

THE VITRUVIAN SYMMETRIA MEANS "MODULAR SIZES"

Abstract. The Vitruvius' word symmetria is usually translated as the symmetry in English, or simetrija in Yugoslav languages, or la simmetria, la symétrie, die Symmetrie, etc. in other European languages (1). This is linguistically correct, but since the word means today something else than in Roman times, the whole passages of Vitruvius are obscured, The vitruvian symmetria means "modular sizes" or "standard measures" (2). Today, the word means the composition of an image with its mirror reflection or, according to Webster, the correspondence in size, shape and relative position of parts on opposite sides of a dividing line or median line (3).

Here is one of the most important architectural precepts on symmetria, emphasized by Vitruvius with a superlative:

Aedium compositio constat ex symmetria, cuius rationem architecti diligentissime tenere debent. Ea autem paritur a proportione, quae graece ἀναλογία dicitur. Proportio est ratae partis membrorum in omni opere totiusque commodulatio, ex qua ratio efficitur symmetriarum. Namque non potest aedis ulla sine symmetria atque proportione rationem habere compositionis, nisi uti ad hominis bene figurati membrorum habuerit exactam rationem (4).

This paragraph in English translation in the Loeb Classical Library edition:

The planning of temples depends upon symmetry: and the method of this architects must diligently apprehend. It arises from proportion (which in Greek is called analogia). Proportion consists in taking a fixed module, in each case, both for the parts of a building and for the whole, by which the method of

symmetry is put into practice. For without symmetry and proportion no temple can have a regular plan; that is, it must have an exact proportion worked out after the fashion of the members of a finely-shaped human body (5).

Serbo-Croatian translation:

Kompozicija hramova zasniva se na simetriji; njezinih se zakona arhitekti moraju držati vrlo pažljivo. Simetrija nastaje iz proporcije, koja se grčki zove *ἀναλογία*. Proporcija je podudaranje odradjenog dijela s pojedinim dijelovima građevine i s cjelinom. Na tom se zasniva i zakon simetrije. Ni jedan hram bez simetrije i proporcije ne može imati pravilne kompozicije, ako u dijelovima nema takvih pravilnih odnosa, kakvi se nalaze, n. pr., kod dobro građena čovjeka (6).

The oldest Italian translation:

La compositione de le aede consta de Symmetrie le ratione de la quale diligentissimamente le Architecti deno tenere. Ma questa si aparturisse de la propotione : quale graecamente analogia si dice. La Proportione si e de la rata parte de li membri in ogni opera et del tuto la commodulatione, de la quale si effice la ratione de le symmetrie. Imperoche non po alcuna aede senza symmetria, et anche proportione habere la ratione de la compositione: se non como al imagine de uno homo bene figurato de li membri hauera hauto exacta la ratione (7).

One of the French versions:

La composition des Temples consiste en symmetrie, de la quelle tous Architectes doyent diligemment entendre le secret. Cette symmetrie est engendree de proportion, que les Grecz nomment Analogie. Proportion est vn certain rapport et conuenance des membres ou particularitez a toute la masse d'vn basti-

ment: et de ceste la vient a se parfaire la conduite d'icelles symmetries (8).

The word symmetria in the vitruvian context is not understood any more. This is one of the reasons why modern modular coordination can not be put into practice effectively. The theory of m.c., as professed by ISO, IMG, and MS (9) believes that one module, 10 cm or 4" long, simultaneously "large enough" and "small enough", is sufficient for the dimensional standardisation in building. In contrast to this belief, the vitruvian term symmetria implies a set of componible modules, i.e. a system of standard modular sizes, not just one module. The litteral Translation of Vitruvius' symmetria is a great disservice for modular architecture.

Only Cesare Cesariano in his oldest Vitruvius (7) is aware that the word symmetria will be not generally understood:

...La qual Symmetria mai alcuni saperano bene intendere: ne operare si diligentemente et promptamente non saperano le regule Arithmetice ...

But, if the word symmetria is translated with the term "modular sizes" or "standard measures", the most important part of the Vitruvius' text becomes comprehensible:

The composition of buildings consists of modular sizes; the architects must strictly keep their ratio (see ill.1). It (sc composition) arises from proportion, which is called analogia by greeks. Proportion is the calculation of every module (10) for the part of the building and for the whole. in which the ratio of standard measures plays a role.(see ill. 2). For without standard modular sizes and proportion no building can have a rational composition; that is, it must have

the exact ratio as in case of the members of a well shaped man" (see ill. 3).

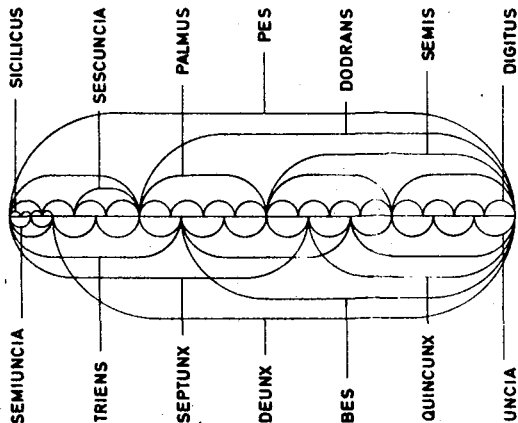
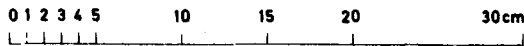
The reason for the misunderstanding of the vitruvian symmetria is the gradual disappearance of standard Roman sizes and the decline of commodulatio, or modular coordination in architecture. The teaching of Vitruvius is still valid and modern trends to reintroduce the method of modular dimensioning into architecture can benefit from it.

Illustration 1: THE SYSTEM OF STANDARD ROMAN SIZES

The system of standard Roman sizes consists of units of length, named for mnemonic reason after the parts of human body. The units, e.g. uncia, palmus, pes, cubitus, passus, etc., are in the ratio of small whole numbers and hence their componibility (11).

Slika 1 : SISTEM STANDARDNIH RIMSKIH MER

Sistem standardnih rimskih mer sestavljajo dolžinske enote, imenovane iz mnemoničnih razlogov po delih človeškega telesa. Enote, kot so n.pr. palec, dlan, čevelj, komolec, korak, itd., so v razmerju malih celih števil in odtod njihova modularna komponibilnost.



DECEMPEDA	1																																							295,74 cm	
PASSUS	2	1																																							147,87 cm
GRADUS	4	2	1																																						73,94 cm
CUBITUS	6 2/3	3 1/2	1 2/3	1																																					44,36 cm
PALMIPES	8	4	2	1 1/2	1																																			36,97 cm	
PES	10	5	2 1/2	1 1/2	1 1/4	1																																		29,57 cm	
DEUNX	10 1/11	5 3/11	2 3/11	1 2/11	1 1/11	1 1/11	1																																	27,11 cm	
DODRANS	13 1/2	6 3/4	3 1/2	2	1 1/2	1 1/2	1 1/2	1																																22,18 cm	
BES	15	7 1/2	3 3/4	2 1/4	1 3/8	1 1/2	1 3/8	1 1/8	1																															19,72 cm	
SEPTUNX	17 1/2	8 3/4	4 3/4	2 3/4	2 1/4	1 3/4	1 1/4	1 3/4	1 1/4	1																														17,25 cm	
SEMI	20	10	5	3	2 1/2	2	1 3/8	1 1/2	1 1/2	1 1/8	1																													14,78 cm	
QUINCUNX	24	12	6	3 3/8	3	2 3/8	2 1/8	1 3/8	1 3/8	1 3/8	1 1/8	1																												12,32 cm	
TRIENS	30	15	7 1/2	4 1/2	3 3/4	3	2 3/4	2 1/4	2	1 3/4	1 1/2	1 1/4	1																											9,86 cm	
PALMUS	40	20	10	6	5	4	3 3/4	3	2 3/4	2 1/4	2	1 3/4	1 1/2	1 1/4	1																									7,39 cm	
SEUNCIA	80	40	20	12	10	8	7 1/2	6	5 1/2	4 3/4	4	3 3/4	2 3/4	2	1																									3,70 cm	
UNCIA	120	60	30	18	15	12	11	9	8	7	6	5	4	3	1 1/2	1																								2,46 cm	
DIGITUS	160	80	40	24	20	16	14 1/2	12	10 3/4	9 1/4	8	6 3/4	5 1/2	4	2	1 1/2	1																							1,85 cm	
SEMIUNCIA	240	120	60	36	30	24	22	18	16	14	12	10	8	6	3	2	1 1/2	1																						1,23 cm	
SICILICUS	480	240	120	72	60	48	44	36	32	28	24	20	16	12	6	4	3	2	1																					0,62 cm	

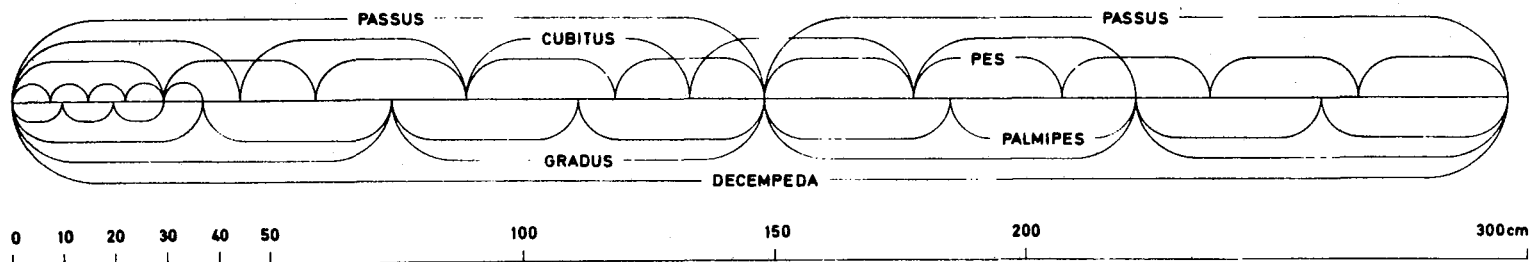


Illustration 2: THE ARCHITECTURAL COMPOSITION CONSISTS OF
 MODULAR SIZES AND ARISES FROM PROPORTION

A fine example of the composition arising from proportion is the colonnade of the peristylium in the Diocletian Palace at Split. The proportion of the colonnade is $\theta = \sqrt{2}+1$. This proportion is approximated with the length to height ratio of the colonnade which is 7:3 and with the height to width ratio of the intercolumnia which is 12:5. Both ratios, 7:3 and 12:5, are rational approximations of θ , expressed with Pell terms:

First Pell series	1	2	5	12	...
Second Pell series	1	3	7	17	...

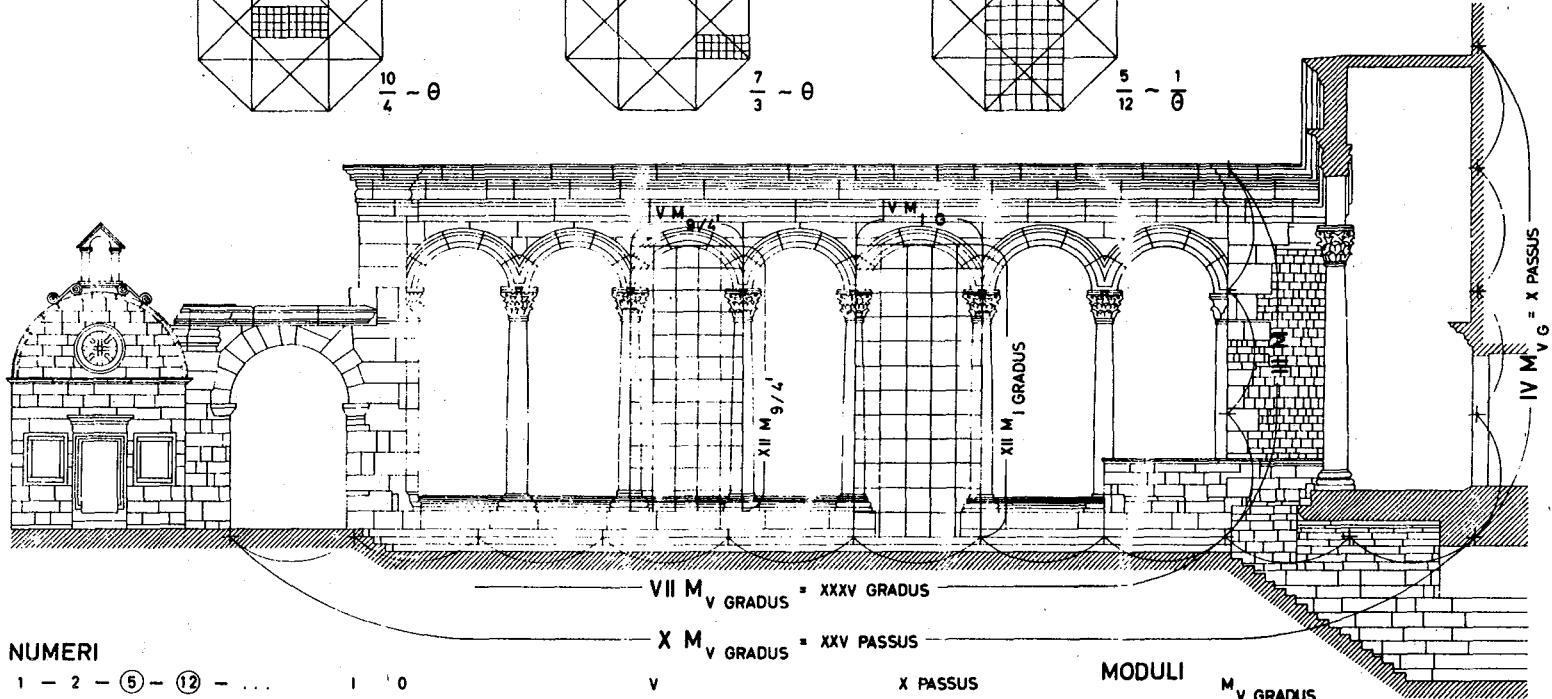
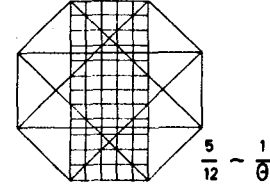
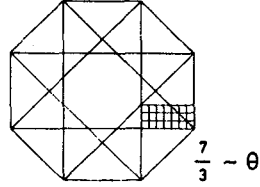
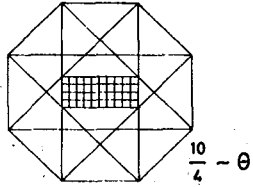
The module of the colonnade is equal to 5 gradus and the module of intercolumnia equals 9 palmi, except in case of the intercolumnium without parapet: this intercolumnium is higher and, to keep the same proportion, also wider. It is still in the ratio 12:5, but its module is 10 palmi or 1 gradus. This is commodulatio, or calculation of modules, in which the ratio of standard modular sizes, or symmetria, is to be taken in account (12).

Slika 2: ARHITEKTONSKA KOMPOZICIJA JE SESTAVLJENA IZ
 MODULARNIH MER, IZHAJA PA IZ PROPORCIJE

Proporcijo $\theta = \sqrt{2}+1$ v splitskem peristilu aproksimirata razmerje kolonade, ali 12:5, in razmerje interkolumnijev, ali 7:3. Modul kolonade meri 5 gradus, modul interkolumnijev pa 9 palmi, razen za višji in širši interkolumnij brez parapeta, kjer je modul dolg 10 palmi (= 1 gradus). Kompozicija tu res izhaja iz proporcije, sestavljajo pa jo standardne mere.

PROPORTIO

$\theta = 1 + \sqrt{2}$



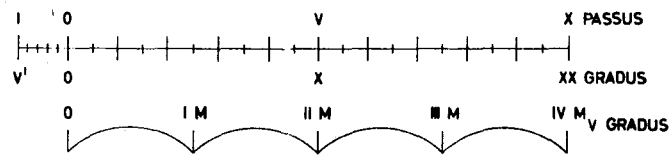
NUMERI

1 - 2 - ⑤ - ⑫ - ...

2 - ④ - ⑩ - 24 - ...

1 - ③ - ⑦ - 17 - ...

$\frac{10}{4} \sim \frac{7}{3} \sim \frac{15}{12} \sim \theta = 1 + \sqrt{2}$



MODULI

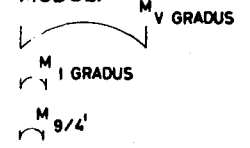


Illustration 3: THE MODULAR SIZES, OR SYMMETRIA, ARE IN THE
RATIO OF MEMBERS OF A FINELY SHAPED HUMAN BODY

The vitruvian symmetria equals standard human sizes, such as cubit, foot, palm, and digit, which are used as modules in the composition of temples, of a balista, of a ship, and of other works, where parts are to be calculated in the ratio of symmetries (13).

Slika 3: MODULARNE MERE, ALI SYMMETRIA, SO V RAZMERJU UDOV
LEPO OBLIKOVANEGA ČLOVEŠKEGA TELESA

Vitruvijeva simetrija je enaka človeškim meram, kot so komolec, čevelj, dlan in prst, ki se uporabljajo kot moduli v kompoziciji templjev, baliste, ladje in drugih konstrukcij, kjer je treba dele odmeriti v razmerju simetrije.

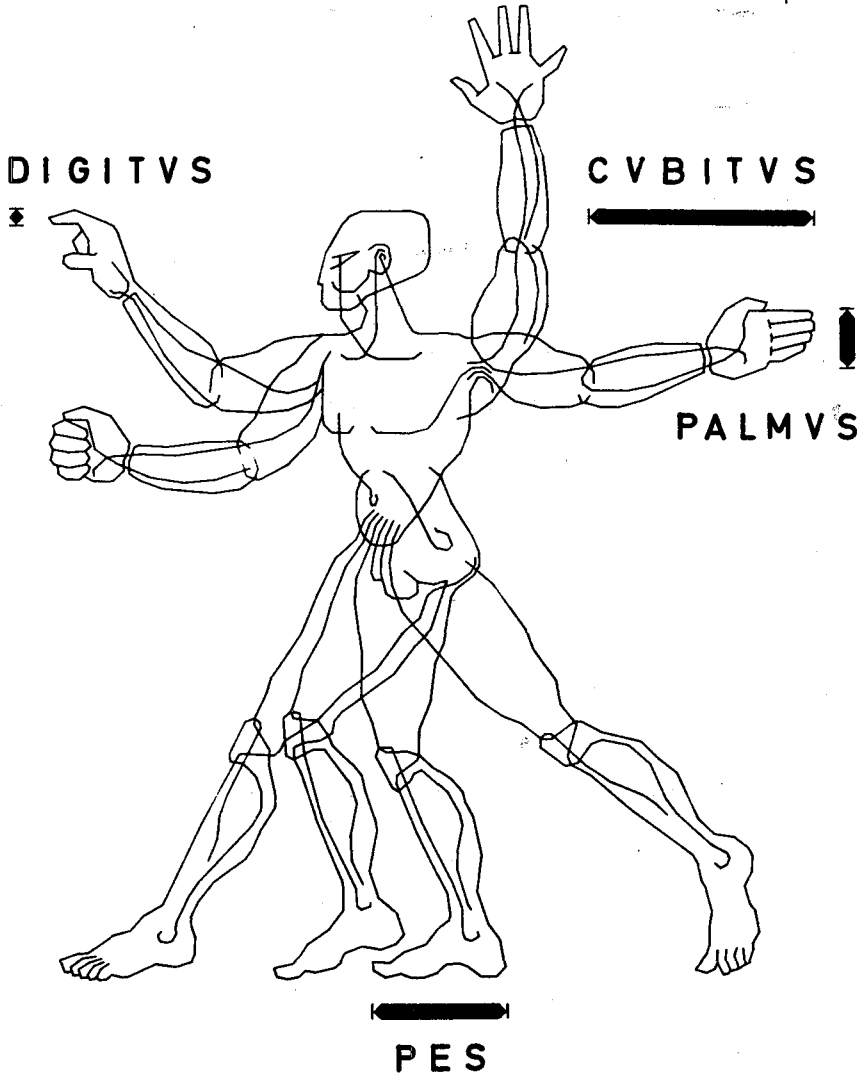
NOTES AND REFERENCES

(1) T.Kurent, Modular Sizes according to Vitruvius. -
Module, Modular Society, Spring 1977.

(2) Graeci...: modulorum mensuras συμμετρίαν.. appella-
verunt : Modular sizes were called symmetry by Greeks.

M.Cetus Faventinus writes: ...architecturae partes
sunt octo, quae sunt ordinatio, dispositio, venustas,
mensura, distributio, aedificatio, conlocatio, machinatio.
ex his Graeci quinque vocabulis studium architecturae esse
docuerunt. nam ordinationem τάξις, dispositionem διατάξις,
venustatem τε decorem εἰρημίας, modulorum mensuras συμ-
μετρίαν, distributionem ὀκονομίαν appellaverunt.

ITEM SYMMETRIA EST EX IPSIUS OPERIS MEMBRIS CONVENIENS CON-
 SENSUS EX PARTIBUSQUE SEPARATIS AD UNIVERSAE FIGURAE SPECIEM RATAE
 PARTIS RESPONSUS . UTI IN HOMINIS CORPORE E CUBITO , PEDE , PALMO ,
 DIGITO CETERISQUE PARTICULIS SYMMETROS EST EURYTHMIAE QUALITAS , SIC
 EST IN OPERUM PERFECTIONIBUS . ET PRIMUM IN AEDIBUS SACRIS AUT E
 COLUMNARUM CRASSITUDINIBUS AUT TRIGLYPHO AUT ETIAM EMBATERE , BAL-
 LISTA E FORAMINE , QUOD GRAECI PERITRETON VOCITANT , NAVIBUS INTER-
 SCALMIO , QVAE DIPECHYAIA DICITUR , ITEM CETERORUM OPERUM E MEMBRIS
 INVENITUR SYMMETRIARUM RATIOCINATIO . L. I , C. II , 4



NAMQUE NON POTEST AEDIS ULLA SINE SYMMETRIA ATQUE PROPOR-
 TIONE RATIONEM HABERE COMPOSITIONES , NISI UTI HOMINIS BENE FIGU-
 RATI MEMBRORUM HABUERIT EXACTAM RATIONEM . L. III , C. I , 1
 ERGO SI ITA NATURA COMPOSUIT CORPUS HOMINIS , UTI PROPOR-
 TIONIBUS MEMBRA AD SUMMAM FIGURATIONEM EIUS RESPONDEANT , CUM CA-
 SA CONSTITUISSE VIDENTUR ANTIQUI , UT ETIAM IN OPERUM PERFECTIONIBUS
 SINGULORUM MEMBRORUM AD UNIVERSAM FIGURAE SPECIEM HABEANT COM-
 MENSUS EXACTIONEM . L. III , C. I , 4

See M. Ceti Faventini De Diversis Fabricis Architectonicae (In the text of Valentine Rose's Large Edition, 1867), published in

Hugh Plommer, Vitruvius and Later Roman Building Manuals, Cambridge University Press, 1973, p. 40 - 41.

- (3) After Webster, the word symmetry means also "beauty of form arising from balanced proportion", which obviously has the origin in the misinterpretation of the vitruvian symmetria.

Principles of symmetry in the arts, in the organic (symmetry classes of crystals) and organic nature (symmetry in the animal kingdom, symmetry of flowers), and philosophico-mathematical significance of the idea of symmetry are discussed in

Hermann Weyl, Symmetry, Princeton University Press, N.J. 1952.

There are 16 types of symmetry (in two dimensions) generated by spatial translation, reflection, rotation and counterexchange, according to

E.L.J. Leeuwenberg and H.F.J.M. Buffart, Formal Theories of Visual Perception, John Wiley and Sons, 1978.

- (4) De Architectura Liber III, Caput I, 1.
- (5) F. Granger, Vitruvius on Architecture, W. Heinemann Ltd, London 1962.
- (6) M. Lopac, Vitruvijske o arhitekturi, Svjetlost, Sarajevo 1951.
- (7) Cesare Cesariano (Como 1521), Vitruvius De Architectura, Wilhelm Fink Verlag, München 1969.

Cesariano's commentary on symmetria : Consta de symmetrie:
cioe di proportionale commensuratione distincta numera-
bilmente in diuerse quantita et particule: quale tute as-
sumpte insiema reassumeno et reformano la sua totale quan-
titate in integru : si como habiamo da Euclide : aut per
figure nuberabile : uel lineale aut de cose superficiale
uel corporeae...

- (8) Jan Martin Secretaire de Monseigneur le Cardinal de Lenoncourt, Architecture ou Art de bien bastir, de Marc Vitruue Pollion, republished in 1964 by Gregg Press Ltd, Farnborough, England.

The confused translation by this Jean Martin offers the word le secret that smacks of mysticism for the mathematical term ratio; Ea, sc compositio, is misunderstood as ceste symmetrie; etc. But modern translations are not much more readable.

- (9) According to The Condensed Principles of Modular Coordination, adopted at a meeting of the International Modular Group, Warshaw, 10-13 September, 1963 (published in The Modular Quarterly, Summer 1964), "the basic module must be small enough to provide the necessary flexibility in design of various buildings for various purposes, as well as large enough to promote simplification of the number of sizes for various components... It has been agreed that the basic module (M) = 10 cm for metric countries and 4" for inch-countries."

See T.Kurent, The Basic Law of Modular Composition.
- The Modular Quarterly, Winter 1964-65.

- (10) ... ratae partis...commodulatio means the calculati-

on of every module, not just one module. The generic genitive ratae partis implies all possible modules (plural) and not just one (singular).

See T.Kurent, Proportio and Commodulatio after Vitruvius Compared to proportion and Modules of Diocletian Palace in Split.-Živa antika, Skoplje 1971.

(11) T.Kurent, L.Muhič, Vitruvius on Module. -Arheološki vestnik 27, 1977.

T.Kurent, The Roman Modular Way.- Official Architecture and Planning no. 12, 1977.

- , Modularna kompozicija.- Arhitektura - urbanizam br.26, 1964.

- , The Basic Law of Modular Composition.- The Modular Quarterly, Winter 1964/65.

- , La legge fondamentale della composizione modulare, Edizione Quaderni di Studio, Facoltà di Architettura, Politecnico di Torino, 1968.

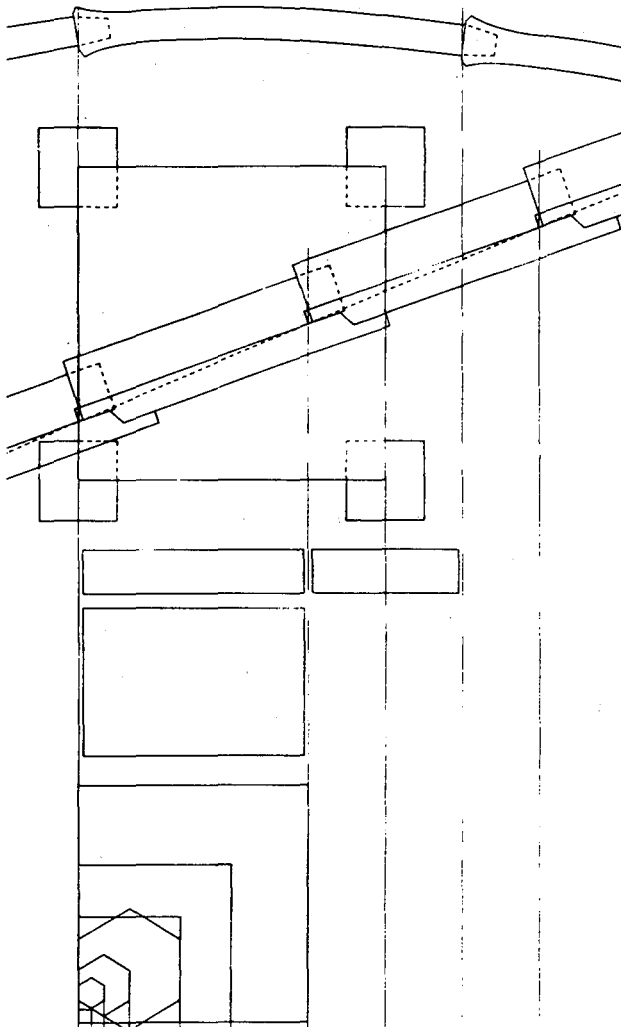
- , Osnovni zakon modularne kompozicije, FAGG, Univerza v Ljubljani 1967.

- , Kompozicija modularnih mer, FAGG, Univerza v Ljubljani 1974..

Illustration 4: STANDARD ROMAN BUILDING COMPONENTS ARE MODULAR

Units of symmetria are used as modular sizes for Roman building components.

Slika 4: STANDARDNI RIMSKI GRADBENI ELEMENTI SO MODULARNI
Merske enote Vitruvijeve simetrije so služile kot modularne mere za gradbene elemente.



VODOVODNE KERAMIČNE CEVI
DOLGE 1 GRADUS

TEGULE IN KORCI MODULARNE
DOLŽINE 3/2', 4 KOSI NA 9^{CI}

OPEČNE PLOŠČE ZA HIPOKAV-
STE 2'x2', 1 PLOŠČA NA 4^{CI}

KAMNITI STEBRIČKI ZA HIPO-
KAVSTE 1/2'x1/2'x2'

OPEKA, LYDICA, MODULARNE
VELIKOSTI 1'x3/2'x1/3'

KVADRATNI OPEČNI TLAKOVCI
VELIKI 1x1 CUBITUS, 1x1 PES,
1x1 BES

ŠESTEROKOTNI OPEČNI TLA-
KOVCI VELIKI 1 BES, 1 TRIENS,
2 UNCIJI

OPEČNI IN KAMNITI MOZAIČNI
KAMENČKI VELIKI 1x1 UNCIA

UNCIA	2,49 cm	
SESCUNCIA	3,73 cm	
PALMUS	7,47 cm	
TRIENS	9,96 cm	
QUINCUNX	12,45 cm	
SEMIS	14,94 cm	
SEPTUNX	17,43 cm	
BES	19,92 cm	
DODRANS	22,41 cm	
DEVNX	27,39 cm	
PES	29,57 cm	
PALMIPES	36,97 cm	
CUBITUS	44,39 cm	
GRADUS	73,90 cm	
PASSUS	147,90 cm	

- (12) T.Kurent, Stonehenge and the Vitruvian Amphitheatre, - Architectural Association Quarterly vol. 7, no. 3, 1975.
- , Proporcijska naprava rimskega arhitekta, zgrajena pod središčem Dioklecianove palače v Splitu. - Sinteza 43-44, 1978.
John Paterson, Information Methods for Design and Construction, John Wiley and Sons 1977, pp 65-69.
- (13) T.Kurent, L.Muhič, Vitruvius on Module. - Arheološki vestnik 27, 1977.

VITRUVIJEVA SYMMETRIA POMENI "MODULARNE MERE"

(kratka vsebina)

M.Cetus Faventinus (2) sporoča, da so "Grki modularne mere imenovali symmetria". Ker beseda simetrija pomeni danes nekaj drugega kot v rimskih časih, prevajalci pa vztrajajo pri izrazu in ga ne komentirajo, so celi odstavki v Vitruviju nerazumljivi. Najpomembnejši Vitruvijev precept v zvezi s simetrijo začenja III knjigo O arhitekturi :

Kompozicijo zgradb sestavljajo modularne mere; njihovih razmerij se morajo arhitekti nad vse vestno držati (glej sl. 1). Ta (namreč kompozicija), pa izhaja iz proporcije, ki se ji po grško reče analogija. Proporcija je izračun (vsakega) modula in njegova vskladitev za gradbene člene in za celoto, pri čemer pride do izraza razmerje med modularnimi merami (glej sliko 2). Kajti nobena zgradba brez modularnih mer in proporcije ne more imeti smiselne kompozicije, se pravi, če ni v razmerju udov lepo raščenega človeškega telesa (glej sl. 3).