TECHNOLOGICAL CONSTRUCTION OF AN ANCIENT GREEK TEMPLE - DESIGN OF AN EARTHQUAKE PROOF RECONSTRUCTION SYSTEM APPLIED ON THE TEMPLE OF ZEUS AT NEMEA

HENDRIK HENDRICKX *PROFESSOR, ARCHITECT-SCULPTOR - FREE UNIVERSITY OF BRUSSELS*
FREDERIC GHYSSAERT *CIVIL ENGINEER-ARCHITECT- FREE UNIVERSITY OF BRUSSELS (V.U.B.)*

Firstly, this paper will treat a few aspects of the technological construction of an ancient Greek temple, with its used basic materials and techniques, and secondly the design of a durable earthquake proof reconstruction system, based on a universal regenerating form- and size system and utilised for the theoretical reconstruction Temple of Zeus at Nemea.

1. TECHNOLOGICAL CONSTRUCTION OF AN ANCIENT GREEK TEMPLE

In the big temples, the houses of the image of God, the Greeks found their concept for an ideal architecture in a balance of construction, measure and order. This resulted in a sacral representative and ideal architecture with completely ideal proportions, reduced to the most essential elements within a strict system of units.

The construction of an ancient Greek temple is an example of ancient Greek "high-tech". The technical insight to use natural stone (limestone, poros, marble (also wood and metallic materials)) and the logical and efficient way in which they made connectable building components that could be piled in an almost perfect and accurate way, prove this.

1.1 A few aspects of the technological construction

1.1.1 Quarrying, systems of transportation, building-up-techniques, material properties, ...:

The stratification of natural stone played an important role in its application for the temple construction. Therefore we shall start at the quarry: quarrying one drove wooden cotters (dowels) into the formerly excavated quarries, parallel with the stratification. After the wood had swollen, due to the constant humidification, blocks splitted from the mother rock, ready for a first big treatment or ready to be distributed.

The direction of the stratification was always linked to the respective place of the component in the totality of the construction. Mainly we can talk about a twofold outspoken application: On the one hand, the stratification was parallel to the groundplane of the temple, for all building components subject to vertical pressure, like floors, walls, columns and others. Architraves on the other hand, also subject to tension, have been implemented in such a way that the stratification is perpendicular to the groundplane of the temple (figure 1a).

The architrave could be looked upon as a vertical series of long small stone disks, for which, from a point of view of a vertical section, it was clear that the dimension of the height was superior to that of the width (figure 1a). This method of utilising natural stone allowed to keep the tensile stress limited.

The conical pre-cut column drums, provided with spaces or sticking out parts (on the four sides perpendicular per pair), allowing to be tied with ropes through a simple lift system (figure 2b), were consequently transported to the correct position (figure 2a). The total column was composed of drums of different heights, but equal in number, though the total height of the columns was perfectly equal.

The most interesting and most fascinating facet of the column construction was the building-up-technique: the drums only had a perfect finishing on both the outside borders of the upper and lower side, and that in between the two, a limited layer had been cut (figure 2d). The centre of each drum contained, as well on the upper as the lower side, complementary with the former and the following, a hole in the shape of a cube, namely an empolion (figure 2d). This edge of the drum, that needed to be finished, had a double goal: firstly it resulted in a joint that connected the two drums in a perfect way, and secondly it constituted the only necessary contact surface to transmit the cumulated compressive forces. The removed material was not a necessity and its presence would only complicate the piling and the uniform transmission of the compressive forces during the building up. The drums and other blocks were initially being piled through the spaces that were foreseen to tie the ropes of the lift system in order to compose a column. The conicity per drum was already present, though the flutes were still lacking in order to constitute the totality of the final column.

Creating the holes in the shape of half cubes, which were located centrally on the top and the foot of the drums, one would see to it that the former and the following holes would be cut in a way that was quite central and complementary, and in a way that their position would not be influenced by the position of the hole in the third and fourth drum, etc..

During construction, both halves of the cubes were provided with an amount of lead in which a double conic wooden chock (dowel) was driven at the time both drums were being piled. This would unify the components of the column. This erection process would precede the final grooving of the flutes. Once plastered, this gave the columns a beautiful and accentuated refined verticality when exposed to the brilliant Greek sun.

1.1.2 The construction of a temple:

The construction can be divided into 4 zones: the krepidoma (the substructure), the columns, the entablature and the roof. The total building configuration of building blocks supported a wooden roof structure, covered with tiles, mostly in natural stone or terracotta and two opposite tympanums. This enormous weight resulted in a major pressure on the cornice and the friezes (triglyphs on metopes) and was consequently distributed trough the architraves via the walls and the columns to the krepidoma, from stylobate to stereobate (figure 1b). The geometrically built foundation blocks (figure 1c) rested on rocky soil, partly rocky soil completed and equalised with stone fragments, or on mixed sand soil, in turn reinforced with stone fragments, to a tableland which allowed building activities. The result with seismic vibrations would have been different depending on whether the construction rested upon hard or soft subsoil, and even more different if the subsoil had a mixed composition.

Since mainly the columns and the entablature (architrave - frieze - cornice) were responsible for the transmission of forces and because they determined the character of the Doric architecture, let us talk about how the compressive forces through architraves and piled drums were being transmitted to the foundation:

1. 1.2.1 The entablature:

The bearing architrave, upon which the wooden beams of the roof rested, extended from centrecolumn to centrecolumn. The necessarily wide supporting surface was being formed by a cubic-shaped plate, called the abacus. By widening the supporting surface, the span and the bending of the architrave could be limited.

To diminish the danger for breaking and to facilitate the mounting, the architrave was made of 2 or 3 beams, positioned in succession on their narrow side (figure 1a).

As mentioned, the natural stone was being placed with its stratification perpendicularly on the ground-plane. This in order to offer maximal resistance to tensile stress in its compact vertical stratification. The perfect connection between the former and the following, centrally positioned on the abacus, was obtained by a precise reversed U-shaped mutual sideways contact surface, which was cut and polished as a remainder of the partly cut surface (figure 2c).

The architrave was followed by the frieze supporting the cornice. The upper part of the cornice was the sima, which drained off the catched water through the gargoyles.

1.1.2.2 The columns:

The column beared the entablature and the roof construction. The transmission of the cumulated vertical forces took place on the outside of the drums, meaning the outside of the bearing construction, because they only had, as mentioned, a perfect finishing on the outside border. The direction of the transmission of the forces was symbolically translated by the flutes on the columns.

1.2 Reconstruction

There is a possibility that the building blocks once carried marks. Marks to be incised on the blocks and drums in a general inventory, as aids to an accurate account of the numbers of blocks needed for certain positions. This could have been done either at the quarry or in the field trimming, or at any stage before the blocks were lifted into place. For the reconstruction of the Temple at Nemea there were doubts about the signification of these marks, and in most of the times they were erased by erosion.

In any way, the empolion cuttings (complementarily between former and following) together with the narrowing of the column towards the top, the presence of flutes complemented with an equal number of drums per column, and an equal total height, constituted the code to assist us for an exact reconstruction. All these elements gave us the key to solving the puzzle, and unconsciously lead to the code to trace the correct position for each drum within each column today. Thanks to this code and with the completion of the restored drawings, the reconstruction could begin.

2. DESIGN OF AN EARTHQUAKE PROOF RECONSTRUCTION SYSTEM APPLIED ON THE TEMPLE OF ZEUS AT NEMEA.

The design of this earthquake proof system of reconstruction applied on the Temple of Zeus at Nemea was originating from the development and the application of a universal regenerating form- and size system. Before moving on to the previous mentioned, let us first take a look at a couple of principles of tension and pressure in order to clarify the modified "temple forces" caused by the incomplete reconstruction, all of this complemented with the philosophy behind the design-methodology based on a regenerating form- and size system.

2.1 Transmission of forces within an ancient Greek temple - Transmission of forces in the reconstructed state of the temple: A balance between supporting and loading.

Concerning the transmission of forces, we will consider the general stability of the temple on the one hand, and on the other hand the level of being earthquake proof. More specifically, we will consider the old Greek temple in its total configuration, and in its reconstructed state:

2.1.1 Completely built up ancient Greek temple:

In short, the construction of the ancient temple can be characterised by a dry piling of limestone building blocks. Its composition had lead to, bottom up, columns (drums), necking, echinus, abacus, architrave, frieze and cornice. Having a certain mass, such building blocks had a major influence on the general stability of a similar construction: The total mass converted in gravity was exercising a certain pressure on the total construction, however, this pressure was of a size that the general stability was ensured under "normal" circumstances. In short, the general stability was realised by a balance between supporting and loading, and was ensured by mainly compressive forces.

In case of an earthquake, the building is subject to as well horizontal as vertical forces. In general, the horizontal ones are the most dangerous ones. Obviously, the construction would be differently affected and would also react in a different way depending on whether the subsoil is of a hard, soft or mixed texture. Therefore, we will make the following distinction:

a.Soft subsoil:

Soft subsoil will deform considerably under the influence of an earthquake, and, as such, the forces transmitted on the construction will be reduced.

b.Hard subsoil:

Hard subsoil, on the other hand, will cause the need for the construction to absorb more energy. Meanwhile, we already know that a temple construction can be characterised by a dry mounting, a limited contact surface between the building blocks and a high compressive force that holds the construction together entirely. All these features enable a similar construction to absorb quite some energy. As the direction of the seismic vibrations is uncontrollable, they obviously exercise multiple forces on the totality of the pile, and ultimately may cause drums to shift. Due to the use of dry piling, the column may withstand a lot, but not all, of the elements of destruction.

c.Mixed soft/hard subsoil:

Without any doubt, mixed subsoil will cause the energy to be partly absorbed by the underground and partly by the construction.

2.1.2 State before reconstruction - reconstructed state:

After reconstruction of the temple, certain parts were missing. This resulted in a smaller weight, and as a consequence in a smaller influence on the total stability. As such, the incomplete composition could no longer display the same characteristics. In order to, at least, obtain the same characteristics and potentials (namely stability and level of being earthquake proof), we needed to take the above in account: as an alternative for the compressive force caused by its dead load, there was a need for the construction (the columns) to have an internal tension that kept the different building blocks together. In this case, for the reconstruction of the Temple of Zeus at Nemea, it was through a prestressed steel construction (see § 2.3.2).

2.2 The philosophy behind the design-methodology based on a regenerating form and size system

In the following section we would like to explain our vision and our design-methodology to the production of the material culture in general. Afterwards, we will illustrate its utilisation for the earthquake proof reconstruction of the Temple of Zeus at Nemea.

As designers we limit ourselves to the material solutions, the artifacts. More and more, they are being confronted with new and existing problems, which evolve faster every day, and which seem to expand in number and extent. Therefore, solutions must be workable to its maximum in order to imply a minimal waste production, and a minimal input of energy and material. This can be obtained if these solutions, as a whole and in their parts, can be adapted, combined, demounted and used in a polyvalent way. In order to obtain this, all material solutions as a whole and in their parts, must be designed and produced from one general applicable regenerating form- and size system.

To finally come to such a form- and size system and for reasons of general feasibility, we especially focus on that which is common in all these artifacts:

Namely, solutions or products have characteristics, qualities and defaults which can be covered by words. These terms are to be decomposed into single characteristics. In other words: all singular features are gradually being expanded through inter- and extrapolation to series of characteristics, extended into their maximal and minimal variants (figure 3a). For example:

A bar can be round, thick, massive, left with plain surface, being long and made of hard rigid steel. These singular characteristics are to be provided by, or extended into their opposites:

Round is provided with rectangular, thick with thin, massive or full with hollow, plain with manufactured, long with short, hard with soft, rigid with souple. In between round and rectangular, at least octogonal is added and the series is completed with triangle. In between full and hollow, variations in wall thickness are added. In between plain and manufactured, for instance variations in depth of manufacturing or threading. Every composite characteristic, solution or product here corresponds with the point where all concerned comprehensive series about singular characteristics cross (figure 3a). Variations or new solutions follow moving of at least one of such series of characteristics through the same point.

This might generate historic missing links and sets of even more future solutions, out of which history and circumstances will make choices.

In other words, we compose an as complete as possible package of criteria on which the general applicable form system can be based. Therefore all criteria must be graphically represented and combined to a simple and minimal model (figure 3b). This model and its parts simultaneously have an indefinite number of characteristics and meanings.

The form system was the result of a, if possible, complete survey concerning the essence of the historical and actual artifacts throughout the different phases of the design, the production, the use, the maintenance, the repair, the adaptation, the re-utilisation and the demounting.

To allow us to use this model in praxis, it must also be provided with sizes. In order to guarantee a maximum number of combinations, we will apply, to a maximum extent, the same sizes as the parts of the existing artifact. Should differences be unavoidable, then we will apply the principle of doubling.

Consequently we projected this gradual, therefore dynamic, model on all materials and all scales so that per material all workable elements can be indicated. The result can be compared to a meccano, which includes all materials and elements and is applicable to all scales: a dynamic meccano (figure 3c).

The final goal is to increase the external efficiency on the one hand, and the internal one on the other hand. The external efficiency indicates the possibility of integrating new systems in existing systems, in other words, the possibility to maintain a balance in the process-relation artifact-context in an integrated adaptable way (space- and time committed). This assumes that we can consider an existing situation as a part of a process instead of a fact. In adapting the composing parts of the artifact, initially based on form- and size compatibility, the internal efficiency is stimulated. This compared to the known material solutions, with a fixating and restricted applicable character, which risk to strand in inflexible and unaffordable material solutions. The present way of designing, reconstructing, restorating, renovating and building in general are examples of this. They only meet the criteria known "hic et nunc". But the problem is that these criteria evolve in time. Thus what is missing, is a time incorporated design-method and that's exactly what we have been looking for.

2.3 Earthquake proof reconstruction of the Temple of Zeus at Nemea

2.3.1 The Temple of Zeus at Nemea:

The Temple of Zeus was probably completed in 320 à 330. Ionic influences had been kept to a minimum. The exterior was austere Doric of the 4th century. Only the interior colonnade of the cella was elaborated with non-Doric forms; the walls which stood behind those same columns retained the Doric simplicity.

The bulk of the stone used in the temple was a hard, local limestone. Soft limestone or poros was used for the Corinthian capitals of the lower order and for the Ionic second storey of the cella. Poros is a soft, pinkish stone that is easy to carve. The poros was coated with the same fine stucco that has been used on the rest of the temple. Finally the sima was made of white marble and the tiles of locally made terracotta.

The foundations of the temple were largely constructed of re-used materials, probably from an earlier temple. The superstructure was built of newly quarried blocks.

The temple peripteros was designed with 12 Doric columns on each flank and 6 at

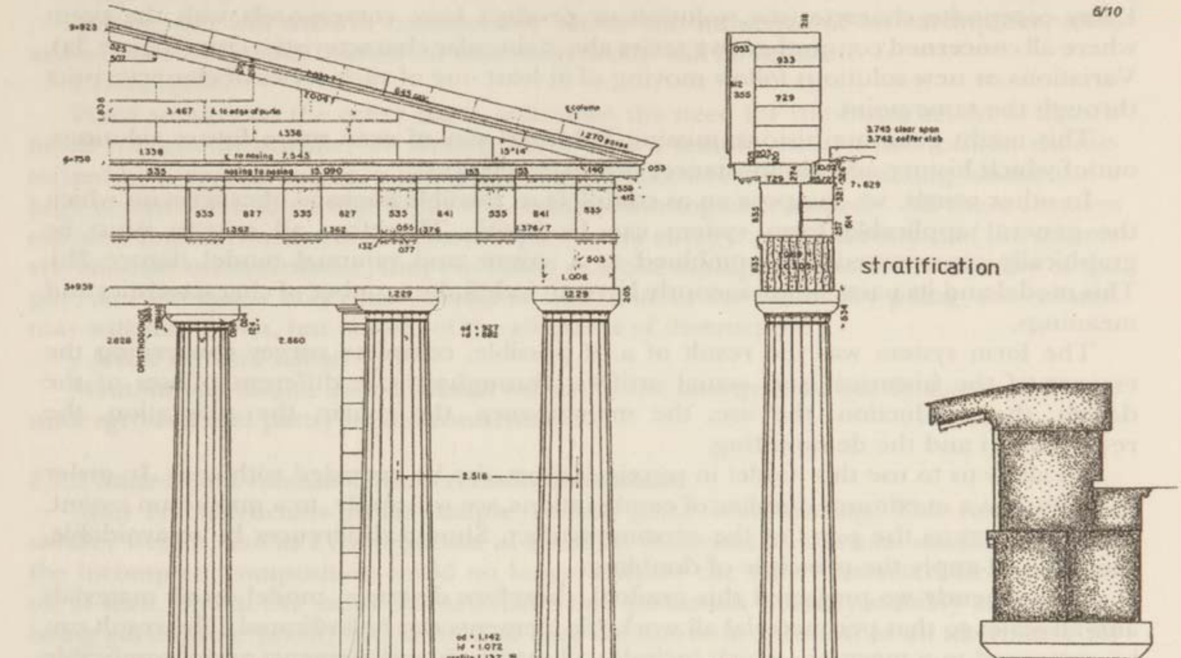
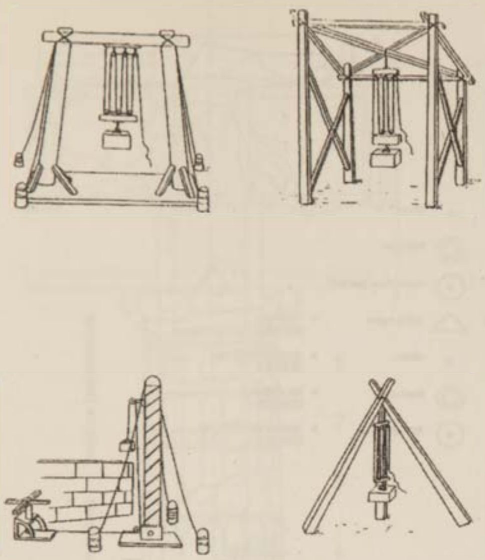


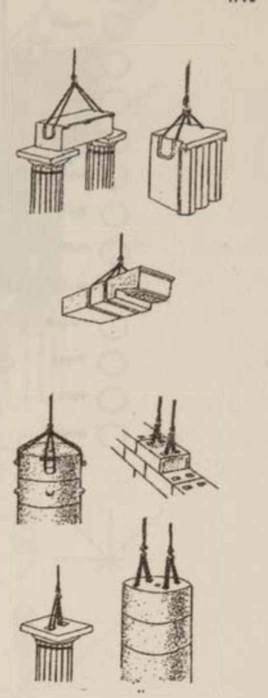
FIG. 1a (From left to right). Facade of an ancient Doric Greek Temple. Facade section and illustration of the stratification of an architrave. Architrave made of 2 or 3 beams to diminish the danger for breaking and facilitate the mounting positioned in succession on the narrow side.

FIG. 1b Components of column and entablature

FIG. 1c Example of the foundations.



2a



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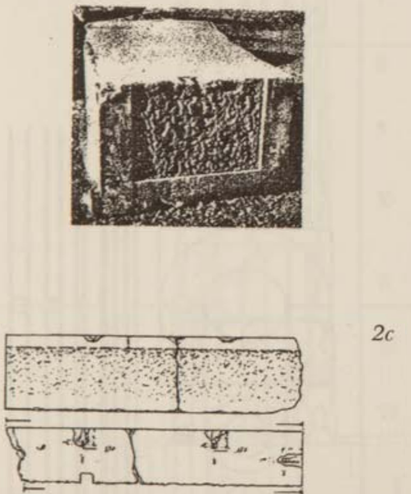

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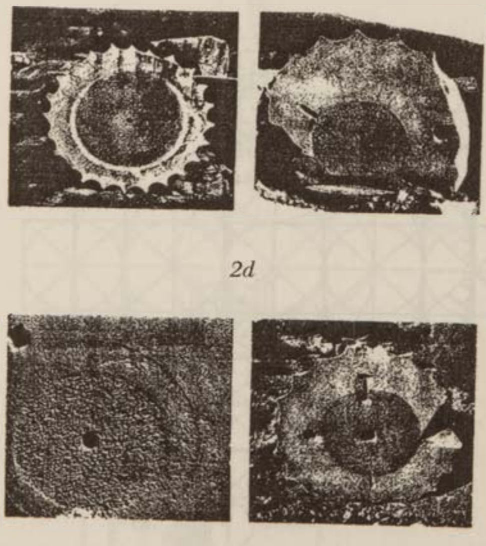
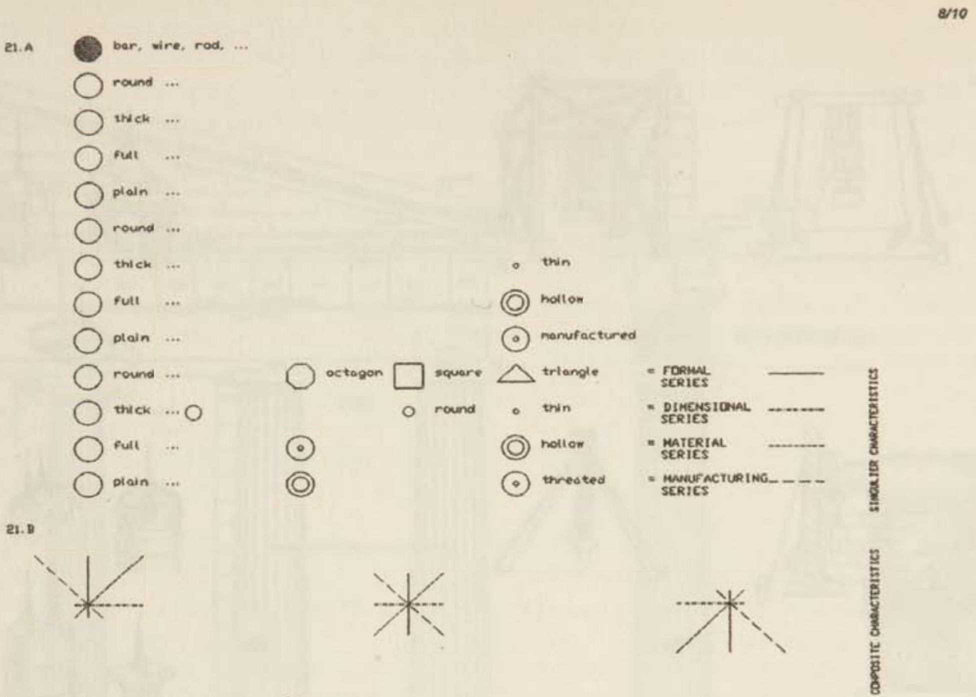


2d

FIG. 2a Mounting techniques.
FIG. 2b Simple lift systems.
FIG. 2c Reversed U-shaped mutual sideways contact surface of an architrave.
FIG. 2d The centre of each drum contains an empolion.



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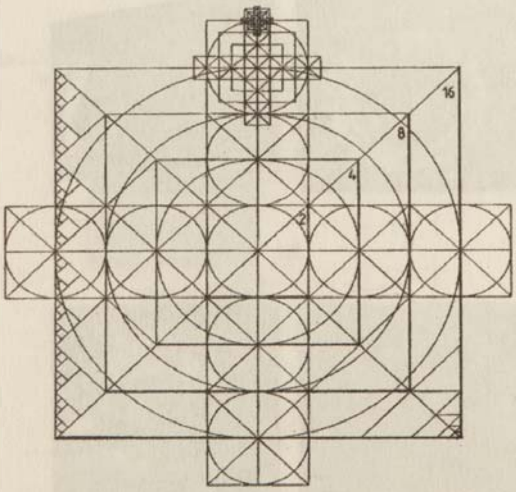

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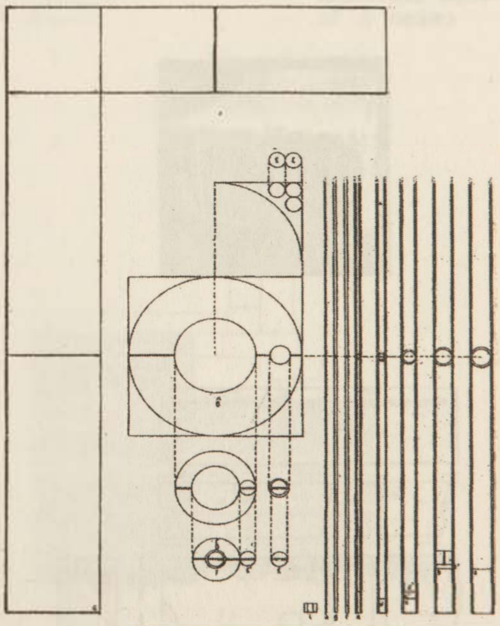

3c

FIG. 3a Singular characteristics provided by or extended into their opposites.
Every composite characteristic corresponds with the point where all concerned comprehensive series about singular characteristics cross.
FIG. 3b Graphically represented minimal model of a regenerating form and size systen.
FIG. 3c The compatible building components of the reconstruction system for the Temple of Zeus at Nemea.

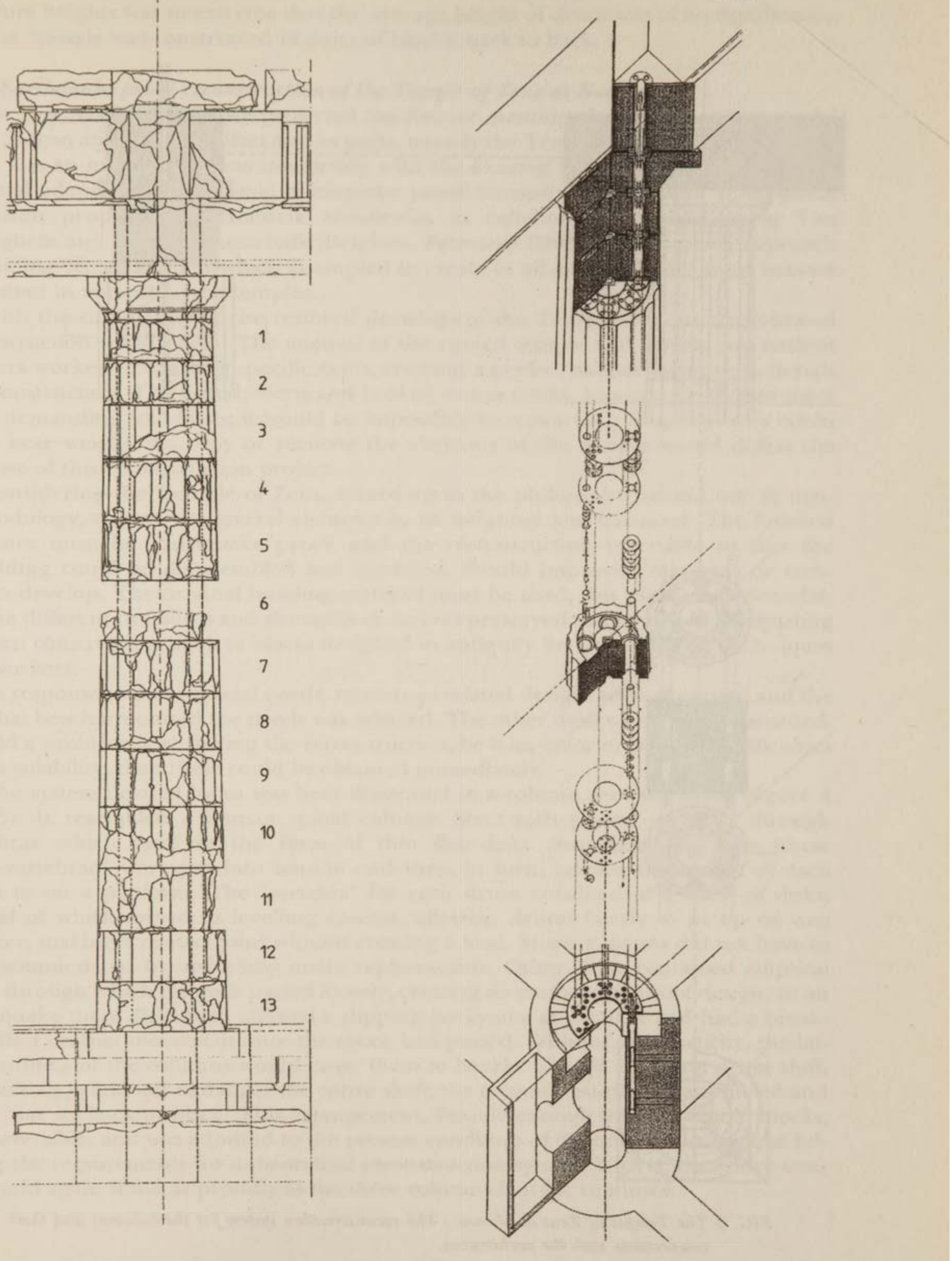

FIG. 4 The Temple of Zeus at Nemea. The reconstruction system for the columns and their connections with the stylobate (bottom) and the architrave (top).

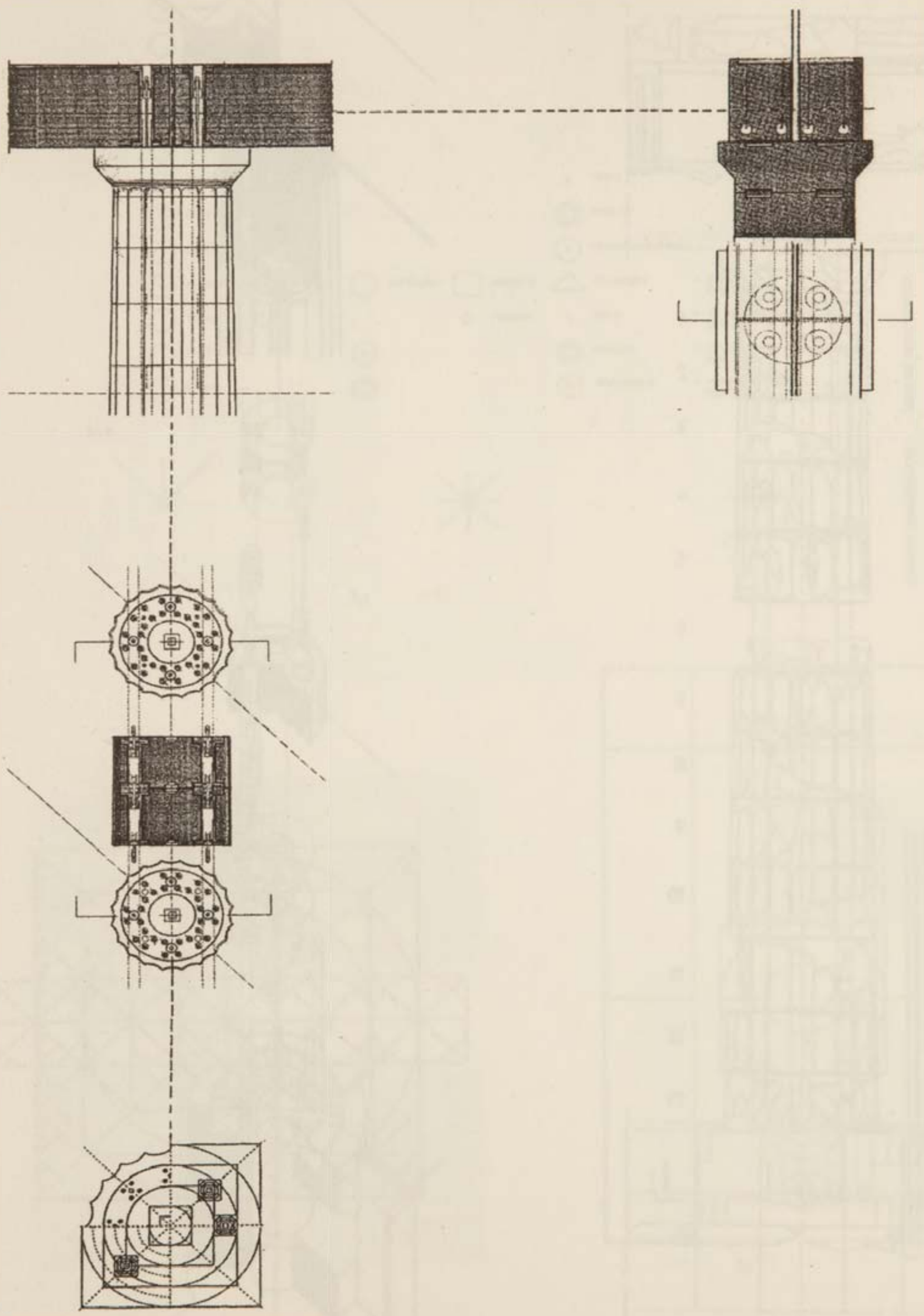

FIG. 5 The Temple of Zeus at Nemea : The reconstruction system for the columns and their connections with the architraves.

each end. Each column was composed of 13 drums. The variation between the individual drum heights was so extreme that the average height of drum was of no significance.

The epistyle was constructed in pairs of blocks, back to back.

2.3.2 Earthquake proof reconstruction of the Temple of Zeus at Nemea

For this reconstruction we projected the former mentioned dynamic system-model (see § 2.2) on an existing artifact and its parts, namely the Temple of Zeus in Nemea. The result was an integrated (thus interacting with the existing forms, sizes and materials), maximal adaptable and optimal earthquake proof reconstruction system. This system was been proposed by Hendrik Hendrickx in collaboration with Hedwig Van Walleghem and Luc De Maesschalk (Belgium, February 1982). It's a modern approach to building reconstruction which attempted to create in all structures the same balance immanent in ancient Greek temples.

With the completion of the restored drawings of the Temple of Zeus, the physical reconstruction could begin. The analysis of the ruined temple had shown that ancient builders worked to exacting specifications, creating a perfect balance between materials and construction. The pitted, worn and broken stones could, however no longer meet these demanding standards; it would be impossible to repair each fragment so it could again bear weight. To copy or recreate the elements of the temple would defeat the purpose of this reconstruction project.

Considering the Temple of Zeus, according to the philosophy behind our design-methodology, there were several elements to be weighted and balanced. The finished structure must be earthquake proof, and the reconstruction reversible so that the rebuilding could be disassembled and modified, should improved materials or techniques develop. The original building material must be used; this means accommodating the different pressures and strengths of various preserved stones as well as adjusting modern construction work to blocks designed in antiquity for very different techniques and workers.

In response to these special needs, numerous related designs were proposed and the one that best harmonised the needs was selected. The other designs were not discarded. Should a problem arise during the reconstruction, be it an error in design or difficulties with availability, than these could be obtained immediately.

The system devised by us was here illustrated in a column reconstruction (figure 4 and 5). It resembled a human spinal column. Steel rods passed as cords through vertebrae which were in the form of thin flat disks. Supported by rods, these "disk-vertebrae" were put into tension and they, in turn, carried the weight of each drum as on a platform. The "vertebra" for each drum consisted of a stack of disks, several of which served as levelling spacers, allowing drums barely to sit up on one another, making a contact joint without creating a load. Missing drums did not have to be accommodated by artificially made replacements. Other disks contained elliptical holes through which the rods passed loosely, creating an earthquake proof design. In an earthquake these disks both allowed a slipping horizontal movement and had a breaking effect on that movement once the shock had passed. Without this elasticity, the lateral stiffness of the columns would cause them to buckle. Should a column drum shift, the shifting would not endanger the entire shaft, the column could be disassembled and the drum set back in place. This arrangement, flexible enough too for seismic shocks, was reversible, and was adjusted to the present condition of the temple blocks, thus fulfilling the requirements for a theoretical reconstruction system. With it, the entire temple could again stand as proudly as the three columns had for centuries.

NOTES

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ΠΕΡΙΛΗΨΗ

ΑΝΑΠΑΡΑΣΤΑΣΗ ΚΑΙ ΣΥΝΤΗΡΗΣΗ ΤΟΥ ΝΑΟΥ ΤΟΥ ΔΙΟΣ ΣΤΗ ΝΕΜΕΑ

H. HENDRIKCX - F. GHYSSAERT

Ο σημερινός τρόπος σχεδίασης, αναπαράστασης, συντήρησης, αναπαλαίωσης και δόμησης γενικότερα καταλήγει συνήθως σε λύσεις προσωρινών υλικών. Υπόκεινται μόνον στα κριτήρια που είναι γνωστά ως "hic et nunc". Το πρόβλημα όμως είναι ότι τα κριτήρια αυτά εξελίσσονται με το πέρασμα του χρόνου. Αυτό που λείπει, λοιπόν, είναι μια μέθοδος-σχεδιασμός που να έχει ενσωματώσει τον παράγοντα χρόνο. Κάτι τέτοιο είναι δυνατό, μόνον εαν ο σχεδιασμός είναι βασισμένος στην αναμόρφωση του σχήματος και των συστημάτων μέτρησης.

Ένα παράδειγμα αυτού του τρόπου σχεδιασμού είναι το σύστημα αναμόρφωσης υλικού για την αναπαράσταση και συντήρηση του Ναού του Διός στη Νεμέα. Ένα σύστημα για την αναδόμηση αυτή προτάθηκε απο τον Hendrik Hendrickx σε συνεργασία με τον Hedwig Van Wallegem και τον Luc de Maesschalk (Βέλγιο, Φεβρουάριος 1982).

Με τη συμπλήρωση των συντηρημένων σχεδίων του Ναού του Διός (βλ. σχέδιο 1), η φυσική ανακατασκευή μπορούσε πια να ξεκινήσει. Η ανάλυση του ερειπωμένου ναού έδειξε ότι οι αρχαίοι οικοδόμοι δούλεψαν με τη μεγαλύτερη δυνατή ακρίβεια, ως προς τις προδιαγραφές, δημιουργώντας την τέλεια αρμονία μεταξύ υλικών και κατασκευής. Όπως και νά'χει, οι βαθουλωμένοι, φθαρμένοι και σπασμένοι λίθοι δεν μπορούν πια να τηρούν τις απαιτούμενες προδιαγραφές. Θα ήταν αδύνατο να επισκευαστεί κάθε σπάραγμα, ώστε να είναι σε θέση και πάλι να φέρει βάρος.

Το να αντιγραφούν ή να δημιουργηθούν εκ νέου τα στοιχεία του ναού θα αναιρούσε το στόχο του Προγράμματος Αναπαράστασης: τη διατήρηση της αρχικής δομής.

Το σύστημα αναπαράστασης που σχεδιάστηκε απο το Hendrik Hendrickx, βασίζεται στις αρχές της "Συντεκτονικής" (Syntecture), μιας σύγχρονης προσέγγισης της

αναδόμησης κτιρίων. Η προσέγγιση αυτή επιχειρεί να προσδώσει ευστάθεια σε όλες τις κατασκευές, όμοια με αυτήν που χαρακτήριζε τους αρχαίους Ελληνικούς ναούς.

Ως υποστηρικτές της "Συντεκτονικής" πιστεύουμε πως η ιδεώδης χρήση των υλικών ανάλογα με τις ανάγκες όχι απλώς συνεπάγεται τον καλύτερο σχεδιασμό κτιρίων, αλλά και προστατεύει τις πρώτες ύλες, προστατεύοντας κατ'επέκτασιν και το περιβάλλον. Επιπλέον, υπάρχει ελπίδα ότι η προσέγγιση αυτή θα συνεχιστεί και στο πολιτικό και κοινωνικο-οικονομικό πεδίο, στα οποία θα ενσωματωθεί σε τέτοιο βαθμό, ώστε και αυτά να λειτουργούν κατά τον καλύτερο δυνατό τρόπο.

Προσεγγίζοντας το Ναό του Διός σύμφωνα με τη "Συντεκτονική", υπάρχουν διάφορα στοιχεία που πρέπει να ζυγιστούν και να εξισορροπηθούν. Η ολοκληρωμένη κατασκευή θα πρέπει να είναι αντισεισμική και η αναπαράσταση αναστρέψιμη, ώστε η αναδόμηση να μπορεί να αποσυναρμολογηθεί και να αναπροσαρμοστεί, εφόσον αναπτυχθούν περαιτέρω τα βελτιωμένα υλικά και τεχνικές. Το υλικό του αρχικού κτιρίου θα πρέπει να χρησιμοποιηθεί. Αυτό σημαίνει ότι θα πρέπει να εναρμονιστούν οι διαφορετικές πιέσεις και τάσεις των ποικίλως διατηρημένων λίθων, καθώς και να αναπροσαρμοστεί η σύγχρονη οικοδομική εργασία σε λίθινους όγκους που σχεδιάστηκαν στην αρχαιότητα για πολύ διαφορετικές τεχνικές και εργάτες.

Ως προσπάθεια ανταπόκρισης στις ειδικές αυτές ανάγκες, πολλά σχετικά σχέδια εκτέλεσης του έργου έχουν προταθεί. Επιλέγεται εκείνο που εναρμονίζει με τον καλύτερο τρόπο τις ανάγκες αυτές, ενώ τα υπόλοιπα δεν απορρίπτονται.

Αν προκύψει πρόβλημα κατά τη διάρκεια της αναδόμησης, είτε πρόκειται για σφάλμα σχεδιασμού, είτε για δυσκολίες ως προς τη διάθεση εξοπλισμού ή των τεχνικών, μια σειρά εναλλακτικών λύσεων, που έχουν προβλεφτεί για την περίπτωση αυτή, θα είναι διαθέσιμες και άμεσα εφαρμόσιμες.

Το σύστημα που επινοήθηκε απο τους Βέλγους απεικονίζεται εδώ για την αναπαράσταση ενός κίονα (βλ. εικόνα 2). Μοιάζει με μια ανθρώπινη σπονδυλική στήλη. Ατσάλινες ράβδοι περνούν όπως ο νωτιαίος μυελός μέσα απο τους σπονδύλους, που έχουν τη μορφή λεπτών επίπεδων δίσκων. Υποστηριζόμενοι απο τις ράβδους, αυτοί οι "δίσκοι-σπόνδυλοι" δέχονται την τάση και φέρουν, αντίστοιχα, το βάρος κάθε σφονδύλου του κίονα, όπως μια πλατφόρμα.

Ο "σπόνδυλος" για κάθε σφόνδυλο του κίονα συνίσταται σε μια σειρά δίσκων, αρκετοί απο τους οποίους λειτουργούν ως ισοσταθμίζοντες ρυθμιστές διαστημάτων, οι οποίοι μόλις που επιτρέπουν στους σφονδύλους του κίονα να καθήσουν ο ένας πάνω στον άλλο, αποτελώντας έτσι αρθρώσεις, χωρίς όμως να επιβαρύνουν. Οι σφόνδυλοι που λείπουν δε χρειάζεται να αντικαθίστανται με τεχνητά μέσα. Άλλοι δίσκοι περιέχουν ελλειπτικές οπές, μέσα απο τις οποίες οι ράβδοι περνούν χαλαρά, κάνοντας έτσι τον όλο σχεδιασμό αντισεισμικό.

Σε έναν ενδεχόμενο σεισμό οι δίσκοι αυτοί αφήνουν περιθώριο για μια ολισθαίνουσα οριζόντια κίνηση, ενώ δρούν ταυτόχρονα και ως ένα είδος φρένου στην εν λόγω κίνηση, μόλις η δόνηση περάσει. Χωρίς την ελαστικότητα αυτή, η πλευρική δυσκαμψία των σφονδύλων των κιόνων θα τους έκανε να στραβώσουν.

Σε περίπτωση που ένας σφόνδυλος του κίονα μετατοπιστεί, η μετατόπιση αυτή δε θα έθετε σε κίνδυνο το συνολικό κορμό. Ο κίονας θα μπορούσε να αποσυναρμολογηθεί και ο σφόνδυλος να ξαναμπεί στη θέση του.

Η διάρθρωση αυτή, η οποία παρέχει αρκετή ευκαμψία, ώστε να μπορεί να αντιμετωπιστεί μια σεισμική δόνηση, είναι αναστρέψιμη, καθώς και προσαρμοσμένη στην παρούσα κατάσταση των λίθων του ναού. Πληρεί λοιπόν τις προυποθέσεις ενός ασφαλούς συστήματος αναδόμησης. Χάρις σ' αυτό, ο ναός μπορεί και πάλι να ορθώνεται στο σύνολό του με την ίδια περηφάνια, με την οποία στέκονταν οι τρείς απο τους κίονές του για αιώνες.