# SPONGE SURFACES & POLYHEDRA-THEIR ABUNDANCE IN NATURE AND IN THE REALM OF THEORETICALLY IMAGINABLE AND THEIR EXPECTED IMPACT ON THE DEVELOPMENT OF SPACE STRUCTURES

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# A

The diversity of shapes and forms which meets the eye is overwhelming. They shape our environment: physical, mental, intellectual. "Our study of natural form".. the essence of morphology.., " is part of that wider science of form which deals with the **forms assumed by nature** under all aspects and conditions, and in a still wider sense, with **forms which are theoretically imaginable"**.. ('On Growth and Form' – D'Arcy Thompson). "Theoretically"…to imply that we are dealing with **casual-rational forms**.

B

The interest in **Sponge Surfaces and Polyhedra** has been prompted by our growing awareness of their abundance in nature. Nature is saturated with sponge structures on every possible scale of physical-biological reality. The term was first adopted in biology: "Sponge: any member of the phylum Porifera, sessile aquatic animals, with single cavity in the body, with numerous pores. The fibrous skeleton of such an animal, remarkable for its power of sucking up water". (Wordsworth Dictionary). Of course the term was applied to **'spherical sponges'.** It turns out that the key characteristic of porosity is attributable to a much wider morphological phenomenon.

With time the expressions: **sponge, spongy, sponginess**, **spongeous**', were adopted in many languages to describe **a physical phenomenon which is characterized by porosity and visual permeability** and the condition of a lump of mater which, as a result of biological-chemical-physical processes of erosion-corrosion, growth and death, acquired its characteristic porosity

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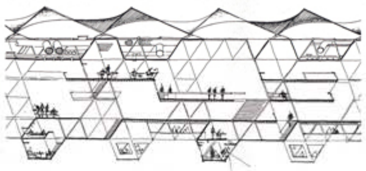
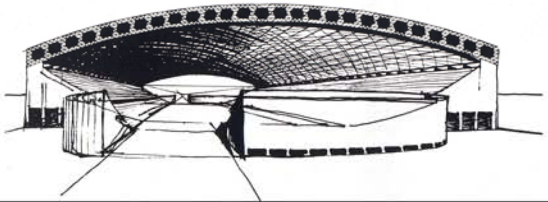
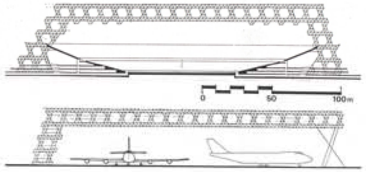
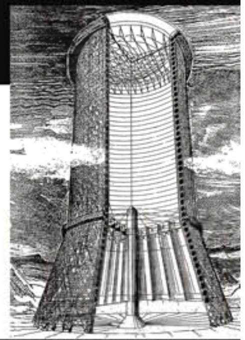
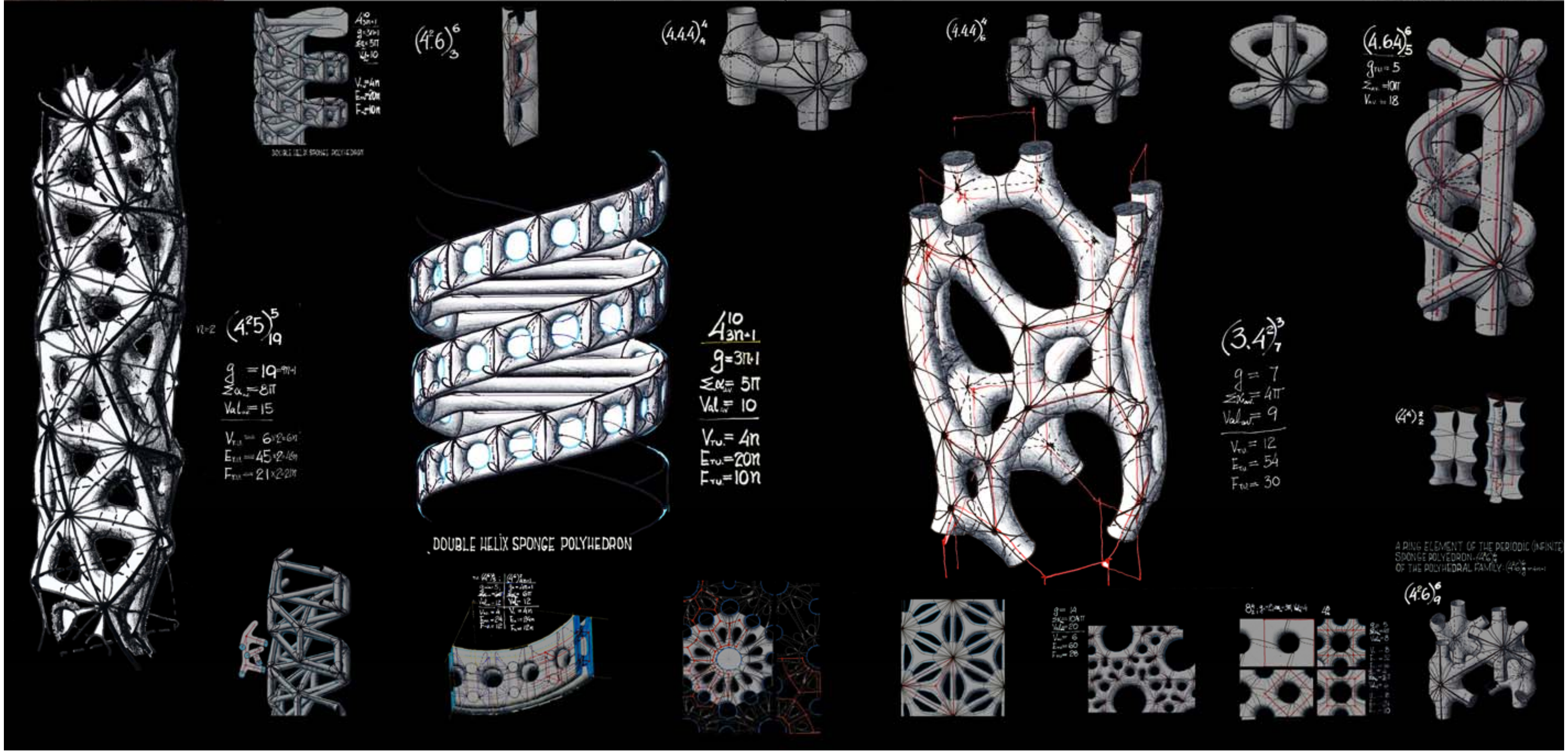
## PERIODIC TOROIDAL SPONGE POLYHEDRA

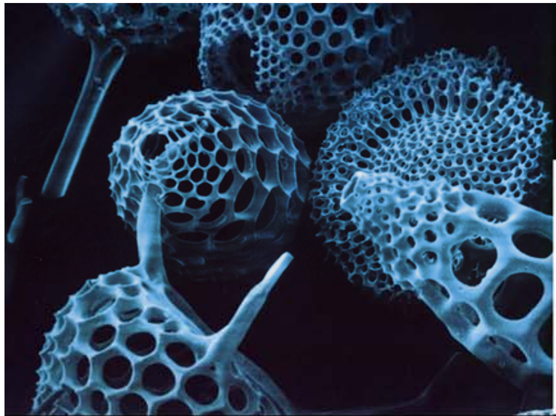












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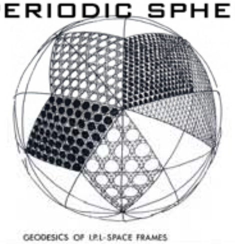
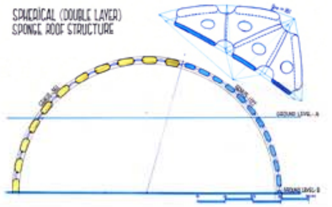
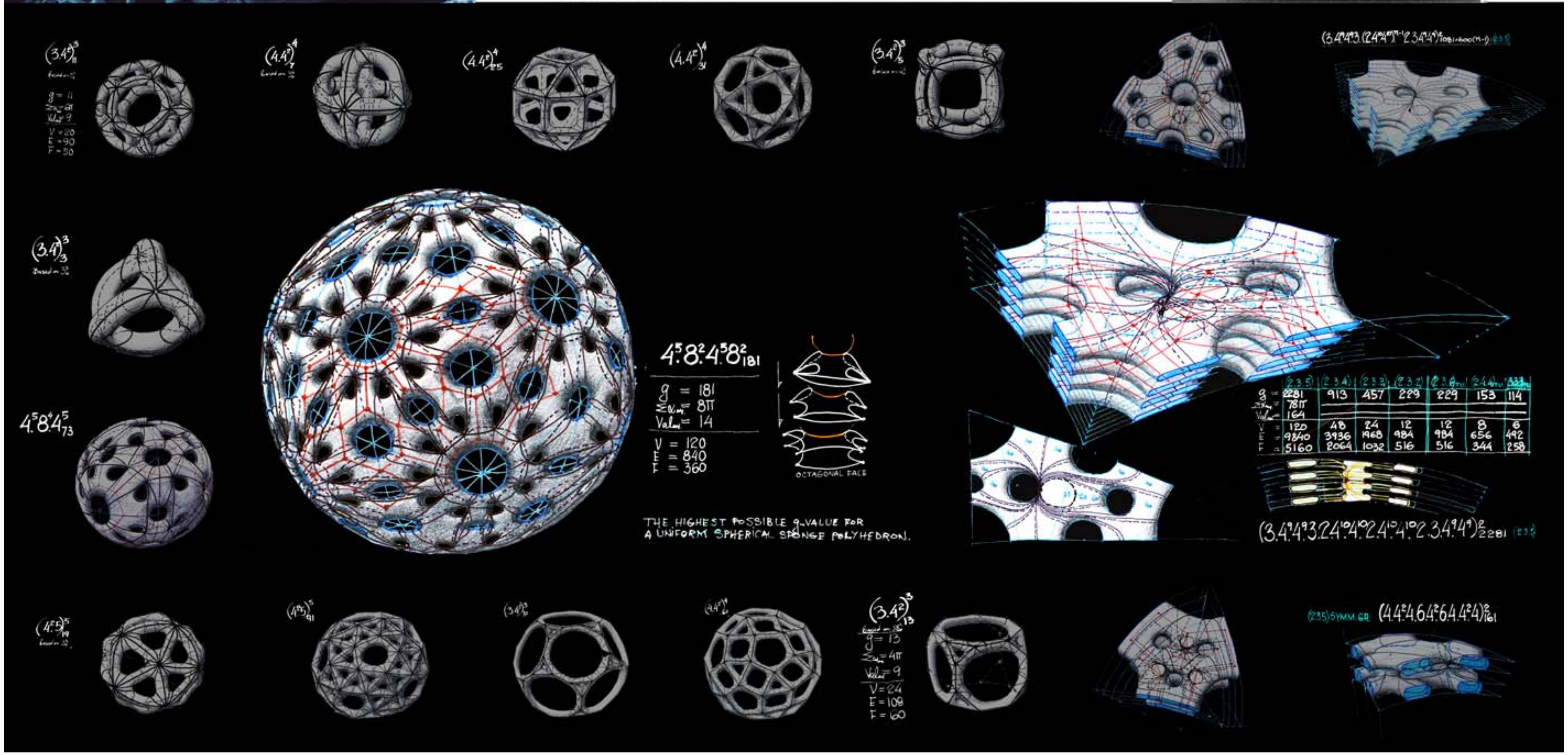
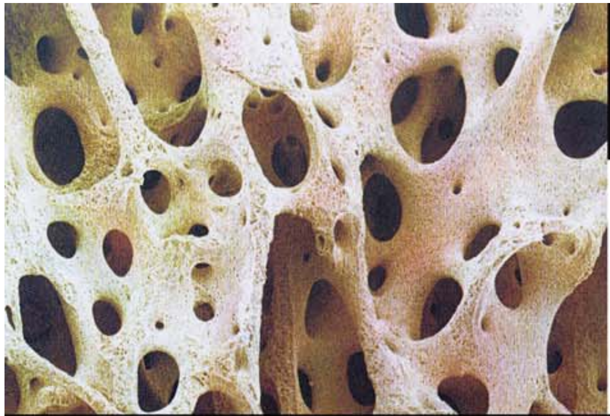
## PERIODIC SPHERICAL SPONGE POLYHEDRA




| | (2.3.5) | (2.3.4) | (2.3.3) | (2.3.2) | [illegible] | [illegible] | [illegible] |
|---|---|---|---|---|---|---|---|
| g = | 2281 | 913 | 457 | 229 | 229 | 153 | 114 |
| Val = | 164 | | | | | | |
| V = | 120 | 48 | 24 | 12 | 12 | 8 | 6 |
| E = | 9840 | 3936 | 1968 | 984 | 984 | 656 | 492 |
| F = | 5160 | 2064 | 1032 | 516 | 516 | 344 | 258 |



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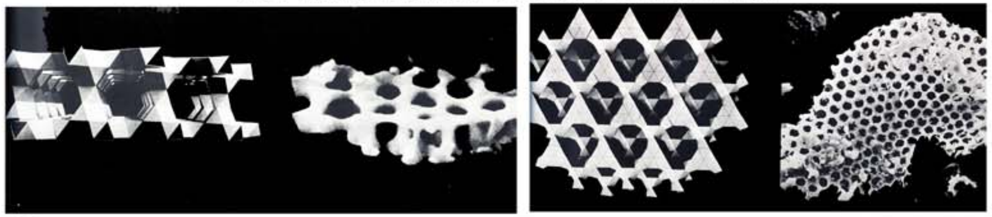
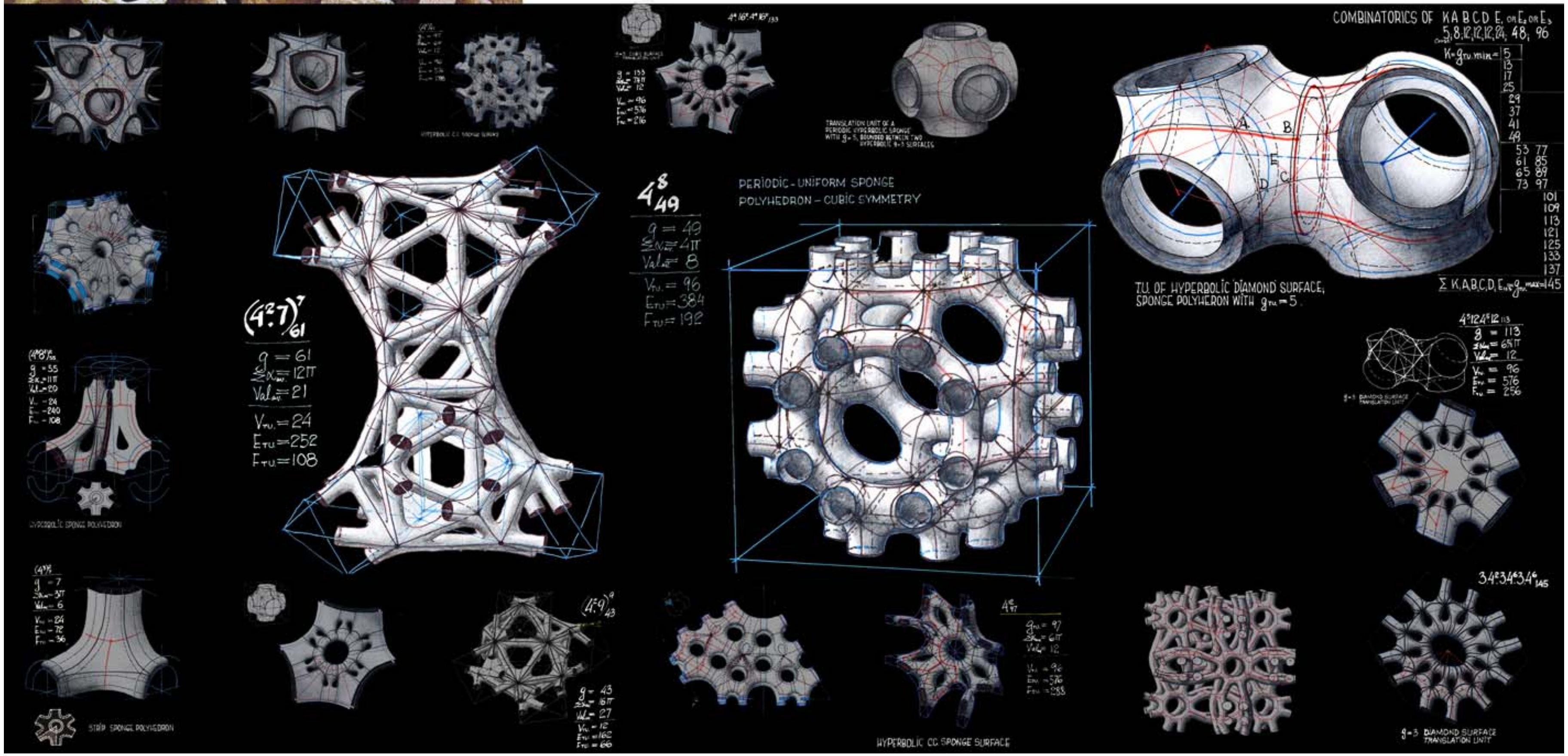
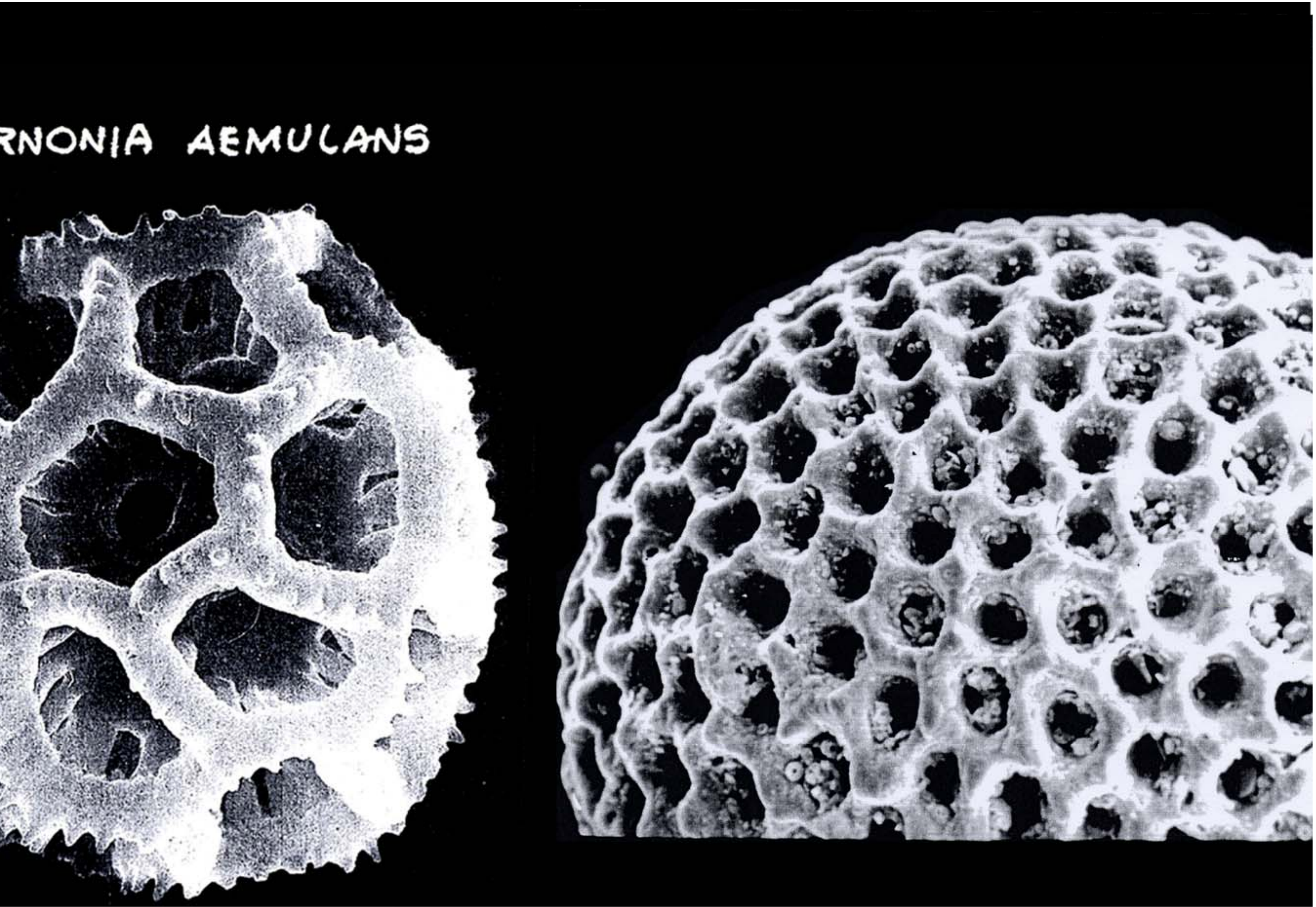
## HYPERBOLIC SPONGE POLYHEDRA






RNONIA AEMULANS

C-1

With some extrapolation of the perceiving mind it is right to claim that **the sponge phenomenon, with its porosity and permeability characteristics, is central to the physical morphological nature of the human habitat, and represents its defining imagery.**




**efinitions**

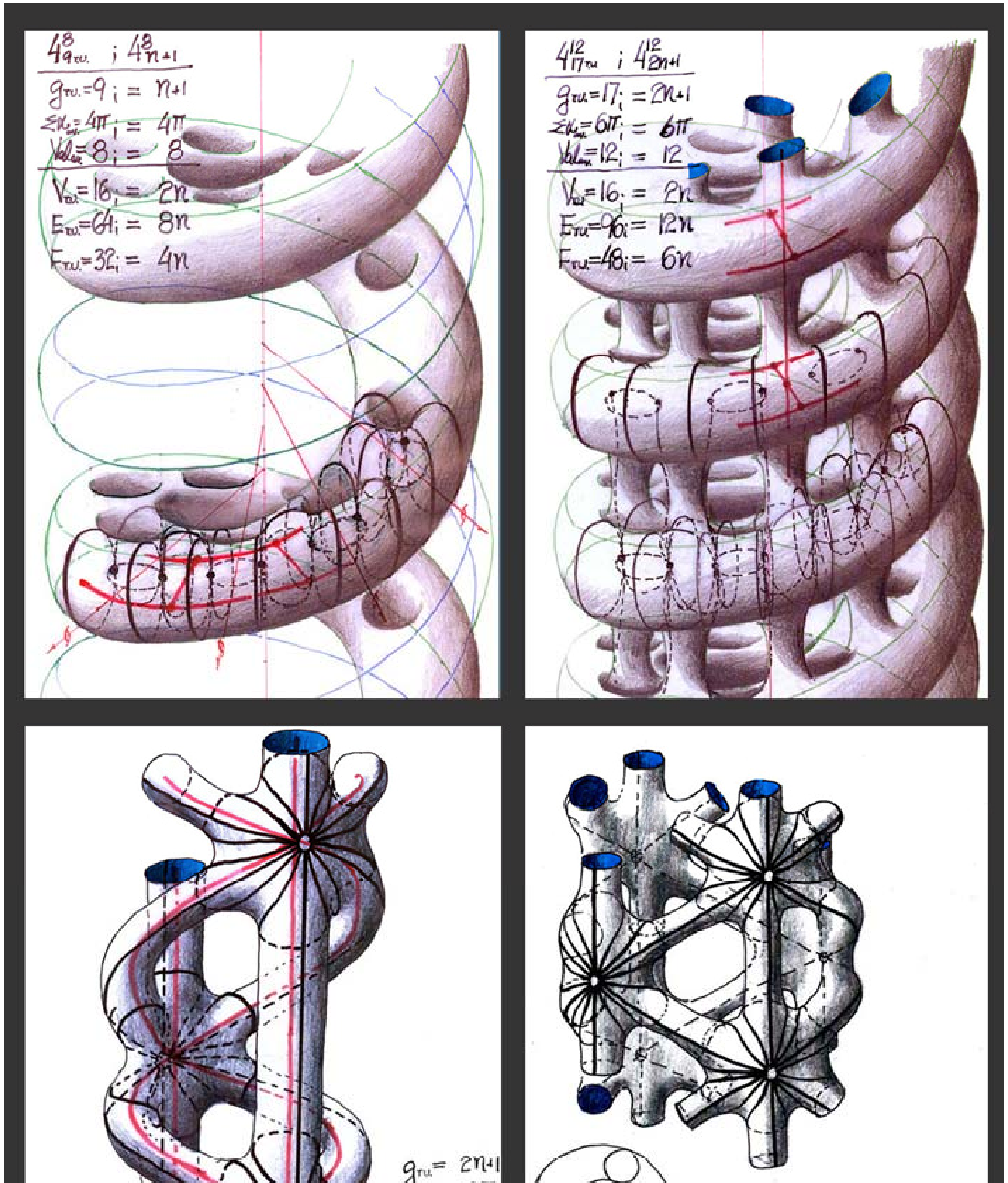
**polygonal region** of order n, for n≥1, is a point set, topologically quivalent to a circular disc with a boundary divided into n edges by set of n ertices. It may have curved edges, maybe non-planar and two edges of the ame region may be matched (Stewart)

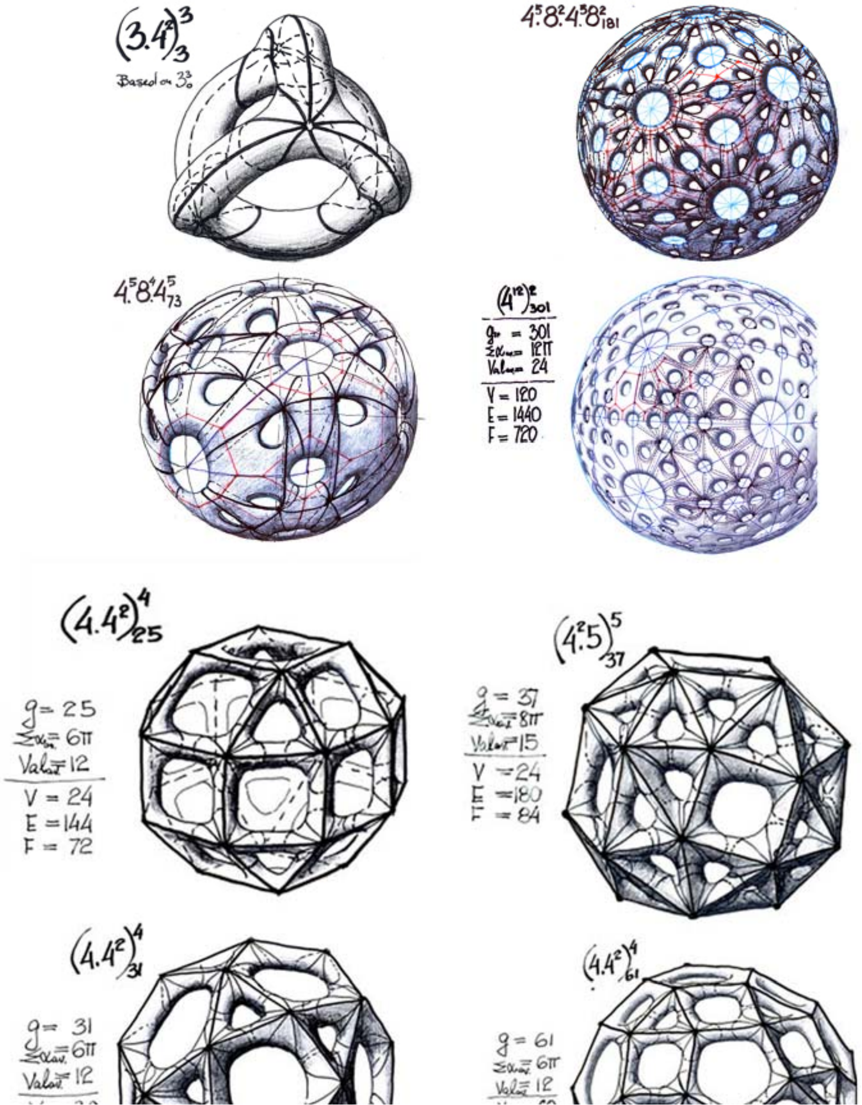
Polyhedral map drawing on a sponge surface must lead to polygonal aces which may constitute,

under a suitable topological transformation, a plane polygonal region.

**Polyhedron-P** is a connected, unbounded 2-dimensional manifold, ormed by a set of simply connected polygonal regions of order n, for n≥o, rranged so that each edge of each region is matched with exactly one ther edge of the same, or another region and vertices are matched only as equired by the matching of edges. It implies that one and the same, or two, nd no more than two distinct polygonal regions (faces) meet at each edge. he restriction of vertex matching in the definition means there is only one ircuit of polygonal regions at each vertex of P.

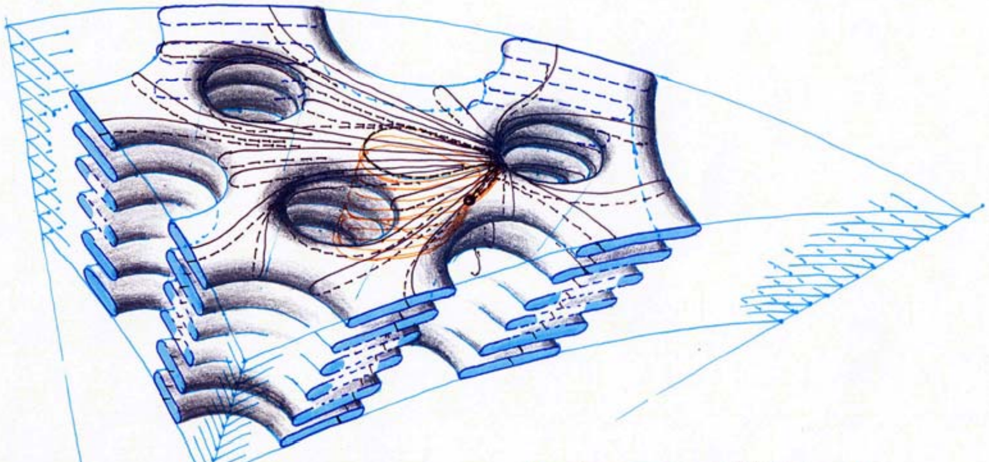
**niform Polyhedron** is a polyhedron with the same repeating vertex figure nd the same cyclic order of polygonal faces about each of its vertices


4⁸ 9ru ; 4⁸ n+1
gru = 9 ; = n+1
Val = 8 ; = 8
V = 16 ; = 2n
E = 64 ; = 8n
F = 32 ; = 4n
4¹² 17ru ; 4¹² 2n+1
gru = 17 ; = 2n+1
6π ; = 6π
Val = 12 ; = 12
V = 16 ; = 2n
E = 96 ; = 12n
F = 48 ; = 6n
gru = 2n+1


Based on 3³₀
g = 301
Σα = 12π
Valence 24
V = 120
E = 1440
F = 720
g = 25
Σα = 6π
Val = 12
V = 24
E = 144
F = 72
g = 37
Σα = 8π
Val = 15
V = 24
E = 180
F = 84
g = 31
Σα = 6π
Val = 12
g = 61
Σα = 6π
Val = 12

$$\underline{(3.4^{11}.4^{11}.3(2.4^{12}.4^{12})^{n-1}.2.3.4^{11}.4^{11})^{2}_{1321+720(n-1)}}\ ;(2.3.5)$$

$n = 1 \ldots\ldots \infty$



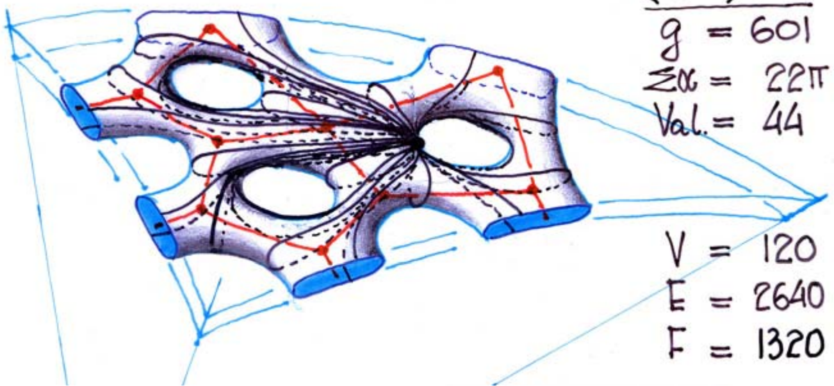
| | | | | | TOROIDAL SPONGE POLYHEDRA | | | |
|---|---|---|---|---|---|---|---|---|
| SYMM. GR | (2.3.5) | (2.3.4) | (2.3.3) | (2.3.2) | (2.3.6)TU. | (2.4.4)TU. | (3.3.3)TU. | 2.2.m |
| g | 1321+720(n-1) | 529+288(n-1) | 265+144(n-1) | 133+72(n-1) | 133+72(n-1) | 89+48(n-1) | 67+36(n-1) | (22+12(n-1))m+1 |
| Σα av. | 46π+24π(n-1) | → | → | → | → | → | → | → |
| Val av. | 96+50(n-1) | → | → | → | → | → | → | → |
| V | 120 | 48 | 24 | 12 | 12 | 8 | 6 | 2m |
| E | 5760+3000(n-1) | 2304+1200(n-1) | 1152+600(n-1) | 576+300(n-1) | 576+300(n-1) | 384+200(n-1) | 288+150(n-1) | (96+50(n-1))m |
| F | 3000+1560(n-1) | 1200+624(n-1) | 600+312(n-1) | 300+156(n-1) | 300+156(n-1) | 200+96(n-1) | 150+78(n-1) | (50+26(n-1))m |

$$\underline{(4^{22})^{2}_{601}}$$

$g = 601$

$\Sigma\alpha = 22\pi$

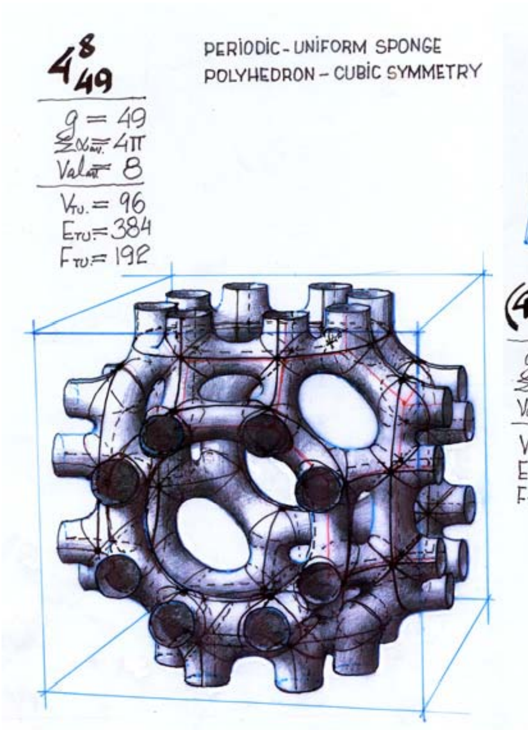
Val. = 44

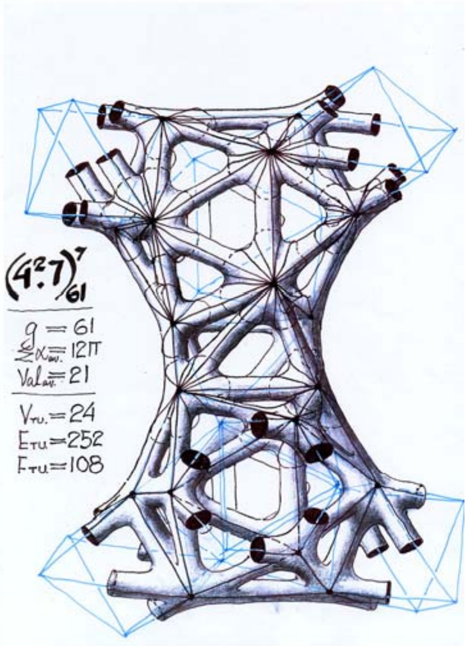


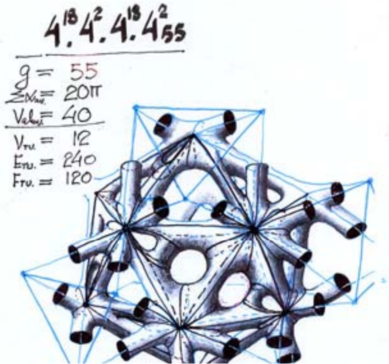
$V = 120$

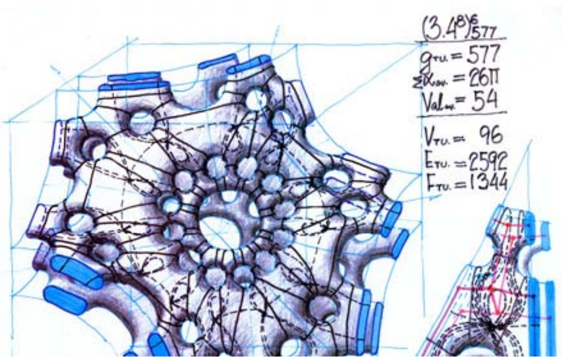
$E = 2640$

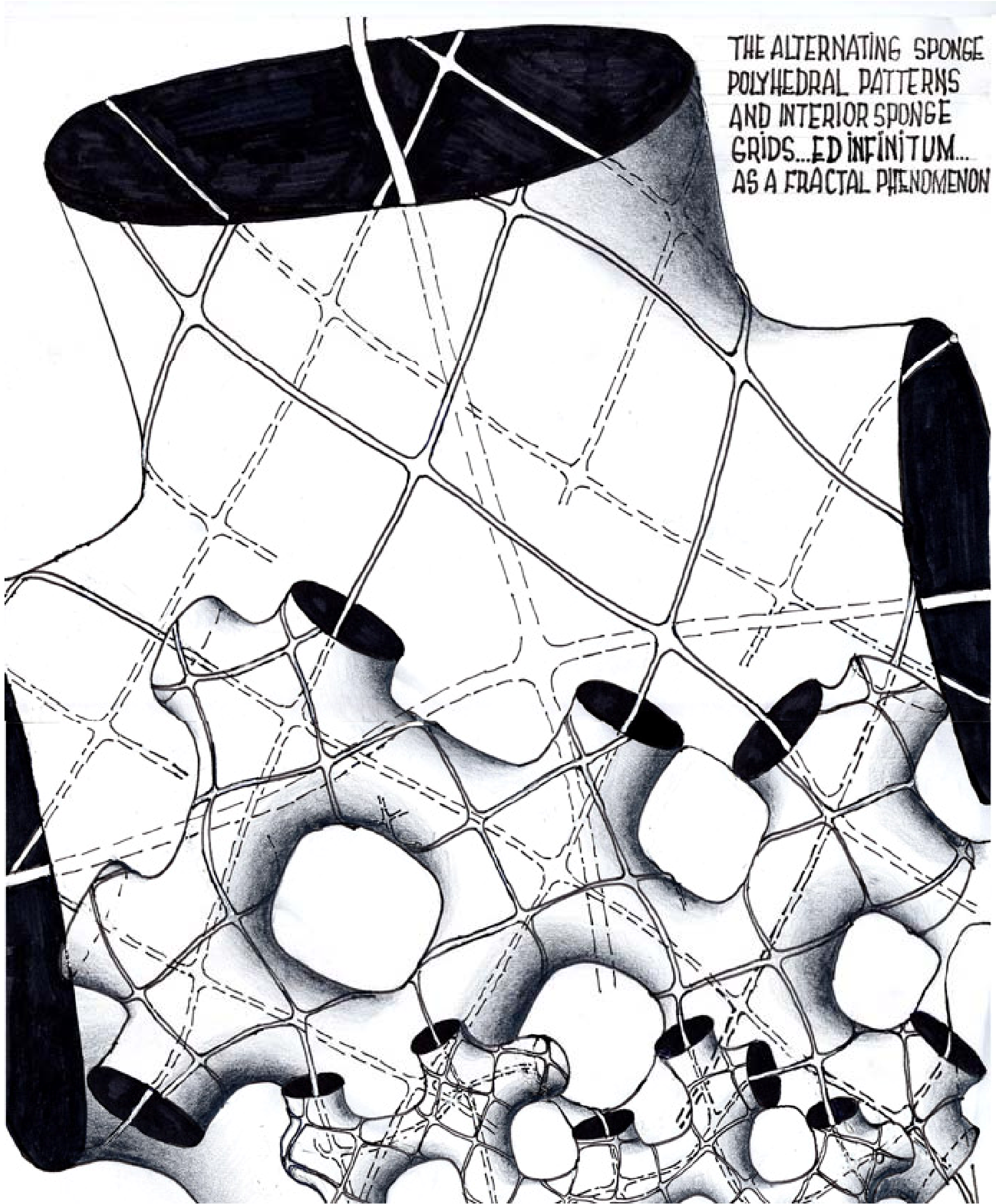
$F = 1320$


PERIODIC - UNIFORM SPONGE
POLYHEDRON - CUBIC SYMMETRY
$4^8_{49}$
g = 49
Val. = 8
V TU. = 96
E TU = 384
F TU = 192


$(4^2.7)^7_{61}$
g = 61
12π
Val. = 21
V TU. = 24
E TU = 252
F TU = 108

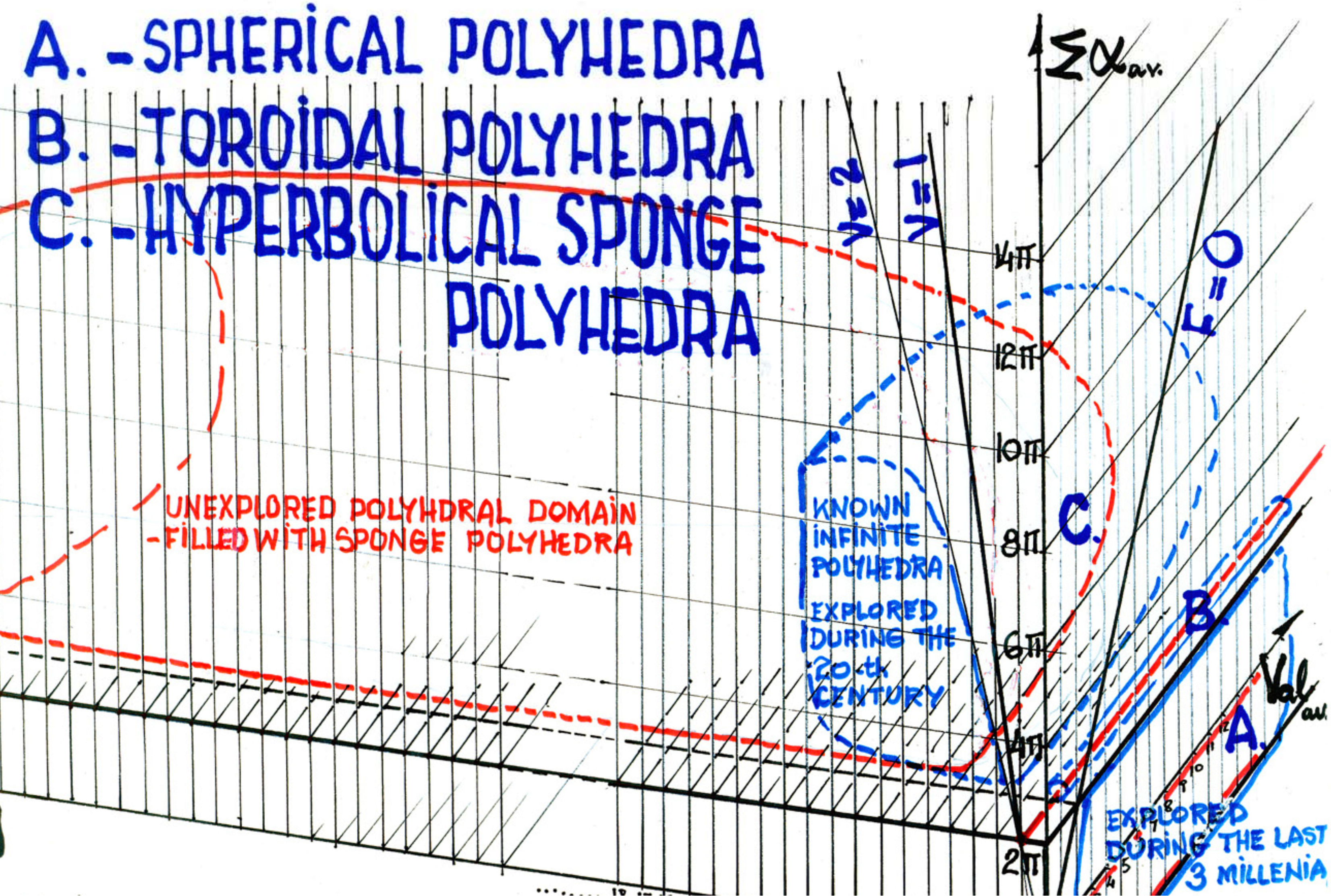

$4^{18}.4^2.4^{18}.4^2_{55}$
g = 55
20π
Val. = 40
V TU. = 12
E TU. = 240
F TU. = 120


$(3.4^8)^6_{577}$
g TU. = 577
= 26π
Val. = 54
V TU. = 96
E TU. = 2592
F TU. = 1344

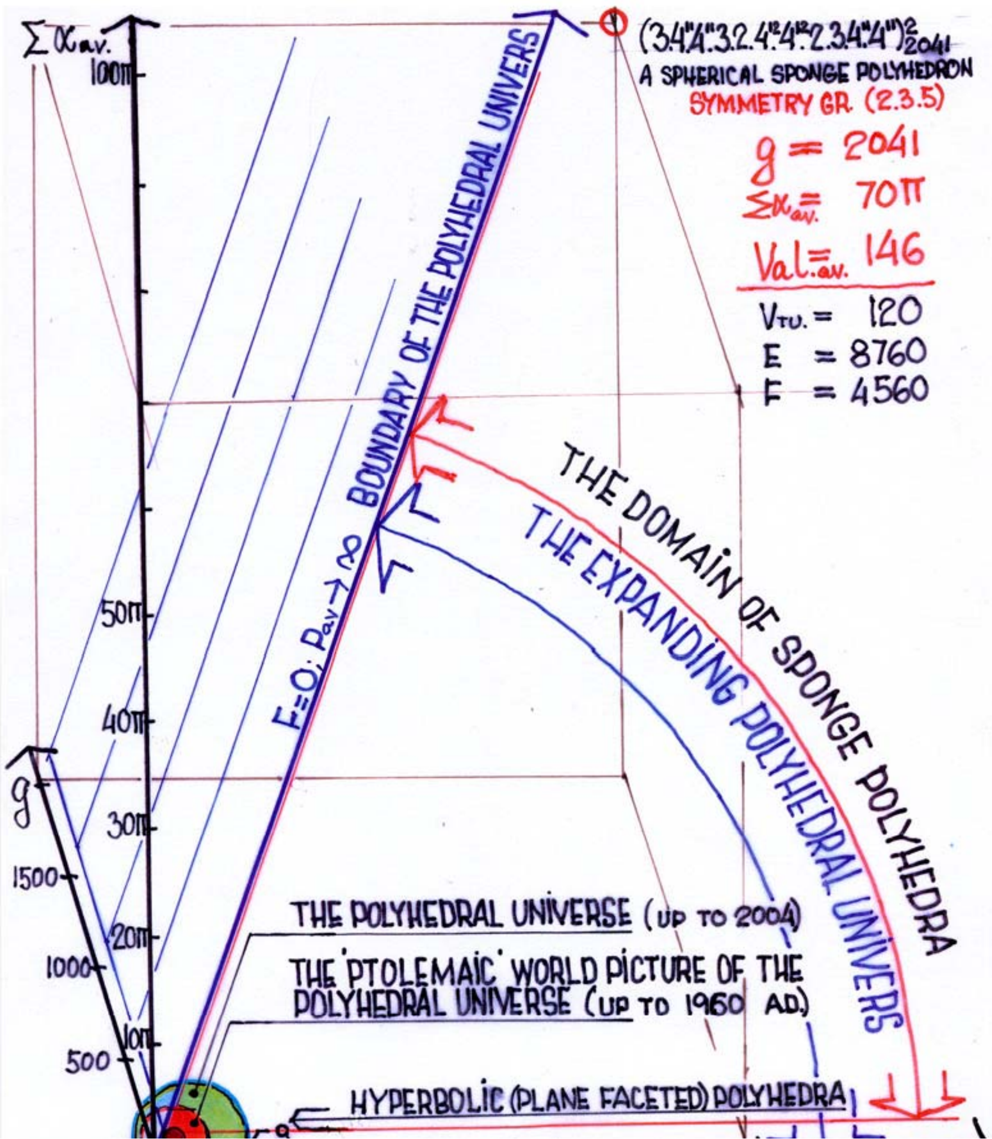

THE ALTERNATING SPONGE
POLYHEDRAL PATTERNS
AND INTERIOR SPONGE
GRIDS...ED INFINITUM...
AS A FRACTAL PHENOMENON

D

was with his publication of **'The Periodic Table of the Polyhedral niverse'** (1996) that the author came to realize that the domain of the **eriodic sponge polyhedra** is potentially extending beyond the erceived horizon, to infinity, and is an 'unexplored terra-nova'. ately, after confronting the prevalent definitions and allowing for **olyhedral maps with curved edge-lines and face surfaces**, the mount of uniform sponge polyhedra exploded, to reveal a multitude of ew polyhedral sponge configurations; spherical, toroidal and yperbolic, their topological and symmetrical nature and their overning hierarchical order.

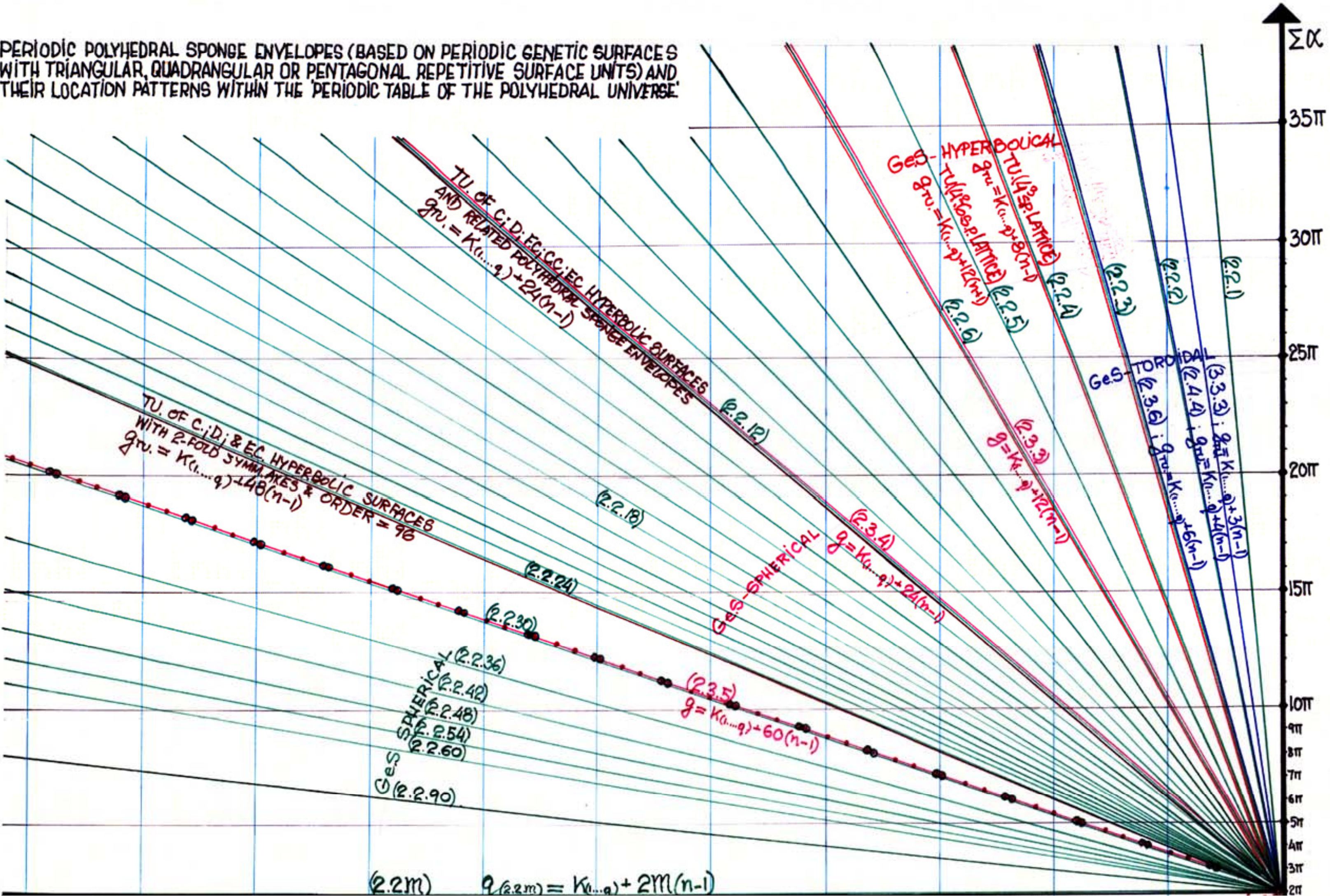


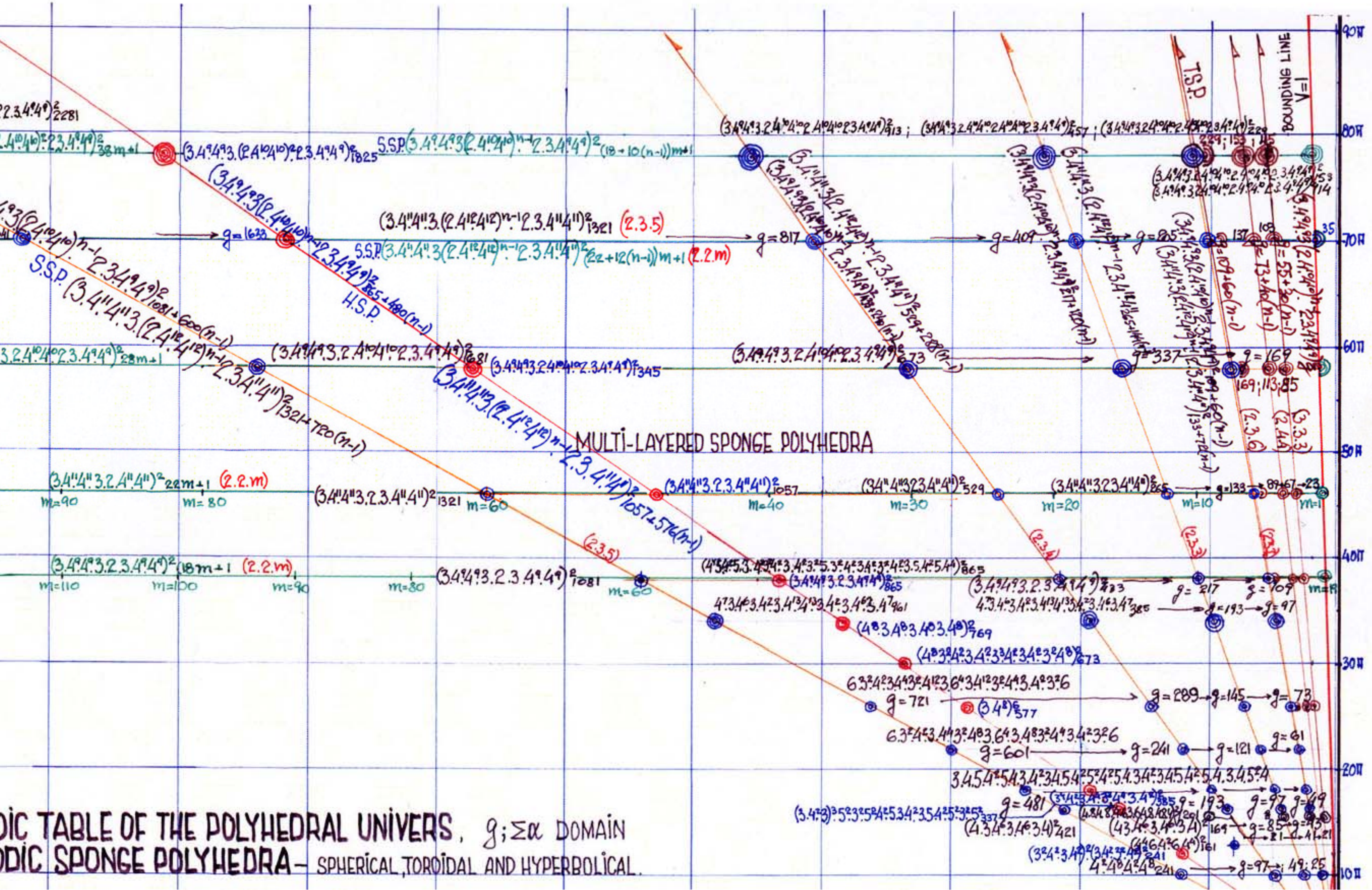
A. - SPHERICAL POLYHEDRA
B. - TOROIDAL POLYHEDRA
C. - HYPERBOLICAL SPONGE POLYHEDRA
UNEXPLORED POLYHDRAL DOMAIN - FILLED WITH SPONGE POLYHEDRA
KNOWN INFINITE POLYHEDRA EXPLORED DURING THE 20-th CENTURY
EXPLORED DURING THE LAST 3 MILLENIA
Σα av.
V=2
V=1
V=0
Val av.
14π
12π
10π
8π
6π
4π
2π
A.
B.
C.



$\Sigma\alpha_{av.}$
100π
50π
40π
30π
20π
10π
g
1500
1000
500
(3.4¹¹.4¹¹.3.2.4¹².4¹².2.3.4¹¹.4¹¹)²₂₀₄₁
A SPHERICAL SPONGE POLYHEDRON
SYMMETRY GR. (2.3.5)
g = 2041
$\Sigma\alpha_{av.}$ = 70π
Val.$_{av.}$ = 146
$V_{TU.}$ = 120
E = 8760
F = 4560
BOUNDARY OF THE POLYHEDRAL UNIVERS
F=0; $P_{av}$ → ∞
THE DOMAIN OF SPONGE POLYHEDRA
THE EXPANDING POLYHEDRAL UNIVERS
THE POLYHEDRAL UNIVERSE (UP TO 2004)
THE 'PTOLEMAIC' WORLD PICTURE OF THE POLYHEDRAL UNIVERSE (UP TO 1960 AD.)
HYPERBOLIC (PLANE FACETED) POLYHEDRA

PERIODIC POLYHEDRAL SPONGE ENVELOPES (BASED ON PERIODIC GENETIC SURFACES WITH TRIANGULAR, QUADRANGULAR OR PENTAGONAL REPETITIVE SURFACE UNITS) AND THEIR LOCATION PATTERNS WITHIN THE 'PERIODIC TABLE OF THE POLYHEDRAL UNIVERSE'





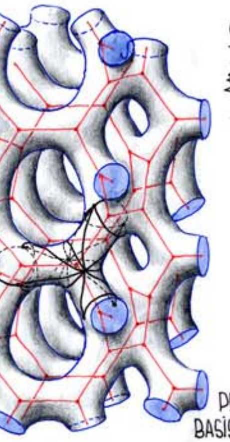
BOUNDING LINE
V=1
T.S.P.
S.S.P.
H.S.P.
MULTI-LAYERED SPONGE POLYHEDRA
DIC TABLE OF THE POLYHEDRAL UNIVERS, g; Σα DOMAIN
DIC SPONGE POLYHEDRA – SPHERICAL, TOROIDAL AND HYPERBOLICAL.

E

her development and exhaustive search of the uniform
ge polyhedra, will be possible only after resolving the
e-partite, tightly interwoven relation of the theoretically
ible and topologically different **uniform space lattices,**
erators, in their turn, of the **genetic periodic sponge**
**aces** from which all other periodic sponge surfaces can be
ved, and only then, to consider all their possible
ellations, thus leading to generation of the probably infinite
y of **uniform sponge polyhedra.**

F

sponge surface is specifically related to its lattice-like
el' system, sharing together topological and overall
netry characteristics. The exploratory exhaustive search of
ces and their 'tunnel lattices' is one and same problem.
**rm space lattices** provide the 'genetic code' of the related
ed) sponge surfaces. Spatial lattice connectivity and
s of the resulting surface share the same value.



$(3^3)^3_4$

$g = 4$

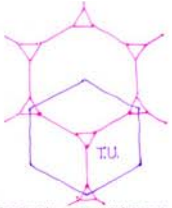
$\Sigma\alpha = 3\pi$

$Val. = 9$

$V_{TU} = 12$

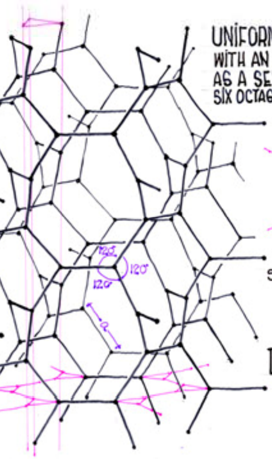
$E_{TU} = 54$

$F_{TU} = 36$

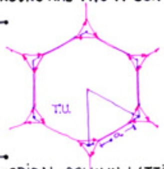



UNIFORM SPONGE POLYHEDRON

PERIODIC SPONGE SURFACE ON THE BASIS OF A UNIFORM TRIVALENT LATTICE

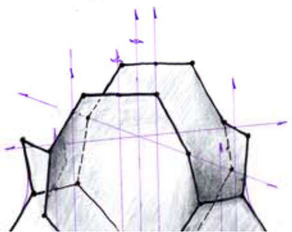



UNIFORM TRIVALENT SPACE LATTICE WITH AN OCTAHEDRAL SADDLE POLYHEDRON AS A SELF CLOSE PACKING SOLID, WITH SIX OCTAGONS AND TWO 14-GON FACES.




SPIRAL COLUMN LATTICE

$Den_{8^6 14^2} = 0.254558441\, a/a^3$



$3^3.4^4_7$

$g = 7$

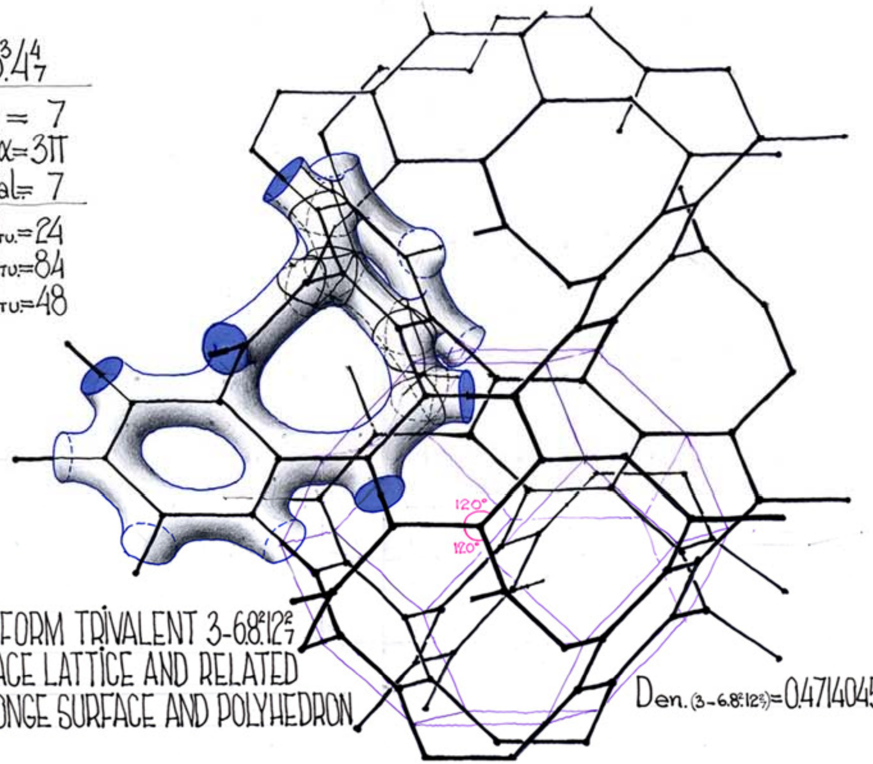
$\Sigma\alpha = 3\pi$

$Val. = 7$

$V_{TU} = 24$

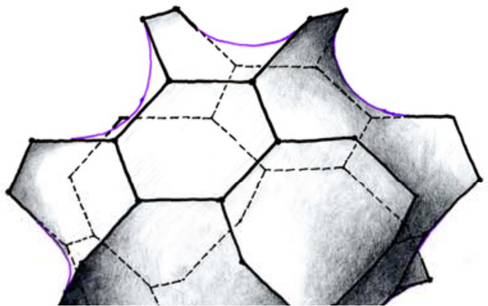
$E_{TU} = 84$

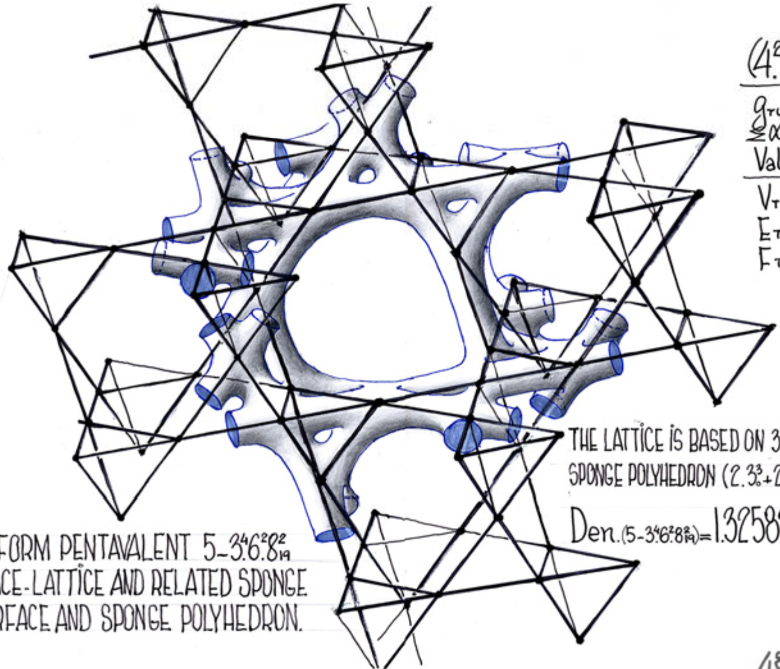
$F_{TU} = 48$




UNIFORM TRIVALENT $3\text{-}6.8^2.12^2_7$ SPACE LATTICE AND RELATED SPONGE SURFACE AND POLYHEDRON

$Den._{(3-6.8^2.12^2_7)} = 0.47140452\, a/a^3$





$(4^2.5)^5_{19}$

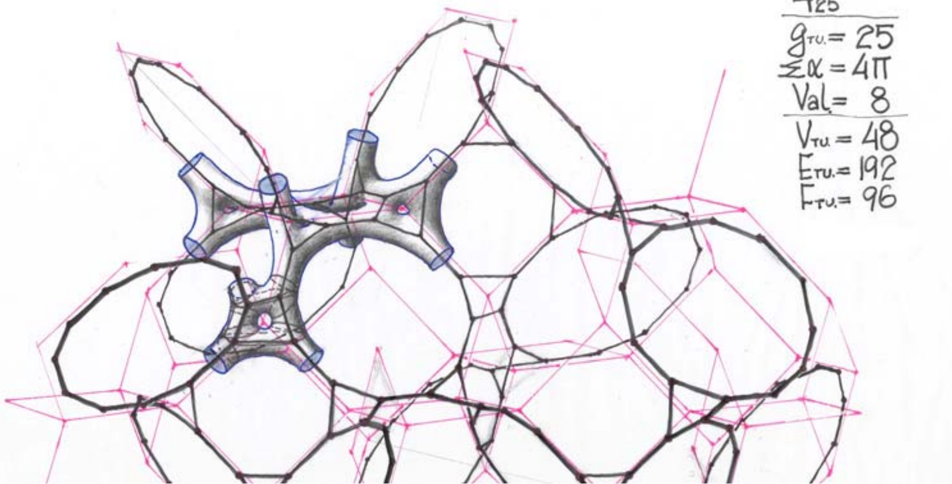
$g_{TU.} = 19$
$\Sigma\alpha = 8\pi$
$Val. = 15$

$V_{TU.} = 12$
$E_{TU.} = 90$
$F_{TU.} = 42$

THE LATTICE IS BASED ON $3^3.6.3.6_3$ - INFINITE SPONGE POLYHEDRON $(2.3^3_0 + 2.6.3.6)$.

$Den._{(5-3^4.6^2.8^2_{19})} = 1.3258252215\ a/a^3$

UNIFORM PENTAVALENT $5-3^4.6^2.8^2_{19}$ SPACE-LATTICE AND RELATED SPONGE SURFACE AND SPONGE POLYHEDRON.



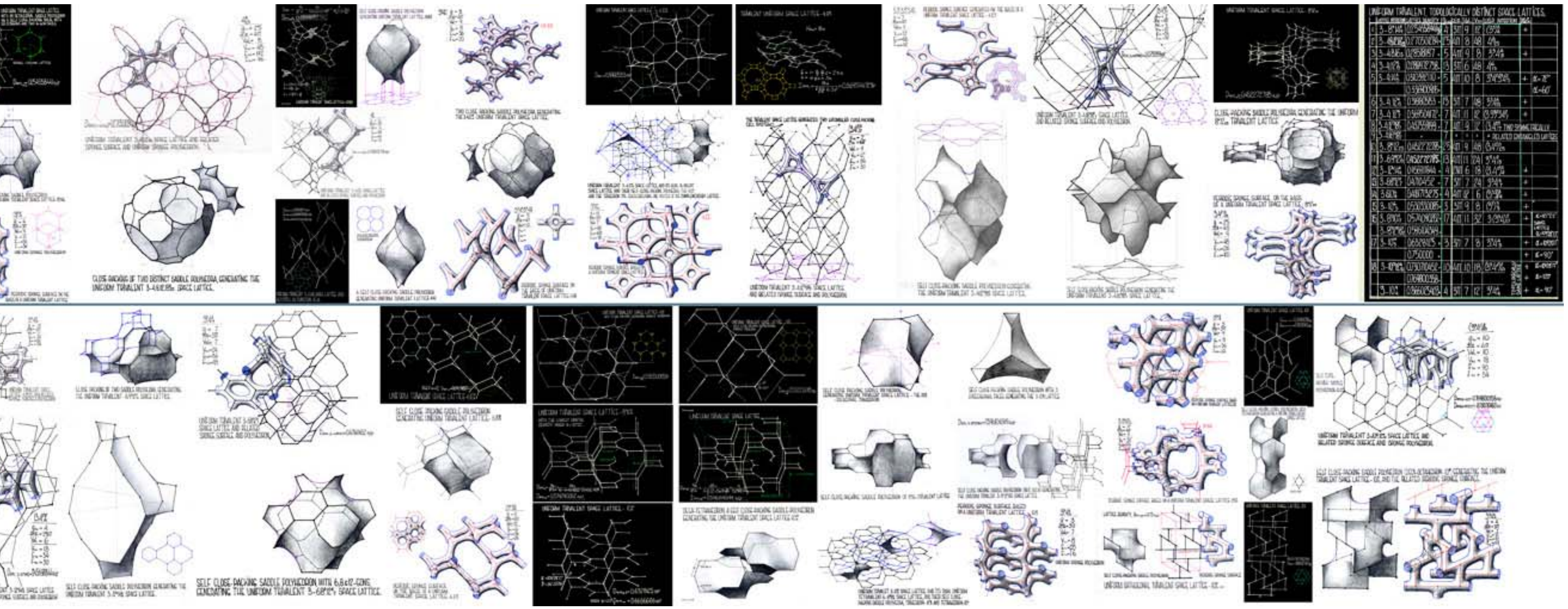
$4^8_{25}$

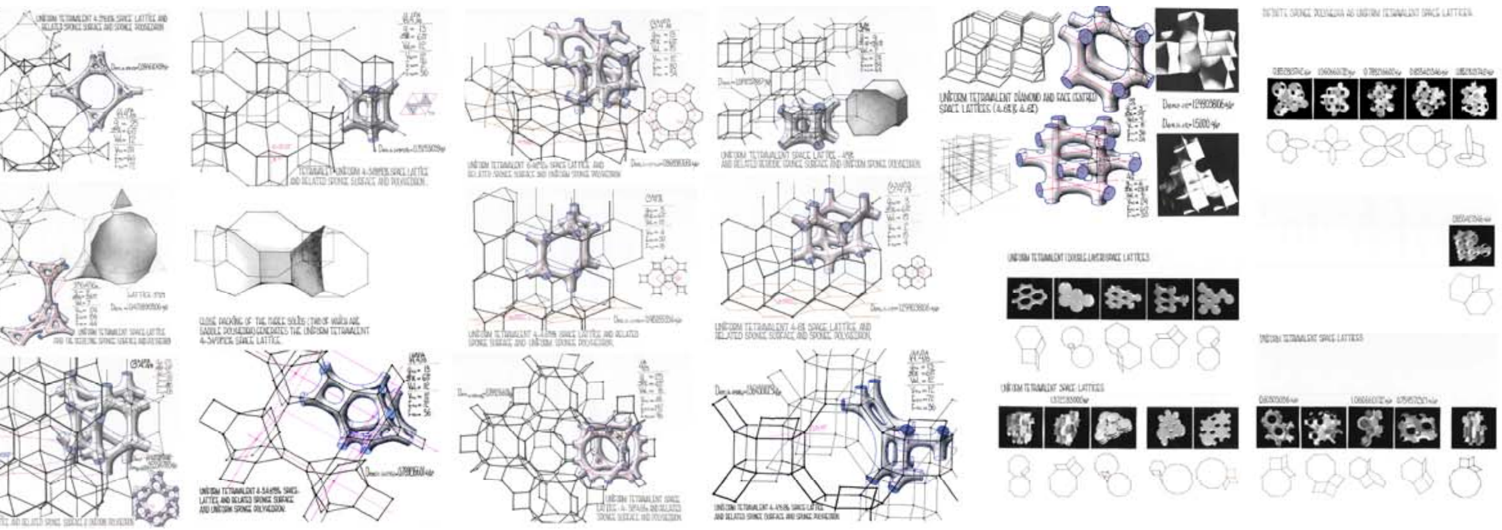
$g_{TU.} = 25$
$\Sigma\alpha = 4\pi$
$Val. = 8$

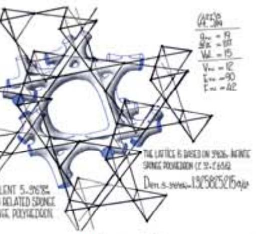
$V_{TU.} = 48$
$E_{TU.} = 192$
$F_{TU.} = 96$

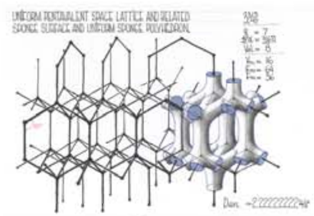
G

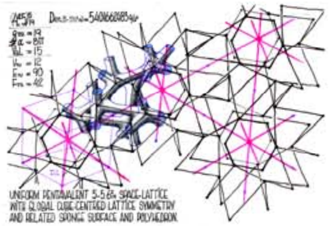
The author's exploratory effort of polyvalent uniform space lattices is still in its initial evolutionary stages, but after generating more than two dozens of uniform trivalent (as the lowest valency lattices) and some dodecavalent lattices (considered to be of the highest possible valency) an opinion is formed that the total array of uniform space lattices is finite, exhaustible, probably in the range of few hundreds only.



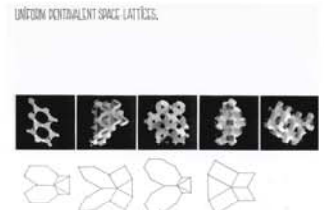

UNIFORM TETRAVALENT DIAMOND AND FACE CENTRED SPACE LATTICES
UNIFORM TETRAVALENT SPACE LATTICES

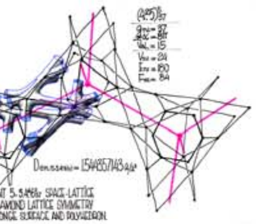

THE LATTICE IS BASED ON 3⁴6⁴ INFINITE SPONGE POLYHEDRON
LENT 5-3⁴6⁷8⁷ₘ
RELATED SPONGE
NGE POLYHEDRON.

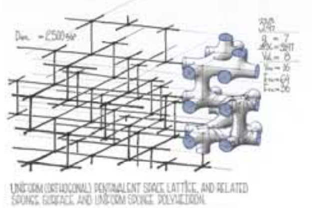

UNIFORM PENTAVALENT SPACE LATTICE AND RELATED SPONGE SURFACE AND UNIFORM SPONGE POLYHEDRON.
Den. =2.222222222

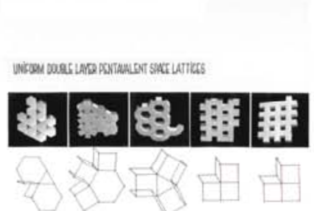

UNIFORM PENTAVALENT 5-5.6⁸ SPACE-LATTICE
WITH GLOBAL CUBE-CENTRED LATTICE SYMMETRY
AND RELATED SPONGE SURFACE AND POLYHEDRON.

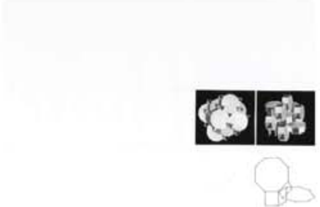

UNIFORM PENTAVALENT SPACE LATTICES.


UNIFORM PENTAVALENT SPACE LATTICES.

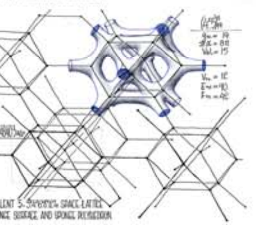

T 5-3.4⁶8 SPACE-LATTICE
AMOND LATTICE SYMMETRY
ONGE SURFACE AND POLYHEDRON.

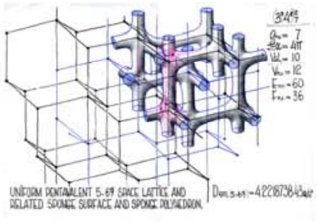

Den. =2.500
UNIFORM (ORTHOGONAL) PENTAVALENT SPACE LATTICE, AND RELATED
SPONGE SURFACE AND UNIFORM SPONGE POLYHEDRON.

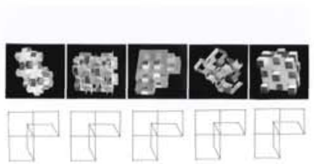

UNIFORM DOUBLE LAYER PENTAVALENT SPACE LATTICES

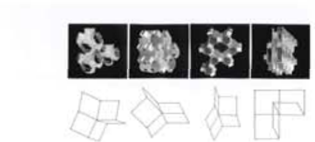


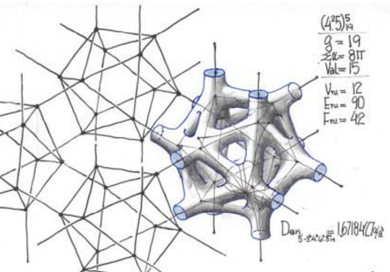

UNIFORM PENTAVALENT SPACE LATTICES.


LENT 5-
NGE SURFACE AND SPONGE POLYHEDRON

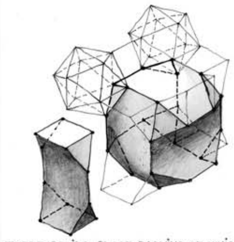

Qᵥ = 7
Vₘ = 12
Fₘ = 60
Fₘ = 36
UNIFORM PENTAVALENT 5-6⁹ SPACE LATTICE AND
RELATED SPONGE SURFACE AND SPONGE POLYHEDRON.
Den. =4.221873843



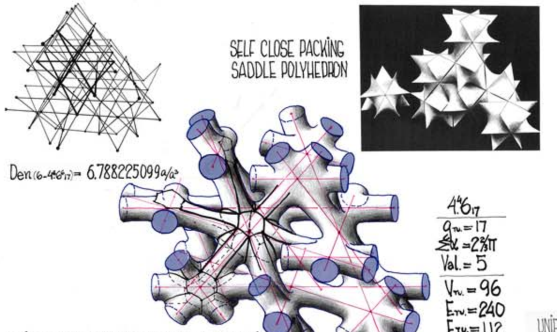





UNIFORM PENTAVALENT 5-$3^4 4^6 6^4 8_{14}$ SPACE LATTICE
AND RELATED SPONGE SURFACE AND SPONGE POLYHEDRON

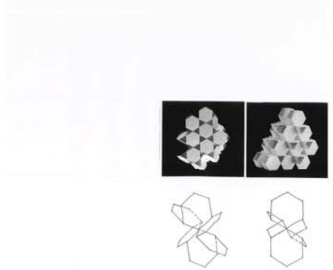


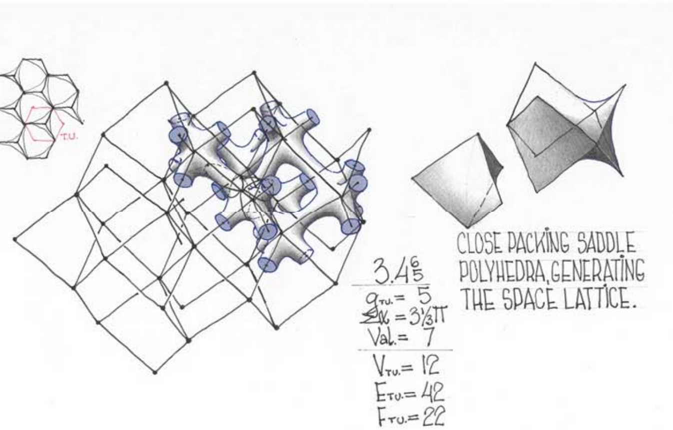
THREE SOLIDS, CLOSE PACKING OF WHICH
GENERATES THE UNIFORM HEXAVALENT 6-$3^4 4^8 2_5$
SPACE LATTICE.




UNIFORM HEXAVALENT 6-$4^6 6^6_{17}$ SPACE LATTICE
AND RELATED SPONGE SURFACE AND POLYHEDRON

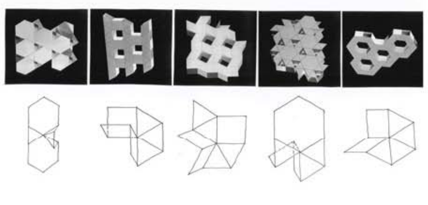
UNIFORM HEXAVALENT SPACE-LATTICES.



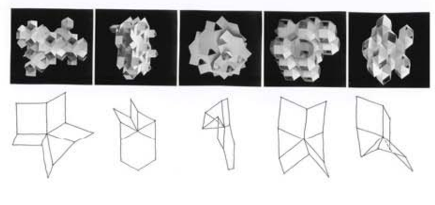



IFORM HEXAVALENT 6-$(4.6)^6_5$ SPACE LATTICE AND RELATED
RIODIC SPONGE SURFACE AND UNIFORM SPONGE POLYHEDRON.

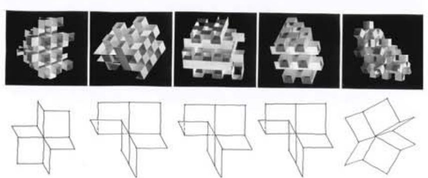
UNIFORM DOUBLE LAYER HEXAVALENT SPACE-LATTICES.

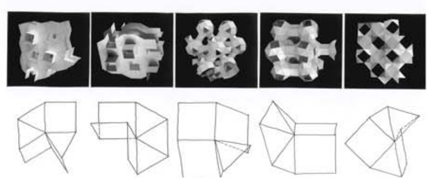


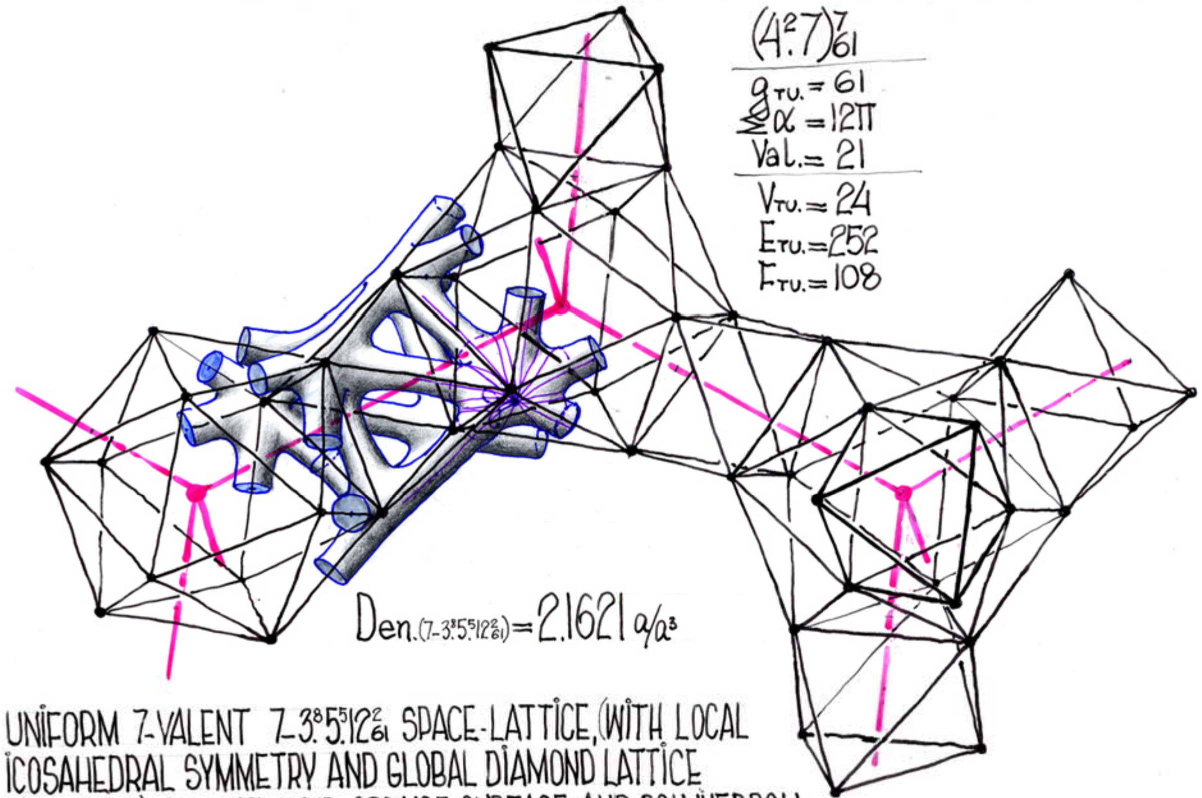
UNIFORM HEXAVALENT SPACE LATTICES.



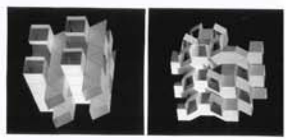
UNIFORM HEXAVALENT SPACE-LATTICES.

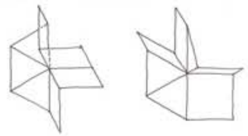




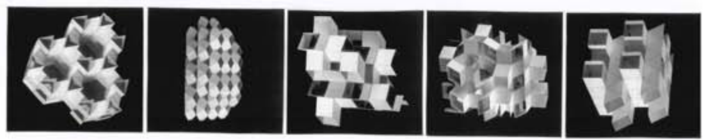


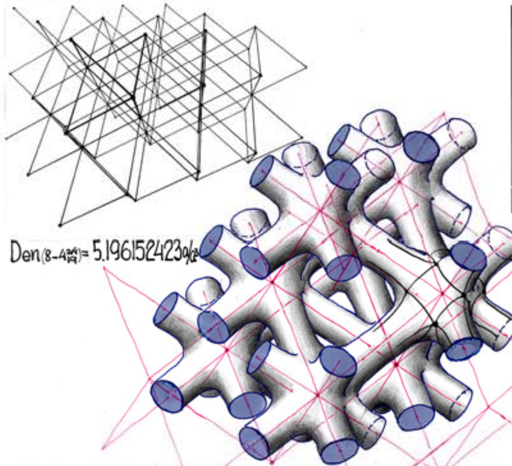

UNIFORM 7-VALENT $7\text{-}3^8.5^5.12^2_{61}$ SPACE-LATTICE, (WITH LOCAL ICOSAHEDRAL SYMMETRY AND GLOBAL DIAMOND LATTICE SYMMETRY) AND RELATED SPONGE SURFACE AND POLYHEDRON.

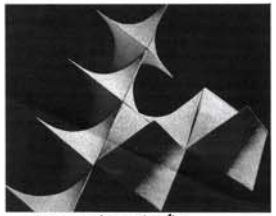




UNIFORM SEPTAVALENT SPACE-LATTICES.

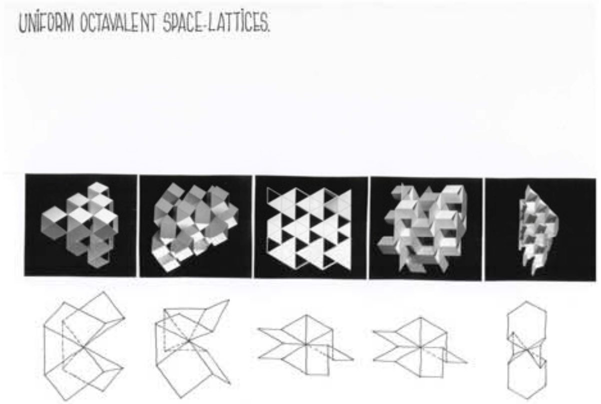


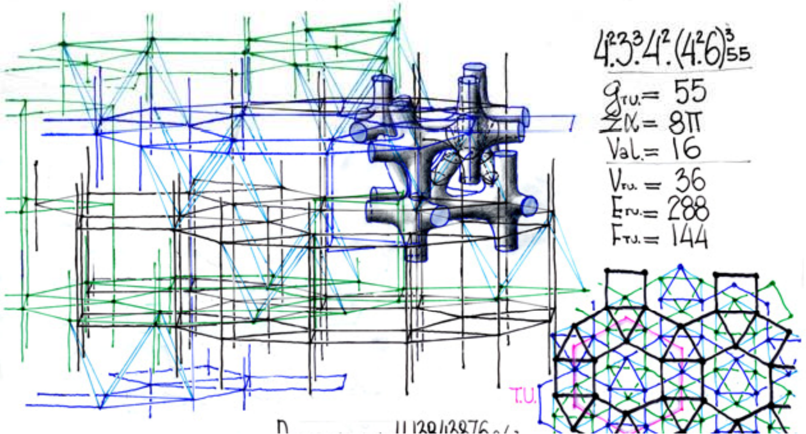


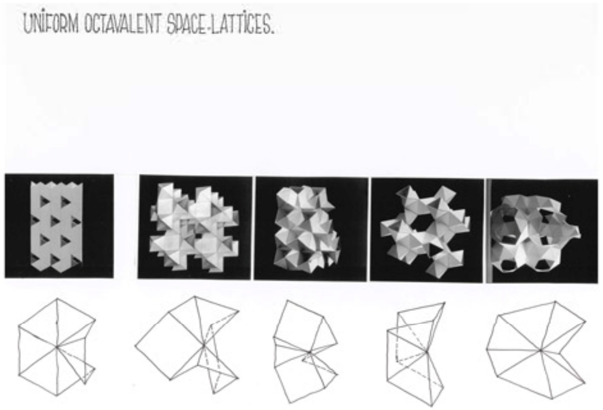



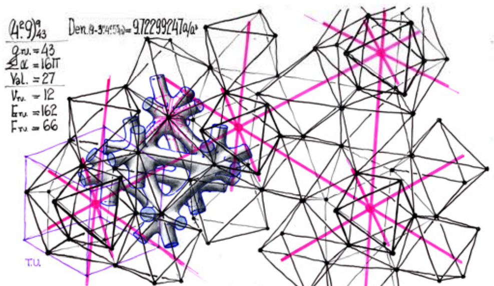
SELF CLOSE PACKING
SADDLE POLYHEDRON,
GENERATING THE LATTICE.

OCTAVALENT UNIFORM 8-4^24_19 SPACE LATTICE AND RELATED
SPONGE SURFACE AND UNIFORM SPONGE POLYHEDRON

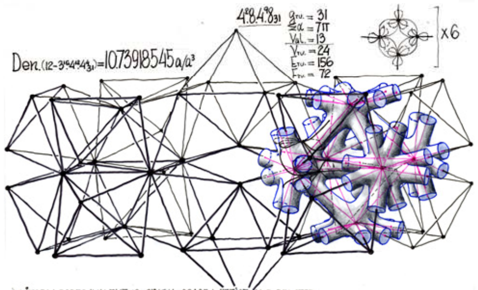


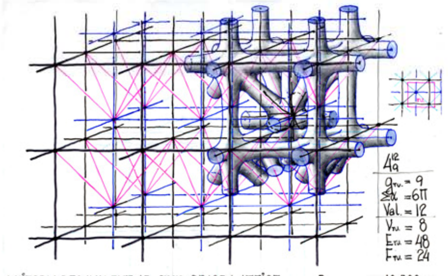






UNIFORM 9-VALENT 9-3^{24}4^{27}5^{18} SPACE-LATTICE (WITH LOCAL ICOSAHEDRAL SYMMETRY AND GLOBAL CUBE-CENTRED LATTICE SYMMETRY) AND REL.

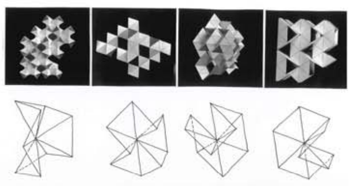


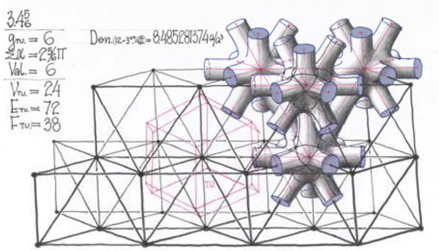

UNIFORM DODECAVALENT 12-3^{24}4^{18}4^{8} SPACE LATTICE AND RELATED SPONGE SURFACE AND UNIFORM SPONGE POLYHEDRON.



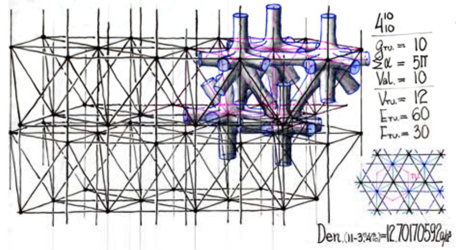

UNIFORM DECAVALENT 10-3^{8}4^{12} SPACE LATTICE AND RELATED SPONGE SURFACE AND SPONGE POLYHEDRA. Den.(10-3^{8}4^{12}) = 10.000 a/a³

UNIFORM 9-VALENT SPACE-LATTICES.



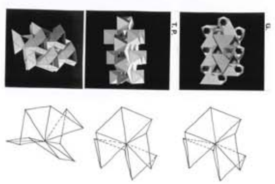



UNIFORM DODECAVALENT 12-3^{8}4^{6} SPACE LATTICE (OCTET LATTICE) AND RELATED SPONGE SURFACE AND UNIFORM SPONGE POLYHEDRON.

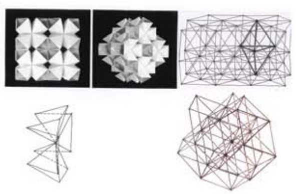


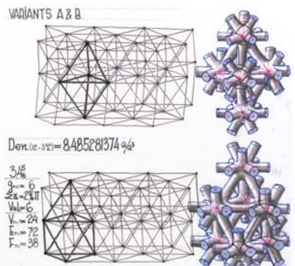

UNIFORM 11-VALENT 11-3^{12}4^{8} SPACE LATTICE AND RELATED SPONGE SURFACE AND UNIFORM SPONGE POLYHEDRON

UNIFORM DECAVALENT SPACE-LATTICES.

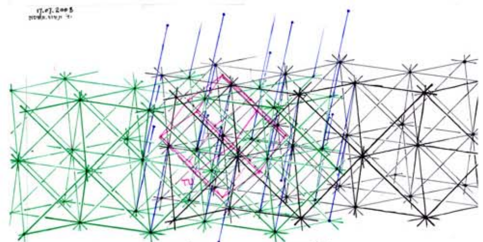


UNIFORM DODECAVALENT SPACE-LATTICES.






UNIFORM DODECAVALENT 12-3^{8}4^{6} SPACE LATTICE (OCTET) AND RELATED SPONGE SURFACES AND SPONGE POLYHEDRA.



DENSITY(13-3^{8}4^{6}) = 18.38477631 a/a³

TWO INTER-PENETRATING UNIFORM OCTET SPACE LATTICES WITH EDGE-a, WHEN JOINED TOGETHER WITH A SET OF PARALLEL a-EDGES, GENERATE A UNIFORM 13-VALENT SPACE LATTICE.

H

hroughout history, only few tried to approach rigorously the ordering roblem of the polyhedral array of forms in its totality. One was **Rene Descartes** who in the first half of the 17th century, while referring to convex egular polyhedra, stated that:

**he total angular deficit, of the sum of the angular deficits, taken over ll the vertices of a convex polyhedron, equals 4π for (all) regular olyhedra.**

**$/= (2\pi-\sum\alpha)\ V=4\pi$**

nother giant, observing the field while standing on the shoulders of Descartes, was **Leonard Euler,** the founder of topology, who stated in the o-called Euler's Theorem:

**The number V-E+F=K, (V, E, F stand for vertices, Edges and Faces, espectively, with K, called the characteristic of the manifold), is the**

J

**HICAL ORDER AND CLASSIFICATION OF THE PERODIC SPONGE SURFACES AND THE**
**M SPONGE POLYHEDRA' DOMAIN**

**es -**a morphological-topological categorization into: **Primitive; Spherical; Toroidal & Hyperbolic** Periodic Sponge Surfaces.

**y group -**classification of the a.m. Phenotypes according to Symmetry Group Characteristics.

**s -**classification according to Tunnel Lattice Systems and related Genetic Surfaces (Ge.S) and their genealogy.

**de -**classification according to the number of Ge.S layers.

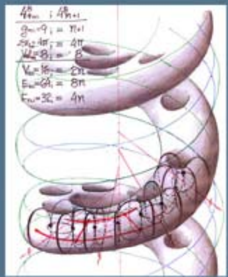
**on mode-**classification according to the mode and extent of Perforation.

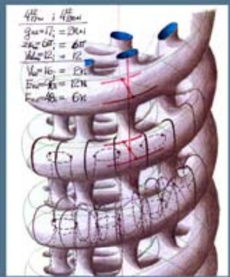
**al Family-** all sponge polyhedra, sharing same phenotype, symmetry-group, Ge.S, number of Ge.S. Layers and same mode of perforations.

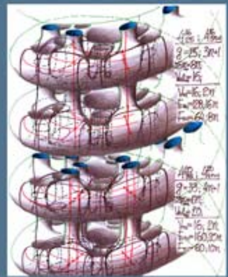
classification, down the hierarchical ladder, is following a path of **increasing polyhedral regularity**

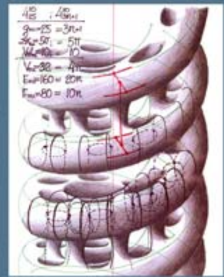
PONT DU GARD

PARK GUEL - GAUDI

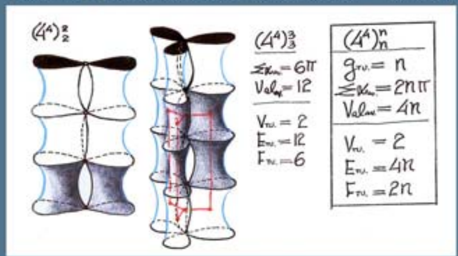


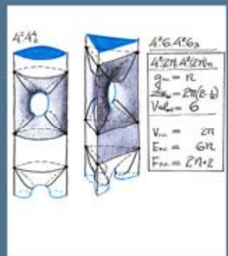


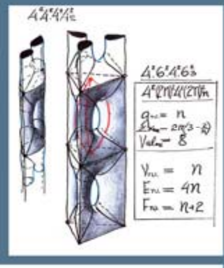




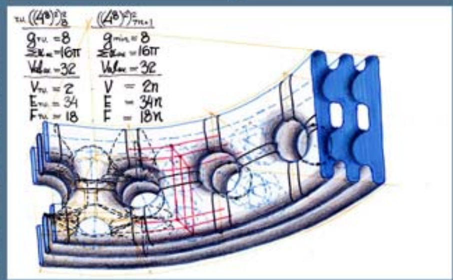
PRIMITIVE UNIFORM SPONGE POLYHEDRA M.BURT

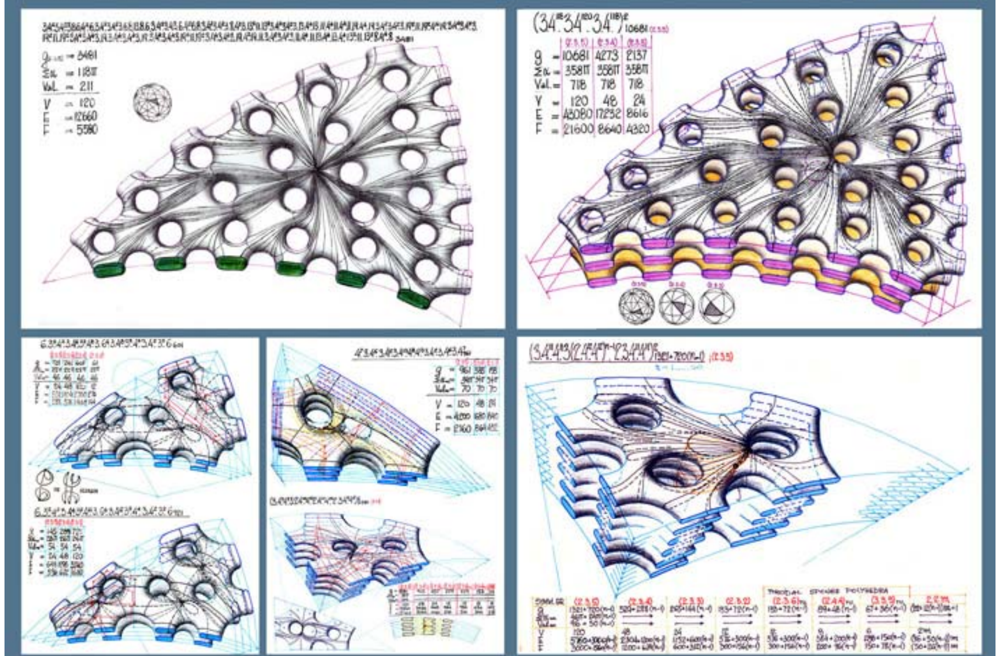






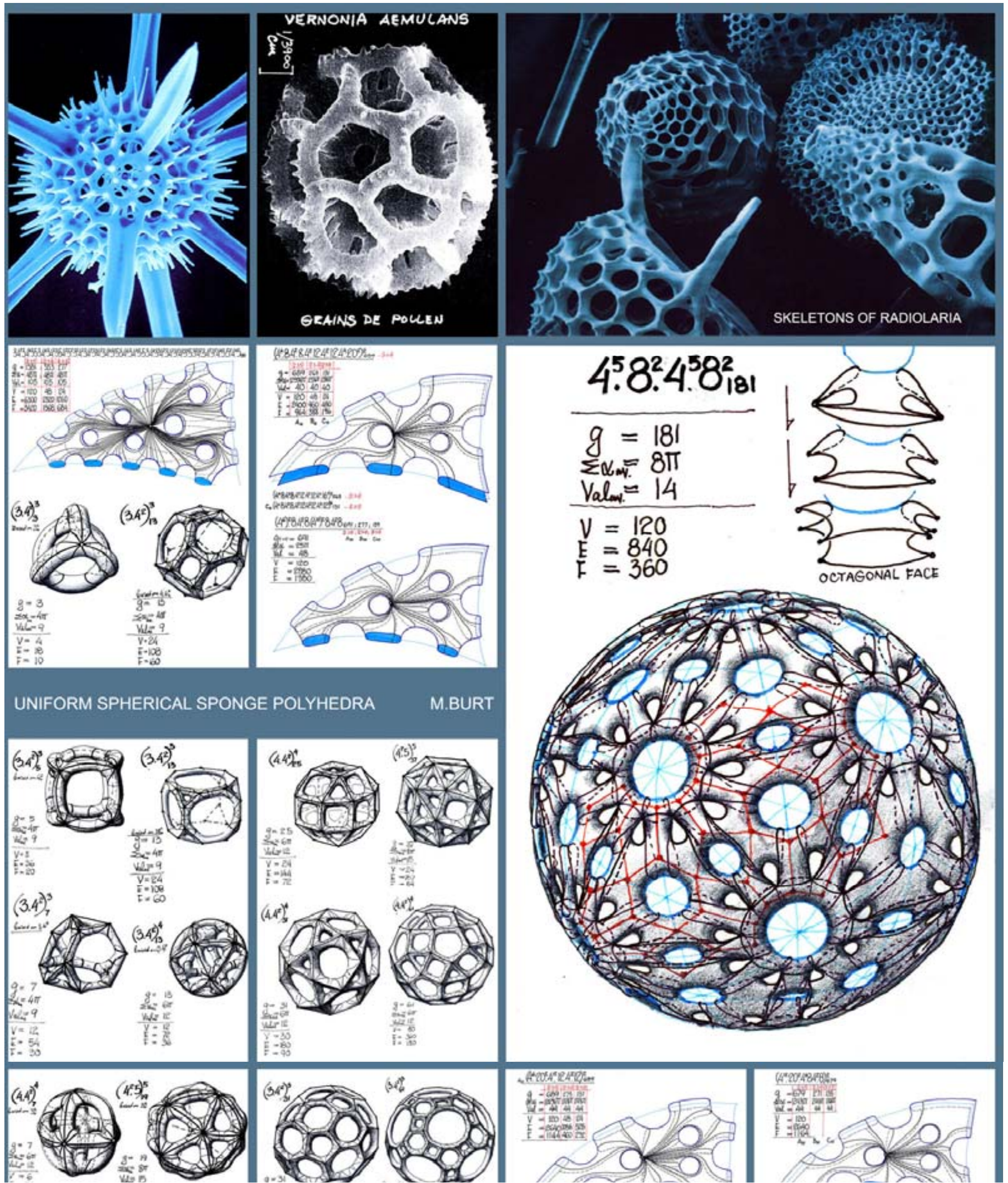
CASA MILLA - GAUDI

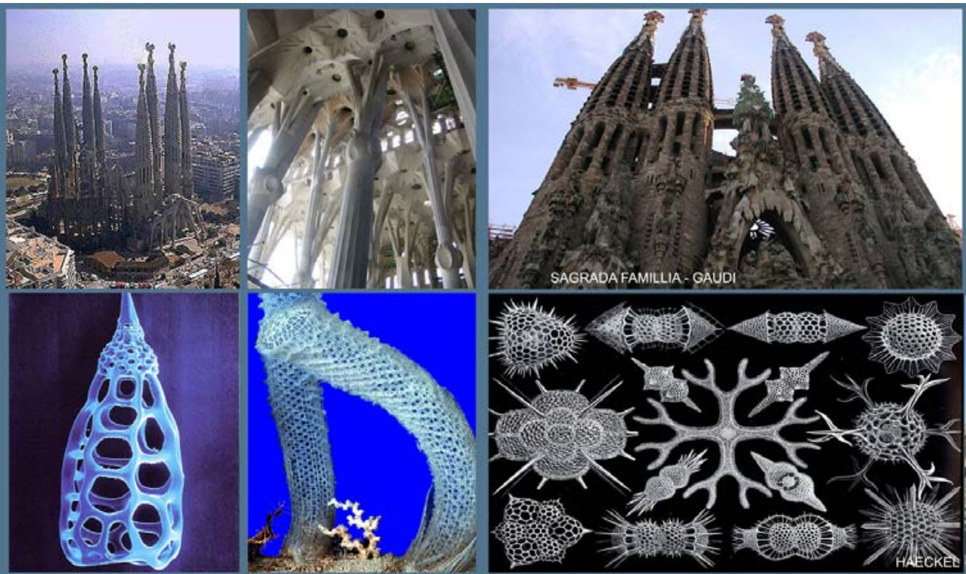


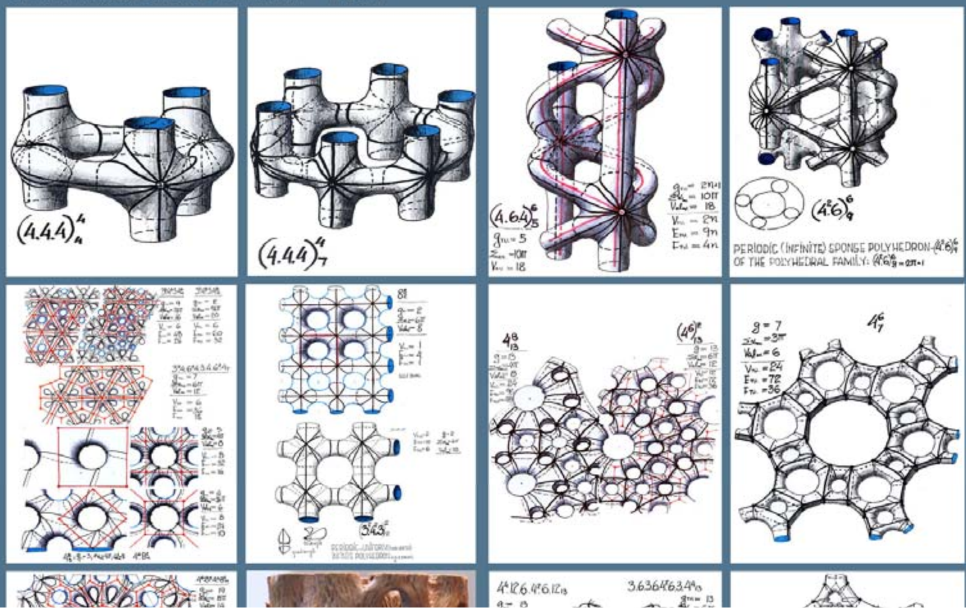
SINGLE AND MULTI LAYERED, UNIFORM, SPHERICAL SPONGE POLYHEDRA

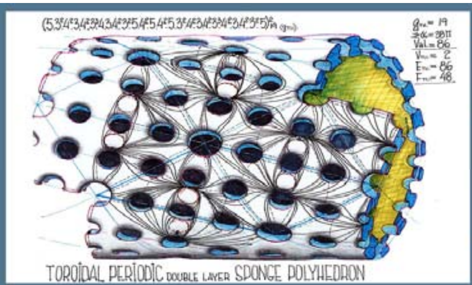
MICHAEL BURT, 2008

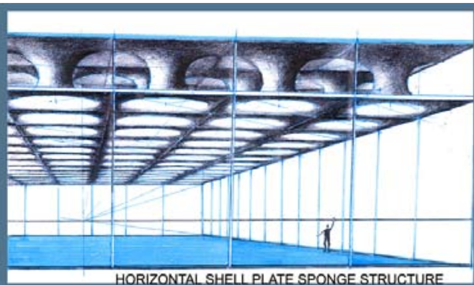

VERNONIA AEMULANS
GRAINS DE POLLEN
SKELETONS OF RADIOLARIA
4.5 8.2 4.5 8.2 181
g = 181
Valov = 14
V = 120
E = 840
F = 360
OCTAGONAL FACE
UNIFORM SPHERICAL SPONGE POLYHEDRA
M.BURT

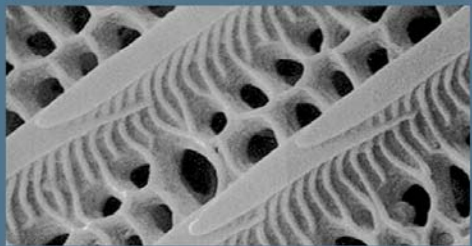



UNIFORM TOROIDAL SPONGE POLYHEDRA M.BURT

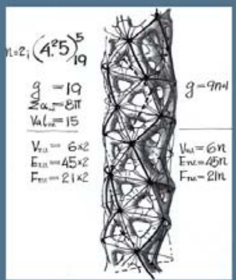


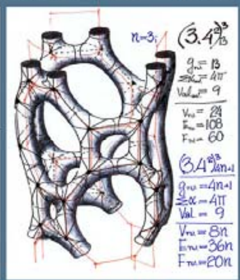


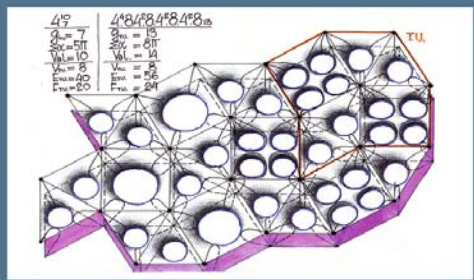



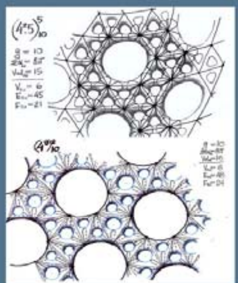



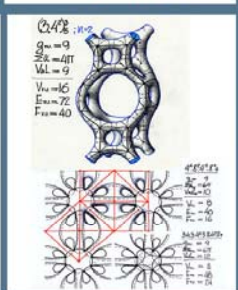
UNIFORM TOROIDAL SPONGE POLYHEDRA M.BURT

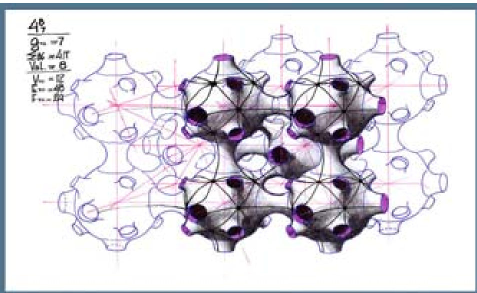


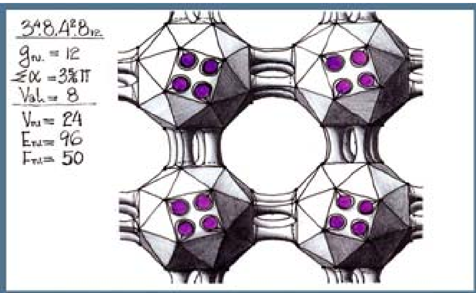


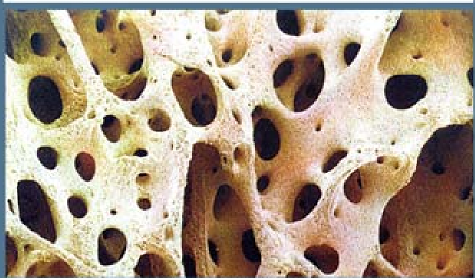


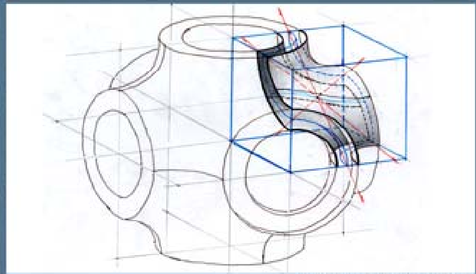






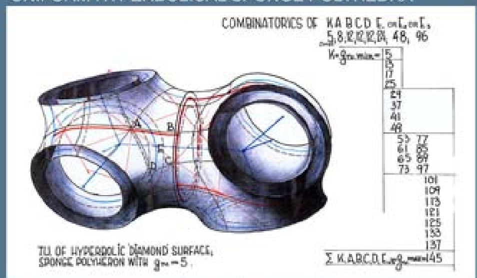


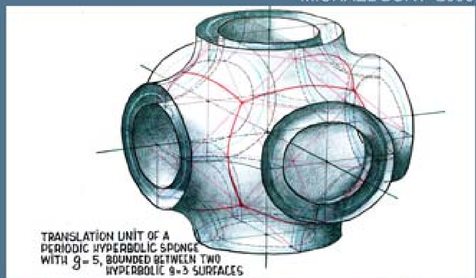


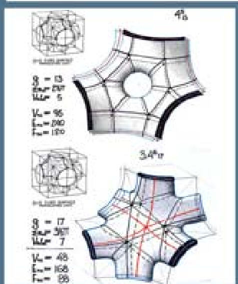


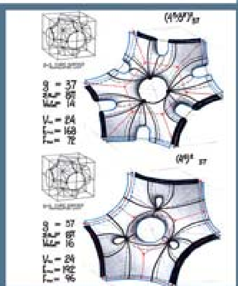
UNIFORM HYPERBOLICAL SPONGE POLYHEDRA

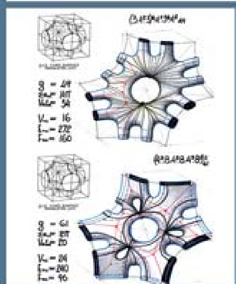
MICHAEL BURT 2008

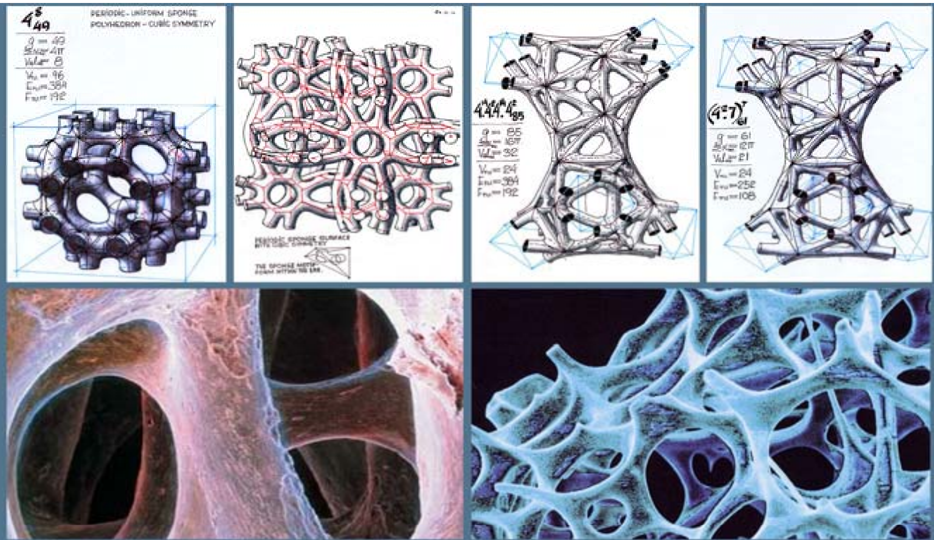


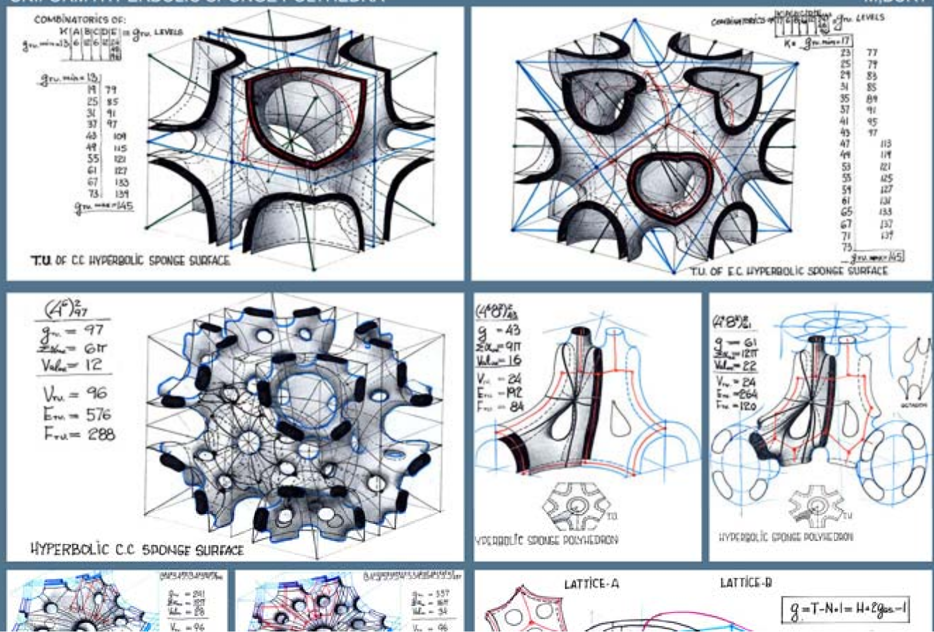







UNIFORM HYPERBOLIC SPONGE POLYHEDRA

M,BURT



K

magery of the Periodic Sponge Surfaces and Uniform Sponge Polyhedra
play a significant role in the morphological research of natural bio-forms and
cal nano-structures, influence the way we perceive our growing urban habitat
ven promote images and ideas of innovative space-structures

L

ain applicative potential of this imagery points at the following space ures categories:

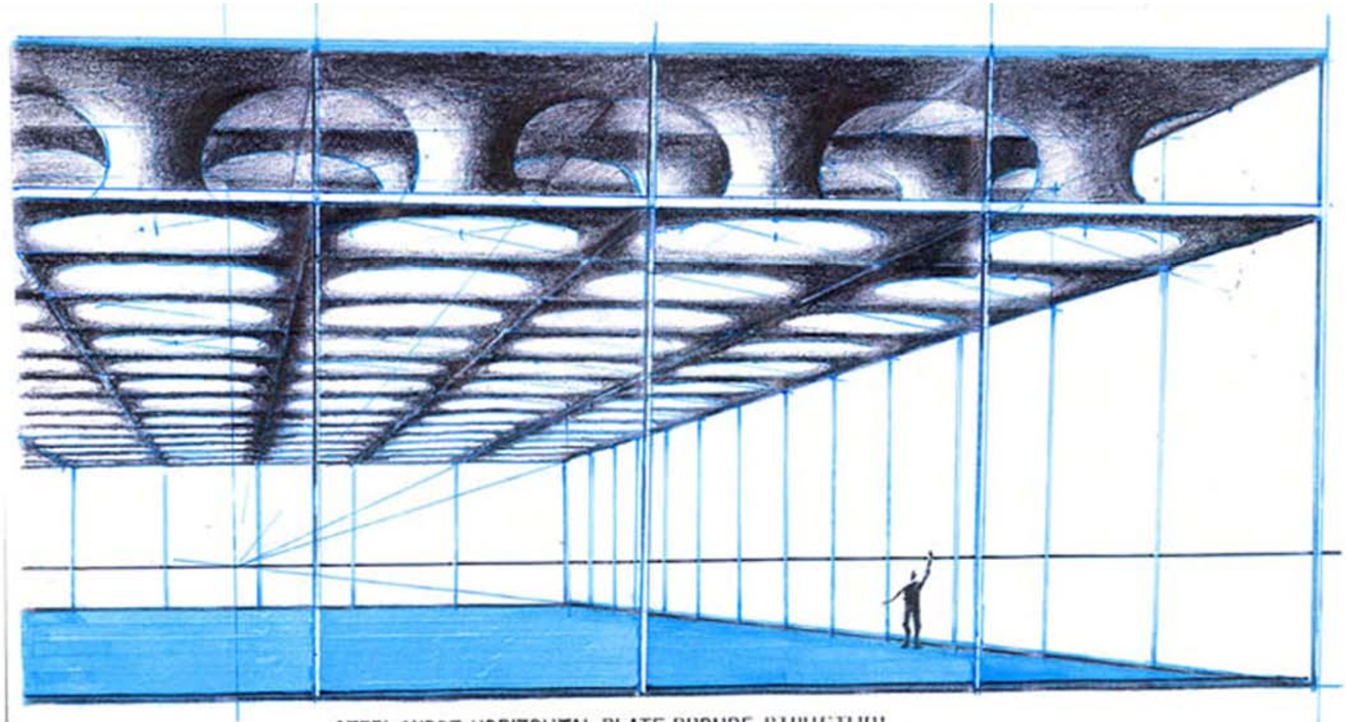
**urface Structures",** critically dependent for their structural performance on ure values, such as

**dic shell structures,** whether continuous or modular, suitable for industrial ulation from a range of materials combining compression- tension nce capabilities (metal or plastic sheets, reinforced concrete or plastic e.t.c);

**hell structures** from curving rectilinear material products;

**rane structures,** either pre-tensioned against a peripheral compression ure or as volumetric sponge surfaces, pneumatically prestressed, zed and rigidified.

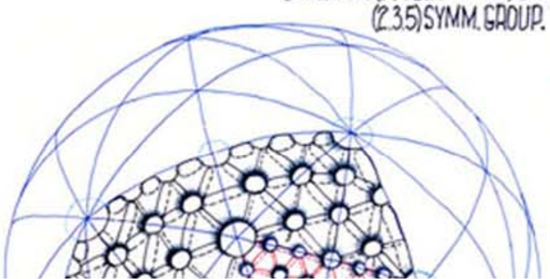
**pace Lattice Structures,** as bar and joint sponge polyhedral configurations, te, vault and dome trusses, characterized as multi-layer, low density e-like **'Infinite Polyhedra Lattice (I.P.L)** truss configurations. Some of



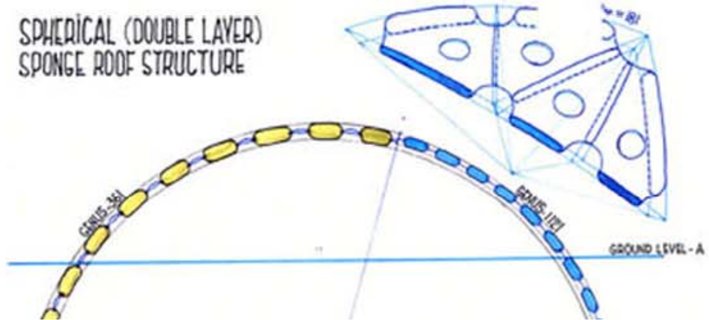
STEEL SHEET, HORIZONTAL PLATE SPONGE STRUCTURE

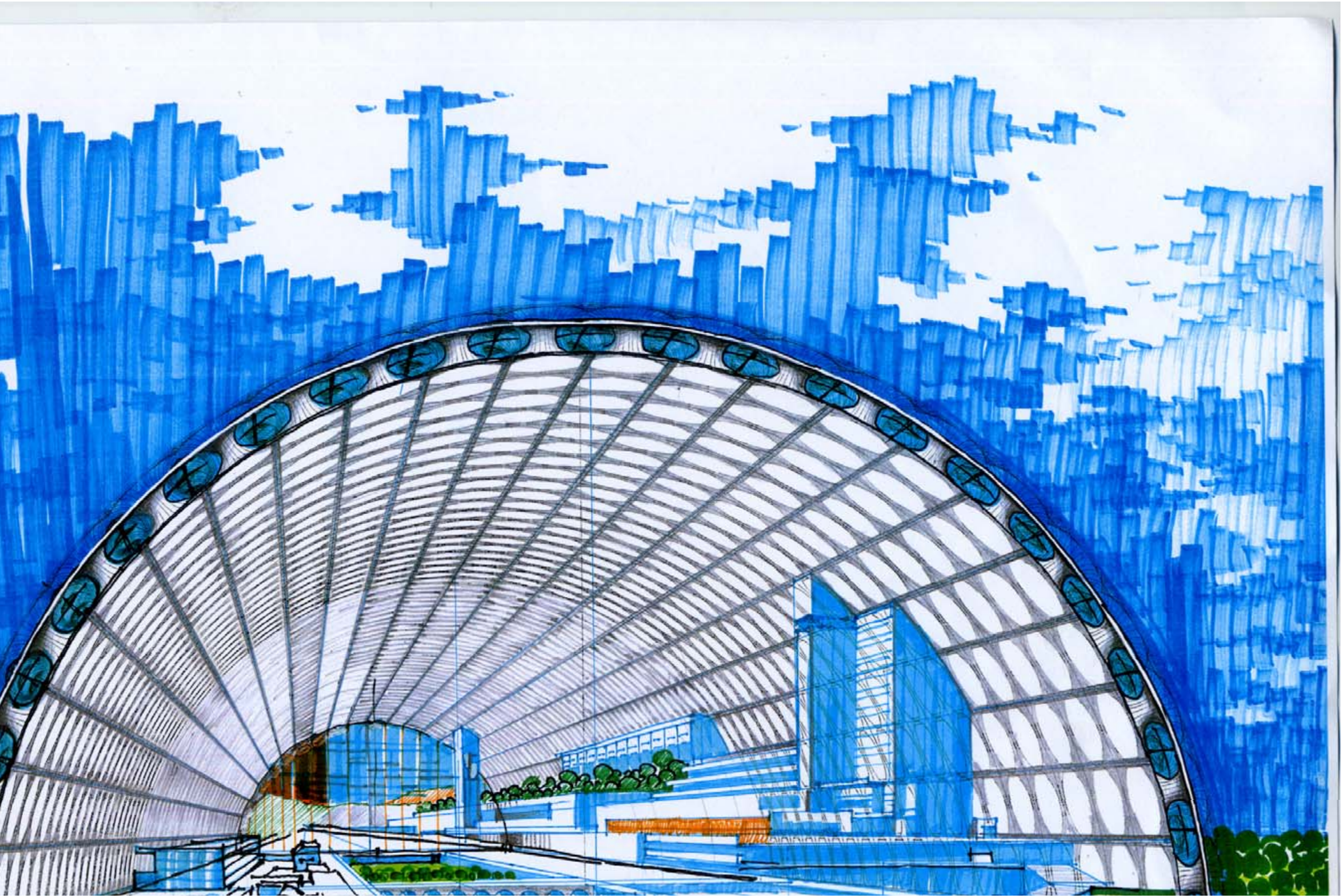
SPHERICA (DOUBLE LAYER) SPONGE STRUCTURE
(2,3,5) SYMM. GROUP. $g_{sp} = 361$

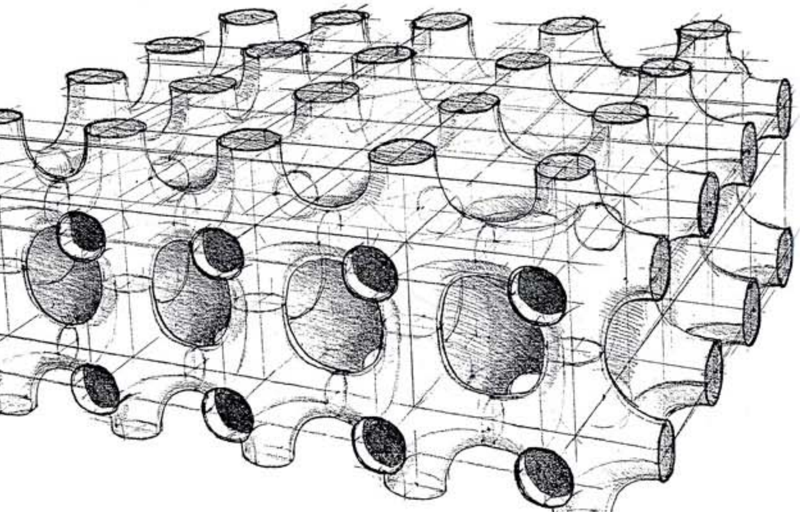
$g_{sp} = 1121$



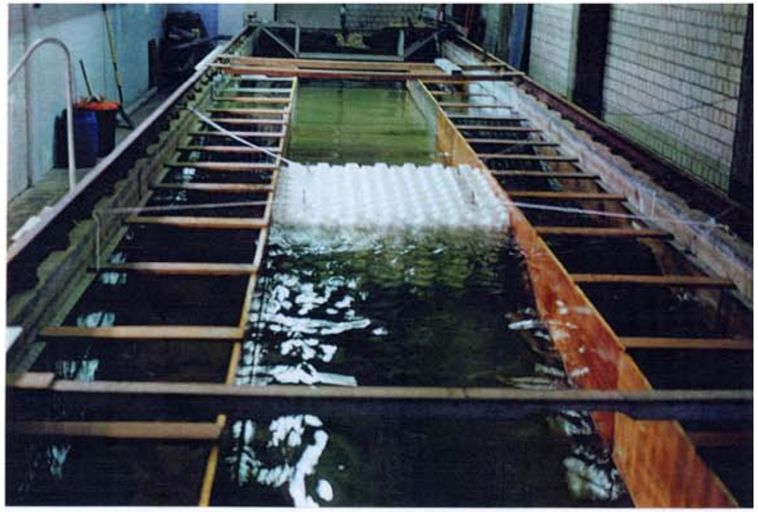
SPHERICAL (DOUBLE LAYER)
SPONGE ROOF STRUCTURE

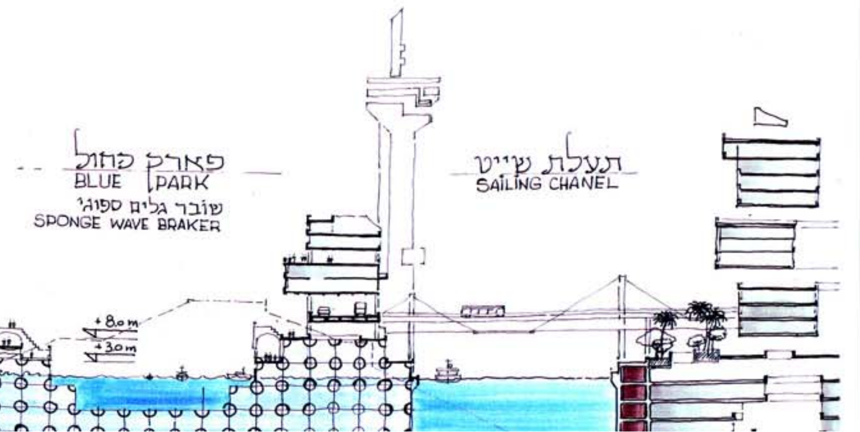


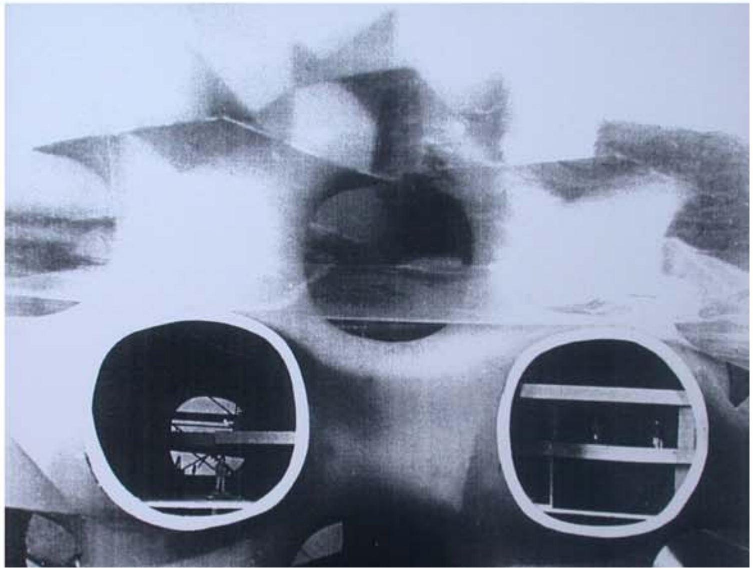


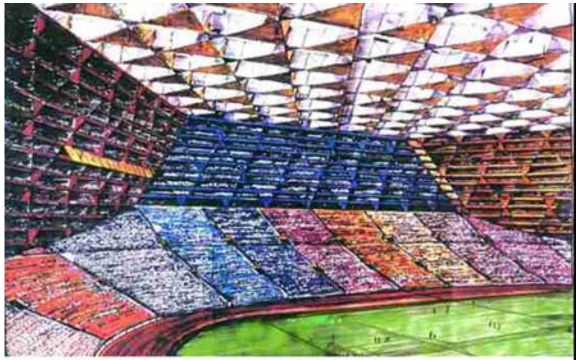


RBOLIC CUBIC SURFACE SHELL STRUCTURE

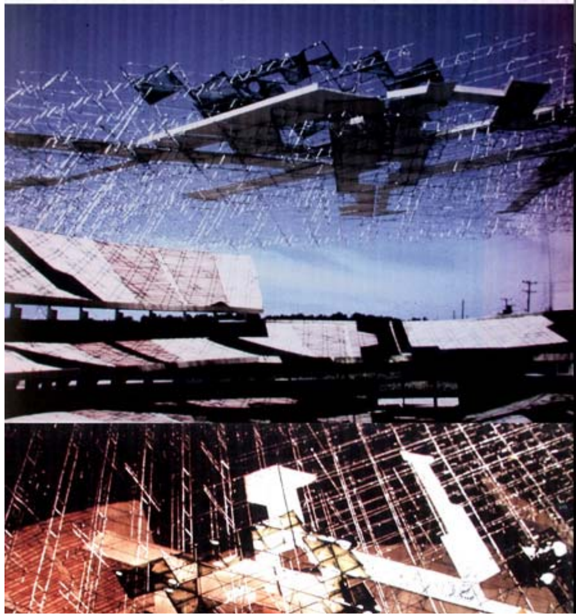


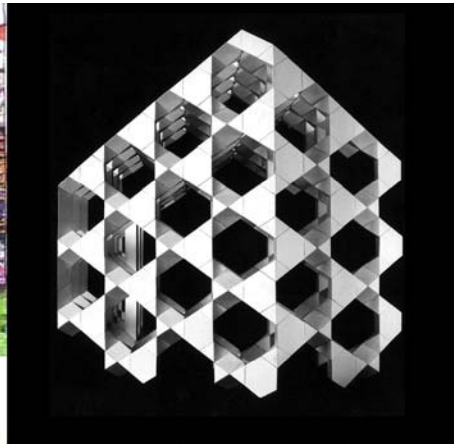


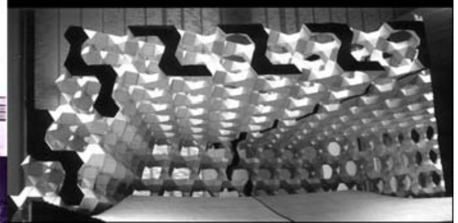



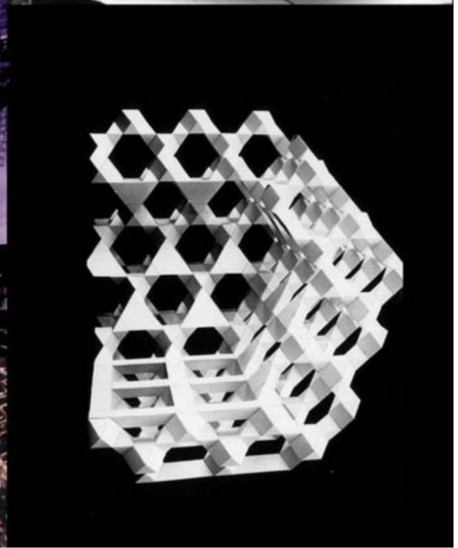



HOSTEL
COMMERCIAL AREA
COMMERCIAL AREA
+40 000 BALCONY SEATS
+60 000 ARENA SEATS
TOTAL 100 000









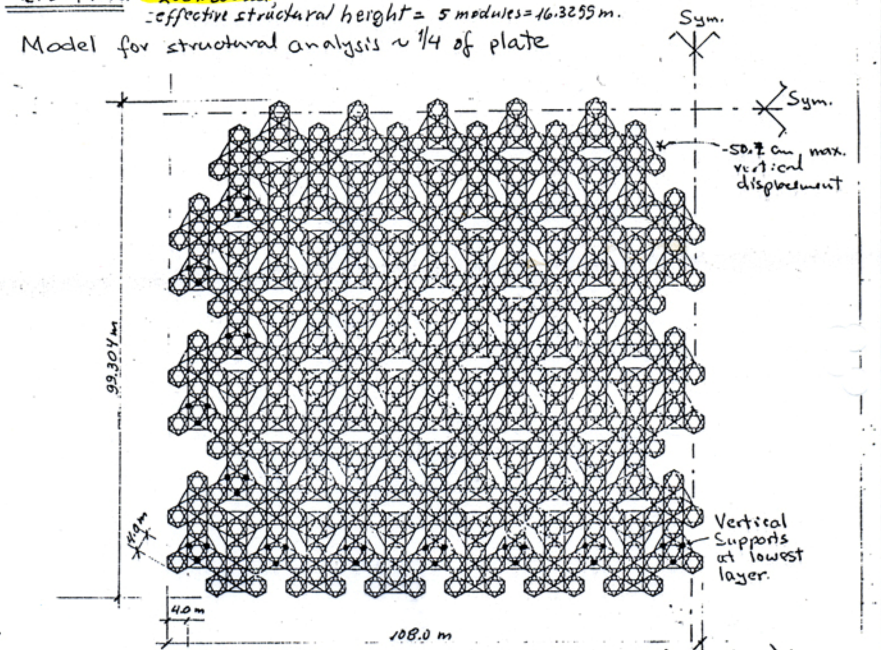
MERO D-8700 Würzburg
Steinachstraße 5
Telefon (0931) 41030

Blatt: I.P.L 200 m x 200 m

ST.B.-Nr.:

IPL- Plate. 200 x 200 m
effective structural height = 5 modules = 16.3255 m.

Model for structural analysis ~ 1/4 of plate

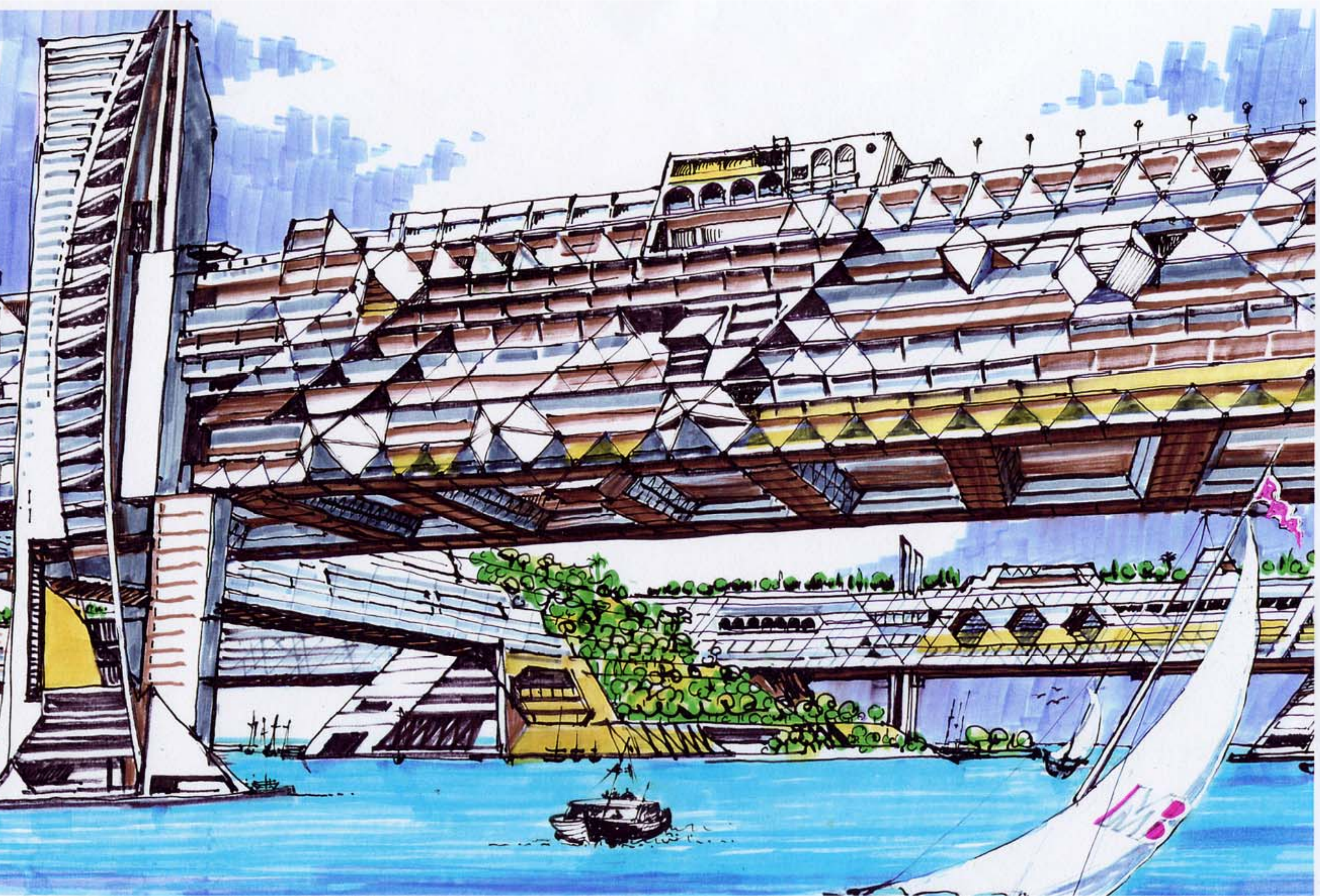


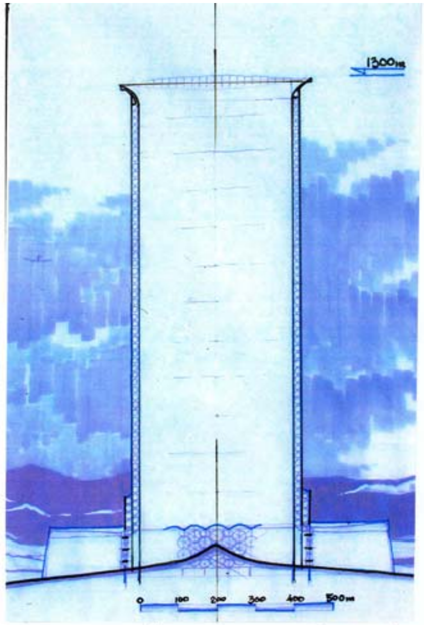

Significant quantities for structural analysis model (~ 1/4 system):

Number of nodes: 2145
Number of members: 7023, 2 lengths: 4.0 m for modules sides and $4 \times \sqrt{2} = 5.6568$ m to diagonalise cuboctahedron-sq
Material properties: of steel
Imposed load: uniform: 1.0 kN/m² (= 100 kg/m²), dead weight of structure include
Supports: vertical, at the sides of plate (+ symmetry constraints at sym. axes).
Maximum vertical displacement = – 50.7 cm at the middle of the plate,
e.i. ~ 1/400 of span.
(Additional horizontal displacements up to 10.0 cm)
Maximum forces: – 167 Tons (compression), 130 Tons (Tension)

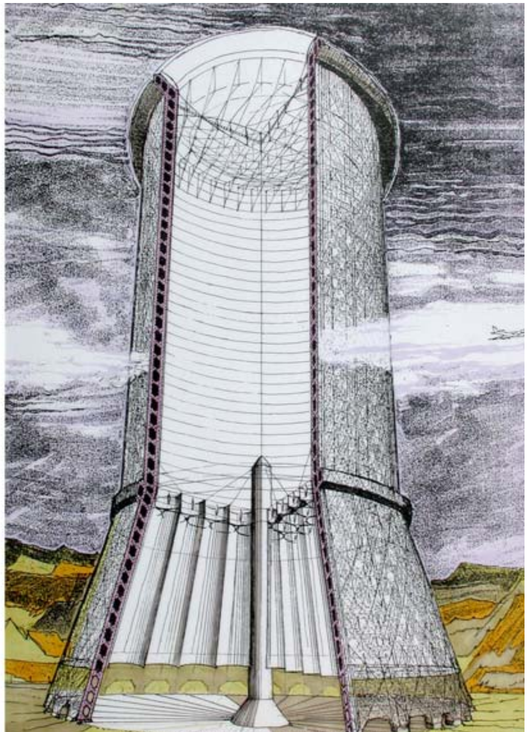
Dimensioning results (for the whole plate with sides 200 m x 200 m = 40 000 m²)
Tubes: 28 092, total length: 119 009.3 m weight = 1343.41 T
Nodes: 8 580, weight = 124.04 T
Σ 1467.45 T → 1500 Tons → 37.5 kg/m²

| Tube size distribution | | Node size distribution (out / flats) | |
| --- | --- | --- | --- |
| ø 88.9 x 3.4 | 57% | ø 110 / 58 | 22.5 % |
| 108. x 3.6 | 17.2 % | 132 / 118 | 20.0 % |

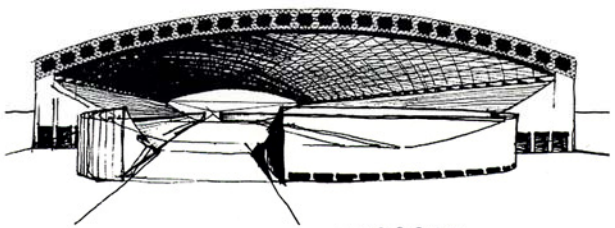





AERO-ELECTRIC POWER STATION, UTILIZING HOT-DRY DESERT AIR (BY DAN ZASLAVSKI), WITH I.P.L STRUCTURE OF 1300m HIGH.



AERO-ELECTRIC POWER STATION I.P.L TOWER



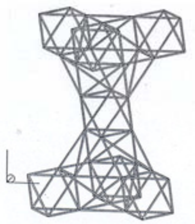
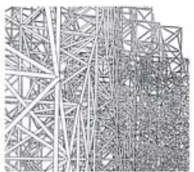
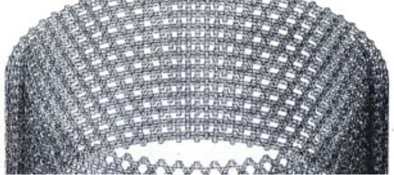
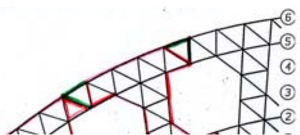
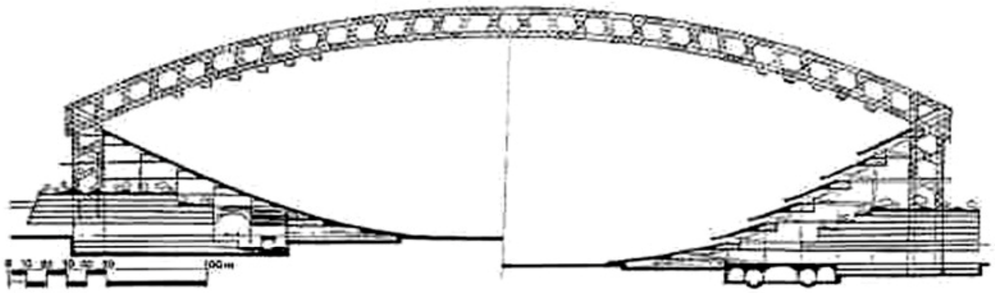


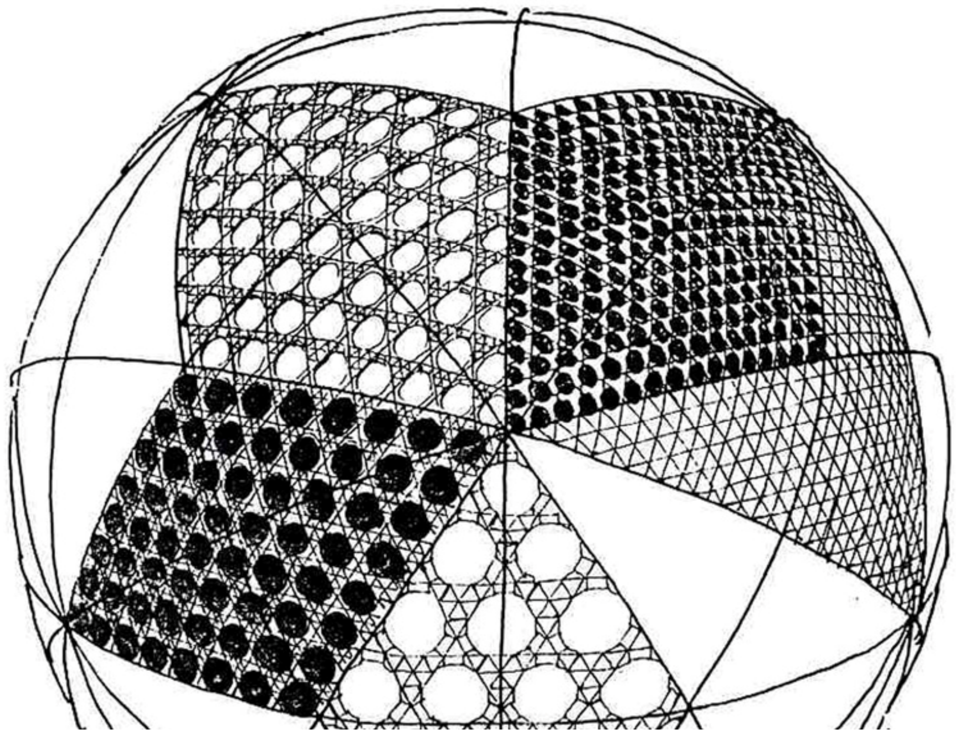
Figure 2. Basic repetitive "column" substructure

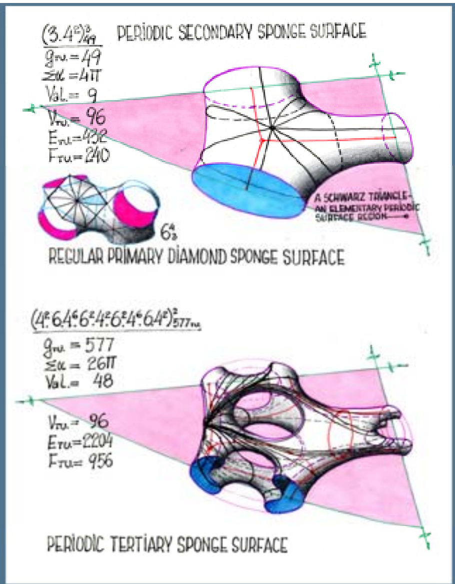


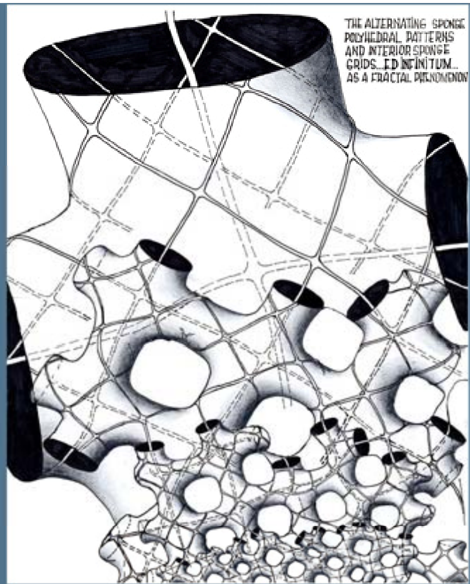


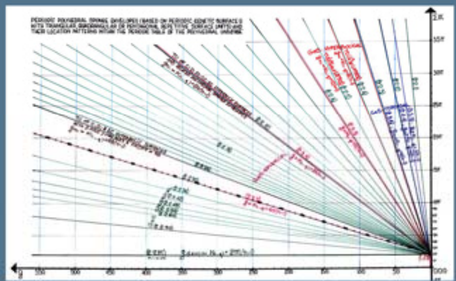




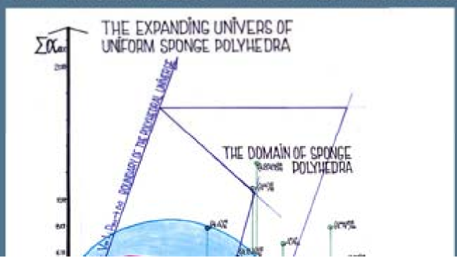


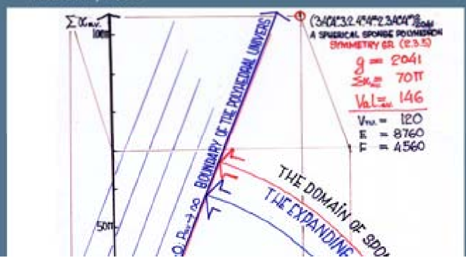


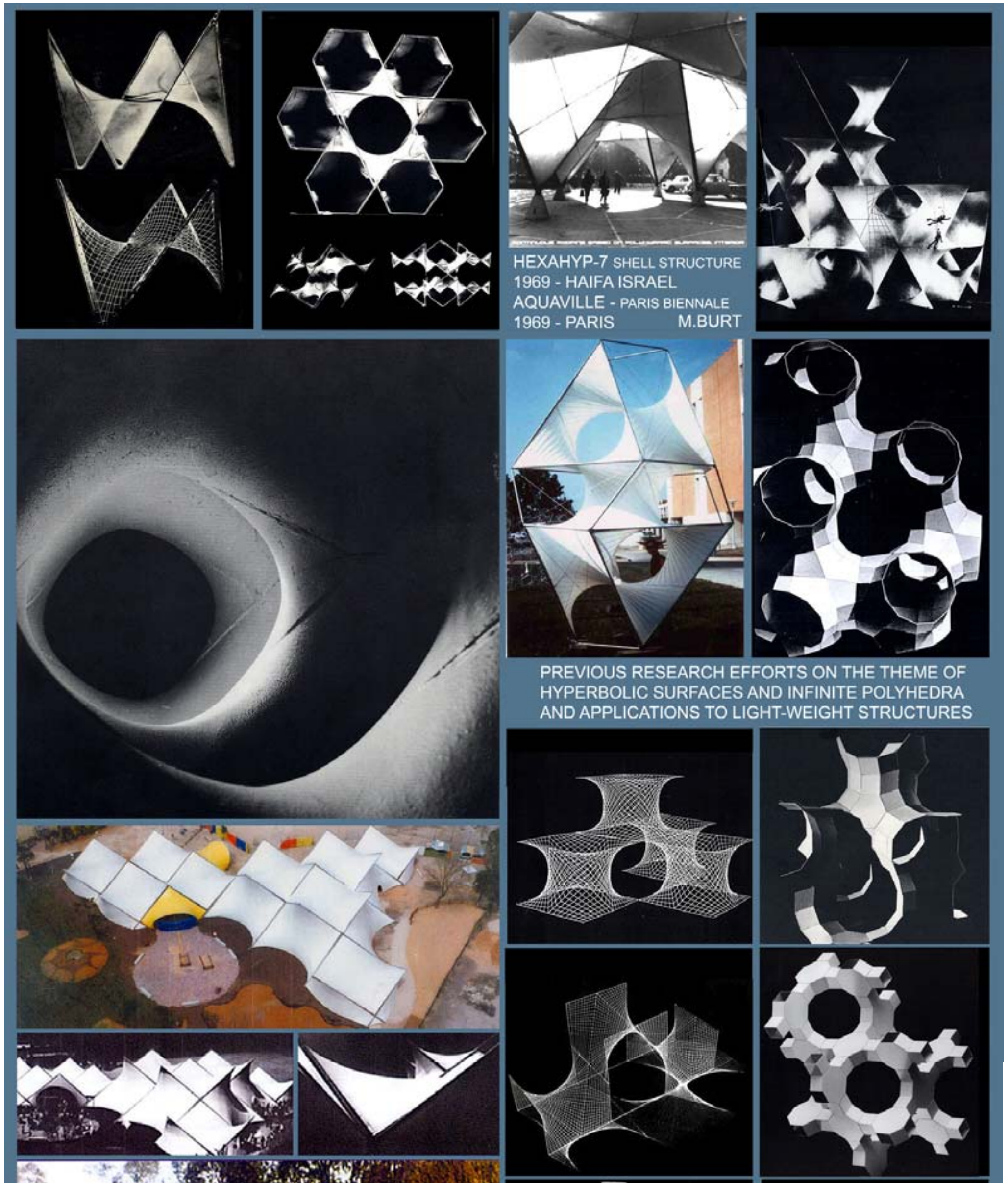



SOME ASPECTS OF PERIODIC SPONGE SURFACES AND UNIFORM SPONGE POLYHEDRA ,
THERE GENESIS, FRACTAL NATURE AND EXPANSION OF THE DOMAIN AS PERCEIVED THROUGH
THE 'PERIODIC TABLE OF THE POLYHEDRAL UNIVERSE' - M.BURT, 1996




HEXAHYP-7 SHELL STRUCTURE
1969 - HAIFA ISRAEL
AQUAVILLE - PARIS BIENNALE
1969 - PARIS M.BURT
PREVIOUS RESEARCH EFFORTS ON THE THEME OF
HYPERBOLIC SURFACES AND INFINITE POLYHEDRA
AND APPLICATIONS TO LIGHT-WEIGHT STRUCTURES

N

hen all the horizon of sponge structures is taken in, it dawns on us that the umber of periodic sponge surfaces with all their phenotypes, symmetries, yered arrangements and modes of perforations and polyhedral families, any of which include infinite number of members, each, is overwhelming; uch in excess of all the familiar polyhedra in the g = 0 (spherical) and the = 1 (toroidal) domains.

o, its not just in the natural-physical-biological, but also in the abstract realm the theoretically imaginable world of geometry that the sponge onfigurations and imagery constitute an overwhelmingly greater majority of hapes and forms, and it is high time to inaugurate their exploration within and the morphological community, to compensate for millennia long neglect of e subject.

he new sponge imagery might play a significant role in the morphological search of bio-forms and physical nano-structures, promote images and ideas innovative space structures and influence the way we perceive our creasingly denser urban habitat