The Architectural Elevation Planning Method of the Nereid Monument at Xanthos
Design methods of Hellenistic tombs (3)

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The aim of this paper is to analyze the architectural planning method of the elevation of the Nereid Monument at Xanthos. The analysis led to the conclusion that the dimensions of each part in both the upper structure, the order and above, and the lower structure, the podium and below, were derived from the dimension of the axial intercolumniation with the use of a "yardstick" of 0.310m as a foot. Many of the design dimensions of the elevation of the Nereid Monument, similarly to its floor plan, show complete figures, demonstrating that the construction aspect was taken into account at the planning stage.

Keywords: Ancient Greece, Hellenistic period, built tomb, Nereid monument, design method

1. Introduction

During the Hellenistic period in the ancient Mediterranean world, tombs in varied architectural forms were built of which it was once said, "It is the characteristic of the tombs built during the Hellenistic period that there never existed the same form twice" 1). However, there are no studies focusing on the tombs during the Hellenistic period so far except for the two papers written by the author2), 3). The whole picture is still unclear, as to what kind of planning methods or design philosophies were behind these tombs or indeed whether these methods and philosophies were shared throughout the ancient Mediterranean world or were limited to the local areas. As a part of the effort in pursuing the investigation, an analysis of the planning method of a Hellenistic tomb is attempted in this study, with a view to elucidating the whole picture of the planning methods and the design philosophies of the Hellenistic tombs in the ancient Mediterranean world. In the previous paper4), the floor planning of the Nereid Monument at Xanthos, constructed in the 4th century BC (Fig.1), was analyzed, which led to the conclusion that the floor plan of the Nereid Monument was first determined by the internal dimensions of the naos to accommodate catafalques, and the dimensions of the other outer members were determined proportionally using the internal dimensions of the naos. This paper focuses on the elevation side of the Nereid Monument. As reported in the previous paper5), the upper part of the building was excavated, more or less thoroughly deconstructed. There are 224 excavated parts (Figs 2 and 3) including smaller members such as a roof tile, a sufficient number to enable reconstruction of the original form with a high degree of accuracy, supported by assumptions regarding the missing parts and their shapes. In fact, Coupel has produced reconstruction drawings with estimated dimensions, identifying the original positions of the excavated parts.

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based on the shapes and erection marks (Figs 4 and 5). The estimated dimensions are trustworthy enough to employ in the analysis of the architectural elevation planning method.

2. Study method

The method of analysis is the same as in the previous paper. As previously mentioned, there are no studies for Hellenistic tombs and no detailed knowledge is established. However, analyses on the Lion Tomb at Amphipolis and the floor planning of the Nereid Monument, conducted by the author, demonstrated the possibility of a planning method using proportional relations, similar to the ones proposed in the studies of temples and stoas by Horiuchi, Hayashida and Coulton. Therefore, the paper first examines whether the planning method for temples and stoas, proposed by Horiuchi and others, can be applied to the Hellenistic tombs. In other words, the analysis starts from the identification of any regular proportional relations between each dimension of the Nereid Monument.

Thinking of the time when the monument was actually built, each dimension must be expressed in the “yardstick” of that time, the “ancient foot.” Therefore, as in the previous paper, the proportional relations and the planning process will be validated by first determining the design dimension using the identified proportional relations and the ancient feet, then comparing the design dimension with the actual measurement. In this investigation, an assumption was made that the ancient foot lies somewhere in the range of 0.294-0.330m, based on recent studies. Another point to consider is the relation of units in the ancient foot. The smallest unit is called a dactyl, four times a dactyl is called a palm, and four times a palm is a foot. Therefore, dimensions of each part of the building need to be expressed so as to fit into these units. Hayashida has suggested the possibility that units of one third and one fifth also existed as well as dactyl, palm and foot. Since one third and one fifth are simple and basic divisional numbers they are used in the analysis in this paper. In other words, the fractions are expressed with the denominators of 2, 3, 4, 5, 8, and 16 when converted into the ancient feet.

For the purpose of the analysis in this paper, the dimensions reported in Coupel’s report are used. The ground plan in the report shows the dimensions up to three decimal places, a digit short of the unit of mm. Therefore, in this study the measurements are picked up from the text of the report, converting each dimension into values with three decimal places, then used for the examination of the planning method. The reason for this manipulation is the known highly technical standard of construction in the ancient Mediterranean architectures, which was capable of achieving the level of precision equal to the present-day millimeter, as described in the previous paper. Therefore, in this paper, the analysis adopted is based on the mm unit.
3. Investigation into the planning method

In this study, a long side of the building is expressed as "L side" while a short side is expressed as "W side". Each part of the Nereid Monument is expressed simply with initials. For example, the "height of the column" and the "lower diameter of the column" are expressed as "H · C" and "LD · C" respectively. The positions of each symbol are shown in Fig. 5 and columns (A) and (B) in Table 1. The detailed dimensions of each part are shown altogether in column (C) of Table 1.

3.1. Examination of the planning process

Having examined the proportional relationships between each dimension, simple and accurate proportional relationships were found at several places (Table 1(D) and (E)).

3-1.1. Planning process of the order

As demonstrated in the previous paper[13], the planning of the Nereid Monument starts from the floor plan. The width and depth of the whole structure are decided according to the available land space, followed by the assignment of cella and pteron. The dimension of the axial intercolumniation and the dimension of the end spaces are then determined. The lower diameter of the column is calculated from the dimension of the axial intercolumniation on the L side. Indeed, the height of most of the upper structure is determined based on the lower diameter of the column as the module. For example, the height of the column base is determined by the ratio of 3 to 4 using the lower diameter of the column while the column height, the higher diameter of the column and the height of the capital are also determined using the lower diameter of the column by the ratios of 4 to 5 (converted from 8/2:5) to 6 and 7 to 5 to 6, respectively. In addition to these, the width and height of the Abacuss are calculated from the lower diameter of the column by the ratios of 6 to 5 and 3 to 4 respectively. Meanwhile, the dimensions of other parts higher than the frieze are not based on the module of the lower diameter of the column. The height of the frieze is determined using the height of the capital by the ratio of 3 to 2 and the heights of dentil and cornice are successively determined using the height of the frieze by the ratio of 2 to 5. The calculation of the dimensions of the order is expressed as follows:

<table>
<thead>
<tr>
<th>(A)</th>
<th>(B)</th>
<th>(C)</th>
<th>Proportional relationship</th>
<th>(D)</th>
<th>(E)</th>
<th>Reference (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Axial Intercolumniation on the L side</td>
<td>L + I</td>
<td>1.914</td>
<td>—</td>
<td>—</td>
<td>6 3/16&quot;</td>
<td>—</td>
</tr>
<tr>
<td>Lower Diameter of the Column</td>
<td>LB · C</td>
<td>0.362</td>
<td>(3/16)L · I</td>
<td>0.003</td>
<td>1 41/256&quot;-1 3/16&quot;</td>
<td>-0.006</td>
</tr>
<tr>
<td>Breadth of the Base</td>
<td>B · B</td>
<td>0.500</td>
<td>(1/1 + 4/90)L · C</td>
<td>0.002</td>
<td>1 81/128&quot;-1 5/8&quot;</td>
<td>-0.004</td>
</tr>
<tr>
<td>Height of the Base</td>
<td>H · B</td>
<td>0.276</td>
<td>(3/4)L · C</td>
<td>0.004</td>
<td>57/64&quot;-7/8&quot;</td>
<td>0.005</td>
</tr>
<tr>
<td>Upper Diameter of the Column</td>
<td>UB · C</td>
<td>0.308</td>
<td>(6/7)LD · C</td>
<td>-0.002</td>
<td>1 1/56&quot;-1 2/5&quot;</td>
<td>-0.006</td>
</tr>
<tr>
<td>Breadth of the Abacus</td>
<td>B · Ab</td>
<td>0.428</td>
<td>(6/5)L · C</td>
<td>-0.006</td>
<td>1 17/40&quot;-1 2/5&quot;</td>
<td>-0.006</td>
</tr>
<tr>
<td>Height of the Capital</td>
<td>H · Ca</td>
<td>0.303</td>
<td>(5/6)L · C</td>
<td>0.001</td>
<td>95/96&quot;-1</td>
<td>-0.007</td>
</tr>
<tr>
<td>Height of the Abacus</td>
<td>H · Ab</td>
<td>0.043</td>
<td>(1/9)L · C</td>
<td>0.003</td>
<td>19/144&quot;-1/8&quot;</td>
<td>0.004</td>
</tr>
<tr>
<td>Height of the Column</td>
<td>H · C</td>
<td>3.040</td>
<td>(8/5)L · C</td>
<td>-0.001</td>
<td>9 39/40&quot;-10&quot;</td>
<td>-0.006</td>
</tr>
<tr>
<td>Height of the Frieze</td>
<td>H · F</td>
<td>0.458</td>
<td>(3/2)L · C</td>
<td>0.003</td>
<td>1 1/2&quot;</td>
<td>-0.007</td>
</tr>
<tr>
<td>Height of the Dentil</td>
<td>H · De</td>
<td>0.183</td>
<td>(2/5)H · F</td>
<td>0.000</td>
<td>3/5&quot;</td>
<td>-0.003</td>
</tr>
<tr>
<td>Height of the Cornice</td>
<td>H · Cor</td>
<td>0.183</td>
<td>(2/5)H · F</td>
<td>0.000</td>
<td>3/5&quot;</td>
<td>-0.003</td>
</tr>
<tr>
<td>Projection of the Motule</td>
<td>P · M</td>
<td>0.550</td>
<td>(3/2)L · C</td>
<td>0.007</td>
<td>1 25/32&quot;-1 3/4&quot;</td>
<td>0.007</td>
</tr>
<tr>
<td>Height of the Cyma</td>
<td>H · Cy</td>
<td>0.235</td>
<td>(2/3)H · F</td>
<td>0.006</td>
<td>3/4&quot;</td>
<td>-0.002</td>
</tr>
<tr>
<td>Height of the center of the Roof</td>
<td>H · R</td>
<td>1.350</td>
<td>(4/9)L · C</td>
<td>-0.001</td>
<td>4 4/9&quot;-4 1/3&quot;</td>
<td>0.007</td>
</tr>
<tr>
<td>Width of the Antae</td>
<td>W · Ant</td>
<td>0.545</td>
<td>—</td>
<td>—</td>
<td>1 4/5&quot;</td>
<td>—</td>
</tr>
<tr>
<td>Height of the Antae Plinth</td>
<td>H · AntP</td>
<td>0.175</td>
<td>(1/3)H · Ant</td>
<td>-0.007</td>
<td>3/5&quot;</td>
<td>-0.011</td>
</tr>
<tr>
<td>Breadth of the Antae Plinth</td>
<td>B · AntP</td>
<td>0.733</td>
<td>(4/9)H · Ant</td>
<td>0.006</td>
<td>2 2/5&quot;</td>
<td>-0.011</td>
</tr>
<tr>
<td>Height of the Antae Base</td>
<td>H · AntB</td>
<td>0.119</td>
<td>(1/5)H · Ant</td>
<td>0.006</td>
<td>9/25&quot;-2/5&quot;</td>
<td>-0.009</td>
</tr>
<tr>
<td>Height of the Antae Capital</td>
<td>H · AntCa</td>
<td>0.293</td>
<td>(1/2)H · Ant</td>
<td>0.020</td>
<td>9/10&quot;-1&quot;</td>
<td>-0.017</td>
</tr>
<tr>
<td>Axial Intercolumniation on the W side</td>
<td>W + I</td>
<td>2.065</td>
<td>—</td>
<td>—</td>
<td>8 2/3&quot;</td>
<td>—</td>
</tr>
<tr>
<td>Height of the whole Podium</td>
<td>H · F · P</td>
<td>4.182</td>
<td>(2)H · L</td>
<td>—</td>
<td>13 1/3&quot;-13 1/2&quot;</td>
<td>-0.003</td>
</tr>
<tr>
<td>Height of the Cornice of the Podium</td>
<td>H · CoP</td>
<td>0.315</td>
<td>(1/13)H · P</td>
<td>—</td>
<td>1&quot;</td>
<td>0.005</td>
</tr>
<tr>
<td>Height of the First Course of the Podium</td>
<td>H · FS</td>
<td>0.417</td>
<td>(2/13)H · P</td>
<td>—</td>
<td>2&quot;</td>
<td>-0.002</td>
</tr>
<tr>
<td>Height of the Second Course of the Podium</td>
<td>H · SC</td>
<td>1.010</td>
<td>(3/13)H · P + 1/8[f]</td>
<td>—</td>
<td>3 1/4&quot;</td>
<td>0.002</td>
</tr>
<tr>
<td>Height of the Third Course of the Podium</td>
<td>H · TC</td>
<td>1.010</td>
<td>(3/13)H · P + 1/8[f]</td>
<td>—</td>
<td>3 1/4&quot;</td>
<td>0.002</td>
</tr>
<tr>
<td>Height of the Fourth Course of the Podium</td>
<td>H · FoC</td>
<td>1.230</td>
<td>(4/13)H · P</td>
<td>—</td>
<td>4&quot;</td>
<td>-0.018</td>
</tr>
</tbody>
</table>

The fractions in the ratio columns show the dimensional ratio between the worked out dimension and the original dimension in which the calculation originates. For example, "4/9H · C" in the "H · R" column means that there is a proportional relation of 4 to 9 found between "H · R" and "H · C".

The fractions in the ancient foot column show the dimensions based on an ancient foot. For example, "4 4/9" means "4 feet and 4 1/3 feet".

<table>
<thead>
<tr>
<th>Reference (g)</th>
</tr>
</thead>
</table>
The height of the capital, which becomes the base for calculating the height of the frieze, is calculated based on the lower diameter of the column. The heights of dentil and cornice are calculated based on the height of the frieze, which means the heights of dentils and cornice can be converted into values relevant to the lower diameter of the column module. In addition, the projection of the mutule and the height of the cyma, which will be described later, can be expressed using the module based on the lower diameter of the column. In these instances too, the proportional relations get simpler and the margin of errors, smaller. Therefore, there is a possibility that the heights of all the frieze, the dentil and the cornice were calculated based on the module of the lower diameter of the column. And if that is so, it will lead to a conclusion that all the dimensions in every part of the upper structure, except for the roof, is derived from the module of the lower diameter of the column. The fact that almost all the dimensions in the upper structure can be worked out from the module of the lower diameter of the column cannot be ignored. However, from the point of balancing the column and the capital, the work should be easier if the height of the frieze is adjusted using the height of the adjacent capital and, in the same way, the heights of the dentil, the cornice and the cyma using the height of nearby frieze. The margin of error is also smaller, though very slightly, if the heights of the frieze, the dentil, the cornice and the cyma are calculated successively from the height of the capital. Therefore, in this paper, the possibility of two methods in determining the heights of frieze, the dentil and the cornice are suggested, with both the proportional relations stated in the figures and tables. In doing so, the calculation based on the module of the lower diameter of the column is given the second place, stated in brackets, taking the smaller margin of errors and the predicted ease of balancing each part of the other method into consideration.

### 3-1-2. Planning process of the roof

The projection of the mutule is determined so that its ratio to the lower diameter of the columns is 3 to 2. The height of the cyma is determined so that its ratio to the height of the frieze is 1 to 2. Then, the heights of the decorative band on top of the roof, the first course of the podium below the band, the second and the third intermediary courses, with the fourth course as the orthostats, are determined in such a way that the proportional relations between them come to the ratio of 1 to 2 to 3 to 4. In this way, the height of the decorative band, for example, works out at 1/13 of the whole height of the podium, while the height of other courses will be integral multiples of one thirteenth. The actual height of the podium is 13 feet and a third of a foot - the calculation will be described in the next section. Without this odd one third of a foot, the heights of each course are complete figures using the aforementioned ratio. So the attempt is made here to absorb this one third of a foot into the second and the third courses, which do not contribute much to the whole shape of the building, assigning one sixth of a foot to each course. As previously mentioned, the ancient foot does not contain the division of six, so one sixth is rounded up to one fourth. As a result the height of the whole podium can be expressed as 13 and a half feet. The calculation behind the dimensions of the podium is expressed as follows:

\[
\begin{align*}
P \cdot M &= (3/2) \text{LD} \cdot C \\
H \cdot Cy &= (1/2) H \cdot F \\
H \cdot R &= (4/9) H \cdot C
\end{align*}
\]

### 3-1-3. Planning process of the anta

Moving to the planning of the anta, a similar process involving the lower diameter was found. The height and width of an anta base are calculated using the width of the anta by the ratio of 1 to 3 and 4 to 3 respectively. The heights of the anta pillar and the anta head are determined again using the width of the anta by the ratio of 1 to 5 and 1 to 2 respectively. The calculation behind the dimensions for the anta parts is expressed as follows:

\[
\begin{align*}
H \cdot \text{AntP} &= (1/3) W \cdot \text{Ant} \\
B \cdot \text{AntP} &= (4/3) W \cdot \text{Ant} \\
H \cdot \text{AntB} &= (1/5) W \cdot \text{Ant} \\
H \cdot \text{AntCa} &= (1/2) W \cdot \text{Ant}
\end{align*}
\]

### 3-1-4. Planning process of the podium

Now let us turn our attention to the construction of the podium. As discussed in the previous paper, the podium of the Nereid Monument consists of five courses of rough stone work and four courses of cut stone masonry on top. Common sense dictates that only the courses of the cut stone masonry should be included as the part planned as a podium. However, multiple possibilities defining the scope of the podium were included in this study as follows and the proportional relations were calculated for each scenario.

1. Only the upper four courses were planned as the podium, and the lower five courses were created as part of the groundwork on the sloping location.
2. All nine courses were planned as the podium.
3. The upper five or six courses, which are visibly recognized from the East, the facade side, were planned as the podium.
4. The upper eight courses, except for the bottom course as the euthenteria, were planned as the podium.

The calculations for any of these scenarios, however, could not produce any simple and clean ratio. Since the buildings whose construction planning has been studied are all temples and stoas, which do not have podia, the possibility of tombs with podia having some proportional relations is not known. In one of the previous papers analyzing the Lion Tomb in Amphipolis, the author suggested the possibility of the height of the podium being calculated using the dimension of the axial intercolumniation. Applying this knowledge, the proportional relation between the height of the podium and the dimension of the axial intercolumniation of the Nereid Monument was investigated. As a result, a series of simple planning steps with a small margin of error was found, if the view of the first scenario, i.e. the upper four courses as the podium, was taken. Firstly, using the the dimension of the axial intercolumniation on the W side, the height of the whole podium is determined by the ratio of 1 to 2. Then, the heights of the decorative band on top of the podium, the first course of the podium below the band, the second and the third intermediary courses, with the fourth course as the orthostats, are determined in such a way that the proportional relations between them come to the ratio of 1 to 2 to 3 to 4. In this way, the height of the decorative band, for example, works out at 1/13 of the whole height of the podium, while the heights of other courses will be integral multiples of one thirteenth. The actual height of the podium is 13 feet and a third of a foot - the calculation will be described in the next section. Without this odd one third of a foot, the heights of each course are complete figures using the aforementioned ratio. So the attempt is made here to absorb this one third of a foot into the second and the third courses, which do not contribute much to the whole shape of the building, assigning one sixth of a foot to each course. As previously mentioned, the ancient foot does not contain the division of six, so one sixth is rounded up to one fourth. As a result the height of the whole podium can be expressed as 13 and a half feet. The calculation behind the dimensions of the podium is expressed as follows:

\[
H \cdot \text{Po} = (2) W \cdot 1 = 13 1/3 \text{[foot]} \to 13 1/2 \text{[foot]}
\]
3-2. Calculation of planning dimensions

3-1-5. Notes

It was elucidated in the previous paper21) that an ancient foot of 0.310m was used at the Nereid Monument with the planning of the inner naos starting with 9 feet on the W side and 11 feet on the L side. Using the same ancient foot of 0.310m and the proportional relations described in the previous sections, the estimated dimension of the width of the antae, as in the aforementioned diagram (Fig.3), can be suggested that the balance adjustment was conducted from the larger members to the smaller. It is not definite at present, but it’s still very interesting if the architect had intended it that way. The architects’ intentions need to be considered when analyzing the planning method of other tombs in future.

3.2. Calculation of planning dimensions

The dimensions calculated using the aforementioned proportional relations must have been expressed in “ancient feet,” which was the yardstick used at the time of the construction. In this section, the planning dimensions will be calculated using the proportional relations worked out in the previous sections and the ancient feet; then, the proposed planning process will be verified by comparing the resulting planning dimensions and the actual measurements.

It was elucidated in the previous paper21) that an ancient foot of 0.310m was used at the Nereid Monument with the planning of the inner naos starting with 9 feet on the W side and 11 feet on the L side. Using the same ancient foot of 0.310m and the proportional relations described in the previous sections, the dimensions of the elevation of the Nereid Monument were calculated. The differences between the resultant figures and the actual measurements are very small, demonstrating that the planning method proposed in this paper is valid.

Also, as shown in the column (F) in Table.1, many of the planning dimensions of the elevation, as well as the floor plan, of the Nereid monument, are complete figures, suggesting that the construction aspect was taken into account when planned. At the same time, it is unlikely that such complete figures were derived using only the proportional planning method, again suggesting the validity of the planning method proposed in this paper.

Summarizing the results, the heights of each course seem to have been determined not just using simple proportional relations but also with an intention of making the heights as complete figures. This suggests, as the author had felt when analyzing the floor planning19), that the construction aspect was taken into account when the Monument was planned. As stated previously, there are only a few studies regarding the planning method of podia. The paper presents the aforementioned method as a conclusion, but further studies are certainly necessary.

As reported in the previous paper14), a shaft of the Nereid Monument is originally made of one piece of rock. However, there is no shaft unearthed intact, even the best-preserved shaft is broken into two, with the middle part missing (Fig.3). Since the height of the shaft is the estimate, the height of the column includes the estimate. As a result, these dimensions might need some correction, though not critical, and a correction may lower the margin of error in calculating the proportional relations.

Generally, the proposed planning steps for the antae contain a wider margin of error compared to other parts of the building. The reason seems to be from the estimated dimension, which was calculated from the excavated articles, not from the real measurement of a shaft. As reported in the previous paper14), a shaft of the Nereid Monument is originally made of one piece of rock. However, there is no shaft unearthed intact, even the best-preserved shaft is broken into two, with the middle part missing (Fig.3). Since the height of the shaft is the estimate, the height of the column includes the estimate. As a result, these dimensions might need some correction, though not critical, and a correction may lower the margin of error in calculating the proportional relations.

Fig. 6 Flowchart of the design process

As for the height of a column, the error was bigger than for the other parts. The reason seems to come from the estimated dimension, which was calculated from the excavated articles, not from the real measurement of a shaft. As reported in the previous paper14), a shaft of the Nereid Monument is originally made of one piece of rock. However, there is no shaft unearthed intact, even the best-preserved shaft is broken into two, with the middle part missing (Fig.3). Since the height of the shaft is the estimate, the height of the column includes the estimate. As a result, these dimensions might need some correction, though not critical, and a correction may lower the margin of error in calculating the proportional relations.

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4. Conclusion

By analyzing the proportional relationships of each part, the planning process of the elevation of the Nereid monument was elucidated. The characteristics of the elevation planning of the Nereid monument are as follows:

1) In this paper, the analysis was conducted on the assumption that the planning was based on proportional relations and indeed a theory for the planning process was elucidated. Since the difference between the planning dimensions, which were derived from proportional calculation, and the actual measurements are small as well, and taking into account the frequent occurrence of complete lengths which cannot be pure coincidence, there is a high possibility that the proportion-based planning approach similar to the ones used for the ancient Greek temples and stoas was conducted at the Nereid monument as well.

2) As for the dimensions of the column and the capital, the parts above the frieze are determined successively from the height of the capital while all the parts below are determined by the module based on the lower diameter of the column. However, even for the parts above the frieze, simple ratios can be worked out, leaving the possibility that these were also planned using the module based on the lower diameter of the column.

3) The planning for both the upper structure and the podium starts based on the dimension of the axial intercolumniation. The dimension of the axial intercolumniation itself was determined by the length of the whole stylobate for both W and L directions. Taking these into account, it can be suggested that the balance adjustment was conducted from the larger members to the smaller at the Nereid Monument.

4) As with the planning of the floor, it is highly possible that the elevation was planned using the ancient foot, which is 0.310m in the previous paper.

5) As with the planning of the floor, many of the planning dimensions for the successive system of proportion was taken into account at the planning stage.

As previously mentioned, there are only a few studies on podia since temples and stoas usually do not have them. Fortunately, however, there are many Hellenistic tombs with podia. A planning method based on the dimension of the axial intercolumniation is presented in this paper, but further research on the planning of podia by analyzing more Hellenistic tombs is called for.

The possibility of adjusting the balances between each part was also found, which suggests the planner may have done so from the larger members to the smaller ones successively. It is difficult to be sure whether this was intentional or not. The author will investigate the intention of the planners along with the analysis of other Hellenistic tombs in future.

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Notes

1) Fedak J.: Monumental Tombs of the Hellenistic Age, Toronto, 1990, p.3; Fedak sums up the characteristics of the Hellenistic tombs, one of which being their varied forms.


4) TAKEDA, op. cit. 2008

5) TAKEDA, op. cit. 2008, p.1105


7) 植田・内藤, op. cit. 1992, p.16; Coulton, op. cit. 1975, p.87; 田村, op. cit. Hornisch, Coulton and Hayashida all conducted their analysis on the basis of the hypothesis that there existed several "ancient foot".

8) Vitruvius, 森田優一訳注：ヴィトゥルヴィウス建築書, 東海大学出版会, 1969, pp.131-137

9) 林田, 伊藤 : op. cit. 1998


11) Coopel: op. cit. 1969, Restitutions, Pl. XXIII

12) TAKEDA, op. cit. 2008, p.1106, 14th line on the right.

13) TAKEDA, op. cit. 2008, p.1107, 7th line from the bottom on the left.

14) TAKEDA, op. cit. 2008, p.1107, 16th line on the right.

15) TAKEDA, op. cit. 2008, p.1108; The width of the anta is calculated in the previous paper.

16) TAKEDA, op. cit. 2008, p.1107, 9th line from the bottom on the left.

17) TAKEDA, op. cit. 2007

18) TAKEDA, op. cit. 2008, p.1109; The axial intercolumniation on the W side is calculated in the previous paper.

19) TAKEDA, op. cit. 2008, p.1110

20) Coulton: op. cit. 1975, pp.66-69; Coulton coined the names "the modular system of proportion" and 'the successive system of proportion' for which Vitruvius had called, for temple designing, the Doric order of proportion and the Ionic order of proportion respectively. In the modular system, dimensions of each part derive from one standard dimension in the form of either multiples of fractions. In the successive system, all the dimensions derive from the one immediately before them in successive manner.

21) TAKEDA, op. cit. 2008, p.1110

22) The descriptions such as '5.5/6 → 6' in the (F) column in Table 1 show that adjustments were made in order to fit the ancient foot when calculating the planning dimensions. As stated in '2. Study method' the ancient foot consisted of fractions such as the palm (1/4 of a foot) and the dactyl (1/4 of a palm), suggesting the fractions of 2, 3, 4, 5, 8, 16 have existed. Since such a number as 5.2 dactyls cannot be expressed in ancient feet, it needed to be converted to the nearest value such 5 dactyls i.e. 5/16 foot.

Source of Figures

Fig.1; Fedak: op. cit. 1990, p.295, fig.59

Fig.2; Coopel: op. cit. 1969, Texte, Planche 26

Fig.3; Coopel: op. cit. 1969, Restitutions, Pl. XXVII

Fig.4; Coopel: op. cit. 1969, Restitutions, Pl. LXI

Fig.5; Coopel: op. cit. 1969, Restitutions, Pl. XCIV (section lines were added by author)

Fig.6; Author's own drawings
和文要約
1. はじめに
ヘレンズ期の古代地中海世界では、豊かな建設活動を持ち輪が建設されるようになる。しかし、これまで、ヘレンズ期の墓を対象とした設計に関する研究は、その多くが地元が執筆した前稿及び論文稿以外にはない。そのため、このヘレンズ期の墓が豊かな建設活動を如何に設計や造形理論に基づいて作られたのかは全くわからなくておわり、ヘレンズ期の墓の設計や造形理論が古代地中海世界全体に広まったものであるか、あるいは地域毎に特異特微を持つものであったのかについても明らかにされていない。
そこで、本研究では、古代地中海世界におけるヘレンズ期の墓の設計のあり方を地元地中海世界の各々のヘレンズ期の墓に対する造形理論の視野に踏み込むことを想定しながら、まずはヘレンズ期の墓の設計の分析を行うことにした。この一環として、前稿では、クサントスのネレドミュメントの平面の設計を分析し、その結果、ネレドミュメントの平面は、ナオスの内法拡大を対象にあわせて決定し、その後では対象に向けて比較的関係に基づき、各部寸法を決定してゆく方法で設計されたと結論づけた。本稿では、この続きとして、ネレドミュメントの平面の設計の分析を行う。

2. 研究方法
設計法の分析方法は、前稿と同様である。すなわち、まずは属内らの提示する古代ギリシアの神殿やストアの設計方法が、ヘレンズ期の墓に適用されている可能性があるのを検討することとする。つまり、まずはネレドミュメントの各部分寸法内において、規則性を持った比類関係を選定することから分析を進めることとする。
また、実際には当世建物が施工された場合のことを考えれば、比類関係によって決定される建物各部分の寸法は、当時のものと同じく、つまり「古代尺」によって表現されなければならない。よって、前稿同様、選出された比類関係と古代尺を用いて設計寸法を導き、設計寸法と実測寸法との誤差の大小を検討することで、選出された比類関係や設計過程の正当性を検証することとする。なお、その際、古代尺の寸法は、近年の研究結果に基づき、0.294〜0.330mの範囲内に何らかに当該すると仮定し、尺寸の端数を表現する際、分母が「3, 4, 5, 8, 16」になるよう留意して行うこととする。

3. 設計法の検討
以下、長辺方向をL方向、短辺方向をW方向と呼称する。

3-1. 設計手順の算出
各部寸法相互の比類関係を計算した結果、単純で正確な比類関係を複数の箇所で見いただすことができた。前稿で示した通り、ネレドミュメントの設計は、能からスタートする。つまり、まず地元の広さに合わせて全体構成を成形し、その後、後ろ、前後に関り付けを決定し、柱間心間距離をエンドスベースの寸法等を決定する。そして、柱間心間距離から円柱下部直径が導かれることとなるが、立面上における上部構造の左右の部分は、この円柱下部直径をモデルとして設計される。また、アッシャにおいて円柱部分を伴う及びアッシャの柱間心間距離をモデルとする設計を導くことができた。ボディウムに関しては、4層目までのボディウムをとし見なした場合において、W方向の柱間心間距離をモデルとし、単純で、誤差の小さい一連の設計法を導くことができた。
以上の結果を踏まえると、ネレドミュメントの立て方は、上部構造もポディウムも、柱間心間距離から派生する格部が決定されている。また、これに対応し、柱間心間距離は、W方向、L方向ともに全体幅から算出されたものであることを踏まえると、ネレドミュメントは、大きな部分から、徐々に小さな部分に向かってバランスを整えられたものとなる。
なお、フリーさ高さ、ディンプル高さ、コーンス高さは、円柱下部直径をモデルに算出した場合においても、その比類関係は関数のものとなり、実測値との誤差も小さいものとなる。加えて、ムトールス突出量や一覧高さも、比較的小さな誤差で、円柱下部直径をモデルとして算出する方法を探ることができる。よって、本稿では、フリーゼ高さ、ディンプル高さ、コーンス高さの一部が円柱下部直径をモデルに算出した可能性があることを指摘している。

3-2. 設計寸法の算出
前稿で導き出した比類関係と古代尺を使って設計寸法を算出し、実測寸法との誤差を検討することで、提案した設計手順の正当性を検証した。その結果、前稿同様、1尺が0.310mの古代尺を用いた場合、先に提案した設計手順に基づいて算出される設計寸法と実測寸法との誤差は非常に小さく、本稿で提示した設計手順の正当性を示すことができた。また、平面の分析の際に同様に、ネレドミュメントの平面の設計寸法に増に合せることができ、施工性の高い設計が行われたことがわたる。それらと同時に、比類に基づいて寸法を決定した際に、偶然切れる良型寸法が導かれる可能性は低いと考えられるので、このことからも、本稿で提示した設計法の正当性が示されたといえる。

4. 結論
1) 本稿では、比率を用いた設計が行われたと仮定して分析を進めただけで、一連の設定過程を見出すことができた。その設定過程によって導かれる設計寸法と実測寸法との誤差が小さいこと、設計寸法には完尺が多く、比率を用いた設計を行った際に偶然寸法が完尺となる可能性が高いことを踏まえると、ネレドミュメントの設計は、古代ギリシアの神殿やストア等と同様に比率を用いた設計がなされてっていたと考えることができる。
2) オーダー部分においては、フリーゼ以上の部位は柱根高さから連続的に決定され、それ以下の部位の寸法は円柱下部直径をモデルとするものである。ただし、フリーゼ以上の部位においても、円柱下部直径をモデルとして単純な比類関係を導くことができ、円柱下部直径をモデルとした可能性が残されている。
3) 上部構造もポディウムも、設計は柱間心間距離を元に開始される。柱間心間距離は、W方向、L方向ともに全体幅から算出されたものである。このことを踏まえると、ネレドミュメントでは、大きな部分から、徐々に小さな部分に向かって、各部位のバランス調整が行われたものと考えることができる。
4) 平面の設計法の分析結果と同様に、立面上の設計法においても、ネレドミュメントでは、1尺が0.310mの古代尺を用いられた可能性が高いといえる。
5) 平面同様、立体の設計法には各部に完尺がみられ、ネレドミュメントでは、施工性の高い設計が行われていたといえる。

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