ARPHA Proceedings

Proceedings CAUSummit 2025, 0071-0184
doi: 10.3897/ap.9.e0071

10th Anniversary
World Summit: Civil Engineering-Architecture-Urban Planning Congress

Historical Units of Measurement in Architecture and their Reflection in Historiography and Cultural Heritage Restoration in Slovakia

Jana Pohaničová[1, a)], Kamila Kráľová[1], Pavol Pauliny[1], Matúš Kiaček[1]

[1] *Institute of History and Theory of Architecture and Monument Restoration, Slovak University of Technology in Bratislava, Bratislava, Slovakia*

[a)] Corresponding author: kamila.kralova@stuba.sk

Abstract. The topic of historical units of measurement, as well as geometric and proportional relationships in architecture, has not yet been systematically addressed in historiography or in cultural heritage restoration, neither in Slovakia nor in the wider European context. Although historical units and proportional principles played a fundamental role in architectural design, they are still not consistently integrated into the current methodology of research and restoration of historical buildings. This paper argues that deeper knowledge of these topics has the potential to contribute to a comprehensive understanding of authorial creative practices, architectural form and design principles of historical buildings. The paper presents a brief historical overview of historical units of length, their application in architecture and reflections on their use in architectural practice. This is complemented by an exploration of their current relevance for research in the field of architectural history and heritage conservation. Special attention is devoted to selected case studies from Slovakia – a territory shaped by European influences – illustrating the importance of historical principles of scale and proportion in architectural design. The first case study analyses a Neoclassicist manor house in Blatnica, in which proportional schemes based on classical principles were identified. The second case study focuses on selected works by Michal Milan Harminc (1869–1964), an exceptional architect from the Central European region, whose works oscillate between historicism, modernism and functionalism across the former Austro-Hungarian Empire and its successor states: Serbia, Hungary, Ukraine, and Slovakia. His relationship to historical architecture, its proportions and scale is evident in his designs and renovations of buildings of various typologies, including religious architecture and cultural buildings with national content. His knowledge of historical measurement systems is applied to the reconstruction of the Church of the Visitation of the Virgin Mary in the village of Rabča in the Orava region. The functionalist reconstruction of the church from the 1930s was based on the original architecture of the Baroque church. It took place after the Metre Convention, which introduced the metre as the only official unit of measurement. Although Harminc no longer used historical units when designing the reconstruction, he incorporated the geometric and proportional principles of Baroque aesthetics into his design. The final case study analyses three of Harminc's buildings for the Slovak National Museum, which reflect classical design principles. These buildings exhibit an evolution – from the subsiding neoclassical language in Martin, through the distinctive formation of official monumentality in Bratislava, to the definitive adoption of rational functionalist forms once again in Martin. The paper underscores the need for further research into historical units and proportions as a prerequisite for the future development of more sophisticated methodological approaches in the study and restoration of historical buildings. It also highlights the importance of this knowledge for preserving architectural authenticity and deepening our understanding of its historical context in the regional setting. Finally, it offers new insights into the background of the work of architect and builder M. M. Harminc, an important personality for the wider European territory.

Keywords: Architecture; historical measurements; proportions; traditional units; Harminc; Slovakia; heritage conservation; photogrammetry; photogrammetric measurement; geometric analysis; Slovak architecture; non-metric systems; modular analysis

© 2025 Jana Pohaničová, Kamila Kráľová, Pavol Pauliny, Matúš Kiaček
This is an open access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Published by CAUSummit and peer-reviewed under the responsibility of "World Summit: Civil Engineering-Architecture-Urban Planning Congress - CAUSummit-2025".

INTRODUCTION

The matter of proportion and human scale has been at the centre of architectural theory and historiography since antiquity. Proportion represents the correct measure of an object, the relationship of its individual parts to each other and to the whole. Classical architecture derived proportional relationships from nature, specifically the human body, and from abstract knowledge, that is, mathematics and geometry. The abandonment of the perception of proportion and proportional measure becomes evident only from the 20th century onwards, when the planning grid allows, for functional and metric reasons, all measurements to be used without mutual proportion. Integral to proportional systems and scale are measures, which in architecture can be understood as basic units of measurement – length, area or volume – that have historically served not only to construct buildings, but also to determine proportions and create harmonious compositions. Prior to the introduction of the metric system, historical measurements were heterogeneous and tied to specific cultural and geographical environments, lacking a uniform standard. Of particular importance were length measures, which, together with geometric and compositional principles, shaped the spatial logic of buildings.

In Slovakia, the issue of historical scales in architecture remains understudied, although it holds significant potential in the European context. Knowledge of measurement standards and proportions allows for the reconstruction of the design principles of the past and serves as a practical tool for authentic restoration. This paper focuses on the analysis of selected historical buildings in Slovakia, with an emphasis on the use of ancient proportions in Neoclassicism and the conscious application of historical compositional principles in the work of M. M. Harminc. In addition, it raises methodological issues related to the research and application of historical units of measurements in contemporary monument care.

METHODOLOGY

Examining historical units of measurement and proportion in architecture requires an interdisciplinary approach, combining knowledge from architectural historiography, geometry, and monument restoration. Understanding a building's evolution, historical context, and archival sources is essential for identifying alterations, secondary interventions and the original function of architectural elements. An important part of the methodology is the direct verification of facts on site through photogrammetry. This method enables the creation of a 3D model from photographs taken in the field, from which orthographic scale views can be generated, allowing for the analysis of proportions and relationships between elements. Smaller architectural details, such as windows, portals, or columns, are considered most suitable for research, as they allow more accurate identification of historical units of measurement due to the lower risk of accumulated errors. The proportions found can then be applied to larger units such as room layouts, height distribution, facades or overall dimensions of the building.

Historical Units of Measurement

Knowledge of the historical measurement systems (systems of units of measurement) used across Europe plays a key role in interpretation. Sources such as specialist manuals and databases enable conversion to the metric system and geographical identification of measurements, reflecting the transmission of building traditions between regions. In the historical environment of Old Hungary, of which Slovakia was a part, Italian, German, Polish and other systems of measure were applied in parallel due to the high mobility of construction groups.

Proportions in architecture can also be traced through compositional principles such as modular systems, the golden section, or symmetry. These relationships represent a conscious choice by architects drawing on historical models. In the 19th and 20th centuries, particularly in Neoclassicism and Modernism, proportion became an expressive means of representation, order and rationality.

The choice of aristocratic residences in Turiec (Slovakia) as a case study is based on their relevance for demonstrating these principles in combination with the documented application of historical units of measurement in the wider region. A different perspective is offered by the architectural work of M. M. Harminc, who integrated classical compositional principles as a central tenet of his work – both in the adaptation of historic buildings and in the design of various architectural types in the spirit of modernism and functionalism.

To approach the topic appropriately and apply the chosen methodology to the selected case studies, an introduction to the historical and theoretical foundations of human scale, anthropomorphic and geometric proportions, and the resulting compositional balance in architectural creation is necessary.

Human Scale in Classical Architecture

Architectural scale – and especially proportion – reflects or, conversely, conditions the relationships between dimension, form and movement that constitute the essence of human scale. Scale represents the relationship of proportional dimension to the human body and our capacity to use a particular building in terms of the physical (approaching the building, moving within it, using its spaces) and the mental (identification with the building as a sign or place of our existence and a form of representation). For this reason, human scale is a prerequisite for successful identification of a person with a building – an architectural object. Furthermore, even a representative building of large dimensions can have a human scale if it becomes proportionally measurable in human terms and thus its monumental connotations are suppressed. By working with proportion, historical architecture was able to successfully integrate the monumental work beyond human scale. Modern architecture, which for functional and operational reasons often multiplies a single element into a monotonously endless series, such as in the façade composition of an office or residential building, creates a sense of gigantism far removed from natural scale. (1) A return to natural scale and the identification of man with the object is possible in modern architecture through the application of traditional scales and proportions. This principle is also evident in the work of architect Harminc, who integrated the compositional and proportional principles of classical architecture into his work in the spirit of modernism.

Proportional Relationships in Numbers

Architecture employs proportional systems that connect Euclidean geometry with natural forms. Broadly speaking, there are two fundamental types of proportional systems, symmetrical systems, which share a common denominator of values, and asymmetrical systems in which the individual magnitudes are not derived from a single unit of measure. (2)

Symmetrical proportional systems have been characteristic of classical architecture since antiquity. They are inspired by music, creating harmonic intervals of the fifth (2:3), the fourth (3:4) and the octave (1:2), as discussed in the work of Renaissance architect Alberti and the historiographical works of Rudolf Wittkower (3) and Paul von Naredi-Rainer (4). Symmetrical proportions are compositionally advantageous because they feature a sufficiently small base modulus, which is made up of multiples of the dimensions and proportions of all the elements of the composition. This is why they are central for the present study. Asymmetrical proportions, which also have their origin in antiquity, are mathematically defined by irrational ratios. They express the diagonal relationship, i.e. the ratio between the sides of a right-angled geometrical figure and the diagonal. The most famous diagonal ratio is the ancient golden ratio of $1:\sqrt{2}$, which was later explored by the modernist Le Corbusier. With the creation of the Modulor, an innovative proportional system in modern architecture, he reintroduced the assymetrical proportion to modern design. Other avant-garde architects of interwar modernism rejected the use of proportional systems in contemporary practice. They believed that proportional systems belonged to the past and were used only by eclectics. The justified return to classical proportional systems in new designs and adaptations of historical architecture is convincingly reflected in the work of M. M. Harminc, the focus of this case study.

Balance – Symmetry and Balanced Asymmetry

Composition based on proportional systems and human scale is inherently balanced. It can be symmetrical or asymmetrical, achieving balance through weight and counterweight. According to Vitruvius, symmetry expresses the order that forms the basis of classical architecture and creates a balance between the parts forming a coherent whole. (5) This balance has both an aesthetic and structural dimension. According to Palladio, from an aesthetic point of view, symmetry is a necessary condition for harmony. (6) From antiquity to the end of the 18th century, axial symmetry was reserved for iconic and important secular buildings for the symbolic and representative expression of balance. However, through its overuse in ordinary buildings during the 19th and early 20th centuries, symmetry lost its status as a symbol of exceptionality. As a result of this discrediting of symmetry, new spatial and compositional approaches based on asymmetrical balance were promoted in modern architecture of the 20th century. (7) Nevertheless, the museum buildings of M. M. Harminc, created within the context of the receding historicism,

modernism and functionalism, make full use of this principle of symmetry to reinforce the phenomenon of representation.

1ST CASE STUDY
NEOCLASSICAL MANOR HOUSES AND CURIAS IN TURIEC (SLOVAKIA)

The Turiec region in the northern part of Slovakia was historically shaped by the strong position of yeomanry and noble families, who introduced cultural and architectural influences to the area. Thanks to their activities, a remarkable collection of rural aristocratic residences – manor houses and curias – was established here. A total of 66 of these buildings are now listed in the Central List of Monuments as national cultural monuments, many of which have retained their original architectural substance without major alterations, especially during the 19th and 20th centuries. Curias, as simpler residences of the lower nobility and yeomen, and manor houses, as the representative dwellings of the middle and upper nobility. Together, they offer a wide range of forms – from modest three-room layouts to block structures or larger three-winged buildings. Their preservation and typological diversity provide ideal material for research.

FIGURE 1. Curia in Blatnica. Photo: K. Kráľová

Curia in Blatnica (Slovakia)

The first case study deals with the analysis of a neoclassical curia in the village of Blatnica (Martin district), which, together with the nearby baroque manor house, forms an integral part of the former noble estate of the Prónai family. Despite its rural setting, the building exhibits a high degree of architectural articulation and proportional schemes derived from ancient principles. These were transmitted to the territory of Old Hungary by itinerant builders who brought with them their own measurement systems, often influenced by patrons from abroad. The Blatnica Curia thus illustrates not only the deliberate application of neoclassical proportions, but also the broader cultural context of the migration of historical units of measurement within the Central European region.

The predecessor of today's Baroque-neoclassicism curia was a 16th-century structure with an irregular rubble-stone basement and a barrel-vault ceiling. The above-ground part was likely wooden and served as housing for estate employees. In the third quarter of the 18th century, it was replaced by a three-bay brick building on a rectangular plan, with an entrance hall and a mansard roof – a feature still preserved today. The rebuilding took place at the same time as in the manor house and was done by Gabriel III Prónai and his wife Eva Roth (8).

The Louise-style portico was added in 1836 by Gabriel VI Prónai, as evidenced by the Latin chronogram: GABRIEL (DE) PRÓNA RENOVARI JVSSIT AMICIS FISCÁLE ATQVE SIBI HAS (HOSP)ITIBVS QVE FIDIS. This can be loosely translated as: "Gabriel Prónai ordered the renovation of these buildings for the friends of the state treasury, as well as for his loyal guests (visitor)" (9)**.**

The cupola-roofed portico is supported by six columns on a shared plinth, with rusticated capitals featuring acanthus leaves and volutes. The column shafts are deeply fluted, rest on moulded bases and support an architrave with a narrow frieze, inscription, stucco rosettes and moulded cornice. The neoclassical extension gave the curia its present form.

FIGURE 2. Louise-style portico at the Blatnica Curia. Photo: K. Kráľová

Analysis of Historical Scale and Proportions on The Louise-Style Portico

Geometric analysis of the portico of the Blatnica Curia revealed a precisely proportional division of the column into eight equal parts, with the base and the head occupying one-eighth of the total column height. In the first step of the analysis, based on photogrammetric data, the proportions of the column and the overall proportions of the portico were determined. This was based on the height of the shared plinth, which is repeated four times within the height of the column. One and a half times the height of the plinth was located at the height of the architrave together with the frieze. The total width and height of the columns with the plinth follow a ratio of 6:5 (or 12:10). The value of the historical unit of measurement derived from these proportions is 341 mm, which corresponds to half of the elbow (braccio, 682 mm) used in the Bormio region of Lombardy in northern Italy, as documented by Zupko (10). The same unit of measure was also identified at the Blatnica Manor house, indicating a deliberate use of historical units of measure.

The application of the Italian historical unit of measure reflects the use of the rules of classical architecture even in the context of a rural noble residence in Turiec. This demonstrates a high degree of cultural transfer and familiarity with architectural theory on the part of the client or the builder. Such a discovery challenges assumptions about local construction practices – it confirms that even in regions like Turiec, building was not solely empirical, but that architects and builders could intentionally apply principles drawn from Renaissance or Baroque treatises.

FIGURE 3. The Blatnica Curia, ortho view of the photogrammetric model. Initial determination of the ratio of the total width of the portico to its height; X was determined by the height of the plinth. Author: K. Kráľová

FIGURE 4. The Blatnica Curia, ortho view of the photogrammetric model. Verification of the ratio from the second control point – the height of the column base. Y has a value of 341 mm. Author: K. Kráľová

2ND CASE STUDY
HARMINC – AN ECLECTIC WITH A FLAIR FOR HISTORICAL UNITS OF MEASUREMENT

Michal Milan Harminc (1869 – 1964) is one of the doyens of Slovak architecture and an exceptional personality on the European architectural scene. He worked not only in major urban centres, but also in small towns and villages across various regions. Between 1887 and 1951, he designed more than 300 buildings spread throughout Central and Eastern Europe (in the territory of the former Austro-Hungarian Empire and its successor states, including in present-day Serbia, Romania, Ukraine, Hungary and Slovakia). His works spans a wide typological and stylistic range, from historicism to modernism and functionalism. (11) Harminc's path to the creative credo of an eclectic is marked by a specific connection to ancient traditions and the creative principles of historical architecture, in harmony with modernity. These principles are most evident in his religious and cultural buildings with national significance. Selected examples demonstrate the use of historical measurements and proportions through photogrammetric methods, analyses of proportional relationships and archival and architectural-historical research both in the reconstruction of buildings and in new architectural designs.

Sacral Architecture – from Historicism to Modernism and Functionalism

Looking back not only at the quantity but also at the confessional diversity of Harminc's sacral architecture, we find Evangelical, Roman Catholic, Greek Catholic and Serbian Orthodox churches represented. This is an exceptional phenomenon not only within Slovak architectural historiography. Harminc designed, reconstructed and often even built around 100 churches and temples of various denominations, approximately 80 of which are located in Slovakia. This wide confessional range reflects not only his stylistic adaptability but also the exceptional quality of his sacral architecture. His new works and reconstructions of churches dominating the image of the city and the rural landscapes continue to reflect the architect's credo of pragmatic eclecticism. These works offer an interesting combination of sacral purpose with the knowledge of tradition, historical scale and proportional relationships of the whole, layout and details in the context of the search for modern simplicity and inventive solutions, in harmony with craftsmanship detail. (12)

Reconstruction of the Church of the Visitation of the Virgin Mary in Rabča (Slovakia)

The architect’s creative approach is often revealed not only in projects conceived from the very beginning as new buildings but also in those in which he was able to adapt to various limitations. Such is the case with the reconstruction of the Church of the Visitation of the Virgin Mary in Rabča in the Orava region.

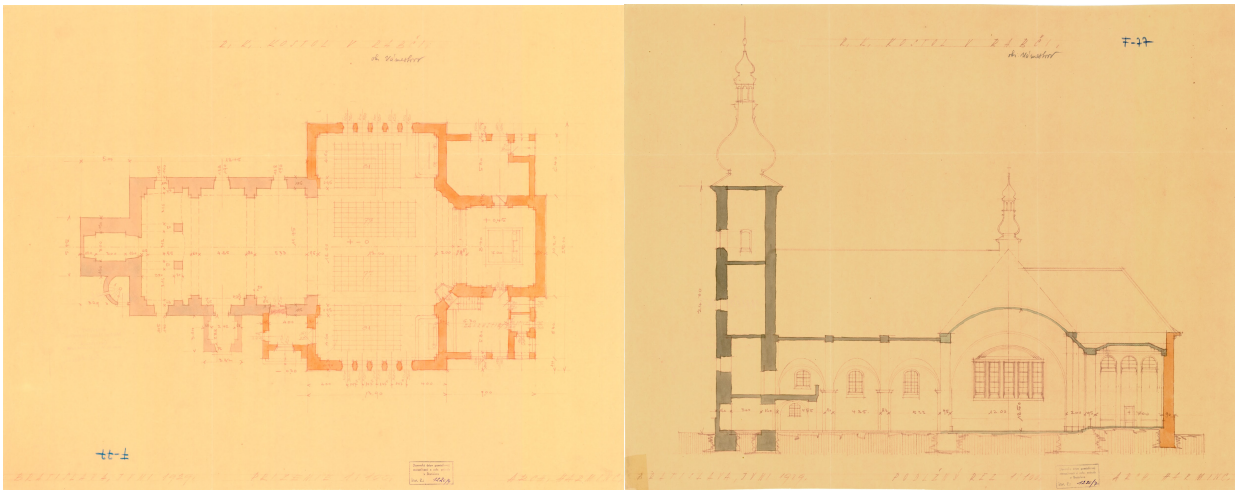

FIGURE 5 and 6. Roman-Catholic Church of the Visitation of the Virgin Mary in Rabča. Plan and view, cross-section, author: M. M. Harminc. Source: Memorial Archive of the Slovak Republic; Collection of projects and plans, sign. A 1220_4 , A 1220_7

In 1772, a Baroque church was built near the Polish border at the upper end of the village of Rabča. In 1928, the local Catholic community decided to enlarge the original single-nave layout by adding a semicircular presbytery and a tower. The plans for the expansion of the church were drawn up by architect Harminc. In 1929, the District Office in Námestovo issued a permit for the demolition of the existing Baroque presbytery, sacristy and side vestibule. Structural problems also necessitated the renovation of the main nave and its vaulting. Harminc preserved the western part of the original church with the tower and the emporium. He added a transept and a new presbytery to the Baroque nave, resulting in a Latin cross floor plan. Harminc placed the main entrance to the church on the south side, with the northern facade adjoining the cemetery. (13) The reconstruction, which lasted only 14 months, was completed with the consecration ceremony on 9 November 1930, attended by the Bishop of Spiš, Ján Vojtašák.

FIGURE 7. New transept of the Church of the Visitation of the Virgin Mary in Rabča. Photo: M. Kováč

Given the preservation of the original Baroque floor plan of the church in Rabča, as well as Harminc's reconstruction designs, it was possible to conduct a proportional geometric analysis as part of the research. This method examines spatial relationships and proportional links between individual parts of the building. However, despite the preserved floor plan, a detailed analysis of historical units of measurement was not possible, as the available survey documentation had already been converted to the metric system. During this transcription, rounding likely occurred, as a result of which the precision of the original measurements was lost, making it impossible to determine the exact units of length with certainty.

Geometric analysis of the floor plan confirmed that Harminc based the expansion of the church on the proportions of the original Baroque structure. The width of the newly designed transept was determined by the length of the original nave, including the tower, in a ratio of 2:1. When designing the transept, Harminc used the dimensions of the Baroque sacristy as the fundamental proportional module. The outer width of the sacristy became the unit of measure, which he applied twice in the longitudinal direction to define the length of the transept, and five times in the transverse direction to establish its width. A similar systematic approach was used in the design of the new presbytery – Harminc kept its width identical to the original Baroque design, while the length was derived from the difference between the original end of the presbytery and the newly designed transept width. He then applied this dimension six times along the length of the presbytery, creating a clear modular structure. In his rebuilding, Harminc consciously continued the original Baroque composition, transforming it into an innovative concept. At the threshold of Harminc's third, functionalist phase, an intriguing hybrid of historical and modern architecture was thus created.

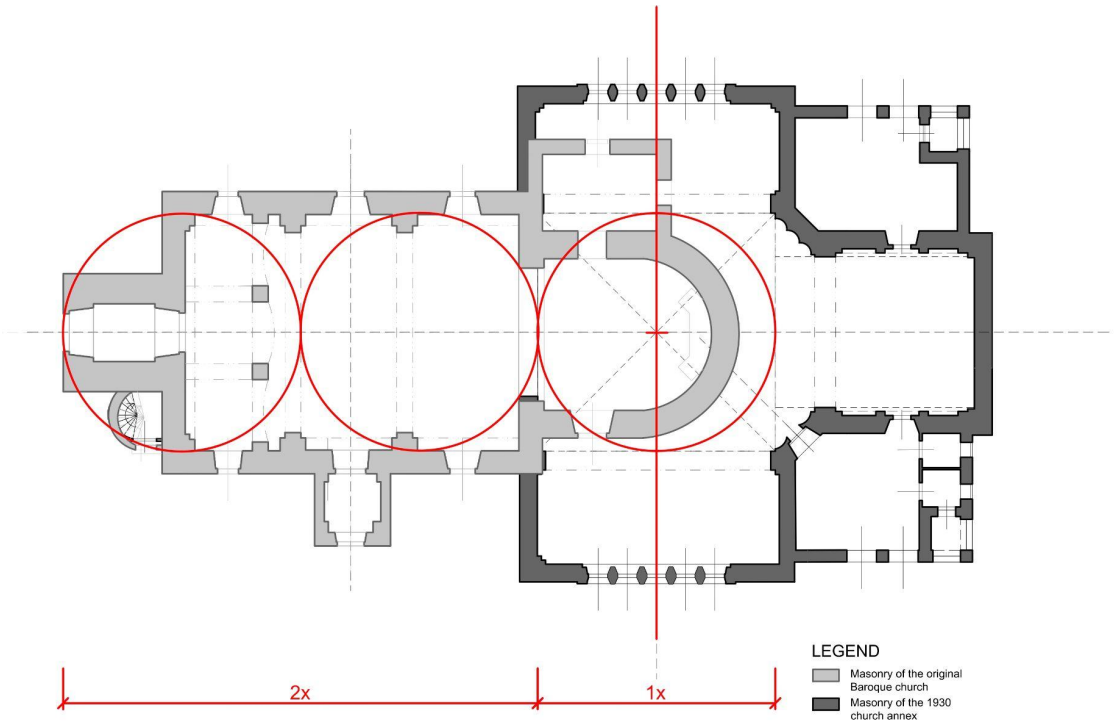

FIGURE 8. Floor plan of the original Baroque church and its extension. Analysis of the proportions of the new transept. Author: K. Kráľová

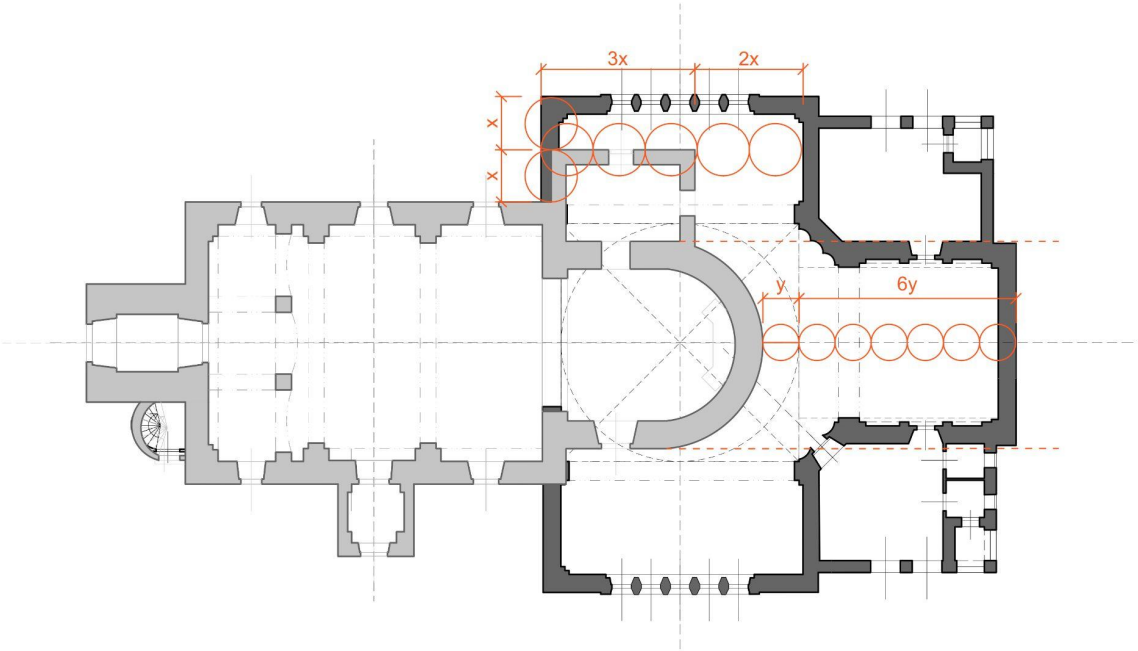

FIGURE 9. Floor plan of the original Baroque church and its extension. Analysis of the proportions of the new transept and presbytery. Author: K. Kráľová

Three Slovak Museums – Variations on an Ancient Theme

Since the 20th century, influenced by artistic individualism, the introduction of the metric system, but also because of the pseudo-scientific nature of ancient proportional systems, proportion and proportional measures have disappeared from architectural practice. However, their application in architectural composition fundamentally contributes to the coherence and balance between parts, both in relation to each other and to the whole. (14) However, the return to proportional systems within historiography and architectural-historical research hold significant potential for identifying and understanding the measurement and compositional principles of historical structures. In modern architecture, it offers the possibility of creative a cohesive composition. This is exemplified by M. M. Harminc's projects from the first half of the 20th century, including cultural buildings for that marked a return to human scale during an era of abstraction and metrification.

The *long* 19th century already heralded a creative continuation of ancient forms and aesthetics not only for this typological category. Over three decades of the 20th century, Harminc designed a triad of Slovak national museums, institutions tied to national identity. An interesting observation of ancient principles can be traced from neoclassical forms in Martin (1906), through the emergence of modern official monumentality in Bratislava (1925), to functionalism once again in Martin (1929). (15)

The First Slovak National Museum in Martin was Neoclassical

The neoclassical building of the First Museum in Martin (1906 – 1908) marked a new direction in the work of the doyen – a move towards classical architectural forms. For this design, he was awarded the title of builder in Budapest (1908).

In the spring of 1906, an architectural competition was announced, in which, alongside historicist and eclectic designs, a neoclassical project won, characterized by a simple layout and a restrained composition of the facades. Here, the author combined national identity with a model of neoclassical architecture rooted in European tradition. However, he was not influenced by the grand models, such as Mihály Pollack's neoclassical National Museum in Budapest (1846) or the two contemporary buildings – the Museum of Fine Arts (1900 – 1906, Albert Schickedanz and Fűlöp Herzog) and the historicist Museum of Art and History in Budapest (1896, Ödon Lechner). Harminc found his own path in the design of the museum, whose features became a rational concept and a local context in the city, which at the dawn of the 20th century was both a centre and a periphery. He created a logically arranged floor plan with a central, representative staircase. The architect also expressed the building's representative function externally through antique morphology on the facades using simple motifs – a columned portico, a neo-antique system with composite pilasters, and triangular risalits. (16)

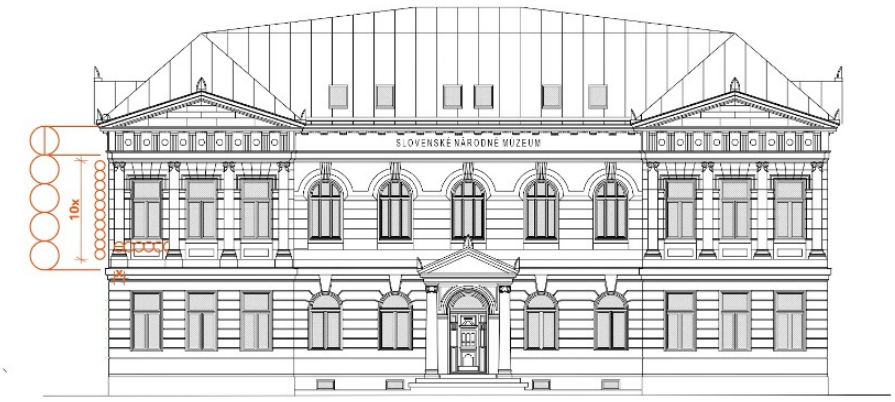

FIGURE 10. Facade of the First Slovak National Museum in Martin, author: M. M. Harminc, Archive of Slovak National Museum, compositional analysis: Matúš Kiaček

The ancient model as a creative principle is also evident on the façade of the First Slovak National Museum – in the decorative pilasters. Geometric analysis of the façade confirms that the pilasters are 0.4 m wide and reach a height of 4 m, corresponding to an exact ratio of 1:10. This ratio is characteristic of the composite order and reflects a

conscious effort to achieve an elegant and noble verticality. According to Vitruvius, the slenderness of the composite or Corinthian column is meant to imitate virginal slenderness, its graceful proportions and decoration evoking the image of a virgin, whose youth is expressed through more graceful body parts. (17) Such slenderness and proportion of the columns support the symmetrical balance of the entrance façade, which in ancient architecture is essential for compositional and tectonic harmony.

By employing these ancient elements, Harminc achieved a form suitably dignified for an institution whose primary mission was the preservation of national collections.

Slovak National Museum in Bratislava – Monumental Concept of Modernism

At the advent of modernism, Harminc was once again given the opportunity to design a museum, this time in Bratislava (Slovak National Museum, originally the Zemědělské muzeum). His initial design was not accepted, nor were the designs of leading Czech architects who participated in the 1924 state-commissioned competition (Bohumil Hübschman, Vít Obrtel, Otakar Novotný and Pavel Janák). The contract was eventually awarded to Harminc without a competition, facilitated by his contacts in agrarian circles. Between 1924 and 1928, he created a national shrine which, at a time when modernism was still undefined, inevitably referenced historical models. The monumental classical-style façade with columns and tympanum, the figural compositions and reliefs on the façades, and the purposefully arranged exhibition layout with elegantly designed interiors together created a prototype of a representative institution. Slovak historian Eduard Toran, the first to summarize the architect's oeuvre, rightly emphasized the classical and dignified character of the museum, reflecting Harminc's affinity for the style of modern official monumentality. (18)

Monumentality in architecture typically arises from a distinctly axial, symmetrically balanced composition and with the impression of architectural dominance over human scale. Yet Harminc handled the dimensions and proportions of the building with sensitivity, ensuring that the resulting monumentality did not drift towards colossal scale that would break with the anthropomorphic character of classical architecture.

FIGURE 11. Slovak National Museum in Bratislava, north façade, compositional analysis: Matúš Kiaček

The museum building consists of a compact block with an inner courtyard, designed on a trapezoidal plan with its longitudinal axis parallel to the Danube. The entrance façade is set on the longitudinal axis, which serves as the main compositional determinant of the axiality of the façade and the whole building. This axiality is further enhanced by a spatial perspective effect, where the side facades, when viewed frontally, visually recede and diverge toward the rear, creating a perspective foreshortening. Harminc drew inspiration from the perspectival optical illusion of ancient Greek temples, where the side facades often bulged outward slightly to ensure visual legibility in an axial view. The axis also defines the symmetrical composition of the entrance façade, which is conceived following the principle of an antechamber temple. However, its ancient proportions diverge from ancient models. The stylized Doric columns are slenderer, with a ratio of 1:10. Similarly, the ratio of the entablature height to the column height is slightly greater than 1:4. Most striking, however, is the disproportionality in the width of the side awnings, which, according to Vitruvius, should be narrower than Doric columns. (19) Harminc, conversely, designed them to be 1.5 times wider. He used identical proportions of the Doric half-columns and placed them on side elevations with eight half-columns. The distance between the half-columns is 7:3 to the width of the half-column, differing from the proportions of the Roman Doric ratio of 7:4. Despite these deviations from ancient canons, Harminc's use of historical inspiration remains remarkably harmonious.

Monumentality in the service of national architecture, exemplified by the Bratislava museum building, testifies the work of an architect deeply rooted in tradition, and thus to classical architecture. The national museum has become a city-forming structure which has contextually entered the landscape of the city on the Danube as its dignified and classical pendant.

FIGURE 12. Slovak National Museum in Bratislava, author: M. M. Harminc, period photograph, Archive of Slovak National Museum

The Third Museum in Martin was Functionalist

Already at the dawn of the functionalist era, Harminc was, for the third time in his life, given the opportunity to design a building tied closely to national identity – the building of the Slovak National Museum, which was to stand again in Martin (1929 – 1932). In an innovation-friendly atmosphere in architecture, a national architectural competition for a new building of the Slovak National Museum in Martin was announced in 1929. Although Harminc's functionalist proposal (co-authored with Ferdinand Silberstein) was awarded third place, the committee of the Slovak Museum Society ultimately entrusted him with the project. (20)

The striking main entrance façade on the ground floor is rhythmically divided by 18 square pillars, which continue through two upper floors in the form of pilasters made of pinkish rhyolite. This motif can be interpreted as a reference to two earlier precedents. The first is the Neoclassicism design of museum buildings rooted in Schnickel's tradition, which left a strong impression on Harminc during his travels in Germany. The second is the ancient Greek stoa – a colonnaded walkway forming a promenade along public buildings and spaces. The public character was embodied through the human scale of a row of Doric columns. Therefore, it is no coincidence that Harminc uses the stoa to express the museum's public and urban role with the stylized proportions of the Doric order. According to Palladio, the ratio of column width to column height is 2:15 (1:7.5), with the column height to the spacing between columns at 15:5.5. (21) The entablature-to-column height ratio is normally 1:4. Harminc retains the entablature-to-column ratio but doubles the others. He changes the column width-to-height ratio to 1:15, and densifies the spacing twofold to a column height-to-spacing ratio of 15:2.75. Had he doubled each pair, he would have matched the proportions of the Doric order. As it stands, only the ratio between the width and spacing of the columns (2:5.5) is maintained. The strict axial symmetry of the symmetrical composition reinforces its monumental character, complemented by a sophisticated urban concept with a grand entrance staircase and a system of rhyolite retaining walls and terraces. This has made the building on a hillside a natural urban landmark. The phenomenon of urbanity becomes a principle here. Harminc thus repeatedly engages with monumentalising symmetry at a time when it was intensely and frequently criticized by the modernists.

The triad of Harminc's national shrines is thus fittingly completed by the functionalist museum in Martin, the largest of them all. No larger purpose-built museum has been constructed in Slovakia since. Moreover, this trio of museums exemplifies the architect's long journey from historicism to modernism and functionalism.

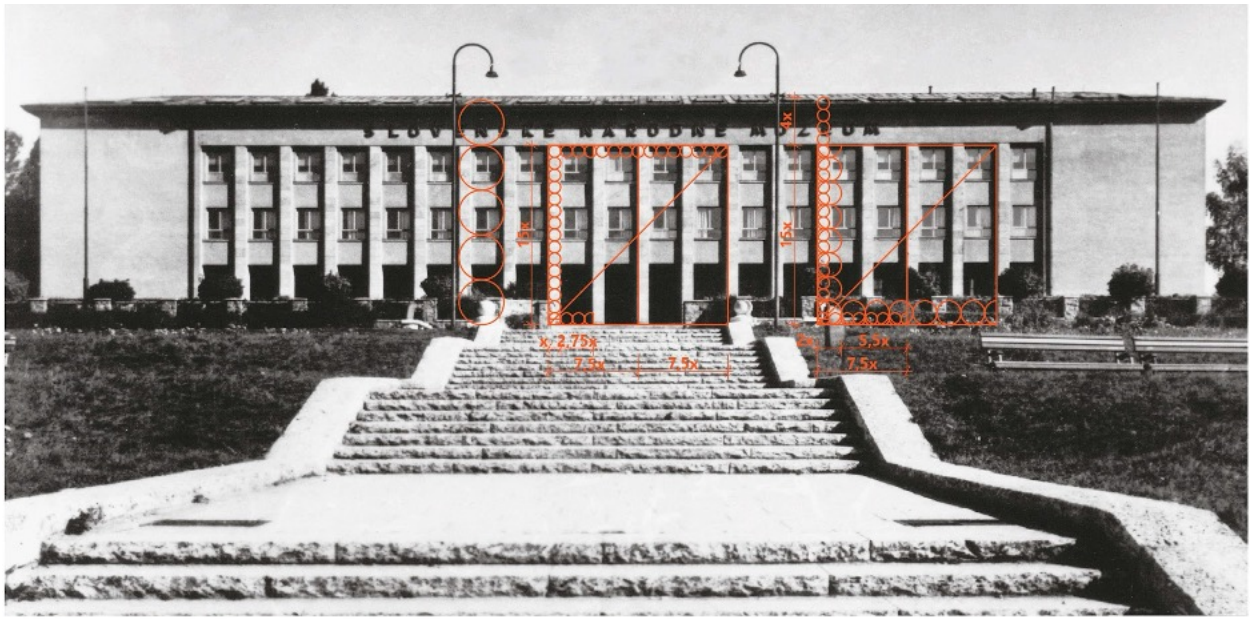

FIGURE 13. Slovak National Museum in Martin, by M. M. Harminc, period photograph, Archive of Slovak National Museum, compositional analysis: Matúš Kiaček

CONCLUSION

Both case studies, examining the application of historical units of measurement and classical proportional principles in the examples of manor houses and curias in Turiec, as well as in the architectural work of M. M. Harminc, have yielded remarkable results in the fields of historiography and research methodology, with implications for the subsequent restoration of historical buildings. Photogrammetric methods, combined with the investigation of proportional and compositional principles, demonstrate the potential of these tools for gaining a comprehensive understanding of the author's creative processes, architectural form and design principles underlying historic buildings.

The examination of the Neoclassicist curia in Blatnica (Turiec) has revealed a remarkable use of historical units of measurement, highlighting the cultural links between the territory of Slovakia and the broader European region of Old Hungary in the context of the migration of historical measurement systems within Central Europe. At the same time, the Blatnica Curia serves as an example of the application of classical proportions in a local setting, reflecting the cultural influence of enlightened builders.

A different perspective on classical units of measurement and proportions is offered by the sacral architecture of M. M. Harminc. It reflects traditional – classical proportional principles and historical units of measurement, while also being open to the broader European influences of modernism and functionalism. The completion of the Roman-Catholic church in Rabča is based on respect for the original Baroque layout, integrated with modern elements. The architect created a harmonious synthesis of peripheral Baroque and rational modernism, attuned to the genius loci of the undulating Orava landscape, with the cemetery in the background.

Harminc's inventive approach to classical design principles is also reflected in the design of public buildings. The results of research into the three Slovak National Museums confirm his work with proportional systems and anthropomorphic scale in achieving symmetrically balanced architectural compositions. The analogy between the human body and characteristic architectural elements is represented by the ancient orders, which Harminc employed in his historically grounded work. In the design of the first building of the Slovak National Museum in Martin, he applies the proportions of a composite column; in the second building in Bratislava, a Doric column; and in the third building, again in Martin, he introduces a simple prismatic column with a modernized doubling of the Doric proportions. It should be noted, however, that Harminc, like the ancient builders, emphasised the primary act of construction over the literal representation of anthropomorphic analogies. Whether Harminc operated with human scale and anthropomorphic references consciously or intuitively does not diminish the validity of the intuitive phenomenon.

The study also demonstrates that Harminc worked with proportional measure throughout the 20th century, both in the reconstruction of historical buildings and in the design of modern new buildings inspired by classical architecture. As a pragmatic architect, he applied proportional systems in his designs and in the buildings analysed. In fact, modern architecture had already shown in the interwar period that the systematic use of asymmetrical proportions was impractical and difficult to apply compared to direct proportions. Finally, Harminc's positive attitude symmetrical balance can also be evaluated, as he consistently returned to the human scale and the compositional and proportional principles of classical architecture.

ACKNOWLEDGMENTS

This paper was supported by this research grant: KEGA 040STU-4/2024 Návrat k mieram. Architekti Harminc a Milučký medzi tradíciou a modernou / Back to scale. Architects Harminc and Milučký between tradition and modernism. (Project lead: prof. Ing. arch. Jana Pohaničová, PhD., Faculty of Architecture and Design, Slovak University of Technology in Bratislava. Ing. arch. Pavol Pauliny, PhD., Ing. arch. Kamila Kráľová, Ing. arch. Matúš Kiaček, are co-investigators).

REFERENCES

1. P. von Meiss, *Elements of Architecture: From Form to Place + Tectonics* (EPFL Press, Lausanne, 2013), p. 69.
2. P. von Meiss, 2013, pp. 75 - 77.
3. R. Wittkower, *Architectural Principles in the age of humanism* (Alec Tiranti, London, 1967), 173 p.
4. P. von Naredi-Rainer, *Architektur und Harmonie [Architecture and Harmony]* (DuMont, Berlin, 1982), 303 p. (in [German]).
5. M. Vitruvius Pollio, *Deset knih o architektuře [The Ten Books on Architecture]* (Arista a Baset, Praha, 2021), p. 99. (in [Czech]).
6. G. Hersey and R. Freedman, "The Background: Palladio and Symmetry," in *Possible Palladian Villas* (MIT Press, Cambridge; London, 2021). [online] https://doi.org/10.1162/a8667414.c662fc31.
7. P. von Meiss, 2013, pp. 83 - 84.
8. Ľ. Veľasová and V. Kapišinská, *Národné kultúrne pamiatky na Slovensku – okres Martin [National Cultural Monuments in Slovakia – Martin District]* (Slovart, Bratislava, 2012), pp. 285
9. A. Janura and K. Zvedelová and M. Sobola, *Vidiecke šľachtické sídla v Turčianskej stolici [Rural Manor Houses in the Turiec Countyt]* (Koloman Sokol Society, 2014) pp. 158-159
10. R.E. Zupko *Italian Weights and Measures from the Middle Ages to the Nineteenth Century* (The American Philosophical Society Press, 1977) p. 45.
11. J. Pohaničová, A klasszicizmustól a modernig. A hosszú század építészete a mai Szlovákia területén. [From Neoclassicism to Modernism. Architecture of the Long Century on the Territory of Today's Slovakia] in *Építés - Építészettudomány [Architectonics and Architecture]*. vol. 43, no. 1-2, 2015, pp. 63-78. (in [Hungarian]). [online] https://doi.org/10.1556/eptud.43.2015.1-2.3.
12. J. Pohaničová and P. Vodrážka, *#Harminc* (Gasset, Praha, 2018), 208 p.
13. J. Pohaničová and M. Dulla, *Michal Milan Harminc (1869 - 1964): Architect of Two Centuries (TRIO Publishing, Bratislava, 2014),* pp. 118-122.
14. P. von Meiss, 2013, p. 78.
15. E. Machajdíková (ed.), R. G. Maretta and J. Pohaničová. *Michal Milan Harminc Staviteľ múzeí [Michal Milan Harminc Museum builder]* (Slovenské národné múzeum, Bratislava 2020), 299 p. (in [Slovak]).
16. J. Pohaničová and M. Dulla, *Michal Milan Harminc (1869 - 1964): Architect of Two Centuries (TRIO Publishing, Bratislava, 2014),* pp. 60 - 63.
17. M. Vitruvius Pollio, 2021, pp. 123 - 127.
18. J. Pohaničová and P. Vodrážka, 2018, pp. 112 - 117.
19. M. Vitruvius Pollio, 2021, pp. 131 - 137.
20. J. Pohaničová and P. Vodrážka, 2018, pp. 132 - 136.
21. A. Palladio, *Čtyři knihy o architektuře [Four Books of Architecture]* (Malvern, Praha, 2022), pp. 35 - 40. (in [Czech]).