zametki [From the history of ancient Russia culture: research and notes]*. Moskva: MGU [in Russian].
- Ponomarov, A., Artiukh, L., & Betekhtina, T. (1994). *Ukrainska mynivshyna [Ukrainian past]*. Kyiv: Lybid [in Ukraine].

Олена Храмова-Баранова

Черкаський державний технологічний університет, Україна

Становлення архітектури України на основі давніх стандартів міряння

Анотація. В статті, на основі фундаментального дослідження літератури та її ґрунтового аналізу висвітлюється значення міряння в культурологічному аспекті розвитку країни та видів мистецтва. Зроблено аналіз літературних джерел, де підтверджується вплив становлення стандартів міряння на розвиток основних видів мистецтва. Актуальність теми полягає в тому, щоб показати зв'язок розвитку технічної думки зі становленням видів мистецтва, що стало одним з фундаментів загального розвитку культури держави. Вагомий внесок у становлення і розвиток стандартів міряння, які вплинули на культурологічний розвиток держави зробили: І. Бабенко, М. Беляєв, Д. Менделєєв, Є. Каменцева, Б. Рибаків та ін. В їх ґрунтовних працях можна знайти відомості про вплив міряння на становлення і розвиток архітектури, декоративно-прикладного мистецтва тощо. Але ці матеріали не дають повного уявлення про концептуальне значення впливу технічної думки на мистецтво та культурний розвиток держави. Мета статті полягає в тому, щоб показати вплив розвитку технічної думки, а саме метрологічних основ на розвиток видів мистецтва. Багатовікова історія метрології корисна для розвитку суспільства, хоч її зародження і становлення висвітлюються лише у розрізних даних. Одним з найбільш ґрунтовних досліджень походження мір у цей період стали праці І. Бабенко “Метрологія”, М. Беляєва “О древних и нынешних русских мерах протяжения и веса”, а Б. Рибаків в своїх працях представив сажени як геометричні лінії розрахункової таблиці зодчих (вавилони). Історію міряння висвітлено в літературі до ХХ ст., яка присвячена процесу становлення метрологічних уявлень у скіфів, сарматів, зарубинецькій і черняхівській культурах, Північному Причорномор'ї, у Київській Русі, Московії, Речі Посполитій та впливу на становлення видів мистецтва тощо. Ні в давньому

світі, ні у Середньовіччі не було метрологічної служби, але існують відомості про впровадження еталонів і зберігання їх, а також про перевірки засобів вимірювань. Точні вимірювання й розрахунки дали можливість досягти зодчим гармонійності в створенні архітектурних пам'яток.

Ключові слова: міряння; давні зодчі; метрологічні уявлення; архітектура

Елена Храмова-Баранова

Черкасский государственный технологический университет, Украина

Становление архитектуры Украины на основе давних стандартов измерения

Аннотация. В статье, на основе фундаментального исследования литературы и ее основательного анализа освещается значение измерений в культурологическом аспекте развития страны и видов искусства. Проведен анализ литературных источников, где подтверждается влияние становления стандартов измерения на развитие основных видов искусства. Актуальность темы заключается в том, чтобы показать связь развития технической мысли и становления видов искусства, что стало одним из фундаментов общего развития культуры государства. Большой вклад в становление и развитие стандартов измерения, которые повлияли на культурологическое развитие государства сделали: И. Бабенко, М. Беляев, Д. Менделеев, Е. Каменцева, Б. Рыбаков и др. В их фундаментальных трудах можно найти сведения о влиянии измерения на становление и развитие архитектуры, декоративно-прикладного искусства. Но эти материалы не дают полного представления о концептуальном значении влияния технической мысли на искусство и культурное развитие государства. Цель статьи заключается в том, чтобы показать влияние развития технической мысли, а именно метрологических основ на развитие видов искусства. Многовековая история метрологии полезна для развития общества, хотя ее зарождение и становление освещаются только в разрозненных источниках. Одним из фундаментальных исследований происхождения мер стали труды И. Бабенко "Метрология", М. Беляева "О древних и нынешних русских мерах протяжения и веса", а Б. Рыбаков в своих трудах представил сажени как геометрические линии расчетной таблицы зодчих (вавилон). История измерений освещена в литературе и в основном посвящена процессам становления метрологических представлений у скифов, сарматов, зарубинецкой и черняховской культурах, Северном Причерноморье, в Киевской Руси, Московии, Речи Посполитой. Ни в древнем мире, ни в средние века не было метрологической службы, но существуют сведения о внедрении стандартов и хранения мер, а также о проверках средств измерений. Точные измерения и расчеты позволили достичь зодчим гармонии в создании архитектурных памятников.

Ключевые слова: измерения; древние зодчие; метрологические представления; архитектура

Received 17.07.2020

Received in revised form 02.10.2020

Accepted 22.10.2020