On the origin of patterning in movable Latin type : Renaissance standardisation, systematisation, and unitisation of textura and roman type

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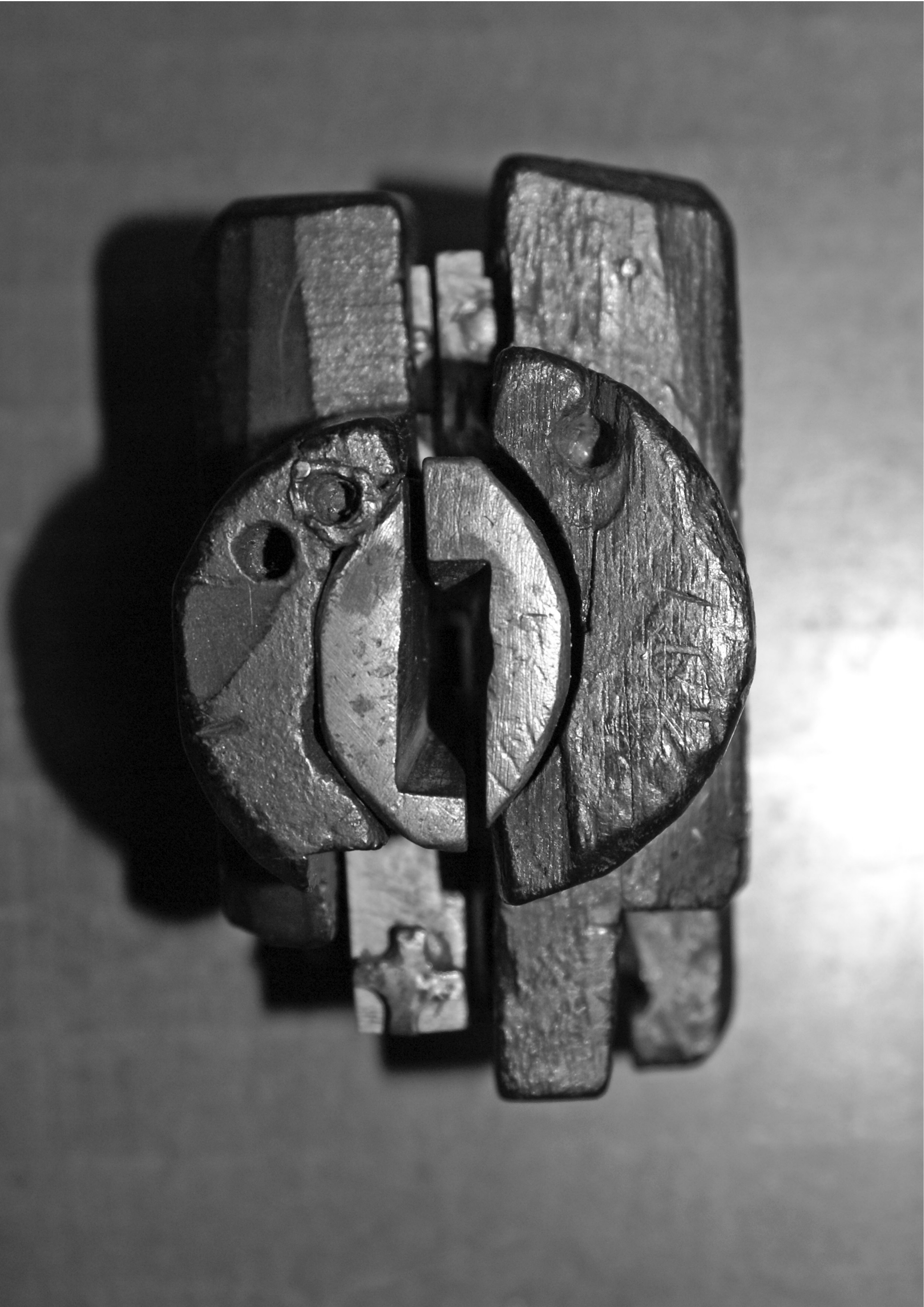
Issue Date: 2016-10-11



CHAPTER 8

The last few chapters discussed the evidence supporting the use of width unitisation in Renaissance font production, and thus the horizontal standardisation of the Humanistic minuscule to the roman type production process in a process analogous to the standardisation of textura hand to textura type production. This chapter will discuss the possible standardisation of vertical proportions in Renaissance type and investigate these in relation to the horizontal standardisation as the last argument to support the hypothesis. To this end dynamic frameworks that may have been used will be presented. Then, as was done with the unit-arrangement system in Chapter 5, the use of the framework will be distilled from historical prints.

My geometric reconstructions of the archetypal models from Jenson and his peers presented in this chapter are not meant to indicate that the early punchcutters above all looked for 'ideal' proportions such as the golden ratio. Geometric patterning was required to control proportions within a prefixed body: the height of the aperture of the mould, which equals the height of the body, was the constraining factor. By defining the proportional relationship between roman and gothic type, the size of the letter parts within a certain mould could be preset, hence preventing an experimental process for every body size.

The fact that the archetypal models are considered optically appealing can be explained by the fact that the golden ratio can be traced in the proportions. However, the question is whether these proportions are purely the result of visual preferences that can be captured in golden section rectangles, or whether they are the result of moulding letters into a geometric framework adapted to both the technical constraints of the Renaissance type production and optical preferences.

8.1 Geometry and roman type

Before introducing my dynamic framework model for the translation of horizontal proportions of roman type to vertical ones, a discussion of the importance of geometry in the Renaissance, on which the model relies, is necessary. The present discussion aims to illustrate the widespread use of geometry in the time of the first punchcutters, and thus to demonstrate the likelihood that they would have encountered it.

How plausible is it that Renaissance punchcutters deliberately applied geometric systems? It is at least likely that goldsmiths were familiar with geometry. Richard A. Goldthwaite writes in *The Building of Renaissance Florence: An Economic and Social History* that goldsmiths knew how to make drawings and that they possessed a working knowledge of geometry. For that reason, building patrons also turned to goldsmiths for architectural ideas.[197] Many of the early punchcutters, such as Gutenberg, Griffo, Garamont, and Granjon, were in fact goldsmiths.

Geometry was commonly applied in the fine arts and the architecture of the Renaissance. For example the painter Pierro della Francesca (ca.1415–1492) was not only an artist, but also a mathematician and geometer. Therefore, he used geometrically based constructions for the layout of his paintings. The mathematician Luca Pacioli applied his theories on geometry in his *De divina proportione*. Geometry was also used during the Renaissance for reconstructing the Roman imperial capitals, as can be seen in the aforenamed publication by Pacioli. His contempories, such as Feliciano and later Albrecht Dürer, also reconstructed the Roman imperial capitals using compass and ruler. Morison writes about this in *Early Italian Writing-Books*: 'The geometrical construction of letters was a branch of the renaissance preoccupation with the revival of the classical canons […]; as such its theory might engage the dilettante as well as its practice the craftsman.'[198]

The Renaissance attempts by scholars and artists to reconstruct the Roman imperial capitals have always been considered to be independent from the Renaissance type production. Morison clearly excluded the possibility of the application of geometry in the early roman type. He was convinced of the ruling of the punchcutter's eyes: 'Having learned and memorised the true proportions of roman letter as taught in the manuals of Moille, Pacioli and others, the goldsmiths, punch-cutters and printers relied on their eyes and not upon their measuring tools.'[199] However, there are no records by the early punchcutters preserved, and Morison does not seem to have provided documented support in his publications for this statement. Although Morison's statement that the punchcutters purely relied on their eyes seems to be no more than an assumption, it is generally embraced within the world of type. Historians connect the attempts to reconstruct the Roman imperial capitals by Renaissance artists and scholars with

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[197] Richard A. Goldthwaite, *The Building of Renaissance Florence: An Economic and Social History* (Baltimore/London: The John Hopkins University Press, 1982), p.358.

[198] Stanley Morison, *Early Italian Writing-Books: Renaissance to Baroque* (Verona/London: Edizioni Valdonega/The British Library, 1990), p.45.

[199] Morison, *Pacioli's Classic Roman Alphabet*, p.78.

the Romain du Roi, but the application of geometric systems in the work of the Renaissance punchcutters seems to be completely out of the question. Interesting in this context is the remark by Herbert Davis and Harry Carter in the introduction of the 1958 reprint of *Mechanick Exercises* that Moxon's account of the whole process of letter-cutting '[...] certainly leaves an impression on the reader that he [...] designed his letters on paper according to the mathematical proportions he sets down [...].'[200]

Whether or not the Romans themselves used geometric constructions as basis for their inscribed imperial capitals is also fodder for discussion. In his 1971 article on Cresci's capitals in *Visible Language*, Anderson described the differences of opinion on the origin of the construction of the Roman imperial capitals between Morison and William Lethaby, the English writer, architect, and designer (1857–1931). Morison followed the epigrapher Emil Hübner in his idea that 'the more elegant inscriptions were drawn or painted with aid of the rule and compass,'[201] whereas Lethaby believed that '[...] most of the great monumental inscriptions were designed in situ by a master writer, and only cut by the mason, the cutting being merely a fixing, as it were, of the writing [...].'[202] It is noteworthy that Morison considers it plausible that the Roman capitals were drawn on paper using measuring tools first, whereas in case of the early punchcutters he excludes the usage of measuring tools.

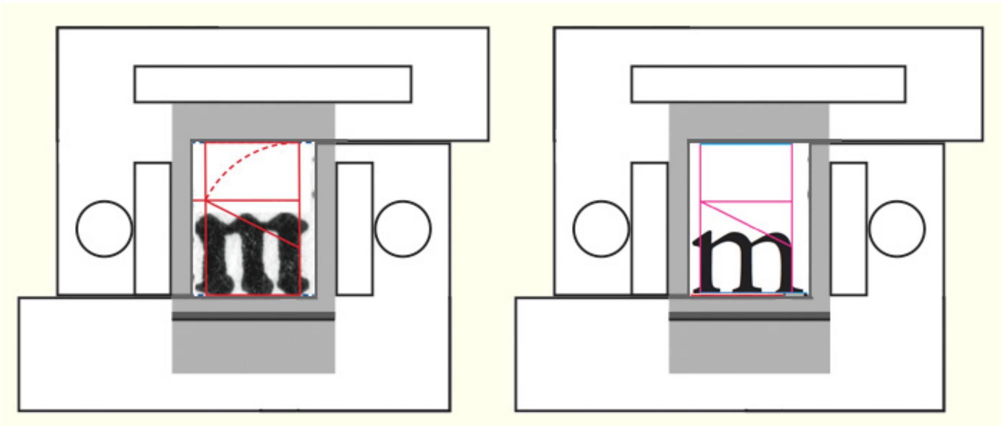

Figure 8.1 Defining the proportions of textura and roman type within a fixed body size.

[200] Moxon, *Mechanick Exercises*, p.xxxvii.
[201] Donald M. Anderson, 'Cresci and His Alphabets', *Visible Language*, Volume v, Number 4 (Cleveland: the Journal, 1971), pp.331–352 (p.346).
[202] Ibid. p.345.

The fact that Gutenberg and Jenson lived in a time in which the application of geometry and the search for divine proportions were warp and weft makes it plausible that they investigated geometric ways to standardise type and that they looked at geometric constructions such as the golden ratio. Gutenberg and Jenson had –one way or another– to set the vertical proportions of the letter parts within a prefixed body: the mould was defining the borders and by controlling the relation between roman and gothic type, the outcomes (x-height, X-height, lengths of ascenders/descenders) on a certain body size could be made predictable (Figure 8.1).

Such a standardisation is useful if one is making type for the first time in history. Of course, one could try to do this empirically and determine the proportions by trial and error, but setting proportions before punchcutting makes the process more controllable and reproducible. In theory a geometric framework for defining the vertical proportions of letter parts had to be made for every body size only once; as soon as the proportions are defined, one can copy these, measurably or optically, without the need for knowledge of the original standardisation. By defining the proportional relationship between roman and gothic type, the size of the letter parts within a certain mould could be preset across different type models. When Gutenberg started producing textura type cross-model standardisation may not have been taken into consideration by him, although it is possible that he was aware of the fact that in Italy the Humanistic minuscule had partly replaced textura handwriting. However, Jenson was from 1458 to 1461 in Mainz to study printing and typefounding before he established his printing firm in Venice.[203] Although Jenson became famous because of his roman type, he cut and applied more gothic type.[204] Cross-model standardisation must have made it easier for Jenson to cut and cast his roman type: he did not have to start from scratch.

The application of the 'divine proportion' in the frameworks presented in this chapter raises the question whether the type was adjusted to it, or whether the golden ratio approximated the proportions they already had in mind. In any case the early punchcutters had to balance technical constraints with visual preferences. One could argue that the fact that the proportions of early type can be

[203] Kapr, *Johannes Gutenberg*, p.252.

[204] Martin Davies, *Aldus Manutius, Printer and Publisher of Renaissance Venice* (London: The British Library, 1995), p.8, and Stanley Morison, *Type Designs of the Past and Present* (London: The Fleuron, 1926), p.15.

captured in geometric models does not necessarily imply that such models were applied. On the other hand, the usage of frameworks for fixing vertical proportions in relation with horizontal proportions is in line with the horizontal standardisation and unitisation I measured and distilled from textura and roman type –especially if it can be proven that the same frameworks can be used for defining the vertical proportions for both textura and roman type. After all, both type models were jointly produced by Renaissance punchcutters.

Having discussed the role of geometry in the context of the Renaissance punchcutters, the next sections will focus on the use of geometry to standardise the proportions of textura and roman type. The application of geometric constructions in Renaissance (applied) arts is further discussed in Appendix 7, *Geometry in the Renaissance.*

8.2 Width-height relationship

For movable type, letters have to be placed on rectangles. The height of such a rectangle (body size) is defined by the lengths of the ascenders and descenders plus some additional height. The latter is required in order to keep some distance between the extremes of the ascenders and descenders and the edges of the rectangles. One option to define such a rectangle would be to do so by eye. This would result in trial and error. Fixed proportions cannot automatically be applied on other type that is morphologically related. For instance, the relatively small counters in textura type require shorter ascenders and descenders than the larger counters in roman type. Defining the proportions by the eye would also not be the most convenient option for scaling type to other body sizes. It is possible that Gutenberg started with defining the size of his textura type empirically. It is also possible that Jenson did the same. However, the possibility cannot be excluded that Jenson related the body size of his type to Gutenberg's.

Horizontally standardised letter proportions result in equally systematised widths of matrices, and this makes the use of standardised copper bars possible. If the horizontal-vertical relationship could be captured in a (geometric) model, then would it even be possible to standardise the relation between character width and body size across different models of gothic and roman type? Such a standardisation within the rectangle is irrespective of whether the actual body size was defined as part of the units of measurement in use in Europe during the Renaissance and in later times, such as the foot, the inch, the cubit, the pace, the thumb, etcetera. This section discusses the possibility that a system related to the horizontal standardisation of character widths discussed in the previous chapters was used to standardise heights in roman type production.

As was described in the previous chapter, the horizontal proportions of Renaissance roman type were based on the n because this letter shows the stem interval perfectly, and the latter can easily be divided into units. For standardising vertical dimensions it would make sense to link these dimensions to the horizontal ones, since the width of characters is inseparably connected to the lengths of ascenders and descenders, and also to the height of the capitals. In both textura and archetypal roman type the m was a repetition of the n. In Fournier's time, and probably also in earlier times, the m was used for defining a pattern for the fitting of the other letters. Furthermore, the height of the capitals seems to be related to the width of the m. Might it then be possible that the m initially formed the basis for defining the body as well?

There is some evidence to indicate that the Renaissance punchcutters used such a system for the production of both textura and roman type. For example, if we look at Jenson's capitals in print, then their heights and widths both appear to be related to the proportions of the m (Figure 8.2). In his type the counters of the m are identical to the ones in the n. In the image, a fence of n's is used at the bottom to show the relationship between the width and the height of the capital N. To the left of the capital is a rotated m built out of two n's. This illustrates the fact that the height of the N equals its width (without the serifs).

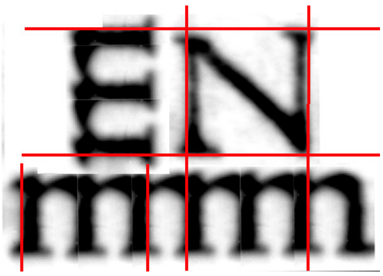

Figure 8.2 The relation between the height and width of Jenson's capitals and the width of the n.

This is a fairly crude image, but examining the relationship between the m and the height of the H (which has the same height as the N) of Adobe Jenson results in related proportions (Figure 8.3). There is a clear difference to Figure 8.2, because a serif of the m is added here to reach the height of the H. Nevertheless, the horizontal unitisation seems to prove that the proportions of the serifs are part of the grid, and hence such a grid could also work in a vertical direction. This is further described in Section 8.6.

Figure 8.3 The relation between the capital height and the width of the m in Adobe Jenson.

There is no documentation from the early days of typography that proves that standardised structures were used to calculate the vertical proportions. If such standardisations were applied during the Renaissance, then evidence has to be distilled from historic prints and from the measuring of matrices. The question is how this can be measured and mapped. What geometric models could have been applied by Renaissance punchcutters to create a flexible, dynamic rectangle for the body size, which is applicable to both gothic and roman type? The following section begins to answer this question by introducing a standardised framework that I distilled from historic prints.

8.3 Standardised proportions in textura and roman type

Before examining the proportions in roman type, it is logical to start with textura type if roman type was produced on the structure of textura type, as I hypothesise. If a framework can be distilled from textura type, it is likely that the same framework can be observed in roman type. To determine whether a standardised construction could be traced in Gutenberg's type, I measured the textura type from his 42-line Bible from 1455. This was simply a matter of trial and error, because I had no idea what kind of structure could have been used. I applied several root rectangles and the related golden section rectangle using the m as the basis for a square.[205] This approach was based on the idea that horizontal proportions formed the basis for the vertical ones. At the end of my investigation I

[205] Root rectangles are rectangles of which the long side equals the diagonal of a square made out of the short side. The ratio of the longer side to the shorter side of a root rectangle is the square root of an integer: √2, √3, etc. See also: <http://www.heamedia.com/Documents/Geometry/A_Closer_Look_at_Root_Rectangles.html>. The golden section rectangle is constructed in a manner related to that of the root rectangles: in this case the diagonal is not drawn from the corner of the square that is made out of the short side, but from the middle of the short side. The length of the diagonal is added then to point where it originated to define the length of long side of the rectangle. See also: <http://www.cut-the-knot.org/do_you_know/GoldenRatio.shtml>.

could reconstruct the proportions of the body textura type from Gutenberg's 42-line Bible by extending the m to a golden section rectangle. The length of the descenders was defined using a root 2 rectangle (Figure 8.4).

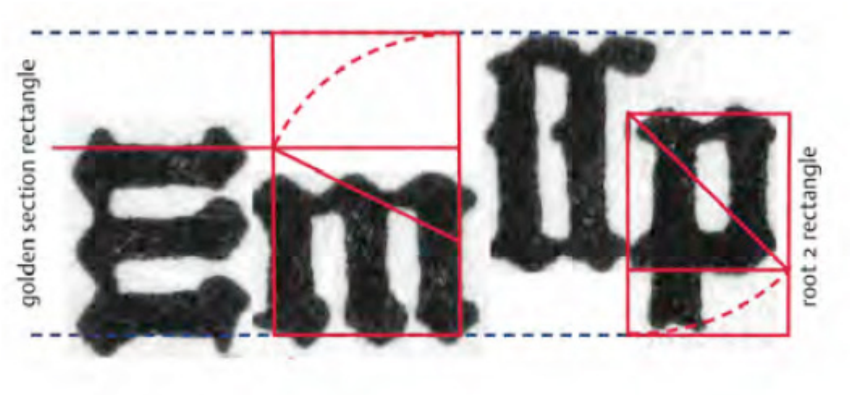

Figure 8.4 Relationship between the proportions of the m and the body size of Gutenberg's textura type from his 42-line Bible.

Assuming that Jenson treated his roman type as a variant of textura type, then it should reveal the same relation between the width of the m and the length of the ascenders and descenders. As Figure 8.5 shows, it does.

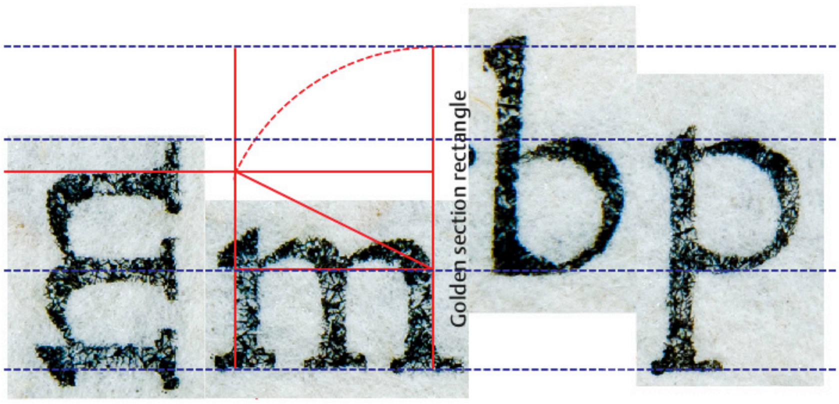

Figure 8.5 Jenson's roman and the extended m-based golden section rectangle.

There is a small deviation noticeable on top of the ascender of the lowercase b: the top serif is a little bit outside the framework. It has to be taken into consideration here that Jenson's roman type is quite small and the x-height is less than two millimetres. Hence, small irregularities in print, but also in the photographs used here, can easily cause such deviations. Figure 8.5 shows that the length of the descenders of Jenson's roman is half the width in between the outside stems of the lowercase m.

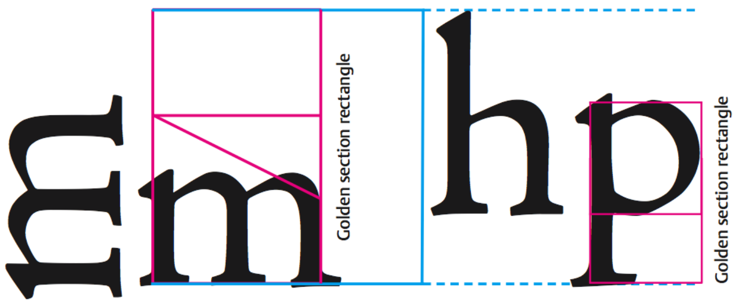

Figure 8.6 Adobe Jenson and the extended em-square.

Most of the proportions of Adobe Jenson are very close to the original model. If a square based on the outside stems of the m of Adobe Jenson is used to calculate a golden section rectangle (the body size), the ascenders and descenders of Adobe Jenson's type fit perfectly into this golden section rectangle. If a square based on the x-height is subsequently made and extended to a golden section rectangle, then the proportions of the descenders can also be determined. The rest of the space is then used for the ascender. Obviously the lengths of the descenders of Adobe Jenson differ from the original ones as shown in Figure 8.5. This can be explained by the fact that Adobe Jenson is part of a modern type family, which contains bold variants (Figure 8,7). Because the x-height of a bold version of roman type is usually larger than that of the regular weight –to prevent that the bold version will look smaller than the regular– the relationship between the lengths of the descenders and ascenders will change. To anticipate this, type designers will make the ascenders a bit longer than the descenders. Jenson never had to deal with this, because there were no bold variants of roman type in his time.

Figure 8.7 Adobe Jenson regular and bold.

The golden section rectangle used here to define the body size is an extension of the 'm-square' or 'em-square'. This offers some room for speculation: maybe the term 'em' originates from the rotated m (which actually reads like a capital E) in combination with the normally positioned m? This 'em-square' is definitely something else than what is called 'em-square' or 'em' nowadays. It is clear what is meant with ‘em’ but it is unknown what exactly forms the origin for the term. This subject is further discussed in Appendix 6, *Units and grids*.

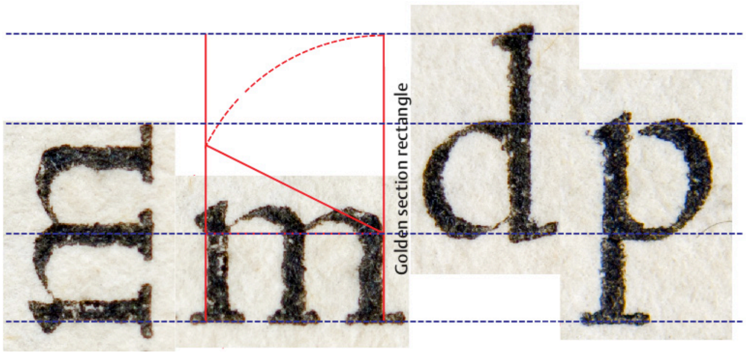

Figure 8.8 The em-square of Griffo’s roman type for De Aetna (1495).

Considering the relation between Jenson’s and Griffo’s roman types, one would expect that the relation between em-square and the length of the ascenders and descenders found in Gutenberg’s and Jenson’s types could also be traced in the types of Griffo. Figure 8.8 shows that this is undoubtedly the case for Griffo’s roman type from 1495, which was applied by Manutius in *De Aetna*. In 1929 The Monotype Corporation faithfully copied the proportions of Griffo’s type and hence the em-square for the production of Monotype Bembo (Figure 8.9).

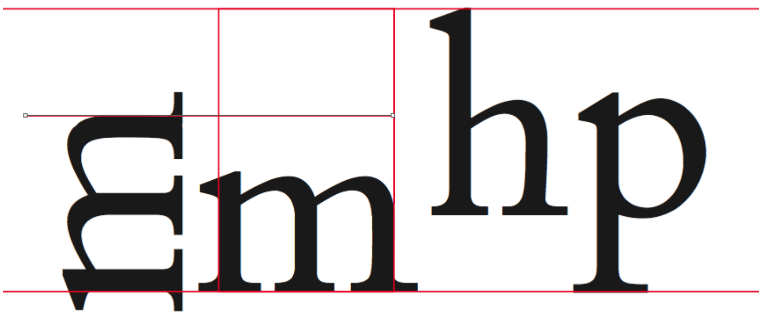

Figure 8.9 The em-square of Monotype’s Bembo (Book weight).

Adobe Garamond, a revival by Slimbach based on Garamont’s Parangon Romain has, not surprisingly, similar proportions (Figure 8.10).

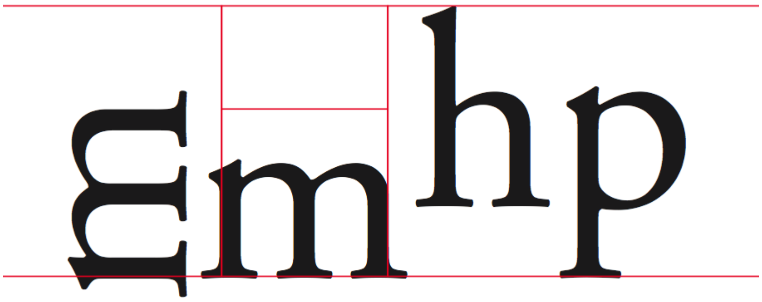

Figure 8.10 The relation between em-square and ascenders/descenders in Adobe Garamond.

Renaissance punchcutters did not need nanotechnology to apply the geometric constructions to their punches, and thus to standardise proportions. The relations between the letter parts could have been drawn and calculated at any size and could then have been translated into a gauge. Furthermore, the sophisticated standardisations I found during my measurements at the Museum Plantin-Moretus in the type and matrices by Garamont, Van den Keere, and Granjon lead me to believe that it is plausible that the Renaissance punchcutters would not have been deterred by technical complications.

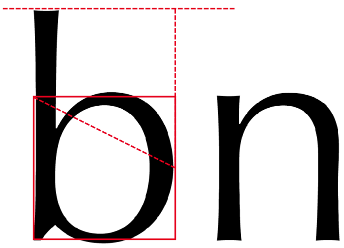

Figure 8.11 Hermann Zapf's Optima is based on the golden ratio.

There is at least one piece of documented evidence of a deliberate application of the golden section on type; but the typeface in question was not designed in the Renaissance but in the 1950s by Hermann Zapf. However, it finds its origin in the fifteenth century: Optima (Figure 8.11) was based on sketches that Zapf made in Italy in 1950 of the Renaissance inscriptions in Florence's Santa Croce.[206] The x-height of Optima forms the square on which the golden rectangles that mark the length of the ascenders and descenders are based.[207]

[206] Hermann Zapf, *Alphabetgeschichten : eine Chronik technischer Entwicklungen* (Bad Homburg/Rochester: Mergenthaler Edition, Linotype GmbH/RIT Cary Graphic Arts Press, 2007), p.43.
[207] Lawson, *Anatomy of a Typeface*, p.329.

In spite of the lack of documented evidence, the appearance of the geometric constructions distilled from historic prints in this section suggests that the Renaissance punchcutters used a framework to standardise the proportions of roman type. The next section discusses the versatility of such a framework by investigating its dynamic aspect.

8.4 The dynamic em-square model

The hierarchical relation between the size of the counters and the length of the ascenders and descenders is captured in the geometric em-square model, which I introduced in the previous section. The em-square model is dynamical because changing the width of the m will result in different lengths of the ascenders and descenders. Widening the m results in a relatively smaller x-height and, conversely, condensing the m results in a larger x-height (Figure 8.12). The geometric em-square model is supplementary to the geometric letter model, discussed in Section 3.1, which only maps the horizontal widths.

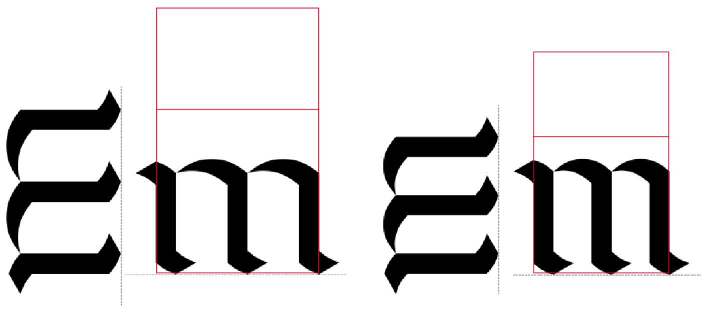

Figure 8.12 A wider m results in relatively smaller x-height; a more condensed m in a relatively larger x-height.

Figure 8.13 shows Adobe Garamond on a dynamic framework. All letter proportions are derived from the widths of the m and n, and the subsequent application of the golden section rectangle. For defining the width of the n-square in Figure 8.13 the h is used because in Garamont's model, and hence in Adobe Garamond, the proportions of the n and the h are identical within the x-height. Additionally the h also shows the length of the ascenders. This dynamic framework works in all directions: changing one of the proportions automatically changes all others too. The resulting proportions can be drawn or calculated at any size and subsequently the outcomes can be transferred, for instance, to a punch.

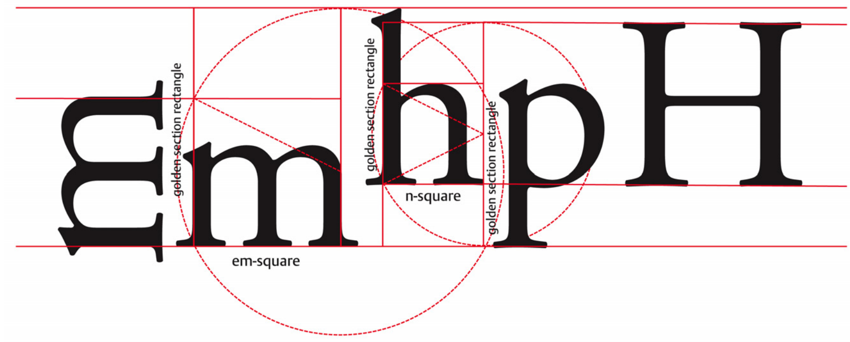

Figure 8.13 Framework for Renaissance type applied on Adobe Garamond.

Such a dynamic framework should cover the space hierarchy. For instance, compression of letters should not only result in shorter ascenders and descenders, but also in the reduced height of the capitals. The framework presented in Figure 8.13 perfectly captures the relationship between lowercase and uppercase letters too.

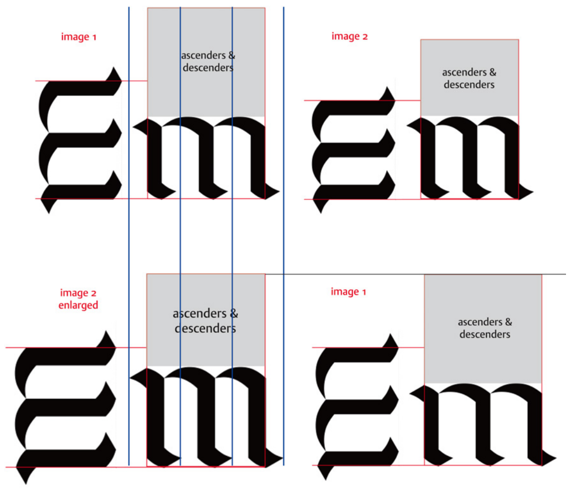

Figure 8.14 Compressed and expanded type sharing widths.

Figure 8.14 illustrates the effect of compression on the relationship between x-height and space remaining for the ascenders and descenders. To obtain the same body size for the compressed m on the right of the top row as for the uncompressed m on the left, the compressed m has to be enlarged. This not only results in a larger x-height and bolder image but also in identical character widths for the uncompressed and compressed m's, as is shown at the bottom row of the figure. The larger x-height of the compressed m results in shorter ascenders and descenders. This is precisely the relationship that textura and roman type reveal at the same body size.

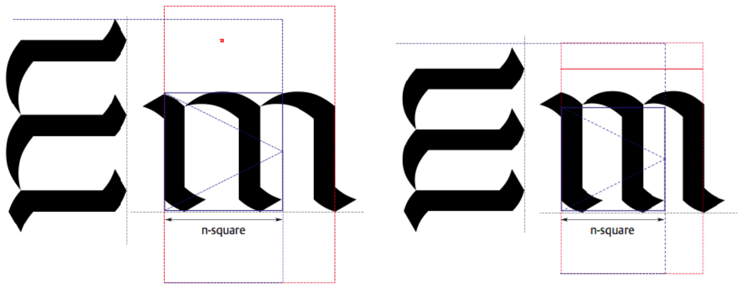

Figure 8.15 A condensed n results in smaller capitals.

If the width of the n is taken as the basis for the 'n-square', as shown in Figure 8.15, the height of the capitals will follow (indicated with blue lines). The fact that on the left the capital height equals the height of the rotated m plus its serif, is purely coincidental. At some point the height of the capitals will equal the length of the descenders, as is shown in the variant on the right. This marks the boundary of the convention for text letters: it is highly unusual that the height of the capitals extends the height of the ascenders.

Having introduced the dynamic em-square model for type proportions, the next section will present further evidence of its use in Renaissance type production by distilling it from Renaissance prints and matrices.

8.5 Distilling evidence of frameworks in Renaissance type

Section 8.3 presented distilled evidence of a dynamic framework in Gutenberg's textura type and Jenson's roman type. In the previous section the relation between the horizontal and vertical proportions of Adobe Garamond, which finds its origin in Garamont's Parangon Romain, was captured in a dynamical framework. The proportions of Garamont's Parangon Romain are closely related to those of Jenson's archetypal model, hence it does not come as a surprise that closely related frameworks can be used to capture the proportions of both types. However, in the French Renaissance the proportions of larger 'display' type deviate from that of the type for text sizes. Some are bolder and more condensed, like textura type, and other variants show relatively large ascenders and descenders. If there was a dynamic framework used for the vertical patterning of type that is related to Jenson's archetypal model, was such a framework also used for type that deviates from the archetypal model, in line with Figure 8.11? This section aims to explore this question.

Figure 8.16 The proportions of Van den Keere's Gros Canon Romain on a dynamic framework.

Van den Keere's Gros Canon Romain from 1573 is shown in Figure 8.16.[208] Applying the em-square, n-square, and related golden section rectangles reveals that the capital E and the descenders fit in this system, but that the ascenders are in fact smaller than the capitals. These are unexpected proportions and result in relatively huge and bold capitals.

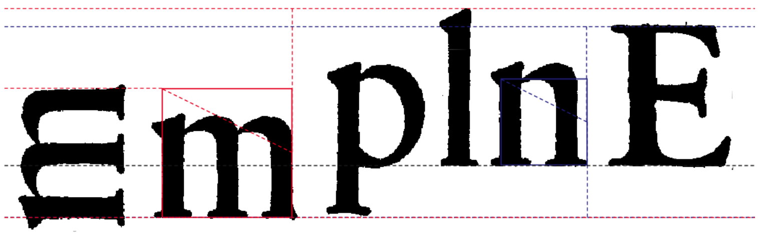

Figure 8.17 Adapted proportions of Van den Keere's Gros Canon Romain.

In Figure 8.17 I adapted the height of the E to the dynamic framework and the result is much more balanced. The unexpected relationship between the height of the ascenders and that of the capitals in Figure 8.16 can be explained by the fact that Van den Keere cut the capitals as a separate font in 1570. These 'Grasses capitales de 3 regles mediane' were combined with the Canon Flamande in 1571 and with the Gras Canon Romain in 1573.[209]

Figure 8.18 shows the 'display' type Double Canon Romain (approx. 45 Didot points) attributed to Guillaume I Le Bé (1525–1598). Le Bé was a French Renaissance punchcutter, trader in matrices, bookseller and paper merchant, who was in his younger years an apprentice to Robert Estienne, in whose house he applied himself to cutting punches for type and the business of typefounding.[210] After working in Venice, Le Bé returned to France in 1550 where he cut a Hebrew type for Garamont. Le Bé's Double Canon Romain shows extremely large

[208] The Gros Canon Romain is also indexed as Canon Romain and Gras Canon Romain (Vervliet, *Sixteenth-Century Printing Types of the Low Countries*, p.230).

[209] Voet, *Inventory of the Plantin-Moretus Museum*, pp.12,13.

[210] Vervliet and Carter, *Type Specimen Facsimiles* 2, p.12.

capitals, of which the height optically exceeds the length of the ascenders. This is clearly a completely different relationship between the x-height of the lowercase and that of the capitals than the one that can be found in Garamont's Parangon Romain.

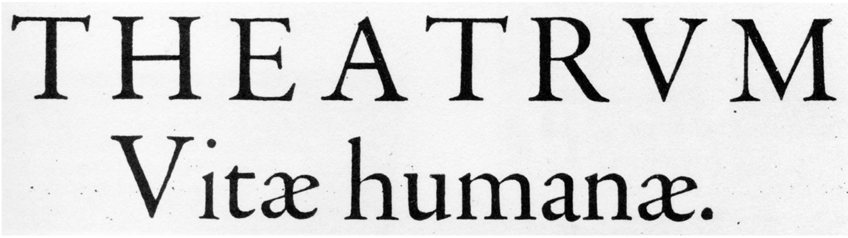

Figure 8.18 Double Canon Romain attributed to Guillaume le Bé the elder.

According to Beatrice Warde (writing under the pseudonym of Paul Beaujon), the 'Estienne face' (a couple of related types for different point sizes) was designed by 'a master with a real knowledge of the mechanics of typecutting.'[211] Although she does not go into detail, according to Warde the proportions are 'much more scientifically effected than by modern typefounders.'[212] I interpret 'scientifically' here as the application of standardisations, such as for instance geometric ones.

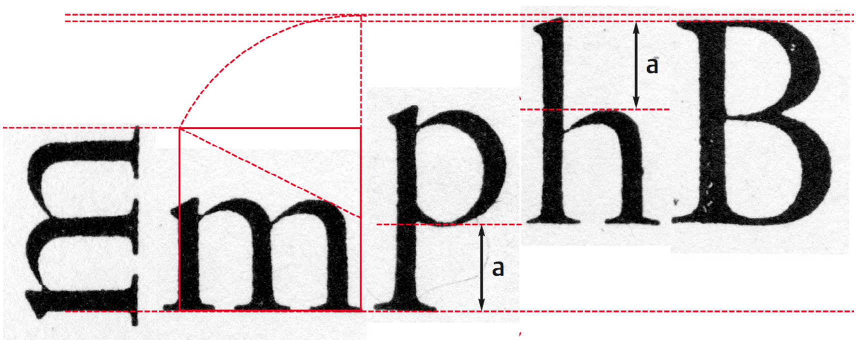

Figure 8.19 Le Bé's Double Canon Romain and the golden section rectangle.

Although the proportions of Le Bé's Double Canon Romain differ from those of Jenson's archetypal model, it is still possible to use a related dynamic framework to explain the relation between x-height, ascenders/descenders and capitals in (Figure 8.19). A small adaptation –the inclusion of the right serif– of the m results in an em-square that fits the lengths of the ascenders and descenders. If the distance from the baseline to the bottom line (the descender of the p) is added to the x-height, then this results in the height of the capitals. This is a simple system

211 Beaujon, 'The "Garamond" Types', p.195.
212 Ibid., p.195.

and hence the relatively more complex application of the n-square for defining the capital height is not required here. The relationship between the horizontal proportions of the lowercase letters and capitals in Renaissance roman type is described in Appendix 8, *Proportions of capitals in roman type*.

Long ascenders and descenders can also be found in Garamont's Gros Canon Romain. A closer look at this type, which appeared for the first time in 1555, reveals that ascenders and descenders are considerably longer than the ones in Le Bé's Double Canon Romain. The proportions of Garamont's large type cannot be explained with the dynamic framework. However, a simpler underlying structure can be observed; the lengths of the ascenders and descenders equal the x-height, as is shown in Figure 8.20.

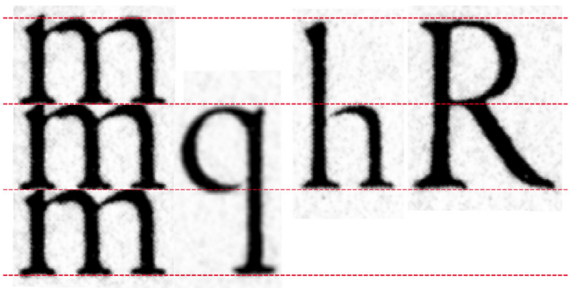

Figure 8.20 Proportional relationships found in Garamont's Gros Canon Romain.

The fact that the body sizes of Renaissance type can be reconstructed using geometric constructions such as the golden ratio could be a remarkable coincidence. However, as I hypothesise in this dissertation, it could also be part of a larger Renaissance scheme to standardise the production of gothic and roman type. For the previous examples I used prints, but would it be possible to distil evidence for such a cross-type standardisation from matrices? Unfortunately there are no matrices or foundry type from Gutenberg or Jenson preserved, but there are French Renaissance matrices from gothic type and roman type in the collection of the Museum Plantin-Moretus. On Wednesday 17 June 2015, together with Hutsebaut, I measured and cast from the matrices (Figure 8.21) of Van den Keere's Gros Canon Romain (1573), which is presented as Canon Romain in the folio specimen from ca.1580, and Van den Keere's Canon d'Espaigne (1574), which is also shown in the aforenamed specimen.

Figure 8.21 Matrices by Van den Keere of the Gros Canon Romain and the Canon d'Espaigne.

When the matrices of both types are compared, it is obvious that their height and thickness are almost identical, as if they were part of the same production process. However, there is a big difference between the sizes of the types. At first sight the Gros Canon Romain and the Canon d'Espaigne do not seem to have much in common. However, the Canon d'Espaigne is a rotunda, which is part of the same morphologic model as textura and roman type, and the Gros Canon Roman is also quite bold and highly condensed.

Vervliet notes on the Canon Romain: 'In the design of this face Van den Keere kept to the regional tradition of bold, fat-faced Romans with a big x-height, comparable for weight with Gothic letters [...].'[213] But could it be that Van den Keere went one step further: that he used an identical pattern for both the Gros Canon Romain and the Canon d'Espaigne and only changed the body size and details?

Figure 8.22 Prints of the Gras Canon Romain (left) and the Gros Canon Flamande compared.

[213] Vervliet, *Sixteenth-Century Printing Types of the Low Countries*, p.230.

At first sight both types have not much in common (Figure 8.22). However, when prints are scaled to the same x-height (Figure 8.23) it becomes clear that the roman and rotunda types were made on exactly the same scheme. They share the same proportions, the same character widths, and the same positioning between the side bearings. This clearly points towards a high degree of standardisation.

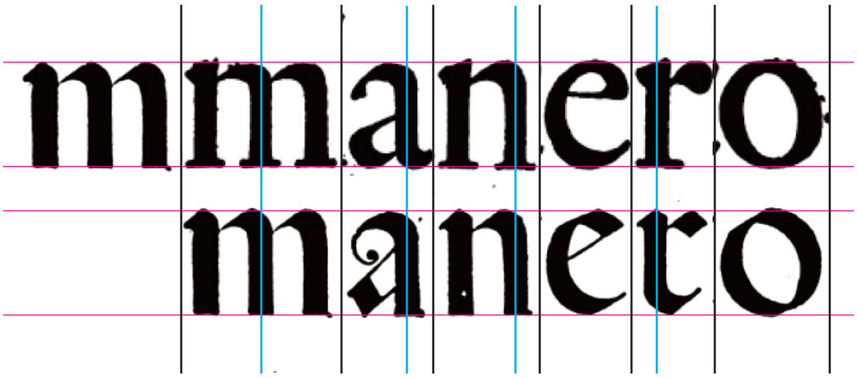

Figure 8.23 Prints of the Gros Canon Romain (top) and the Canon d'Espaigne scaled to the same x-height.

Van den Keere cut the Canon Flamande, which is a textura type, and his 'Grasses capitales de 3 regles mediane' in 1570. Both were combined in Plantin's *Psalterium* from 1571.[214] The body sizes of the Gros Canon Romain and the Canon Flamande are identical. The widths of both m's are also identical and the height of the textura m equals the distance between the stems of the roman m (Figure 8.24).

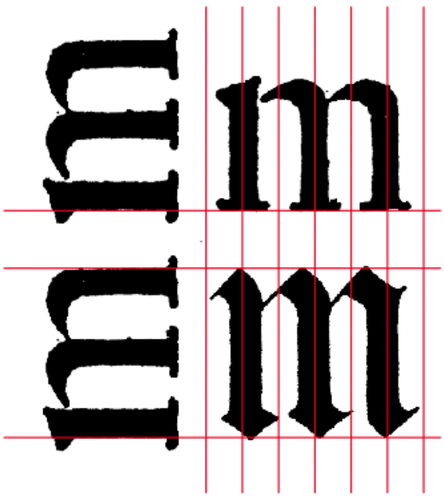

Figure 8.24 Prints of the Gros Canon Romain (top) and the Canon Flamande compared.

[214] Vervliet, *Sixteenth-Century Printing Types of the Low Countries*, p.86.

This section presented further evidence for the fact that the proportions of textura and roman type were in the same way standardised in Renaissance type production. This supports my hypothesis that roman type was the result of the standardisation of the Humanistic minuscule to the Renaissance type production process, in a process analogous to the standardisation of textura hand for textura type production.

8.6 Underlying unitisation in vertical proportions

In the previous two chapters I discussed the horizontal unitisation of Renaissance roman type. If horizontal proportions were used by Gutenberg and Jenson and their successors for defining vertical proportions, is it possible that the same unitisation that can be distilled horizontally can also be distilled vertically? In this section I investigate and illustrate examples of such unitisation using prints of Renaissance type.

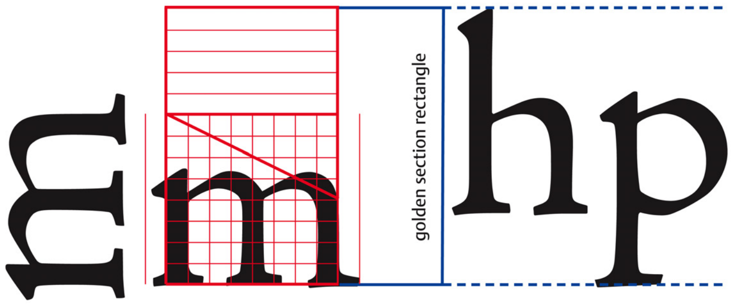

Figure 8.25 Simple unitisation of the em-square.

For the calculation of the body size in Figure 8.25 I used only the distance between the outside stems of the m. One could argue that the whole structure is therefore quite arbitrary. However, the fact that this seems to work for both Gutenberg's textura type and Jenson's and consorts' roman types, as discussed in the previous sections, makes the use of such a framework plausible. The stroke endings of textura are less prominent than the serifs in Jenson's type. That makes it difficult to take the stroke endings into account when defining a standard for the body size that also has to work for roman type.

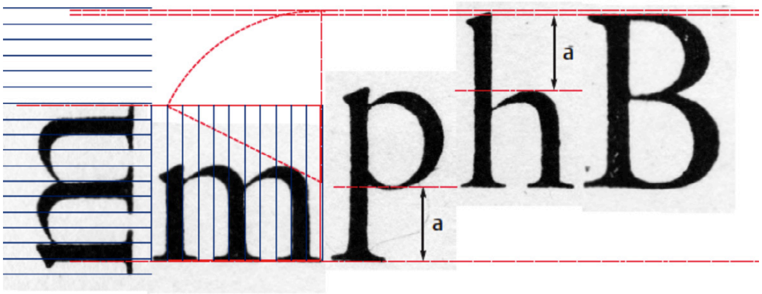

Figure 8.26 Le Bé's Double Canon Romain fits on an enlarged em-square.

On the other hand, the stroke endings of textura type and the serifs of roman type are part of the pattern. Serifs in roman type preserve the stem interval because they function as wedges between the letters and this way preserve equilibrium of white space. The serifs are not additional elements, but rather intrinsic segments of roman type. All elements of archetypal roman type, including the serifs, can be captured in a unit-arrangement system. Such a unit-arrangement system is not meant for defining the space between characters, as discussed in Chapter 5, but for defining the proportions of stems and serifs within the body. As part of a dynamic framework, such a system is versatile because its basis (the em-square) can be enlarged and reduced by adding or subtracting units. Figure 8.26 shows Le Bé's Double Canon Romain on such a grid; in this case the width of the em-square includes both serifs and subsequently results in larger ascenders and descenders.

The body size of the textura and roman-type m in Figure 8.1 equals the distance from ascender to descender, because the body size is defined by the dynamic framework. This body size is in line with Moxon's definition in *Mechanick Exercises*: 'By Body is meant, in Letter-Cutters, Founders and Printers Language, the Side of the Space contained between the Top and Bottom Line of a Long Letter.'[215] Moxon's definition is annotated by Davis and Carter as being 'Not a good definition because letters are often cast on a body larger than it need be. It is the dimension of type determined by the body of the mould in which it was cast (from the punchcutter's point of view: "is intended to be cast").'[216]

[215] Moxon, *Mechanick Exercises*, p.102.
[216] Ibid. p.102.

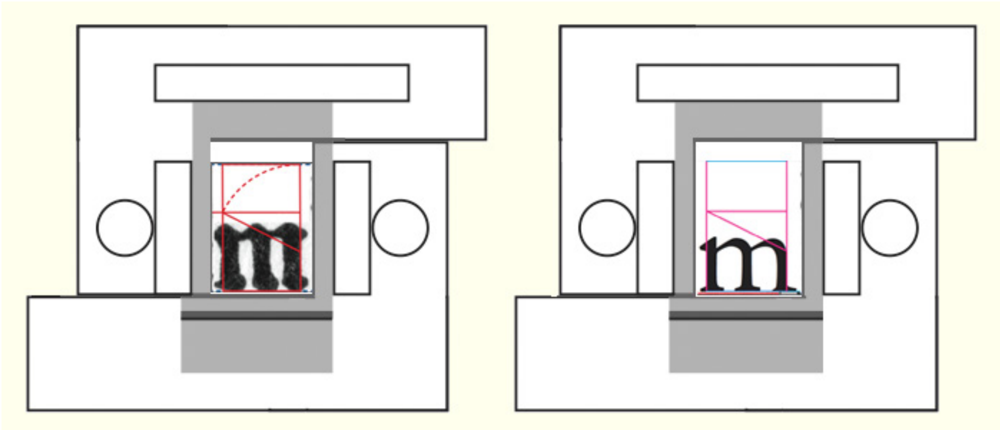

Figure 8.27 Early foundry type was cast on a body that exceeded the boundaries of the dynamic framework.

The reason for casting letters on a larger body was to incorporate some extra distance between lines. One needs this not only for the separation of the lines, but also for positioning diacritics, especially for the ones on top of capitals and ascenders.[217] Figure 8.27 shows that for the 'real' body as described by Davis and Carter, the dynamic rectangles on which the letters are placed have been made smaller in relation to the height of the aperture of the mould, i.e., the body size. This results in a certain amount of additional space to the dynamic rectangles. This amount does not have to be calculated using a geometric construction: it simply can be a division of the dynamic framework, such as one fifth, or even an arbitrary value (although the latter is unlikely considering the discussed forms of standardisation by the early punchcutters). Present-day type is designed on an em-square that equals the dynamic framework, i.e., from top ascender to bottom descender. But a digital typeface contains additional table values that prevent clipping of parts that are placed outside the em-square. Quite often the amount that is added is around one fifth of the em-square.[218]

[217] In case the additional space on the movable-type body was not required, it was not uncommon to cast type on a smaller body using a different mould.

[218] This is defined by the WinAscent/WinDescent for Windows and related 'hhea' entries for macOS. One fifth will roughly correspond with the extra 20 percent that InDesign adds by default as line spacing. For Vietnamese diacritics even more space is needed (that was certainly out of the scope of the Renaissance punchcutters).

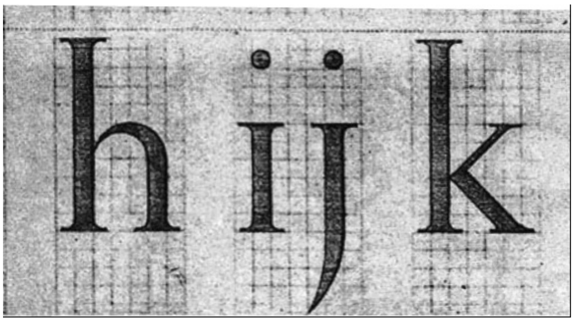

Figure 8.28 Letters of the Romain du Roi on a simple grid.

Such a grid was perhaps also required for transferring large-sized written or drawn letters to the punches, as was done many centuries later for the Romain du Roi (Figure 8.28). The instruction plates for constructing Rotunda in Sigismondo Fanti's *Theoretica et practica* from 1514, which were reprinted in Ugo da Capri's *Thesauro de Scrittori* from 1535 (Figure 8.29), could give us an indication of such a practice. These are clearly not instructions for writing but for constructing lowercase letters using a compass and ruler. The Rotunda type used on several pages of Da Capri's book seems to be modelled after the instruction sheets.

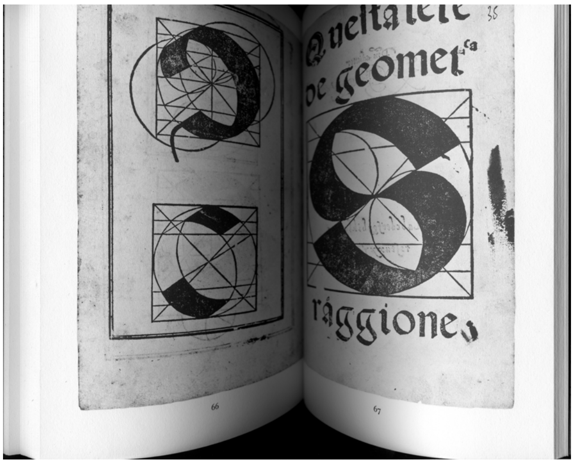

Figure 8.29 Rotunda type constructions in Ugo da Capri's *Thesauro de Scrittori*.

The standardisation by the use of frameworks and grids presented in the previous sections contradicts Morison's statement that the goldsmiths, punchcutters and printers relied on their eyes and not upon their measuring tools. Standardisation is simply a prerequisite for the production of type and it is plausible that grids were used long before the production of the Romain du Roi.

8.7 Digital dynamic frameworks

Present-day tools for digital font production are perfectly suited for applying the dynamic framework to fonts. The design process can be made simpler by connecting the width of the characters directly to the lengths of the ascenders/descenders and the capital height. By changing the width of a character, the lengths of the ascenders/descenders and the height of the capitals change automatically as well. This process requires intelligent scaling, as the thickness of the stems and curves has to remain the same when condensing or expanding glyphs. The new font editor named FoundryMaster, which is developed at URW++ in Hamburg in cooperation with the Dutch Type Library contains this technology.[219]

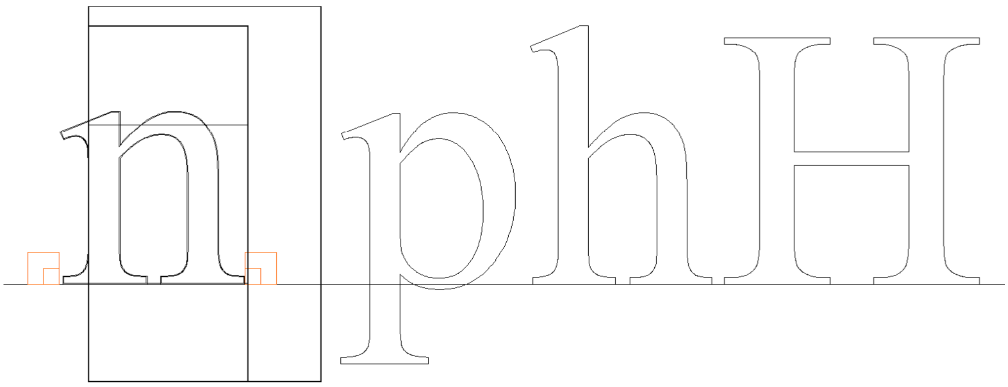

Figure 8.30 Original proportions of Times New Roman.

The dynamic framework fixes the relation between the letter parts. If applied on an existing typeface, such as Times New Roman for example, then the proportions of the ascenders/descenders and the capital height would change. Figure 8.30 shows the original proportions of Times New Roman. The smaller rectangle indicates the height of the capitals calculated using the n-square and the larger rectangle indicates the body based on the em-square. Figure 8.31 shows the glyphs adapted to these calculated proportions, i.e., to the dynamic framework.

[219] <https://www.youtube.com/watch?v=uOsYMctPRNg>

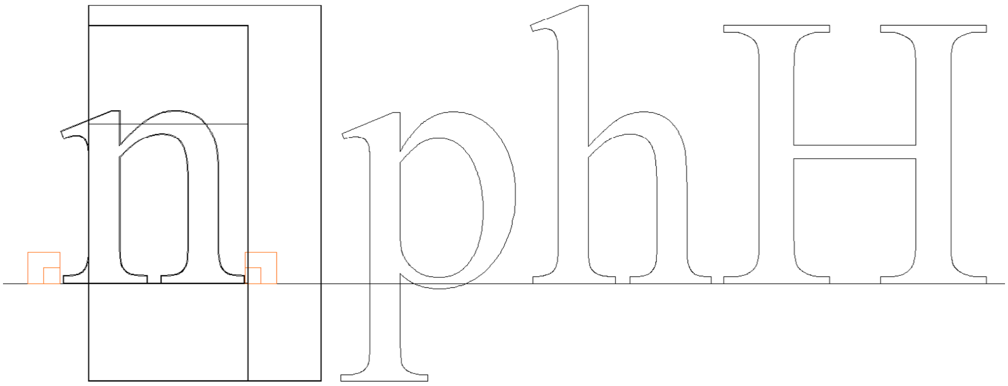

Figure 8.31 Proportions of Times New Roman adapted to the dynamic framework.

8.8 Details and optics

Before concluding this chapter, this section addresses an argument that may be used against my theories about the application of geometric models in Renaissance roman type: that it is likely that the punchcutters were technically incapable of applying very minute details to type. However, if one looks at the details of Pierre Haultin's Nompareille Romaine (approx. 5.3 Didot points) and accompanying cursive, or at Van den Keere's Iolie Romaine or Granjon's Iolie Cursive (approximately 5,6 Didot points) it is my opinion clear that the most skillful Renaissance punchcutters were able to control the tiniest details.

The research on the 'in-house norms in the typography of Manutius' by the typographer, artist, teacher, and author on typography Peter Burnhill (1922–2007) also seems to suggest that Renaissance punchcutters were capable of controlling minute details: '[…] Griffo was working near the limits of vision, using a sub-modular unit of measurement discernible with little if any optical assistance.'[220] Optical assistance was available in Manutius's time however. Eye glasses and magnifying lenses were used long before Jenson and Griffo made their type:

> […] by the end of the thirteenth century in another comprehensive synthesis based on classical and Latin translations of Arabic optical sources, the Perpectiva [ca.1265] by Roger Bacon (ca.1214/1220–ca.1292), magnifying lenses were mentioned as reading aids without fanfare, implying their long-standing use.[221]

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[220] Peter Burnhill, *Type Spaces* (London: Hyphen Press, 2003), p.87.

[221] Vincent Ilardi, *Renaissance Vision from Spectacles to Telescopes* (Philadelphia: American Philosophical Society, 2007), p.41.

Bacon described the functioning of the magnifying glass and how it would enlarge letters for 'those who have weak eyes.'[222] In fifteenth-century Italy there was a 'massive diffusion of spectacles.'[223] Therefore, it is in my opinion quite reasonable to assume that magnifying glasses were used for the production of type.

This chapter focused on the standardisation of vertical proportions in relation to the horizontal standardisation in textura and roman type production. It discussed the widespread use of geometry in the Renaissance, and then presented a framework for proportion standardisation that can be distilled from Renaissance type. Along with the previous chapters on width standardisation, the information presented in this chapter further supports my hypothesis that roman type was the result of the standardisation of the Humanistic minuscule to the Renaissance type production process; this was in analogy to the more straightforward standardisation of the written textura quadrata for the textura type production.

By supporting this hypothesis, the present chapter also supports the overarching hypothesis of my dissertation, which is that roman type was largely the result of technical rather than æsthetic considerations. Having now thoroughly discussed the technical evidence that supports this hypothesis, the next chapter will focus on changes in the production of movable type that show up after the Renaissance and their effects on the the role of æsthetics in roman type production.

[222] Ibid., p.41.
[223] Ibid., p.64.