THE DESIGN OF THE ANCIENT SYNAGOGUES IN GALILEE - V*

Beth Yerach, Horvat Shema', and 'En Neshut

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Beth Yerach (Fig. 1)[1]

To discern the original unit of measurement used in the design of the plan of the building we divide the inner width of the naos, 20.75 m, by consecutive whole numbers:

20.75 m : 2 = 10.38 m
" : 3 = 6.92 m
" : 4 = 5.19 m
" : 5 = 4.15 m
" : 6 = 3.46 m
" : 7 = 2.96 m
" : 8 = 2.59 m

Since 2.96 m is very close to the length of the standard Roman *decempeda*, 2.957 m, the basic unit of measurement is the Roman foot, *pes*, of 0.2957 m.

Calculation of the dimensions of the building according to the *pes* of 0.2957 m gives:

Inner (axial) length of the building: 121 *pedes* = 35.78 m (35.80 m average of the measurements)
Inner length of the naos: 100 *pedes* = 29.57 m (29.75 m measured)
Inner width of the naos: 70 *pedes* = 20.70 m (20.75 m measured)
Inner width of the nave (clear): 33 *pedes* = 9.758 m (9.70 m measured)
Inner width of the nave (foundations): 30 *pedes* = 8.87 m (8.90 m measured)

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*. The present article is the fifth in a series of contributions that have appeared in this journal. The four preceding contributions – 28 (1978) 193-202; 30 (1980) 255-258; 36 (1986) 235-240; 38 (1988) 247-252 – are by D. Chen.

1. Hiram, A.S., "Synagogenkirchen der Ecclesia ex Circumcisione im Heiligen Lande", *Akten des VII Internationalen Kongresses für Christliche Archäologie*, Trier 1965, Pl. 5.

LA 41 (1991) 449-454; Pls. 55-56

Inner width of the lateral aisles (clear): $16^1/_2$ *pedes* = 4.88 m (4.90 m the average of the measurements)
Inner width of the transverse aisle (clear): 13 *pedes* = 3.84 m (3.85 m measured)
Chord of the apse (clear): 33 *pedes* = 9.75 m (9.70 m measured)
Chord of the apse (foundations): 30 *pedes* = 8.87 m (8.90 m measured)
Depth of the apse (clear): 21 *pedes* = 6.21 m (6.22 m measured)
Depth of the apse (foundations): $19^1/_2$ *pedes* = 5.77 m (5.80 m measured)
Inner length of lateral rooms: $17^1/_2$ *pedes* = 5.17 m (5.10 m measured)
Inner width of lateral rooms: $16^1/_2$ *pedes* = 4.88 m (4.92 m measured)
Breadth of the foundations of the lateral walls of the building: 4 *pedes* = 1.18 m (1.20 m measured)
Breadth of the back wall of the building: 3 pedes = 0.887 m (0.90 m measured)
Breadth of the back wall and the front wall of the lateral rooms: $3^1/_2$ *pedes* = 1.03□m (1.05 m measured)
Breadth of the lateral stylobates in the naos: $3^1/_2$ *pedes* = 1.03 m (1.05 m measured)
Breadth of the stylobate of the transverse aisle in the naos: 5 *pedes* = 1.48 m (1.50□m measured)

The ratio between the inner length and the inner width of the naos is:

$$\frac{100\ pedes}{70\ pedes} = 1.428$$

or, measured at the site:

$$\frac{29.75\ \text{m}}{20.75\ \text{m}} = 1.434$$

In both coefficients we readily recognize the value of the second root of two, 1.414, which engenders the *diagon* (the $\sqrt{2}$:1 rectangle).

The ratio between the inner length and the inner width of the building is:

$$\frac{121\ pedes}{70\ pedes} = 1.728$$

or, measured at the site:

$$\frac{35.80\ \text{m}}{20.75\ \text{m}} = 1.725$$

These coefficients are very close to the value of the second root of three, 1.732, which engenders the *sixton* (the $\sqrt{3}$:1 rectangle).

We reconstruct the stages in the design of the plan as follows (Fig. 1): First, the inner width of the naos was set by laying out the square ABCD with base AB 70 *pedes* long. This dimension is identical to the inner length of the synagogue at Chorazin.[2] Second, projecting the diagonal BD of the square ABCD aside, the architect defined the inner length of the naos at 100 *pedes* long, forming the geometric figure of the *diagon* ABFE. The inner contour of the building and the apex of the apse were set by projecting aside the diagonal AF of the diagon ABFE, 121 *pedes* long, engendering the *sixton* ABGH.

In considering the sub-division of the naos into the nave and lateral aisles we rely: (a) on the dimensions of a column- base found on the stylobate of the western colonnade, it measures 0.58 m by 0.58 m, that is 2 by 2 *pedes*, and (b) on the clear length of the chord of the apse which measures 33 *pedes.* Since the chord of the apse, 33 *pedes*, plus half the width of both stylobates, 2 *pedes*, render the axial width of the nave at 35 *pedes* , the axis of the colonnades must have been set 35 *pedes* apart. This dimension is exactly half the inner width of the naos, showing the inner division follows the pattern 1:2:1.

Horvat Shema' (Fig. 2)[3]

We discern the unit of measurement used in the design of.the plan of the building in the breadth of the outer walls which measure in average 0.90 m This dimension closely corresponds to two standard Roman *cubiti*, which is the same as 3 Roman *pedes* of 0.2957 m

Calculation of the dimensions of the naos according to the *cubitus* of 0.4435 m yields:

Inner length of the naos: $31\frac{1}{2}$ *cubiti* = 13.97 m (13.80 m to 14.00 measured).
Inner width of the naos: 21 *cubiti* = 9.313 m (9.25 m to 9.35 m measured).
Width of the nave (clear): 8 *cubiti* = 3.548 m (3.45 m to 3.55 m measured).
Width of the aisles (clear): 5 *cubiti* = 2.217 m (2.15 m to 2.31 m measured).
Breadth of the outer walls: 2 *cubiti* = 0.887 m (0.90 m average of measurements).

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2. Chen, D. "The Design of the Ancient Synagogues in Galilee", i, *LA* 28 (1978) 193-202.

3. Meyers, E.M., Kraabel, A.T., and Strange, J.F., *Ancient Synagogue Excavations at Khirbet Shema', Upper Galilee, Israel 1970-1972*, Durham 1976, 37; Meyers, E.M., "The Synagogue at Horvat Shema', in Levine, I., (ed.) *Ancient Synagogues Revealed*, Jerusalem 1981, 70-74; .

The ratio between the inner length and the inner width of the naos is:

$$\frac{31\,^1/_2\ \textit{cubiti}}{21\ \textit{cubiti}} = 1.5$$

or, measured at the site (the average of the measurements):

$$\frac{13.90\ \text{m}}{9.30\ \text{m}} = 1.495$$

Both ratios reflect the *hemiolion* (the 3:2 rectangle) as the geometric figure that engendered the plan of the naos.

We reconstruct the stages in the design of the plan as follows (Fig. 2): First,the square ABCD, having base AB 21 *cubiti* long, was laid out, thus the inner width of the naos was set. Second, by projecting aside half the side CD, $10\,^1/_2$ *cubiti* long, the architect defined the *hemiolion* ABFE and thus outlined the inner length of the naos. Third, since the inner width of the naos, 21 *cubiti*, the clear width of the nave, 8 *cubiti*, and the clear width of the aisles, 5 *cubiti*, correspond numerically to the members of the first Fibonacci series: (1), 1, 2, 3, ***5***, ***8***, 13, ***21***, 34, . . . clearly, the architect subdivided the naos of the synagogue in terms of the proportion of the Golden Section.

Perhaps owing to the terrain and since the synagogue was erected in an already densely built quarter, the monumental stairway and the room adjacent to the naos (in the western part of the synagogue) do not reflect any distinct geometric, harmonic, or modular pattern.

Ein Nashut(Fig. 3)[4]

In discussing the role of the preferential numbers in the early Byzantine architecture in the East D. Chen[5] noted that the length of 10.40 m – equiva-

4. Ma'oz, Z., "The Art and Architecture of the Synagogues of the Golan", in Levine, I., (ed.) *Ancient Synagogues Revealed*, Jerusalem 1981, 98-105; idem, "Ancient Synagogues of the Golan", *Biblical Archaeologist* 51/2 (June) 1988, ff.

5. Chen, D., "On Planning of Synagogues and Churches in Palaestina: A Comparison with Syria and Illyricum", in G.C. Bottini - L. Di Segni et al. (eds.), *Christian Archaeology in the Holy Land: New Discoveries*. Archaeological Essays in Honour of V.C. Corbo, Jerusalem 1990, 523-534.

lent to 33 Byzantine *podes* of 0.315 m – features as: the radius of the dome of the Rotunda Anastasis in Jerusalem, the inner width and length of the baptistery of the North Church at Emmaus-Nicopolis, the inner width of the synagogue at ed Dikke, in Galilee, the inner width of the Central Church at Herodium[6], and as the inner length of the synagogue at Ein Nashut.

Calculation of the dimensions of the naos of the synagogue at Ein Nashut according to the *pous* of 0.315 m renders:

Inner length of the naos: 33 *podes* = 10.395 m (10.40 m measured)
Inner width of the naos: 30 *podes* = 9.45 m (9.44 m to 9.30 m measured)
Width of the nave (clear): 15 *podes* = 5.197 m (5.23 m to 5.27 m measured)
Width of the aisles (clear): $5^1/_2$ *podes* = 1.73 m (1.69 m measured)

The ratio between the inner length and the inner width of the naos is:

$$\frac{33\ podes}{30\ podes} = 1.1$$

or, measured at the site (the average of the measurements):

$$\frac{10.40\ \text{m}}{9.37\ \text{m}} = 1.11$$

In both coefficients we recognize the value of the half the second root of five, 1.118, which engenders the *hemidiagon* (the $\frac{\sqrt{5}}{2}$:1 rectangle).

We reconstruct the stages in the design of the plan as follows (Fig. 3): First the square ABCD was set, 30 *podes* by 30 *podes*, which defined the inner width of the naos. Next, this square was subdivided into four smaller squares. The centers of these squares at points E and F define the position of the colonnades in the naos, which is the the clear width of the nave, 15 *podes*. After the inner width of the naos and the clear width of the nave had been set, the basic square ABCD was divided into two rectangles ADHG and BCHG, each 15 *podes* by 30 *podes*. By projecting aside diagonals of these rectangles the architect

6. Milson, D., "Byzantine Architects at Work at Herodium, Palaestina Prima", *LA* 39 (1989) 209.

formed the *hemidiagon* ABJI, 33 *podes* by 30 *podes*, and thus fixed the inner contour of the naos.

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