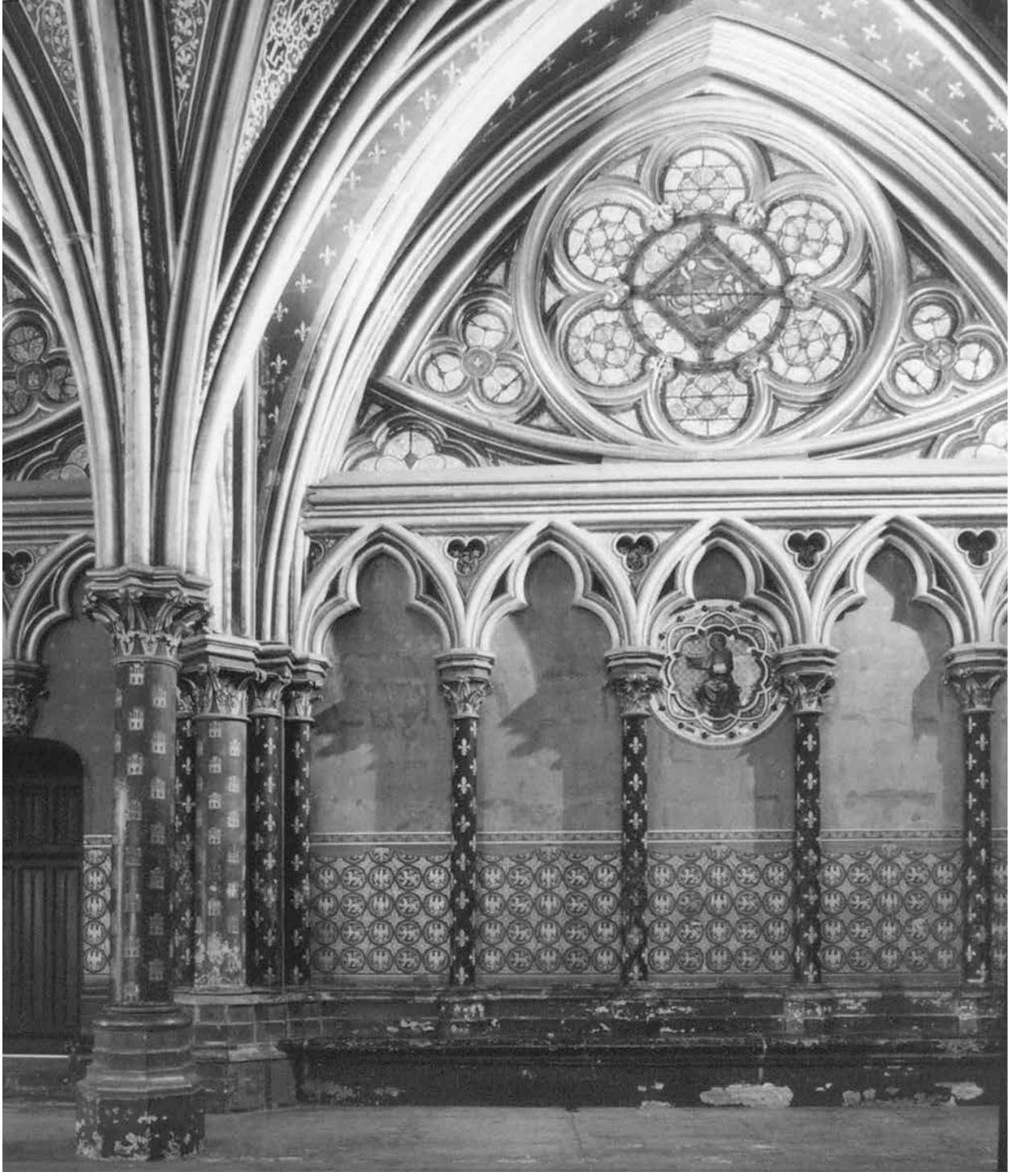
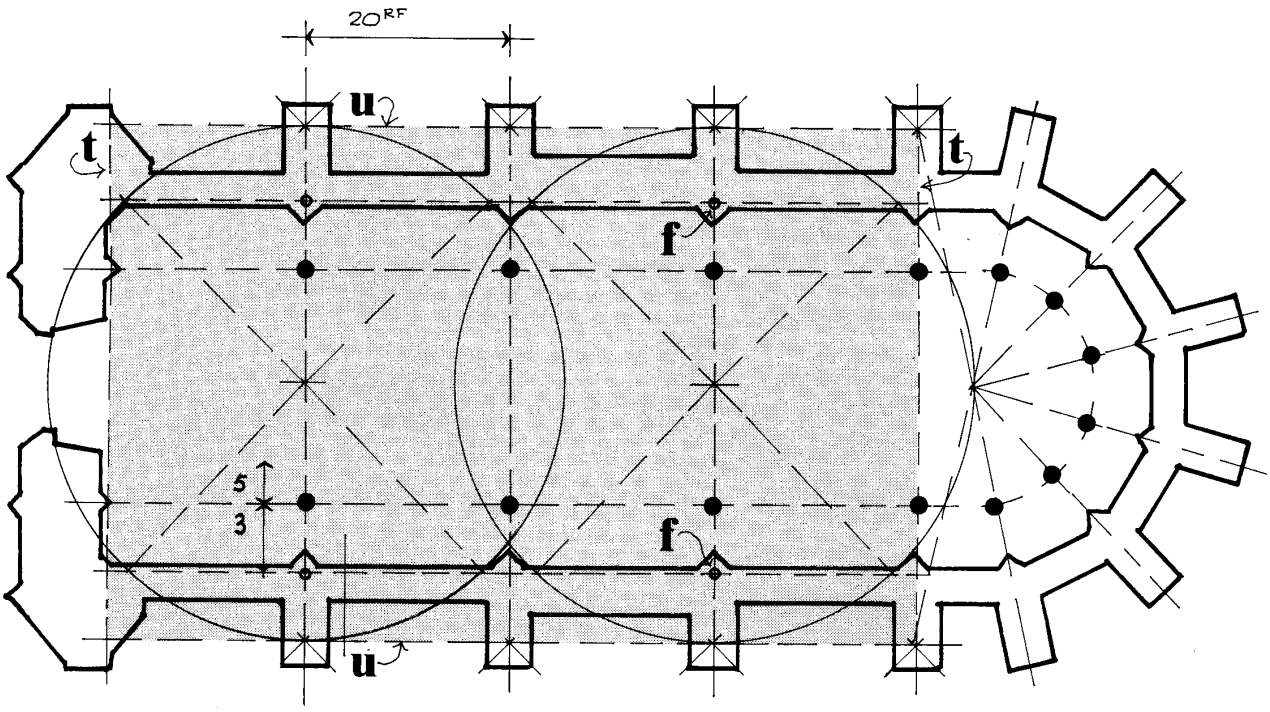


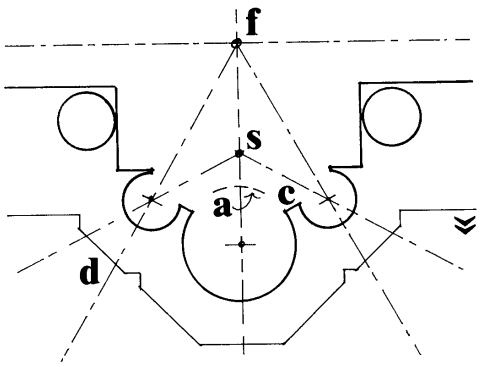
The geometry of La Sainte-Chapelle

Extracted from *The Template-makers of the Paris Basin*

La Sainte-Chapelle was probably built between 1239 and 1246, and was paid for from the ample resources of the crown. Robert Branner dated the building from August 1239/ September 1241 to January 1246 when the newly appointed College of Canons moved in. Painting and glazing may have continued into the spring prior to the consecration in April 1246. A specially chosen crew of skilled carvers seems to



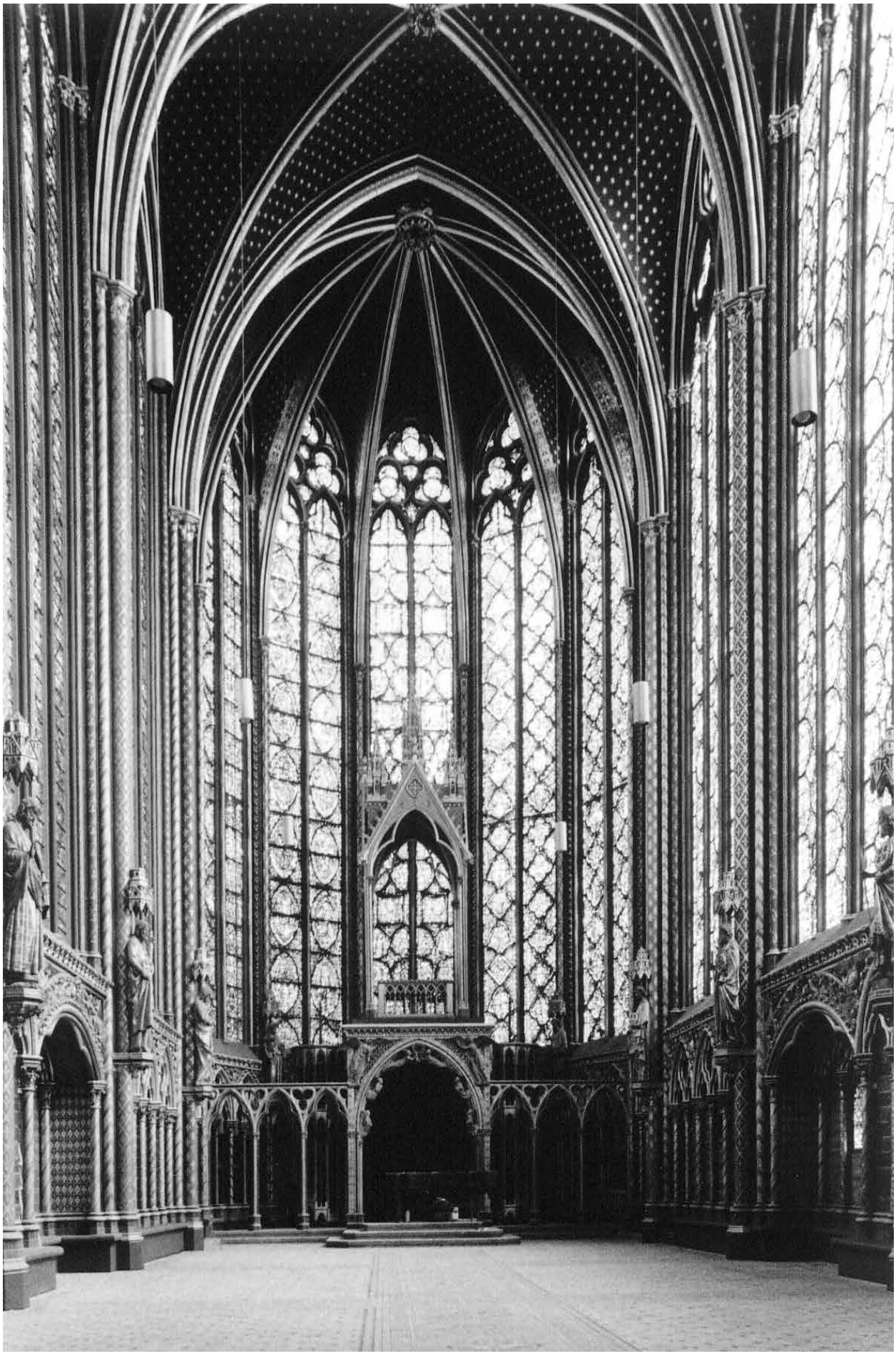
have executed the capitals of the upper chapel that were at the eye-level of the king himself. The different geometries used to set out the two chapels confirms that more than one crew of master masons was involved.



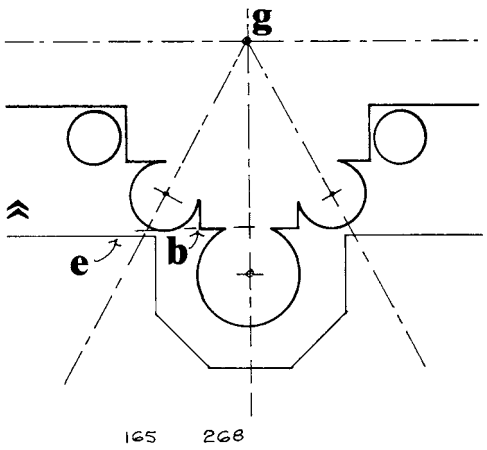
In the lower chapel the axes through the rib shafts meet at "f" in [r1]. The span "f-f" measures 10,610mm and the bay width measures 5,895mm [a]. These form the proportion of 9:5 precisely. The height of the torus mould is one twentieth of this bay, and at 295mm is the length of the Roman foot, and may have been the foot measure of the master in charge.

The axes along the ribs of the 'aisles' locate the second centre "s". The proportion of this smaller span to the bay is 17:10 (which is a whole-number approximation for $\sqrt{3}$) and, in what seems a confirmation of the foot unit, the distance "f-s" is twice the Roman foot. Therefore, the dimensions of the interior divisions of the lower chapel were based on units of the Roman foot, with the bay measuring 20 feet, and the span 36 feet with 32 feet between the "s" centres. This geometry is based on the whole numbers ratios of 5, 8 and 9.

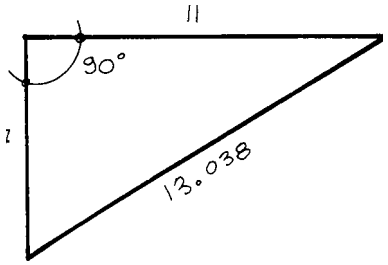
The as-built accuracy of most axial dimensions is ±12mm, and of the elements themselves around ±1mm. The geometry described coincides with the measured dimensions within these tolerances: these tolerances are importance for establishing the veracity of this geometric interpretation.



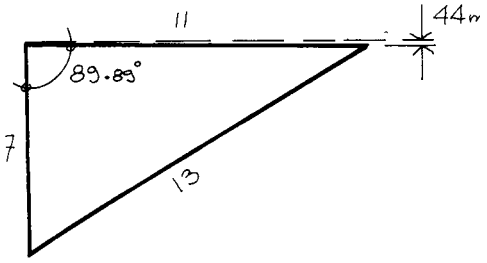
The piers of the upper chapel [r1] are laid out to a different system The "g-g" span is 340mm more than "f-f" in the lower, and forms the proportion with the bay of 3:φ. This cannot be derived from simple subdivisions, but only through a geometric figure. It is not hard to do, but the process is geometric while in the lower chapel the process is mainly numeric.

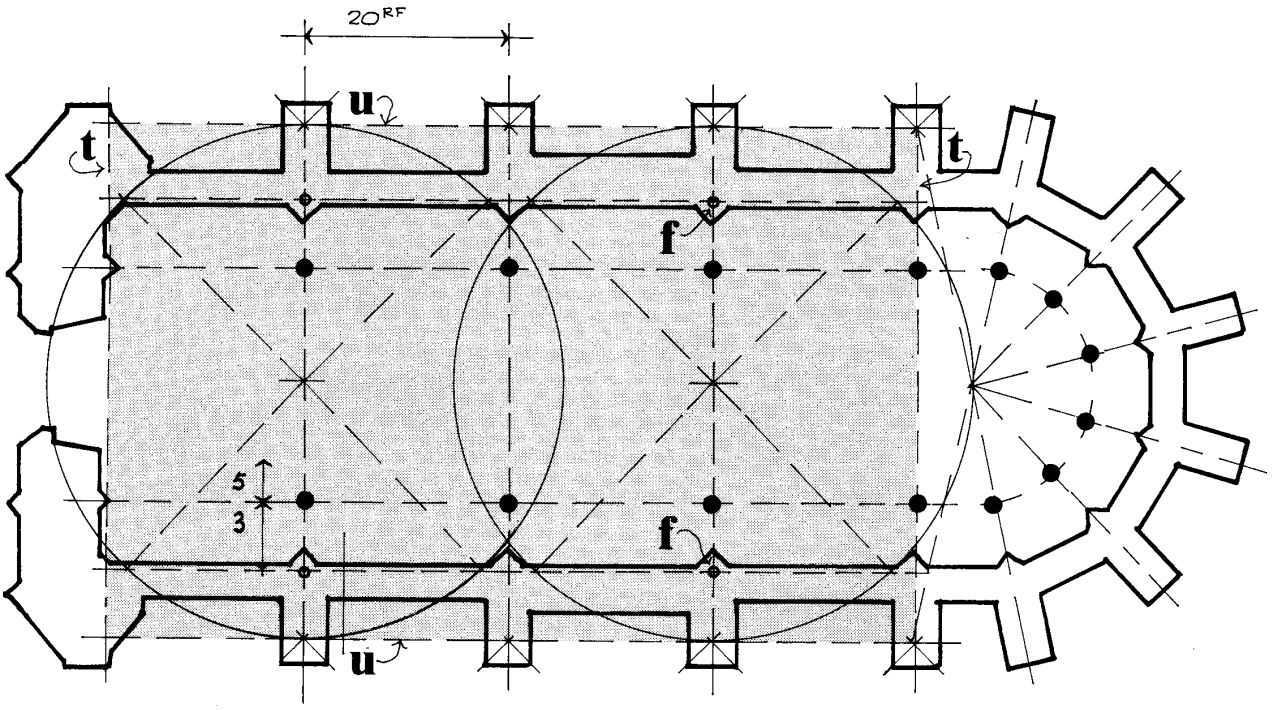


There is one particularly fascinating item in the setting out of the lower chapel. The length of all four bays "t-t" is 23,580mm while the distance between the buttress epicentres "u-u" measures 15,005mm [b]. These are in the proportion of 7:11. If the shaded rectangle had been established from the right-angle triangle [r2], the hypotenuse would have been proportionally 13.038 to the other sides, just a mite more than 13 meters. If it had been formed from three sides with the whole-number proportions of 7:11:13 in [r3], the resulting triangle would not have had a 90° angle.



In fact, measurement on site shows that the span is slightly smaller at the eastern end of the chapel, by 48mm. This is almost exactly the calculated divergence over the length of the chapel if the diagonal had been made from 13 units, rather than 13.038. The small difference shows the importance of the miniscule if we are not to end up with erroneous conclusions. The plan therefore seems to have been laid out from the three primes of 7, 11 and 13, and as the walls converge towards the east, the triangles were set out from





the western end, so that the dimensions of the apse do not relate directly to the modules used in setting out the nave.

The symbolic use of 7 is more obvious than 11 or 13, but one explanation may be that multiplied they come to 1001, which is MI in Roman numerals. Was this intended to represent the third note in the musical scale? Vivian Paul believes the use of similar 7:11 proportions in the geometric figure incised onto the roof at Narbonne stems from a half π. This ratio at the Sainte-Chapelle stems from the 7:11:13 triangle in which this ratio for π may be implied, without having been the originator of the figure. The connections between the master of the lower chapel and Clermont-Ferrand, and the family connections between the architects of Clermont-Ferrand and Narbonne make the use of this ratio in both buildings somewhat intriguing, for it suggests a geometric modality passed on in the team from father to son.

When one considers the different way these items have been handled in the two chapels, it is clear that not one of the templates issued for the lower chapel was similar to any made for the upper chapel. If one master had been in charge of both levels and only wanted to make the upper chapel more decorative than the lower, why did he use different dimensions upstairs, why alter the techniques used to derive the plans for the wall shafts and, finally, why make the upstairs profiles simpler than the downstairs? I can conclude only that the carving of each dado was under the direction of a different master. Whether we examine the setting out, the shafts, ribs or capitals, it is hard to find more than superficial similarities between them.

Thus, the master of the upper chapel followed the master of the lower only in the major forms of the building on which his work had to sit, those being the overall shape, the buttresses and the location of the stairs. The minor similarities are no more than may be found in many contemporary buildings, and do not detract from the possibility of a master plan prepared at the beginning and approved by the client.