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Research Notes

MEDIEVAL MASONS' TOOLS: THE LEVEL AND THE PLUMB RULE

LONNIE R. SHELBY*

IN CONTRAST TO THE vast number of studies dealing with medieval art and architecture, the technology of medieval construction has received relatively little attention.¹ Much work remains to be done in this field, particularly in studying the development of equipment and tools used in medieval construction work.² Unfortunately, no medieval Vitruvius or Heron of Alexandria supplied detailed descriptions of equipment, tools, or methods of construction.³ In view of this absence of authoritative written sources, it is unfortunate that little use has been made of manuscript miniatures.⁴ Yet miniatures can be a valuable source for the history of medieval construction work, as is demonstrated by the study of medieval masons' tools. We may take as examples the form and use of the mason's level and plumb rule.

The problems of leveling a horizontal course of stone and of plumbing a vertical wall had been solved in ancient Egypt and in Rome with the use of various tools incorporating a line and weight, that is, a plumb line and bob. Medieval masons also used the principle of the plumb line, but the tools which they devised for its use were quite different in appearance and in application from those of the Egyptians and Romans.⁵ A thirteenth century miniature⁶ clearly portrays a level that was simply a long board, or straight-edge, with a raised semi-circle in the middle of the top edge (Fig. 1). From this semi-circle hung a string with a plumb bob attached. The string was of sufficient length so that the bob hung below the bottom edge of the level. A fifteenth century miniature depicts a similar level, but with the semi-circle replaced by a vertical board, from which hung the string and plumb bob (Fig. 2).⁷ These levels contrast with the Egyptian and Roman levels, which were A-shaped (Fig. 3).⁸ With these latter, the plumb line was attached to the vertex of the two legs and thus hung across the middle bar connecting the legs.

We may now reconstruct the way in which the medieval level was used. Though the details of the miniatures do not show it, there was probably a vertical line drawn on the side of the straight-edge,

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directly beneath the point at which the string was attached.⁹ When the level was placed on the top edge of a horizontal course of stone, the plumb bob hung free; if the wall was level the plumb line hung directly over the vertical line drawn on the straight-edge. But if one end of the level was higher than the other, the plumb line and the vertical mark did not coincide. This indicated that the stonework was not exactly level and that it needed adjustment. An interesting comparison of the use of the ancient and the medieval levels may here be noted. Because of its form, the ancient tool could check the levelness only of two points at a time, namely, those points at which the two legs of the level touched the course of masonry. But the medieval level, being a straight-edge, checked the levelness of the masonry along the entire length of the level. This provided a decided advantage over the ancient tool in working with small stone, for the levelness of several stones could be checked simultaneously.

More complicated and probably less accurate was the use of the plumb rule in checking vertical walls. A miniature from the early fourteenth century¹⁰ represents this tool as a semicircular board with a diameter of probably less than a foot. A smaller semi-circular section is removed from the board, so that the tool looks somewhat like a truncated horseshoe (Fig. 4). In the miniature the tips of this "horseshoe" are held against the wall with one hand, while a plumb line is held with the other hand in such a way that the line passes through the inside semi-circle. The bob on the end of the string is shaped like a small flat-iron. From this representation we may surmise the use of the tool. Again we must postulate the existence of a line that is not shown in the details of the miniature. Apparently there was a line or niche on the inside edge of the "horseshoe," exactly at the middle point of its inner circumference. The plumb line which passed through this semi-circle was then held against this line or niche. The lower end of the string was attached to the center of the plumb bob, which was of a specific size and shape. It appears that the distance from the edge of the bob to the point where the bob was attached to the string was somewhat less than the distance from the wall to the niche on the inside semi-circle. Thus when the "horseshoe" was held against the wall and the plumb line was passed through the niche, the free-swinging bob would not touch the wall if the wall were truly vertical; for the distance from the vertical wall to the niche would be slightly greater than the distance from the edge of the bob to the point where the bob was attached to the string. But if the wall were leaning in, then the bob would touch the wall; while if the wall were leaning out, the bob would be considerably away from the wall. If the use of the plumb rule showed the wall to be thus leaning in or out, the mason would have to make adjustments in the stonework in order to bring it into a vertical line.

What was previously said about the advantage of the medieval level

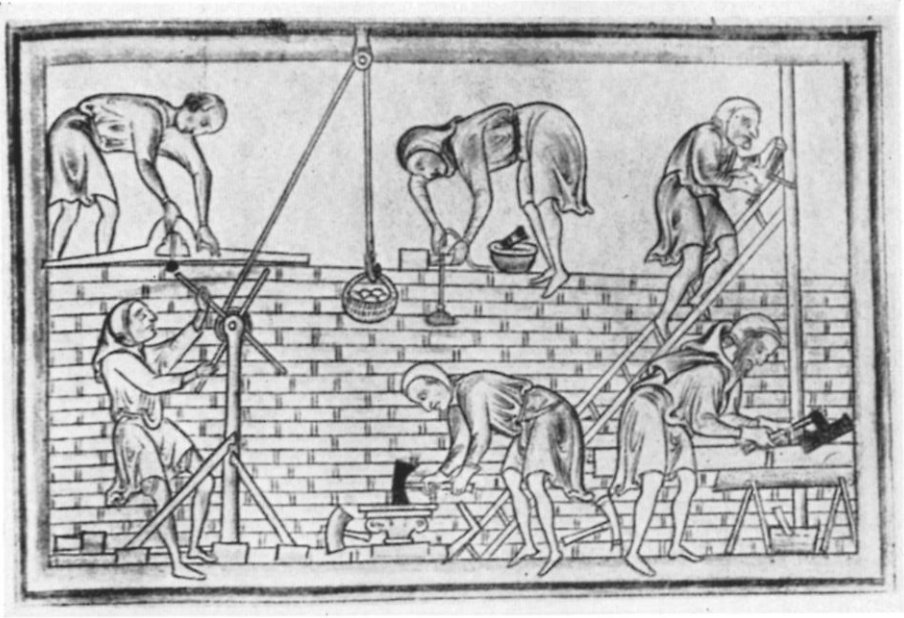


Fig. 1. Thirteenth Century. Reproduced from L. F. Salzman, *Building in England down to 1540*, by permission of the Clarendon Press, Oxford.

Fig. 2. Fifteenth Century. Reproduced from Charles Singer, *et al.*, *A History of Technology*, by permission of the British Museum and the Clarendon Press, Oxford.



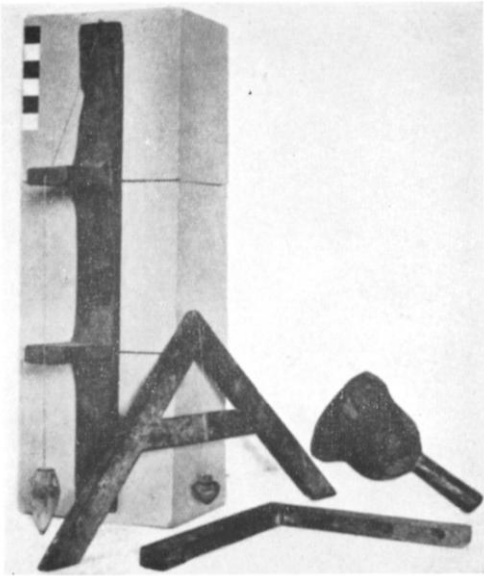
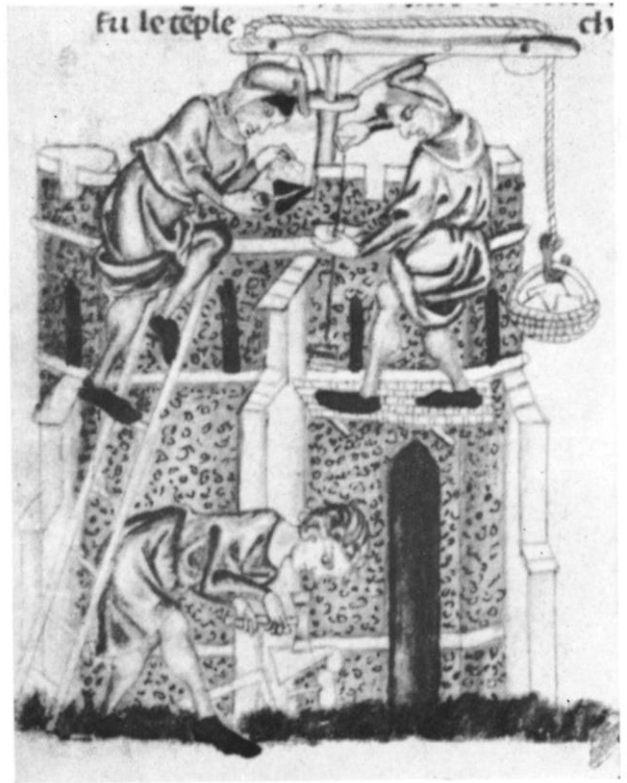


Fig. 3. Ancient Egyptian masonry tools. Reproduced from S. Clarke and R. Engelbach, *Ancient Egyptian Masonry*, by permission of the Clarendon Press, Oxford.

Fig. 4. Fourteenth Century. Reproduced from W. O. Hassel, *The Holkham Bible Picture Book*, by permission of the Earl of Leicester, the British Museum, and the Dropmore Press.



over the ancient is just reversed in regard to the plumb rule. The Egyptian plumb rule was a vertical board with two horizontal planks, over the edges of which hung the plumb line (Fig. 3). When the plumb rule was placed against a wall out of plumb, the line hung either away from or against the lower plank, depending on which way the wall was leaning. But since the Egyptian plumb rule was also a straight-edge, each point along the rule was checked for plumbness. On the other hand, the medieval plumb rule was capable of checking only two points at a time: those points where the "horseshoe" and the plumb bob touched or approached the wall. However, this disadvantage in the medieval plumb rule could be partially alleviated by checking the approach of the bob to the wall as the plumb line was raised or lowered.

REFERENCES

¹The most important recent study of the subject is L. F. Salzman, *Building in England down to 1540: A Documentary History* (Oxford, 1950).

²We thus take issue with Mr. Salzman's assertion, *Building in England*, p. 330: "The tools in use in the building trade varied little between the Roman period and the nineteenth century, and it is chiefly in the matter of nomenclature that the study of them presents any particular difficulty."

³The closest approximations are to be found in Suger's *Liber de rebus in administratione sua gestis*, the abbot's account of the building of St. Denis, translated by E. Panofsky, *Abbot Suger on the Abbey Church of St. Denis* (Princeton, 1940); and the notebook of Villehard de Honnecourt, the thirteenth century architect. See H. R. Hahnloser, *Villard de Honnecourt* (Vienna, 1935).

⁴An exception is the brief article on the medieval building trades by R. G. H. Thompson in Charles Singer, *et al.*, *A History of Technology* (Oxford, 1956), II, pp. 383-396. Salzman, though including many relevant miniatures in his *Building in England*, avails himself but little of the information provided in them.

⁵Somers Clarke and Reginald Engelbach, *Ancient Egyptian Masonry: The Building Craft* (London, 1930), Fig. 264, reproduce photographically an ancient Egyptian level and a plumb rule. The authors provide no description of the use of these tools. Vitruvius, *De architectura*, VIII, 5, describes the *chorobates*, a level that utilized both the principle of the plumb line and that of the water level. Albert Neuburger, *The Technical Arts and Sciences of the Ancients*, trans. Henry L. Brose (New York, 1930), p. 394, has provided a reconstruction of the *chorobates*. However, there seems to be no sufficient reason for making the *chorobates* a four-legged instrument, as Neuburger has shown it. Vitruvius' description does not require it; nor would it have been a very convenient working tool, as anyone will verify who has been inconvenienced by a four-legged table on an uneven floor.

⁶Dublin, Trinity College Lib., MS. E. 1. 40; reproduced in Salzman, *Building in England*, Pl. 4.

⁷London, B. M., MS. Add. 19720, f. 27; in Singer, *History of Technology*, II, Pl. 30b.

⁸ That the Romans used this same type of A-shaped level as the Egyptians is evidenced by the representations of masons' tools on some Roman tombstones and doorplates. See Neuburger, *Technical Arts*, p. 394, Fig. 536.

⁹ The Egyptian level has this vertical line on the crosspiece (Fig. 4). On the other hand, it appears from Vitruvius' description (VIII, 5, 1), which is admittedly somewhat obscure, that there were two perpendicular marks on the Roman *chorobates*, and that the plumb line hung between the two marks. The medieval level could possibly have had this type of marking.

¹⁰ London, B. M., MS. Add. 4780, f. 27; in W. O. Hassell, *The Holkham Bible Picture Book* (London, 1954), f. 27.