Study of the architectural history of the St. Martin’s Church, Zaventem, Flanders, by means of preliminary material-technical research

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1. Introduction
The St. Martin’s Church in Zaventem at first sight seems to be a common Gothic style church as so many churches in Flanders. It is constructed in a local lime sand (Brusselian) stone. The church got its actual Gothic appearance rather late as the main architectural changes of its exterior and interior took place between the late 16th and 18th centuries. The interior, showing a basilical ground plan, is characterised by plastered brick cross ribvaultings in choir, middle and side aisles. The nave’s walls, Romanesque still, extending unto a level higher than the actual late Gothic vault and former Romanesque top lights, carry an older (yet hidden) 17th century stuccoed vault. In 2012 a preliminary material-technical study of this stuccoed ceiling and the adjacent walls was carried out. This study also comprised a condition diagnosis and conservation advice. In this paper only results directly related to the building history and providing more information on the complex architectural evolution of the church will be presented.

2. Short description of historical data
Studies and descriptions of the history and architectural evolution of the church mainly date back to the beginning of the 20th century [De Ceuster, 1929; Lemaire, 1905]. Dates referred to during our study are predominantly based on De Ceuster’s article. Most important data are summarised underneath. There is a big historical gap between the Romanesque era and the first gothic adaptations in the beginning of the 16th century.

XVI 1567 Gothic cross ribvaultings choir.
XVII 1607-1608 New (wooden) ceiling in middle aisle (by Jan Gots).
1607 Construction of new “vunctkoor” near church entrance.
1607-1610 Demolition of old and re-construction of new side aisles.
1608-1646 Plastered ceilings in (side aisles?) and transepts. Lime washing of interior.
1621 Altars in transepts with Antony Van Dijck’s painting.
1648 Stone cross ribvaulting in north transept.
1687 Stuccoed ceiling in middle aisle.
XVIII 1749 Stone cross ribvaulting in south transept.
1772-1773 New roof on side and middle aisles.
1785 Cross ribvaulting middle aisle Le Cat Brussels.
XIX 1864 New west bay.
The first Romanesque church is dated in the 13th century. The early descriptions mainly focus on the Romanesque top lights but also mention the presence of the original lime stone cornice at the exterior and some remnants of old terracotta tiles. The Romanesque windows at both exterior and interior sides show bevelled jambs and offsets. Holes in the north and south exterior walls probably reveal the early fixation of the former side aisle roof ratters and joists. Literature mentions a flat wooden ceiling possibly covering the middle aisle in Romanesque period. The first (known) adaptations to gothic architecture concerned the choir. It was enlarged and got stained glasses and gothic cross vaults in 1567. In the beginning of the 17th century the church underwent major architectural changes: The tower was raised for the first time in 1605, the middle aisle got a new wooden ceiling (1607-08), both side aisles were pulled down (separately), widened, heightened and provided with new gothic cross vaults (1608/1610-1646). The north and south transepts got stained glass windows (which have disappeared today) and the St. Martin’s (with the Anthony Van Dijck’s painting) and Our Lady’s altars were to be seen yet at about 1621. The church must have been reshaped to gothic style except for the side aisles, that were not ready before the middle of the 17th century, and for the nave vault that was not changed to gothic style until late in the 18th century.

3. Material technical study

3.1 Stratigraphical study

3.1.1 Introduction and description of probes

Stratigraphical probes were carried out on exterior and interior walls as well as on the stuccoed vault. Main architectural sub-structures of which layering needed to be compared were the exterior walls and jambs (1), the interior walls (2) and jambs (3), the brickwork fillings of the Romanesque windows (4), the east wall (5), the stuccoed ceiling (wooden elements (6) and panels (7)).

3.1.2 Results of the stratigraphical study

(1) On the exterior walls and jambs a single layered and original Romanesque lime rendering is still present. The plaster layer is thin, very hard and shows vertical and horizontal lines scratched into it with the jointer in order to imitate a stone patron. These “joints” are clearly executed by free hand. Along the arches of the windows the joints follow a radial pattern. No traces of paint have been found. The Romanesque rendering is extremely well preserved as it is protected in the attics of the actual side aisles of the church.
(2) On the interior walls a packet of 20 layers in total was found. The first layer is the Romanesque lime rendering, which was executed simultaneously and similarly to that of the exterior walls. Upon the rendering remnants of a coloured paint layer (ochre, red) are found. As remaining paint fragments are very limited, further assessment of the kind of architectural polychromy (stone patron?, figurative painting?) was not possible. It is assumed though that this paint layer dates back to the earliest Romanesque decoration of the church interior. This coloured paint layer is covered by a second rendering. It has a pale yellow colour, is thin and less coherent than the first Romanesque rendering. This mortar apparently is post-Romanesque although precise dating was not possible yet. The same rendering occurs on the east wall (5). On this post-Romanesque rendering there is a wall painting. Its condition is very bad as the rendering on which it is executed lost its adhesion with the underlying rendering and support. The wall suffered from severe humidity and salt problems which have been so destructive that the stratigraphical study could not be finalised at desired spots. At first sight the wall painting seems more likely to be dated early gothic than Romanesque. The actual study could not reveal whether the east wall was painted entirely or not. A former opening or doorway was covered in function of its execution, showing that the painting belongs to a post-Romanesque phase.

(3) On the jambs of the interior walls only part of the layering packet existing on the walls, has been counted. The window openings have been masoned in two phases (4). The first phase is situated when the first north (and south?) transept(s) was introduced to the church. The windows of the 5th and 6th Romanesque bays were partly supremated and filled with stones as the roof of the new transept partly crossed them. The second filling phase concerned all windows and is to be situated when the stuccoed ceiling was introduced in the middle aisle of the church. The filling occurred with bricks of Spanish size (24 x 12 x 6 cm) commonly in use in the province of Brabant from the 16th until late 18th century. On these bricks a first single layer lime rendering is found. Superimposed is a layering packet containing at least seven paint layers. All these paint layers are lime based, some of them are coloured with litmus, a colouring agent that was often added to lime wash layers from the second half of the 17th until late in the 18th century. Its colour depends on and changes between more red or more blue with the pH of the calcium hydroxide. The number of layers occurring on the interior jambs of the windows added to the packet of layers on the masonry in the windows results in the total number of layers occurring on the interior walls.

(7) The layering on the stuccoed ceiling is identical to that of the masoned windows. A packet of lime based layers is executed on a lime rendering, the latter consisting of a ground and a thinner top layer. Thus it can be concluded that the Romanesque windows were closed at the time when the stucco ceiling was constructed. According to archival documents this took place in 1687. (6) The layering on the wooden construction elements of the stuccoed ceiling is identical too, except for some particularities: on the tiebeams an older and different lime layer is found under the above mentioned lime rendering. On top of this layer traces of red and yellow ochre paint remain, though very limitedly.
Very rarely, on the tranvers arches, spots of red paint have been found. They are covered by the layering packet also present on the vault. This leads to the assumption that the wooden construction elements are older than the stucco work on the panelled fields in between the wooden construction elements.

3.1.3 Conclusions of the stratigraphical study
In Romanesque period the interior and exterior walls were covered by a thin, dense lime rendering, showing a patron of stone imitations by scratched joints. The interior was painted. In a post-Romanesque era all the interior walls were covered by a new thin pale yellow coloured lime rendering and paint layers. At the east wall a figurative painting was executed. The post-Romanesque rendering covers a former opening in the east wall. When the first north transept was added to the church, the windows in bays 5 and 6 were filled with stones as high as the incline of the new roof of the transept. According to archival material this must have taken place at about 1600. All the windows have been entirely masoned at the time the stuccoed ceiling was introduced. According to archival material this was done in 1687. Stratigraphical research however reveals that remnants of earlier decors exist on some of the wooden elements. This means that they are older.

3.2 Study of other architectural features
3.2.1 Description of studied elements
Further some particular architectural features were studied. Wooden construction elements investigated are: the support of the stuccowork (1), the roof construction of middle and side aisles (2) and the Romanesque joinery (3). Apart from that some features in the stone walls were looked to in detail: the repetitive holes in north and south exterior walls, negative traces of an old roof of the north transept, of a roof of an annexed portal or choir to the south wall (4) and of the old roof of the middle aisle (5). Finally there are still remnants of an old plaster layer of the south wall of the former north transept. Dendrochronological analysis was carried out. A thorough study of the Romanesque joinery revealed how they were constructed and composed, how they were fixed into the nudes and how the glass panels were held.

3.2.2 Results of additional study
The above mentioned architectural features partly belong to the original Romanesque church. The original cornice, remnants of terra cotta pantiles and negative witnesses of the ratters and joists and ceilings of the old roofs of the side aisles of the Romanesque church, as mentioned in literature, are still visible (3). The construction of the Romanesque joinery is very simple. Two posts are connected by four rails of half section. All connections are half-lap and strengthening is realised by means of pegs. The upper semi circular rail fits into the arch of the window. This half-lap construction method using pegs for fixing and without glue is typical for the oldest constructions [Laenen, n.d., 1]. The upper rail was sewed from a much longer plank than the other rails and these jutting out lateral parts were masoned with lime mortar into the nudes, thus consolidating the joinery into the masonry. The windows were separated
in three squares into which iron window frames must have been fixed with forged nails.

(5) On the upper part of the east wall, that is momentarily hidden on top of the actual stucco vault, the negatives of the former groove of the old roof of the Romanesque middle aisle can be seen. Right beneath it the aforementioned opening is situated. It possibly functioned as a former doorway from the tower to the attic on top of the former Romanesque ceiling. In a later period the roof above the middle aisle was raised.

From the north transept, one can still see remnants of the old boarding of the second roof. This means that the middle aisle roof was still entirely visible and this very probably in combination with the roof of the first north transept. As the actual north aisle roof probably is dating from the period in which the stone ceiling was introduced (1646), the former situation must have been earlier, probably around 1600. (4) At the south wall the incline of a roof that was built against the wall of the middle aisle is visible. If this roof belonged to a chapel added after 1600, this means that the construction works of the south aisle were carried out later than those of the north aisle (which was finished at 1646).

(1,2) Roof and vault constructions very likely were realised simultaneously. Thorough study of the stuccowork in relation to its support however leads to the conclusion that the latter were realised simultaneously too and that the wooden support was constructed in function of the stuccowork. This leads to a contradiction: The roof construction of the middle aisle has to be dated before 1646, the stuccowork is dated in 1687.

The support of the stucco ceiling consists of lats that were nailed onto the ribs and purlins. Where they are connected to the ribs the lats have been shredded conically in order to fit into a slit sliced into the ribs. Although this constructions seems to be realised in one single period, material as well as archival sources reveal that a wooden barrel vault very probably had been realised at about 50 years before the stucco work was executed. Probably this wooden ceiling was very similar to the actual stuccoed one, except that it contained wooden panels in stead of stuccoed ones. On the crossings of ribs and purlins, where now the sculpted stuccoed ornaments are present, probably wood carved ornaments were realised. This hypothesis coincides with the fact that, on some of the wooden elements, a decoration earlier than the one of the stucco ceiling occurs.

3.2.3 Conclusions of additional study

Negative traces in the east stone wall on top of the actual wagon vault and remnants of an older wooden boarding reveal that the middle aisle must have had at least three roofs. The first one (Romanesque period) was much lower than the actual one and is probably to be dated in the 13th century. The second one, a little bit higher, was probably executed when the tower was raised but before the renewal of the roof of the north transept. As the latter can be dated at about 1646 (simultaneously with the roof of the new north aisle and with the new stone ceiling in the north transept), the second roof is to be dated before (around 1600-1605). At this time the wooden ceiling construction was
added too and thus should date from around 1600. This coincides with material traces of earlier decoration found on the tiebeams and on some ribs, and with a wooden ceiling, executed by Gots, mentioned in literature. Other material traces confirm Romanesque architectural features. However, an effective proof for the presence of flat wooden ceiling in Romanesque period was not found yet. The addition of a chapel or portal to the nave’s south wall matches with the later finishing of the new south aisle and the literature sources mentioning a “vunctkoor”.

3.3 Scientific research

3.3.1 Mortar analysis

Some mortar samples were analysed: the Romanesque mortar (1), the ground
(2) and top (3) layers of the ceiling stuccowork, and the first mortar found on the tiebeams (4). Mortar 1 consists of lime, fine sand and fine clay or brick powder, functioning as hydraulic additive. Also proteinaceous material was found. The binder/filler (b/f) ratio is 4 or 5 parts of lime to 1 part of sand. This means that the filling material consists partly of carbonatated material. Mortar 2 consists of lime and fine sand. To this mortar animal hair was added. Mortar 3 is comparable to 2 but consists of finer sand. The b/f ratio is normal. Mortar 4 is very comparable but does not belong to the same plastering phase. On this plaster layer a painting consisting of yellow and red ochre is present. The mortar contains animal hair, comparable to that in mortar 2.

3.3.2 Optical microscopy
Samples of the Romanesque joinery were studied. The sample was boiled and embedded in paraffin, and sliced by microtome. It was studied using an optical microscope using transmitted light. The wood showed up to be sweet chestnut (Castanea sp. Fagaceae) [Indekeu, 2012, 9]. Study of rings generally learnt that the wood was fast growing and probably concerned coppice-exploitation wood.

3.3.3 Dendrochronology
The aim of dendrochronology was to find out whether the different supporting wooden elements of the stuccoed ceiling indeed were added in the same period. Dendrochronologists were asked to carry out dendrochronological study of the tiebeams, the wall plates, the transvers arches and the Romanesque joinery. Unfortunately on none of the aforementioned elements a dating could be carried out, due to poor dendrochronological quality of the wood. Alternatively, some samples of the side aisles’ roof constructions were taken. Of one sample the final year ring could be dated in 1643. This date agrees well with the year of finalisation of the renovation works (1646) of the north aisle. Further dendrochronological analysis will be carried out during future conservation. Some parts of the roof construction of the middle aisle will be studied.

4. Results
By means of stratigraphical and material technical studies of architectural particularities, more information about the building phases of the church could be deducted. Although some dates are still hypothetical, a reconstruction of more building interventions during history was possible. Studies of both wooden elements and their negative traces in stone masonry clearly contributed to a better understanding of the architectural evolution of this church.

1. The Romanesque church had narrow side aisles with possibly flat ceilings in both side and middle aisles. However and particularly for the middle aisle no material technical evidence of this flat ceiling has been found yet. The church was plastered at the interior and exterior parts with a thin plaster layer, in which joints were scratched imitating a stone pattern. On the interior plaster layer traces of painting (ochres) have been found. In the east wall there was a passage or doorway, probably from the tower to the attic on top of the nave.

2. In a post-Romanesque phase this doorway was masoned in function of a
later plastering of the east wall on which a wall painting was executed. This plaster has a pale yellow colour and has much weaker cohesion in comparison to the Romanesque plaster layer. Presumably at the same moment the church was provided by a north transept with a low barrel vault and a plastered ceiling. The Romanesque windows in the 5th and 6th (east) bays were partly filled. At the south part a similar intervention took place (probably in function of a tower). This building phase is dated in the 15th century. This date is still hypothetical and mainly based on style characteristics of the wall painting.

1. Romanesque XII-XIII; 2. Post-Romanesque XIV-XV-XVI

As the wall painting occurs on the east wall on a level higher than the vault’s springing, the ceiling could not be flat anymore.

3. The middle aisle got a new roof, probably when the tower was first elevated in 1605. The new roof must have existed contemporary to the roof on the north aisle. Together with the new roof the vault construction for the middle aisle was realised and as a consequence the middle aisle showed a wooden panelled ceiling. This coincides with archival material mentioned by De Ceuster. The Romanesque windows remained open still; More or less contemporarily building works at the north and south aisles must have started.

4. Meanwhile construction works at the north and south aisles started. Those were completed in 1646, this date being confirmed by dendrochronological study. According to the results of the stratigraphical research the windows were not filled yet, although presumably blinded (as the side aisles had been broken down).

5. In 1687 the stucco decoration was executed. In function of this works the Romanesque windows have been masoned and plastered. The first layers were white lime bound paint layers. Later overpainting are nearly all lime bound, two of which have been coloured with litmus. The rendering and paint layers found on the ceiling panels, wooden elements and masoned windows are the same.

3. XVII B: c. 1605-1608; 4. XVII B: c. 1648

5. XVII B: c. 1687; 6. XVIII B: 1785 (Le Cat)
6. In 1785 the brick stone rib vaulted ceiling of the middle aisle was constructed.

5. Conclusions
Results of stratigraphical and material technical investigations of some (traces of) building particularities of this church have lead to at least a better understanding of some of the architectural changes and interventions in the period between Romanesque era and the late 19th century introduction of the brick ceiling in the middle aisle of this church.

Hitherto no material technical evidence has been found that the first Romanesque roof indeed was flat. Further study of the east wall should reveal more information on this. What is clear however is that in a post-Romanesque period the ceiling definitely could not be flat anymore. De Ceuster mentions the construction of a wooden ceiling in the beginning of the 17th century. We assume that this wooden ceiling was almost the same as the actually existing stuccoed one, but with wooden panelling in stead of stuccoed panels on lats. These lats had been introduced in function of the stucco work, thus in 1687. None of the described architectural features are visible from the exterior nor interior open to the public.

Notes
1 Plan nr. 9 by TV Ebtca multiprofessionele architecten vennootschap en Sofie Beyen Architecten bvba.
2 Mortar analysis was carried out by D. Bossiroy of ISSeP (Instiut Scientifique pour la Service Publique), Liege, Belgium.
3 Dendrochronological analysis was carried out by S. van Daalen, Van Daalen Dendrochronologie, Deventer, The Netherlands.

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