HOUSES OF NIPPUR: AN ARCHITECTURAL STUDY USING ENCAB

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Abstract
The article presents an examination of the cost of construction, in terms of working hours and manpower, of three contemporary 2nd millennium private houses from areas TA and TB at Nippur, calculated using energetic algorithms from the EnCAB digital publication.

1. Introduction

The aim of this article is to provide a synchronic view of one specific type of domestic architecture found in Nippur, the square type house found in excavation areas TA and TB.[1] By examining precise calculations of perimeter, area and volume of the diverse spaces (as walls, roofed space and courtyards) in a building, a more accurate understanding of the structure can be obtained: specifically, internal analysis relating to function and space, comparative analysis relating to relative 'costs' between buildings, as well as an analysis of the choices made when planning a structure. In terms of internal analysis, for example, questions relating to the proportion between roofed and open space within a structure can be answered, or examinations of room size for spaces dedicated to specific functions (such as kitchens or storage).[2] The use of volumetric calculations of the built space, together with algorithms which make it possible to quantify 'cost' (in terms of energy), allows scholars to compare structures on a much deeper level than mere size.[3] Such an approach also lends itself to studies examining choices made by ancient architects and builders – for example, what is the added cost in terms of roofing beams if one area was divided into a roofed space and a courtyard as opposed to a single large courtyard (as is the case with House I rooms 152a and 152b, see below)?

On the technical level, this analysis uses CAD software to measure and analyze the floor plans of the structures as well as create 3D models of the walls in order to calculate the volume of the built environment. On the basis of that data, the Energetic Calculator for Ancient Buildings – EnCAB is used to examine the material and energetic cost of the structures.[4]

Two principles serve as the foundation for the research being proposed here: the use of 'old data' and reproducibility. It is unfortunately often the case that projects in digital humanities require new data to be collected, making older studies obsolete (consider laser scanning, photogrammetry, scanning of cuneiform tablets, database or GIS-based field documentation techniques). The methodology followed here gives a series of measurements and calculations which allow not only for a comparison within this paper but also proposes a means of analyzing architecture which can be duplicated in a wide range of other contexts. By publishing not only the results of the study but also the way in which the calculations were derived and making the files used available as downloadable data files online, the results here can be checked, reproduced and emulated.

2. Houses at nippur

For the purpose of this study examples of domestic architecture have been chosen from areas TA and TB in Nippur. In her seminal publication on the houses found in these two areas, Stone divides them into two types: linear and square.[5] This study focuses on three of the square type houses, Houses C, D and I. In examining room types and the small finds, she posits that rooms which are larger than 7.25 m^2 (excluding entrances) are to be considered living rooms;[6] with this division, she is able to hypothesize that the linear houses, with one living room, were inhabited by nuclear families, while the square type houses, with two or more living rooms, were inhabited by extended families. Continuing this analysis based on the

[1] It is truly a singular honor for a son to contribute, as colleague, to a Festschrift for his parents. I offer this study with the very greatest esteem, gratitude and affection.
[2] For an example of room size as related to storage see Buccellati 2019.
[3] For an example of this from Uruk see Hageneuer, Levenson 2018, for an examination of the relationship between size and monumentality see Buccellati *et al.* 2019.
[4] Buccellati 2018.
[5] Stone 1981, 27.
[6] Stone 1981, 27-29.

Nippur houses, she shows that a nuclear family has, on average, one living room, two subsidiary rooms and one courtyard, with an average of 23 m^2 of roofed area per nuclear family.[7]

The distinction between roofed area and enclosed open spaces is important, also for the analysis of area and volume which follows: Stone shows how the calculations made in the sale of buildings or parts of buildings is based not on the total square meters of a building's footprint, but rather on only the square meters of roofed space. This distinction is possible because of contracts of sale for Houses I and F (or portions thereof) which give figures for the house (é - d ù - a) in g í n (using 1 g í n= 0.58806 m^2) which correspond to the square meters of roofed space (and not the total footprint of the house) as found in the archaeological record.[8] An interesting addendum to Stone's article[9] states: "McGuire Gibson recently told me that modern-day Iraqi officials used roofed floor space, excluding walls and courts, for their assessment of compensation due to those whose houses were to be flooded by the Hamrin dam."

As the houses in area TB were inhabited by persons from the temple administration, Stone suggests that these houses were 'municipal' houses in origin, built by the city or temple administration, while the houses in TA, inhabited primarily by landowners, were built by their inhabitants.[10] Thus the square type houses, present both in TA (House I) and TB (House C and D), were built by both individuals and the administration.[11]

The structures changed to a remarkable degree over time; Stone shows how, over just a few years, single rooms of House I were inherited, traded, and sold.[12] For example, house I gains a room (room 144) as well as access to another adjacent house (House H) in Level XA (approx. 1720 BC). Interestingly, the fact that individual rooms were sold to neighbors in order to enlarge their houses may be one of the reasons that the walls separating one house from another are single and not double walls, and it also leads to the conclusion that while houses could change and mutate within the confines of the block of structures, it is only very seldom that new rooms are added by taking away space from the street. In another example, House C was divided into two houses in Level I floor 1[13] (the division into two houses already on Plate 31, so floor 2 which lay below floor 1, seems premature, based on the division of rooms and the nature of the entrance), thus creating two separate houses from a single large structure. The square type houses, perhaps because of their larger size, tend to change in function over time as well: in later levels, House C is not only divided, but one portion (C-1) may have become a bakery, while House D seems to have become a scribal school.[14]

2.1. Chronology and Stratigraphy of Houses C, D and I

The three examples of domestic architecture (Houses C, D and I) which have been chosen for this study were selected for three main reasons: completeness, chronology and size. Each of the three houses represent a completely excavated example of domestic architecture – structures with a portion unexcavated could not be easily compared with the others. In terms of chronology all three houses were used at approximately the same time; in terms of size all are comparable, thus, in theory, excluding structures which housed other types of functions or belonged to much larger or smaller groups of people.

All three structures were completely excavated; of the three, the most poorly preserved is house C. The schematic diagrams of all three houses given in figure 4 show the number of rooms, the linking doorways and the known functions for the rooms of each house (fig. 4). Such schematic diagrams, derived from Hanson and Hillier's space syntax, are of great use as a graphic aid to determine the presence or absence of certain functions within groups of structures, as well as making room clusters more evident and highlighting access patterns.

Areas TA & TB in Nippur date from approximately 2000BC to 1720BC based on the stratigraphy and the epigraphic finds in the houses.[15] The floor plans for the three buildings come from the more recent periods, approximately 1740BC: the plan of house I is taken from Level XI floor 1 of area TA[16] while the floor plans for C and D come from Level II floor 1 of area TB.[17] The date of House I is, thanks to epigraphic finds, the most accurately dateable, 1742-1734 BC.[18] The plans for houses C and D were taken

[7] Stone 1981, 29.
[8] Stone 1981, 20; see for example Baker (Baker 2014) on house sizes in a wider geographic and chronological range; Haines argues that the courtyard is the principal space of the house (MacCown, Haines 1967, 37-38), but the analysis of Stone seems to convincingly refute that claim.
[9] Stone 1981, 33.
[10] Stone 1981, 27.
[11] Stone notes, however, that the square type house in TB were probably built following a model developed by individual builders rather than the other way around (Stone 1981, 27).
[12] Stone 1981.
[13] Stone 1987, pl. 32.
[14] Stone 1987, 86-90.
[15] MacCown, Haines 1967, 56-65; Stone 1987, 117-121.
[16] Stone 1987, pl. 19.
[17] MacCown, Haines 1967, 56-58; Stone 1987, 30.
[18] Stone 1987, 65-66.

from Level II floor 1 since it is here that the floor plan was most complete – but the archaeological record has both houses present (albeit with changes to C which are difficult to determine due to damage done by 19th century excavations)[19] and in use during TB Level I floor 2, the level contemporary with TA Level XI floor 1; thus the three houses were in use during the same period.

2.2. Measuring Area and Volumes

In order to use AutoCAD 2012 to create the right kind of volumes needed to measure cubic meters I went through the following steps. First a raster image of the floor plan is imported into AutoCAD. This image has to come from a scan of the publication or field documentation which is then saved in JPEG format. Once imported that image needs to be scaled and oriented; thus the scanned image needs to include both a scale and a north arrow. Next the outlines of the walls have to be traced with polylines, ideally placed on a new layer; it is important that the polylines (AutoCAD 2012 command: PLINE) tool is used, as other types of lines often cannot be made into 3D solids; additionally the polylines have to be closed. Next these polylines should be copied on to a new layer, as the second set will disappear from the drawing during the extrusion process; in this way the original polylines are preserved. The second set of polygons should then be extruded (EXTRUDE) to the desired wall height. Finally, using the volume measure tool (MASSPROP; note that volumes are given in cm^3 and may need to be converted to m^3), one can determine the cubic meters of individual walls or the complete structure. In order to calculate the square meters of the entire floor plan of one structure, a closed polyline must be made around the outer perimeter of the building, and measured using the area measure tool (AREA; as with volume, area may be given in cm^2 and thus may need to be converted to m^2, while a perimeter given in cm may need to be converted to m). The square meters of individual rooms as well as the total roofed area of a building can be calculated in the same way. In order to estimate the number of beams needed, the length (the longer side of the room) and width (the shorter side of the room) of each roofed room is needed: the length determines the number of beams needed (assuming the beams are laid in order to use more beams that are shorter) while the width determines the beam length (here one needs to add at least the width of the walls, as the beams must completely rest on the walls). The three AutoCAD files (one per house) used in this study had 11 layers each: (1) Raster Image, (2) Areas – Courtyards, (3) Areas – House, (4) Areas – Rooms, (5) Lines – Reconstructed, (6) Lines – Room Length, (7) Lines – Shared Walls, (8) Lines – Walls, (9) Volumes – Reconstructed, (10) Volumes – Shared Walls, (11) Volumes – Walls. I have given this detailed description of the workflow in order to aid others to reproduce the results and/or to better understand the data files (see below) related to this study.

Determining wall height for these structures is difficult, as the walls uncovered in the excavation were less than a meter in height. I have estimated an average of 250 cm for the wall heights. The average wall width is approximately 60 cm (determined both in the plan and also given in Stone's volume on Nippur).[20] Stone excludes the presence of a second story[21] due to the relatively narrow width of the walls, thus the wall height reflects a standard height for a single story domestic structure. The volumes presented here exclude foundations, which, however, were either not present at all or of merely one brick depth.[22]

While Stone excludes a second story, it is very likely that the roof space was also used by the households. The presence of shared walls between some of the houses poses an interesting problem: was roof space also shared between households, or were these shared walls raised higher than other internal walls in order to isolate the roof space between the various houses? Unfortunately we are not able to answer this on the basis of the available evidence, so in the model used in this study all the walls are given the same height.

The following table (table 1) gives specific dimensions for each room, courtyard and the overall structure for all three houses under consideration. In addition to giving the room number and the type or function (if known) of each room,[23] the table gives the area of each room followed by the area of all the roofed space, followed by the courtyards and the calculations of the area of the living space (room areas + courtyard areas) and the complete structure (including walls).[24] The table then gives the perimeter for each of the rooms and courtyards, as well as the perimeter of the complete structure. Finally, the room length (distance of the long side of the room)

[19] Stone 1979, 291-296; 1987, 87-88.

[20] Stone 1987, 36.

[21] Stone 1987, 36.

[22] MacCown, Haines 1967, 35.

[23] Stone 1987.

[24] One calculation has always surprised me when considering architecture – due to the thickness of the mudbrick walls (which here are not even particularly thick) the amount of usable space as a percentage of the total footprint is quite low – only 53%-57% of the total area of these buildings is usable living space, the rest (43%-47%) is covered by the walls; this calculation can be reached by dividing the 'House w/o Walls' area by the 'House inc. Walls' area.

is given as well as the room width (extrapolated from the perimeter). The calculation of the total roofed space is of particular use when considering the discussion of the ancient (which also holds true for the Hamrin Dam repayments, see above) way of calculating house dimensions in a sale contract. One may note that the total roofed area calculated here, 56.9 m^2, is greater than the 52.21 m^2 from Stone's study.[25] This is due to the fact that the calculations made by Stone were based on the Level VIII structure (this analysis was done on the Level XI plan), which added several walls (179 and 201 were divided, and the entrance was shifted from the north side of 157 to the west side).[26]

Measurements and Calculations of Rooms, Courtyards and Entire House

House	Room Number	Type / Function	Area (in m2)	Perimeter (in m)	Length (in m)	Width (avg.; in m)
House C	14	Room, Kitchen	6.82	12.34	4.68	1.49
	18		5.97	10.66	3.80	1.53
	19		6.99	10.71	3.25	2.11
	32		6.48	11.63	4.32	1.50
	104		6.43	10.82	3.73	1.68
	105		9.68	12.49	3.54	2.71
	109	Room, Chapel?	12.55	14.76	4.56	2.82
	111		7.11	10.97	3.35	2.13
	122	Room, Entrance	6.91	11.21	3.81	1.79
	123		7.44	11.17	3.44	2.15
	132		3.88	8.34	2.77	1.40
	157		2.12	6.61	2.43	0.88
	158		8.30	13.95	5.51	1.47
	Total Roofed Space		90.68			
	30	Courty., Tombs	20.06	18.86	6.13	3.30
	159	Courty., Kitchen	10.40	14.91	5.45	2.01
	House w/o Walls		121.15			
	House inc. Walls		213.88	60.63		
	Total Perimeter			240.05		
House D						
	57/69		12.29	19.03	8.05	1.47
	82	Room, Storage?	2.17	5.93	1.64	1.33
	110		4.98	9.07	2.67	1.87
	113	Room, Entrance	6.12	10.21	3.12	1.98
	136	Room, Kitchen?	7.19	10.91	3.22	2.24
	138		5.13	12.22	5.10	1.00
	142		5.04	9.01	2.44	2.07
	Total Roofed Space		42.92			
	137	Courtyard	24.31	19.71	5.14	4.72
	House w/o Walls		67.23			
	House inc. Walls		126.86	45.21		
	Total Perimeter			141.28		
House I	152a		9.08	12.58	4.05	2.24
	155		6.57	10.79	3.06	2.33
	157	Room, Entrance	8.22	12.75	4.69	1.68
	179		7.85	13.11	4.96	1.59
	185		6.02	10.90	4.02	1.43
	201		19.15	19.40	6.80	2.90
	Total Roofed Space		56.90			0.00
	152b	Courtyard	6.06	11.12	3.93	1.63
	House w/o Walls		62.96			
	House inc. Walls		115.69	47.03		
	Total Perimeter			137.69		

Table 1. Measurements and calculations of living and built space by room, courtyard and for entire house.

The following table gives the volumes of the mudbrick walls, divided by the walls which serve only the house under study, walls which the house shares with neighboring houses and finally the reconstructed walls. The total volume of mudbrick walls is given in two forms: the complete volumes including the shared walls in their entirety, and the volumes of the walls but including only ½ of the shared walls.

Calculation of Volumes (in cubic meters)

	House C	*House D*	*House I*
House Walls	123.16	70.04	71.01
Shared Walls	71.23	71.04	40.70
Reconstructed Walls	0	0	5.12
Total	194.39	141.08	116.83
Total Assuming ½ Shared	158.77	105.56	91.36

Table 2. Calculation of volumes of mudbrick walls, given in cubic meters; volumes assume a wall height of 2.5 meters.

I have not included images of the 3D models for the specific reason that the visual rendering of the models is not the reason for their creation: this is rather unusual for 3D models, as one expects models to be seen. Instead, this study uses a 3D model to produce the measurements (in area and volume) given in this table (table 2). However, in the interest of reproducibility as discussed in the introduction, the CAD files used in this study will be available for download from my website, http://www.federicobuccellati.net under Publications.[27]

2.3. *Using EnCAB to Examine Architecture*

Using the volumes generated above one can now examine the cost of construction of the individual houses (table 3). First, the volumes produced above are for compete walls, including mortar. An algorithm from EnCAB gives the formula that mortar comprises about 1/6 of the total volume of a wall.[28] In order to calculate the number of bricks, the brick size is needed; the excavators give 24-26 x 16-18 x 7-8 cm as the range of brick sizes for the houses in question.[29] Taking the middle of the range gives a brick size of 25 x 17 x 7.5 cm, a volume of 3187.5 cm^3 or 0.0031875 m^3. By combining this figure with the volume of the walls (as some walls are shared, the volume which includes ½ of the shared walls is used in all of these calculations), one arrives at the total number of bricks per structure. A further algorithm gives figures for the amount of chaff in bricks;[30] assuming the same percentage of chaff in the mortar, the same algorithm can be used to calculate the required chaff there as well.

[25] Stone 1981, 21.

[26] Compare Stone 1981, 21 to Stone 1987, pl. 19.

[27] To guarantee, for as long as possible, access to this data the website is mirrored on GitHub (http://fabfab1.github.io); additionally, the models will be saved in as many formats as are available in the hope that at least one of these file formats will be importable into future CAD software.

[28] Buccellati 2018, alg. Robson_1999_67; I have followed this formula to cite the individual algorithms within the Energetic Calculator for Ancient Buildings digital publication; for more on citing EnCAB, see http://encab.net/cite/cite.html.

[29] MacCown, Haines 1967, 35.

[30] Buccellati 2018, alg. Oates_1990_390.

Materials Needed (Based on Total Assuming ½ Shared)			
	House C	*House D*	*House I*
Total Volume of Mortar (m^3)	26.46	17.59	15.23
Total Volume of Bricks (m^3)	132.31	87.97	76.13
Total Number of Bricks	41509.37	27597.67	23884.70
Chaff for Bricks & Mortar (in kg)	5497.69	3655.16	3163.40
Total Surface to Plaster (m^2)	600.13	353.21	344.22
Total Plaster needed @ 1.5cm (m^3)	9.00	5.30	5.16
Chaff needed for Plaster (in kg)	935.11	550.36	536.36
Total matting needed for roof (m^2)	104.28	49.36	65.44
Total Beams needed	103	56	61
Total Length of Roofing Beams (m)	312.77	157.31	200.88

Table 3. Calculation of quantity of materials needed for construction; figures are based on the 'Total Assuming ½ Shared' volumes from Table 2.

The excavators state that the houses were completely covered with mud plaster, 1-2 cm thick.[31] In order to calculate the total plaster, first one needs to calculate the total surface area to be plastered; this can be determined by using the perimeter of the rooms plus the perimeter of the courtyard(s) and finally adding the perimeter of the house.[32] This gives the total linear distance of the walls to be covered, so the figure should be multiplied by the wall height, in this case 2.5 m (see above). Finally, this figure representing the total surface area to be covered needs to be multiplied by the thickness of the plaster (in this case I have used 1.5 cm or 0.015 m). In order to determine the amount of chaff needed for the plaster, one can treble the algorithm determining the chaff needed for the mud plaster.[33]

Moving on to the roof, first the area of the rooms also gives the total surface area of the roof, which can be used to calculate the quantity of reed matting needed. The figure given adds 15% to take necessary overlap between different sections of mats as well as a portion overlapping the top of the walls.[34] In order to determine the meters of roofing beams needed a calculation based on the length and width of the roofed rooms is needed. First, assuming that palm trunks were used, one needs to determine if any of the rooms exceed the maximum width which can be spanned by a palm trunk, 3.5 m.[35] If this is not the case, one can assume that all roofing beams were made from palm trunks, the most readily available wood.[36] Then one needs to determine the length of beam needed for each room, calculated by adding 1.2 m (the width of the two walls, each 60 cm thick – needed as the beams must rest on the entire thickness of the wall) to the width of the room. One then needs to calculate the number of beams needed per room – beams are placed 40 cm apart[37] so the number of beams can be calculated by dividing the length of the room (minus 40 cm as the first span is held up by the wall itself) by 40 cm and then ignoring any portion of the number after the decimal place (as any distance beyond the last beam is held up by the wall itself). By multiplying the number of beams needed per room by the beam length (room width + both wall widths) one can determine the linear meters of beam needed.

Such calculations can help specific types of analysis, in particular calculations relating to the energetic cost of construction (table 4). As we know the number of bricks needed for a structure, one can determine the number of person-days (p-d) needed to make them,[38] the time it would have taken to excavate the earth required in person-hours,[39] the weight of the bricks,[40] which, if the distance transported was known, would allow one to calculate the p-h required to carry that number and weight of bricks.[41] Further algorithms allow for an analysis of resources used (and thus economic studies) such as the number of hectares planted with barley needed to produce the required amount of chaff.[42]

Further Calculations			
	House C	*House D*	*House I*
Hectares needed to produce chaff	13.40	8.76	7.71
Person-days needed to make bricks	172.96	114.99	99.52
Time to excavate earth for bricks (p-h)	254.44	169.17	146.41
Weight of bricks (kg)	198,731.28	132,127.31	114,350.97

Table 4. Further material and energetic calculations based on EnCAB algorithms.

[31] MacCown, Haines 1967, 36.

[32] Such a calculation assumes that the plaster used inside doorways is equivalent to the amount needed if there was no doorway; this may be slightly off (doorways may require a bit less than a solid wall, considering a wall thickness of 60 cm) but the difference is quite minimal in relation to the total surface.

[33] The calculation for the amount of chaff in mud plaster is difficult, as examples vary widely from region to region Buccellati 2016, 118. In personal experience, plaster from archaeological contexts contain three times the volume of chaff when compared to bricks (volume being directly proportional to weight – one should remember that chaff used for plaster is normally double the length of chaff used for bricks, so the number of pieces of chaff in a certain volume is not an adequate measure).

[34] For more on mats see Aurenche 1977, 155; Buccellati 2016, 121-122.

[35] Buccellati 2018, alg. MacCownHaines_1967_37; this distance is clearly not the total length of the tree, as the 3.5 m is the measure of the room to be spanned, but the beam needs to rest on both walls, so must (in the case of 60 cm wide walls) be at least 4.7 m long.

[36] Buccellati 2016, 121.

[37] Buccellati 2018, alg. Heimpel_2009_135.

[38] Buccellati 2018, alg. Minke_1994_55.

[39] Buccellati 2018, alg. Abrams_1994_47_1.

[40] Buccellati 2018, alg. Buccellati_2016_108.

[41] Buccellati 2018, alg. Abrams_1994_47_3.

[42] Buccellati 2018, alg. Oates_1990_390.

3. Conclusions

The aim of this study was to compare three very similar structures: square type houses from two very closely related excavation areas dating to the same chronological period. In this study several results have been obtained relating to the methodology for analyzing structures, an internal comparison within the data set, a baseline for future research and a first step in the use of EnCAB in scholarly publications.

In terms of methodology, a set of measurements and calculations (distance, perimeter, area and volume of the living and built space) for an architectural plan taken from an archaeological field publication has been proposed; these measurements and calculations allow for a wide range of analyses, for example calculating the area of roofed space which was used in ancient documents (as é - d ù - a) for house sales or examining the percentage of area occupied by walls in a structure. By combining these data with the algorithms from EnCAB, one can identify specific costs (in terms of energy) for a structure such as the hours needed to make the required mudbricks, the number of roofing beams needed or the quantity of chaff used in the mortar. All of these calculations can be made on the basis of 'old data', breathing new life into old documentation by using them within Digital Humanities projects such as EnCAB.

These calculations of individual buildings allow also for a comparison between structures. The three houses discussed here are of the same period and type, and yet show a certain variability, since House I is at the lower end of the range, House D is in the middle and House C is at the higher end. Thus this study provides a baseline for understanding the construction materials and energetic costs for domestic architecture of this period – a baseline which includes the range of variability within this house type. This baseline defines some 'cost' parameters for the construction of houses in this period, thereby providing an analysis which can be subsequently used as comparative material for other studies of this type in other regions or periods. Thus houses of a different type from this period could be compared to the square type house, or other houses from other periods could be shown to be more or less 'costly' then those found in Nippur. Furthermore, by analyzing a palace from the period one could determine the greater 'cost' of a public, monumental building and compare it to these private houses.

Finally, this study is the first publication which draws on the EnCAB digital publication, demonstrating not only a methodology for its use but also showing how to incorporate a digital publication of this type into a scholarly publication.

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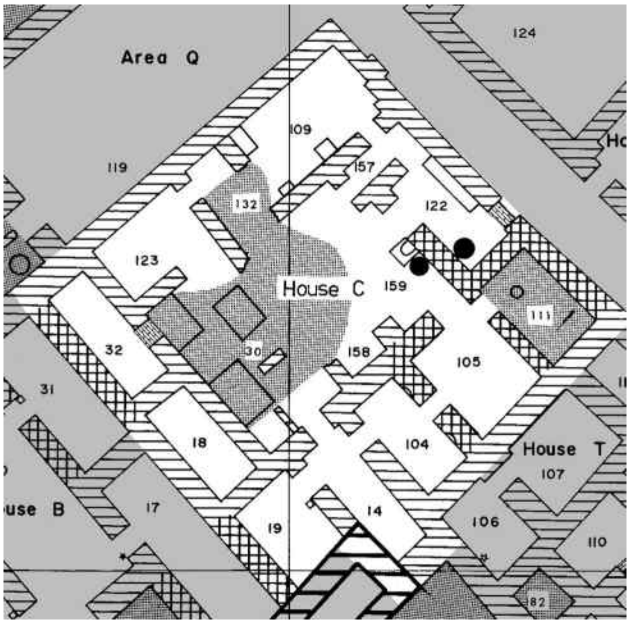

Fig. 1. Plan of House C, taken from Stone 1987, pl. 30.

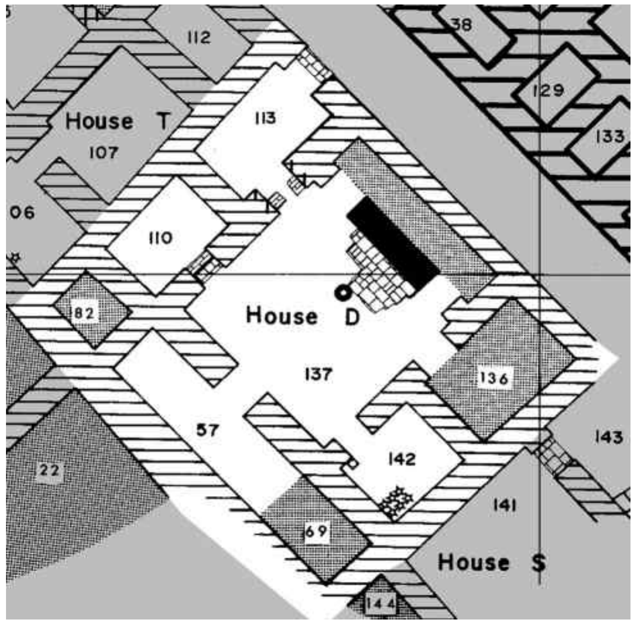

Fig. 2. Plan of House D, taken from Stone 1987, pl. 30.

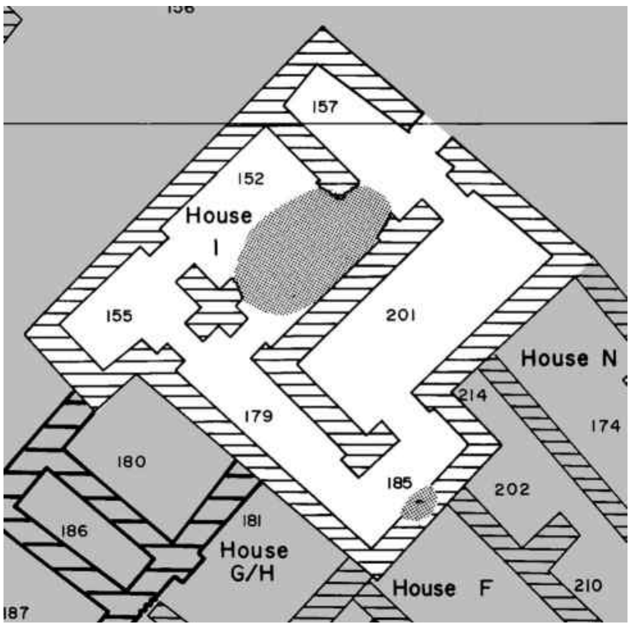

Fig. 3. Plan of House I, taken from Stone 1987, pl. 19.

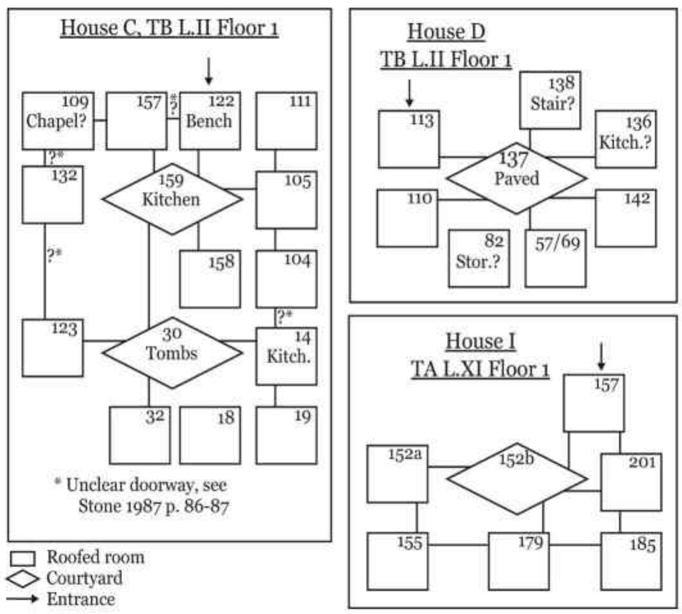

Fig. 4. Schematic diagrams of the architecture showing rooms, courtyards, doorways and functions.

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SANEM 3- Studies on the Ancient Near East and the Mediterranean

BETWEEN SYRIA AND THE HIGHLANDS

STUDIES IN HONOR OF GIORGIO BUCCELLATI & MARILYN KELLY-BUCCELLATI

Stefano Valentini - Guido Guarducci
(*editors*)

Arbor Sapientiae
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Guido Guarducci, Stefano Valentini
(Direzione CAMNES)

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TABLE OF CONTENTS

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