THE GEOMETRY OF FLEMISH GOTHIC TOWN HALLS

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***Abstract**: Can we find evidence for the application of design rules in the plans of the gothic town halls in Flanders? This question was dealt with in a recent investigation into the layout of some medieval town halls of the southern low countries.*
The research was initiated following a series of accidental discoveries. These indicated that not only medieval churches were built according to a symbolic geometry, but certain civic buildings as well. Starting from a graphical analysis of the building plans of the town halls under investigation, an attempt was made to reconstruct the scenario of their design.
As a result, we may put forward a number of conclusions. A particular system of 'applied mathematics', characteristic of the gothic tradition, was used to set out the building plans. The geometry is based on manipulations of the compass and the carpenter's square. A taste for symbolic series of numbers and figures appears. Acting together with the local measurement systems that were used to set out the plan, we often obtain a subtle game of numbers in the entire composition, expressed in local feet or rods.
If the medieval building master is known to have applied symbolic geometries in religious buildings, thereby referring to the metaphysic views of his time, then we may now state that he did this also in the civic architecture of the town halls. The medieval city had at that time become a powerful entity, challenging the established orders, and the town hall was in its design the very expression of this new reality. As such it

confirmed the consciousness of the citizen in way proper of the Middle Ages: by symbolic representation.

Recent research on the design of a number of gothic town halls in the southern low countries indicates that not only medieval churches were built according to a symbolic geometry, but certain civic buildings as well. Starting from a graphical analysis of the building plans of a number of representative town halls in and around Flanders, an attempt was made to reconstruct the scenario of their design.

Methodology

The research was started from a selected set of premises, after a building module in the design of the Leuven town hall was discovered rather accidentally.
A first assumption deals with the validity of a research on hidden design and proportion systems in a building. Do we have reasons to look for such a system, and what is the probability rate of the findings? As there is a good deal of evidence about the existence of medieval design systems in general, a closer look to the town halls under consideration was at least defendable. As a further constraint, only those schemes would be accepted that are relatively simple, evident, and robust. The last condition means that conclusions should have a tolerance margin, accounting of e.g. survey errors in the plans, and building particularities.
Carrying on, a set of design principles has been selected for consideration. We can summarize them as follows:

- Buildings are set out in the local measurement units, in use at the time of construction. Documentation about the measures in use in Flanders during the middle ages is available, with a high degree of reliability;
- Following some medieval writings, we should consider that what is to be found in plan, is reflected in elevation [1]: we have to find a three-dimensional approach based on 'pulling up' the plan;
- Symbolic, simple integer number series, such as to obtain simple ratios between dimensions, are typical of medieval architecture and sculpture. So they may well occur in the current research subject;
- An applied geometry, based on manipulations of the compass and the carpenter's square, is likely to be a major design canon for similar reasons.

Emphasis was put on a graphical analysis of the buildings as they stand; research on literary sources was limited to building history information necessary to reconstitute, as much as possible, the medieval situation. It should be noted that in the 18th and 19th centuries a lot of "correcting" restoration was performed on medieval buildings, often creating an idealized "reconstruction" of something that never existed before. Doors were moved, balustrades added, and so on.
Finally, used building plans should have a reasonable degree of accuracy for the purposes of the research. In the case of Leuven, a new survey of some cardinal points of

the building was made, confirming the satisfactory precision of the survey plans at disposition.
In what follows, we bring forward some results of the research that point towards the existence of a number of generally applied design principles. The buildings that were investigated are situated in Brugge, Oudenaarde, Brussel, Leuven (B), Veere (NL), Arras and Saint-Quentin (F).

Issue 1: the cubic grid

For the buildings situated in present Flanders (B), it could be verified that they are set out in the local, medieval measurement units of the city where they stand. All of the four cities had a different basic foot, and a rod composed of a different number of these local feet.
Moreover, for the buildings outside actual Flanders, it was possible to find a similar modularity in the overall dimensioning of the composition.
We can conclude that the contouring volumes of the buildings are simple rectangular parallelepipeds, with the ribs made up of a simple number of rods. For example, in Brugge we find a contouring volume of 3 x 5 x 7 Brugge rods.
As an illustration, we give two graphical examples of buildings where this cubic grid is a major characteristic of the design. Figure 1 shows Leuven, figure 2 shows Veere.

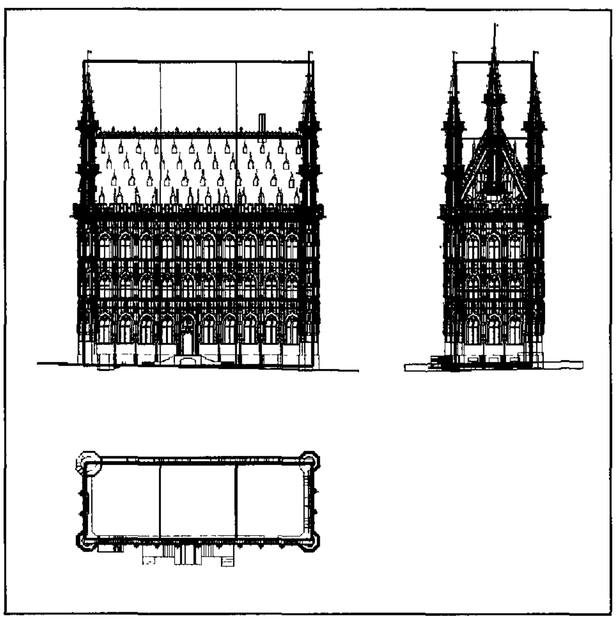
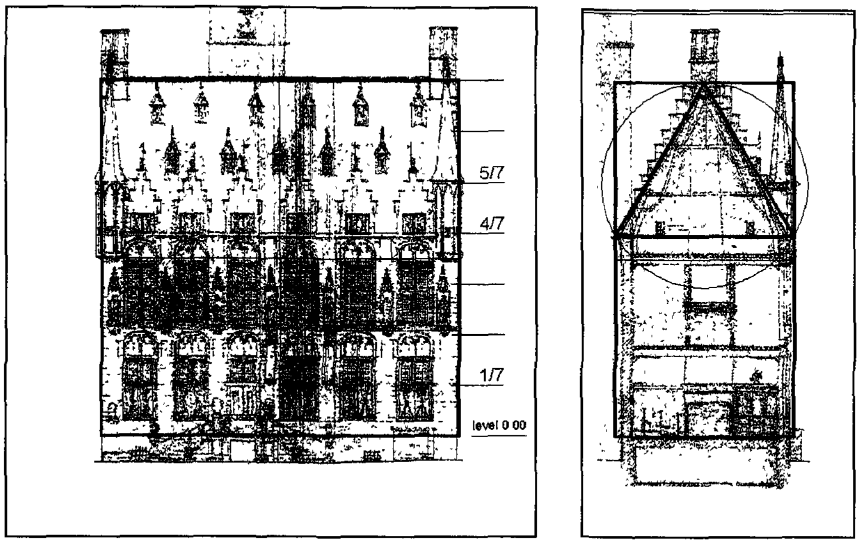


Figure 1: Leuven grid



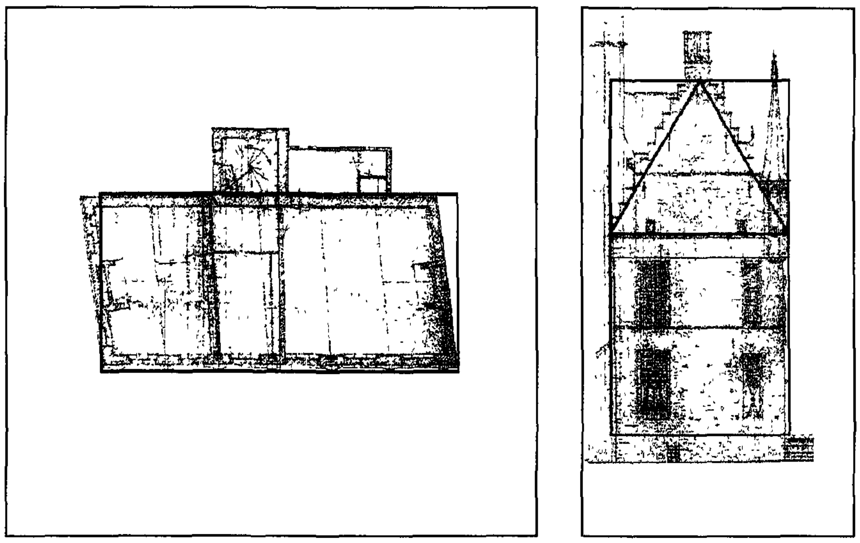


Figure 2: Veere grid

For Leuven, the basic cube of the grid has a side of two Leuven rods, or 5.71 meter. See further on for comments on this dimensional module.
For the buildings outside the actual Belgian borders, it should still be checked if the apparent module coincides in a similar way with a precise number of local rods or feet.

Issue 2: the contouring square

In connection with the first finding, the front elevation of the town halls, including the projection of the roof, is dictated by a contouring square. This square may be put on a base in some cases.
As an illustration, we show the contouring square for Leuven. Further on the ones for the other town halls will appear in connection with other design elements.

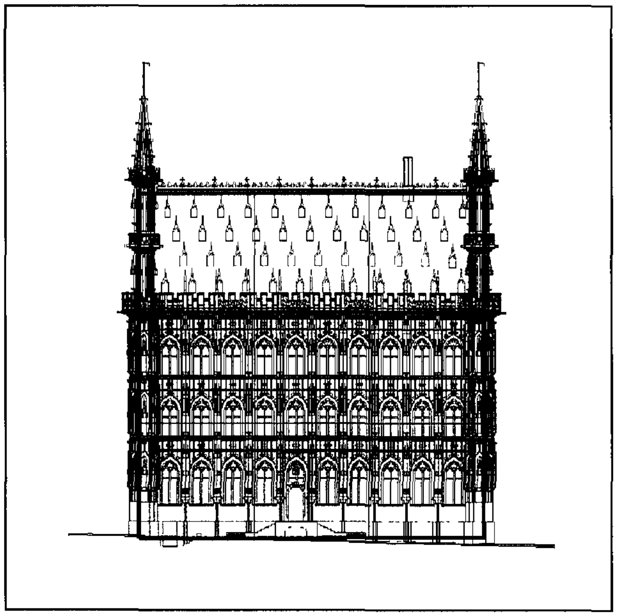


Figure 3: the principle of the contouring square (Leuven)

Issue 3: circle, triangle and square; or the numbers 1, 3 and 4

Not only do the front elevations of the town halls display the contouring square, but often, this square is also embedded in a symbolic construction composed furthermore of a circle and its inscribed equilateral triangle. So we have a composite figure created from a 1-sided, 3-sided and 4-sided polygon. At this point it is interesting to notice that the construction of this figure also gives good approximations for the division of a side of the square into 3rd and 7th parts.

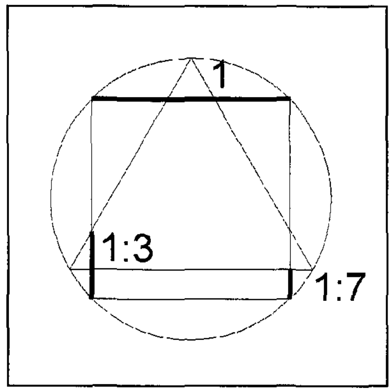


Figure 4: symbolic circle, triangle and square. The fat lines give the exact proportions of 1 to 3 and 1 to 7. The intersections of the square and the triangle are very good approximations of these positions.

The symbolic meaning of this figure could probably be explained by tracing "compagnonesque" knowledge, but by now we may assume already that a medieval verse is stating this kind of construction as follows: *"A point in a circle – And that can be situated in the square and the triangle – Do you know the point? All is for the better – Don't you know it? All is in vain".* [2]
Moreover we find, corresponding with this figure, a number series that is especially confirmed in the design of the town hall at Oudenaarde. The series is as follows: 1 – 3 – 4 – 7 (i.e. 4 + 3) – 12 (i.e. 4 x 3). One Oudenaarde rod is 21 (i.e. 3 x 7) Oudenaarde feet, hence a number game in all of the town hall's composition.
Together with the scheme applied for Oudenaarde, we give a few other significant examples of this design canon in the other buildings. Note that entrance doors often reach until the 1:7 level of the square side, and roof balustrades until the 4:7 or 5:7 level.
In two cases, Oudenaarde and Saint-Quentin, the scheme can be repeated half of the radius of the circle upwards, i.e. putting the base of the second triangle through the center point of the first circle. Doing this we find the position of other cardinal points of the front elevation.
In Brugge, by contrast, the scheme seems to have been repeated half a Brugge rod, or seven Brugge feet, upwards.

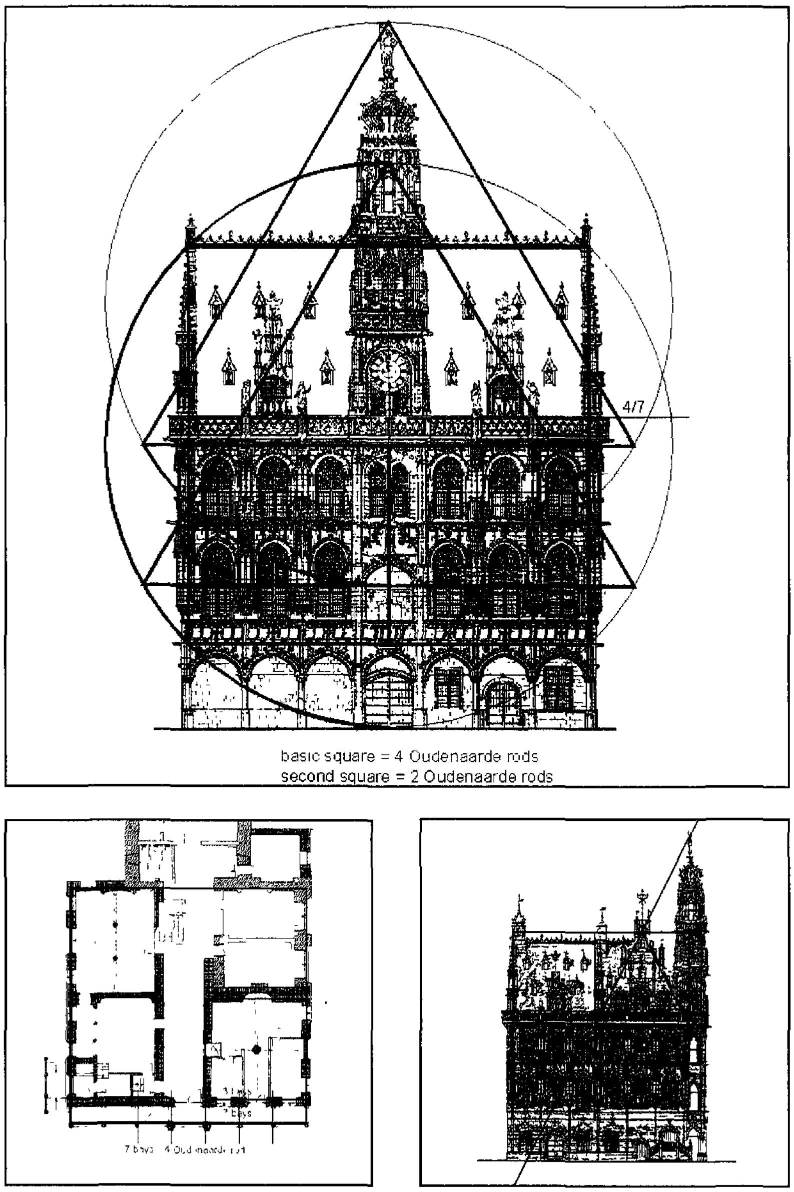


Figure 5: facade composition for Oudenaarde with shifted scheme (R/2), relations between plan & elevation.

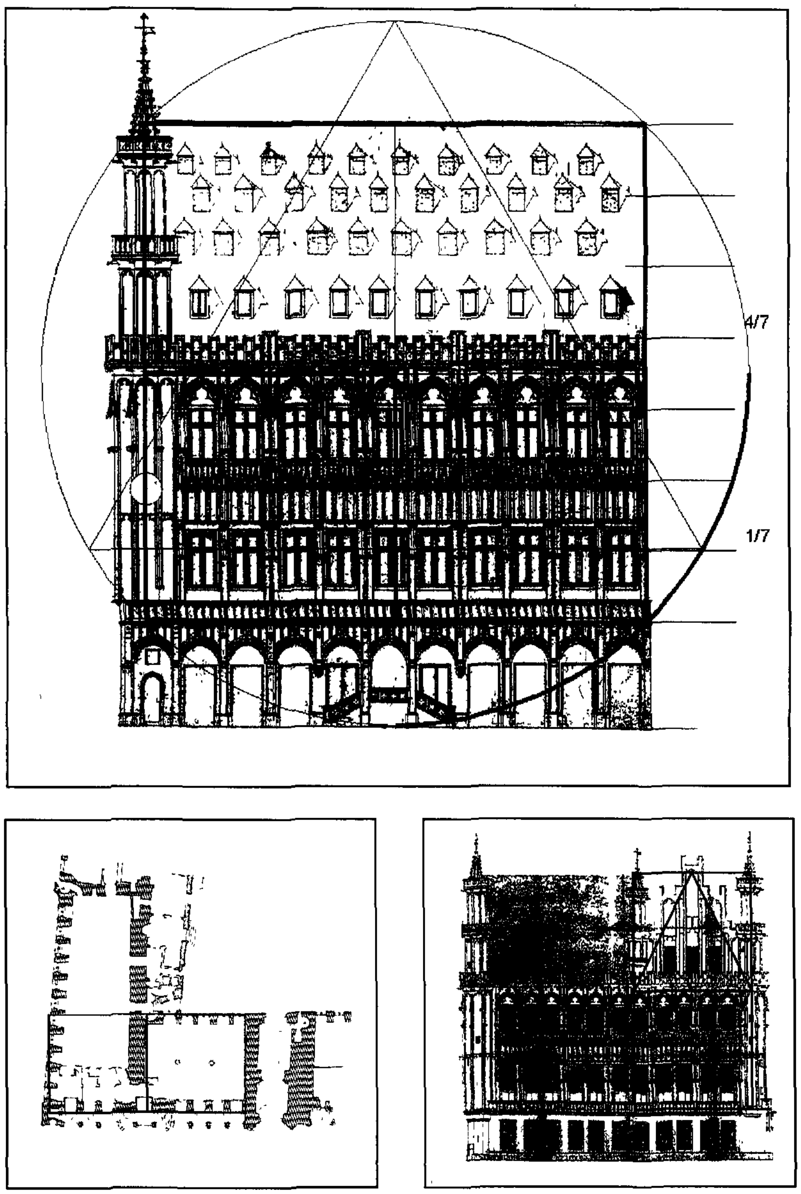


Figure 6: facade composition for Brussel; relations between plan & elevation. Note that for Brussel only the oldest front wing of the building is considered. The more recent half of the building, right of the central gate and tower (not on plan), does not seem to obey to the design system of the first building concept.

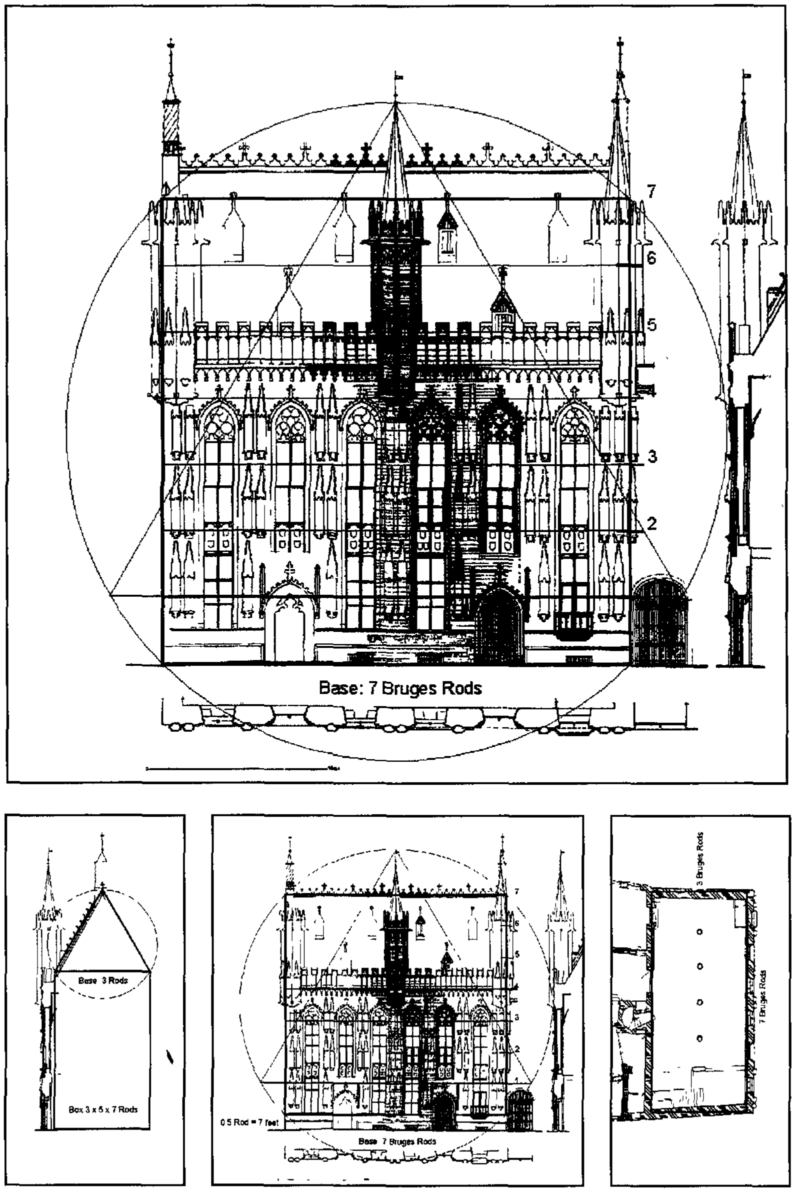


Figure 7: facade composition for Brugge; relations between plan & elevation, shifted scheme (7 feet)

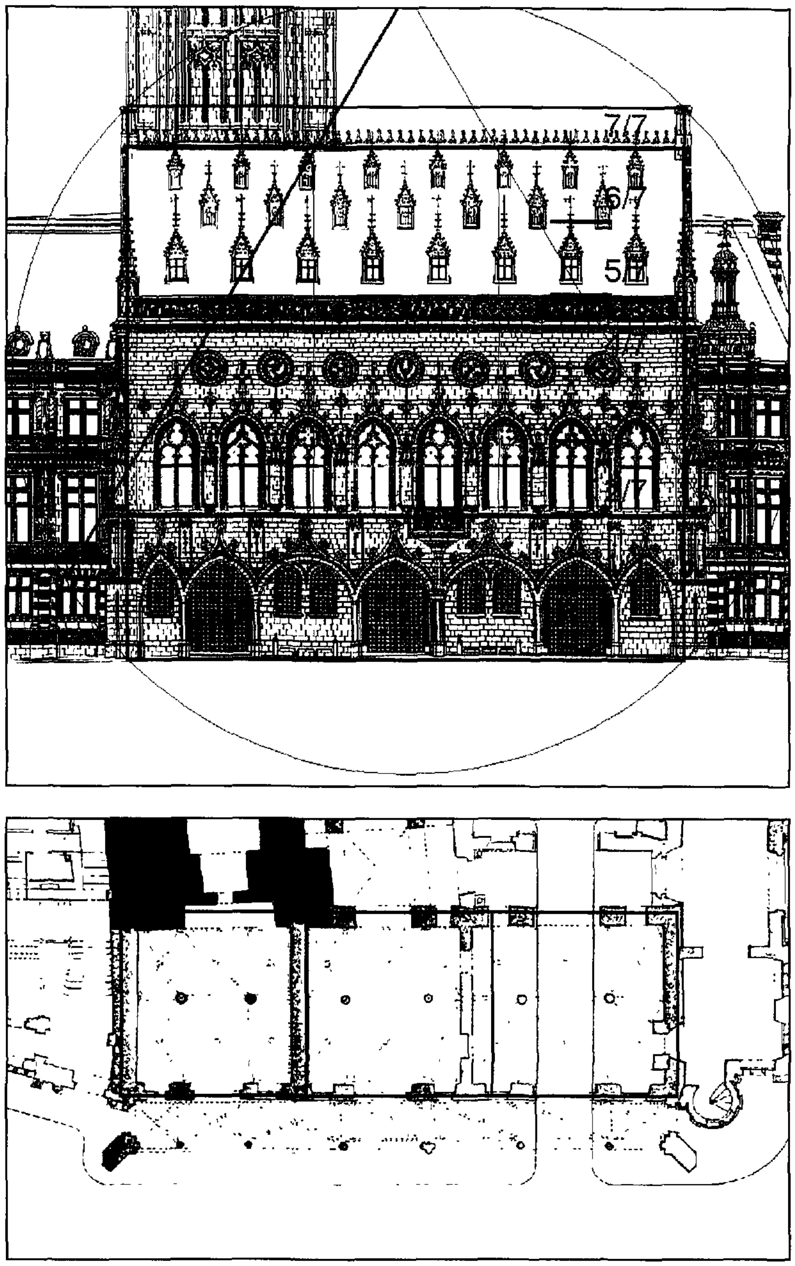


Figure 8: facade composition for Arras; relations between plan & elevation.

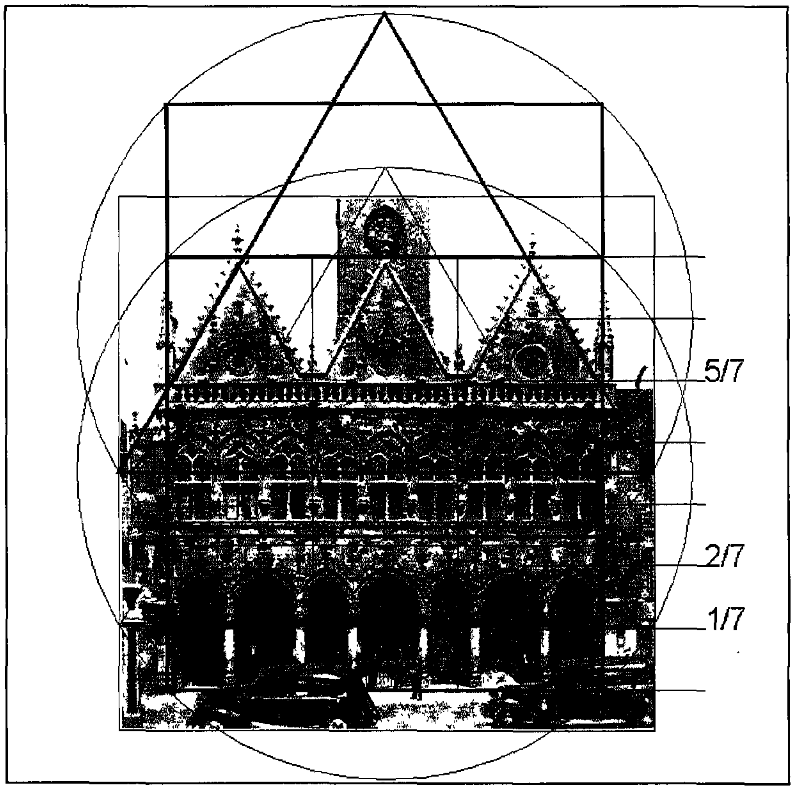


Figure 9: facade composition for Saint-Quentin, shifted scheme (R/2).

Some considerations about symmetry.

In our times, we tend to interpret a composition as being symmetrical when it can be perfectly mirrored around an axis or a point. Through the research, it can be illustrated that the concept of compositional symmetry had a different interpretation in the Middle Ages. Often, the design of a building and of its facades is (slightly) asymmetric, due to the program of use, the situation of the building site, or for other reasons. It was not considered a problem that, e.g. the main entrance door did not sit centrally in the front facade. As such, it was at first found strange that a notorious historian of the 16th century, Justus Lipsius, praised the beautiful symmetry of the building: "Magnitudo iusta est, symmetria bellissima" [3].
Denes Nagy has pointed out that we indeed should refer in this case to a different meaning of the word symmetry, which lasted until the 17th-18th century. It goes back to the ancient Greek concept of symmetria, which refers to "commensurability" and stands

for the correspondence between the part and the whole, for the common measure between the different parts of the composition and their relation to the whole.
It is moreover very significant that the main facades of some town halls were modified in the 18th century, to obtain the "new" kind of symmetry. In Leuven, one front door was added beside the existing one, and in Bruges one of the two existing doors was moved, in both cases to obtain a strictly axial symmetry.
But as mentioned higher, we should consider a different approach for the medieval building master. A look back to the ground plans of Bruges, Brussels and Veere indicates already the ease with which these plans were adapted to the particularities of the building site.
In the facades at Leuven, we find a particular game of "asymmetry" as well, for example in the series of balustrade motives (figure 10), or in the east gable facade. In the last case, a stair tower imposes a subtle shift of the axial positions of different building elements. However, these translations are combined in such way that a very balanced overall composition is obtained (figure 11).

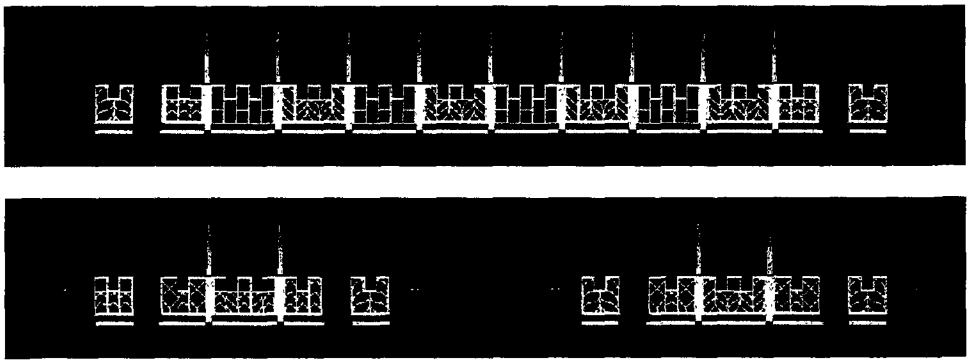


Figure 10: roof balustrades of the town hall in Leuven

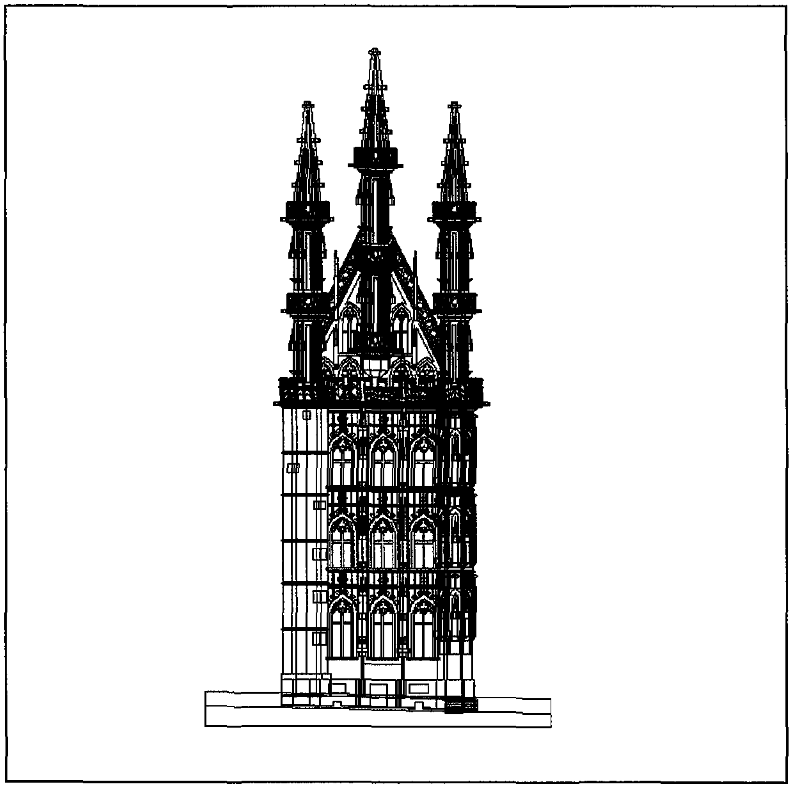


Figure 11: east elevation of the town hall in Leuven. Note the asymmetry, caused by the lower left tower drum, provoking eccentric positions of the gable and the corner towers as well.

A final note on medieval measurement units

Considering the different measurement systems that were in use in the towns (each Flemish town had its own privileges, jurisdiction, and even measurement units), Leslie Greenhill has suggested that those units would probably be re-combinations or re-interpretations of ancient measurements.

For the Leuven rod, which is known to be 5.7102 meters, he considers that this length corresponds with 225 inches in the British Imperial system. 5.7102 meters at 39.37 inches a meter brings us indeed to 224.8121 inches, which gives a deviation of only 0.1% from the 'symbolic' 225 inches. That measure should be seen as 15 x 15 inches, or as 6.25 (2.5 squared) yards. Square or cube numbers tend indeed to indicate

symbolic design. The British system is on its turn based on older, antique measurement units, but this last issue is still under investigation.
The appearing of the number 225 is especially interesting in relation to antique design, as e.g. the Parthenon in Athens is known to exhibit the 225:100 proportion (length to breadth of the top of the stylobate). This ratio is often expressed as 9:4. But the use of the number 225 occurs also in other places, and would further go back to Egyptian times.
Here we probably come on the track of the building lodges of the "free masons", which have their roots in antiquity as well. We may mention the Greek Pythagorian brotherhoods, with their three degrees of initiation, as forefathers of the medieval companions. A consistent body of knowledge that was transferred through the centuries is the most probable assumption to start from when we want to further investigate this subject.

References

[1] *Shelby, L.R.,* Gothic design techniques – the fifteenth-century design booklets of Mathes Roriczer and Hanns Schuttermayer, *Southern Illinois University Press, Carbondale and Edwardsville, 1977, p. 168, citation from "Die Satzungen des Regensburger Steinmetzentages nach dem Tiroler Huttenbuche von 1460", in* Zeitschrift fur Bauwesen, *46 (1896).*

[2] *Ghyka, M.,* Le nombre d'or: rites et rythmes pythagoriciens dans le développement de la civilisation occidentale, *Gallimard, Paris, 1969, p. 72; and also Ballegeer, J.,* Stadhuis Brugge, *De Gulden Engel, Wommelgem, 1987, p. 20*

[3] *Justus Lipsius,* Lovanium: sive opidi et academiae eius descriptio. Libri tres, *Antwerp, 1605, p. 88 (2nd edition, Antwerp, 1610, p. 90).*