Lutyens's proportional system:

an analysis analyzed

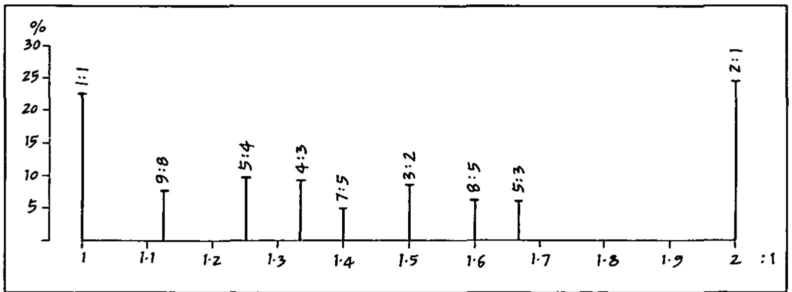
Precision – and chance

John Rollo's paper on Lutyens ('Metiendo Vivendum', **arq** 3/2) raises questions about the precision of measurement needed to detect specified proportional ratios in plans. Rollo has measured the internal dimensions of all 'principal rooms' – halls, dining rooms, drawing rooms – in the majority of Lutyens's country houses. He tabulates the results in terms of the frequency of occurrence of certain whole-number ratios (his Fig. 2a – see next page). I have replotted these statistics as percentages in the graph shown in Fig. 1. Thus, reading from the left, the vertical bars show 22% of rooms with proportion 1:1, 8% with proportion 9:8, etc. (Rollo combines the numbers of rooms with proportions 5:3 and 8:5. I have assumed arbitrarily, for the sake of the diagram, that these numbers are equal.) Rollo has omitted from these statistics some 7% of the rooms that he measured, presumably because their proportions did not conform sufficiently closely to any of the specified ratios.

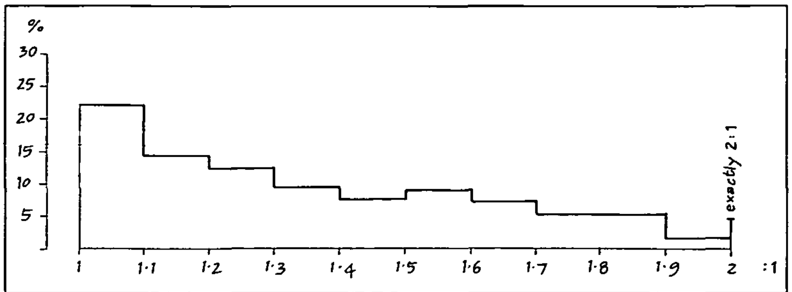
Rollo interprets these results as showing that nearly 80% of all Lutyens's rooms '... conformed to one of Palladio's six rectilinear room proportions ...' (1:1, 2:1, 4:3, 5:3, 3:2 and √2:1 approximated as 7:5). There is, within this group '... an extraordinarily high bias in favour of the unit and half-unit ratio cases ...' (1:1 and 1:2). At first sight this result is impressive and seems conclusive; but several caveats are in order.

Suppose, just for the sake of mathematical illustration, that Lutyens had selected his pairs of room dimensions *at random*. Suppose further that he had picked only dimensions corresponding to whole numbers of feet. His use of gridded paper for planning could have had this effect. What distribution of proportional ratios would have resulted? To set limits on this theoretical exercise, let us allow dimensions to range only between 5 and 25ft, which seems reasonable for 'principal rooms'; and specify that in no case shall the shapes of rooms become more elongated than 2:1. I have tabulated *all pairs* of dimensions under these constraints, and plotted percentages of all cases with specified ratios, in 10 bands. These are shown in Fig. 2. Thus at the extreme left, 22% of all 'possible room shapes' have proportions lying between 1:1 and 1.1:1.

These statistics represent a kind of null hypothesis. They show what would tend to result is Lutyens – or any other architect – showed *no* preferences in the selection of room dimensions (within the given limitations), whether on functional, aesthetic or any other grounds. One counterintuitive point to notice immediately is that there are many more instances in the band from 1:1 to 1.1:1 than in any other. Squares and near-squares are not rare in the total range of possibilities, they are quite common. There are more possible combinations of integral dimensions resulting in such shapes, than there are in other



1 John Rollo's statistics replotted as percentages



2 Percentages of theoretical room shapes

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bands. There is also a slight peak corresponding to the band from 1:1.5 to 1:1.6, since ratios of 3:2 – plus approximations thereto – are more numerous than proportional values in neighbouring bands. Note the comparable slight rise in observed numbers of cases in a similar position in Rollo's statistics.

The key difference between these theoretical figures and Rollo's empirical results, is that Rollo's are shown as a small number of exact ratio values, while I have grouped *ranges* of values within each band. Whether we can legitimately compare the two sets of statistics depends, then, on the accuracy of Rollo's original measurements. He mentions that these were made on xerox copies of schematic plans from Butler or Weaver, not from working drawings or the buildings themselves. Inaccuracies could have crept in here. He mentions in the doctoral thesis from which the paper derives that his measurements have indeed been rounded to whole numbers of feet. There is the further question of just how close an approximation he has been prepared to accept, as an instance of one of his selected ratios. He refers for instance to the approximation of the Golden Section by the ratio 5:3, and of √2:1 by the ratio 7:5. As a concrete example, suppose that a room whose actual dimensions were 20 x 19ft had been included, through a combination of errors in the original drawing, in xeroxing, and in subsequent rounding, as an example of a square shape. This would mean counting a true ratio of 1.053:1 as an instance of 1:1.

If approximations of this order were to be occurring generally in Rollo's measurements, then it *would* become reasonable to compare his empirical findings with my theoretical enumeration of possibilities. Rollo's 22% of square rooms would then seem less remarkable and less significant, against the 22% of 'possible room shapes' with proportions between 1:1 and 1.1:1. It would be necessary to show that Lutyens was selecting specified proportions at a rate higher than chance, before one could legitimately conclude that he was exercising any deliberate preferences. The one marked difference of this kind between the two diagrams above, is Lutyens's apparent strong preference, over chance, for rooms with double-square shapes. (Although the relatively small number of theoretical possibilities here is partly a result of the decision to set a precise upper limit of 2:1, and thus to exclude any slightly more elongated approximations to 2:1.)

I certainly would not want to suggest that Rollo's measurements are so error-prone as to invalidate his general conclusions; rather to point out the potentially insidious cumulative effects of a series of what separately might seem like minor approximations. I believe that Rollo has been able to show that, on occasion, Lutyens preferred certain room proportions over others. There is clear evidence, in the plan diagrams in Rollo's paper, of Lutyens using simple proportioning systems to generate similar room shapes by the repetition of dimensions in rectangular grids. My point is a more general one: that, to provide conclusive proof of architects choosing specific ratios for the shape of individual rooms requires two things. The first is great precision of measurement. The second is some recognition of what distribution of room shapes might be expected, on the basis of nothing more than chance.

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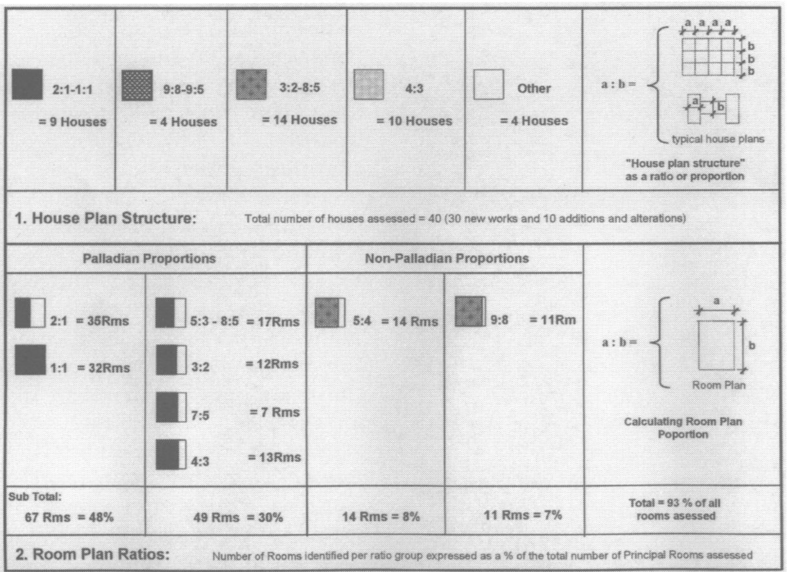

3 John Rollo's room plan ratios as shown in arq 3/2

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