The 7th century minster at Winchester interpreted

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The first church in Winchester was built by King Cenwalh of Wessex *c* 648. It was not the see of Birinus, the bishop of Wessex, for that was in Dorchester on Thames. The church became a cathedral about 662 when Wini was appointed. This cathedral became known as Old Minster after another church (New Minster) had been constructed immediately to the north *c* 901-3.

In 1093-4 Old Minster was utterly demolished to make way for and provide building materials for the nave of the Norman cathedral. Not only were the standing walls demolished, but the foundations were robbed out so that all that was left of Old Minster was a negative imprint in the ground, a pattern created by robber trenches (lettered R-T; Fig 134). The church which was demolished in 1093-4 was very different from the church Cenwalh constructed almost four and a half centuries before. During those centuries Old Minster went through alterations and enlargements (Fig 135), but that which had taken centuries to create was destroyed in two short years. New Minster was demolished in *c* 1110. The sites of the two minsters were lost for almost 850 years, until the late Roger Quirk so perceptively read the historical clues and initiated the excavation of the Old Minster and New Minster sites in 1961 under the direction of Martin Biddle (Quirk 1957).[1]

Old Minster was excavated during the summers of 1962-9. The excavated area covered (apart from narrow baulks) about three-quarters of the robbed remains of the 7th century church (Fig 136). The south wall of the nave and the south porticus have been reconstructed symmetrically around the east-west axis. The pattern of 10th and 1lth century robber trenches (Fig 135) obscured the plan of the 7th century church to such a degree that the nature and extent of its plan was not understood until 1968.

The principal elements discovered (Fig 136)

The walls of the 7th century church comprised three elements: foundations, footing wall, and standing wall. The 2.5m wide foundations were found throughout the area excavated. Upon them was built a footing wall of reused and retrimmed squared green sandstones, found in *situ* only on the south side of the east porticus (W.25). The bottom edges of the robber trenches (R-T), often with imprints of the footing blocks surviving, show the maximum possible width of the footing wall in all cases. No part of the foundation was robbed, the whole remaining *in situ.* By contrast no part of the standing wall was ever found in position on the footing. Postholes found around the east porticus are interpreted as the settings for scaffold-poles used in the original construction.

Central axis

From the evidence of the 1964 excavations a centre-line was established for the building, running along 500N. Further excavation showed this to be almost the true centre-line, but the 1969 excavation in the area of the east porticus has allowed a new and more accurate centre-line to be established for the 7th century church along 500.25N ± 50mm. A centre-line along 500.25N was at first followed in the theoretical reconstruction.

Thickness of the standing walls

Below R-T C part of the footing wall (W.25) was found *in situ.* The width of the robber trench bottom above this footing wall shows that the standing wall above the footing can have been at most 0.92m wide. This point is still below the 7th century ground level, above which there is good reason to suppose that the standing wall was even narrower above some kind of offset.

There are other limits: if the north wall of the nave was straight, then it cannot have been further north than 505.85N (R-T edge), or further south than 505.00N(R-T U). This gives a width of 0.85m. These measurements are again below the 7th century ground level, and it is unlikely that the standing wall was placed right on the outside edge of the footing wail. If the south wall of the nave is reconstructed symmetrically around the centre-axis, then its north edge cannot be further north than 495.50N, or more probably 495.45N. North of the centre-axis the corresponding line would therefore run along 505.05N. If 0.10m is allowed on the north side of the nave between the standing wall and the north edge of the robber-trench (ie the north edge of the footing wall), then the north wall of the nave would run between 505.05N (south side) and 505.75N (north side), and the wall would be 0.70m thick. A wall 0.70m thick was therefore used for the theoretical reconstruction. The wall however might have been 0.75m thick if the evidence is pushed to the limit, or the wall could have been thinner than 0.70m.

The theoretical layout of the nave

The external lines of the walls were followed as established above and the centre-axis along 500.25N was at first accepted (AL-AK; see Fig 136 for the lettered points, although this shows Cenwalh's church as it has finally been reconstructed (see below, p. 209)).

1. *North wall:* Wall line (0. 10m south of the north side of R-T) shown as line C-D along 505.75N theoretically.
2. *South wall:* South side of the wall shown as line F-E theoretically along 494.80N.
3. Distance C-D and F-E was *10. 95m.*
4. If one supposes that the nave was twice as long as it was wide, then the length would be *21.90.m* There is room for this length: at the west end there are only broad limits, but at the east end the nave wall will have to avoid R-T O, R-T U, and R-T L_2. If one allows 0.10m between the east side of the east wall of the nave and the west end of R-T E (R-T C is a complicated robbing, and its west end is not directly relevant here), then the east end of the nave falls on

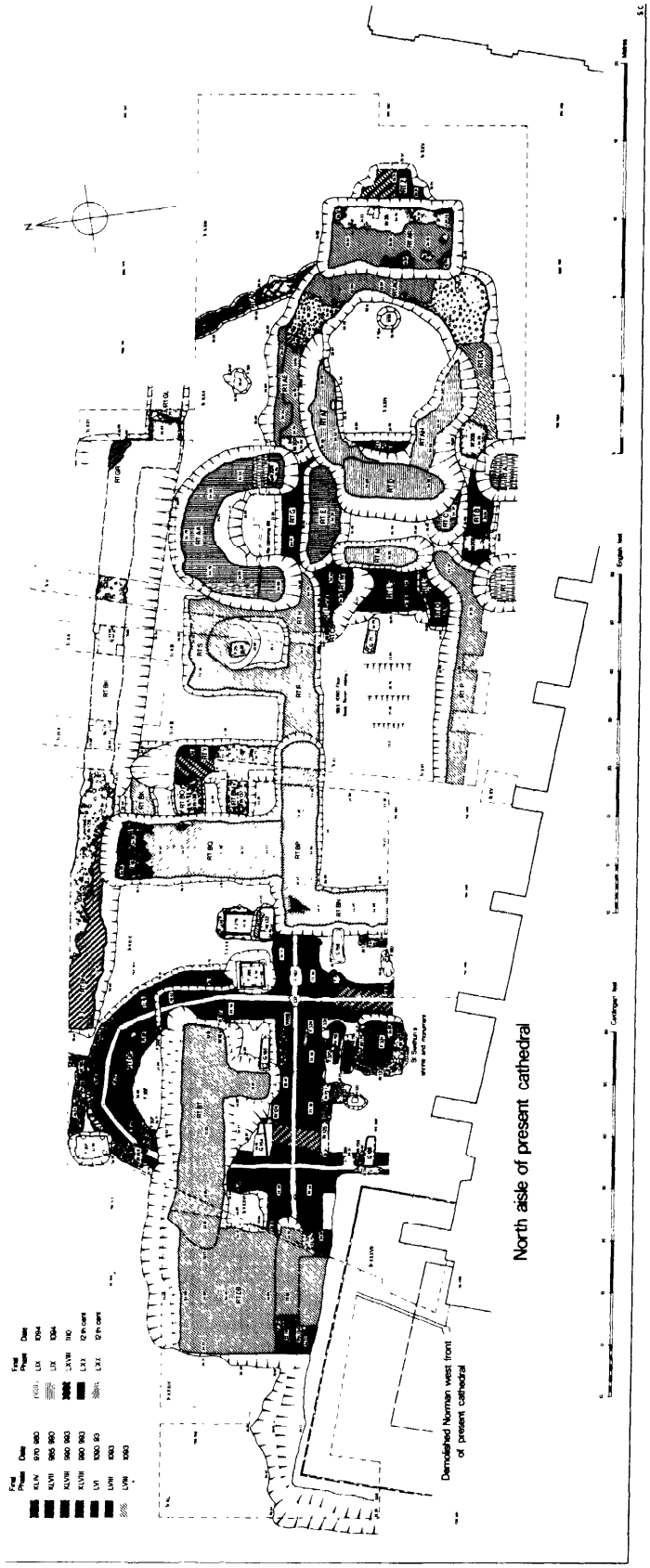

Fig 134 Winchester: plan of the robbed Old Minster and the south wall of New Minster (Wall 128, R-T BH) (scale 1:400)

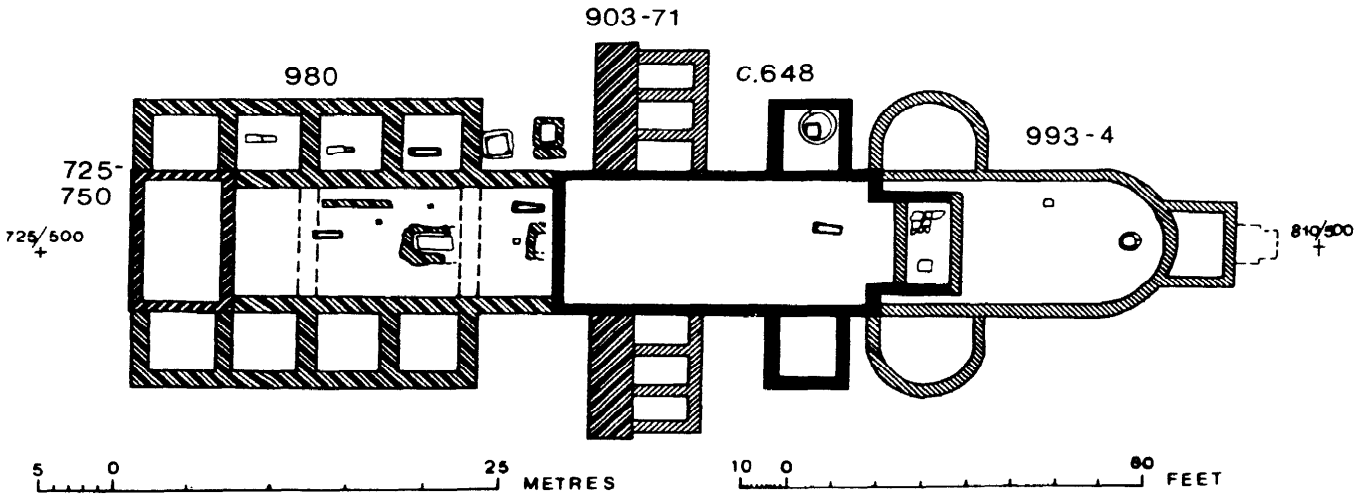

Fig 135 Winchester: Old Minster in its final stage c *993/4-c 1093/4; the plan shows reconstructed standing walls; 7th century minster church in black (scale 1:500)*

line D-E along 780.40E. If 21.90m is accepted as the length of the nave, the west end will fall along 758.50E, line C-F. Points C, D, E, and F thus each mark an external corner of the nave.

5 The nave as first reconstructed was a rectangle 21.90 x 10.95m, consisting of two large squares each 10.95 x 10.95m or eight smaller squares each 5.475 x 5.475m. These smaller squares are called *Base squares.* The side of the Base square is called x. The centre of the eastern large square is point AS; the centre of the western large square is point AZ. A circle centred on these points and circumscribing the large squares will have a radius equal to the diagonal of a Base square = AZ - C = AZ - F = AS - D = AS - E. On the theoretical layout the length of this radius, called the Base *radius,* is 7.7428m.

Eastern porticus

The faces of the south wall have to lie between 496.31N and 497.55N (the edges of R-T C). The north wall has to lie between 503.00N and 504.25N (the south edge of R-T E and the southern limit of the scaffold postholes along the north side of R-T E).

The foundations and the scaffold postholes show that the plan of the east porticus was probably square rather than rectangular. There are various theoretical possibilities:

1 An east porticus one-quarter the length of the nave, that is the size of a Base square. This is not possible since the standing walls would not fit on the footing walls (this porticus is too small for the footing walls).

2 An east porticus the length of which equals one-third the length of the nave. There is room to construct a square porticus this size.

3 A square with sides equal to the Base radius (theoretically 7.7428m) cannot be constructed in the porticus areas, as the south wall of such a porticus would overlap a later wall foundation built against the footing wall of the 7th century wall (W.206). There is therefore no room for a square east porticus with sides equal to Base radius.

The construction and robbing of the east porticus is extremely complex, involving the construction of an apsidal east end on the 7th century foundations in the 8th century, as well as the conversion of the east porticus into a crypt in the late 10th century (Fig 135). These complexities and their understanding will not be considered here.[2]

North and south porticus

The total east-west external length of the 7th century church is: nave + east porticus (1/3 nave) or 4x + 1/3x = 5 1/3x (where x = side of Base square). Half the total east-west length is $2^2/3$; theoretically this is 14.56m. The centre-point east-west of the church would be at 773.09/500.25 (point BF) as theoretically reconstructed. The west faces of the north and south porticus can theoretically fall on a north-south line through this halfway point. The edges of the robber trenches of the walls of the north porticus, together with the robbing of the 10th century baptistery in the north porticus (R-T S), narrowly define the limits within which the standing walls of the porticus could have stood. A porticus constructed with its western face along 773.09 E could have its external dimensions equal to the sides of a Base square (x). The porticus could not be any wider east-west, but there is room (because the bottom line of the robber trench for the north wall was not well understood) for a porticus measuring up to about 5.80m north-south. Such a porticus would leave an unexplained and astructural gap between the 10th century clay baptistery lining and the inner face of the north wall. The reconstruction which fits best and leaves least to be explained has been accepted, namely a north (and south) porticus which corresponds to the area of a Base square. The distance north-south across the full width of the two porticus (Fig 136, BA-BB) is the same as the length of the nave, namely four Base squares (4x).

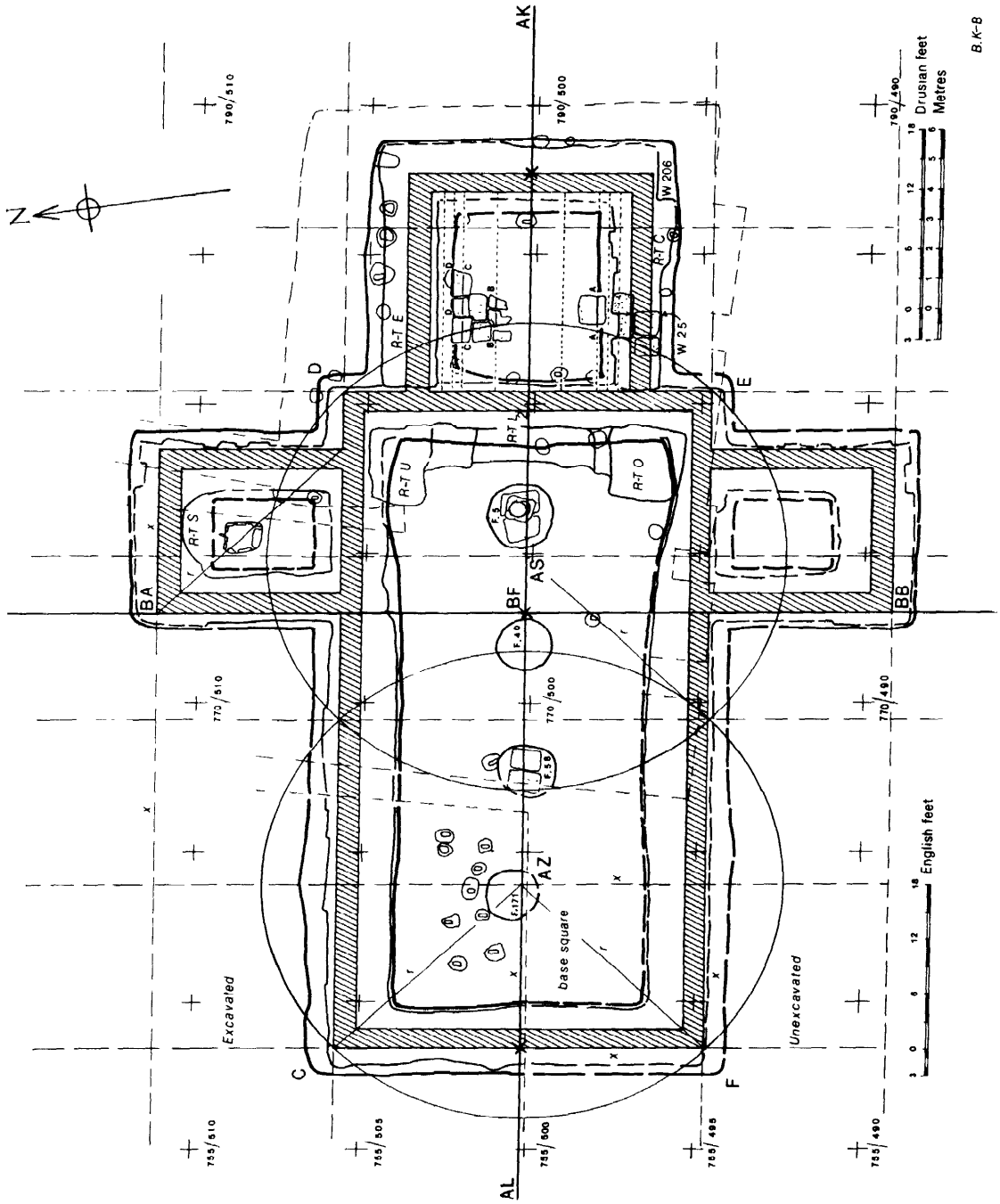

Fig 136 Winchester: 7th century minster church. Plan in the site grid showing foundation trenches (heavy outline), robber trenches (thinner outline), scaffold-postholes, circular foundations in the nave, and original floor in the east porticus. Superimposed upon the archaeological evidence are: 1 Standing walls (hatched) with a width of 2 Drusian feet; 2 A grid of Base squares of 16½ x 16½ Drusian feet; 3 Base circles enclosing the nave (scale 1:200)

The plan (Fig 136)

Cenwalh's church in Winchester may therefore have had the following dimensions:

Nave 1ength:width	2:1
Nave 1ength:east porticus	3:1
Nave east-west: porticus north-south	1:1

This is a simple plan, easy to lay out on the ground and pleasing to the eye.

The unit of measurement: some possibilities

So far metric coordinates derived from the excavation survey grid have been used to describe the elements found on the ground. In the 7th century, of course, the metre was not used.

There are several units of measurement which might have been used in the construction of the 7th century church.

1 The classical Roman foot, equal to 0.295m
2 The English (or Staufian) foot, equal to 0.3048m
3 The Drusian (or Carolingian; or indeed 'Northern') foot, equal to 0.333m (Grierson l971, 35-7; Skinner 1952, 179-81)
4 The long Carolingian (or *pied de Lyon)* foot, equal to 0.34m[3]

Table 5 shows the measurements of the 7th century church expressed in terms of these different units.

The figures provided by the excavation results and their interpretation are generally accurate within ± 0.l0m. For example, the wall width is theoretically assumed to be 0.70m, but the walls could be 0.75m or 0.65m wide; they could not be any wider, but they could be narrower. The length of the nave used in the calculations is 21.90m, and the ratio 1:2, nave width to nave length, is presumed correct. The nave could be up to 0.10m shorter or up to 0.20m longer and this same ratio could still be maintained. Any greater variation from 21.90m would be impossible, since the standing walls would then either override their foundations or would be cut into by, or would cut, features in use with these walls. Thus the nave cannot vary more than +0.20m or - 0.l0m from 21.90m. External measurements have been used for these basic proportions. If the walls were to be much narrower than 0.70m, it would have to be the internal wall face which was moved, since the external face seems fixed by the general coherence of the proportional system.

Because there is generally no more than 0.10m tolerance in any measurement, no more than one-quarter of any foot should have to be added or subtracted to produce a number (of units) used in the external measurements. Slightly greater variation is permissible for internal measurements.

From Table 5 it can be seen that none of the various units divide into the metric measurements to produce an even number of feet. In Tables 6 to 9 the 'best' numbers of feet have been used for the four possibilities considered, and the amaunt added or subtracted to produce a whole number of units is given in brackets.

Internal arrangement

Only comparatively little evidence for the internal arrangement of the 7th century church was discovered in excavation.

Nave

Along the central axis four circular foundations were found, numbered from west to east: F.171, F.58, F.40, and F.S. F. 171 and F.40 were robbed before *c* 993-4 and all four were sealed by the late 10th century floor of the nave. In F.58 and F.5 there remained two rectangular stone blocks set in pale yellow mortar and stone dust with many limestone chips. On the blocks in F.5 there was set a further square stone with a circular depression cut into its uppermost side. This stone was placed to the east of the centre of F.5. The centre of the circular depression lies approximately on 776.45/500.40, and the centre of F.171 is approximately on 763.50/500.40.

Because the western three circular foundations are somewhat irregular, their centres cannot be established with an accuracy of more than ± 0.l0m in the case of F.171 and F.58, while for F.40 the tolerance is greater, perhaps ± 0.15m. By contrast, for the circular depression of F.5 an error of as little as ± 0.05m is permissible. F.5 also shows that the actual focus of each foundation need not be above the centre of the foundation pit.

As a working hypothesis, however, I presume that the centres of the three western foundations were the same as the finished foci. For F.5, the centre of the circular depression is used.

The overall distance east-west between the two outermost centres ('foci') of F.171 and F.5 is 12.95m ± 0.15m. Converted into the various feet this distance would be:

Classical Roman feet	= 44 feet (12.98m)
English feet	= 42 feet (12.80m)
Drusian (Carolingian) feet	= 39 feet (12.999m)
Long Carolingian feet	= 38 feet (12.92m)

The distance between the 'finished foci' of the four features should be, if they were equidistant, 12.95m ÷ 3 = 4.32m. In the various feet this would be:

Classical Roman feet	= 44 ÷ 3 = 14 2/3'
English feet	= 42 ÷ 3 = 14'
Drusian (Carolingian) feet	= 3 9 ÷ 3 = 1 3 '
Long Carolingian feet	= 38 ÷ 3 = l2 2/3'

The centre of F.58 lies on 767.75E ± 0.10m; the centre of F.40 lies on 771.95E ± 0.15m; the centre of F. 171 lies on 763.50 E ± 0.10m.

The foci of these features could have been equidistant if the focus of F. 171 was 0.06m west of its 'centre', if F.58's focus was 0.0lm east of its 'centre', if F.40's focus was 0.13m east of its 'centre,' and if F.5's focus lay 0.05m west of its 'centre'.

The distance between the 'corrected' focus of F. 171 and the inner face of the west wall of the nave on the 'uncorrected' metric plan is in theory 4.24m. This is 0.08m shorter than the distance of 4.32m established above as the possible distance between the 'finished foci'.

It can be seen from Tables 6 to 9 that certain tolerances have been accepted in order to fit the various feet to the metric measurements. Only those feet which have

Table 5 The dimensions of the 7th century church

Dimensions	Metres	0.295 m. Roman foot	0.3048 m. English foot (equals staufian foot)	0.333 m. Drusian foot (Carolingian)	0.34 m. Long Carolingian foot (pied de Lyon)
A. EAST-WEST					
a. Length of nave					
(i) external	21.90	74.2373	71.8504	65.7658	64.4118
(ii) internal	20.50	69.4915	67.2572	61.5616	60.2941
b. Length of eastern porticus					
(i) external	7.30	24.7458	23.9501	21.9219	21.4706
(ii) internal	6.60	22.3739	21.6535	19.8198	19.4118
c. Overall length of church					
(i) external	29.20	98.9831	95.8005	87.6877	85.8824
(ii) internal	27.80	94.2373	91.2073	83.4835	81.7647
d. Length (east-west) of north and south porticus					
(i) external	5.475	18.5593	17.9626	16.4414	16.1029
(ii) internal	4.075	13.8136	13.3694	12.2372	11.9853
B. NORTH-SOUTH					
a. Width of nave					
(i) external	10.95	37.1186	35.9252	32.8829	32.2059
(ii) internal	9.55	32.3729	31.3320	28.6787	28.0882
b. Width of eastern porticus					
(i) external	7.30	24.7458	23.9501	21.9219	21.4706
(ii) internal	5.90	20.0000	19.3570	17.7177	17.3529
c. Width (north-south) of north and south porticus					
(i) external	5.475	18.5593	17.9626	16.4414	16.1029
(ii) internal	4.775	16.1864	15.6660	14.3393	14.0441
d. Width of church across north and south porticus					
(i) external	21.90	74.2373	71.8504	65.7658	64.4118
(ii) internal	20.50	69.4915	67.2572	61.5616	60.2941
C. OTHER DIMENSIONS					
Wall thickness	0.70	2.3729	2.2966	2.1021	2.0588
Radius of base-circle (= base - radius)	7.7428	26.2468	25.4029	23.2517	22.7729
Half base-radius	3.8714	13.1234	12.7014	11.6258	11.3865
Side of base square	5.475	18.5593	17.9626	16.4414	16.1029
Circumference of nave	65.70	222.7119	215.5512	197.2973	193.2353
Circumference of church overall	102.20	346.4407	335.3018	306.9069	300.5882

Table 6 The dimensions in classical Roman fact (1'=0.295 m)

Dimensions	CLASSICAL ROMAN FEET: Figure used	Rounded by	Divided by: √2	2	3	4	5	6	7	8	9	11	Other		ELL ($1\frac{1}{2}$ FEET): Figure used	Divided by: √2	2	3	4	5	6	7	8	9	Other
A EAST–WEST																									
a. Length of nave external	$74\frac{1}{4}$	$(+\frac{1}{100})$	$52\frac{1}{2}$	$37\frac{1}{8}$	$24\frac{3}{4}$						$8\frac{1}{4}$	$6\frac{3}{4}$			$49\frac{1}{2}$	35	$24\frac{3}{4}$	$16\frac{1}{2}$			$8\frac{1}{4}$			$5\frac{1}{2}$	
b. Length of eastern porticus external	$24\frac{3}{4}$	$(+\frac{2}{500})$	$17\frac{1}{2}$		$8\frac{1}{4}$						$2\frac{3}{4}$				$16\frac{1}{2}$		$8\frac{1}{4}$	$5\frac{1}{2}$			$7\frac{3}{4}$				
c. Overall length of church external	99	$(+\frac{1}{50})$	70	$49\frac{1}{2}$	33	$24\frac{1}{2}$		$16\frac{1}{2}$			11	9	$8\frac{1}{4}$ x 12		66	$46\frac{2}{3}$	33	22	$16\frac{1}{2}$		11		$8\frac{1}{4}$	$7\frac{1}{3}$	
d. length of north and south porticus external	$18\frac{5}{8}$	$(+\frac{13}{200})$	$13\frac{1}{8}$												$12\frac{1}{3}$										
B. NORTH-SOUTH (external only)																									
a. Width of nave External	$37\frac{1}{8}$	$(+\frac{3}{500})$	$26\frac{1}{4}$												$24\frac{3}{4}$	$17\frac{1}{2}$	$12\frac{3}{8}$	$8\frac{1}{4}$			$4\frac{1}{8}$			$2\frac{3}{4}$	
b. Width of eastern porticus external	$24\frac{3}{4}$	$(+\frac{1}{500})$	$17\frac{1}{2}$		$8\frac{1}{4}$						$2\frac{3}{4}$				$16\frac{1}{2}$		$8\frac{1}{4}$	$5\frac{1}{2}$			$7\frac{3}{4}$				
c. Width of north and south porticus external	$18\frac{5}{8}$	$(+\frac{13}{200})$	$13\frac{1}{8}$												$12\frac{1}{3}$										
d. Width of church across north and south porticus	$74\frac{1}{4}$	$(+\frac{1}{100})$	$52\frac{1}{2}$	$37\frac{1}{8}$	$24\frac{3}{4}$						$8\frac{1}{4}$	$6\frac{3}{4}$			$49\frac{1}{2}$	35	$24\frac{3}{4}$	$16\frac{1}{2}$			$8\frac{1}{4}$			$5\frac{1}{2}$	
C. OTHER DIMENSIONS																									
Wall thickness	$2\frac{1}{2}$	$(+\frac{13}{100})$		$1\frac{1}{4}$			$\frac{1}{2}$								$1\frac{2}{3}$										
Radius of base-circle (= base-radius)	$26\frac{1}{4}$	$(+\frac{3}{1000})$		$13\frac{1}{8}$	$8\frac{3}{4}$		$5\frac{1}{4}$		$3\frac{1}{4}$						$17\frac{1}{2}$		$8\frac{3}{4}$			$3\frac{1}{2}$		$2\frac{1}{2}$			
Half base-radius	$13\frac{1}{8}$	$(+\frac{1}{500})$													$8\frac{3}{4}$					$1\frac{3}{4}$		$1\frac{1}{4}$			
Side of base square	$18\frac{5}{8}$	$(+\frac{13}{200})$	$13\frac{1}{8}$												$12\frac{1}{3}$										
Circumference of nave	$222\frac{3}{4}$	$(+\frac{1}{25})$		$111\frac{3}{8}$	$74\frac{1}{4}$						$24\frac{3}{4}$	$20\frac{1}{4}$	89 x $2\frac{1}{2}$		$148\frac{1}{2}$	105	$74\frac{1}{4}$	$49\frac{1}{2}$			$24\frac{3}{4}$			$16\frac{1}{2}$	
Circumference of Church Overall	$346\frac{1}{2}$	$(+\frac{3}{50})$		$173\frac{1}{4}$	$115\frac{1}{2}$			$57\frac{3}{4}$	$49\frac{1}{2}$		$38\frac{1}{2}$				231		$115\frac{1}{2}$	77	$57\frac{3}{4}$	$46\frac{1}{5}$	$38\frac{1}{2}$	33		$25\frac{2}{3}$	11 x 21
D. INTERNAL ARRANGEMENT: a. Distance: F.171 -F.5, focus	44			22	$14\frac{2}{3}$	11	$8\frac{4}{5}$	$7\frac{1}{3}$		$5\frac{1}{2}$		4			$29\frac{1}{3}$		$12\frac{2}{3}$		$7\frac{1}{3}$				$3\frac{2}{3}$		
b. Distance: F.171 – F.58, F.58-F.40, F.40-F5	$14\frac{2}{3}$			$7\frac{1}{3}$		$3\frac{2}{3}$						$1\frac{1}{3}$			$9\frac{7}{9}$				$2\frac{1}{3}$						

required a lengthening of the nave are relevant here. In these cases, the tolerances are:

The classical Roman foot	= 3/50th foot or 0.0177m
The English foot	= 3/20th foot or 0.04572m
The Drusian foot	= 6/25th foot or 0.07572m
The Long Carolingian foot	= 9/100th foot or 0.0306m

The nave needs to be 0.08m longer for the distance between F. 171's focus and the west wall to be the same as the distance between the foci of the four foundations. Only the Drusian (Carolingian) foot suggests a nave almost exactly 0.08m longer; the other feet allow only half or less of that amount to be added.

This is obviously a very tentative calculation, since there are so many uncertainties, but the arrangement of the circular foundations and their relation to the nave seem to favour the Drusian (Carolingian) foot (0.333m) as the unit of measurement.

The relationship of F.5 to the east end of the nave is more complex because there was an opening towards the east; no calculation should be made.

Eastern porticus

Eight flagstones remained *in situ* from the original 7th century floor. They not only give an idea of the impressive treatment of the interior as well as the level of the floor, but also preserve a series of four shallow and parallel east-west 'steps' in their surface. The flagstones sealed the scaffold postholes around the walls of the east porticus and lay on a layer of pale yellow stone dust and mortar mixed with limestone chips, a deposit exactly the same as that found in the postholes themselves, and in the four circular axial foundations discussed above. There is no question but that the flagstones are part of the original 7th century floor. The surface of the flagstones and the 'steps' was in some places covered with the same kind of pale yellow 'dust-mortar' with a hard smooth surface, and this was particularly well preserved over the 'steps'. It seems very unlikely that the 'steps' were secondary.

These 'steps' are important. The southern 'step' (A) runs along 498.20N, the next 'step' (B) along 501.20N, the third 'step' (C) along 502.20N, and the fourth 'step' (D) along 502.53N. The 'steps' are only between 0.02m and 0.03m deep. They are not completely vertical and have an uneven finish. Where they were covered with the hard-surfaced dust-mortar they have been almost smoothed out. It is perhaps as if they were not meant to be seen once they had served their purpose. The only foot which fits the distances marked by the 'steps' is the Drusian (Carolingian) foot of 0.333m. The distances between the 'steps' are:

A-B = 3m	= 9′ (Drusian)
B - C = 1 m	= 3′ (Drusian)
C-D = 0.33m	= 1′ (Drusian)

The lines of the 'steps' are accurately measured, but as their finish is irregular, the distances between them would vary ± 0.01m between any two points. This is unimportant for 'steps' A, B, and C where we either have a good long run or a large enough distance to measure, so that 0.01m does not matter. For 'step' D which is short, the irregularity matters. The distance C-D seems to give us our unit of measurement. However, had this been the only evidence available for the unit of measurement, it could not have been used to get to a firm conclusion. Fortunately the distance C-D does not stand alone.

No flagstones survived between 'steps' A and B, and therefore there is no evidence to say how many 'steps' there might have been between them. There were no 'steps' between 'steps' B and C which indicate a Drusian 3-foot unit at this point.

The 'steps' step down from the outer edges of the floor towards the middle of the porticus, but it is impossible to say whether there would have been a stepping down or up from the outer edges of the preserved floor to the inner sides of the walls. The overall differences in floor level are so small that no significance can be placed on them.

As already seen, the central axis has been reconstructed along 500.25N, with a 0.05m tolerance. The axis could thus have run along 500.20N, ie along either a missing 'step' or at least equidistant from 'steps' A and C. The distance between the central axis and the inner faces of the north and south walls is 2.95m. This is no immediately obvious multiple of the Drusian (Carolingian) foot, although 2.95m is 10 classical Roman feet. The 'steps' do not however fit with the classical Roman foot. Had the walls been narrower (that is, the internal faces would move out) as would be required for a wall 2 Drusian (Carolingian) feet thick, then the inner wall faces would be along 503.20N and 497.20N respectively, which is 9 Drusian (Carolingian) feet north and south of the centre line. This would give the following internal divisions in the east porticus:

Inner face of north wall to 'step' D	2 Drusian (Carolingian) feet
'step' D to 'step' C	1 Drusian (Carolingian) foot
'step' C to 'step' B	3 Drusian (Carolingian) feet
'step' B to centre-axis	3 Drusian (Carolingian) feet
centre-axis to 'step' A	6 Drusian (Carolingian) feet
'step' A to north face of south wall	3 Drusian (Carolingian) feet
Internal north-south width	18 Drusian (Carolingian) feet

One might well presume that 'step' A on the south corresponds to 'step' C on the north, and that there might have been divisions at one foot north of 'step' C and south of 'step' A. Of these only part of 'step' D has survived. It is clear however that the Drusian (Carolingian) foot alone works with the steps in the east porticus. None of the other feet fit.

Construction unit (external measurements)

The classical Roman foot (Table 6)

Table 6 shows that the rounded figures in this foot do not divide into any simple unit in feet, but that the ell (a unit of 1 ½ ft) is interesting.

The English foot (Table 7)

Table 7 shows that in the construction of the nave a 2, 3, 4, 6, or 9-foot or even 2, 3, 4, or 6-ell unit could have been used. The Base square could have been laid out using either a 2, 3, 6, or 9-foot or a 2, 3, 4, or 6-ell unit. (The Base radius is of course √ 2 x the side of the Base square.) Six is one of the perfect numbers, and the nave would be 6 x 6 feet wide externally. The number 153 (important because

Table 7 The dimensions in English (Staufian) feet (1'= .3048 m)

	ENGLISH FEET													ELL (1½ FEET)										
			Divided by												Divided by									
Dimensions	Figure used	Rounded by	√2	2	3	4	5	6	7	8	9	11	OTHER	Figure used	√2	2	3	4	5	6	7	8	9	Other
A EAST-WEST																								
a. Length of nave external	72	(+$\frac{15}{100}$)		36	24	18	$14\frac{2}{5}$	12		9	8			48		24	16	12	$9\frac{3}{5}$	8			$5\frac{1}{3}$	$\frac{496}{48} = 10\frac{1}{3}$
b. Length of eastern porticus external	24	(+$\frac{5}{100}$)	17	12	8	6	$4\frac{4}{5}$	4		3	$2\frac{3}{4}$			16		8	$5\frac{1}{3}$	4	$3\frac{1}{5}$	$2\frac{2}{3}$				$\frac{532}{16} = 33\frac{1}{4}$
c. Overall length of church external	96	(+$\frac{1}{5}$)		48	32	24	$19\frac{1}{5}$	16		12				64		32	$21\frac{1}{3}$	16	$12\frac{4}{5}$			8		√64 = 8
d. length of north and south porticus external	18	(+$\frac{4}{100}$)	$12\frac{3}{4}$	9	6	$4\frac{1}{2}$	$3\frac{3}{5}$	3			2		$\frac{153}{18} = 8\frac{1}{2}$	12	$8\frac{1}{2}$	6	4	3	$2\frac{2}{5}$	2		$1\frac{1}{2}$	$1\frac{1}{3}$	$\frac{496}{12} = 41\frac{1}{3}, \frac{153}{12} = 12\frac{3}{4}, \frac{532}{12} = 44\frac{1}{3}$
B. NORTH-SOUTH																								
a. Width of nave External	36	(+$\frac{7}{100}$)		18	12	9	$7\frac{1}{5}$	6		$4\frac{1}{2}$	4		√36 = 6	24	17	12	8	6	$4\frac{4}{5}$	4		3	$2\frac{2}{3}$	$\frac{496}{24} = 20\frac{2}{3}$
b. Width of eastern porticus external	24	(+$\frac{5}{100}$)	17	12	8	6	$4\frac{4}{5}$	4		3	$2\frac{3}{4}$			16		8	$5\frac{1}{3}$	4	$3\frac{1}{5}$	$2\frac{2}{3}$				
c. Width of north and south porticus external	18	(+$\frac{4}{100}$)	$12\frac{3}{4}$	9	6	$4\frac{1}{2}$	$3\frac{3}{5}$	3			2			12	$8\frac{1}{2}$	6	4	3	$2\frac{2}{5}$	2		$1\frac{1}{2}$	$1\frac{1}{3}$	$\frac{496}{12} = 41\frac{1}{3}, \frac{153}{12} = 12\frac{3}{4}, \frac{532}{12} = 44\frac{1}{3}$
d. Width of church across north and south porticus	72	(+$\frac{15}{100}$)		36	24	18	$14\frac{2}{5}$	12		9	8			48		24	16	12	$9\frac{3}{5}$	8			$5\frac{1}{3}$	$\frac{496}{48} = 10\frac{1}{3}$
C. OTHER DIMENSIONS																								
Wall thickness	$2\frac{1}{4}$	(-$\frac{5}{100}$)			$\frac{3}{4}$						$\frac{1}{4}$			$1\frac{1}{2}$			$\frac{1}{2}$			$\frac{1}{4}$				
Radius of base-circle (= base-radius)	$25\frac{1}{2}$	(+$\frac{1}{10}$)	18	$12\frac{3}{4}$	$8\frac{1}{2}$		$5\frac{1}{10}$	$4\frac{1}{4}$						17	12	$8\frac{1}{2}$	$5\frac{2}{3}$	$4\frac{1}{4}$	$3\frac{2}{5}$					$\frac{153}{17} = 9{,}10\frac{1}{2}$ x 0 16.989
Half base-radius	$12\frac{3}{4}$	(+$\frac{5}{100}$)	9		$4\frac{1}{4}$									$8\frac{1}{2}$	6	$4\frac{1}{4}$								
Side of base square	18	(+$\frac{4}{100}$)	$12\frac{3}{4}$	9	6	$4\frac{1}{2}$	$3\frac{3}{5}$	3			2		$\frac{153}{18} = 8\frac{1}{2}$	12	$8\frac{1}{2}$	6	4	3	$2\frac{2}{5}$	2		$1\frac{1}{2}$	$1\frac{1}{3}$	$\frac{496}{12} = 41\frac{1}{3}, \frac{153}{12} = 12\frac{3}{4}, \frac{532}{12} = 44\frac{1}{3}$
Circumference of nave	216	(+$\frac{45}{100}$		108	72	54	$43\frac{1}{5}$	36		27	24		12 x 18, 16 x $13\frac{1}{2}$	144		72	48	36	$28\frac{4}{5}$	24		18	16	√144 = 12, 15 x $9\frac{3}{5}$
Circumference of Church Overall	336	(+$\frac{70}{100}$		168	112	84	$67\frac{1}{5}$	56	48	42	$37\frac{1}{3}$		√336 = $18\frac{1}{3}$, 12x28, 14 x 24, 16 x 21	224		112	$74\frac{2}{3}$	56	$44\frac{4}{5}$	$37\frac{1}{3}$	32	28		12 x $18\frac{2}{3}$, 14 x 16, 21 x $10\frac{2}{3}$
D. INTERNAL ARRANGEMENT: a. Distance: F.171 -F.5, focus	42			21	14	$10\frac{1}{2}$	$8\frac{2}{5}$	7	6	$5\frac{1}{4}$	$4\frac{2}{3}$			24	17	12	8	6	$4\frac{4}{5}$	4		3	$2\frac{3}{4}$	
b. Distance F.171 – F.58, F.58-F.40, F.40-F.5	14			7	$4\frac{2}{3}$	$3\frac{1}{2}$	$2\frac{4}{5}$	$2\frac{1}{3}$	2	$1\frac{3}{4}$				$9\frac{1}{3}$		$4\frac{2}{3}$		$2\frac{1}{3}$			$1\frac{1}{3}$			

Table 8 The dimensions in Drusian (Carolingian) feet (1'= 0.33 m)

	DRUSIAN FEET													ELL ($1\frac{1}{2}$ FEET)										
Dimensions	Figure used	Rounded by	Divided by √2	2	3	4	5	6	7	8	9	11	OTHER	Figure used	Divided by √2	2	3	4	5	6	7	8	9	Other
A. EAST-WEST																								
a. Length of nave external	66	(+$\frac{28}{100}$)	$46\frac{2}{3}$	33	22	$16\frac{1}{2}$	$13\frac{1}{5}$	11		$8\frac{1}{4}$	$7\frac{1}{3}$	6	$\frac{100}{66} = 1\frac{4}{6} = 1\frac{2}{3}$	44	$31\frac{1}{9}$	22	$14\frac{2}{3}$	11	$8\frac{4}{5}$	$7\frac{1}{3}$		$5\frac{1}{2}$		11 x 4
b. Length of eastern porticus external	22	(+$\frac{9}{100}$)	$15\frac{5}{9}$	11	$7\frac{1}{3}$	$5\frac{1}{2}$	$4\frac{2}{5}$	$3\frac{2}{3}$		$2\frac{3}{4}$		2	$\frac{110}{22} = 5$	$14\frac{2}{3}$		$7\frac{1}{3}$		$3\frac{2}{3}$						$\frac{100}{14\frac{2}{3}} = 7\frac{1}{2}$
c. Overall length of church external	88	(+$\frac{37}{100}$)		44	$29\frac{1}{3}$	22	$17\frac{3}{5}$	$14\frac{2}{3}$		11		8		$58\frac{2}{3}$		$29\frac{1}{3}$		$14\frac{2}{3}$				$7\frac{1}{3}$		
d. length of north and south porticus external	$16\frac{1}{2}$	(+$\frac{7}{100}$)	$11\frac{2}{3}$	$8\frac{1}{4}$	$5\frac{1}{2}$	$4\frac{1}{8}$		$2\frac{3}{4}$					$\frac{100}{16\frac{1}{2}} = 6\frac{2}{3}$	11	$7\frac{7}{9}$	$5\frac{1}{2}$	$3\frac{2}{3}$	$2\frac{3}{4}$	$2\frac{1}{5}$					$\frac{100}{11}$=10, 1x 11
B. NORTH-SOUTH																								
a. Width of nave External	33	(+$\frac{14}{100}$)	$23\frac{1}{3}$	$16\frac{1}{2}$	11	$8\frac{1}{4}$	$6\frac{3}{5}$	$5\frac{1}{2}$			$3\frac{2}{3}$	3	$\frac{110}{33} = 3\frac{1}{3}$	22	$15\frac{5}{9}$	11	$7\frac{1}{3}$	$5\frac{1}{2}$	$4\frac{2}{5}$	$3\frac{2}{3}$		$2\frac{3}{4}$		2 x 11
b. Width of eastern porticus external	22	(+$\frac{9}{100}$)	$15\frac{5}{9}$	11	$7\frac{1}{3}$	$5\frac{1}{2}$	$4\frac{2}{5}$	$3\frac{2}{3}$		$2\frac{3}{4}$		2	$\frac{110}{22} = 5$	$14\frac{2}{3}$		$7\frac{1}{3}$		$3\frac{2}{3}$						$\frac{100}{14\frac{2}{3}} = 7\frac{1}{2}$
c, Width of north and south porticus external	$16\frac{1}{2}$	(+$\frac{7}{100}$)	$11\frac{2}{3}$	$8\frac{1}{4}$	$5\frac{1}{2}$	$4\frac{1}{8}$		$2\frac{3}{4}$					$\frac{100}{16\frac{1}{2}} = 6\frac{2}{3}$	11	$7\frac{7}{9}$	$5\frac{1}{2}$	$3\frac{2}{3}$	$2\frac{3}{4}$	$2\frac{1}{5}$					$\frac{100}{11}$=10, 1x 11
d. Width of church across north and south porticus	66	(+$\frac{28}{100}$)	$46\frac{2}{3}$	33	22	$16\frac{1}{2}$	$13\frac{1}{5}$	11		$8\frac{1}{4}$	$7\frac{1}{3}$	6	$\frac{100}{66} = 1\frac{4}{6} = 1\frac{2}{3}$	44	$31\frac{1}{9}$	22	$14\frac{2}{3}$	11	$8\frac{4}{5}$	$7\frac{1}{3}$		$5\frac{1}{2}$		11x4
C. OTHER DIMENSIONS																								
Wall thickness	2	(-$\frac{1}{10}$)		1	$\frac{2}{3}$	$\frac{1}{2}$	$\frac{2}{5}$			$\frac{1}{4}$			$2 = \sqrt{2} \times \sqrt{2}$	$1\frac{1}{3}$		$\frac{2}{3}$								
Radius of base-circle (= base-radius)	$23\frac{1}{3}$	(+$\frac{8}{100}$)	$16\frac{1}{2}$	$11\frac{2}{3}$			$4\frac{2}{3}$		$3\frac{1}{3}$				$\sqrt{23\frac{1}{3}} = 4\frac{5}{6}$	$15\frac{5}{9}$	11									
Half base-radius	$11\frac{2}{3}$	(+$\frac{4}{100}$)					$2\frac{1}{3}$		$1\frac{2}{3}$					$7\frac{7}{9}$	$5\frac{1}{2}$									
Side of base square	$16\frac{1}{2}$	(+$\frac{7}{100}$)	$11\frac{2}{3}$	$8\frac{1}{4}$	$5\frac{1}{2}$	$4\frac{1}{8}$		$2\frac{3}{4}$					$\frac{100}{16\frac{1}{2}} = 6\frac{2}{3}$	11		$5\frac{1}{2}$	$3\frac{2}{3}$	$2\frac{3}{4}$	$2\frac{1}{5}$					$\frac{100}{11}$=10, 1x 11
Circumference of nave	198	(+$\frac{70}{100}$)	140	99	66	$49\frac{1}{2}$	$39\frac{3}{5}$	33		$24\frac{3}{4}$	22	18	$\frac{198}{12} = 16\frac{1}{2}$, $\frac{198}{15} = 13\frac{1}{5}$	132		66	44	33	$26\frac{2}{5}$	22		$16\frac{1}{2}$	$14\frac{2}{3}$	$\frac{132}{11} = 12$
Circumference of Church Overall	308	(+$1\frac{9}{100}$)		154	$102\frac{2}{3}$	77	$61\frac{3}{5}$	$51\frac{1}{3}$	44	$38\frac{1}{2}$		28	$\frac{308}{12} = 25\frac{3}{4}$, $\frac{308}{14} = 22$	$205\frac{1}{3}$		$102\frac{2}{3}$		$51\frac{1}{3}$			$29\frac{1}{3}$	$25\frac{2}{3}$		
D. INTERNAL ARRANGEMENT: a. Distance: F.171 -F.5, focus	39			$18\frac{1}{2}$	13	$9\frac{3}{4}$	$7\frac{4}{5}$	$6\frac{1}{2}$			$4\frac{1}{3}$			26		13	$8\frac{2}{3}$	$6\frac{1}{2}$	$5\frac{1}{5}$	$4\frac{1}{3}$		$3\frac{1}{4}$		
b. Distance F.171 – F.58, F.58-F.40, F.40-F.5	13			$6\frac{1}{2}$	$4\frac{1}{3}$	$3\frac{1}{4}$	$2\frac{3}{5}$							$8\frac{2}{3}$		$4\frac{1}{3}$								

Table 9 The dimensions in long Carolingian (*pied de Lyon)* feet (1'=0. 34 m)

	LONG CAROLINGIAN FEET														ELL ($1\frac{1}{2}$ FEET)										
Dimensions	Figure used	Rounded by	Divided by √2	2	3	4	5	6	7	8	9	11	OTHER		Figure used	Divided by √2	2	3	4	5	6	7	8	9	Other
A. EAST–WEST																									
a. Length of nave external	$64\frac{1}{2}$	$(+\frac{9}{100})$		$32\frac{1}{4}$	$21\frac{1}{2}$			$10\frac{3}{4}$							43		$21\frac{1}{2}$	$14\frac{1}{3}$	$10\frac{3}{4}$						
b. Length of eastern porticus external	$21\frac{1}{2}$	$(+\frac{3}{100})$		$10\frac{3}{4}$											$14\frac{1}{3}$										
c. Overall length of church external	86	$(+\frac{12}{100})$		43	$28\frac{2}{3}$	$21\frac{1}{2}$	$17\frac{1}{5}$	$14\frac{1}{3}$		$10\frac{3}{4}$					$57\frac{1}{3}$		$28\frac{2}{3}$		$14\frac{1}{3}$						
d. length of north and south porticus external	$16\frac{1}{8}$	$(+\frac{2}{100})$	$11\frac{3}{8}$												$10\frac{3}{4}$	$7\frac{7}{12}$									
B. NORTH-SOUTH																									
a. Width of nave External	$32\frac{1}{4}$	$(+\frac{5}{100})$	$15\frac{1}{5}$		$10\frac{3}{4}$										$21\frac{1}{2}$		$10\frac{3}{4}$								
b. Width of eastern porticus external	$21\frac{1}{2}$	$(+\frac{3}{100})$		$10\frac{3}{4}$											$14\frac{1}{3}$										
c, Width of north and south porticus external	$16\frac{1}{8}$	$(+\frac{2}{100})$	$11\frac{3}{8}$												$10\frac{3}{4}$	$7\frac{7}{12}$									
d. Width of church across north and south porticus	$64\frac{1}{2}$	$(+\frac{9}{100})$		$32\frac{1}{4}$	$21\frac{1}{2}$			$10\frac{3}{4}$							43		$21\frac{1}{2}$	$14\frac{1}{3}$	$10\frac{3}{4}$						
C. OTHER DIMENSIONS																									
Wall thickness	$2\frac{1}{8}$	$(+\frac{7}{100})$													$1\frac{5}{12}$										
Radius of base-circle (= base-radius)	$22\frac{3}{4}$	$(-\frac{3}{100})$	$16\frac{1}{8}$						$3\frac{1}{4}$						$15\frac{1}{6}$	$10\frac{3}{4}$									
Half base-radius	$11\frac{3}{8}$	$(-\frac{1}{100})$													$7\frac{7}{12}$										
Side of base square	$16\frac{1}{8}$	$(+\frac{2}{100})$													$10\frac{3}{4}$	$7\frac{7}{12}$									
Circumference of nave	$193\frac{1}{2}$	$(+\frac{26}{100})$		$96\frac{3}{4}$	$64\frac{1}{2}$			$32\frac{1}{4}$			$21\frac{1}{2}$				129		$64\frac{1}{2}$	43	$32\frac{1}{4}$	$25\frac{4}{5}$	$21\frac{1}{2}$			$14\frac{1}{5}$	
Circumference of Church Overall	301	$(+\frac{41}{100})$		$150\frac{1}{2}$	$100\frac{1}{3}$	$7\frac{1}{4}$ 5	$60\frac{1}{5}$		43						$200\frac{2}{3}$		$100\frac{1}{3}$					$28\frac{2}{3}$			$14x14\frac{1}{3}$
D. INTERNAL ARRANGEMENT: a. Distance: F.171 -F.5, focus	38			19	$12\frac{2}{3}$	$9\frac{1}{2}$	$7\frac{3}{5}$	$6\frac{1}{3}$		$4\frac{3}{4}$					$25\frac{1}{3}$		$12\frac{2}{3}$		$6\frac{1}{3}$						
b. Distance: F.171 – F.58, F.58-F.40, F.40-F5	$12\frac{2}{3}$			$6\frac{1}{3}$											$8\frac{4}{9}$										

it represents the number of fishes caught in the Miraculous Draught and is used in a significant way six times in the layout of Old St Peter's; Bannister 1968, 21-2) divided by the length of the side of the Base square, 18 feet, is 8½, or 1/3 the Base radius. 153 divided by the length of the Base radius is 6, or 1/3 the side of a Base square. In feet, 153 is l/3 Base radius x the side of the Base square. In ell, 153 is ¾ Base radius x the side of the Base square; 153 divided by the length of the Base radius equals 9. It would be possible to construct the church using a 9-foot or 6-ell unit, or a 6-foot or 4-ell unit, with 153 as an important number.

Table 10 shows how divisions of 153 can be set against the Pythagorean series of musical numbers. The resulting figures account for all the important dimensions of the church in English feet as can be seen by comparing Table 7 with Table 10. For the internal arrangement of the axial circular foundations the magical number seven might have been of importance. However the 'steps' in the east porticus floor cannot be accommodated in the English foot. Table 11 shows a 9 or 6-system set against the Pythagorean series of musical numbers. Here again important dimensions of the church in English feet occur. More of the important dimensions occur however in the 153 table (Table 10) than in Table 11.

This short discussion shows that there is no single unit in any one system which stands out as being 'right'. The 153-system is interesting, particularly if combined with a 6-foot unit, but no definite result emerges from the English foot possibility.

The Drusian (Carolingian) foot (Table 8)

Table 8 shows that a 2, 3, 4, 6, 9, or 11-foot unit is possible, also a l-e11 unit. The number 110 might be important here (the sum of the dimensions of the Temple in Jerusalem (Conant 1963, 12; Bannister 1968, 16-20)).

If Table 8 is compared with Table 10 (the 153-system), it can be seen that no Drusian dimensions occur there. The same is the case if Tables 11, 12, and 13 are compared with Table 8. However, if one multiplies the Pythagorean series of musical numbers by 11 (Table 14), most of the important dimensions can be accounted for. If the unit used was 1 ell, v2 x 11 would equal the Base radius and the length of the side of the Base square would be 11 ell (cf Tables 8 and 14).[4] As has been pointed out, the Drusian foot is the only unit which matches the 'steps' on the 7th century floor in the east porticus, and which may indeed give us the unit of measurement in the 1 foot division (C-D), as well as suggesting a 3-foot module.

As for the much more hypothetical dimensions of the circular foundations in the nave, the Drusian foot works best, but the English foot as well as others also fit. These distances cannot be a decisive factor in the discussion of the unit of measurement.

The most crucial dimension of all, namely the side of a Base square, is 16½ Drusian feet long. This module of 16½ feet is a rod, an Anglo-Saxon unit of measurement used for instance in the charter of Edward the Elder *c* 904, granting land to New Minster (Quirk 1961; Sawyer 1968, no 1443). Table 15 shows how all principal dimensions of the 7th century church, laid out in the Drusian foot, appear using a 16½-foot unit system against the Pythaeorean musical ratio 3:4:5.

The long carolingian (pied de Lyon) *foot (Table 9)*

Table 9 shows that this foot provides no obvious unit in the 7th century church.[5]

Controlling dimensions

The basic proportions'

The basic proportions of the 7th century church were suggested above and may be repeated here, and then further explored in terms of the various feet:

Nave 1ength:nave width	2:1
Nave 1ength:east porticus	3:1
Nave east-west: porticus north-south	1:1

The English foot (Table 7)

The modules could be 31, 7, and 3 ell, following the 'Isidorian' system (Table 12); the ratios are the musical ratios 1:2, 1:3, 1:4, 1:6, 1:8, 1: 10, 1:12, and 1: 16. The wall width is ½ a module of 3 ell; the side of the base square is 2 modules of 3 ell; the width of the nave is 8 modules of 3 ell, and the length is 16 modules of 3 ell. For the east porticus the dimension is an unsatisfactory 5l/3 modules of 3 ell.

Important distances not included in Table 12 depend on the square root of two. The 1: v2 ratio of Vitruvius seems to have been important in the early Middle Ages (Conant 1968, 33-8) and perhaps also in Winchester. It is after all only the coefficient of the diagonal of a square, here a square with sides equal to 12 ell. The circumference of the nave is 144 ell (equal to 12^2) or 216 feet (equal to 6x6x6).

If one believes that the English foot was used as a basis for constructing the 7th century church in Winchester, then the Base square stands out as being the primary element, as indeed it is, for different reasons, when using the Drusian foot. The dimensions in the English foot could have been Pythagorean and the system used (if any) may have been Isidorian, in which both the perfect number six and the magical number seven played an important role. The number seven could have been important if the hypothetical distance between the circular foundations is correct.

The Drusian (Carolingian) foot (Table 8)

The module could be either 1 foot as marked in the east porticus or 1 ell. The number 110 may have been important and the basis for calculations would have been the side of the Base square, 16½ feet (one rod) or 11 ell long. Table 15 shows how all the important dimensions with modules 1, 2, and 3 work with the Pythagorean musical ratio 3:4:5. Table 14 uses 110 as the vital number, set against 2, 3, and 4. In this small table all the dimensions again occur.

Discussion

The preceding pages have shown that the classical Roman foot and the long Carolingian foot *(pied de Lyon)* are unlikely to have been used in laying out the 7th century church. This leaves the English (Staufian) foot and the Drusian (Carolingian) foot. Of these only the Drusian foot fits the 'steps' in the east porticus floor and, perhaps less important, only the Drusian foot would make the distance between the inner face of the west wall of the nave and the

Tables 10-15 Possible controlling dimensions in the 7th century church

Table 10
153 Module

	⅓	17	8½	5⅔	3*	2⅔
	½	25½	12¾	8½	4½	4¼
Modules	*1**	51	25½	17	9*	8½
		(+153÷3)	(+153÷6)	(+153÷9)	(+153÷17)	(+153÷18)
	2*	102	51	34	18	17
	3*	+153	76½	51	27	25½
	4*	204	102	68	36	34
	**6*	306	+153	102	54	51
	8*	408	204	136	72	68
	9*	459	229½	+153	81	76½
	12*	612	306	204	108	102
(by extension)	16*	816	408	272	144	136

Table 11
9 or 6 system

3*	2*	*1*	⅔
4½	3*	1½	*1*
9*	**6*	3*	2*
		(9÷3)	(6÷3)
18	12*	**6*	4*
27	18	9*	**6*
36	24	12*	8*
54	36	18	12*
72	48	24	16*
81	54	27	18
108	72	36	24
144	96	48	32

Table 12
Isidorian system

	⅓	10⅓	2⅓	*1*
	½	15½	3½	1½
Modules	*1**	+31	+7	3*
	2*	62	14	**6*
	3*	93	21	9*
	4*	124	**28	12*
	**6*	186	42	18
	8*	248	56	24
	12*	372	84	36
(by extension)	16*	**496	112	48

Table 13
Fibonaccian system

1⅔	2⅔	4⅓	+7	11⅓	18⅓
2½	4*	6½	10½	17	27½
+5	8*	13	21	34	55
+10	16	26	42	68	+110
15	24	39	63	102	165
+20	32	52	84	136	220
+30	48	78	126	204	330

Table 14
110 Module

Modules	*1**	22	11	5½
		(+110÷5)	(+110÷10)	(+110÷20)
	2*	44	22	11
	3*	66	33	16½
	4*	88	44	66

Table 15
16½ Module

	¼	4⅛	8¼	16½
	⅓	5½	11	22
Modules	*1**	16½	33	66
		(16½×1)	(16½×2)	(16½×4)
	3*	49½	99	198
	4*	66	132	264
	+5*	82½	165	330

* Pythagorean musical number
1 Isidorian 'monad'
** Perfect number (symbol precedes number)
\+ 'Symbolic' number

In these tables the numbers in each column are derived by multiplying the number in the module line by *the division or multiples shown* in *the left hand column of each table.*

focus of F.171 equal to the distances between F. 171, F.58, F.40, and F.5. It cannot be ignored that the controlling dimension in the Drusian foot is the rod of 16½ feet.

On balance it seems that the Drusian (Carolingian) foot is the one which was used. Had we not found the 'steps' in the east porticus floor, the English foot might at first have seemed almost as likely as the Drusian foot, but the further analysis presented here demonstrates that the Drusian (Carolingian) foot and the rod module were in use in the first church at Winchester. In a wider context, it is perhaps significant that the Continental evidence suggests that the Staufian (here English) foot tends to be late rather than early (ie 10th rather than 7th century) (Binding 1971, 64; Sunderland 1959), while the Drusian foot seems to emerge early, to become the standard foot of the Carolingian empire, or at any rate the standard from which builders deviated (Horn & Born 1966, esp 290-l).

Had there been remains of the standing walls of this church, it might have been possible to work from these to the unit of measurement supposedly used. A foot could have been derived which would, say, make the total length equal to 100 feet, or whatever other rounded number was wanted. But it would not be easy to find a foot which fitted with 'better' numbers than either the English or the Drusian foot. Were we to make the nave 0.0456m longer than the theoretical 21.90m, the side of the Base square would then be 0.0114m longer and the English foot would fit exactly. If the nave were to be made 0.10m longer than 21.90m, the side of the Base square would then be 0.025m longer and the Drusian foot would fit exactly.

Because of the 'steps' in the east porticus (which may have been barely noticeable on the floor, since they were covered in mortar), and because of the emergence of the 16½ feet rod which will not work in English feet, the Drusian foot has been chosen as the one used in the 7th century. In drawing the plan (Fig 136) the walls of the 7th century church have been moved on the plan from the theoretical positions so that all measurements work in the Drusian foot (Fig 136, Table 8). The centre-line is placed on 500.20N, the west face of the nave is placed along 758.40E, and the north and south faces along 505.70N (instead of 505.75N) and 494.70N (instead of 494.80N).

This church was added to and changed during the next four centuries. All these additions, as well as the placing of vital graves on the centre-line, work exactly with a 7th century church built in the Drusian foot, with a Base square of 16½ Drusian feet to the side (5.50m). These additions include apses constructed with Base radii of v2 x 16½ = 23½ Drusian feet (7.78m). In other words, the system proposed here works.

From the apparently hopelessly destroyed remains of Cenwalh's church it has been possible to suggest that in Wessex in the mid 7th century a church was constructed using:

1 the Drusian foot (0.333m);
2 a rod of 16½ Drusian feet (5.50m);
3 with planned proportions of 1: 1, 1:2, 1:3.
4 Most speculatively, the dimensions of the Winchester church were perhaps based upon the sum of the dimensions of the Temple of Jerusalem: 110.

Notes

1 Interim reports by Martin Biddle on the excavations of 1962–9 are in *Antiq J*, **44** (1964) to **50** (1970).

2 A full discussion will appear in Martin Biddle and Birthe Kjølbye-Biddle, *The Anglo-Saxon minsters of Winchester*, Winchester Studies, **4**.i, Oxford (forthcoming).

3 This foot may simply be a deviant of the Drusian foot, but it was used at Cluny II: see Conant 1961. See also Sunderland 1957, 2–5.

4 The number 11 is certainly likely to have been important: cf Augustine, *The City of God*, Book XVIII.1ii '. . . no further persecution remains except the eleventh, which is held to be in the very time of Antichrist'; or, indeed, *Byrhtferth's Manual* (Early Engl Text Soc, original ser, **177** (1929; repr 1966), 221).

5 It is rather satisfactory that the long Carolingian foot does not make especially good sense in a 7th century church, since it seems to be a late unit, found for instance in Cluny II and Charlieu (Burgundy) in the second half of the 10th century; see above, n3.

6 Most continental churches of relevant date are smaller than the 7th century Winchester minster. These small churches tend to be 'fatter' than the 1:2 nave ratio in Winchester. Amongst the churches published by Binding only three larger churches have a ratio higher than 5:8, and several are wider north–south than east–west. The largest church has a nave *c* 33 Staufian feet long east–west internally (Binding 1971, 1–87). Reichenau-Niederzell is a church dedicated in 779, with a nave 64 Carolingian feet (of 0.3329m) long, and a nave ratio of 1:2 (Erdman 1973, 91–103). Most surviving Anglo-Saxon churches are large in comparison with Binding's examples. For a discussion of nave ratios, see Taylor 1978, 1031–4, and a review article by Martin Biddle, Rosemary Cramp, Milton McC Gatch, Simon Keynes, and Birthe Kjølbye-Biddle of *Anglo-Saxon architecture* in *Anglo-Saxon England*, **14** (forthcoming).

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