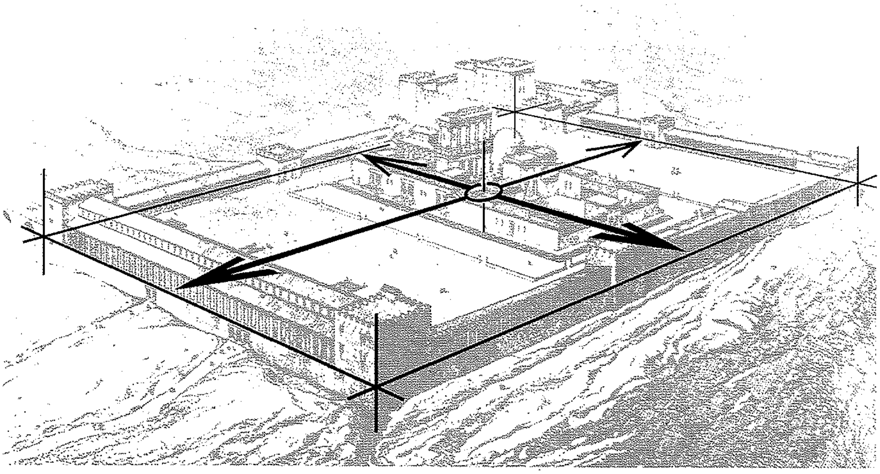
Erwin F. Reidinger



The Temple Mount Platform in Jerusalem from Solomon to Herod: An Archaeological Re-Examination

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TEL AVIV UNIVERSITY

The Yolanda and David Katz Faculty of the Arts
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The Temple Mount Platform in Jerusalem from Solomon to Herod: An Archaeological Re-Examination

Erwin F. Reidinger

For Judith and David

The technician's language is the drawing. Buildings are realised building plans; should one be lost it can therefore be reconstructed from the other.

Introduction

The author employs the know-how of the construction engineer and building researcher to approach the question whether the original layout of the Temple complex in Jerusalem can be reconstructed on the basis of the surviving building substance. His method has allowed him to determine for the first time the layout of the Herodian complex, the Solomonian complex and the orientation of the Temple in a logical manner. In addition, he has proved that the Temple was oriented according to the rising sun. This was carried out in the year 957 BCE, on the first day of the spring full moon, which is identical with 15 Nissan, the feast of Pessach. In relation to the Bible this absolute mark corresponds with the fourth year of the reign of King Solomon in which he started to build the Temple (1 Kings 6:1).

It was initially the quadrilateral of the Temple Mount platform that awakened this author's curiosity. For me there was no doubt that the complex had been planned, the question was which plan had been used? Following this introduction I shall take as my starting point the assumption that it is possible to work out this plan on the basis of the existing structures.

Some may ask what business a constructional engineer has in the field of archaeology. In reply I can only say that it was people from the field of construction who planned and built such structures. In this sense I view them as my "colleagues" and I also understand their "language" which has been preserved over the course of time in the form of the unwritten laws of technology. On this account I wish to introduce here the concept of an area of research that I call "building construction archaeology". The subject of this discipline can be described as the reconstruction of the appearance of built complexes and research into their foundation dates. Knowledge of building construction technology, geodetics and astronomy are essential prerequisites for this work.

The basis of the work presented here is provided by geodetic plans of the existing buildings on the Temple Mount platform, the results of archaeological excavations as well as historical dates. The Bible is in this context a framework, but not the scientific basis. The independent starting point used in my research can produce comparisons with this basis and can offer proof of its validity. It will be shown whether it is possible to arrive by a series of individual progressive steps at the foundation date of the Temple complex.

Naturally, I did not embark upon an undertaking of this kind without having considerable experience. I have been able to trace the various planning stages of many built complexes, in particular mediaeval towns, and in some cases have even been able to determine their foundation dates.[1] In the case of the latter it was always the orientation of religious buildings towards the rising sun that offered the key to research into absolute dates.

The contribution presented here represents an abbreviated version of my full manuscript, which was produced in an easy-to-follow way as the basis for a book. With this work I endeavour to build a bridge to other disciplines, in particular to the field of biblical archaeology and the religious history of Israel.

The following is a short historical overview of the most important constructional phases of the Temple complex from the time of Solomon (Fig.1).[2] The results of my research are not taken into account at this stage.*

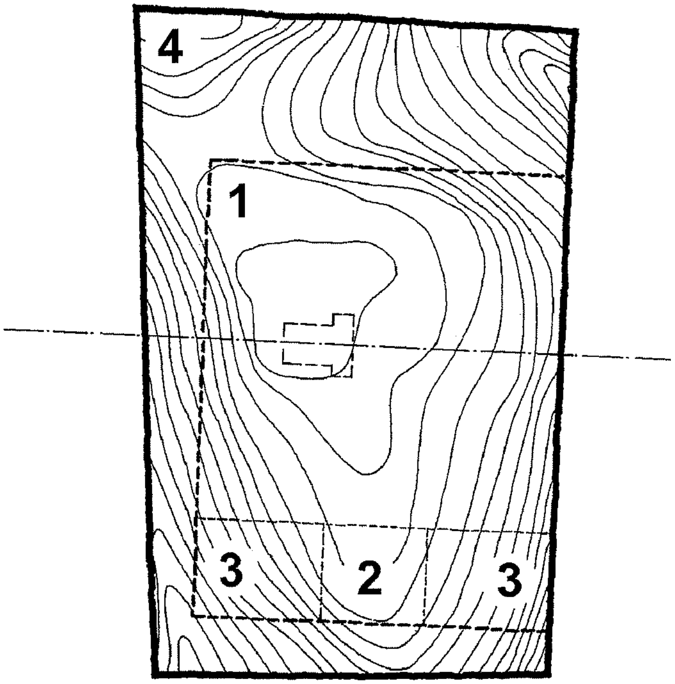

Fig. 1: Construction phases of the Temple Mount complex
1 The complex under Solomon
2 Expansion under the Seleucids
3 Extension by the Hasmoneans
4 The complex under Herod
(Drawing by the author adapted from Murphy – O'Connor 1999)

- 10th century BCE: David captures Jerusalem from the Jebusites and makes it his capital.
- C. 966 BCE: Solomon erects the first Jewish Temple on the site chosen by David. The results of excavations suggest a square temple platform measuring 500 x 500 cubits (building phase 1 in Fig.1).
- 587 BCE: Nebuchadnezzar from Babylon captures Jerusalem, destroys the Temple and leads part of the Jewish people into captivity to Babel.
- 539 BCE: Cyrus of Persia captures Babylon. He allows the Jews to return to Jerusalem and to rebuild the Temple.
- 515 BCE: Completion of the second Temple under the governor Zerubbabel on the same site as the Temple of Solomon.

- 186 BCE: Jerusalem is ruled by the Greco-Syrian dynasty of the Seleucids. Erection of the fortress of Akkra directly on the south side of the Temple Square as an observation point (building phase 2 in Fig.1)
- 141 BCE: Capture of the fortress of Akkra by the Hasmonaean Simon Maccabee. Reconsecration of the Temple and extension of the Temple platform by about 40 metres to the south (building phase 3 in Fig.1).
- 63 BCE: The Roman general Pompey occupies Jerusalem.
- 37 to 4 BCE: Reign of Herod the Great, appointed King of Judea by the Romans. He plans a major rebuilding of the Temple complex. By enlarging the original platform on three sides he created one of the largest religious complexes in the Roman world. Only the eastern side of the earlier shrine was incorporated into the project (building phase 4 in Fig.1).
- 70 CE: On 29 August the Temple was destroyed by Roman soldiers under Titus.
- 638 CE: Jerusalem is captured by the Caliph Omar. The devastated Temple precinct becomes a Muslim shrine. Erection of the El-Aqsa-Mosque on the Haram as-Sharif (elevated shrine), the previous temple area.
- 691/692 CE: In the year 72 of the Muslim calendar the Dome of the Rock, which was built upon the rock Moriah, is completed under Abd el-Malik .
- Present-day: The Temple complex in Jerusalem from the southeast (aerial view) (Fig. 2).

Building analysis and examination

Basis

No reconstruction is possible without a plan. The plan required must have geodetic qualities. By this I mean the precise recording of the existing buildings on an ordered grid as the basis for calculations within a system of coordinates. Suitable documents for this purpose were made available to me by the Israeli plan archives in Tel-Aviv (Survey of Israel). On the basis of these documents, by means of scanning and overlaying two plans,[3] I was in a position to prepare the required plan (Fig. 3).

With this plan I created a basis suitable for further geodetic processing in AutoCAD.[4] All the coordinates are now available on the computer. Due to the drawing precision of the 1942 survey the individual points can differ from the actual position by about ± 0.2 to 0.3m. This degree of precision is certainly adequate for further work, especially given the size of the Temple complex.

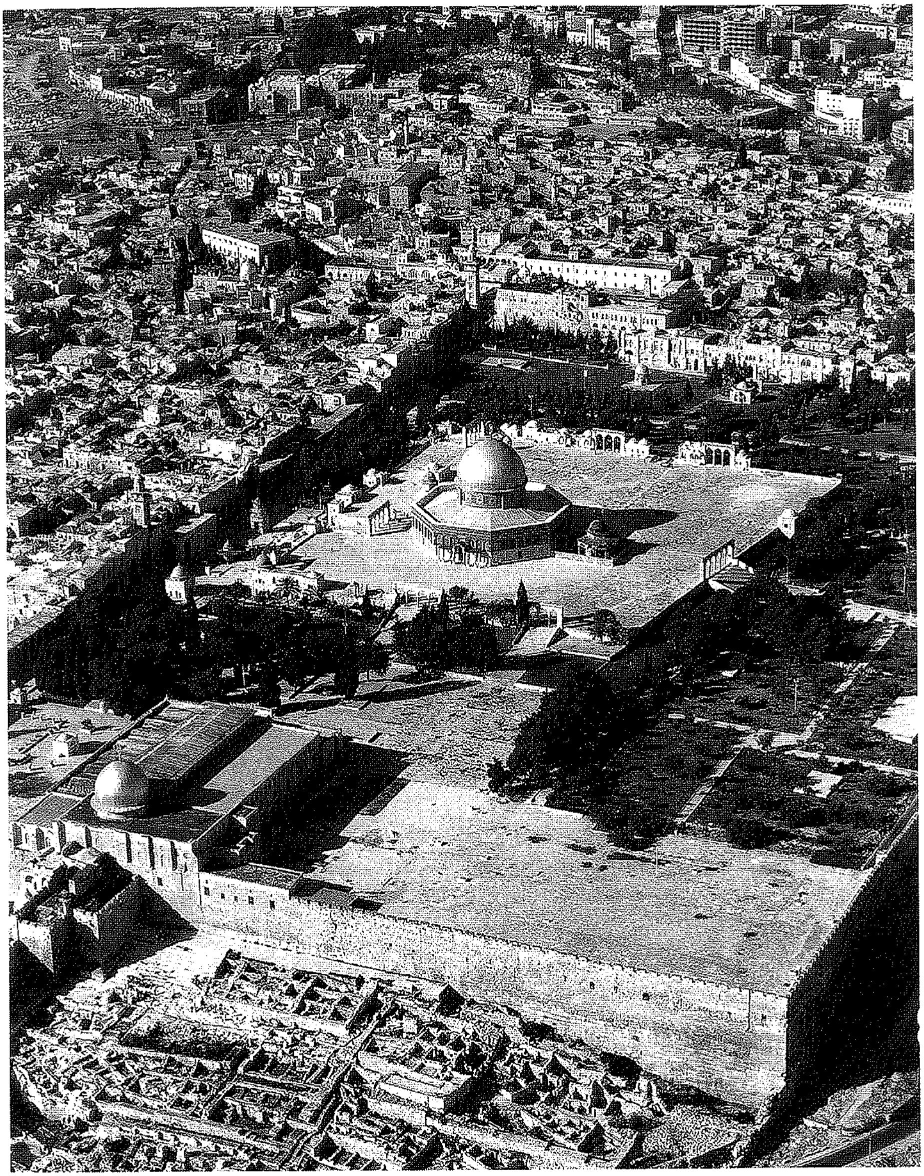

Fig. 2: Aerial view of the Temple precincts from the southeast (part) (Sonia Halliday Photographs 1984)

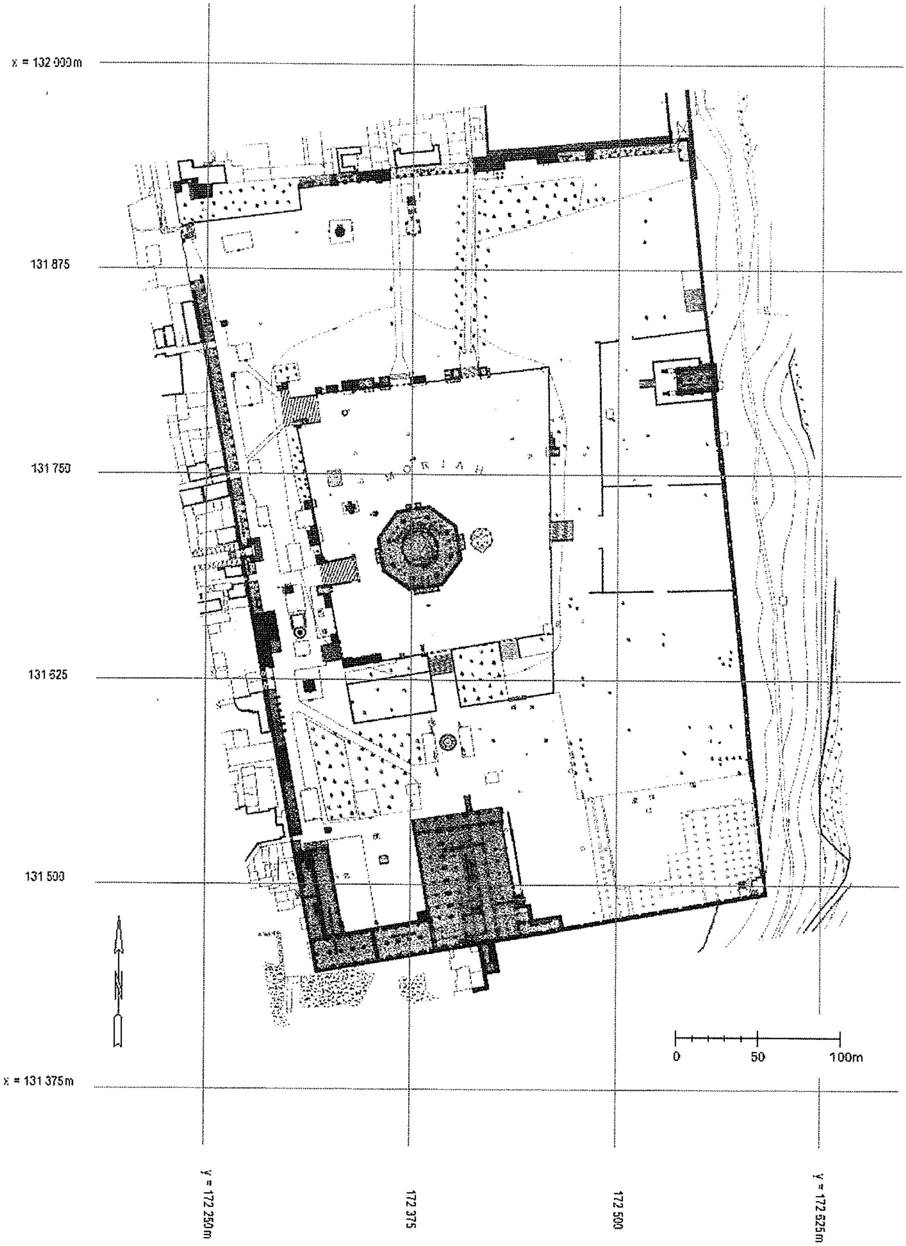

Fig. 3: Plan of the Temple Mount platform with the existing buildings and coordinate grid. (Site plan from the Survey of Israel , cf. n. 3. AutoCad computer processing and drawing by author)

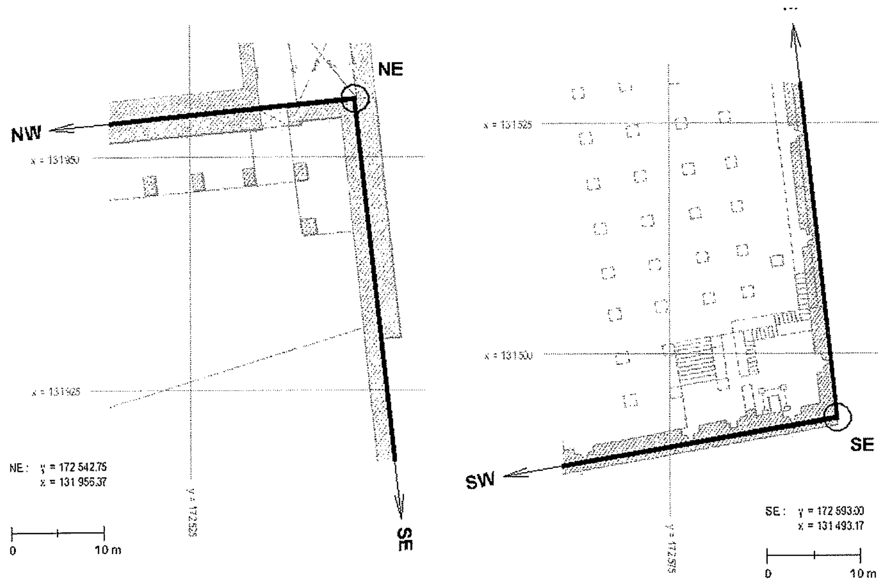

Fig. 4: Position of the NE and SE corner points (Existing building substance. Enlarged from Fig. 3. Reconstruction of the corner points and drawing by author)

Planning and building are three-dimensional tasks; therefore the cross-section of the Temple Mount is an additional evaluation criterion. To the east it is flanked by the Kidron valley and to the west by the Tyropoion valley with its steep slopes. The interesting point is the flat domed summit at the centre of the complex where today the Dome of the Rock stands. We know the original form of the terrain, which is formed by rock.[5]

Geometry of the Temple Mount platform – existing structures

Corner points

The geometric figure of the Temple Mount platform is a quadrilateral. I have determined its corner points according to constructional and technical viewpoints, taking into account wall ramparts and projections as intersecting points of the sides. Only at the NW corner is the position not completely clear, as there are no reliable guidelines in this area. This is of relevance only to the geometry of the existing buildings and for the comparison between planning

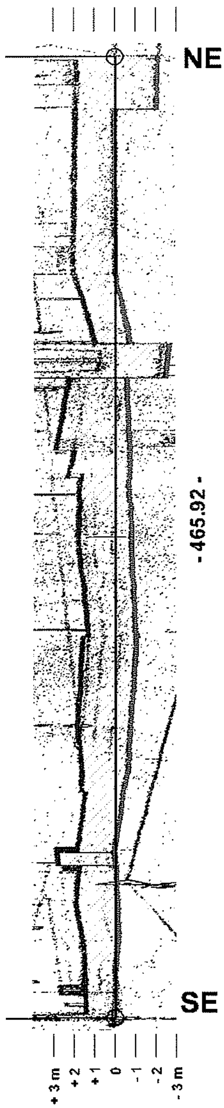

Fig. 5: Comparison of the east side (NE-SE) with the actual line of the wall (width multiplied by a factor of ten in relation to the length). (Existing building substance from Fig. 3. Distorted depiction and drawing by author)

and execution. Fig. 4 shows, for example, the position of the NE and the SE corner points in detail.

In order to check the position I have compared the connecting lines (the sides) with the actual lines of the existing walls. To illustrate more clearly the differences a distorted scale is used in which the width is multiplied by a factor of 10. Significant differences occur only at the central area of the east side, as illustrated in the example (Fig. 5).

Corner	y (m)	x (m)
NE	172 542.75	131 956.37
SE	172 593.00	131 493.17
SW	172 318.06	131 445.68
NW	172 229.57	131 924.70

Table 1: Coordinates of the corner points of the Temple platform quadrilateral

The coordinates of the corner points are presented in Table 1 and are binding for further work. The fact that they are given in centimetres is not intended to suggest any exaggerated precision. They are produced by determining the positions from the scanned survey plan. (Fig. 3)

Geometry of the quadrilateral

Fig. 6 shows the resulting geometric shape and presents the lengths of the sides with their directions [6] and internal angles.

Side	**Length in metres**	**Length in round fathom values**	**Fathom length** (test values)
North side	314.78	170	1.852
East side	465.92	250	1.864
South side	279.01	150	1.860
West side	487.12	260	1.874

Table 2: Lengths of the sides in metres, expressed in round fathom values using different fathom lengths (test values)

If we wish to understand the nature of planning and building in antiquity we must research the historic units used at the time. These should initially be regarded as unknown quantities that can be discovered by examining the respective building substance. The metre as a unit was first defined in the 19th century and serves as an aid in the search for the historic unit of length. Whether foot, cubit, fathom (*orgya*) or another unit of length was used can first be discovered by testing it (Table 2). Round measurements (i.e. precise lengths made up of multiples of five or ten fathoms) can be an indication of a correct solution and of a unit that was in fact used in the planning and setting-out

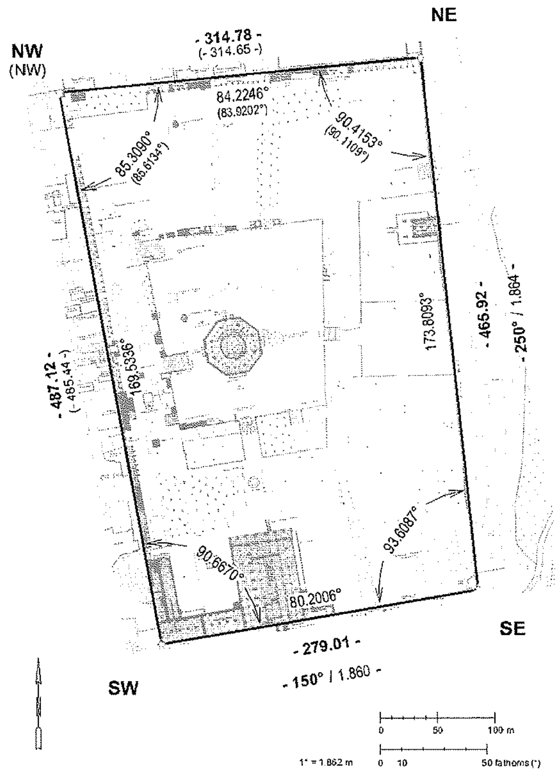

Fig. 6: The quadrilateral of the Temple Platform defined by the corner points NW, NE, SE and SW (coordinates Table 1) with the lengths of the sides (length and direction), internal angles and values in fathoms (east and south sides).
NW...the intersection of the west side with the projected line of the wall at the eastern part of the north side
Alternative: (NW)...intersection of the west side with the course of the northern site boundary (building line, rock edge?) in the corner area (the corresponding lengths of the sides and angles are given in brackets).
(Building substance from Fig. 3. Geometry of the complex and drawing by the author)

(survey). In the search for the as-yet-unknown fathom, based on constructional and technical considerations, I use the average value of the length, in fathoms, of the east and south sides, which is 1.862 ±□□0.003m. I shall pve in the section on the setting-out of the complex that this value does in fact represent the fathom used.

A further helpful reference point for the length of the fathom is provided by the history of Biblical Israel[7] during the period of the extension to the temple

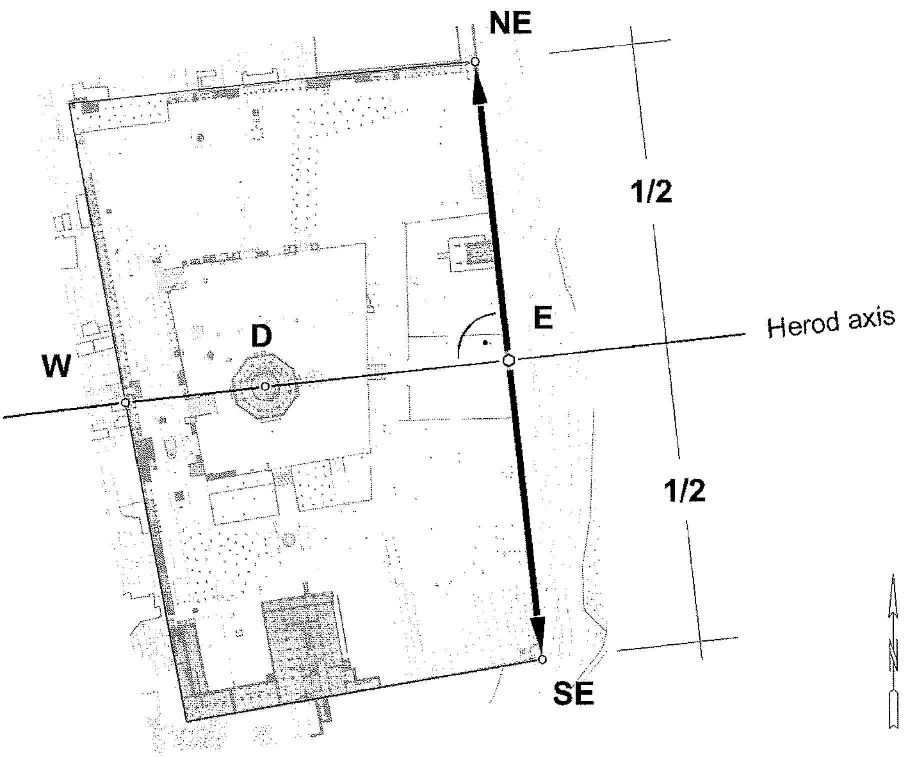

Fig. 7: The perpendicular to the east side from the centre of the side (point O) runs directly through the centre of the Dome of the Rock (centre of the Holy Rock, point D) and intersects the west side at point W. (Trigonometry of the land survey). (Existing building substance: reduction in scale from Fig. 3. Geometry and drawing by author)

complex under Herod, the time of transition from the Hellenistic period (332 to 30 BCE) to the Roman period (30 BCE to 324 CE). As it agrees with the Attic-Olympic foot of 310.60 ± 0.388mm (1 fathom = 1.864 ± 0.002m)[8] I regard the value of the fathom which I derived for the Herodian complex (1.862 ±□□0.003m) as confirmed.

A special straight line

In my search for the construction (the setting-out plan) of the complex I encountered a very special line. This line stands at right angles to the east side, which it intersects precisely at the latter's centre point, and runs through the centre point of the Dome of the Rock, D (Fig.7). On the basis of these geometric relationships I suggest that this is the temple axis at the time of the Herodian extension. The Temple was still standing at this time and obviously provided an important reference point for planning and surveys. One could also speak here of a cardinal line for which I have coined the name "Herod axis". I have described its points of intersection with the eastern and western boundary of the temple square as E and W respectively, the length between these two points amounts to 297.19m, which is approximately 160 fathoms, taking a fathom as 1.86m.

The geometrical definition of the existing buildings provides the basis for further research into the Herodian complex and the Solomonian complex, with the aim of reconstructing their layout.

Reconstruction of the planning and setting-out

Introduction

In the course of my research into the layout of medieval cities I have been able to identify certain general principles of town planning.[9] It turns out that these have been used from antiquity up to modern times as technical guidelines for the laying out of towns and major open spaces (Fig. 8). A well-known example is the layout of Roman camps and colonial towns in which the main axes were laid out as *cardo* and *decumanus* from the origin of a system of coordinate axes (the *groma* point).

The characteristic feature of this method of setting-out is a system of coordinate axes at right angles to each other that provide the basic framework for the planning and layout. The term planning includes any possible corrections necessary to take into account natural features - the coordinate axes serve as an aid on the basis of which the final execution is applied to the terrain (the building site). The origin is the starting point for the survey; it should also be regarded as the "founding point" of the complex. Consequently I call this point the setting-out point and describe it as point "A". It is also sometimes known as the *groma* (surveyor's cross) point, angle point or cardinal point. The position of the setting-out point on the site and the orientation of the coordinate axes are derived from the terrain and other outline circumstances such as, for example, the course of streets or rivers.

The lengths of the arms of the axes are generally rounded to multiples of fathoms (e.g. to exact multiples of five or ten fathoms). I describe the four end points of the axes as main points. As their position was chosen they are already

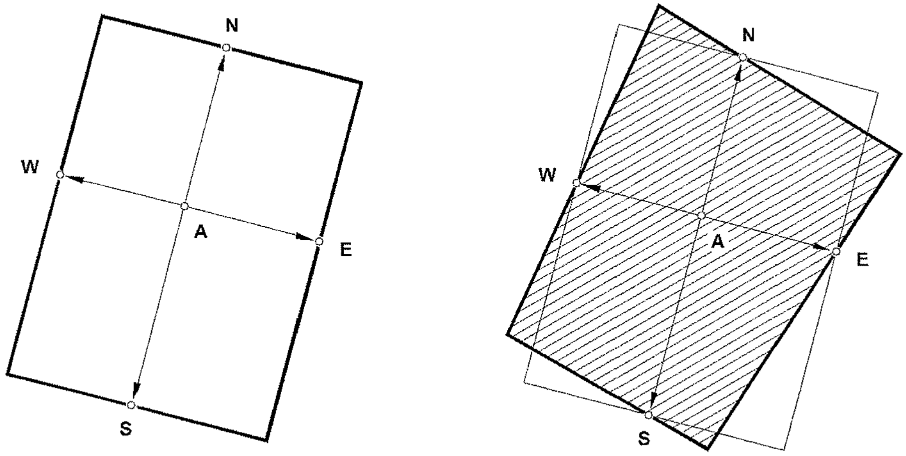

Fig. 8: General principles for the setting-out of towns and large public spaces. (Drawings by the author)

A .... setting-out point of the complex
N, E, S, W .... main points (end points of the coordinate axes)
Lengths AN, AE, AS, AW... arms of the coordinate axes
Lengths NS, EW .... main axes of the system of coordinate axes (sides of the basic rectangle)
Case 1: the basic rectangle matches the complex as built (ideal plan)
Case 2: the basic rectangle is an aid used to construct a general quadrilateral (the straight sided variation)

adapted to the terrain and therefore are often reliable points in determining the position of boundaries (town walls). I describe the quadrilateral inscribed around the coordinate axes as the "basic rectangle".

Generally speaking in setting out quadrilateral complexes we can distinguish between two cases:

- **Case 1** (Fig. 8): the basic rectangle matches the completed project. Later corrections are not necessary (ideal case, for example on a flat site).
- **Case 2** (Fig. 8): the basic rectangle serves as an aid. In applying it to natural conditions the necessity of carrying out certain adjustments becomes clear (e.g. adaptation to the particular nature of the terrain).

On certain occasions the main points of the basic rectangle are not adhered to. Any departures made are not arbitrary, but always follow a geometrically logical approach. It is probable that the Temple square in Jerusalem is such a case.

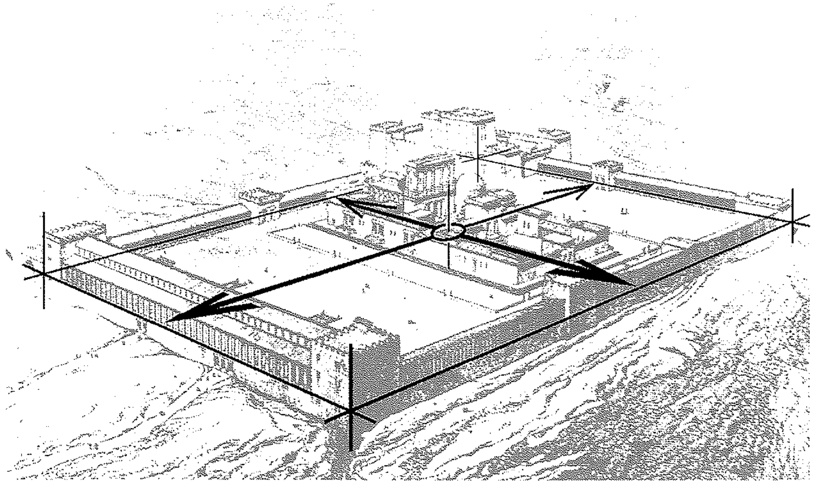

Fig. 9: "Model" of the rectangular ideal plan of the Herodian complex. The Temple axis (Herod axis) is the axis of symmetry. (Reconstruction of the Temple complex after M. de Vogüé 1864, the Temple has been shifted to the centre of the complex by the author. Ideal plan and drawing by the author).

The Herodian complex

If I assume that the ideal plan of the Herodian complex was rectangular in design this could have looked as shown by the plausible "model" in Fig. 9. The axis of symmetry would be the temple axis, which would correspond to the line I have described above as the Herod axis (Fig. 7).

If the quadrilateral of the Herodian complex was planned and built according to the general principles for the setting-out of towns and major open spaces (see above), then it too must have used a system of coordinate axes and a basic rectangle. For the present I assume that the quadrilateral formed by the existing complex (Fig. 6) is the quadrilateral of the Herodian complex. Even though certain sections of wall seem to date from more recent times, I assume that the foundations were left unaltered and that therefore the lines of the existing walls are the same as those of the original walls.

Coordinate axes and basic rectangle

Reference points in the search for the coordinate axes and basic rectangle are provided by the east side of the complex, which has a length of 250 fathoms, and the perpendicular to this line erected at its centre point, which I have already referred to as a particularly important line and have entitled the Herod axis (Fig. 7). I have described the intersection with the east side as E, that with the west side as W and have given the distance between these two points as 160 fathoms. In comparison to the length of the south side (150 fathoms) and of the north side (c. 170 fathoms), the length E-W is the average between these two, also a round figure.

As there are always unavoidable differences between planning and execution, I describe the points of the planning phase with a superscript asterisk, e.g. N*, NW*, to distinguish them from the points of the execution. The plan can thus be described as an ideal case without any errors. The "errors" in the execution are due to imprecision in the setting-out and later in the construction, which are impossible to avoid.

I provisionally designate a point half way along the length of E-W (160 fathoms) as setting-out point A* (Fig. 10). I hereby assume that this length corresponds to the east-west axis of the coordinate axes and that the arms of the axis were of equal length. From the considerations described I define the coordinate axes of the basic rectangle with origin A* and the arms of the axes with a length of 125 fathoms to the north and south of the origin and 80 fathoms to the east and the west. This produces the dimensions of the basic rectangle, 160 x 250 fathoms. A different position for A* would produce uneven values for the lengths of the main axes, which I regard as a reason for excluding such an alternative solution.

In comparing the basic rectangle with the existing boundary walls of the Temple Mount platform it is revealed that on the north and east sides the two correspond quite precisely, whereas on the south and west sides there are striking discrepancies between them. If it proves possible to explain these departures from the basic rectangle in terms of geometry, then this offers proof that the Herodian complex was set out using the assumed basic rectangle. Generally speaking, I believe the reason for such departures lies in the constructional necessity of adapting to the site (the rock), a procedure that I have described in general as "planning in nature" (Fig. 8, case 2).

Departures from the basic rectangle (adapting the planning to nature)

In examining the possibility of a geometric relationship between the basic rectangle and the course of the southern and western boundary walls which differ from the lines of this rectangle, I turn my attention to the southwestern corner point of the basic rectangle SWG* (Fig. 11). The reference point for these differences is the point H* which is the intersection of the extended south side with the extended west side of the basic rectangle. The distance between SWG* and H* is ten fathoms. Whether this distance results from extending the west

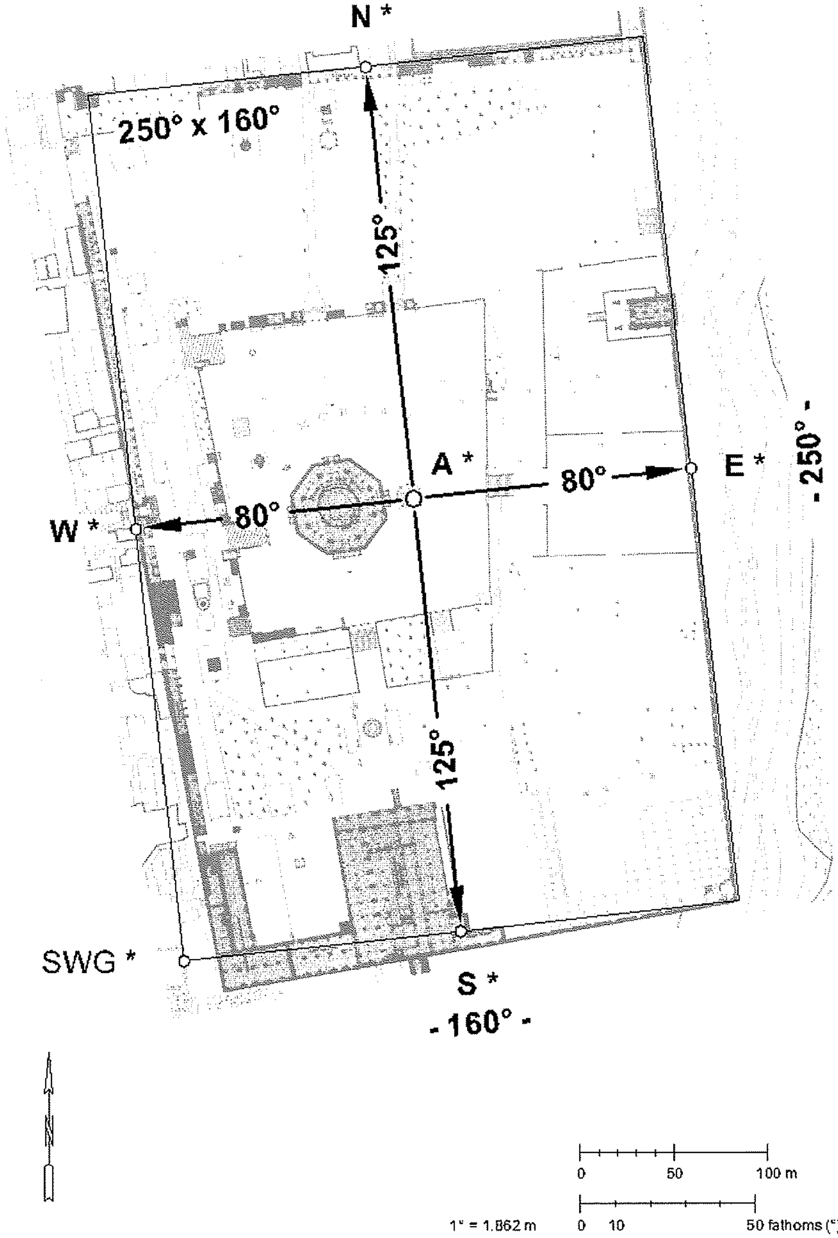

Fig. 10: The basic rectangle of the Herodian complex (160 x 250 fathoms). (Existing building substance from Fig. 3. Geometry and drawing by the author)

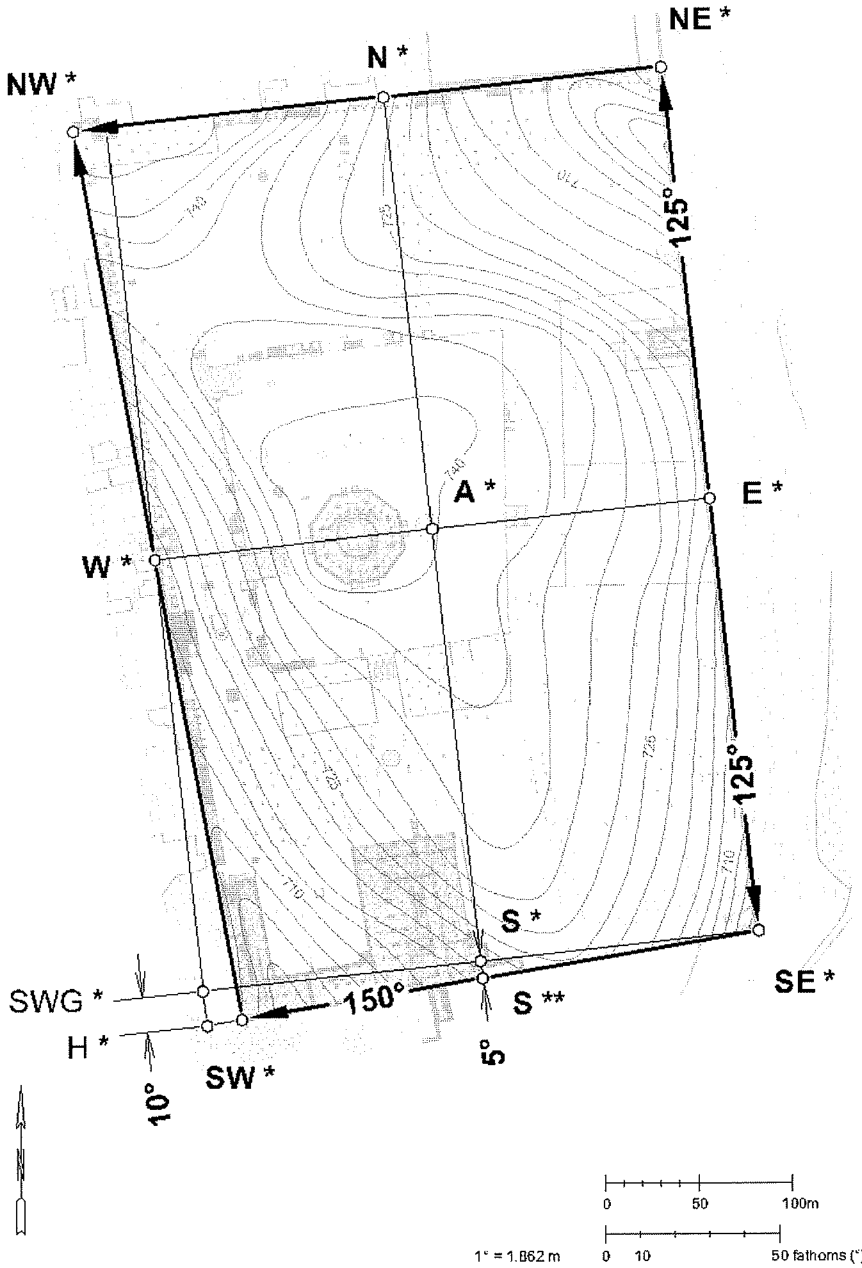

Fig. 11: Setting out of the boundary walls of the Herodian complex using the basic rectangle of 160 x 250 fathoms as a constructional aid. (Building substance from Fig. 3. Contour plan according to Pearce and Hubbard 1966. Geometry and drawing by the author.)

side of the basic rectangle by ten fathoms to the south or from extending the north-south axis five fathoms from point S* to S** is unimportant, as both methods produce the same result.

These even values clearly represent a geometric relationship between the departure from the basic rectangle and the actual construction, which I also present as proof for the existence of coordinate axes with the basic rectangle as a constructional aid. Particularly convincing is the length of the southern arm of the axis which was increased from 125 (basic rectangle) to 130 fathoms (actual construction) an "even" solution which could be obtained only by using the setting-out point A*.

The location of the southwestern corner SW* thus results from setting out an even value of 150 fathoms from the point SE* along the corrected line of the wall of the south side. From the given geometrical relationship we also recognise that the laying out of the south side was the first correction "in nature" to be carried out.

Initially I saw the reason for the corrected line of the south side in an optimised adaptation of the line taken by the wall to the existing terrain (the domed summit) between the Kidron and Tyropoion valleys. Another reason could possibly lie in an adaptation to an older existing development of Ophel (David's City), as the corrected line of the south side lies parallel to the exposed walls (Fig. 2) and this departure from the basic rectangle also suited the nature of the terrain. I attribute the correction in the length of the south side, from 160 fathoms to the shorter rounded value of 150 fathoms, entirely to the adaptation to the site in connection with the west side.

Subsequently the west side was determined in accordance with the general principles of the setting-out of towns and large open spaces (Fig. 8, case 2), from the south-western corner SW*, by continuing it through the western main point W*. Both points were already adapted to the terrain of Tyropoion valley and therefore decisive for the determination of the west side planned as a straight line. The northwestern corner point NW* is the intersection of the line of the west side with that of the north side, which was planned as a perpendicular to the east side.

Thanks to this logical setting-out it can be clearly recognised that the lengths of the west and north sides were constructed "in nature" and thus have uneven values in fathoms. In contrast the setting-out lengths of the east and south sides are 250 and 150 fathoms respectively which I have therefore understandably used as a basis in calculating the length of a fathom as 1.862 ± 0.003m. Through this reconstruction I have also produced proof that the position of the setting out point A* at the centre point of both coordinate axes is correct.

The method of setting-out described here allows us to clearly recognise the new layout of the south, west and north sides of the Herodian complex. Only the central section of the east side forms an exception, as it was already in existence at the time of building the Herodian complex and was thus merely extended in both directions. The practical implications of this planning are shown in the massive walls, in particular in the area of the SE corner where the height is approximately 44m.[10] Using the existing rock as a foundation for these walls was an important factor in ensuring their stability.

I have been able to trace the planning of the Herodian complex geodetically: Fig. 12 shows a geometric representation of the complex.

Comparison of the planning with the actual execution

I have already referred to the fact that there are unavoidable differences between the planning (ideal values) and execution (actual values). The differences in the lengths of the sides, the internal angles and the directions can be seen by comparing the values in Fig. 12 with those in Fig. 6.

Corner	**y-difference (m)**	**x-difference (m)**	**Resulting lengths (m)**
NE / NE*	+ 0.39	- 0.17	0.43
SE / SE*	+0.34	+ 0.25	0.42
SW / SW*	+ 0.03	+ 0.35	0.35
NW / NW*	- 0.34	- 2.55	2.57

Table 3: Differences between planning and execution in the position of the corner points

The differences in the position can be best expressed by the differences in the coordinates of the corner points (Table 3). The absolute differences are calculated as the results of the respective x and y differences. The resulting differences in column 4 of Table 3 can be separated into three values of around 0.4m and a considerably larger value of 2.57m. I regard the first three values in relation to the precision of the planning basis (± 0.2 to 0.3m) as essentially the same and see this as a clear evidence of the application of the plan.

The difference of 2.57m occurs at the NW corner. I have already referred to uncertainties in determining the NW corner point. Perhaps this corner point is so hard to determine because the Castle of Antonia stood there. Due to the lack

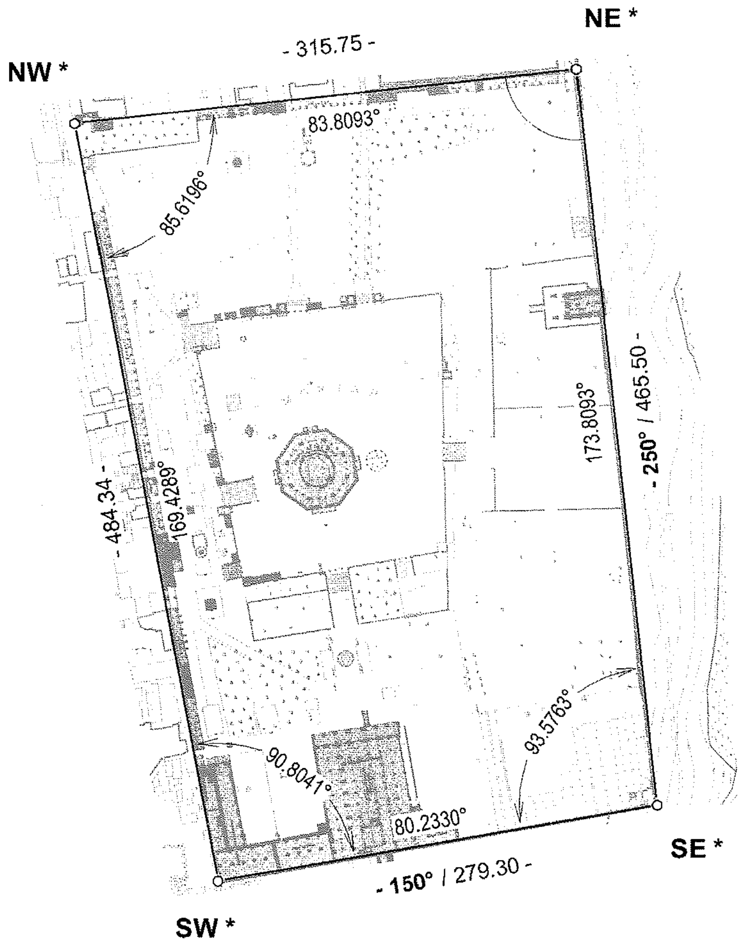

Fig. 12: Geometry of the planning (execution cf. Fig. 6). (Building substance from Fig. 3. Geometry and drawing by the author)

of a Herodian wall corner I have defined this corner point as the intersection of the west side with the projected line of the eastern section of the north side. If instead I had determined this corner point as the intersection of the west side with the course of the northern site boundary (building line) the difference would have been only 1.10m. The length of the west side would then be 485.44m (instead of 487.12m) and that of the north side 314.65m (instead of 314.78m). I have also entered these values as alternatives in Fig. 6.

Businnk states that, for a length of around 120m, the western part of the north side is bordered by the rocks of the Castle of Antonia.[11] He also quotes Vincent, who mentions that the cliff face had been worked along a length of about 45m to a height of between 6 and 10 metres.

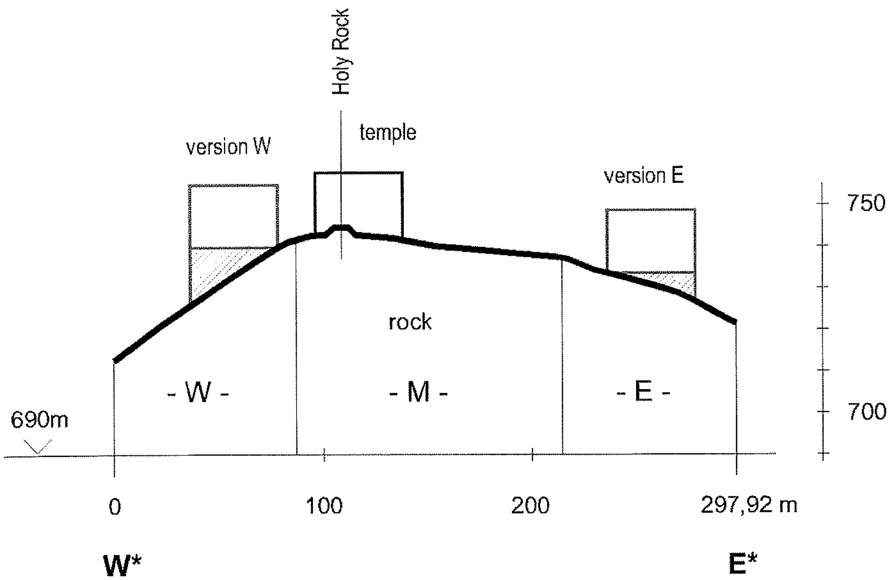

Fig. 13: Section through the terrain along the reconstructed Temple axis to examine suitable locations for the Temple (height multiplied by a factor of two in relation to width) (Drawing by the author)

It is most likely that an answer to the question of the true location of the NW corner point can be found only by geodetically determining the line of the rock edge. The result could be agreement between the planning and execution phases, as is the case with the other corner points. However the position of the NW corner point (intersection of the north and west sides) has no bearing on further research as, essentially, the adequately defined east side is here decisive (Figs. 7, 10 and 11).

Position of the Temple

There are no accurate details about the former position of the Temple; the Bible is also silent on this matter. The traditional understanding is that the Temple stood where the Dome of the Rock now stands. Other opinions suggest that the temple could have been to the north or the south of the Holy Rock. However the assumption of continuity in the location of the place of worship from the time of Solomon to Herod appears confirmed.[12]

In my view the Temple, which was an important part of the complex, must have been geometrically linked to it. I provisionally dismiss the idea that the

Temple had an isolated position not related to the general planning concept. The geometric relationship we are looking for could be most easily revealed by a particular position of the Temple axis, which is as yet undiscovered. On this account I here again refer to the Herod axis (Fig. 7), which I have already suggested could in fact be the Temple axis. I pursue the planning basis suggested by this possible link, not only in the case of the Herodian complex but later also in regard to the Temple of Solomon.

To postulate the Herod axis as the Temple axis would in fact be premature at this stage. In view of my reconstruction of the planning (Figs. 10, 11), in which the link sought with the geometry of the complex as a whole can be recognised, I wish however to adhere to this supposition, particularly because the fact that this axis is identical with the east-west axis of the coordinate axes I have laid down is indeed remarkable.

In all their considerations those responsible for building under Herod had a vision of the Temple before their eyes. The "model" in Fig. 9 conveys an impression of the dominant position of the Temple within the Herodian complex. It therefore seems plausible that the Temple axis was used as a reference axis for the extension of the complex and that planning and execution were based on this axis. A particular feature is the symmetrical extension of the east side in relation to the temple axis. Given the difficult nature of the terrain this was an ambitious planning goal and represented a particular constructional challenge. Perhaps this symmetrical extension represented a wish to recreate an old order, which may have existed in the Solomonian complex. It is conceivable that this order was lost in the course of time during the various stages of the extension to the south (Fig. 1) but remained anchored in the consciousness of the priests and builders.

Up to this I have referred only to the reconstructed Temple axis. This axis does not yet determine the exact position of the temple but does narrow down its possible location. As a next step, attention should be directed to the situation of the Temple along this axis.

This can most easily be done by examing the suitability of all possible positions from a technical viewpoint (Fig. 13). In such an evaluation the contours of the site are of decisive importance. The east-west axis (axis Herod = Temple axis) can be divided into three characteristic sections: in the centre is the flatly domed area with the Holy Rock as its highest point (section M), while on either side (sections W and E) the ground falls steeply. This change in levels is clearly recognisable, even without a contour plan, in the flights of steps still in existence (Figs. 2, 3).

From the viewpoint of building construction I draw the conclusion that the Temple can have only been located in the rounded domed area (section M). What speaks in favour of this conclusion is the almost level site and the excellent qualities of the rock visible here as a building ground. The area needed to lay out a forecourt of appropriate dimensions to the Temple building is also a criterion in making this evaluation.

Locating the Temple in the sloping sections of the site would have brought with it considerable architectural, constructional and structural difficulties. The slope of the site would have demanded a sub-structure with a height of up to fifteen metres (versions W and E in Fig. 13).

Additionally it should be taken into account that at the time of the planning under Herod the Temple was already in existence and thus formed a given constraint, a matter I shall deal with at length in the section on the complex of Solomon. However at this stage one can say that, on account of the smaller size of the Solomonian complex, its Temple cannot have been as far west from the Holy Rock as could have been the case in the larger Herodian complex.

In a first approach based on the arguments outlined above, I place the Temple in such a way that it lies on the already defined Temple axis (Herod axis) with the Holy of Holies on the Holy Rock (Fig. 14). The locations of the cisterns should be noted, they should not conflict with the position of the reconstructed Temple, as it is most likely that the area directly in front of these underground structures was kept free of buildings.

Fig. 15 shows in detail the situation of the Temple in my reconstruction with the Holy of Holies above the Holy Rock. The Temple shown is the Temple of Solomon/Zerubabbel that was rebuilt and extended by Herod.

The setting out point A* of the Herodian complex with the coordinate axes for the extension of the temple square lies in front of the Temple portal (cf. Fig. 14). In setting out the main points N*, E* und S* the view to the north, east and south was most probably unobstructed. The location of the western mainpoint W* had to be determined with the help of construction lines (parallel setting-out).

The Solomonian Complex

In contrast to the Herodian complex, which I have been able to reconstruct on the basis of the existing structures, there is no basis of this kind for a reconstruction of the Solomonian complex. (I here use the term Solomonian complex irrespective of whether it was actually built by Solomon or not).

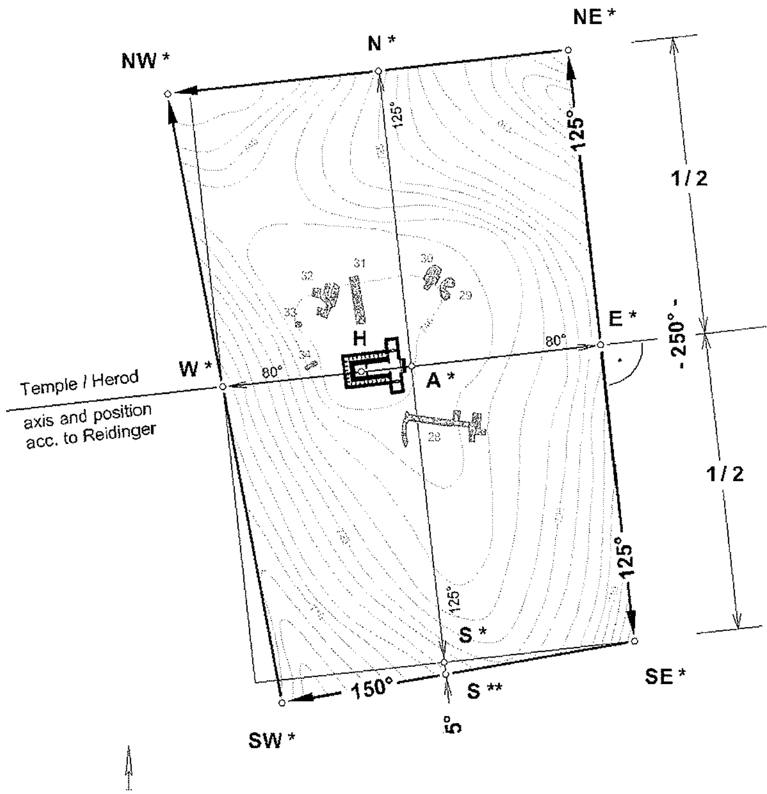

Fig. 14: Reconstruction of the Herodian complex with the location of the Temple on the Holy Rock with contour plan and the position of the cisterns H ... Holy Rock (Contour plan according to Pearce and Hubbard 1966. Position of the cisterns from Schrick, 1896: Plate IX. Geometry of the complex, position of the Temple and drawing by the author).

Biblical references (Temple area, units of measurement)

The only source that can provide information on the extent (the dimensions) of the Solomonian complex is Ezekiel's vision of a new Israel (Ezekiel 42: 20), in which he says:

'He measured it on the four sides. It had a wall around it, five hundred cubits long and five hundred cubits broad, to make a separation between the holy and the common.'

Whether this biblical statement represents symbolic or realistic dimensions has not been clarified. In regard to the length of the cubit we read in Ezekiel 40: 5:

'And behold, there was a wall all around the outside of the temple area, and the length of the measuring reed in the man's hand was six long cubits, each being a cubit

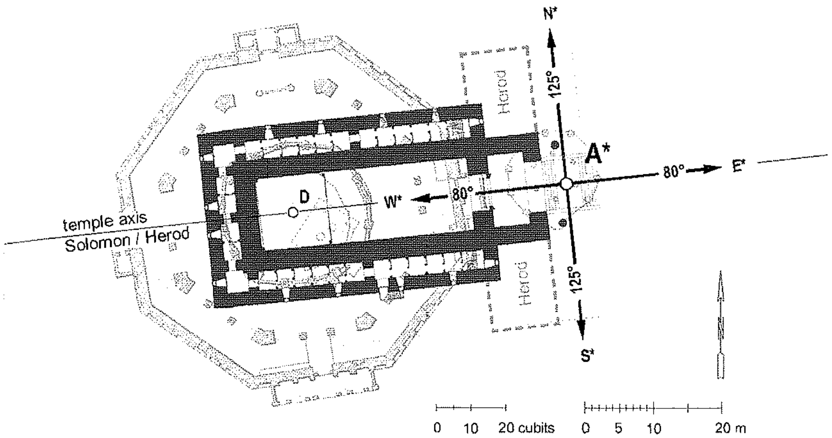

Fig. 15: The Temple with the Holy of Holies above the Holy Rock in relationship to the setting-out point and coordinate axes in front of the Temple portal. The illustration shows the Temple of Solomon with the planned extension by Herod compared to the position of the Dome of the Rock. (Dome of the Rock: enlargement from Fig. 3, plan of the Temple from Zwickel 1999: 94. Position of the Temple with the extension by Herod as well as Temple axis and coordinate axes drawn by the author)

and a handbreadth in length; so he measured the thickness of the wall, one reed; and the height, one reed.'

These biblical cubits are the so-called royal cubits whose length is probably that of the Egyptian royal cubit, i.e. around 52cm.[13] The agreement with the oldest unit in the world, discovered in Mesopotamia, the so-called Nippur cubit (original cubit) from the fourth millennium, which measured 51.89 ± 0.08cm, is remarkable. [14]

Pfeiffer derives the length of the cubit from the Egyptian angle iron, which was used to layout right angles in building. [15] This angle iron was a Pythagorean triangle with sides in the ratio 3 : 4 : 5 on a base measuring four handbreadths. This base is also described as a foot, as every triangle "stands" upon it. Its length is 29.7cm, which matches the Egyptian-Grecian-Roman foot (four handbreadths, each 7.43 cm).

The royal cubit is the length of the thread that is stretched across both *catheti* (3 + 4 = 7 handbreadths = 52cm). The length of the standard cubit (common cubit) was $1^1/_2$ feet (6 handbreadths). In the words of the Bible, the length of the cubit that was used as a unit of measurement is made up of the common cubit plus. 1 handbreadth (6 + 1 = 7 handbreadths) which gives 7.43 cm X 7, that is also 52cm. Regarding the period from which the passages quoted from the Bible date, Braulik states as follows:[16] *'Regarding Ezek. 40:5 and 42:20: Ezek. 40 – 48, the so-called "constitutional version": developed to its present length in what was probably a complex development process from the second half of the sixth century to the early third century BCE.'*

On the basis of this statement I assume that the details about the dimensions of the Solomonian complex and the unit of measurement used are realistic. I incorporate them in my building analysis and will look for proof of them. If in the course of the building analysis a dimension is discovered that indicates a relationship to the biblical sources this could be regarded as proof of the "square of Ezekiel".

A square measuring 500 x 500 cubits

For this section of the research the buildings of the pre-Herodian period are decisive. These include the Temple, which Herod only adapted and extended, as well as the central section of the east wall that was incorporated in the Herodian project. Nothing remains of the Temple of Solomon

I shall attempt, using "building construction archaeology" and by means of a reconstruction of the planning of the entire complex, to provide a suggestion for the location. I have already done this for the Herodian complex; the outcome was the location directly on the Holy Rock (Figs. 14, 15).

The question remains as to whether it is possible to reconstruct the Solomonian complex. As regards the Temple the position and axis discovered in the section on the Herodian complex remain valid. They can thus be seen as important parts of the Solomonian complex.

I shall investigate in greater detail the location of the Holy of Holies directly on the Holy Rock. Most experts today are of the opinion that the Temple stood on the point where the Dome of the Rock was erected at the time of the Umayyads.

The central section of the east wall is without doubt a part of the construction dating from the time before Herod. The relationship to the Solomonian complex, which we are endeavouring to locate, is not yet clear, as the wall was extended on either side and these extensions date from different construction phases (Fig. 1). The right-angled link between the Temple axis and the east wall however remains (Fig. 14). The question whether there exists a further geometric relationship between the position and orientation of the Temple and that of the east wall will also form part of the research into the Solomonian complex.

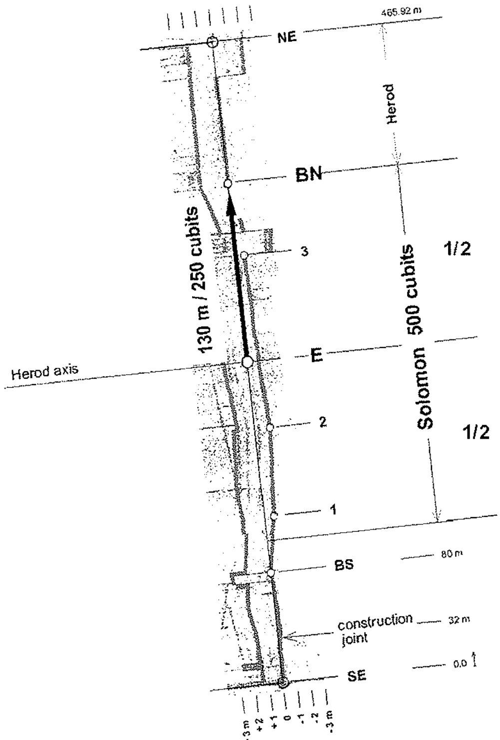

Fig. 16: Eastern line of the wall with the points at which it bends and the differences to the connecting line SE-NE, exaggerated depiction (the width has been multiplied by a factor of 10 in relation to the length)
BS – southern point at which the wall makes a bend
BN – northern point at which the wall makes a bend
(Building substance from Fig. 3. Exaggerated depiction, geometry and drawing by the author.)

For the constructional analysis of the east wall I recall here the illustration of the line of the wall in which the width is multiplied by a factor of ten (Fig. 5). To prepare this illustration it is necessary to precisely measure the course of the wall, which can be defined most simply as a polygonal line (Fig. 16).

The connecting line between the SE and NE corner points of the Herodian complex will provide the "reference line" against which differences can be measured. Starting from the SE point, after a distance of about 32 metres we find a vertical construction joint. Further along, about a further 48 metres, there is a clear bend in the wall at the point BS. Between SE and BS the line of the wall corresponds to that of the reference line. From the point BS to the point

BN the wall bends outwards and can be subdivided into four straight sections – the difference to the reference line reaches a maximum of around 1 metre at point 2. The point BN again lies on the reference line and therefore so does the 105 metre long stretch of the wall from BN to the NE corner point. The angle of the bend made by the wall at point BS is c.1° and at point BN around 1.3°.

I regard the points at which the wall bends in the outer sections as the boundary points of various building phases. I do not consider the question whether the wall is part of the original building substance, as I assume that the original foundations were used in any reconstruction work that may have been carried out. I suggest that the northern point BS, at which the wall bends, is the north-eastern corner of the former Solomonian complex and thus regard it as a "linking point" between the older part of the east wall and the Herodian complex. I do not apply the same considerations to the southern bend point BS as it lies in the area of the later extensions (Fig. 1) and therefore cannot be regarded as part of the original plan of the complex.

My starting point for the reconstruction of the Solomonian complex is thus based on the distance between the northern point at which the wall makes a bend (BN) and the middle point E, which is already defined as the intersection of the Temple axis with the east side. The distance betweeen BN and E amounts to 130m (Fig. 16). If we divide this value by the biblical cubit described above (52 cm) the result is: 130 / 0.52□= 250 cubits. Thus I have found what I have been looking for: i.e. a round value in cubits that can justifiably be regarded as a planning value of the Solomonian complex. This dimension is exactly half the length of the sides of the square mentioned in the vision of Ezekiel (500 x 500 cubits). The Temple axis (Herod axis) is here the axis of symmetry and the point BN is the NE point of the Solomonian complex.

As building is always a three-dimensional task I also examine the results of my research in the elevation of the east wall (Fig. 17). The striking thing about the drawing is that at the point BN the wall also rises upwards. This upward bend does not exist in the terrain, which instead dips downwards at this point. I do not consider this fact in my subsequent research because the upward rise in the wall certainly dates from a later period. However, it is remarkable that this point where the wall changes, so to speak, is the same in both plan and elevation, which suggests a connection of some kind.

In Fig. 17 it can be seen that the extension by Herod to the north (BN-NE) cuts across a valley that was clearly avoided by builders until the final (Herodian) construction phase. Among the logical considerations in fixing the NE corner point of the Solomonian complex (point BN) are the wish to avoid

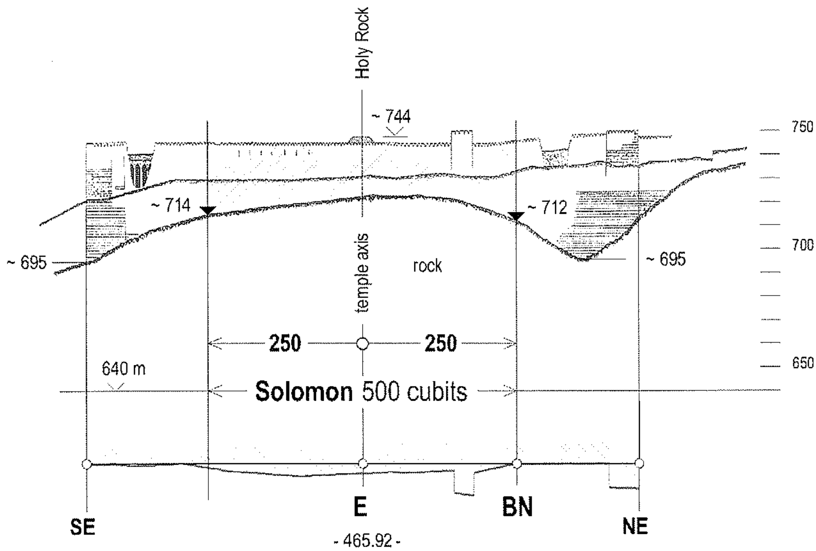

Fig. 17: East wall in elevation (vertical scale multiplied by a factor of two), BN is the northern point at which the wall bends, the Solomonian complex is crosshatched. (Drawing by the author, longitudinal section from Busink 1980: 979)

unnecessarily difficult construction and to exploit the valley as a natural barrier.

If we trace the line of the surface of the rock to the south too, we note that the complex of Solomon (with sides measuring 500 cubits) was built upon a flat rounded dome. The optimal adaptation to the terrain is remarkable and deserves our attention as both the corner points of the east side on the rock were laid out at approximately the same level (Fig. 17).

From the southern end of the Solomonian complex the depth of the foundation bed increases considerably the further one moves along. In the first (southern) extensions the problems posed by this fact were obviously taken into account as it was regarded as important to retain the protection offered by the natural moat against attack from the north.

The dimension of 250 cubits is half the length of the side measuring 500 cubits and is probably also the length of the arms of the coordinate axes required to set out the square. In both cases (Solomon and Herod) the position of the Temple and the Temple axis are the same and coincide with the east-west axis of the coordinate axes used in both cases. In addition this axis runs across the Holy Rock.

Fig.18 shows the terrain of the original Solomonian complex and the extended complex of Herod. It can be clearly seen that the step from the first

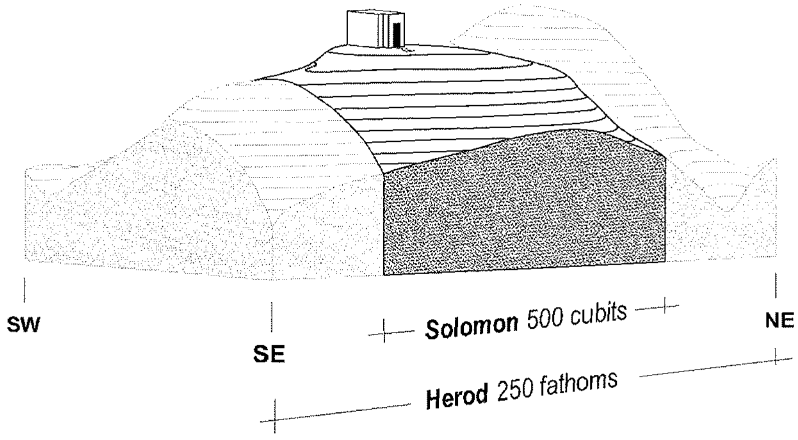

Fig. 18: Perspective of the Temple Mount with rock contour lines and the Temple on the Holy Rock in relation to the complexes of Solomon and Herod (the height has been enlarged 2.5 times in relation to the length) (drawing by the author)

complex (on the rounded summit) to the extension entailed considerable constructional difficulties.

After finding the "biblical" length of 500 cubits in the line of the east wall and establishing a geometrical relationship to the temple axis there are no further obstacles to reconstructing the Solomonian complex (Fig. 19). The rectangle we have been looking for is simply produced by extending at right angles in a westerly direction. Thus the coordinate axes of the Solomonian complex can also be determined using the origin A and 250 cubits as the length of the arms of the axes. The temple axis is thus the axis of symmetry of the complex. In the metrical system of measurement this would represent a square with sides measuring 0.52 x 500 = 260m. The distance from the centre of the Holy Rock to the east side, around three hundred and sixty cubits, is also striking; it most likely represents a value used in the planning (perhaps with a symbolic meaning)

The resemblance between the design of the Ezekiel Temple according to Vincent (Fig. 20) and my reconstruction is remarkable, although both reconstructions started from completely different premises. Both are characterised by symmetry and the central position of the Temple above the Holy Rock.

The Temple of Solomon

In reconstructing the layout of the Herodian complex I placed the Temple with the Holy of Holies directly upon the Holy Rock and justified this

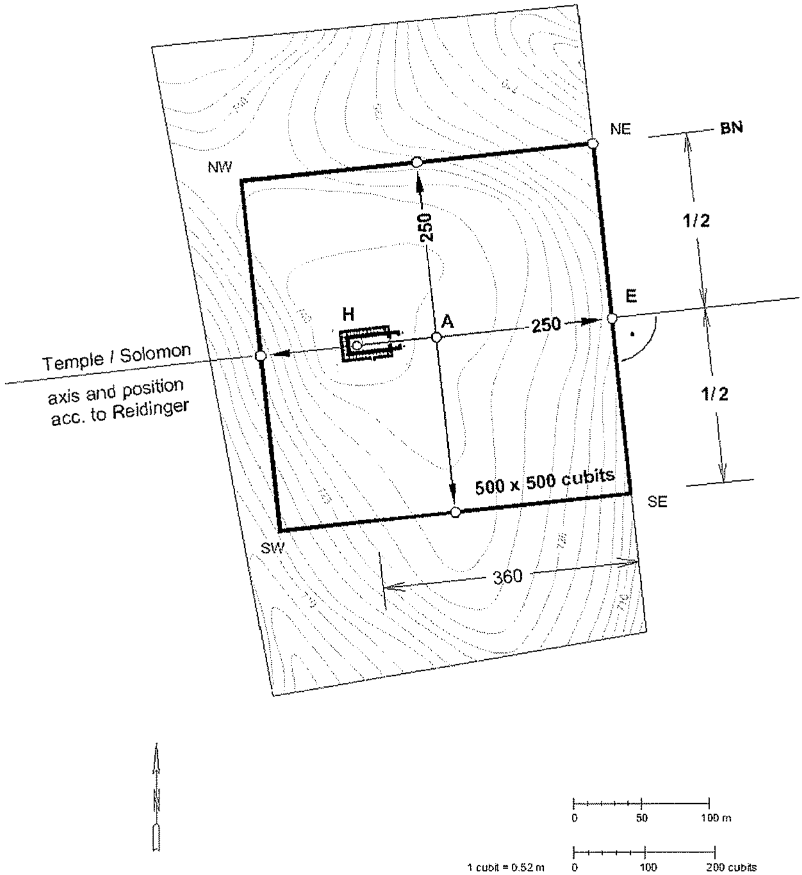

Fig. 19: Reconstruction of the Solomonian complex measuring 500 x 500 cubits. Setting-out plan with coordinate axes (distance from the Holy Rock to the east wall = 360 cubits) (Contour plan according to Pearce and Hubbard 1966. Position of the Temple and the complex of Solomon and drawing by the author)

positioning in terms of building construction (Figs. 14 , 15). Decisive here were the contours of the terrain along the reconstructed Temple axis, which at this point is the highest elevation of the Temple Mount (Fig. 13).

Fig. 18 shows the position of the Temple on the Holy Rock in a perspective view showing the extent of the Solomonian complex (500 x 500 cubits) and the extensions made for the Herodian complex. On the basis of this special position the question arises as to whether there might not be traces of the Temple in the Holy Rock that could offer us proof of its position. I will subsequently undertake a search for such traces.

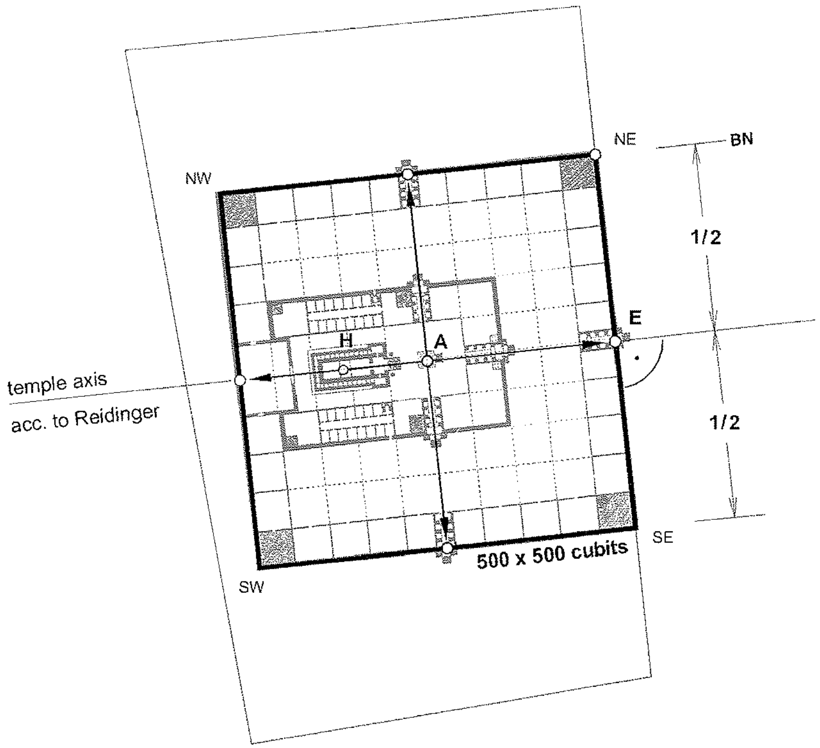

Fig. 20: Ezekiel Temple design according to Naredi-Rainer 1994. (Temple design from n. 17, adaptation to Fig. 19 and drawing by the author)

In comparison to Fig. 15, in which I first represented the situation of the Solomonian Temple above the Holy Rock, important detailed information is provided in Fig. 21. In concrete terms these are the artificially made rock edges that I link to the plan of the Temple of Solomom. It is noticeable that the western rock edge could coincide with the line of the west wall of the Holy of Holies and the northern and southern rock edges could coincide with the position of its sidewalls. Equally conceivable is the supposition of a geometric relationship between the lines of the rock edges and the geometry of the complex.

In Fig. 21 it can be seen that the artificial rock edges represent an "imposed" direction, as they do not follow the lines of the natural rock fissures. This is all the more remarkable as the difference in the directions is only about 4°. From this I derive that there was a building at this point whose orientation must have had a particular reason. I assume that this building was the Temple of

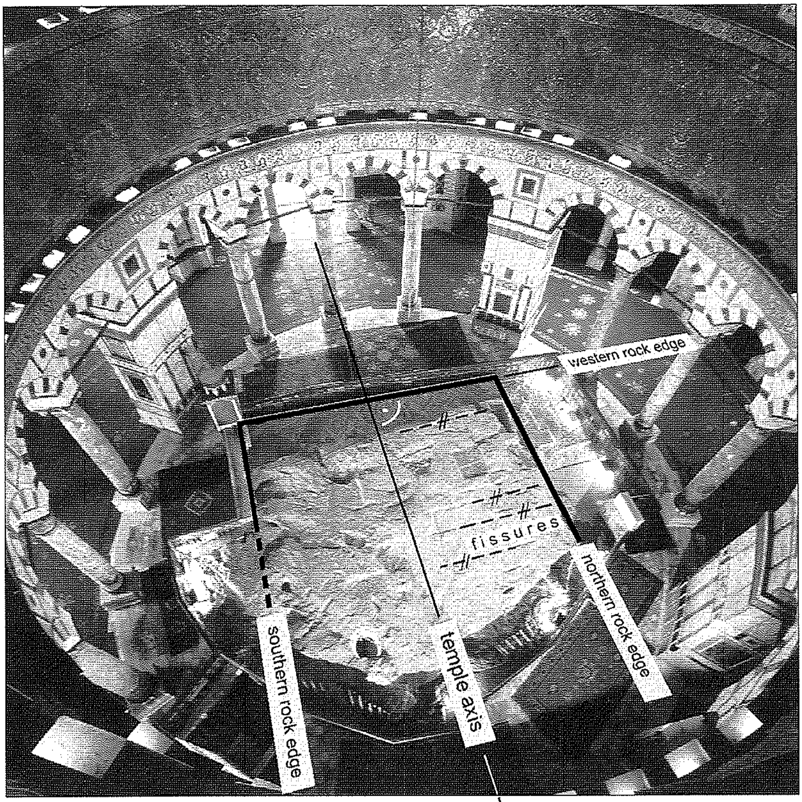

Fig. 21: The Holy Rock inside the Dome of the Rock with its particular geological and geometric characteristics. (Photograph by Nalbandian Garo. Geometric interpretation of the rock edges and drawing by the author.)

Solomon. I shall deal with the question of the special orientation in the section on the astronomical investigation.

The natural fissures in the rock area run approximately parallel to each other. This is evident in Fig. 21 where they are indicated by dashed lines. A line along which the rock was broken that runs across the entire width is particularly striking, as it is oriented on the line of the fissures. I regard this as a later intervention, possibly made by the Crusaders. In accordance with the geometric relationship indicated in Fig. 21 between the rock edges and the Temple axis as reconstructed by me (Figs. 14, 19) I ascribe these edges to the Temple of Solomon.

On further examination of the rock edges in Fig. 21 it can be seen that the western rock edge follows approximately the line taken today by the parapet.

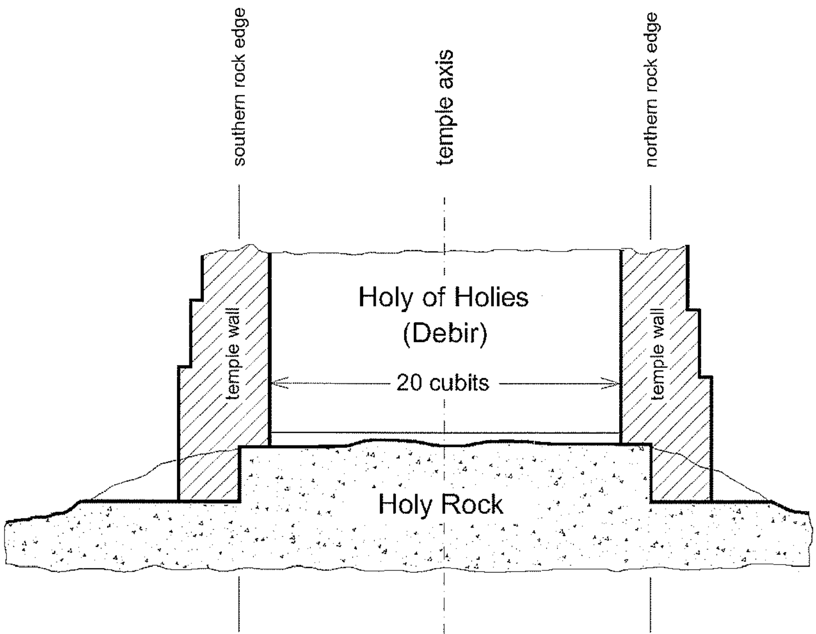

Fig. 22: The way the Temple "sits" on the Holy Rock (without depiction of the side rooms), section A-B in Fig. 23 (drawing by the author)

It begins at the southwestern corner where there is a shrine and ends in the northwest at the change in level to a lower rock base. The distance between these two points is about 12.2m.[18] The midpoint of this western rock edge lies on the temple axis, which runs at right angles to the line of the rock edge. The northern rock edge is defined by a change of level (step); it extends a length of c. nine metres across the visible area of the rock. The southern rock edge is not as long, only c. four and a half metres. It ends at the internal corner of the parapet. The reason that this edge is shorter could relate to the descent into the cave. If this edge had been continued the natural vault provided by the rock above the descent would have been destroyed. For structural reasons it was probably wished to avoid doing this.

The relationship between the lines of the rock edges and the position of the temple walls can be explained in terms of building construction, more precisely in terms of the foundations for these walls. (Fig. 22). There is no doubt that rock offers an excellent base for building. This does not, however, mean that the natural course of the rock is suitable as a foundation bed. In general, according to the principles of construction, foundation beds are laid out horizontally. This allows optimal bonding with the ground that assures stability and is suited to normal techniques of building with stone blocks. However,

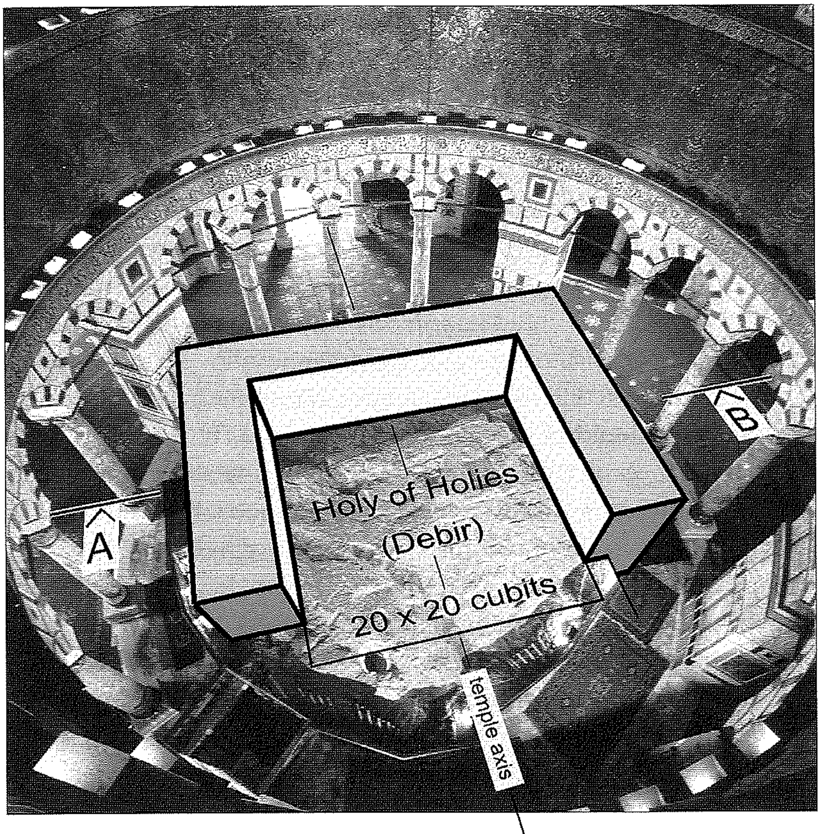

Fig. 23: The Holy of Holies on the Holy Rock (side aisles not depicted) (Photograph: Nalbandian Garo. Reconstruction of the Holy of Holies and drawing by the author)

vertical jumps in the foundation bed, both in a longitudinal and transverse direction, are not unusual in such constructions.

The parallel distance between the southern and northern rock edges, which amounts to c. 12.2 metres, suggests a relationship to the Temple. Expressed in biblical cubits of 0.52m this distance is around 23 $^1/_2$ cubits. This figure can be related to the clear internal width of the Holy of Holies.

The relevant Bible passages here are 1 Kings 6 : 2 and 20: *The house which King Solomon built for the LORD was sixty cubits long, twenty cubits wide, and thirty cubits high.*

and:

The inner sanctuary was twenty cubits long, twenty cubits wide, and twenty cubits high.

The first dimensions relate to the "house" and therefore could be understood as external dimensions, whereas the second passage clearly refers to internal dimensions. Twenty cubits is 20 x 0.52 = 10.40m. This value should be compared with the distance between the rock edges of 12.2m, the difference amounts to c. 1.8m. Half of this is around 0.9m, which also represents $1^3/_4$ cubits or 3 feet; in Fig. 22 this is the width of the inner (higher) section of the foundation. The outer part of the foundation, which lies lower, could, according to my structural "intuition", have been about twice as wide as this. In this light the biblical dimensions of the temple could be seen as completely realistic values.

The information indicated in Figs. 21 and 22 now allows a reconstruction of the part of the temple containing the Holy of Holies measuring 20 x 20 cubits on the Holy Rock, depicted in Fig. 23 in perspective. The Temple of Solomon matches the position of the Temple of Herod. Both relate to their respective surrounding complexes with which they are geometrically linked (Figs. 14 , 19).

On the basis of this result I dispute the generally held view that there are no remaining traces of the Temple of Solomon. On the contrary, I recognise the working of the rock edge for the purpose of building construction as an indication of the Temple's location. In concrete terms this is the foundation bed, which is clearly visible. This is the interface between building site and building, both belong inseparably together and thus one can also talk of the "imprint" of the Temple on the Holy Rock. I view this as constructional proof of the Temple's position with the Holy of Holies directly on top of the Holy Rock.

Astronomical examinations

Introduction

In the Middle Ages church axes were frequently oriented according to the position of the rising sun on specific days. I have been able to prove this in the case of a number of urban churches and many village churches.[19] In the case of planned complexes the church axis is frequently linked to the geometry of the town. A characteristic feature of "sun-oriented" churches is the so-called axial kink or bend. This occurred as the result of a two-phase orientation process in which the axis of the nave and that of the choir were determined independently of each other. I understand this as a symbolic transition from earthly to heavenly life.

In all these cases an absolute mark was eternalised by the orientation of a particular building or the layout of a town towards the rising sun. From the orientation on a particular feast day (e.g. Easter) we can also deduce the founding year. In this way, in addition to the three spatial dimensions the fourth dimension – time – is introduced into building research. Under auspicious circumstances we can answer not only the question of how but also the question of when the building was erected.

In antiquity the builder had to possess knowledge of the stars and the regular paths of the heavenly bodies.[20] The current state of research suggests that several ancient places of worship were oriented towards the rising sun, such as, for example, the Great Temple of Ramesses II (1279 –1213 BCE) in Abu Simbel.[21] There, twice yearly (20 February and 20 October), the statues of the gods in the sanctuary were lit by the rays of the rising sun.[22]

Therefore, from the viewpoint of those involved in the world of building construction my research work on the Temple Mount platform in Jerusalem would be incomplete without discussing the question of a possible astronomical orientation of the temple. In the description of the building of the temple (1 Kings 6f) there are no indications of such an orientation.

Researchers agree that the Temple axis was laid out in an east-west direction and they also agree that the Holy of Holies was in the west and the entrance in the east. However the reason for this orientation has not been clarified. Over the course of time various opinions have been formed on this matter that are contradictory on several points. Several experts speak in favour of a solar orientation, while yet others refute this idea. I present a number of opinions below.

1904: Charlier[23] assumes as his starting point that the Temple was oriented east-west and that therefore the rays of the rising sun at the vernal and autumnal equinoxes fell along the line of the Temple axis. From this he wishes to prove *That on Yom Kippur the rays of the sun along the temple axis fell into the Holy of Holies and that a revelation of Yahweh (a "lighting up of the face of Yahweh") was associated with this.*

1994: Albani[24] explains the relationship between the kingship and sun in Jerusalem. He is of the opinion that, on account of much discussed passages in the Bible (2 Kings 23:11 and Ezekiel 8:16), there must have been some kind of sun worship or other in the Jerusalem Temple cult. In the Temple consecration phrase (1 Kings 8:12): *Then Solomon said, 'The Lord has set the sun in the heavens, but has said that he would dwell in thick darkness.'* Albani sees here a reference to elements of a solar cult and possibly to the replacement of the sun cult by the YHWH cult.

1999: Zwickel[25] is of the following opinion regarding the orientation of the Temple: *If no proof can be supplied of the equation of YHWH with a sun god then the thesis that the temple was oriented towards the sun is invalidated.*

2002: Görg[26] has informed the author that, from the viewpoint of the history of religion and Biblical archaeology, it is not known up to the present whether the so-called Solomonian Temple was oriented in an east-west direction or where it stood. He therefore says that it is impossible in his specialist field to arrive at a definite Temple axis or an orientation towards the rising sun.

My own conclusions: from these examples it is obvious that there is no single clear answer regarding the orientation of the Temple. Therefore the question arises as to whether it might be possible to achieve clarity by using my starting point. This begins with an astronomical examination of the Temple axis, which I have already reconstructed for the Solomonian complex (cf. Fig. 19). According to the criteria applied to building in antiquity, my constructional examination would be incomplete if I were to omit an astronomical observation, regardless of whether it produces an answer or not.

In contrast to those days when orientation was carried out by direct observation of the rising sun, today this process can only be traced by means of calculation. By virtue of my geodetically determined Temple axis my work differs from that of others who took as their starting point an assumed east-west direction (90°) and therefore inevitably related the orientation of the Temple to the equinoxes. The question frequently crops up as to how orientation towards the sun can be carried out in the case of bad weather. It is conceivable that the rising sun was observed over a period of several days beforehand and that the direction of the sun could be extrapolated from the results of these observations for the planned orientation day.

Temple axis

So far, by the term "Temple axis" I have meant solely the "Herod axis" reconstructed from the Herodian complex and have equated it with the axis of the Solomonian complex (Figs. 14, 19). In the astronomical examination this simplification is not assumed from the start; instead, it should be examined whether it is possible to define the Temple axis more precisely.

In fact there exists a second line that could have the status of a temple axis: this line is at right angles to the line of the Solomonian wall around the middle of this side (approximate length c.130m); I describe it as the Solomon perpendicular (Fig. 24). It is swivelled by c. - 0.18° from the temple axis.

The Herod axis is already a reconstructed temple axis (Fig. 7), which was

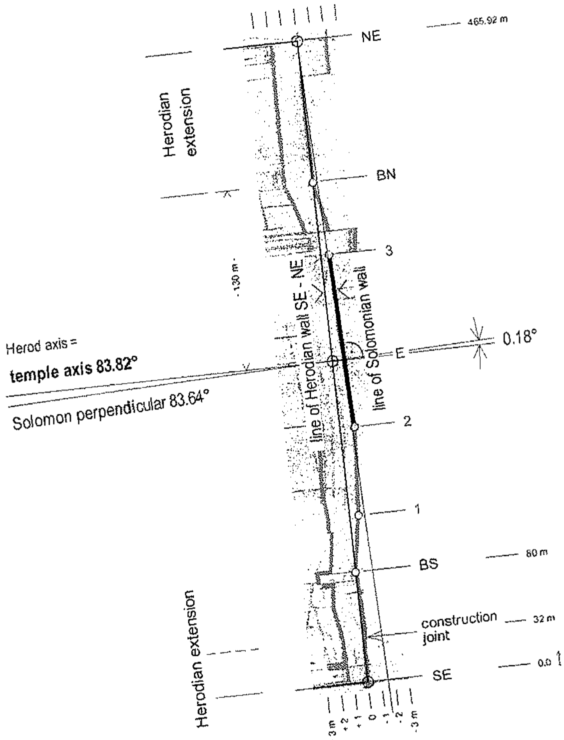

Fig. 24: East side with the Herodian line (connecting line SE- NE) and the line of the Solomonian wall (width multiplied by a factor of ten in relation to the length)
Herod axis = Temple axis (azimuth 83.82°)
Solomon perpendicular (azimuth 83.64°)
(Distorted depiction of the building substance according to Fig. 16. Geometry and drawing by the author)

traced by the Herodian engineers with a high degree of precision from the existing Temple building. I reject a definition of the Temple axis as the connecting line between the Temple portal and the mid-point of the east side because at that time the east side had already been extended to the south (Fig. 1). I regard the Solomon perpendicular as less important than the Herod axis because it appears to me to be more logical that the axis was derived from the Temple. However, I shall keep the Solomon perpendicular in mind and examine its effects on the results of my work.

For an astronomical evaluation, the geographical (astronomical) orientation of the Temple axis is decisive. It is derived from the geodetic orientation taking into account meridian convergence.[27] The result for the Herod axis is an orientation of 83.82°. I regard its degree of precision very highly as I have reconstructed it from the "large" complex and not from the "small" building.

Herod axis:	geodetic orientation	83.8093°
	meridian convergence	+ 0.0118°
Temple axis:	geographical orientation (Herod)	**83.82**11°
Solomon perpendicular:	geographical orientation :	83.82 – 0.18 = 83.64°

The astronomical examination of the Herod axis, hereafter referred to as the Temple axis, will show whether it is linked with the cosmos and can therefore be described as a "holy line". Such a description is appropriate if it can be proven that it is related to Jewish feast days. To obtain such proof knowledge of the precise position of the Temple along this axis is not required; the decisive factor is the direction of the axis.

Position and height

I have selected the Holy Rock as the reference point for the astronomical examination, as my technical reconstruction of the position of the Temple produced this position (Figs. 14, 15). Any possible differences to the position in the area of the Holy Rock have no decisive influence on the results of the astronomical examination.

Position[28] and height of the Holy Rock:	geographical length	- 35.2346°
	geographical width	+31.7777°
	height	c. 744m

There is no exact information about the height of the Holy Rock at the time and the height at the time of Solomon is also unknown. There exist reports that the Crusaders broke off part of the rock.[29]

Horizon

The natural horizon on the temple axis extended eastwards is determined by the Mount of Olives. I have constructed its outline on the basis of a contour plan.[30] Fig. 25 shows the long section on the Temple axis.

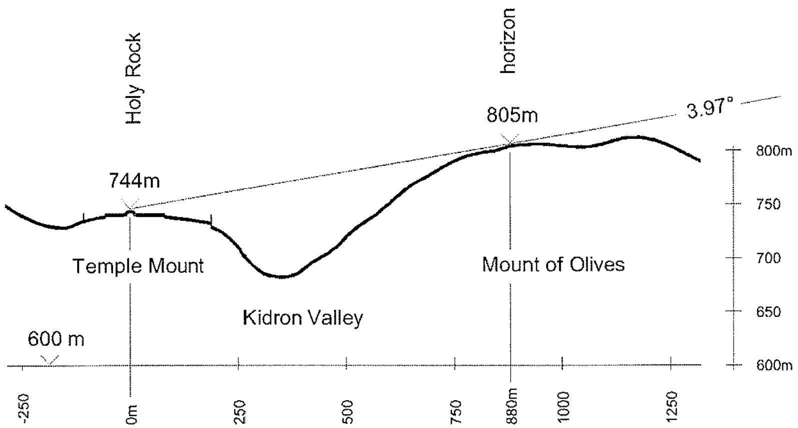

Fig. 25: Longitudinal section on the Temple axis (vertical scale multiplied by a factor of two in relation to the length, drawing by the author)

For the angle of elevation of the horizon on the Temple axis (without any woods) the height of the Holy Rock (744m) and the height of 805m on the Mount of Olives (about 880m distant) are decisive. From this an angle of elevation of 3.97° is calculated. This is on the cautious side, as each increase of 1m at the Holy Rock would sink the horizon by 0.07°. If we assume dense planting (olive trees), with a height of 4 to 5m, the horizon would lie about c. 0.30° higher. The influence of these possible differences in relation to the apparent diameter of the disc of the sun amount to c. 0.52°.

Time framework

To arrive with certainty at the date when the construction of the Temple began, we must determine a temporal framework for the astronomical study. The precise date of the founding of the Temple is unknown, as is the date of the start of Solomon's reign. There is a relative date given in 1 Kings 6:1, which says: *...in the fourth year of Solomon's reign over Israel, in the month of Ziv, which is the second month, he began to build the house of the LORD.*

Even if the biblical statements are regarded as reliable, the determining of absolute dates is frustrated by the uncertain chronology of the time. In the relevant literature the dates given for the reign of King Solomon differ greatly (differences of about 8 years). According to the Anchor Bible Dictionary,[31] King David is supposed to have ruled from c.1005 to 965 and King Solomon from c. 968 to 928. According to. Handy[32] Solomon first started the construction of the temple around 957 BCE. Whatever the dates given it is uncontested that we do not have a definite year for the start of the rule of Solomon nor for the beginning of the building of the Temple. For this reason I extend the framework for my study from 976 to 938 BCE. I have here allowed myself to be guided by the cycle of Meton (432 BCE) according to which, after nineteen Julian years, almost precisely the same positions reoccur between the moon phases and the sun.

Calendar

Julian calendar: In astronomy and for historical purposes, for the epoch before 46 BCE the Julian calendar is used. This is an extrapolation, which is why we also talk of a "projected" Julian calendar.[33] In the Julian / historical dating it should be noted that the year 1 CE is directly preceded by the year 1 BCE, i.e. the year 0 does not exist. In contrast to this, in the astronomical dating a year 0 is inserted. Therefore, for example, the historical year 965 BCE is the astronomical year –964.

Jewish calendar: For the work presented here the calendar at the time of King Solomon is decisive. Little is known about it. The start of the Jewish month was festively proclaimed at the reappearance of the crescent moon, the so-called new light. The calendar council convened for this purpose gathered on the thirtieth of each month in the morning and announced on the evidence of two reliable witnesses: 'the new moon is blessed'. Thus the thirtieth day of the month was declared the first day of the new month. If the crescent moon was not sighted on the thirtieth, the new month first began on the thirty-first day. The news of the beginning of the month was spread throughout the country from the Mount of Olives by specially lit fires.[34]

The general rule was: The day of the new crescent moon = 1st of the month (Thirtieth or thirty-first day of the old month).

Combination of the Julian with the Jewish calendar: in converting the Julian into Jewish dates and the other way around the different ways of dividing the day must be taken into account. The Julian day is defined as running from midnight to midnight whereas the Jewish day is from evening to evening. This means that, according to the Julian calendar, the rising of the moon crescent in the evening and the sunrise on the morning following that same night represent two consecutive days, but in the Jewish calendar it is the same day. The linking element is the moon, whose appearance as a new crescent moon can be precisely calculated according to the Julian calendar and which determines the start of the month in the Jewish calendar.

Feast days

A preliminary examination of possible orientation days on the Temple axis has shown that all Jewish feast days occurring in April and September should be examined. According to the Jewish calendar this would be the months Nissan and Tischri, in which nowadays the feast days of Pessach (Passover) and Yom Kippur (Day of Atonement) are celebrated. These were originally agricultural festivals that occurred in the fertility month (Nissan) and in the harvest month (Tischri).

I cannot accept any starting point for a solution other than that of examining the present-day Jewish feast days at the time of Solomon. The Biblical references to the feast days mentioned are to be found in the Book of Exodus (12:1-8) and the Book of Leviticus (23:5-6). In the decree on the feast days in Leviticus we read:

[5] *In the first month, on the fourteenth day of the month in the evening, is the LORD's passover.* [6] *And on the fifteenth day of the same month is the feast of unleavened bread to the LORD; seven days you shall eat unleavened bread.*

Pessach is nowadays celebrated on 15 Nissan; it commemorates the Exodus from Egypt. According to the Jewish definition the evening of the fourteenth day is the end of that day. From this we can conclude that the following night and the next sunrise are the fifteenth day. The general definition is: the fifteenth day of the first month. In astronomical terms this festival is determined by the first "full moon" in spring, as on the fifteenth day after the new crescent moon it is apparently still full moon.

Yom Kippur (Day of Atonement) is nowadays celebrated on 10 Tischri. The Biblical reference is also to be found in the decree of the feast days in Leviticus 23: 26-27 where it says:

[26] *And the LORD said to Moses,*

[27] *"On the tenth day of this seventh month is the day of atonement; it shall be for you a time of holy convocation, and you shall afflict yourselves and present an offering by fire to the LORD."*

As the tenth day begins in the evening, sunrise on the following morning is also a part of this same day, 10 Tischri.

As is the case with the months, the names of the feast days are not of significance for this work - only their dates. The beginning of the month is the day of the new crescent moon.

Braulik informed me as follows about the dates when the scripture quotes references were written:[35]

Exodus 12:1-8 is, most probably, a text composed by the priesthood, i.e. from the second half of the sixth century, but could also possibly be around 100 to 150 years younger and incorporate an older existing text. Leviticus 23:4-6 and 26-27 are, in comparison, probably younger texts of the holiness laws.

Sunrises on the Temple axis

Introduction

First of all, the question arises as to whether sunrise occurred at all on the Temple axis I have reconstructed. The answer is positive, as its orientation (83.82°) - lies between the summer solstice (–964 07 02) and the winter solstice (–964 12 29) (Fig. 26).

According to the astronomical calculation programme I used [36] the position of the sun is calculated according to the way it was actually seen. I therefore speak of the apparent altitude in contrast to the geometrical altitude, which is expressed without refraction. The sun moves twice in twelve months between the summer and winter solstice. This means that there must be two solutions along the Temple axis, days that lie symmetrically seventy-five days on either side of the summer solstice.

I describe these solutions as the "spring solution" and the "autumn solution" and ascribe them, where they coincide with the movable Jewish feast days (Pessach or Yom Kippur), to the Temple of Solomon and the Temple of Zerubbabel.

Temple of Solomon:	Spring solutions:	Autumn solutions:
	18 April 957 BCE	14 September 944 BCE
	19 April 968 BCE	13 September 952 BCE
	18 April 976 BCE	14 September 963 BCE
Temple of Zerubbabel:	Autumn solution:	11 September 515 BCE

In the remainder of this work I shall consider only the results for the years 957, 968 and 515 BCE because, due to specific historic connections, I regard these as possible "orientation years".

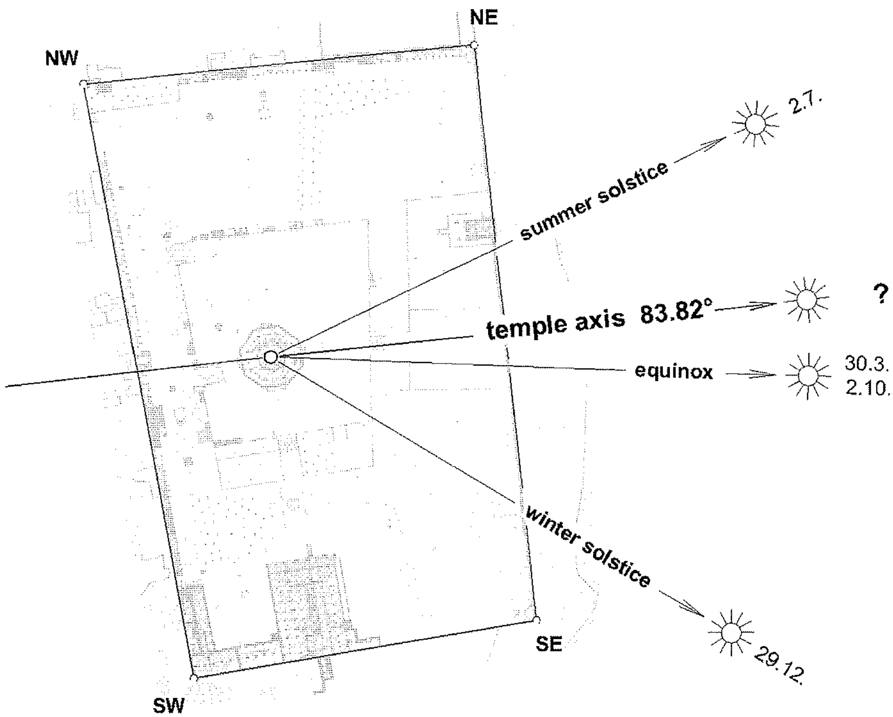

Fig. 26: Sunrises on the Temple axis (83.82°) in comparison with the azimuths of the sunrises at the summer and winter solstices as well as at the equinoxes at a horizon height of 4° (drawing by the author)

In a table for the period laid down, which extends from 976 to 938 BCE, I present the study of the years in which 18 / 19 April coincides with 15 Nissan (Table 4). This table is generally valid and other days can be used in column 8.

As an example of how Table 4 is built up and used I have chosen the year 957 BCE (-956) in which 18 April coincides with the 15 Nissan. The columns in the row for this year contain the following information.

Columns 1 and 2: historical and astronomical year
Column 3: new moon was on 2 April
Columns 4 and 5: time of new moon (CET and true local time)
Column 6: 1 Nissan began on the evening of 3 April (new crescent moon)
Column 7: 1st sunrise in the new month was on 4 April, which is also 1 Nissan
Column 8: Sunrise on 15 Nissan therefore occurred on 18 April

Temple of Solomon
Calculation of the years

year		new moon			1 Nissan		15 Nissan	difference to	
historical BCE	astronomical	on	at MEZ	true local time	new crescent moon	sunrise	sunrise	18.4. days	19.4. days
1	2	3	4	5	6	7	8	9	10
976	-975	2.4.	14:18	15:33	3.4.	4.4.	18.4.	0	- 1
975	-974	23.3.	7:03	8:18	24.3.	25.3.	8.4.		
974	-973	11.4.	6:33	7:48	12.4.	13.4.	27.4.		
973	-972*	30.3.	16:33	17:48	31.3.	1.4.	15.4.		
972	-971	19.3.	19:22	20:37	21.3.	22.3.	5.4.		
971	-970	7.4.	11:46	13:01	8.4.	9.4.	23.4.		
970	-969	27.3.	14:08	15:23	28.3.	29.3.	12.4.		
969	-968*	14.4.	9:30	10:45	15.4.	16.4.	30.4.		
968	-967	3.4.	22:02	23:17	4.4.	5.4.	19.4.	+ 1	0
967	-966	24.3.	14:34	15:49	25.3.	26.3.	9.4.		
966	-965	12.4.	14:53	16:08	13.4.	14.4.	28.4.		
965	-964*	1.4.	5:19	6:34	2.4.	3.4.	17.4.	- 1	- 2
964	-963	21.3.	13:06	14:21	22.3.	23.3.	6.4.		
963	-962	9.4.	6:44	7:59	10.4.	11.4.	25.4.		
962	-961	29.3.	7:13	8:28	30.3.	31.3.	14.4.		
961	-960*	16.4.	0:20	1:35	17.4.	18.4.	2.5.		
960	-959	5.4.	7:55	9:10	6.4.	7.4.	21.4.		
959	-958	25.3.	21:58	23:13	26.3.	27.3.	10.4.		
958	-957	13.4.	22:00	23:15	14.4.	15.4.	29.4.		
957	**-956***	2.4.	14:46	16:01	3.4.	4.4.	**18.4.**	**0**	**-1**
956	-955	23.3.	3:30	4:45	24.3.	25.3.	8.4.		
955	-954	10.4.	23:33	24:48	12.4.	13.4.	27.4.		
954	-953	31.3	2:09	3:24	1.4.	2.4.	16.4.	- 2	
953	-952*	17.4.	18:21	19:36	18.4.	19.4.	3.5.		
952	-951	6.4.	21:09	22:24	8.4.	9.4.	23.4.		
951	-950	27.3.	6:46	8:01	28.3.	29.3.	12.4.		
949	-948*	3.4.	22:21	23:36	4.4.	5.4.	19.4.	+ 1	0
946	-945	1.4.	20:05	21:20	3.4.	4.4.	18.4.	0	-1
938	-937	3.4.	10:48	12:03	4.4.	5.4.	19.4.	+ 1	0

Table 4: 15 Nissan in the Julian calendar from 976 to 938 BCE (–975 to –937)

Column 9: differences to the solution 18 April = 15 Nissan
(agreement = 0 days / as in the years 976 and 946 BCE.)
Column 10: differences to the solution 19 April = 15 Nissan
(difference = -1 day, agreement = 0 days / 968, 949 and 938 BCE.)

The times of sunrise in column 8 and their assignation to the spring solutions in columns 9 and 10 are calculated values that relate to a specific day. These results will be further examined, discussed and illustrated, taking into account the course of the particular day, the horizon and the Temple axis.

Explanations and proofs to Table 4:

Column 3 (new moon): the basis for the linking of the Julian with the Jewish calendar is the day of the new moon. This can be precisely calculated in the Julian calendar and falls on 2 April.[37]

Columns 4 and 5 (the hour of the new moon): the hour of the new moon gives a reference point for the day of the new crescent moon. If this hour is late it can happen that the new crescent moon can first be seen on the second day after the new moon.

Column 6 (new crescent moon): The day of the new crescent moon generally falls on the day after new moon. Whether the new crescent moon actually occurred or not on a certain day can be calculated according to the system used by K. Schoch.[38] This shows that after the new moon of 2 April (-956 04 02) there was certainly a new crescent moon on 3 April 957 BCE. Taking into account the different definitions of a day in the Julian and the Jewish calendars, the beginning of 1 Nissan coincides with the evening of 3 April (new crescent moon).

Column 7 (1st sunrise of the new month): the first sunrise in the new month occurred on 4 April, which in the Jewish calendar was still 1 Nissan.

Column 8 (sunrise on 15 Nissan): subsequently sunrise on 15 Nissan in all years within the chosen period was to be calculated as a Julian date. This is done by adding 14 days to the values in column 7. The dates calculated extend over a timespan of about one month. The reason that 15 Nissan constantly changes in the Julian calendar is that it is a so-called movable feast that is dependent on the moon. The fact that this feast moves in the calendar is what makes it possible to find time marks, as the feast day of 15 Nissan coincides with sunrise along the temple axis on 18/19 April only very rarely over the course of the years.

Column 9 (differences to the date 18 April): In this column the agreement or difference to 18 April (Column 8) are calculated. There is agreement (difference = 0 days) in the years 976, 957 and 946 BCE. Differences of, for example, +1 day occur in the years 968 and 949 BCE.

Column 10 (differences to the date 19 April): In contrast to columns 9, here 19 April is used as the base date.

Sunrise on 18 April 957 BCE (Pessach/15 Nissan)

```
Jerusalem, Sunrise on the Temple axis
on 18 April 957 BCE (15 Nissan)

Date CET   :  -956/04/18    4h38m46s   Due          Sideral time 19h07m34s
Date UT    :  -956/04/18.1519                       JD (UT) : 1371986.6519
Date DT    :  -956/04/18.4110  (□T= 6h13.1m)        JD (DT) : 1371986.9110

Geogr.longitude = -35.2346°, Geogr.latitude = +31.7777°,   Height = 744m

                       Sun and Moon: Rise/Set and Twilight

Begin: astronom.twilight    2h 53m           Moonrise                8h 36m
       nautical twilight    3h 23m           Moon culmination        --  --
       civil twilight       3h 52m           Moonset                 5h 09m

Sunrise                     4h 16m     Moon: illuminated fraction   0.98
                                             age                15.6 days
Sun culmination             10h 39m          after full moon

Sunset                      17h 01m     Sun: geometrical altitude +3.87°
                                             refraction              0.20°
End:   civil twilight       17h 26m          apparent altitude     +4.07°
       nautical twilight    17h 55m          azimuth               83.82°
       astronom.twilight    18h 25m
```

Table 5: Calculation of sunrise on the Temple axis on 18 April 957 BCE (-956 04 18) at 4h 38m 46s CET or 6 :00 true local time (reformatted computer print out)

The astronomical calculation for 18 April 957 BCE (15 Nissan) produces an apparent altitude of the sun on the Temple axis (83.82°) of + 4.07° (Table 5). To evaluate the visible shape of the sun I define two horizons (Fig. 27). The higher horizon is based on the upper edge of the Holy Rock (Fig. 25). From this horizon approximately seventy percent of the sun's diameter would be visible above the horizon of the Mount of Olives without woods (duration of sunrise c.110 seconds). The lower horizon is based approximately on the eye level of an observer standing on the Holy Rock. This observer would have seen almost the entire disc of the sun (duration of sunrise c.150 seconds). Wavy lines indicate the part of the sun's disc in the area between the two horizons (0.13°).

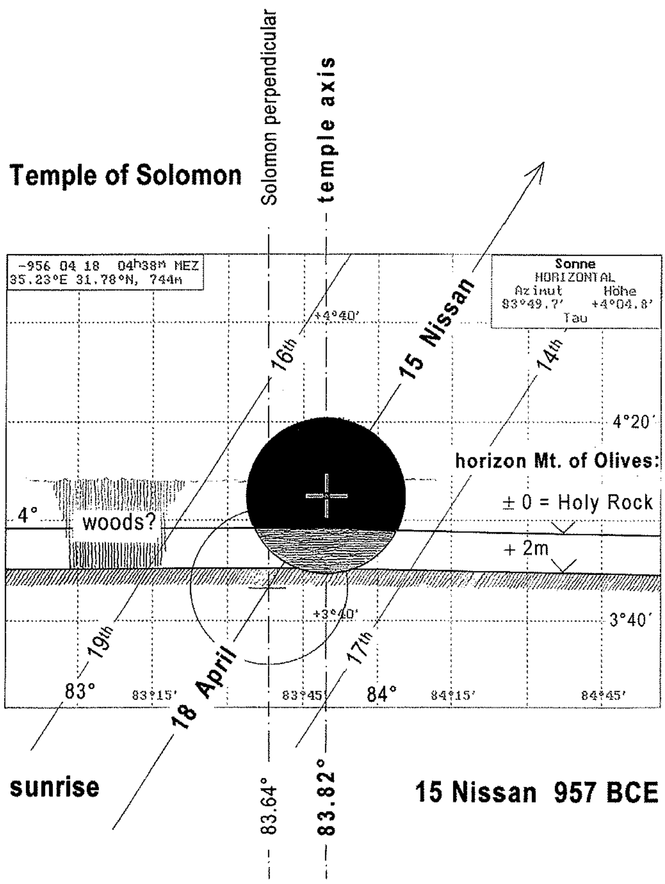

Fig. 27: Representation of sunrise on the Temple axis (83.82°) and along the Solomon perpendicular (83.64°) on 18 April 957 BCE / 15 Nissan with two assessment horizons (± 0 = top of the Holy Rock, + 2m = two metres above this, computer graphics, with additions by the author)

If the horizon was in fact formed by woods four to five metres high, in both cases part of the sun would have peered over the horizon. On the Solomon perpendicular 83.64° the sun was 0.28° lower and would have been visible only if there were no woods on the mountain.

The solution for the year 957 BCE is the only one within the period from 950 to 967 BCE (Table 4); in the case of an orientation of the Temple axis to the full disc of the sun it is the only valid result until the year 975 BCE. Table 5 shows that on the evening of 15 Nissan there was a full moon (illuminated fraction 0.98).

Sunrise on 19 April 968 BCE (Pessach/15 Nissan)

Jerusalem, Sunrise on the Temple axis on 19 April 968 BCE (15 Nissan)

Date CET	: **-967/04/19** 4h40m09s Wed	Sideral time	19h11m35s
Date UT	: -967/04/19.1529	JD (UT)	: 1367969.6529
Date DT	: -967/04/19.4141 (□T= 6h16.1m)	JD (DT)	: 1367969.9141

Geogr.longitude = **-35.2346°**, Geogr.latitude = **+31.7777°**, Height = 744m

Sun and Moon: Rise/Set and Twilight

Begin:	astron.twilight	2h 52m		Moonrise	17h 27m
	nautical twilight	3h 22m		Moon culmination	23h 02m
	civil twilight	3h 51m		Moonset	3h 57m
Sunrise		4h 16m	**Moon:**	illuminated fraction	**1.00**
				age	15.3 days
Sun culmination		10h 38m		after full moon	
Sunset		17h 01m	**sun:**	**geometrical altitude**	**+4.34°**
				refraction	**0.18°**
End:	civil twilight	17h 26m		**apparent altitude**	**+4.53°**
	nautical twilight	17h 55m		**azimuth**	**83.82°**
	astronom.twilight	18h 25m			

Table 6: Calculation of sunrise on the Temple axis on 19 April 968 BCE (-967 04 19) at 4h 40m 09s CET or 6 : 02 true local time (re-formatted computer print out)

In contrast to the solution for the year 957 BCE, in which Pessach coincided with 18 April, in this case Pessach coincided with 19 April. In the Temple axis (83.82°) the apparent altitude of the sun was + 4.53° (Table 6). To assess the form of the sun I refer to the two horizons used for the year 957 BCE (Fig. 28). In the case of the higher horizon the sun on the Temple axis was a distance of half its diameter above the horizon (duration of sunrise c. 240 seconds). In the case of the lower horizon it was a distance of eighty percent of its diameter above the horizon (duration of sunrise c. 280 seconds). In both cases the entire disc of the sun was visible and probably caused a considerable degree of glare. This would also have been the case even if the summit were covered with woods.

In the Solomon perpendicular (83.64°) the disc of the sun sat on the horizon (without woods): if there were trees on the mountain about seventy percent of its diameter would have been visible. For the sake of comparison the positions of the sun on 18 April or 14 Nissan are depicted. However, they are not relevant

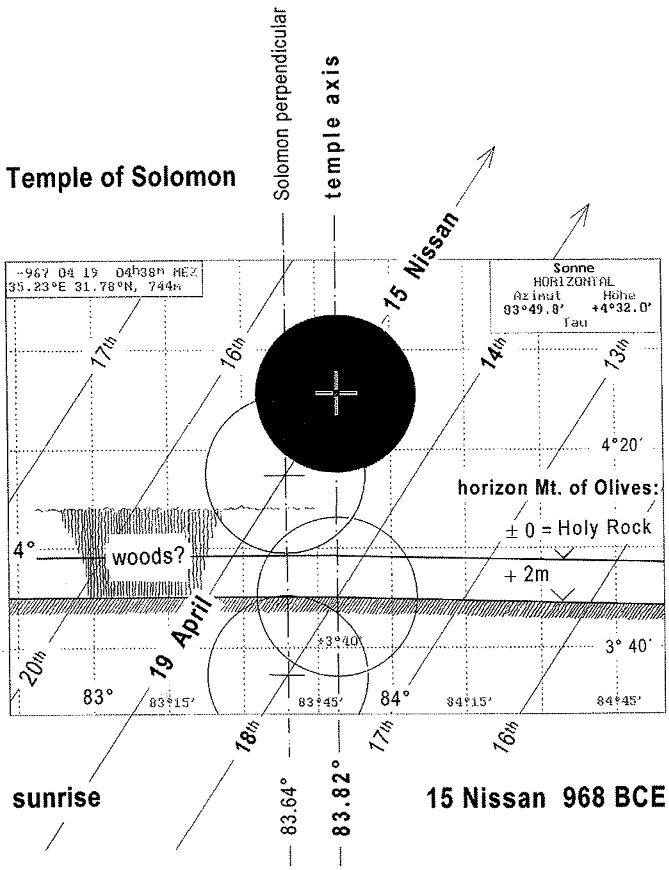

Fig. 28: Illustration of sunrise on the Temple axis (83.82°) and on the Solomon perpendicular (83.64°) on 19 April 968 BCE or 15 Nissan with two assessment horizons (± 0 = top edge of the Holy Rock, + 2m = two metres above this). (Computer graphics with additions by the author)

as 14 Nissan was not Pessach. Table 6 shows that on the night of 15 Nissan there was a full moon (illuminated fraction 1.00).

The Temple of Zerubbabel

Calculation of the years

For the Temple of Zerubabbel, in contrast to the Temple of Solomon, the Temple axis was an existing constraint as this temple was re-erected at the old position (and on the old foundations) in 519 BCE and is supposed to have been completed in March 515 BCE.[39]

On account of the confirmed chronology the dates for this Temple, in contrast to those for the time of King Solomon, should be reliable. Finegan[40] gives the day of completion for the Second Temple as 12 March 515 BCE: *The completion of the rebuilding of the temple was on the third day of the month of Adar in the sixth year of the reign of Darius (Ezra 6:15). The date was March 12, 515.*

For the astronomical determination of the day on which the sun rose along the Temple axis I remain with the Day of Atonement in the year 515 BCE (10 Tischri). Due to certain imprecisions in the Julian calendar, sunrise on the Temple axis moved between the time of Solomon and that of Zerubabbel from 14 September to 11 September.

The date for the entry into the astronomical calculation is therefore 11 September 515 BCE (- 514 09 11). To acquire an overview of all the eventual solutions I have again laid down a fixed period of time. In view of the construction dates of the second Temple I fix this period from 520 to 500 BCE. Here again the question arises whether within this period there are years in which sunrise on the 11 September coincides with 10 Tischri. The results of the analysis are shown in Table 7, according to the system already used in Table 4, taking as an example the year 515 BCE.

Column 3: New moon was on 31 August

Column 6: Tischri began on the evening of 1 September (new crescent moon)

Column 7: 1st sunrise in the new month was on 2 September, which also coincided with 1 Tischri.

Column 8: **Sunrise on 10 Tischri therefore took place on 11 September**

Column 9: differences to the solution 11 September = 10 Tischri (agreement = 0 / only in the year 515 BCE)

Column 10: differences in years to the neighbouring results to the solution 515 BCE

From Table 7 it is clear that during the period of time laid down here, there was only one case when 11 September coincided with 10 Tischri (Yom Kippur); this was in the year 515 BCE. The day of the new crescent moon on 1 September 515 BCE was calculated according to the system used by Schoch.[41]

On 12 September 507 BCE there was a result that came close to the solution. However I reject it as the sun on the Temple axis was below the horizon. A spring solution on 15 Nissan (Pessach) did not occur in 515 BCE.

year		new moon			1 Tischri		10 Tischri	difference to	
historical BCE	astronomical	on	at MEZ	true local time	new crescent moon	sunrise	sunrise	11.9. days	515 years
1	2	3	4	5	6	7	8	9	10
520	-519	26.8.	21:40	23:00	28.8.	29.8.	7.9.		
519	-518	14.9.	20:42	22:02	16.9.	17.9.	26.9.		
518	-517	4.9.	3:11	4:31	5.9.	6.9.	15.9.		
517	-516*	23.8.	3:50	5:10	24.8.	25.8.	3.9.		
516	-515	10.9.	21:30	22:50	12.9.	13.9.	22.9.		
515	**-514**	31.8.	1:32	2:52	1.9.	2.9.	**11.9.**	**0**	**0**
514	-513	20.8.	12:58	14:18	21.8.	22.8.	31.8.		
513	-512*	7.9.	13:45	15:05	8.9.	9.9.	18.9.		
512	-511	28.8.	6:09	7:29	29.8	30.8.	8.9.		
511	-510	17.8.	20:29	21:49	18.8.	19.8.	28.8.		
510	-509	5.9.	18:15	19:35	6.9.	7.9.	16.9.		
509	-508*	24.8.	22:46	24:06	26.8.	27.8.	5.9.		
508	-507	12.9.	16:24	17:44	13.9.	14.9.	23.9.		
507	-506	1.9.	16:45	18:03	2.9.	3.9.	12.9.	+ 1	+ 8
506	-505	21.8.	22:57	24:17	23.8.	24.8.	2.9.		
505	-504*	8.9.	22:13	23:33	10.9.	11.9.	20.9.		
504	-503	29.8.	13:24	14:44	30.8.	31.8.	9.9.		
503	-502	19.8.	5:48	7:08	20.8.	21.8.	30.8.		
502	-501	7.9.	5:24	7:02	8.9.	9.9	18.9.		
501	-500*	26.8.	15:22	16:42	27.8.	28.8.	6.9.		
500	-499	14.9.	10:44	12:04	15.9	16.9.	25.9.		

Table 7: 10 Tischri in the Julian calendar from 520 to 500 BCE (-519 to -499)

Sunrise on 11 September 515 BCE (Yom Kippur/10 Tischri)

Jerusalem, Sunrise on the Temple axis
on 11 September 515 BCE (10 Tischri)

Date CET	:	**-514/09/11** 4h37m09s Sun	Sideral time	4h52m50s
Date UT	:	-514/09/11.1508	JD (UT) :	1533572.6508
Date DT	:	-514/09/11.3328 (□T= 4h22.1m)	JD (DT) :	1533572.8328

Geogr.longitude = **-35.2346°**, Geogr.latitude = **+31.7777°**, Height = 744m

Sun and Moon: Rise/Set and Twilight

Begin:	astronom.twilight	2h 52m		Moonrise	14h 09m
	nautical twilight	3h 22m		Moon culmination	19h 28m
	civil twilight	3h 51m		Moonset	-- --
Sunrise		4h 16m	**Moon:**	illuminated fraction	**0.79**
				age	11.1 days
Sun culmination		10h 37m		befor full moon	
Sunset		16h 59m	**sun:**	**geometrical altitude**	**+3.72°**
				refraction	**0.21°**
End:	civil twilight	17h 24m		**apparent altitude**	**+3.93°**
	nautical twilight	17h 53m		**azimuth**	**83.82°**
	astronom.twilight	18h 22m			

Table 8: Calculation of sunrise on the Temple axis on 11 September 515 BCE (-514 09 11) at 4h 37m 09s or 6:00 true local time (reformatted computer print out)

The astronomical calculation for 11 September 515 BCE (10 Tischri) gives an apparent altitude of the sun of + 3.93° (Table 8) on the Temple axis (83.82°). In contrast to the orientation of the first Temple towards the rising sun, the issue here is the entry of light into the interior of the existing temple.

Hence I have determined three horizons for the evaluation and related these to the top of the Holy Rock and two possible door heights of five and ten cubits (2.6 and 5.2 m, Fig. 29). Depending upon which reference horizon was used and assuming a horizon free of woods one would have seen on the Temple axis c. forty, seventy or one hundred percent of the disc of the sun. The respective duration of the sunrise in each position can be calculated as c. 70, 115 and 160 seconds. This means that in all three cases light would have entered the Temple. As the door height is unknown, I have represented the portion of the disc of the sun above the five-cubit horizon with wavy lines. If there were woods on the mountain, light would still have entered along the Temple axis. However, as regards the Solomon perpendicular (83.64°) this would not have been the case for any of the three postulated horizons.

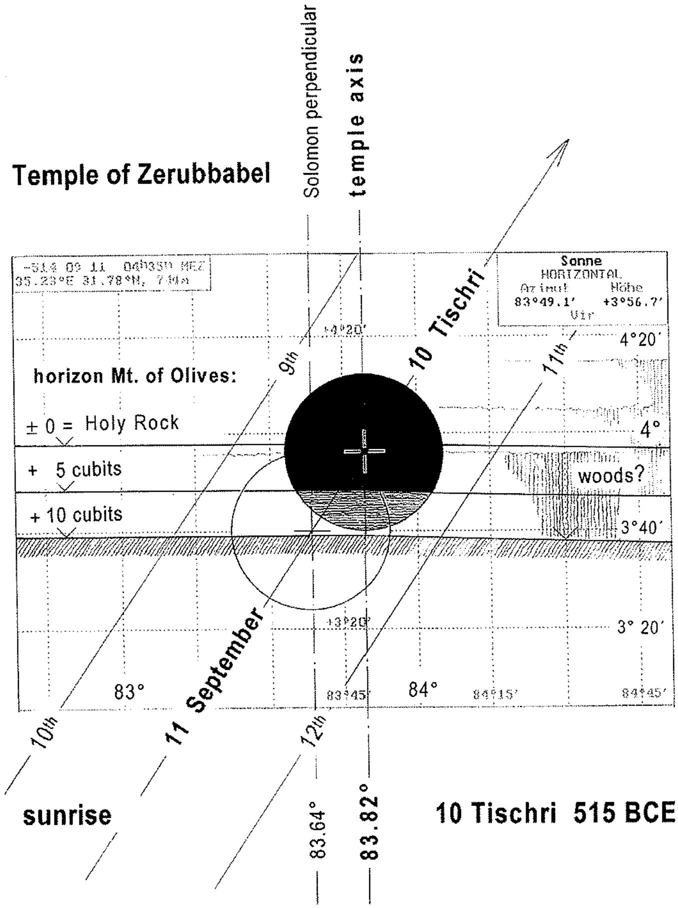

Fig. 29: Representation of sunrise on the Temple axis (83.82°) and on the Solomon perpendicular (83.64°) on 11 September 515 BCE / 10 Tischri with three evaluation horizons (the top of the Holy Rock as well as five and ten cubits above it) (computer graphics, with additions by the author)

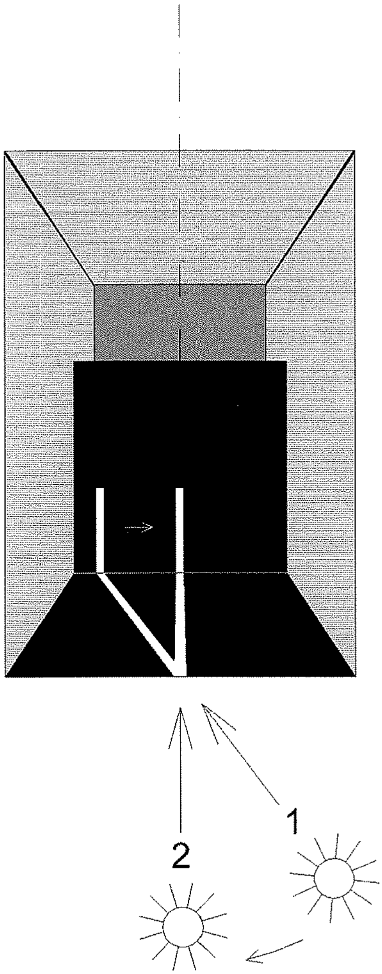

Fig. 30: The entry of light into the Holy of Holies on 11 September 515 BCE with the limit values for direct entry of the sun's rays with an assumed door height of ten cubits.
1) Sunrise at the beginning of August
2) Sunrise on Yom Kippur
(drawing by the author)

The entry of light into the Holy of Holies

At the centre point of these reflections is my belief that, as the sun rose, it shone into the Holy of Holies, and in this respect I follow the thoughts of Charlier.[42] By just slightly opening the entrance door the day on which the sun would rise on the Temple axis could be exactly observed and determined in advance (Fig. 30).

The entry of light into the interior of the Temple starts more precisely with the first rays of the sun that strike the top of the door opening. When the first direct ray of the sun reached the threshold of the door (± 0), half of the sun was already visible from the top of the door opening (assumed height ten cubits) (Fig. 29).

Given the gilding of the interior described in 1 Kings 6: 20f, it can be assumed that, when the door to the Holy of Holies was open, the entire space was intensly lit by reflections. This effect intensified as the sun rose and then gradually declined once the sun no longer entered directly. Given the lack of more precise details I cautiously estimate the period of intensive illumination at around half an hour.

Conclusions

Evaluation in terms of building analysis

On the basis of geodetic information it was possible to carry out a reconstruction of the Temple complex with a sufficient degree of accuracy. In the first step I retraced the Herodian complex and in the second step directed my attention to the Temple and complex of Solomon. Finally, it was possible to make a statement about the location of the Temple.

The Herodian Temple complex

In my search for the setting-out plan (the construction) of the complex I discovered a special line that I described as the Herod axis. It turned out to be decisive for the coordinate axes and the Temple axis. It is characterised by the fact that it is at right angles to the east side, which it intersects precisely at the middle, and runs through the centre point of the Dome of the Rock (Fig. 7).

It proved possible to trace the planning and setting-out of the Herodian Temple complex by employing coordinate axes and the basic rectangle (250 x 160 fathoms) (Fig. 10). The coordinate axes were oriented to the line of the east side; the origin lay in front of the Temple portal (Figs. 14 , 15). The arms of the axes of the basic rectangle were determined as 125 and 80 fathoms. Another solution that offers round fathom values (in units of five fathoms) does not exist. The planning of the Herodian complex was based on a unit of length of 1□ fathom = 1.862± 0.003m.

As regards the actual application of the plan, adaptations were made to take into account the nature of the terrain. These adjustments were derived geometrically using the basic rectangle as a planning aid (Fig. 11). It was shown that the east side was laid out with a length of 250 fathoms, the south side with 150 fathoms and that the remaining sides were constructed "in nature".

This reconstruction provides proof that the line of the present-day boundaries to the Temple Mount platform can be definitely ascribed to the Herodian complex.

The Temple complex of Solomon

I recognised as the "linking point" between the complex of Herod and that of Solomon a clear bend in the northern section of the east wall, which suggests that the extension by Herod started at this point (Fig. 16). The distance from this bend to the centrepoint of the east side (intersection with the Temple axis) amounts to 130 metres, which is exactly 250 cubits (1 cubit = 0.52m). By comparing this with the Biblical dimensions of 500 x 500 cubits (Ezekiel 42:15-20) I conclude that the point at which the wall bends is the northeastern corner of the Solomonian complex. The Temple axis is thereby the axis of symmetry (Fig. 19). On the basis of the reconstruction described, the square Temple complex as described in the vision of Ezekiel can now be seen as reality.

The position of the Temple

In a closer examination of the Holy Rock we also discover a technical and constructional relationship to the Temple. Concretely, this relationship is revealed in traces of work (cut rock edges) that suggest the foundations for a building on the rock and can be seen as an "imprint" (Figs. 21–23).

The fact that this imprint agrees with a reconstructed position of the Temple based on the logic of building construction in my opinion offers proof that the Temple of Solomon in fact stood upon the Holy Rock. The geometrical relationship to the east side (central part of the Herodian complex) suggests that this must have been a new building. This assertion is confirmed by the results of the astronomical examination as the orientation of the Temple on the feast of Pessach offers evidence only of a dedication to YHWH and to no other god. Thus from the viewpoint of building construction and astronomy no confirmation can be offered of an adaptation of an existing Jebusite shrine, a possibility suggested by Rupprecht.[43]

Astronomical evaluation

If we wish to relate the data on the sunrise along the Temple axis to the building, this can only be done according to the criterion of an intentional orientation towards the rising sun. The days worked out on which the sun rose along the Temple axis should be regarded as material evidence.

I have selected the results for the Pessach feast (15 Nissan) in the year 957 BCE and Yom Kippur (10 Tischri) in the year 515 BCE, as in both cases certain historical connections can be made. The results apply in general to a larger area of the Temple Mount complex, as each location parallel to the position of the temple on the Holy Rock produces very similar results.

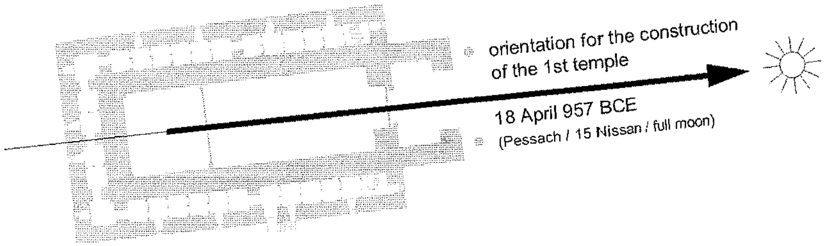

Fig. 31: Linking of the Temple axis with the cosmos by the rising sun as a metaphor for the Creation on Pessach on 15 Nissan 957 BCE (orientation for the new building) (Drawing by the author, plan of the Temple cf. Fig. 15)

The Temple of Solomon

The examination has shown that, during the time of Solomon, the sun rose on the Temple axis on 18 April (Fig. 31). This date lies within the range of possible dates for the movable Pessach feast ("day of the full moon"), which, due to its festive character and the significance of the Temple, is in a certain sense predestined as an "orientation day". If the Temple was indeed oriented towards the rising sun this can only have been done in the year 957 BCE. If we date the setting-out of the Temple's orientation in the first month this would agree with the Biblical date given for the start of construction of the Temple, which is the second month (1 Kings 6:1).

The historic agreement with Handy [44] also speaks in favour of the year 957 BCE: *..in 1.17 Josephus (Contra Apionem) reports that the Tyrian records contain references showing that Solomon´s temple was built 143 years and eight months before the Tyrians founded Carthage.*

Carthage was founded in 814 BCE. From this Handy derives the date for the beginning of the construction of the Temple as 957 BCE (814 + 143 = 957).

I have rejected the possible solution in 968 BCE as no historical relationship of comparable significance could be found for this date and, in addition, the sun stood too high in the sky to allow an orientation (Fig. 28).

The Temple of Zerubbabel

The "autumn solution" on 11 September 515 BCE (10 Tischri) relates to the rebuilt Temple under Zerubbabel (Fig. 32.) This is the historically proven year of consecration.[45] The feast on 10 Tischri (Atonement Day) is derived from the sunrise on the Temple axis, which was already in existence and thus formed a given constraint.

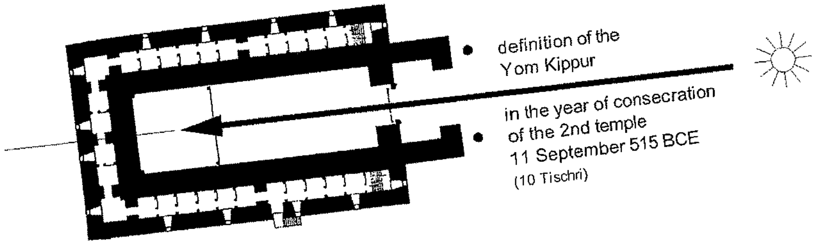

Fig. 32: Tracing of sunrise on the Temple axis on the occasion of the reconsecration of the Second Temple on 10 Tischri 515 BCE, with ascription to Yom Kippur (Drawing by the author, plan of the Temple cf. Fig 15)

The date of the festival could therefore no longer be chosen freely. From this I conclude that this festival was either first introduced at this time or, alternatively, was moved to this day. Solomon is supposed to have linked the festive consecration of the Temple with the autumn festival.[46] Thus seen, 10 Tischri 515 BCE could be viewed as the origin of the Atonement Day feast, or as a repetition of the consecration feast of the Temple of Salomon (cf. 1 kings 8:1-4, transfer of the Ark of the Coverant in the 7th month). A special feature was that the High Priest was allowed to enter the Holy of Holies only once a year - on Yom Kippur. In addition in the year of the consecration of the Temple the sun could have shone directly into the Holy of Holies (Fig. 30).

General assessment

The Temple Mount platform in Jerusalem has its origin in the square of the Solomonian complex. It was terminated by the planned extension carried out under Herod. In both complexes the Temple axis remains the original one and in both cases is geometrically linked to the respective complex. Through its orientation to the rising sun it also relates to the cosmos (Fig. 33).

It proved possible to determine 18 April 957 BCE as an absolute time mark. It is the date on which sunrise on the Temple axis coincides with Pessach ("full moon day"). I view this as the "orientation day" for the start of construction of the First Temple. On the basis of this time mark the relative temporal details given in the Bible about the start of Solomon's reign (1 Kings 6:1) and the completion of the Temple (1 Kings 6:38) can be more precisely defined as 961 / 960 and 951 / 950 BCE.

I regard the exact historical agreement with the year 515 BCE (year of consecration of the Second Temple) as proof that the starting point used for

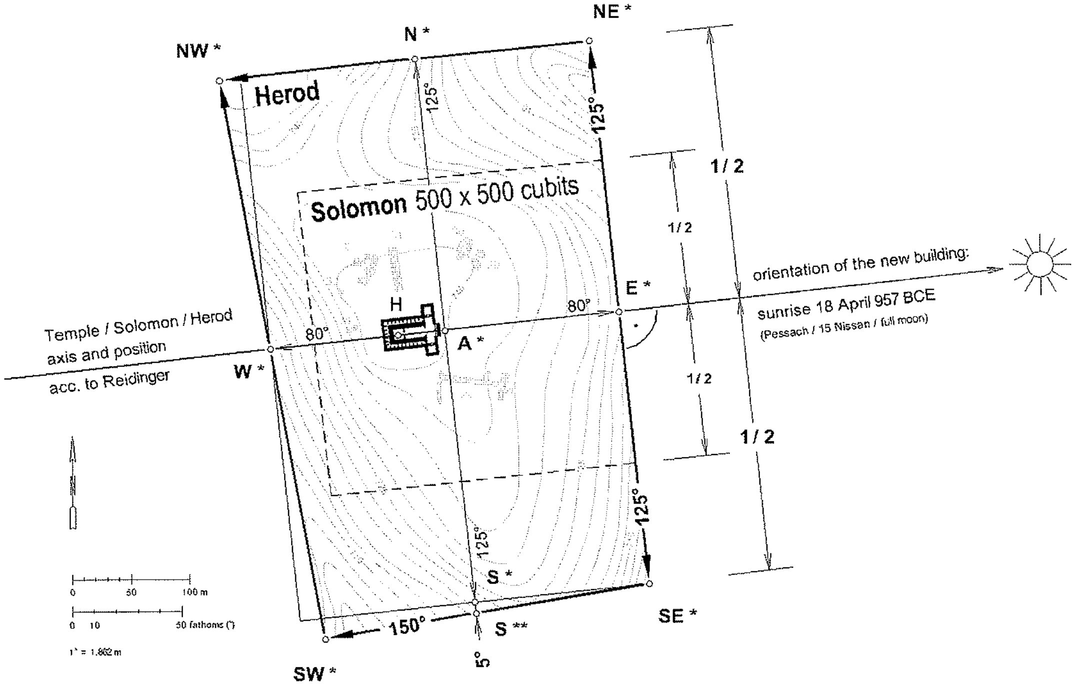

Fig. 33: Orientation of the Temple and the complex of Solomon towards the rising sun on Pessach 957 BCE and proof of the continual presence of the shrine on the Holy Rock from the time of Solomon to the times of Zerubabbel and of Herod (Drawing by the author, contour plan and position of the cisterns according to Fig. 14)

my solution, i.e. examining the sunrise on the Temple axis on the chosen feast days, was the correct one. I draw an analogous conclusion for the correctness of the spring solution 957 BCE (orientation of the new building). At the same time I view this agreement as further confirmation of the reliability of my reconstruction of the Temple axis and the complexes of both Solomon and Herod.

The results of my research work presented here do not concern only building construction archaeology, but should also be seen as an interdisciplinary contribution as they can supply both questions and answers for the disciplines of biblical archaeology and the religious history of Israel.

Notes

* It is of particular importance to me to express my sincere thanks to the following people who assisted me with advice and practical assistance in the course of my research work: Ron Adler (Tel Aviv), Matthias Albani (Leipzig), Georg Braulik (Vienna), Helmut Buschhausen (Vienna), Carl Ehrlich (Toronto), Harald Gnilsen (Vienna), Manfred Görg (Munich), Asher Kaufmann (Jerusalem), Othmar Keel (Fribourg), Rainer Mikulits (Vienna), Hermann Mucke (Vienna), Paul Naredi-Rainer (Innsbruck), Franz Neuwirth (Vienna), Johannes Reiss (Eisenstadt), Michael Turner (Jerusalem), Giora Solar (California), Johann Wuketich (Bad Fischau), Wolfgang Zwickel (Mainz).

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1. Reidinger 2001.
2. Murphy - O'Connor 1999: no. 13, 8-9.
3. Survey of Israel, Institute for Geodesy, Tel Aviv, Plan of the Temple Mount platform (1944), chart of the survey with coordinate grid in Cassini-Soldner projection (1942), both at a scale of 1 : 625.
4. AutoCAD = Programme for automatic, computer aided design.
5. Pearce and Hubbard 1966; Zwickel 1999: 42; Busink 1970: 78.
6. By direction is meant here the difference to geodetic north (0.00°) in a clockwise direction.
7. Zenger 2001: 534.
8. Rottländer 1993.
9. Reidinger 1998.
   Reidinger 2001: 141-161, 194-197, 378-380.
10. I have corrected the heights of the wall at the SE corner, given by Busink as 55m to 44m, using a foot of 30.48cm (instead of 30cm). Cf. Busink 1970: 953.
11. Busink 1970: 990, 993.
12. Zwickel 1999: 37.
13. Arnold 2000: 74; Minow 2001: 242-247; Zwickel 1999: 47.
14. Rottländer 1993: 7, 11.
15. Pfeiffer 1986: 14, 16-17, 63, 66.
16. This statement was made personally to the author by Georg Braulik (Vienna)
17. Naredi-Rainer 1994: 25.
18. Measured from: Creswell, I/1, 1909: 45, Fig 11, compared with the photograph in Fig.21 in this article.
19. Reidinger 2001: 376-380 (for village churches in the author's archives).
20. Fensterbusch 1991: 25.
21. Görg 1997: M. Görg, 51.
22. Arnold 2000: 10.
23. Charlier 1904: 386-394, 390.

24. Albani 1994: 311-322.
25. Zwickel 1999: 49-53.
26. Statement made to the author by Manfred Görg (Munich).
27. Meridian convergence means the difference between the geodetic and geographical north. In Jerusalem (Cassini-Soldner Projection) the value is +0.0118° and was calculated by Ron Adler, Survey of Israel, Tel-Aviv.
28. Survey of Israel, Tel-Aviv, Temple Mount Map, scale 1: 625.
29. Zwickel 1999: 41.
30. Survey of Israel, Tel-Aviv, Jerusalem Map 1 (with height contours), scale 1 : 2500.
31. See Cogan 1992: 1002-1011 (for table showing the dates of reigns 1010).
32. Handy 1997: 96-105, 97.
33. Husfeld 1996.
34. Herlitz and Kirschner 1987: IV, *s.v.* 'Rosch Chodesch', cols. 1485-1486.
35. Information given personally to the author by Georg Braulik (Vienna).
36. Pietschnig and Vollmann 1998: sun and moon, computer programme.
37. Pietschnig and Vollmann 1998: year review, computer programme.
38. Schoch 1927: 37.
39. Murphy-O'Connor 1999: 3-7; Küchler 1992: *s.v.* 'Jerusalem', col. 305.
40. Finegan 1998: 267.
41. Schoch 1992: 37.
42. Charlier 1904: 386-394, 390.
43. Rupprecht 1977: 100.
44. Handy 1997: 96-105, 97.
45. Finegan 1998: 267.
46. Angerstorfer 1994: *s.v.* 'Sukkot', col. 591.

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Appendix to: Erwin F. Reidinger, "The Temple Mount Platform in Jerusalem From Solomon to Herod: An Archaeological Re-Examination" in Assaph, Tel Aviv, 9/2004

The Temple in Jerusalem – Origins in Space and Time

Original lecture given on 21st October 2004 in the Yad Ben Zvi-Institute, Jerusalem

Erwin F. Reidinger

Discussion on the foundation date 957 BCE

Initiated by remarks made by Dr. Ari Belenkiy, astronomer, Bar-Ilan University

A written response

The Temple in Jerusalem – Origins in Space and Time

Erwin F. Reidinger

Original lecture given on 21st October 2004 in the Yad Ben Zvi Institute, Jerusalem

Discussion on the foundation date 957 BCE

Appendix to: Erwin F. Reidinger, "The Temple Mount Platform in Jerusalem From Solomon to Herod: An Archaeological Re-Examination" in Assaph, Tel Aviv, 9/2004

During the discussion that followed my talk in October **Dr. Ari Belenkiy** from the mathematics department of Bar-Ilan University raised two points relating to the founding date of the Temple (957 BCE) that I had arrived at as a result of my research.

Points of discussion:

1. ***He pointed out that within a 19-year cycle (the cycle of Meton) there are several periods that could be considered as solutions. These periods extend ± 8 (the oktaeteris) and ± 11 years on either side of each reference year (which in my case is 957 BCE).***

2. ***In addition Dr. Belenkiy remarked that, as there are uncertainties regarding the founding date of Carthage, it could not be used as the basis for a completely clear statement about the founding of the Temple in Jerusalem.***

In the course of the discussion after my lecture it was not possible to adequately answer these specific questions. Therefore I decided to make a written response to these important points. I await the publication of my work in Assaph[1] as a suitable time because the answers, at least to the first point above, are to be found there. In order to clarify any unclear points I go into further detail below, using an illustration (attachment, fig. 5), which is not contained in the original publication, to explain my findings.

On point 1 above: periods ± 8 and ±11 years – astronomical viewpoint

My solution for the orientation of the Temple (new building):

Sunrise 15 Nissan/18 April 957 BCE. (Pessach, first full moon in spring).

According to 1 Kgs. 6:1 building work was started in **the second month**. This corresponds with the normal order of things (first comes the orientation and the layout/survey, then the actual building work!).

The basis of the astronomical examination is provided by the Temple axis that I reconstructed (83.82° from north), and the horizon of the Mount of Olives: 3.97° (from the top of the Holy Rock) or 3.84° from the eye level of an observer standing on the rock (I regard the latter as significant). The precision of these data is an important precondition for the results of my research.

As the dates of Solomon's reign are not known I have selected a period of time from 976 to 938 BCE and have examined every year during this period when 18 April (sunrise on the temple axis) coincides with 15 Nissan (Pessach, a moveable feast) *(cf. my article in 'Assaph', note 1, table 4/ column 8 and fig. 27).* Hereby I have assumed that the orientation was made on Pessach and not on a normal day.

The fact that the second Temple was consecrated on Yom Kippur in the year 515 BCE strengthens my assumption that the first Temple was oriented on an important feast-day (Pessach). In the case of the second Temple no such assumption was necessary, as in year of consecration the sun rose on the temple axis on 10 Tischri (Yom Kippur) *(cf. my article in 'Assaph' note 1, table 7/column 8 and fig. 29).* Here too solutions within the range of years referred to above are listed but most can be excluded from the start, as the year of consecration is historically known.

18 April and Pessach coincide exactly in the year 957 BCE *(cf.my article in 'Assaph' note 1, table 4/ column 8).* Approximate solutions occur in the years ± 8, ±11 and ±19. In these approximations (periods) the date of Pessach moves between 17th and 19th April. An evaluation based on the days alone is not sufficient (due to the differences within the leap years) and therefore I examine each of the possible solutions in detail.

Fig. D1 (attachment): **The Temple in Jerusalem – founding date**
Comparison of sunrises in the year 957 BCE and during the periods 8, 11 and 19 years before and after this date on the temple axis (circles) and along a time scale (arrows)

To illustrate these solutions I refer to illustration fig. D1, which shows all the sunrises on the temple axis (83.82°) along a time scale and in relation to the horizon. Table D1 contains the relevant astronomical data with an evaluation of the individual solutions.

The solution 957 BCE is characterized by the fact that the disc of the sun (fig. D1, black disc) "sits" on the natural horizon of the Mount of Olives (3.84°) which means that the full disc was used as orientation. In comparison, in the approximate solution 968 BCE, the sun is too high in the sky – the distance to the horizon is 85 % of the sun's diameter *(cf. my article in 'Assaph' note 1, fig. 28).*

Year BCE	Periods years	Astronomical date/Pessach year/month/day	Height of the sun on the temple axis	Sun top-/ bottom edge (± 0,26°)	Evaluation see below
1	2	3	4	5	6
976	+ 19	- 975 / 04 / 18	+ 3.80°	4.06° / 3.54°	rejected
968	+ 11	- 967 / 04 / 19	+ 4.53°	4.79° / 4.27°	rejected
965	+ 8	- 964 / 04 / 17	+ 3.36°	3.62° / 3.10°	rejected
957	**± 0**	**- 956 / 04 / 18**	**+ 4.07°**	**4.33° / 3.81°**	**solution**
949	- 8	- 948 / 04 / 19	+ 4.80°	5.06°/ 4.54°	rejected
946	- 11	- 945 / 04 / 18	+ 3.63°	3.89° / 3.37°	rejected
938	- 19	- 937 / 04 / 19	+ 4.34°	4.60° / 4.08°	rejected

Table D1: astronomical data (temple axis 83.82°, horizon - Mount of Olives 3.84°)

Evaluation of the solutions (table D1/column 6) and fig. D1 *(attachment)*

957 BCE: *orientation of the Temple (temple axis) according to the rising sun (full disc). Within the period 957 ± 7 years (i.e. 964 to 950 BCE.) there is no other solution.*

957 ± 8 years:

965 BCE: *the sun on the temple axis did not rise above the horizon; therefore I reject this solution!*
949 BCE: *the sun on the temple axis was too high above the horizon (around 1.35 times the disc's diameter); therefore I also reject this solution!*

957 ± 11 years:

968 BCE: *the sun on the temple axis is already too high (the bottom edge of the disc of the sun was c. 0.83 of its diameter above the horizon); I therefore reject this solution rejected!*
946 BCE: *orientation was possible (c. 0.10 of the diameter of the disc of the sun is visible), but given the date, orientation was rather unlikely (cf. remarks on point 2);I also reject this solution!*

957 BCE ± 19 years:

976 BCE: *orientation was possible (about 0.42 of the diameter of the disc of the sun was visible), but, given the date, orientation was rather unlikely (cf. remarks on point 2); this solution is rejected*
938 BCE: *The sun on the temple axis is too high (the bottom edge of the disc of the sun was a distance of c. 0.45 times its diameter above the horizon);I therefore reject this solution!*

Summary

The astronomical examination has shown that the temple axis, which I reconstructed, lies in the direction on which the sun rose on Pessach 957 BCE (15 Nissan / 18 April). I therefore regard this day as the orientation day for the construction of the new Temple.

It is also remarkable that, between 975 and 947 BCE, there are no other acceptable solutions for an orientation. From a historical viewpoint this period includes the beginning of King Solomon's reign and the start of the construction of the Temple (see the remarks on point 2, Carthage).

On point 2 above: Carthage – the historical viewpoint

Lowell K. Handy has conducted extensive research into the dates of the reign of King Solomon.[2] He relies on Josephus *(1.17, Contra Apionem),* which contains references, independent of the Bible, that Carthage was founded 143 years and 8 months after the start of construction of the Temple in Jerusalem.

Handy gives 814 BCE ±1 year as the likely founding date for Carthage. He dates Solomon's accession to the throne with an accuracy of ± 3 years and justifies this with the imprecision of the expression "year 1" and the imprecise way of numbering the years of a reign in Tyros and Judea, whereby he uses the founding of Carthage as his starting point.

As the start of construction of the Temple is dated in relation to Solomon's accession to the throne, (1 Kgs. 6:1 '*in the fourth year of Solomon's reign over Israel ... he began to build the house of the LORD*'), this date is subject to the same uncertainty. Handy therefore gives the date of the **start of construction of the Temple** as **957 BCE ± 3 years.**

On 1) and 2), link:

Essentially the historic viewpoint of L. K. Handy and my astronomic examination represent two completely separate paths of research, which, remarkably, lead to the same conclusion.

Comparison regarding the start of construction of the Temple:

Reidinger: start of construction: in the 2nd month 957 BCE (derived from the orientation of the new building: sunrise on 15 Nissan 957 BCE / Pessach linked with 1 Kgs. 6:1)

Handy: start of construction 957 BCE ± 3 years

In comparing the dates one notes that both solutions cite the year 957 BCE. The astronomical solution cites this year precisely, while the historian's solution gives it as a mean value within a range of ± 3 years. This imprecision imposed on Handy due to the imprecise historical data can be completely eliminated by the astronomical examination, so that the year 957 BCE remains as the year in which the construction of the Temple was started.

From the illustration fig. D1 (see the scale line at the very bottom, Lowell K. Handy) it can be seen that the date given (957 BCE ± 3 years) could, in fact, be 957 BCE +18 /-10 years. The astronomical solution 957 BCE remains accurate, as throughout this period there was never a relevant sunrise on the temple axis (in 968 and 949 BCE the sun was too high, in 965 BCE too low).

Using the astronomical date for the start of construction of the Temple - 957 BCE - other biblical and historical dates can be given as absolute (rather than just relative) values, such as for example:

Start of the reign of King Solomon: 961/960 BCE (1 Kgs. 6:1, '*in the fourth year of Solomon's reign...*')

Completion of the Temple: 951/950 BCE (1. Kgs. 6:38, '*in the eleventh year ... the house was finished in all its parts...He was seven years in building it.*')

Founding of Carthage: 10th month, 814 BCE (143 years and 8 months after the start of construction of the Temple in Jerusalem, see remarks under point 2).

Written on 18th November 2004 (1 081 341 days after the orientation of the Temple in Jerusalem)

Erwin F. Reidinger

Attachment: illustration fig. D1

[1] **Erwin F. Reidinger,** "The Temple Mount Platform in Jerusalem From Solomon to Herod: An Archaeological Re-Examination" in: Assaph, Tel Aviv, 9/2004, 1-64.

[2] **Lowell K. Handy,** "On the Dating and Dates of Solomon's Reign" in: L. K. Handy (ed.) *The Age of Solomon. Scholarship at the Turn of the Millennium (Studies in the History and Culture of the Ancient Near East XI),* Leiden 1997, 96-105.

Appendix to the Discussion (question from 11 February 2005, sent by E-Mail)

3. ***Dr. Ari Belenkiy introduces the fact that the influence of the retardation of the earth's rotation at the time of Solomon could amount to two to three hours. This is related to the question what effect this phenomenon might have on my solution, which postulates the orientation of Solomon's Temple according to the rising sun on 18 April 957 BCE (15 Nissan, Pessach).***

Hermann Mucke has dealt exhaustively with the "phenomenon of the irregular retardation of the earth's rotation".[1] In the astronomical programme "Urania Star"[2], which I used, the retardation of the earth's rotation is taken into account. The calculation with the standard setting gives the most likely values. Other settings are also possible and can be used to examine special cases such as, for example, here.

To provide the proof required I selected differences from the standard setting of –1, +1 und +2 hours.[3] The results given show the apparent height of the sun (h_s) on the temple axis (83.82°) and the differences (Δh_s) in relation to the value of the standard setting with h_s= + 4.07°(**Table D2**).

Date	Time (MEZ)	ΔT	h_s	Δh_s	Difference to the standard setting
1	2	3	4	5	6
-956 / 04 / 18	4h 38m 35s	5h 13,1m	+ 4.05°	- 0.02°	- 1 hour
-956 / 04 / 18	**4h 38m 46s**	**6h 13,1m**	**+ 4.07°**	**± 0**	**± 0** (cf. Table D1)
-956 / 04 / 18	4h 39m 05s	7h 13,1m	+ 4.11°	+ 0.04°	+ 1 hour
-956 / 04 / 18	4h 39m 20s	8h13,1m	+ 4.14°	+ 0.07°	+ 2 hours

Table D2: Influence of the retardation of the earth's rotation on the orientation of the Temple of Solomon according to the rising sun on 18 April 957 BCE. (Pessach).

ΔT.... dynamical time (taking into account the retardation of the earth's rotation)

Conclusion:

The different approaches to the retardation of the earth's rotation have no significant influence on the outcome of the research on the orientation of the Temple of Solomon according to the rising sun on 18 April 957 BCE, because the daily paths of the sun, and therefore the apparent height of the sun on the temple axis, differ only slightly. The results of the calculation tend to confirm an orientation towards the complete disc of the sun.

Erwin F. Reidinger

[1] **Hermann Mucke,** Himmelserscheinung und Erddrehdauer in: „Der Sternenbote", Österreichische Astronomische Monatsschrift, Astronomisches Büro, Vienna, 46. Jg., 5 (2003), 82-89.
[2] **Pietschnig Michael and Vollmann Wolfgang,** Himmelskundliches Softwarepaket Uraniastar 1,1, Vienna 1998
[3] Personal recommendation of **H. Mucke** (This framework certainly includes the true value)

The Temple in Jerusalem

Date of Founding 957 BCE

Erwin Reidinger

Attachment: **Fig. D1**