Construction of Church Roofs in the Brussels Capital Region, 1830-1930: Ahead of Technology?

Romain Wibaut, ine Wouters, and Thomas Coomans

1. Department of Architectural Engineering, Vrije Universiteit Brussel (VUB), Belgium; 2. Faculty of Engineering Science, Department of Architecture, University of Leuven (KU Leuven), Belgium

Introduction

Although churches are not the first building type one thinks of when discussing structural innovation in the nineteenth and early twentieth centuries, previous research has revealed the innovative use of new materials in churches. [1] As early as 1813-16, three churches were built in Liverpool with entirely cast-iron internal structures [2]; in 1840-45, engineer Emile Martin and locksmith Theophile Mignon combined cast and wrought iron to rebuild the roof trusses of the Cathedral of Chartres; and in 1899-1905, architect Anatoile de Baadot adopted reinforced concrete to construct the Saint-Jean-de-Montmartre church in Paris. [3] Nevertheless, general studies of the construction history of churches are lacking, except for the Netherlands. [4] How did the many developments in building technology in this period affect church construction in Belgium, an early-industrialised country with a fast-growing population?

After Belgium gained independence in 1830, the Roman Catholic Church recovered its visibility in society, and new churches expressed the Catholic revival. [5] More than 2,500 churches were constructed before World War I. Some were very innovative, such as the iron Gothic revival church of Argenteuil built 1855-62 by banker Ferdinand-Philipe de Meois (now demolished); the royal glasshouse chapel in Lacken built 1892-93 by architect Alphose Baltat for King Leopold II; the Gothic revival chapel built by the Ursulines with prefabricated reinforced concrete wall panels, at Overpelt in 1909-10; and the huge Sacred Heart Basilica of Koekelberg designed by architect Albert Van Huffel and built 1926-51. The structure and dome of the latter, one of the largest Catholic churches in the world, were constructed with reinforced concrete and modular terracotta elements. [6] Most other churches, however, followed academic movements and the 'antimodern' Pugin-esque Gothic revival of the St. Luke Schools. [7] Recent inventories of nineteenth-century religious buildings in the nation's three regions (Flanders, Wallonia and Brussels Capital Region) [8] paid little attention to the materials and techniques used in their construction. Thus, the technologies – traditional or novel – that were used to build churches in this period have not been documented.

This paper focuses on the construction of church roofs in the Brussels Capital Region. This Region presently includes the historic centre of Brussels and surrounding municipalities, which became urbanized from the 1860s to the 1930s (Fig. 2). The timespan of the research covers the period from 1830 to 1930. As a starting point for the research, the independence of the Kingdom of Belgium was selected. From the point of view of the relationships between church and state, 1830 concluded a turbulent period. During the French anti-clerical regime, all Catholic churches were confiscated. This was followed by the Concordat of 1801 and the 1815 annexation to the United Kingdom of the Netherlands, which stipulated that parish churches had to be erected with public money and
Construction of Church Roofs in the Brussels Capital Region, 1830-1930: Ahead of Technology?
designed by state architects. The year 1930 marks the end of the period studied in order to include churches whose construction was delayed by World War I.

Peak of parish church construction
During the nineteenth century, the population of the municipalities that presently form the Brussels Capital Region boomed, increasing from 65,000 to 625,000 inhabitants. The vast majority of the population being Catholic, there was a large need for new Catholic parish churches in the developing suburbs of Schaerbeek, St. John Molenbeek, Etterbeek, St. Gilles, Ixelles, Uccle, Auderghem, Jette, Forest, St. Lambert’s Woluwé and Laeken. Their construction had a significant impact on the urban fabric and the architectural landscape of the capital. Thus, it is not surprising that the architecture of churches was widely debated. In 1846 the Royal Academy of Sciences, Letters and Arts put forward the question of the construction of Belgian churches, taking into account the specific climate, Belgian resources and the nation’s industrial progress. The military engineer André Demanet — professor at the Brussels military school — formulated an answer in his Mémoire sur l’architecture des églises (1847): he promoted the use of cast iron for columns, bricks or concrete for load bearing walls, wrought iron to construct roof trusses, and iron sheets or slates to cover roofs. [9] Did Demanet’s plea for structural and material innovation influence the designers of the new Catholic churches in the capital? To answer this question, the recently developed database of churches in the Brussels Capital Region [10] was consulted in order to investigate all Catholic parish churches built between 1830 and 1930. Then, 23 of the 35 still existing churches were visited and their roof construction analysed (Figs 1-2).

In the following pages the various materials used to build the roofs of churches — timber, iron, steel and concrete — are discussed and contextualised. Special attention is paid to the influence of timber carpentry on iron roof structures, and to the widespread use of the Wiegmann-Polonceau truss.

---

**Figure 1. Number of Catholic parish churches built in the present Brussels Capital Region per decade classified by the main material of their roof trusses. (Drafted by R. Wibaut)**

---

**Figure 2. Location of Catholic parish churches in the present Brussels Capital Region classified by the main material of their roof trusses. (Drafted by R. Wibaut)**

---

**Timber roofs**
Timber is the most frequently used material for the construction of roofs during the period studied: in 13 of the 23 churches, timber is the main construction material. In 1847, lieutenant colonel André Demanet advocated using timber trusses when building church roofs of timber. [11] However, so far, only one church has been identified that has an original truss: St. Anne’s Church (1842-43) in the municipality of Auderghem (Fig. 3). The roof trusses of other cases divide equally between raised or common tie-beam types.

---

**Figure 3. St. Anne’s Church (1842-43). Auderghem. Architect, L. Spaak. Photos: R. Wibaut (left), I. Wouters (right).**
Construction of Church Roofs in the Brussels Capital Region, 1830-1930: Ahead of Technology?

designed by state architects. The year 1930 marks the end of the period studied in order to include churches whose construction was delayed by World War I.

Peak of parish church construction

During the nineteenth century, the population of the municipalities that presently form the Brussels Capital Region boomed, increasing from 65,000 to 625,000 inhabitants. The vast majority of the population being Catholic, there was a large need for new Catholic parish churches in the developing suburbs of Schaerbeek, St. John Molenbeek, Etterbeek, St. Gilles, Ixelles, Uccle, Auderghem, Jette, Forest, St. Lambert’s Woluwé and Laeken. Their construction had a significant impact on the urban fabric and the architectural landscape of the capital. Thus, it is not surprising that the architecture of churches was widely debated. In 1846 the Royal Academy of Sciences, Letters and Arts put forward the question of the construction of Belgian churches, taking into account the specific climate, Belgian resources and the nation’s industrial progress. The military engineer André Demanet — professor at the Brussels military school — formulated an answer in his Mémoire sur l’architecture des églises (1847): he promoted the use of cast iron for columns, bricks or concrete for load bearing walls, wrought iron to construct roof trusses, and iron sheets or slates to cover roofs. [9] Did Demanet’s plea for structural and material innovation influence the designers of the new Catholic churches in the capital? To answer this question, the recently developed database of churches in the Brussels Capital Region [10] was consulted in order to investigate all Catholic parish churches built between 1830 and 1930. Then, 23 of the 35 still existing churches were visited and their roof construction analysed (Figs 1-2).

In the following pages the various materials used to build the roofs of churches — timber, iron, steel and concrete —are discussed and contextualised. Special attention is paid to the influence of timber carpentry on iron roof structures, and to the widespread use of the Wiegmann-Polonceau truss.

Figure 1. Number of Catholic parish churches built in the present Brussels Capital Region per decade classified by the main material of their roof trusses. (Drafted by R. Wibaut)

Figure 2. Location of Catholic parish churches in the present Brussels Capital Region classified by the main material of their roof trusses. (Drafted by R. Wibaut)

Timber roofs

Timber is the most frequently used material for the construction of roofs during the period studied: in 13 of the 23 churches, timber is the main construction material. In 1847, lieutenant colonel André Demanet advocated using for arched trusses or raised tie-beam trusses when building church roofs of timber. [11] However, so far, only one church has been identified that has an arched truss: St. Anne’s Church (1842-43) in the municipality of Auderghem (Fig. 3). The roof trusses of other cases divide equally between raised or common tie-beam types.

Figure 3. St. Anne’s Church (1842-43), Auderghem. Architect, L. Spaak. Photos: R. Wibaut (left), I. Wouters (right).
Construction of Church Roofs in the Brussels Capital Region, 1830-1930: Ahead of Technology?

The early nineteenth-century development of the iron industry in Belgium fostered the use of iron bolts and nuts in the assembly of timber elements. It is therefore not surprising to find such connections in most of the timber roofs that were examined. In some connections, however, mortice and tenon assemblies were present. Although trusses in which a tie-rod replaced collar beam and kingpost were used in many Belgian churches as early as the seventeenth century [12], the nineteenth century saw a larger development of mixed timber-iron structures. One notices the desire of carpenters, architects and engineers to decrease both the weight of the trusses and costs of construction by replacing the tension elements with iron. Hence, in St. Peter’s Church (1878-80) in Jette and St. Anne’s Church (1911-12) in Uccle, an iron tie-rod partially replaces the kingpost; while in St. Elisabeth’s Church (1912-16) in Schaerbeek, tie-rods bind the two bearing walls to the middle of the kingpost. In two other churches built in Schaerbeek, I-shaped profiles were used. In the Holy Family Church (1900-07), a sandwich beam — iron I-beam sandwiched between two timber planks — replaced the collar beam; while in St. Albert’s Church (1928-29), the architect opted for a steel beam topped by a timber plank in order to facilitate connections. As already demonstrated by Louis Vandenabeele for other building types in Belgium [13], the combination of iron and timber in trusses was not simply a feature of a period of transition from timber to iron, but rather an expression of an alternative construction principle. Indeed, such mixed structures were used throughout the study period — alongside full-timber or full-iron trusses — because they were lightweight and relatively low cost.

Iron Roofs

Tradition inherited from carpentry (1830-50)

Only one of the investigated churches built before 1850 used iron roof trusses: the Neo-Renaissance St. Joseph’s Church erected from 1842 to 1849 (Fig. 4). This is the earliest church in Belgium built with an entirely iron roof structure.

In 1837, the first intensive development in Brussels’ suburbs began, undertaken by a private developer, the Société civile pour l’agrandissement et l’embellissement de Bruxelles. Ferdinand-Philippe de Mevis, the president of the Société générale, was the principal shareholder in the company. Architect Tillman-François Suys (1783-1861) was chosen to design this extension of Brussels. In 1842, in the centre of the new neighbourhood (along the Frère-Orban square), Suys broke ground for the construction of St. Joseph’s Church, which he had designed. The ambition of the developer was to create a Catholic parish church in order to attract people to the area. However, a parish failed to materialize, and in order to find another suitable occupant for the newly-built church, the de Mevis family bought it and offered it to the religious Institute of the Redemptorists. [14]

The roof trusses of St. Joseph’s Church are composed of wrought-iron bars (Fig. 4) and are remarkable for their similarity to simple, kingpost timber trusses. Figure 5 shows the wrought-iron trusses of St. Joseph’s Church (Fig. 5.a) together with the timber trusses of St. Boniface’s Church (Fig. 5.b), which was built nearby in Ixelles in the same period (1846-49) and designed by architect Joseph-Jonas Dumont (1811-59). The shapes of both trusses are very similar although made of different materials. Indeed, one may observe that both principal trusses are composed of two principal rafters, one tie-beam to prevent these elements from spreading apart, one kingpost and two struts linking the principal rafters with the kingpost. Moreover, both trusses are also braced by means of two members that link the kingpost to the ridge purlin (Fig. 4). Therefore, the shape of St. Joseph’s wrought-iron truss clearly appears to be a transposition into iron of a traditional truss type already successfully tested in timber. That iron was selected may have been due to the backgrounds of those involved: architect Suys had already used iron in previous projects, while the Société générale owned metalwork industries that de Mevis wanted to develop and promote.
Construction of Church Roofs in the Brussels Capital Region, 1830-1930: Ahead of Technology?

The early nineteenth-century development of the iron industry in Belgium fostered the use of iron bolts and nuts in the assembly of timber elements. It is therefore not surprising to find such connections in most of the timber roofs that were examined. In some connections, however, mortice and tenon assemblies were present. Although trusses in which a tie-rod replaced collar beam and kingpost were used in many Belgian churches as early as the seventeenth century [12], the nineteenth century saw a larger development of mixed timber-iron structures. One notices the desire of carpenters, architects and engineers to decrease both the weight of the trusses and costs of construction by replacing the tension elements with iron. Hence, in St. Peter’s Church (1878-80) in Jette and St. Anne’s Church (1911-12) in Uccle, an iron tie-rod partially replaces the kingpost; while in St. Elisabeth’s Church (1912-16) in Schaerbeek, tie-rods bind the two bearing walls to the middle of the kingpost. In two other churches built in Schaerbeek, I-shaped profiles were used. In the Holy Family Church (1900-07), a sandwich beam — iron I-beam sandwiched between two timber planks — replaced the collar beam; while in St. Albert’s Church (1928-29), the architect opted for a steel beam topped by a timber plank in order to facilitate connections. As already demonstrated by Louis Vandenabeele for other building types in Belgium [13], the combination of iron and timber in trusses was not simply a feature of a period of transition from timber to iron, but rather an expression of an alternative construction principle. Indeed, such mixed structures were used throughout the study period — alongside full-timber or full-iron trusses — because they were lightweight and relatively low cost.

Iron Roofs

Tradition inherited from carpentry (1830-50)

Only one of the investigated churches built before 1850 used iron roof trusses: the Neo-Renaissance St. Joseph’s Church erected from 1842 to 1849 (Fig. 4). This is the earliest church in Belgium built with an entirely iron roof structure.

In 1837, the first intensive development in Brussels’ suburbs began, undertaken by a private developer, the Société civile pour l’agrandissement et l’embellissement de Bruxelles. Ferdinand-Philippe de Mevis, the president of the Société générale, was the principal shareholder in the company. Architect Timon-François Suys (1783-1861) was chosen to design this extension of Brussels. In 1842, in the centre of the new neighbourhood (along the Frère-Orban square), Suys broke ground for the construction of St. Joseph’s Church, which he had designed. The ambition of the developer was to create a Catholic parish church in order to attract people to the area. However, a parish failed to materialize, and in order to find another suitable occupant for the newly-built church, the de Mevis family bought it and offered it to the religious Institute of the Redemptorists. [14]

The roof trusses of St. Joseph’s Church are composed of wrought-iron bars (Fig. 4) and are remarkable for their similarity to simple, kingpost timber trusses. Figure 5 shows the wrought-iron trusses of St. Joseph’s Church (Fig. 5.a) together with the timber trusses of St. Boniface’s Church (Fig. 5.b), which was built nearby in Ixelles in the same period (1846-49) and designed by architect Joseph-Jonas Dumont (1811-59). The shapes of both trusses are very similar although made of different materials. Indeed, one may observe that both principal trusses are composed of two principal rafters, one tie-beam to prevent these elements from spreading apart, one kingpost and two struts linking the principal rafters with the kingpost. Moreover, both trusses are also braced by means of two members that link the kingpost to the ridge purlin (Fig. 4). Therefore, the shape of St. Joseph’s wrought-iron truss clearly appears to be a transposition into iron of a traditional truss type already successfully tested in timber. That iron was selected may have been due to the backgrounds of those involved: architect Suys had already used iron in previous projects, while the Société générale owned metalwork industries that de Mevis wanted to develop and promote.
Construction of Church Roofs in the Brussels Capital Region, 1830-1930: Ahead of Technology?

Another interesting feature is the assembly marks hammered and carved on the wrought-iron elements (Fig. 6). This derives from the practice of carpenters, who marked timber elements in order to facilitate assembly and simplify their final incorporation into the structure. As all connections were formed by hand, each timber piece was unique and corresponded to one specific location. In the roof of St. Joseph, as the different members were manufactured in wrought iron, the ends of each element were adjusted by hand in order to be sure that the different constituents of the trusses would fit together. Afterwards, these members were assembled on-site using iron bolts or tenons (Fig. 6), the latter system inherited from typical mortice and tenon timber connections. Therefore, these assembly marks served to ease the assembly and to situate each truss within the entire roof construction.


Dominance of the Wiegmann-Polonceau truss (1850-80)

Almost simultaneously, Camille Polonceau (1813-59) of France and Rudolf Wiegmann (1804-65) of Germany developed a truss in which all the forces in the different members were (in theory) purely in tension or compression. The truss was composed of two trussed beams connected with a horizontal tie. The compression struts situated at mid-span and perpendicular to the principal rafters reduced the bending of the latter. Hence, Polonceau and Wiegmann opted for an optimal use of the different components. In 1839, Polonceau stated that his configuration required the minimum quantity of materials, which resulted in a very light and cheap truss. [15] At that time, indeed, the cost of an iron structure was mainly determined by the amount of material, since labour costs were comparatively low. It is therefore not surprising to find this type of truss in many Belgian buildings including churches built during the second half of the nineteenth century. Between 1850 and 1880, four churches with Wiegmann-Polonceau trusses were built: Our Lady Church in Laeken (1852-72) designed by architect Joseph Poelaert (1817-79) (Fig. 7b, Fig. 8), which was extended in 1907-09 by the German architect Heinrich von Schmidt (1850-1925) (Fig. 7f); St. Catherine’s Church (1854-74) in the historic centre of Brussels, designed by the same Poelaert and completed by architect Wynand Janssens (1827-1913) (Fig. 7c, Fig. 9); St. Gilles’ Church (1866-76) in the municipality of St. Gilles, designed by architect Victor Besme (1834-1904) (Fig. 7d, Fig. 9); and St. Servais’ Church (1871-76) in Schaerbeek, designed by architect Gustave Hansotte (1827-86) (Fig. 7e, Fig. 9).

Figure 7. Timeline of the construction of iron and steel pitched roofs of the Catholic parish churches built between 1830 and 1930 in the present Brussels Capital Region. (Drafted by R. Wibaut)

Originally, the compression elements of a Wiegmann-Polonceau truss were made of timber and the tension elements of wrought iron, such as in the truss Polonceau designed for a railway shed built 1837-39 in France. But the type rapidly evolved into full-iron trusses, with timber replaced by cast-iron components. Later, the compression elements were made using wrought iron, leading to a progressive use of entirely wrought-iron trusses. None of the churches used timber compression elements (not for the compression strut, nor for the rafter). The principal rafters of all the trusses studied are composed of an iron I-beam and compression struts made of cast or wrought iron. A second observation is that traditional cast-iron cruciform sections were used for the compression struts in St. Gilles’ trusses (1866-76) and in the original lateral naves of Our Lady Church in Laeken (1852-72). In the main nave of the latter, as well as in St. Catherine’s Church (1854-74) and in St. Servais’ Church (1871-76), designers opted for commercial wrought-iron sections (round bars, I-shaped or U-shaped rolled sections). It appears therefore that the use of wrought iron or cast iron for the compression struts does not correspond to the previously mentioned chronological evolution, as both materials were used simultaneously. Finally, one may also notice that all the trusses use round wrought-iron bars for the tension ties, just as in Camille Polonceau’s truss from 1837-39.
Construction of Church Roofs in the Brussels Capital Region, 1830-1930: Ahead of Technology?

Another interesting feature is the assembly marks hammered and carved on the wrought-iron elements (Fig. 6). This derives from the practice of carpenters, who marked timber elements in order to facilitate assembly and simplify their final incorporation into the structure. As all connections were formed by hand, each timber piece was unique and corresponded to one specific location. In the roof of St. Joseph, as the different members were manufactured in wrought iron, the ends of each element were adjusted by hand in order to be sure that the different constituents of the trusses would fit together. Afterwards, these members were assembled on-site using iron bolts or tenons (Fig. 6), the latter system inherited from typical mortice and tenon timber connections. Therefore, these assembly marks served to ease the assembly and to situate each truss within the entire roof construction.

![Image of St. Joseph's Church](image)


Dominance of the Wiegmann-Polonceau truss (1850-80)

Almost simultaneously, Camille Polonceau (1813-59) of France and Rudolf Wiegmann (1804-65) of Germany developed a truss in which all the forces in the different members were (in theory) purely in tension or compression. The truss was composed of two trussed beams connected with a horizontal tie. The compression struts situated at mid-span and perpendicular to the principal rafters reduced the bending of the latter. Hence, Polonceau and Wiegmann opted for an optimal use of the different components. In 1839, Polonceau stated that his configuration required the minimum quantity of materials, which resulted in a very light and cheap truss. [15] At that time, indeed, the cost of an iron structure was mainly determined by the amount of material, since labour costs were comparatively low. It is therefore not surprising to find this type of truss in many Belgian buildings including churches built during the second half of the nineteenth century. Between 1850 and 1880, four churches with Wiegmann-Polonceau trusses were built: Our Lady Church in Laeken (1852-72) designed by architect Joseph Poelaert (1817-79) (Fig. 7, b, Fig. 8), which was extended in 1907-09 by the German architect Heinrich von Schmidt (1850-1925) (Fig. 7); St. Catherine’s Church (1854-74) in the historic centre of Brussels, designed by the same Poelaert and completed by architect Wimand Janens (1827-1913) (Fig. 7, c, Fig. 9); St. Gilles’ Church (1866-76) in the municipality of St. Gilles, designed by architect Victor Besme (1834-1904) (Fig. 7, d, Fig. 9); and St. Servais’ Church (1871-76) in Schaerbeek, designed by architect Gustave Hansotte (1827-86) (Fig. 7, e, Fig. 9).

Originally, the composition elements of a Wiegmann-Polonceau truss were made of timber and the tension elements of wrought iron, such as in the truss Polonceau designed for a railway shed built 1837-39 in France. But the type rapidly evolved into full-iron trusses, with timber replaced by cast-iron components. Later, the compression elements were made using wrought iron, leading to a progressive use of entirely wrought-iron trusses. None of the churches used timber compression elements (not for the compression strut, nor for the rafter). The principal rafters of all the trusses studied are composed of an iron I-beam and compression struts made of cast or wrought iron. The second observation is that traditional cast-iron cruciform sections were used for the compression struts in St. Gilles’ trusses (1866-76) and in the original lateral naves of Our Lady Church in Laeken (1852-72). In the main nave of the latter, as well as in St. Catherine’s Church (1854-74) and in St. Servais’ Church (1871-76), designers opted for commercial wrought-iron sections (round bars, I-shaped or U-shaped rolled sections). It appears therefore that the use of wrought iron or cast iron for the compression struts does not correspond to the previously mentioned chronological evolution, as both materials were used simultaneously. Finally, one may also notice that all the trusses use round wrought-iron bars for the tension ties, just as in Camille Polonceau’s truss from 1837-39.
Construction of Church Roofs in the Brussels Capital Region, 1830-1930: Ahead of Technology?

The Wieghmann-Polonceau type influenced the conception of trusses built in later periods. The steel trusses of Our Lady of the Holy Heart Church in Etterbeek (1926-28) (Fig. 7.6) clearly were designed following the principles introduced by Wieghmann and Polonceau. One can identify two trussed beams linked together with a horizontal element in tension. Although it is already an improvement that the trussed beams are composed of multiple compression struts (seven fields per rafter), the major evolution lies in the use of industrially produced steel components.

Figure 8. Our Lady Church in Laeken (1852-72). Brussels. Architect, J. Poelaert. Top left: façade; top right: lateral nave’s truss; bottom left: principal nave; bottom right: principal nave’s truss. Photos: R. Wibaut.

Large span iron and steel trusses (1900-30)

The last period identified within the timeline of the construction of iron and steel pitched roofs (Fig. 7) runs from 1900 to 1930 and includes two churches, St. Henri’s Church (1908-11) in St. Lambert’s Woluwé and Our Lady of the Holy Heart Church (1926-28) in Etterbeek. It is important to notice that these two roofs cover naves respectively 17 and 20 meters wide. In contrast, the spans of church roofs built in the previous periods are much narrower, between 10 and 12 meters. Through this simple observation, it is clear that the understanding of iron as a construction material evolved considerably. These two latest churches also reflect an evolution of roof structures in their use of industrially produced iron and steel elements. St. Henri’s Church, designed by architect Julien Walckiers (Fig. 7.g), is a reconstitution of a thirteenth-century Gothic church of the Dominican convent of Ghent. New materials were adopted for the hidden structural elements. In Our Lady of the Holy Heart Church, designed by architect Edmond Serneels (1875-1934) (Fig. 7.h), the roof is composed of upgraded Wieghmann-Polonceau trusses, which cover a reinforced-concrete ceiling. Lastly, one may notice that the extension of the lateral naves of Our Lady Church in Laeken (1907-09), designed by the German architect Heinrich von Schmidt, also uses similar industrially produced elements and connections (Fig. 7.f).

Figure 9. Top: St. Catherine’s Church (1854-74), Brussels. Architect, J. Poelaert; photos: J. Wouters (left), R. Wibaut (right). Centre: St. Gilles’ Church (1866-76), St. Gilles. Architect, V. Basme; photos: THOC (left), V. Duvaigne (right). Bottom: St. Servais Church (1871-76), Brussels. Architect, G. Hanusse; photos: THOC (left), J. Wouters (right).
Construction of Church Roofs in the Brussels Capital Region, 1830-1930: Ahead of Technology?

The Wiegmann-Polonceau type influenced the conception of trusses built in later periods. The steel trusses of Our Lady of the Holy Heart Church in Etterbeek (1926-28) (Fig. 7.h) clearly were designed following the principles introduced by Wiegmann and Polonceau. One can identify two trussed beams linked together with a horizontal element in tension. Although it is already an improvement that the trussed beams are composed of multiple compression struts (seven fields per rafter), the major evolution lies in the use of industrially produced steel components.

Figure 8. Our Lady Church in Laeken (1852-72). Brussels. Architect, J. Poelaert. Top left: façade; top right: lateral nave’s truss; bottom left: principal nave; bottom right: principal nave’s truss. Photos: R. Wibaut.

Large span iron and steel trusses (1900-30)

The last period identified within the timeline of the construction of iron and steel pitched roofs (Fig. 7) runs from 1900 to 1930 and includes two churches, St. Henri’s Church (1908-11) in St. Lambert’s Woluwé and Our Lady of the Holy Heart Church (1926-28) in Etterbeek. It is important to notice that these two roofs cover naves respectively 17 and 20 meters wide. In contrast, the spans of church roofs built in the previous periods are much narrower, between 10 and 12 meters. Through this simple observation, it is clear that the understanding of iron as a construction material evolved considerably. These two latest churches also reflect an evolution of roof structures in their use of industrially produced iron and steel elements. St. Henri’s Church, designed by architect Julien Walckiers (Fig. 7.g), is a reconstitution of a thirteenth-century Gothic church of the Dominican convent of Ghent. New materials were adopted for the hidden structural elements. In Our Lady of the Holy Heart Church, designed by architect Edmond Serneels (1875-1934) (Fig. 7.h), the roof is composed of upgraded Wiegmann-Polonceau trusses, which cover a reinforced-concrete ceiling. Lastly, one may notice that the extension of the lateral naves of Our Lady Church in Laeken (1907-09), designed by the German architect Heinrich von Schmidt, also uses similar industrially produced elements and connections (Fig. 7.f).

Figure 9. Top: St. Catherine’s Church (1854-74), Brussels. Architect, J. Poelaert; photos: J. Wouters (left), R. Wibaut (right). Centre: St. Gilles’ Church (1866-76), St. Gilles. Architect, V. Basme; photos: THOC (left), V. Dusigne (right). Bottom: St. Servais Church (1871-76), Brussels. Architect, G. Hanotte; photos: THOC (left), J. Wouters (right).
Construction of Church Roofs in the Brussels Capital Region, 1830-1930: Ahead of Technology?

Iron and steel domes

All of the above-mentioned churches were constructed with pitched roofs covering linearly organised plans. Two Catholic parish churches, however, were built according to centrally organised plans. As explained by architect Louis Van Overstraeten (1818-49) when discussing the construction of his own St. Mary’s Church (1840-45) in Schaerbeek, the central plan was adopted because of the irregularly shaped site, which was not suitable for linear development. [16] Van Overstraeten had designed a full cast iron dome in his initial project, dating back to 1844, which differed from the built structure. He described it as follows: “The internal vault, which is made of long cast iron edges and which is linked to the outer wall, forms, in some way, a single element with the latter”. [17] But the construction of the dome was postponed and only completed in 1888, using riveted wrought-iron elements.

Later, architect Jules Bilmeyer (1850-1920), originally from Antwerp, designed a metallic dome for St. Job’s Church (1911-13) in Uccle. Unlike the previous example, the plans drawn by Bilmeyer for the church and the finished structure were extremely similar.

Reinforced concrete churches

In 1925 architect Jean Combaz (1889-1979) designed St. Susan’s Church in Schaerbeek to be built of reinforced concrete (Fig.10). This construction not only makes use of in-situ cast concrete, but also applies prefabricated panels coloured by adding crushed brick aggregates. Its general design refers to the archetypal concrete Church of Notre-Dame du Raincy in Paris by Auguste Perret (1922-23). St. Susan’s has a flat roof built up in concrete Vierendeel trusses. It is not only the first church constructed entirely in reinforced concrete in the Brussels Capital Region, but is Belgium’s first concrete church. [18] Two other parish churches would soon follow: St. John the Baptist Church in St. John Molenbeek (1930-33) by architect Joseph Diongre (1878-1963), and St. Augustin’s Church in Forest (1927-35) by architect Léon Guinnomette (1891-1976). [19] These three buildings ushered in architectural modernity and the use of concrete in religious architecture in Belgium.


Conclusions

The ongoing survey of churches in the Brussels Capital Region lacks information about materials used and structural forms. To gain insight into whether and how technological innovations may have been introduced in the

Romain Wibaut, Ine Wouters, and Thomas Coomans

buildings, we investigated roof structures in the majority of the 35 extant Catholic parish churches built from 1830 to 1930 in the Brussels Capital Region.

This study shows that in timber trusses, despite the introduction of iron components in a few instances, there were no major advances in their construction, not in their typology, nor in their assembly. Yet the relatively early use of wrought iron in the construction of roof trusses in some churches is remarkable, as was the rapid evolution of these trusses through new construction principles. In less than one century, indeed, they evolved from traditional principles inherited from carpentry, through the efficient Wiegmann-Polonceau type, to industrially produced components matching with the latest technological advances. Although the introduction of reinforced concrete into churches was quite late, once introduced, the new material was accepted and even applied to the interior structure. In the near future, onsite investigations will be continued and the study will be augmented with archival research in order to uncover the impact of the different actors and to trace the differences between designed and realised structures.

Acknowledgments

This study received financial support from the Strategic Research Program on Construction History of the Vrije Universiteit Brussel. Special thanks to the colleagues in the Department of Architectural Engineering, as well as to the church fabrics for their time and for disclosing their archives.

References

Construction of Church Roofs in the Brussels Capital Region, 1830-1930: Ahead of Technology?

Iron and steel domes

All of the above-mentioned churches were constructed with pitched roofs covering linearly organised plans. Two Catholic parish churches, however, were built according to a centrally organised plan. As explained by architect Louis Van Overstraeten (1818-49) when discussing the construction of his own St. Mary’s Church (1845-88) in Schaerbeek, the central plan was adopted because of the irregularly shaped site, which was not suitable for linear development. [16] Van Overstraeten had designed a full cast iron dome in his initial project, dating back to 1844, which differed from the built structure. He described it as follows: “The internal vault, which is made of long cast iron edges and which is linked to the outer wall, forms, in some way, a single element with the latter”. [17] But the construction of the dome was postponed and only completed in 1888, using riveted wrought-iron elements.

Later, architect Jules Bilmeyer (1850-1920), originally from Antwerp, designed a metallic dome for St. Job’s Church (1911-13) in Uccle. Unlike the previous example, the plans drawn by Bilmeyer for the church and the finished structure were extremely similar.

Reinforced concrete churches

In 1925 architect Jean Combaz (1896-1979) designed St. Susan’s Church in Schaerbeek to be built of reinforced concrete (Fig.10). This construction not only makes use of in-situ cast concrete, but also applies prefabricated panels coloured by adding crushed brick aggregates. Its general design refers to the archetypal concrete Church of Notre-Dame du Raincy in Paris by Auguste Perret (1922-23). St. Susan’s has a flat roof built up in concrete Vierendeel trusses. It is not only the first church constructed entirely in reinforced concrete in the Brussels Capital Region, but is Belgium’s first concrete church. [18] Two other parish churches would soon follow: St. John the Baptist Church in St. John Molenbeek (1930-33) by architect Joseph Dioisge (1878-1963), and St. Augustin’s Church in Forest (1927-35) by architect Léon Guinnotte (1891-1976). [19] These three buildings ushered in architectural modernity and the use of concrete in religious architecture in Belgium.


Conclusions

The ongoing survey of churches in the Brussels Capital Region lacks information about materials used and structural forms. To gain insight into whether and how technological innovations may have been introduced in the

Acknowledgments

This study received financial support from the Strategic Research Program on Construction History of the Vrije Universiteit Brussel. Special thanks to the colleagues in the Department of Architectural Engineering, as well as to the church fabrics for their time and for disclosing their archives.

References

The Österreichischer Ingenieur- und Architekten- Verein’s Tests on Vaults 1890-1895. Towards the Affirmation of Concrete for Bridges and Roofs in the Austro-Hungarian Empire.

Giulia Chemoli

Theory and History of Architecture Laboratory 3, Swiss Federal Institute of Lausanne (EPFL), Switzerland

Introduction

Various structures of concrete, reinforced or not, were built in Europe during the second half of the nineteenth century, exploring the characteristics of these new materials.

In the Austro-Hungarian Empire, these innovations had particular difficulty asserting themselves against the traditional methods of the time. The use of concrete was initially limited to hydraulic works, for example in the context of the management of part of the Danube river basin, or in the Adriatic harbours; it was then progressively extended to other kinds of buildings, such as construction for military purposes, low-cost housing, factories, warehouses, and bridges.

In its first applications in the Austro-Hungarian Empire, concrete based on Roman cement was poured and tamped in layers (Stampfbeton), creating a mass which acted like a monolith. Later, the use of Portland instead of Roman cement permitted an increase in its resistance. In a second phase, reinforced concrete came into use. However, in both cases, the lack of a building tradition and of a complete theory was an obstacle to the correct design of the structures, particularly of vaults. Loading tests were sometimes organized to build single vaulted objects, until the Österreichischer Ingenieur- und Architekten- Verein (Austrian Association of Engineers and Architects), took the initiative to program and supervise a complete series of tests on vaults and on their materials.

Vaults in Stampfbeton before 1890

The first significant attempt to construct vaults in Stampfbeton in the Austro-Hungarian Empire took place near Bécs, Hungary, where, in 1854, the engineer Johann von Mihálik (János Mihálik von Madanyecz, 1818-1892) began building - entirely in concrete - the sluice Franz-Josef, on the canal connecting the Danube to the Tisa. Mihálik was an expert in hydraulic construction. After completing his studies in Pest in 1845, he visited modern hydraulic works in Italy, Bayern and Holland. In 1858, he published, in Wien, a fundamental and comprehensive book on concrete construction [1], which was then reprinted in various editions. In 1855 Mihálik erected, on the building site of the sluice, a pioneer proof bridge in Stampfbeton. This structure spanned 30' and it was tested...