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Early use of the reinforced concrete in the architecture of the Historicism in Austria–Hungary

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Abstract

The study examines the early incorporation of reinforced concrete in the architecture of Historicism in Austria–Hungary. Spanning the late 19th to early 20th centuries, the research illuminates the period's stylistic pluralism and the transformative impact of reinforced concrete. The paper examines the integration of reinforced concrete into traditional forms, providing detailed case studies and architectural examples. It navigates through various aspects, including the evolution of reinforced concrete during the historicist period, its adoption in notable structures, and its documentation in contemporary literature. Case studies, such as the Lutheran Church in Battyánd (now Puconci, Slovenia), the Roman Catholic Church in Topolya (now Bačka Topola, Serbia), and the former Synagogue in Český Krumlov, Czechia, showcase the innovative ways reinforced concrete addressed structural challenges while adhering to historicist aesthetics. The research concludes by reflecting on the transformative role of reinforced concrete in challenging the conventions of Historicism, paving the way for modern architectural expressions.

KEYWORDS

Austria–Hungary, Historicism, reinforced concrete

1 | INTRODUCTION

Reinforced concrete is identified with modern architecture, as seen in the works of Adolf Loos (1870–1933; Steiner House, 1910—an example of rationalist architecture in Vienna, Austria) or Otto Wagner (1841–1918; Postal Savings Bank—Postsparkasse, 1906—an example of Viennese modernism in Vienna, Austria) from the early 20th century. Both buildings utilize reinforced concrete as a structural material. Loos employs the new material in severe, curveless cubic forms without any decoration, while Wagner's building is one of the first to use reinforced concrete in its construction. Although reinforced concrete was synonymous with modernism and later with brutalism in 20th-century architecture, it emerged in the late 19th century.[1] During the historicist period at the end of the 19th century and the beginning of the 20th century, scientific applications of reinforced concrete started along with the development of the first building codes. This era marked the age of various revival styles, where architectural forms evolved according to the characteristics of traditional building materials, especially masonry structures. A vault, a dome, has a specific shape designed to eliminate tensile stresses within the structure, a demand that masonry structures are unable to withstand. This is also the rationale behind curved spatial coverings, aperture closures, and, consequently, the necessity of support systems capable of withstanding horizontal forces. Reinforced concrete eliminates the limitation of masonry structures, which cannot resist tension, as emphasized by Pier Luigi Nervi (1891–1979), as quoted by T. Iori and S. Poretti[2] [p. 283] "Adaptability to any form and the capacity to resist all three major stresses make reinforced concrete the most revolutionary material in the history of the construction industry".[3] Furthermore, Nervi stated, "The possibility to create cast stones of any form, which, being more resistant to stress, are better than the natural ones, is somewhat magic".[3] Nervi's original writing was published in Italian in 1945 under the title "Scienza o arte del costruire?"

2 | REINFORCED CONCRETE IN THE LATE HISTORICISM

In the late 19th century and towards the end of the century, revolutionary new materials like reinforced concrete and steel were initially used to construct traditional forms. Two characteristic examples are the completion of the Cologne Cathedral (Cathedral Church of Saint Peter in Cologne, Germany, 1248–1880) and the Hungarian Parliament in Budapest, Hungary (Imre Steindl, 1885–1904). While the visible parts of these buildings exhibit pure Gothic forms, hidden elements reveal the use of metal structures instead of traditional timber or masonry structures. In Cologne, the roof structure uses metal,[4,5] and in Budapest, both the roof structure and the dome incorporate metal elements.[6] The latter statement is particularly intriguing, as the characteristics of the parliament dome (the cross-section shapes a pointed arch, the structure consists of ribs and panels between them, and pinnacles can be found at the springing of the ribs) all have structural significance in the case of masonry structures, whereas in the case of metal structures, they serve purely decorative purposes.

Around 1900, the former Austria–Hungary or Habsburg Central Europe (1867–1918) witnessed a stylistic pluralism. "The architecture subsumed under the category of Late Historicism generally consists of pathos-filled and overloaded combinations of ornamental scraps of Renaissance, Baroque, Rococo, and Gothic, in which, for economic reasons, the industrial manufacture of ornamentation played a role"[7] [p. 99]. Simultaneously, "Otto Wagner's great project of developing a modern (imperial) universal style (with all its secessionist and constructivist inclusions)"[7] [p. 98] took place in the Austrian part of the Empire.

In the late 19th century, reinforced concrete rapidly gained popularity within the geographical confines of the former Austro-Hungarian Empire (1867–1918). Szilárd Zielinski (1860–1924), an engineer and university professor, played a key role in introducing the practice of reinforced concrete construction in historical Hungary. After his studies (1884), he went to Paris for further education and worked at the Eiffel company. Upon returning to Budapest in 1888, he established an office and, by 1889, commenced designing predominantly industrial structures and urban installations such as bridges and water towers. His designs were grounded in the patents of Hennebique.[8]

Contemporary literature extensively documented the evolution of concrete and reinforced concrete utilization in the construction industry. The Millennium Exhibition was held in Budapest in 1896, commemorating the thousandth anniversary of the Hungarian conquest of the Carpathian Basin. The periodical "Építő Ipar" (Construction Industry) featured a report that drew comparisons between the observations made at the 1885 national exhibition and those at the Millennium Exhibition, particularly in relation to advancements in the cement industry: "If we compare the number of cement industrialists who appeared at the millennium exhibition, and the quality and diversity of the exhibited objects with those seen at the national exhibition in 1885, we see such progress that can fill us with joy. At the 1885 exhibition, apart from two small fountain basins, only sewer pipes and [...] plain, uncolored concrete slabs and some mosaic tiles were the representatives of the cement industry. At the millennium exhibition, concrete was already used to a large extent on the buildings, and in addition—not counting the cement industry products exhibited in and around the construction industry hall—six Budapest companies set up separate pavilions."[9] [p. 214].

This description holds particular interest due to the Millennium Exhibition serving as a showcase for Historicism: individual architectural ensembles were allocated to represent each major historical style. The article featured in "Építő Ipar" systematically examines the characteristics of three patented reinforced concrete structures showcased at the exhibition: the original Monier system, the Mátrai-style wire-netting structure,[1] and the Wünsch Róbert-style[2] reinforced concrete structures. "On the occasion of the exhibition, we see the three competing structures together, each in its deemed best form and most precise assembly—because each party was aware of the competition; now is, therefore, the most favorable opportunity for comparing and evaluating them."[9] [p. 214].

Colby Albert Ladd's publication in 1909, titled "Reinforced Concrete in Europe," provides an examination of both the Austrian Systems[10] [p. 23, 31] and the Hungarian Systems[10] [p. 23, 32] of reinforced concrete. According to the documentation, none of the six Austrian origin systems and four Hungarian origin systems employ specially shaped bars. In Hungary, the Mártai system obtained a patent in 1895, and the Kovács system in 1904. In Austria, the Visintini system[3] secured patents in 1902 and 1905.

The limited development of systems in Austria is attributed to the early adoption of the Monier system.

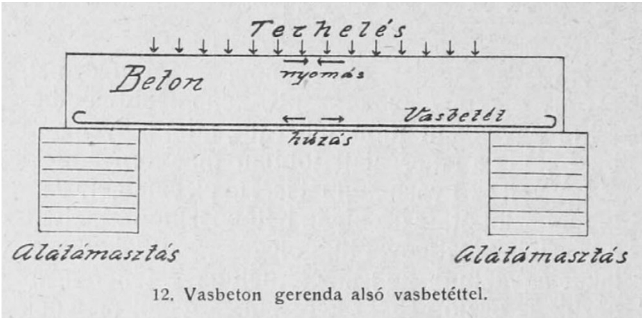


FIGURE 1 Reinforced concrete beam with lower reinforcement[12] [p. 176].

Monier's Austrian patents were acquired in 1880 by R. Schustler, later joined by G. A. Wayss. Dr. F. von Emperger significantly contributed to the progress of reinforced concrete construction in Austria, commencing his writings on the subject in 1897. Dr. Emperger compiled the most up to date and crucial work on this topic and served as the editor of "Beton & Eisen." The introduction of the Monier (French) system in Hungary in 1887 is credited to G. A. Wayss of Germany, while the Visintini (Austrian) system was introduced in 1903 by Joseph Schustler.[10] [p. 31–32].

An 1894 article, also expressed in an optimistic tone, celebrates the proliferation of reinforced concrete, citing historical-style buildings as examples:

"The domestic reinforced concrete industry, despite strong competition-driven opposition, is now gaining broader usage. Reinforced concrete constructions have proven themselves not only in ordinary residential buildings such as corridors, floors, and stairs but, due to their strength, lightness, and cost-effectiveness, have more recently been utilized in the Catholic Church in Zenta (architect: János Szilágyi),[4] the Jewish temple in Nagybecskerek (architect Lipót Baumhorn),[5] and the dome ceiling of the main hall of the town hall in Kecskemét (architects: Pártos and Lechner).[6,11] [p. 248].

During that era, the unique properties of this new material were extensively covered in both specialized and popular press within Austria–Hungary. An illustrative example is found in a 1913 article by Uy Károly titled "Mi a vasbeton?" (What is Reinforced Concrete?), where he explains the force dynamics of horizontal, parallel-belted beams (tension below, compression above) through a clever diagram (Figure 1). This study[12] [p. 171–179] is accompanied by a thorough textual explanation covering every detail.

The 1913 article represents one of the early publications in the Hungarian language addressing the nature, anatomy, and applicability of reinforced concrete. It cites the following structures as examples of reinforced concrete constructions (with images) in the former Austria–Hungary: bathing cabins with reinforced concrete in Vízakna Spa (today Ocna Sibiului, Romania), the upper floor of a rental house on Petőfi Square (Budapest, Hungary), the transformation of the small dome of the Hungarian Royal Opera House into reinforced concrete, the reformed church on Városligeti Alley (both in Budapest, Hungary), warehouse of the Hungarian National Railway in Fiume (today Rijeka, Croatia), the reinforced concrete balcony of the Lutheran church in Battyánd (today Puconci, Slovenia), and the Roman Catholic church in Muraszombat (today Murska Sobota, Slovenia).

In 1914, an article published in the "Magyar Iparművészet" (Hungarian Applied Arts), "A vasbeton formanyelve" (The Formal Language of Reinforced Concrete), still discusses that reinforced concrete has not yet transcended narrowly defined architectural tasks. "The combination of concrete with iron, before which the boldest architectural curvature is not considered among the impossibilities, has incorporated new and surprising beauties into the monumental construction of today's metropolis—qualities such as flexibility, bold and dynamic curves, and solidly constructed bridge lines. However, beyond closely defined architectural tasks, the new technique has not ventured much."[13] [p. 84].

In 1914, Uy published the book "Vasbetonépítés" (Reinforced Concrete Construction), encompassing both theoretical and practical aspects, discussing various structural elements through examples (detailed drawings and images).[14]

In the Viennese literature, articles with titles such as the following were published:

- "Die graphische Berechnung von Balken aus Eisenbeton" (The graphical calculation of reinforced concrete beams) in 1903, Vienna, published in the "Beton & Eisen."
- "Zur Ästhetik des Betonbaues" (On the Aesthetics of Concrete Construction)—Report about the lecture by Oberbaurat Alexander v. Wielemans in "Wiener Bauhütte" 1909; 3(3)64.
- "Zur Anatomie de Eisenbetons" (On the Anatomy of Reinforced Concrete) in "Der Architekt" 1909; (15) 20–22.
- "Der Betoneisenbau in der Architektur" (Reinforced Concrete Construction in Architecture)—Printed text of the lecture by Alexander Wielemans de Monteforte in 1909, "Wiener Bauhütte" 1910; 4(4):79–93.
- "Eisenbeton und Maurerhandwerk" (Reinforced Concrete and Masonry)—Report about Ludwig Roth's 1911 lecture, "Wiener Bauhütte" 1911; 5(4)50–55.

Especially noteworthy among these examples is the first one, "Die graphische Berechnung von Balken aus

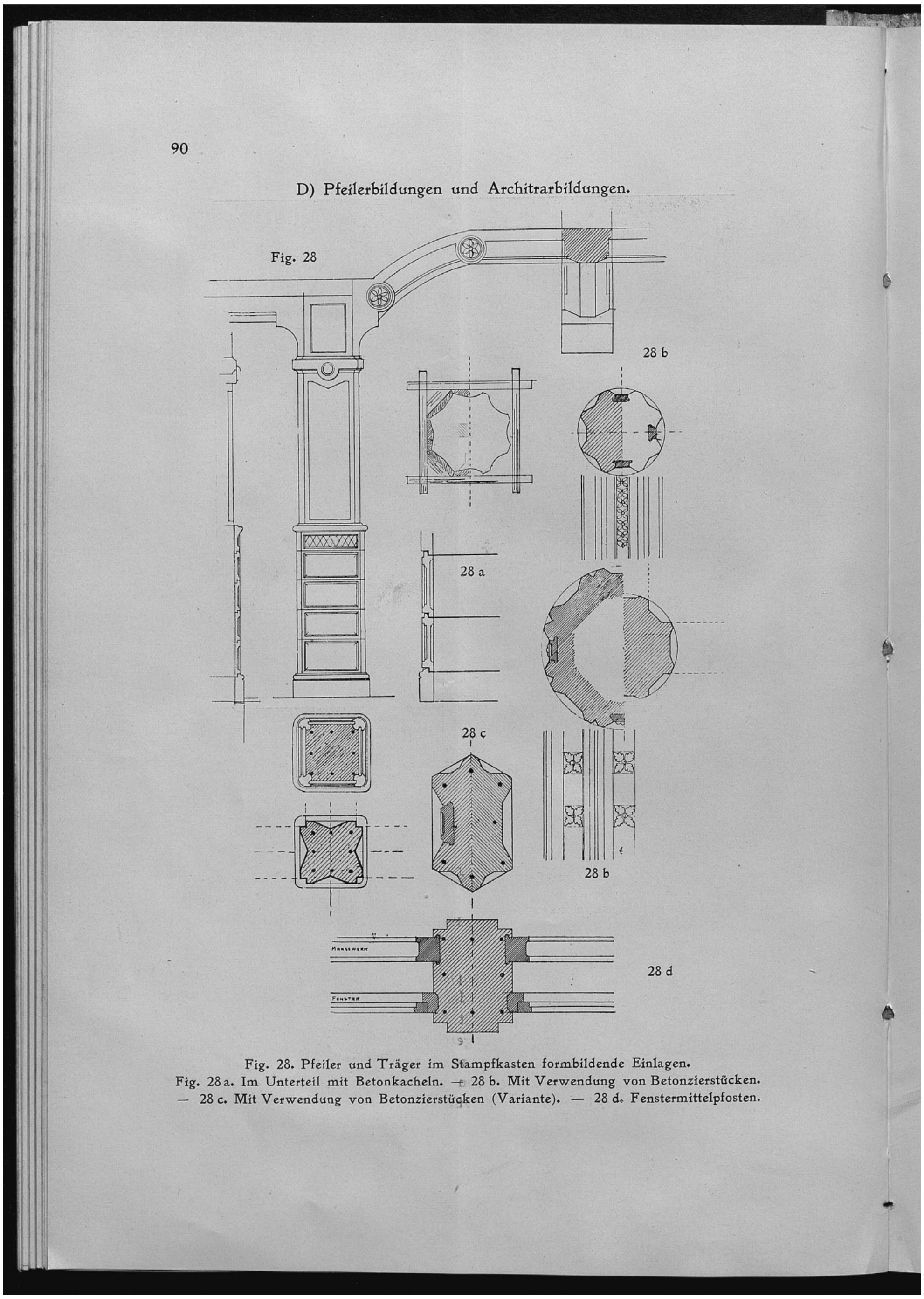


FIGURE 2 Historicist architectural forms made of reinforced concrete—details[15] [p. 90].

Eisenbeton", which discusses the application of now largely forgotten graphostatic methods. Developed for the calculation of prevalent masonry structures of that era, this method was particularly suited for such structures, locationg where in the structure the stress might changes to tension—an aspect crucial for these structures but not applicable to reinforced concrete.

The article in the "Wiener Bauhütte" from 1910 provides examples, featuring not only photographs but also detailed drawings. The adoption of reinforced concrete in architecture was not limited to functional structures but also extended to ornate and historically inspired designs. The publication featured examples of historicist forms in reinforced concrete (Figure 2), including courtrooms (Brno, today in Czechia; and Salzburg, today in Austria, formerly both in Austria–Hungary), residential houses in Brno, and ventilation grilles, domes, vestibules and columns, showcasing the adaptability of the material.

Austrian journals ("Beton & Eisen" or "Zement und Beton") served as sources of information for their Hungarian counterparts, keeping them well-informed about reinforced concrete construction. In a lecture by Ludwig

FIGURE 3 Lounge hall of the Grand Hotel Bristol in Meran.[16]

Roth, a civil engineer and partner at N. Rella & Neffe, Vienna, held in Vienna on February 15, 1911, the Hotel Bristol in Meran (then Austria–Hungary, now Italy) was highlighted for being entirely constructed of reinforced concrete. The hotel's original 1910 brochure[16] features images and descriptions, showcasing external features adhering to the architectural aesthetics of Historicism. However, the internal structures, such as the reading room, dining room, and restaurant, left the columns and beams uncovered. Special emphasis was placed on the design of the lounge hall's ceiling and vaults, intending not to conceal the reinforced concrete framework. The ceiling, visible from below, exhibited a gentle slope and was constructed with reinforced concrete, ribbed on the underside, supporting loads in two directions (Figure 3).

As illustrated by the examples and presentations in "Wiener Bauhütte", even in the early 20th century, the introduction of new materials did not inherently lead to the exploration of more innovative forms. In fact, a peculiar example demonstrates the opposite.

In 1909, the Evangelical Church in Battyánd (then part of the Austro-Hungarian Monarchy, now Puconci, Slovenia) underwent renovation. The sole nave of the church, originally covered with a simple flat timber ceiling, had deteriorated. During the renovation, a new reinforced concrete ceiling was constructed, deviating from the shape of the original flat ceiling, although the reinforced concrete would be perfect for that shape. Instead, a reinforced concrete structure imitating a barrel vault with transverse arches was installed.

At the same time, and bold cantilevered gallery was constructed in the church, utilizing the auspicious characteristics of reinforced concrete (Figure 4).

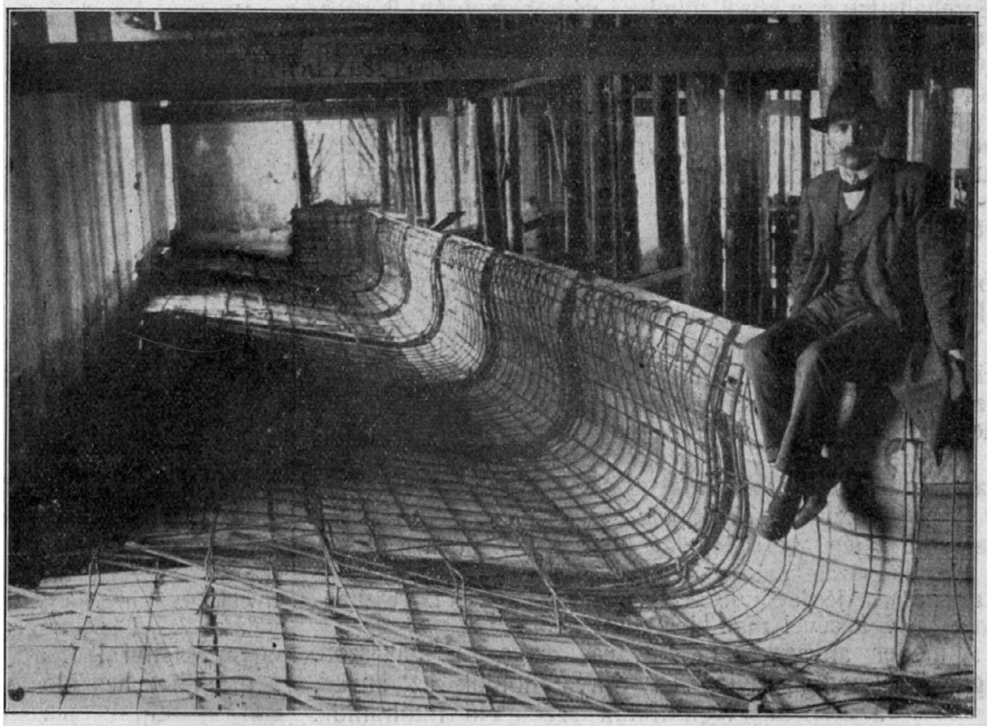
In his related article from 1911, structural designer Uy Károly outlines the primary requirements that a structure must fulfill: durability, fire resistance, thermal insulation, and definition of the shape of architectural spaces. According to his observations, "These requirements are shared by three elements of the structure: 1. the outer cladding; 2. the core; 3. the inner cladding"[17] [p. 61].

In the case of the Puconci Lutheran Church, the architectural features are articulated as follows:

- Outer shell: Retains its original pitched roof constructed from timber.
- Core: Comprises a flat, reinforced concrete slab.
- Inner Shell: Constructed using staff (rabitz), arched to emulate a barrel vault with transverse arches (Figure 5).

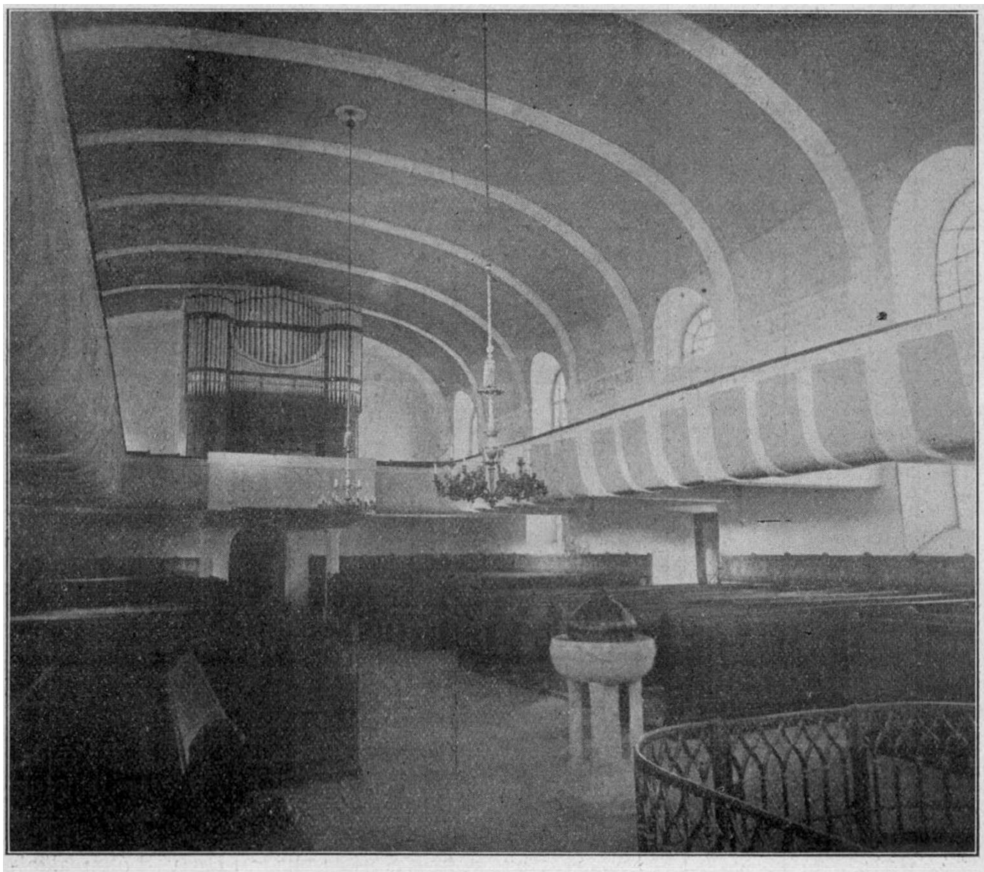
In the realm of historical architecture, the aforementioned "core and inner shell" was one single structure. For millennia, the symbiosis of the stone vault, typically constructed from stone, and the timber roof structure has been the standard covering for churches: the latter's role is to shield the inherently non-water-resistant and potentially cracked stone vault from external elements such as rain, freeze, and snow, while the former forms a fire-resistant barrier towards the interior in the event of a possible—and by that times relatively frequent—roof fire.,,[18]

The neogothic Sarlós Boldogasszony (Visitation) church in Topolya (Bačka Topola), situated in present-day Serbia and formerly part of Austria–Hungary, also adheres to this architectural system. However, in contrast to the Puconci example, it innovatively advances the Gothic system by



6. ábra. A battyándi ág. ev. templom vasbétonkarzatának vasszerelvényei.

FIGURE 4 The steel reinforcements of the reinforced concrete gallery of the Puconci Lutheran Church[17] [p. 63].



3. ábra. A battyándi ág. ev. templom átalakított belseje.

FIGURE 5 The altered ceiling of the Puconci Lutheran Church[17] [p. 62].

FIGURE 6 Church interior in Bačka Topola. Pillars: Reinforced concrete, transverse arches: Masonry, ribs: Reinforced concrete, panels: Staff (rabitz). *Source*: Éva Lovra, 2023.

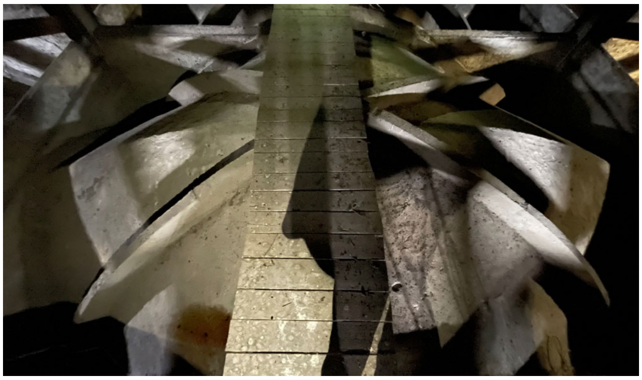


FIGURE 7 The top surface of a vaulting bay with the reinforced concrete diagonal ribs of the church in Bačka Topola). *Source*: Zoltán Bereczki, 2023.

further refining its structural logic. This structure represents a clever combination of traditional masonry and modern reinforced concrete elements. The pillars supporting the vault are composed of reinforced concrete, while the transverse arches are constructed from masonry. The ribbing of the vault is reinforced concrete, and the panels are made of rabitz (staff). The utilization of a non-masonry structure for the vaulted areas resulted in a substantial reduction in weight, facilitating an expansion of internal dimensions. The height of the vault, along with the slender design of the reinforced concrete columns, contributed to the creation of a spacious interior (Figure 6). Both of these solutions were considered innovative in the early 20th century. The designer, Ferenc Raichle (1869–1960), originally conceived the plans without these advancements. According to the initial plans, the internal support system of the church would have comprised brick pillars with a diameter of 120 cm. Construction, as indicated by the construction diary, commenced in 1904. Following preliminary discussions, the aforementioned Dr. Zielinski Szilárd was assigned the task of structurally designing the columns, and subsequently, Melocza Péter was invited to submit a new proposal. Ultimately, the proposal from the Milis és Társa company specified reinforced concrete columns and ribbed vaults with mesh reinforcement for the rabitz panels. According to archival photos documenting the construction process, the transverse arches of the vault eventually took on a traditional masonry structure (the use of reinforced concrete in these arches would not have resulted in a significant reduction in weight), and these arches support the rabitz material of the vault. Structurally, these elements represent mesh-reinforced, easily moldable, and contemporary shell structures, perfectly aligned with the Gothic form[19] [p. 138].

The reinforced concrete ribs of the vaults address a challenge encountered in traditional masonry cross vaults, where the thrust line of the diagonal ribs escapes from the structure: "the balancing thrust 'in' the diagonal rib, in fact, acts above the rib."[20] [p. 59]. To overcome this issue in simpler structures, backfill over the shoulders was applied, while more substantial buildings utilized a structure known as "tas-de-charge," meaning that the ribs up to a certain height are not independent but integrated into the back structure. The reinforced concrete ribs (Figure 7) of the church in Bačka Topola, designed to withstand bending, effectively eliminate this problem.

The cross-sectional system of the Roman Catholic church in Bačka Topola is a so-called hall church, where the side aisles are of equal height to the nave. In this design, the vaults of the side aisles counterbalance the lateral thrust of the nave vault, while the buttresses connected to the outer walls directly bear the lateral thrust of the side aisle vaults.

Another primary cross-sectional type of medieval churches is the basilica. In this system, the nave significantly rises above the side aisles, requiring additional structures—the flying buttresses—to support the lateral thrust of the nave vault.

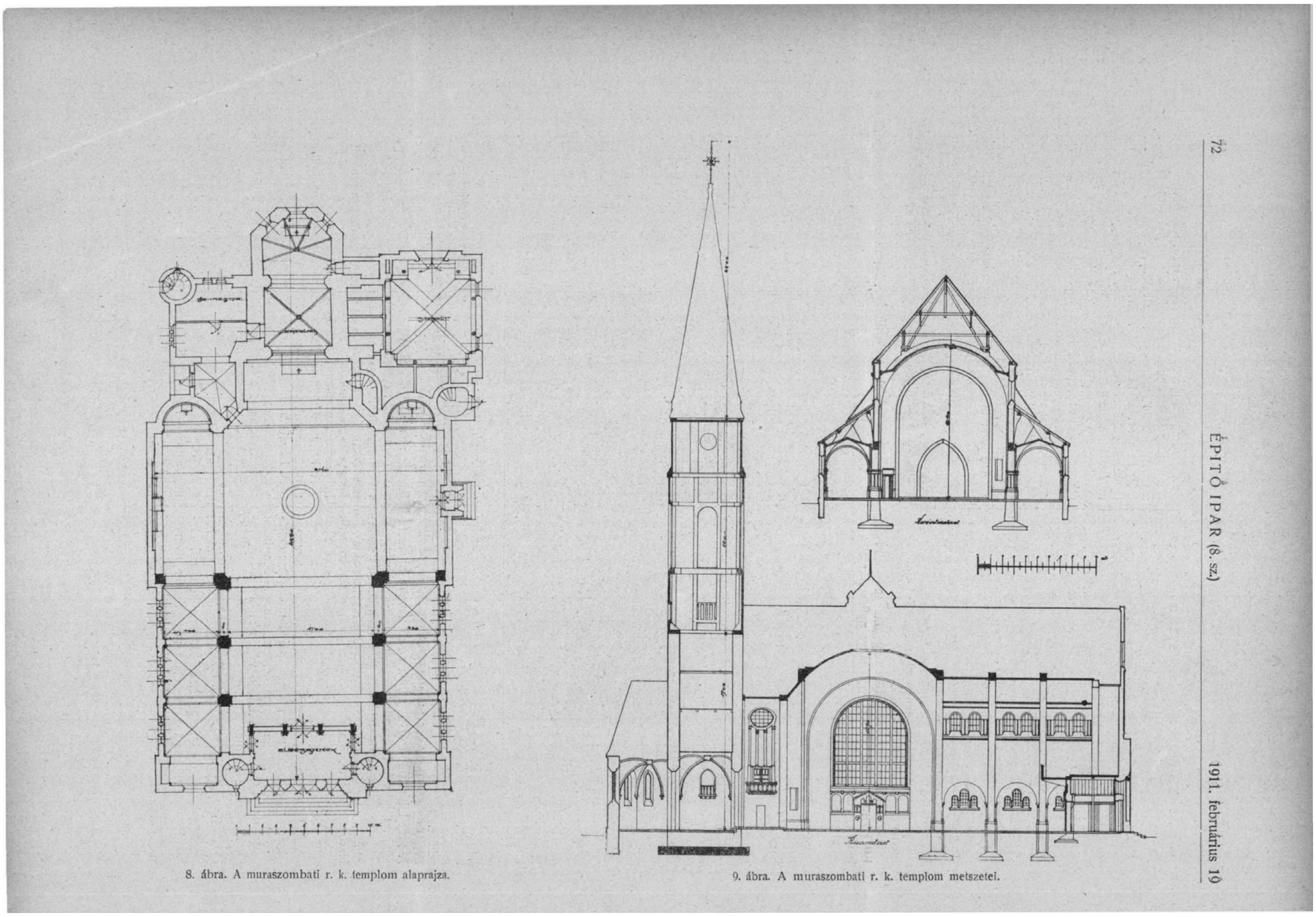


FIGURE 8 Layout and sections of the reinforced concrete basilica-type church in Murska Sobota[21] [p. 72].

An example of an early reinforced concrete basilica-type church is the St. Nicholas Church in Muraszombat (formerly Austria–Hungary, now Murska Sobota, Slovenia). Here, a medieval church's preserved sanctuary was extended with a substantially larger nave with two aisles (Figure 8). The construction took place in 1910–1911, designed by architect László Takáts, with structural engineering by the previously mentioned Uy Károly[21] [pp. 71–76].

In this building, as evident from the cross-section, form and structure completely diverge. Unlike the traditional system where pillars and outer walls bear the load of vaults, transmitting it to the foundation, the external walls in the Murska Sobota church are not load-bearing. Only the internal row of pillars carries the loads. Steep flying buttresses start at the height of the nave's vault shoulders, supported not by the external walls (or associated buttresses) but by large cantilevers starting from the main pillars at the height of the side aisle vaults. This structural system is cantilevered, making the side aisle vaults only decorative, and the external walls serve merely as space dividers. The advantages of this structural system, as articulated by Károly Uy, include the following: "Thus, from a structural perspective, the system became statically more determined, and any potential uneven settlements do not cause as significant changes in the structural condition as if the load transfer were to occur at four locations. This cantilevered solution was desirable even for the purpose of preventing the upper ends of the relatively tall columns from being excessively exposed to one-sided bending moments. Additionally, the external form and the interior spatial delineation necessitated the vault's springing line to be considerably higher than the eaves line of the roof. Consequently, horizontal tie beams could not be used to eliminate the lateral thrust of the roof. In the absence of these beams, instead of complicating and expensive shaping of the roof, further simplification was achieved by having it sit on shelves formed by reinforced concrete arches. The increased load on the arches was then significantly reduced by the cantilevered suspension of the side aisle ceilings."[21] [p. 71].

While undoubtedly clever and innovative, this solution is not visually apparent on the building itself, as the desire for a historicist appearance obscures it (Figure 9).

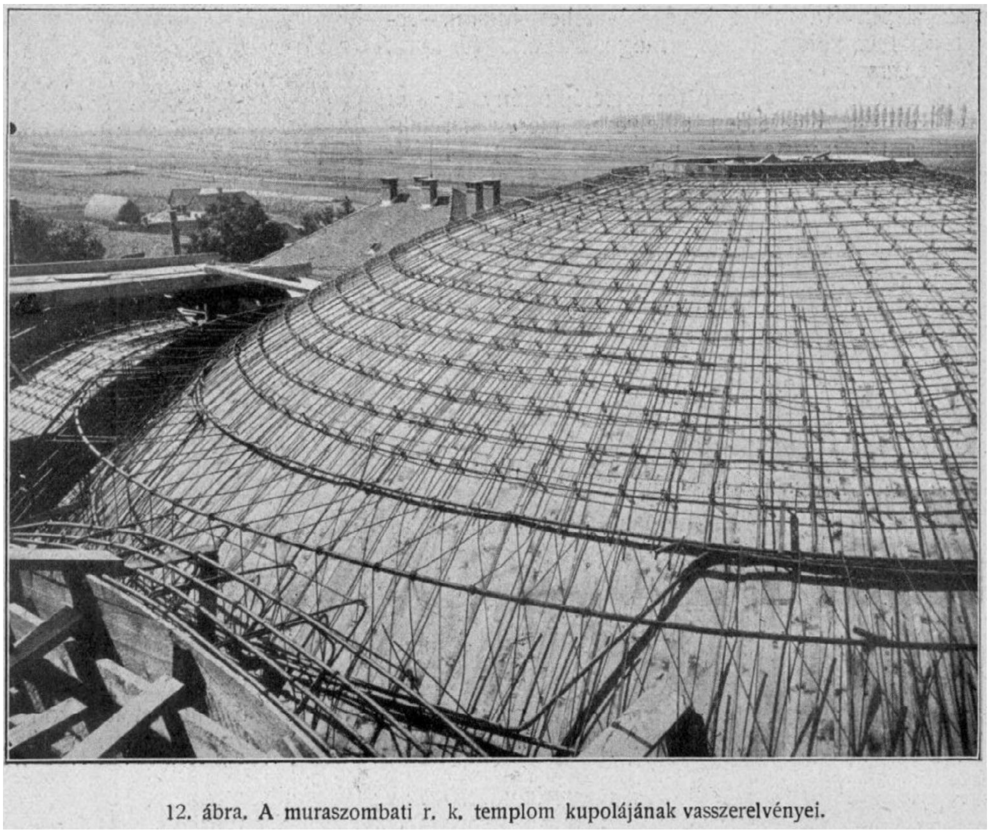


FIGURE 9 The iron fittings of the dome of the church in Murska Sobota[21] [p. 74].

FIGURE 10 The garden stable (in the middle of the Szent György Plaza) of Archduke Joseph in Buda Castle in1905. *Source*: Fortepan/ Széman György.

Architecture had to overcome this desire to visually exploit the possibilities offered by reinforced concrete.

The synagogue in Český Krumlov, constructed in 1909, is an example of a reinforced concrete structure with an octagonal tower. Designed by architect Viktor Kafka in Vienna and Prague,[22] the temple appears as a typical Neo-Romanesque building externally, and it gives the same impression internally too, at least at first sight. However,

FIGURE 11 The Academy of Music (Budapest) in 1940. *Source*: Fortepan/Somlai Tibor.

this form could not have been achieved with traditional masonry: the lateral thrust of such a span in a masonry barrel vault would overwhelm the filigree buttresses, and the walls applied are unusually thin. The building vividly illustrates how reinforced concrete allowed for significant reductions in structural thicknesses.

The garden stable of Archduke Joseph in Buda Castle, built in 1903, represents a Renaissance-inspired structure (Figure 10) with a quarter-ellipse floor plan, designed by architects Korb Flóris (1860–1930) and Giergl Kálmán (1863–1954)[23] [p. 148]. The building was entirely constructed using reinforced concrete for floors, pillars, and walls. The structural design included ribbed concrete slabs with a span of over 10 m without intermediate support. Insulation was achieved by placing the support pillars between 6 cm thick concrete walls, leaving an empty space between the two layers of walls[24] [p. 104]. Severely damaged during World War II, the building was subsequently demolished and is now slated for reconstruction under the National Hauszmann Program.

Similarly, designed by Korb and Giergl, the building of the Academy of Music (Figure 11) was conceptualized in 1906 by Jemnitz Zsigmond, head of Zielinski Szilárd's office. All essential elements of the building, including floors, balconies, and roof structures, were constructed using reinforced concrete. Although designed by Jemnitz, the credit for the plans of the concrete-framed building is generally attributed to Zielinski. The Academy of Music, with its rich ornamentation, visually conceals the structural forms. Only the large balcony of the so-called concert hall hints at the innovative use of reinforced concrete at that time.

3 | CONCLUSION

"The future aesthetics will significantly differ from the past in this way. We must also reckon with the fact that it takes a long time to achieve the perfection of classical and medieval styles. From the future aesthetics, one could say that the works of past eras, whose material approximates concrete in terms of strength, provide some hints[25]" [p. 34].

The exploration of reinforced concrete in the Austro-Hungarian Monarchy provides insights into the dynamic interplay between tradition and innovation during a transformative period in architectural history. Reinforced concrete architecture came to fruition in the 20th century within modern architecture. Early examples, such as the buildings of Adolf Loos or Otto Wagner, saw widespread use of reinforced concrete in the latter half of the 19th century in the Austro-Hungarian Empire, where it began to be applied globally at a very early stage. The adoption of reinforced concrete in architecture was not limited to functional structures but also extended to ornate and historically inspired designs. The dissemination of knowledge on reinforced concrete in Austrian journals like "Beton und Eisen" influenced Hungarian publications, keeping them informed about developments in reinforced concrete construction. Academic discussions, such as the graphical calculation of reinforced concrete beams, aesthetic aspects of concrete construction, and the anatomy of reinforced concrete, were prevalent in Austrian literature. Examining early 20th-century illustrations and examples from the Vienna Bauhütte revealed that the adoption of reinforced concrete did not immediately lead to novel forms. In some cases, the use of reinforced concrete replicated historical styles.

The study focuses on public buildings within the context of Historicism, following the stylistic forms of revival styles. The introduced case studies are lesser known, as public awareness is primarily shaped by the works of István Medgyaszay, cited as early examples of reinforced concrete application.

Through case studies, various developmental types and applications of reinforced concrete in historicizing architecture can be distinguished. In the early application of the reinforced concrete in the late 19th and early 20th centuries the material attempted to mimic historicist forms. In these early buildings the form follows a historical style (mostly classical or medieval styles mentioned by Medgyaszay), but the structure often does not adhere to the structural logic typical of that style. The case studies presented varying degrees of this duality, ranging from the Roman Catholic church in Bačka Topola, where reinforced concrete addressed the weaknesses of masonry, following the structural logic derived from the form; to the church in Murska Sobota, where the structural framework became entirely independent of the chosen architectural form. Reinforced concrete, as a revolutionary material, challenged the formal language of Historicism, allowing for the emergence of modernism. In modernism, the elimination of load-bearing roles of walls became an important tool and declared goal for free spatial and façade design. Medgyaszay's vision of the future, our present, truly diverges significantly from the past in this manner.

DATA AVAILABILITY STATEMENT

Data sharing not applicable to this article as no datasets were generated or analysed during the current study.

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ENDNOTES

[1] The fundamental static concept of the Mátrai system is to achieve a reduction in stresses and the required cross-sectional modulus of the beam by transferring the loads to the ends. The system employs a chain-curve-like transverse and diagonal wire mesh to ensure this load transfer. The mesh is designed to be self-supporting under load, so that the gravel or slag concrete serves only as a filler.

[2] Róbert Wünsch's invention is the rigid reinforced concrete structure, in which a steel construction corresponding to the form is embedded in the concrete. Wünsch used a rigid steel frame, making the steel frame itself load-bearing. He designed the steel frame as a frame structure, thus eliminating the need for stronger walls or bridge abutments to absorb the support forces.

[3] The system incorporates the fundamental concept of truss-girders into reinforced concrete construction. The beams are built using a parallel-chord truss configuration. For the tension members, we neglect the tensile strength of the concrete and design the reinforcement to carry the full tensile force. The diagonal members under compression are not reinforced, while the primary function of the reinforcement in the compressed top chord is to anchor the reinforcement in the tension diagonals. For upper chord segments longer than 40 cm, these members must also be designed for bending.

[4] The Jesus Heart Church in Zenta (today Senta, Serbia) was consecrated in the autumn of 1896. Construction works commenced in 1893 based on the architectural plans of János Szilágyi, a Budapest-based architectural designer. Erected in the Neo-Gothic style, the three-aisled structure follows a Latin cross floor plan, with a length of 44 meters, a width of 18 meters, and a main tower height of 47 meters. It stands to this day.

[5] Today Zrenjanin, Serbia. The plans for the synagogue were created by Lipót Baumhorn, who later designed numerous other Hungarian synagogues. The synagogue was constructed in 1896 but has since been dismantled.

[6] Kecskemét, Hungary. It was constructed based on the plans of Ödön Lechner and Gyula Pártos between 1893 and 1897. It still stands today.

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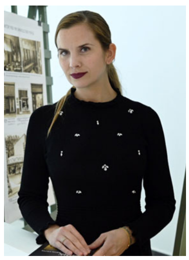

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