Hidden modernity: Reinforced concrete trusses in Brussels parish churches (1935–40)

Romain Wibaut

Vrije Universiteit Brussel, Brussels, Belgium
KU Leuven, Leuven, Belgium

Thomas Coomans

KU Leuven, Leuven, Belgium

Ine Wouters

Vrije Universiteit Brussel, Brussels, Belgium

ABSTRACT: In the 1920s, modernist and Art Deco architects experimented enthusiastically with new materials, designs and ornaments. In the Brussels Capital Region several modernist churches were built entirely in reinforced concrete and decorated with abstract forms. In the following decade, however, because of the economic crisis and the stagnation of the construction sector, traditional design and styles took over again. New technologies and reinforced concrete were still used, but they were hidden. This paper focuses on the less studied churches from the late 1930s, which turned their back to modernism and combined Romanesque forms and regional characters. Based on fieldwork, archive and literature study, this paper contributes to understanding the technical use and esthetical context of reinforced concrete in church construction in the late inter-war period.

Keywords: 20th century, Brussels (Belgium), Roof Construction, Church, Reinforced Concrete

1 INTRODUCTION

After World War I, Belgium not only had to be rebuilt, but a new society had to be shaped: a fairer, less individualistic and democratic society to which architecture should prominently contribute (Smets 1985). Brussels became therefore one of the capitals of Art Deco architecture as well as Modernism, hosting CIAM III in 1930 (Vandenbreeden&Vanlaethem1996; Van Loo 2003, 49–67). At the same time, the still predominant Catholic Church adapted to the more social(ist) oriented society by promoting Catholic social works, Catholic groups' organisations, more inclusive liturgy, and new architectural church types that could accommodate larger congregations (De Maeyer 2009). This new religious architecture broke with the traditional Gothic revival model. By using reinforced concrete structures, it became possible to cover the large single-nave that the new liturgy required.

Three of Belgium's earliest *avant-garde* churches were erected in the Brussels Capital Region (Fig. 1): St. Susan's at Schaerbeek designed in 1925 by architect Jean Combaz (Fig. 1a), is a

reinforced concrete box with a flat roof using concrete Vierendeelgirders (Fig. 1b); St. John the Baptist church at Molenbeek (1931–33) by Joseph Diongre (Fig. 1c); and St. Augustin's church at Forest (1932–35) by Léon Guinnotte and André Watteyne (Fig. 1d). At the same time, the construction works of the Sacred Heart Basilica (1926–51), one of the largest Catholic churches in the world, started in Koekelberg according to Albert Van huffel's design. In recent literature dealing with inter-war churches, these four churches received much attention from construction historians (Cordeiro 1994; Spapens 2003; Vandenbreeden & de Puydt 2005; Van de Voorde & De Meyer 2010; Van de Voorde 2011, 307).

The booming post-war period was undermined from the early 1930s by the Great Depression. The government undertook many attempts to revitalise the construction sector, such as organising a World's fair in Brussels in 1935. Far from that expectation, however, the sector remained unproductive until after World War II. Yet, one notable exception was church construction, which continued because of the development of new parishes and the state policy of subsidised public works.

Figure 1. (a) St. Susan's church in Schaerbeek; (b) Vierendeel girders at St. Susan's; (c) St. John the Baptist church in Molenbeek; (d) St. Augustin's church in Forest. (ACF St. Susan, R. Wibaut).

Especially the suburban neighbourhoods (including Brussels' surrounding areas) that developed in the 1920s now needed their parish church (Coomans 2014; De Maeyer 2009). These churches were designed in a regionalist style, according to a conservative ideology, as if they were places of worship in the middle of a village. Some of them, as we will see, replaced or enlarged an old village church that had become too small. Most architectural historical studies neglected these churches because they did not follow the path to modernity (Morel 2006). "Regionalism, however, cannot be thought of separately from modernity;" it is rather "a way of dealing with it" (Meganck et al. 2013, 13). This makes the churches built between 1935 and 1940 remarkable because they conciliated the conservative ideas of the archbishopric of Malines-Brussels, the liturgical requirements and the need to adapt to modern construction practices as well as to the crisis context.

Reinforced-concrete roof structures are present in an important number of churches built in the late 1930s. Nevertheless, they have not yet been studied because they are hidden above vaults or behind cladding materials. Our study gained new knowledge about this hidden modernity.

2 A SYSTEMATIC SURVEY

Reinforced concrete was introduced from 1925 in churches in the Brussels Capital Region. The period 1925–40 appeared to be a flourishing period with the construction of 25 parish churches mainly concentrated in the years 1935–40. Systematic on-site analysis of the church roofs was carried out resulting in a dataset which specifies the materials applied for the roof structure, the construction features and the present state of conservation. Archive and literature study complement the dataset with additional information such as the preliminary designs, the actors and the construction phases.

The starting point is clearly marked with the construction of the three already mentioned modernist churches that exposed reinforced concrete inside and outside (Fig. 1). These iconic *avant-garde* churches echoed Auguste Perret's Notre-Dame du Raincy (1922–23). At the same time, however, other but less radical attempts were undertaken to integrate reinforced concrete in church construction. For instance the Neo-Romanesque St. Teresa of Avila church in Schaerbeek, designed by Jules Coomans in 1926 (built 1932), has timber trusses laying on a concrete frame. The Our Lady of the Holy Heart in Etterbeek, designed by Edmond Serneels in 1926 (built 1931–35), has steel trusses on top of a 22-meters-wide ceiling made of a grid of reinforced-concrete beams.

Our research revealed that reinforced concrete became the main structural material in the construction of church roofs in the Brussels Capital Region from 1935 onwards: the roofs of seven churches erected between 1935 and 1940 were built with hidden reinforced-concrete trusses while only six were built with other structural materials: three in steel and three in timber (Fig. 2).

Sources related to the construction of the seven studied churches are conserved in different archives. Firstly, the archives of the church fabrics (ACF) can vary from no information at all

Figure 2. Catholic parish churches built in the Brussels Capital Region classified according to the main material of their roof trusses. (R. Wibaut).

(St. Peter, Our Lady of the Holy Heart) to a complete file including pictures of the construction site (Divine Saviour), reproduction of the plans (St. Alix) or execution plans (St. Adrian). Secondly, documents were found in the municipal archives: plans and notes about the Divine Saviour (ACS), Ss. Peter and Paul (AVBb) and St. Peter (ACWSP) as well as the preliminary design (in steel) of the St. Adrian's church (AVBa). Third, the archives of the Royal Commission for Monuments and Sites (AOEV) conserve plans of St. Lambert's church. Furthermore, articles related to individual churches were retrieved in contemporaneous periodicals.

3 HIDDEN REINFORCED CONCRETE TRUSSES (1935–40)

3.1 *Description of the seven churches*

Fieldwork of the seven churches has shown that, in these cases, the roof truss cannot be dissociated from the other structural components. The reinforced-concrete columns, which are hidden behind cladding and raised on strip foundations, are connected to the reinforced-concrete roof trusses. These trusses, which are hidden above the vaults, are connected together by means of longitudinal concrete beams. This structural configuration allowed to create churches with a single but wide nave, which met the new liturgical requirements (Morel 2006). Although the structural concept of the seven churches is similar, the morphologies of their trusses are different (Fig. 3).

In 1934, architect Julien de Ridder (1891–1963) designed the new St. Peter's church in the municipality of Woluwe-Saint-Pierre, an urbanised former village on the outskirts of Brussels (Fig. 3a). The new church integrates some parts of the previous eighteenth-century village church. The construction, undertaken by the contractor L. Feyaerts started in 1935 and was completed in 1936, except the interior finishing. The reinforced-concrete trusses have a span of approximately 10 meters and are constructed over a flat concrete ceiling. They are similar in shape to raised-collar configuration of trusses that one can observe in timber construction. Here, all the purlins are reinforced-concrete beams, while in the other cases steel was often preferred. These beams are topped by a timber plank to ease the assemblies with the timber rafters.

The Ss. Peter-and-Paul's church in Neder-Over-Heembeek, a former rural village integrated into Brussels city (Fig. 3b), was designed by the same architect Julien de Ridder. It was built in 1935 with a span almost twice as large as at St. Peter's

(approx. 20 meters). The trusses of the main nave show similarities to a timber king-post configuration. One out of two trusses also contains members linking the “king post” with the principal rafters. Most remarkable is that the single frame situated above the 25-meters-long transept —the span of which is in the same direction as the other trusses—, is a concrete cast-in-place Vierendeel girder. At the level of the crossing, the lower chord of this girder follows the curvature of the longitudinal vault.

In 1935, architect Léonard Homez (1900–?) designed the churches of the Divine Saviour in the municipality of Schaerbeek (Fig. 3c) and St. Alix in the municipality of Woluwe-Saint-Pierre (Fig. 3d). However, the shapes of the roof trusses and their spans are different. At the Divine Saviour's church, the trusses cover a 14-meters-wide nave and its shape is largely inspired by a traditional timber king-post truss: a “collar beam”, “principal rafters” and a (very thin) “king post” are present. At St. Alix's church, although a “king post” was present on the plans, the built structure, which spans a 16-meters-wide nave, is more similar to a queen-post truss. This influence of timber carpentry is not only visible in the truss morphology but also in some details. Hence, one may observe that the assemblies between the concrete trusses and the steel purlins is influenced by the traditional cleats that were used for the same purpose in timber trusses. One may note that architect Homez also designed the St. Teresa's church in Dilbeek (a border municipality with the Brussels Capital Region), which follows the same concept.

The construction of Homez's churches occurred simultaneously to the erection of the church of Our Lady of the Holy Heart, built in Anderlecht with a span of approximately 14 meters (Fig. 3e). The architect who built this church is not yet identified and no archival document was yet retrieved. Fieldwork uncovered that the shape of the concrete trusses is inspired by the traditional king-post configuration.

In 1937, architect Guillaume-Chrétien Veraart (1872–1951) designed the new St. Lambert's church in the municipality of Woluwe-Saint-Lambert. A small twelfth-century Romanesque village church —that still conserves a part of its original timber roof structure and its tower—, had to be flanked by a new large church in the same Romanesque style (Fig. 3f). Veraart was a famous church builder and restorer, who had previously designed two other churches in Brussels: the Gothic revival St. Remi's church in Molenbeek (1906–07) with roof trusses in steel and St. Charles Borromeo's in Molenbeek (1914–16) with timber rafters on steel purlins. Nevertheless, at St. Lambert's, the trusses are in reinforced concrete and cover the

Figure 3. Overview of the churches with hidden reinforced concrete structures in the Brussels Capital Region. (R. Wibaut, THOC).

12-meters-wide nave. Although Veraart's original design for the trusses included a "king-post", it was finally erected without this element.

At the same period, architect Auguste Vanden Nieuwenborg (1890–1979) was designing the St. Adrian's church to be built in the municipality of Ixelles (Fig. 3 g). Although the preliminary design (1936) included a steel roof construction, the church was finally built in reinforced concrete, respecting the execution plans drafted in 1938. The steel purlins are here trussed in both direction by means of struts and ties. In this church, if not hidden above the vaults, concrete has been clad with yellow bricks.

3.2 Construction process

Often the archival material is incomplete and does not allow to trace back the construction process. Fortunately, different sources were retrieved for the two churches designed by Léonard Homez. Photographs of the construction site (Fig. 4), original plans or reproduction and an article written in the periodical *Bâtir* in 1939 allow to get insight in the design and construction stages of both the Divine Saviour's church in Schaerbeek and St. Alix's church in Woluwe-Saint-Pierre. The construction of the reinforced-concrete structure can therefore be analysed, while pointing out the

Figure 4. Construction of the reinforced-concrete roof structure at the Divine Saviour's church in Schaerbeek (1935), photographs by contractor F. De Knoop. (ACF Divine Saviour).

respective contribution of some building actors who have collaborated on this work. Even though the following paragraphs are related to two specific churches, one can assume that the construction process was very similar for the other churches excepted at St. Adrian's. This hypothesis is based on the observation of the structural details.

Both churches were built simultaneously under the patronage of the important textile-trader Jules Waucquez. This Catholic Maecenas had also financed the architecture studies of Léonard Homez at the famous Brussels St. Luke's school (Homez's father was one of Waucquez's employees). Therefore architect Homez was commissioned to design both churches (Gilon 2006). During the design phase, the study of the reinforced-concrete structure was entrusted to engineer M.E. Rossbach, the same engineer who had provided technical advices and scientific support for the construction of St. Augustin's church (1932–35), one of the three *avant-garde* concrete churches (Queille 1936; Deletang 1939) (Fig. 1d). In 1935, once the plans were accepted by both the bishopric of Malines-Brussels and the Royal Commission for Monuments and Sites, the construction started. For both churches, the works were undertaken by general contractor F. De Knoop.

Three photographs of the Divine Saviour's church provided by the family of contractor De Knoop to the church fabric show the erection of the concrete trusses. By cross-checking the analysis of these photographs with other archival documents, an overview of the construction stages is outlined, focusing on the construction of the vaults and roof trusses. Before starting with the construction of the roof structure itself, the concrete strip foundations were poured and the concrete columns were erected above these foundations.

The first main step in the construction of the roof occurred simultaneously with the construction of the masonry walls: a temporary timber scaffolding was erected, which supported the bottom of the arched formwork. The second step consisted of the implementation of the reinforcement: steel bars and stirrups were placed from the top of the columns up to the "collar beam" (Fig. 4a). The next step corresponded to the construction of the wooden formwork around these reinforcements. At that moment, concrete could be poured up to the level of the "collar beam" (Fig. 4b). Later, the remaining part of the truss (the uppermost triangle and the "king post") was constructed following the same steps: reinforcement (connected to the bars of the lower part), formwork and pouring. After the construction of all the individual trusses,

they were each connected together by means of two concrete beams resulting in a strong monolithic system (Figs 3c,4 c). The first beam, in which the purlin is embedded, is situated at the ridge (the other purlins are steel *poutrelles Grey* coming from the *Forges de la Providence*, Marchienne-au-Pont, and assembled to the trusses by means of reinforced-concrete cleats). The second beam links the trusses by the middle of their “collar beams” and sustains the vault at its summit.

The construction of the vault only started when the roof covering (timber rafters, battens and roof tiles) was completed. As mentioned in the periodical *Bâtir*, its construction was entrusted to the company *Joseph Tignol and Adolphe Joly*, Brussels. It was realised using their own “well-known” bricks-and-concrete system. The free-standing vaults in hollow bricks were settled only by means of an angle template, without any formwork or support. A projection of concrete was then sufficient to strengthen the whole construction (Deletang 1939, 471). The main argument put forward by this system was that, combined with the right choice of materials, it allowed to reduce the horizontal forces applied on the vertical support to a negligible amount, rendering all kind of buttresses obsolete and resulting therefore in economic benefits.

Eventually, these photographs show how easy reinforced concrete could be applied on the building site: neither crane nor other machinery were necessary for the erection of the church. The cost of the construction was therefore relatively low. Indeed, the final cost for the construction of St. Alix's church was 950,000 Belgian francs (Deletang 1939, 471), which is three times less than the construction of Our Lady of the Annunciation in the municipality of Ixelles, a church similar in scale and built at the same period but using steel trusses on masonry (Ossature Métallique 1935, 8). As mentioned in the journal *Le Béton Armé*, the churches using that principle also show another important asset compared to timber or iron constructions: in case of fire, the trusses keep sustaining the vaults, avoiding large disasters (Béton Armé 1925, 52). The same article gives also insight in the reason why these reinforced-concrete structures were developed: it could be partly due to the difficulty caused by WWI to procure enough-important timber (Béton Armé 1925, 56) or sufficient iron elements necessary for the construction of such roof trusses. The Belgian ironworks, indeed, had been partially dismantled during the German occupation.

4 CONCLUSIONS

By means of systematic fieldwork and archival investigations, this paper bridges the gap that

existed in the construction history of inter-war parish churches built with reinforced concrete as main structural material in the Brussels Capital Region. It demonstrates that these aesthetically-regionalist churches actually deal with hidden (structural) modernity.

It sheds light on the fact that reinforced concrete as main structural material is not limited to the documented *avant-garde* churches (1925–35) but continued to be used in the following decade. Above and beyond, this study uncovered that, although hidden and devoted to purely structural needs, reinforced concrete became the most widely adopted structural material in the construction of church roofs in that period (1935–40). Seven of the thirteen churches built in that period using reinforced concrete as main structural material were designed according to a new structural concept: the reinforced-concrete columns, hidden behind cladding and raised on strip foundations, bear the reinforced-concrete roof trusses, which are hidden above the vaults.

Probably developed as a response to the inter-wars lack of resources, the use of this system was fostered by many factors. Indeed, the study of the construction works uncovered the easy implementation that this system required and pinpointed the relatively low-cost, lightweight, durability and fire safety that it provided. The archival material also shed light on the different actors involved in the design and construction of the churches. Even though an engineer was appointed for the structural analysis, it does not mean that the architect was not involved in that part. On the contrary, all his notes and drawings bear witness of his structural understanding.

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