The English Cube
and Metatron Numbers

A new class of constants in geometry

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Abstract. The cube and the English alphabet share a count: the cube has 26 characteristic elements — 8 vertices, 12 edges and 6 faces — and the alphabet has 26 letters. Labelling the one with the other gives the *English Cube*. The 26 elements are joined by 253 non-overlapping segments whose total length is a constant, here called a *Metatron Number*. For the unit cube that grand constant is $24\sqrt{1} + 36\sqrt{2} + 16\sqrt{3} + 7 + 16\sqrt{4} + 36\sqrt{5} + 24\sqrt{6} \approx 280.9107$. This paper sets out the counting, tabulates the eight distinct segment lengths, gives the constants for the surface, the centre and the body separately, proposes a notation, and extends the idea to other polyhedra.

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1 The coincidence of 26

The most common polyhedron, the cube, and the world's most common language, English, happen to have the same number of characteristic features or basic elements.

In the case of the English language it is the 26 letters (A–Z) of the alphabet; in the case of the cube it is the 26 characteristic features — 8 vertices, 12 edges and 6 faces — as defined and used by Plato, Euclid, Leonardo da Vinci and Leonhard Euler.

This coincidence lends a golden opportunity to label the 26 elements of a cube with the 26 letters of the English alphabet, creating the highly educational **English Cube** through a perfect one-to-one correspondence. Vertices take A–H, faces I–N and edges O–Z.

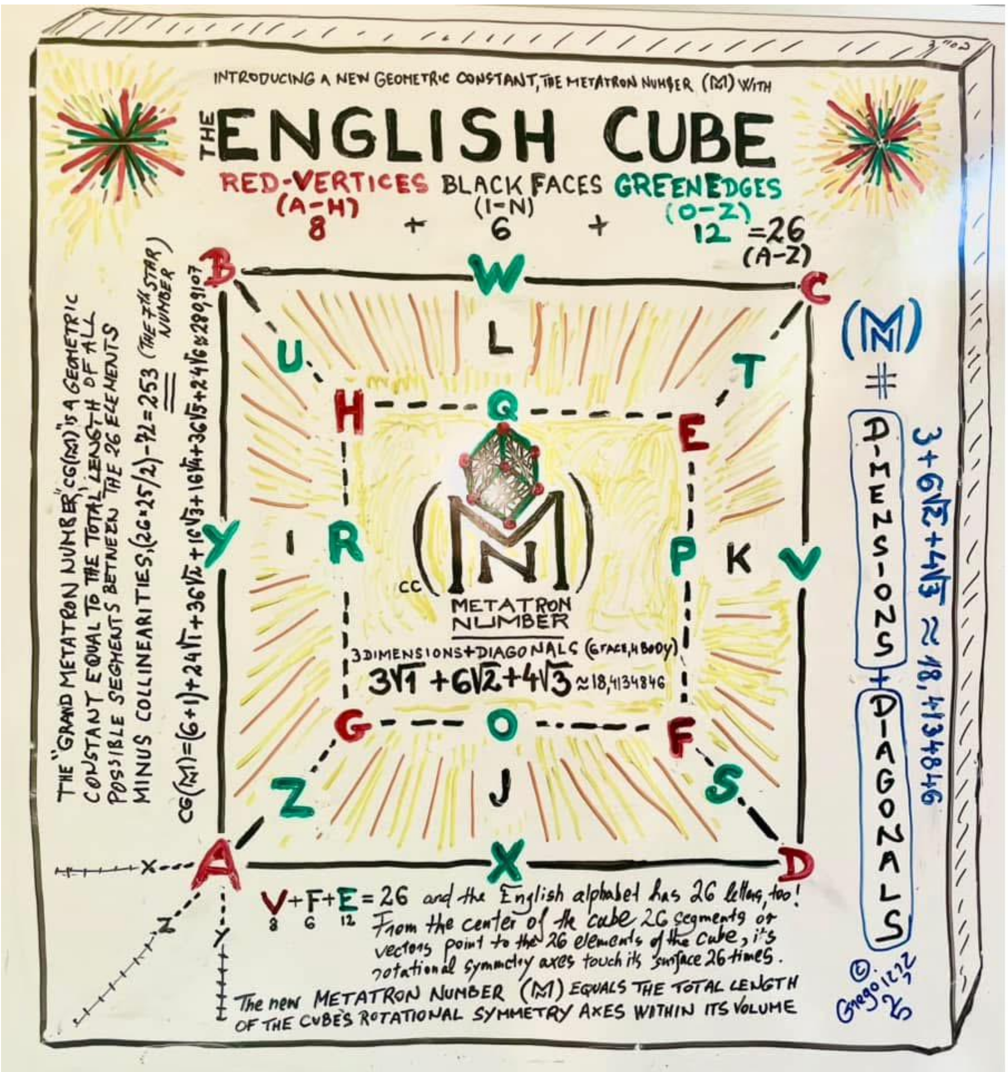


Figure 1. The English Cube. Red vertices A–H (8), black faces I–N (6), green edges O–Z (12), together 26 = the letters of the alphabet.

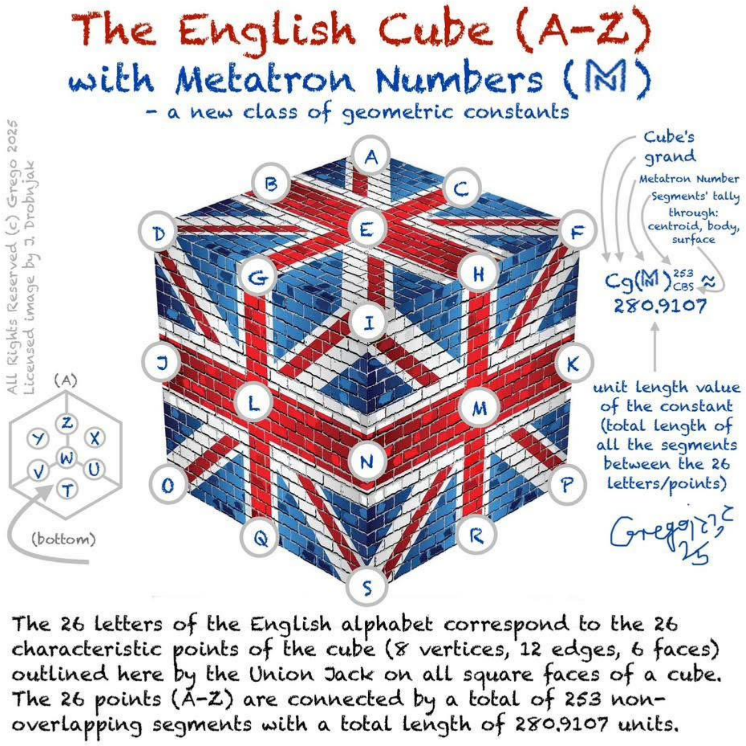


Figure 2. The same labelling laid out on a cube whose square faces each carry the Union Jack, with the bottom face unfolded at the left. Licensed image by J. Drobnjak.

2 Counting the segments: 325 becomes 253

Because there are so many elements, and because so many of them are collinear, it is a complex task to calculate the number and the length of the segments connecting the 26 letter-labelled elements — the vertices and the midpoints of the edges and of the faces.

The complete graph on 26 points has (26 × 25) / 2 = 325 connections. Of these, 72 are collinear with others and are therefore absorbed: 24 vertex-to-edge, 24 vertex-to-face and 24 edge-to-face segments of length $\sqrt{2} / 2$. Subtracting them leaves the count of genuinely distinct, non-overlapping segments:

$$(26 \times 25) / 2 - 72 = 325 - 72 = \mathbf{253}$$

One way to group these 253 segments is to consider those that run i) through the cube's centroid — the 27th element, if you like — ii) on its surface, and iii) within its body, with or without the 12 unit edges of the frame.

2.1 Why 253 is worth a second look

253 is both a star number and one of Euler's and Gauss' 65 idoneal numbers (*numerus idoneus*). A star number is $6n(n-1) + 1$, and 253 is the seventh: $6 \times 7 \times 6 + 1 = 253$. A positive integer is idoneal if and only if it cannot be expressed as $ab + ac + bc$ where a, b and c are positive integers with $0 < a < b < c$.

253 is also the result of moving the first digit of 325 to the end — 325 being the full graph before the 72 collinear surface segments are subtracted.

253 is the number of pairings, the full graph, of 23 points, as used in the known Witt Steiner system S(4, 7, 23). The Leech lattice in 24 dimensions, the tightest sphere packing there is, projected onto three directions drawn from the Golay code, makes its 196,560 shortest vectors fall into shells, and the first three hold 6, 12 and 8: faces, edges, corners, in that order — reason or rhyme, I do not know…

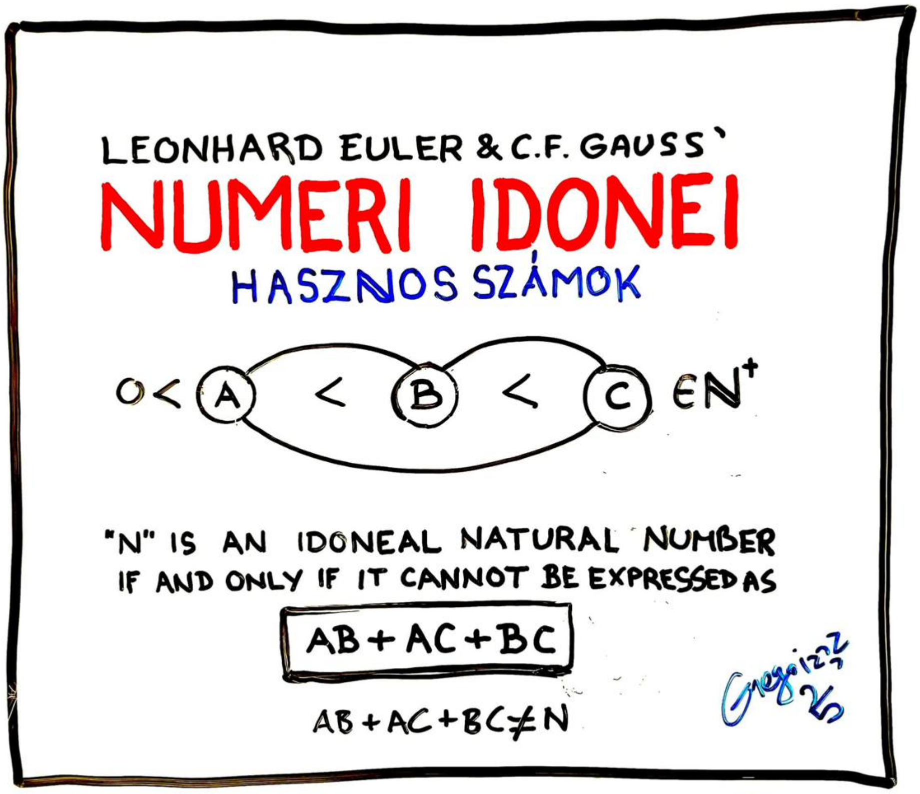


Figure 3. The idoneal condition. N is an idoneal natural number if and only if it cannot be written as ab + ac + bc. Named here by the author as "hasznos számok" for the first time in known Hungarian mathematical literature.

3 The eight segment classes

Every one of the 253 segments falls into one of eight length classes. Each length is the hypotenuse of a right triangle built on the cube's own dimensions, so all eight are exact surds. Table 1 gives the class code, how many segments carry it, the exact length, its decimal value and which kinds of element the segment joins.

	Code	Count	Length	≈	Joins	From legs
1	CBD	4	√3	1.7321	VV(B)	1, √2
2	HCBD	24	3/2	1.5000	VE(B)	1, √5/2
3	CFD	18	√2	1.4142	VV(S_1), EE(B_1)	1, 1
4	QCBD	48	√6/2	1.2247	VF(B), EE(B_2)	1, √2/2
5	QCFD	72	√5/2	1.1180	VE(S), EF(B_1)	1, 1/2
6	CE	27	1	1.0000	VV(12), EE(S_1), FF(B_1)	√2/2, √2/2
7	ECBD	24	√3/2	0.8660	EF(B_2)	1/2, √2/2
8	ECFD	36	√2/2	0.7071	EE(S_2), FF(B_2)	1/2, 1/2
	Σ	**253**		**280.9107**		

Table 1. The eight segment classes. CBD cube body diagonal, CFD cube face diagonal, HC half cube, QC quarter cube, EC eighth cube, CE cube edge. V vertex, E edge, F face; S on the surface, B in the body. Read off the author's construction sheet, Figure 4.

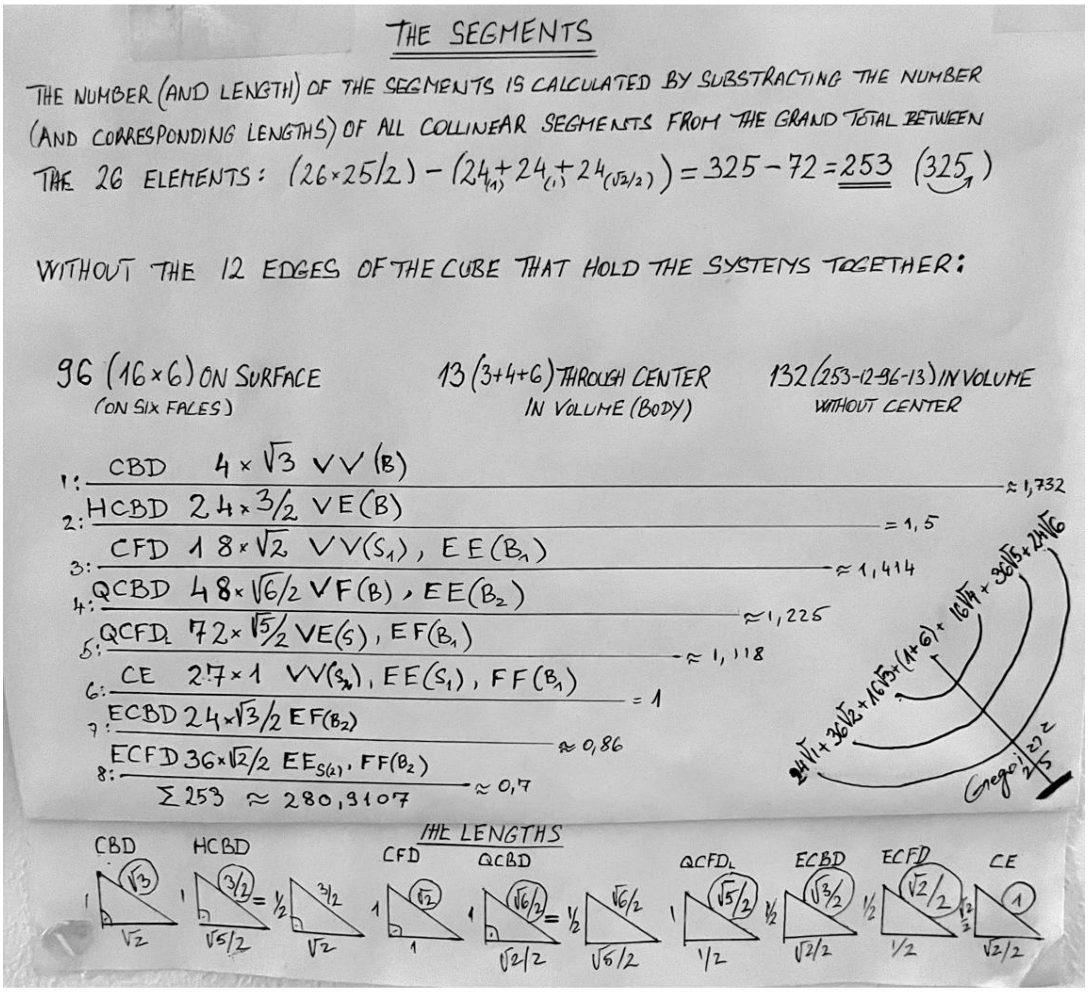


Figure 4. The segments. The counting at the top, the eight classes in the middle with their element pairs and decimal lengths, and at the foot the right triangles from which each length is derived.

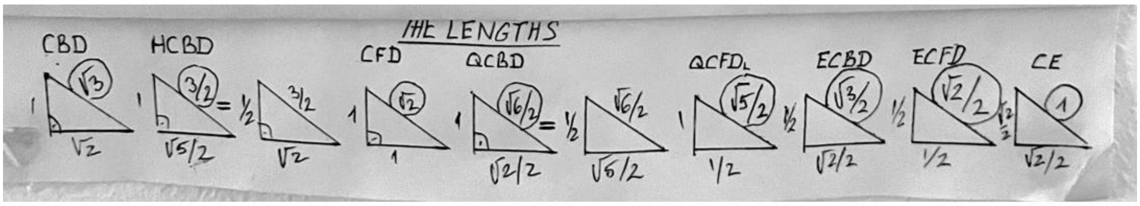


Figure 5. Detail of Figure 4: the length constructions. Each hypotenuse is circled — √3, 3/2, √2, √6/2, √5/2, √3/2, √2/2 and 1.

4 The cube's Metatron Numbers

To curtail such cumbersome calculations I propose the use of constants called **Metatron Numbers**, written with a custom designed symbol featuring a capital M with a capital N under it, enclosed in brackets. Such constants can be determined for a great many other polyhedra as well.

The 253 segments split into three disjoint families plus the frame: 96 lie on the six faces, 13 run through the centroid, 132 lie inside the body without touching the centroid, and 12 are the edges of the frame itself. Table 2 gives the constant for each family, alone and with the frame included.

Constant	Segments	Expansion	Value
$C(\mathbb{M})^{96}_{s}$	96	12√1 + 24√2 + 24√5	99.6068
$C(\mathbb{M})^{108}_{s,12}$	108	24√1 + 24√2 + 24√5	111.6068
$C(\mathbb{M})^{13}_{c}$	13	3√1 + 6√2 + 4√3	18.4134846
$C(\mathbb{M})^{25}_{c,12}$	25	15√1 + 6√2 + 4√3	30.4134846
$C(\mathbb{M})^{132}_{b}$	132	36√1 + 6√2 + 12√3 + 12√5 + 24√6	150.8907
$C(\mathbb{M})^{144}_{b,12}$	144	48√1 + 6√2 + 12√3 + 12√5 + 24√6	162.8907
$C(\mathbb{M})^{253}_{cbs,12}$	**253**	**24√1 + 36√2 + 16√3 + 7 + 16√4 + 36√5 + 24√6**	**280.9107**

Table 2. The cube's Metatron Numbers for a unit edge. Subscript s on the surface, c through the centroid, b in the body without the centroid; the trailing 12 means the frame's unit edges are counted in.

4.1 The partition is exact

The three families and the frame are mutually exclusive and together exhaust the drawing, which gives a check on the whole calculation. The counts add up and so do the lengths:

$$96 + 13 + 132 + 12 = 253$$

$$99.6068 + 18.4135 + 150.8907 + 12 = 280.9107$$

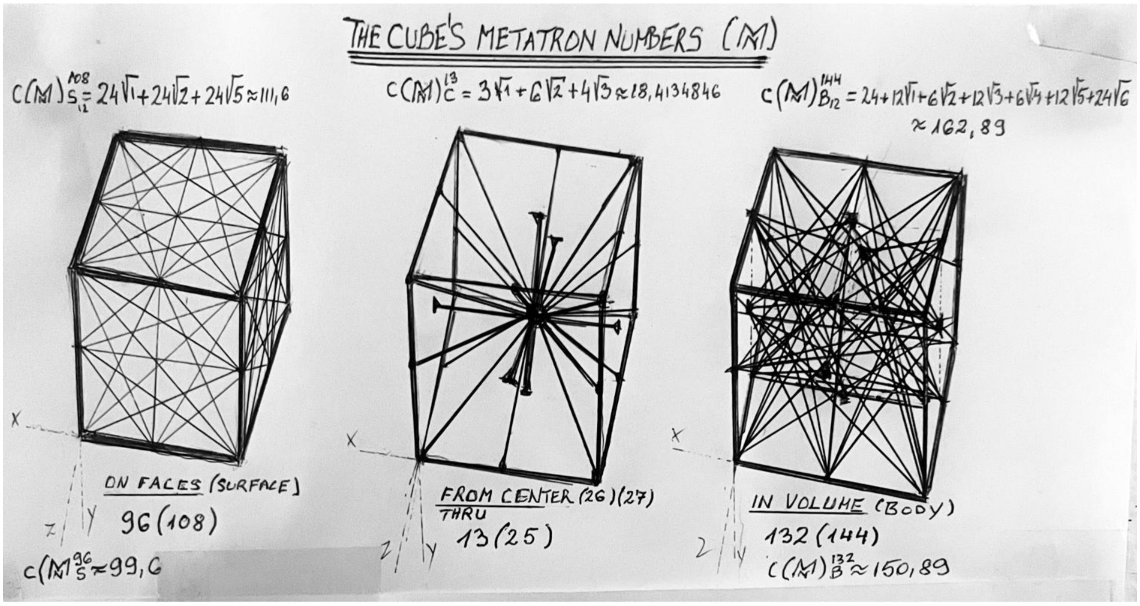


Figure 6. The three families drawn separately: 96 segments on the six faces, 13 through the centroid, and 132 inside the volume without the centroid. Bracketed numbers include the 12 edges.

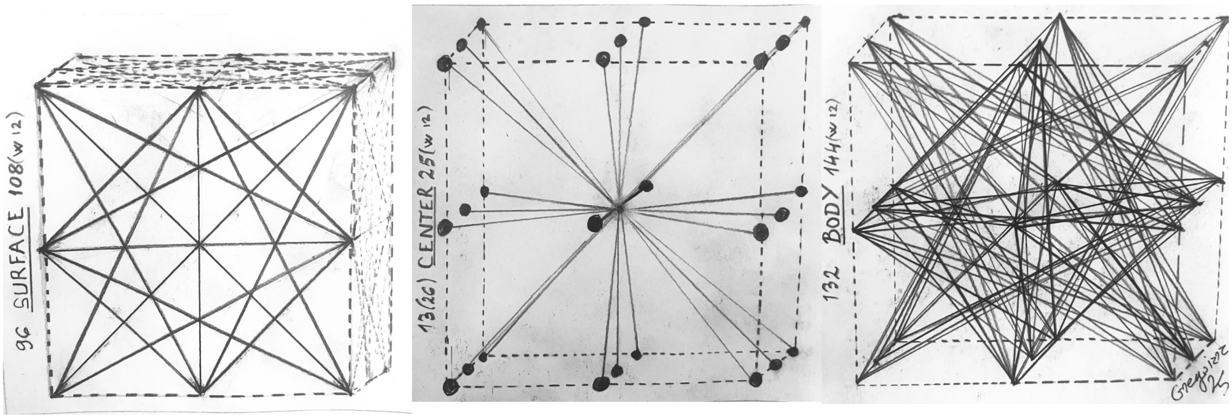


Figure 7. The same three families drawn full size. Left, on the surface: 96 segments, 108 with the frame. Centre, through the centroid: the 13 rotational symmetry axes, 3 of length 1, 6 of length √2 and 4 of length √3, or 25 with the frame. Right, in the volume: 132 segments that miss the centroid, 144 with the frame.

5 The grand Metatron Number

Adding the families together gives the constant for the whole English Cube:

$$C(\mathrm{M})^{253}_{\mathrm{cbs},12} = 24\sqrt{1} + 36\sqrt{2} + 16\sqrt{3} + 7 + 16\sqrt{4} + 36\sqrt{5} + 24\sqrt{6}$$

$$\approx 280.9107$$

The summation of the segment lengths is rearranged here to display all square roots from 1 to 6 in a full and symbolic symmetry of the coefficients — 24, 36, 16 on either side — with the number 7, the days of creation, in the middle, illustrated as a seven-branch candelabrum. Note also that adding the digits of the rounded value 280.9107 gives 27: the 26 elements plus the centroid, the 27th.

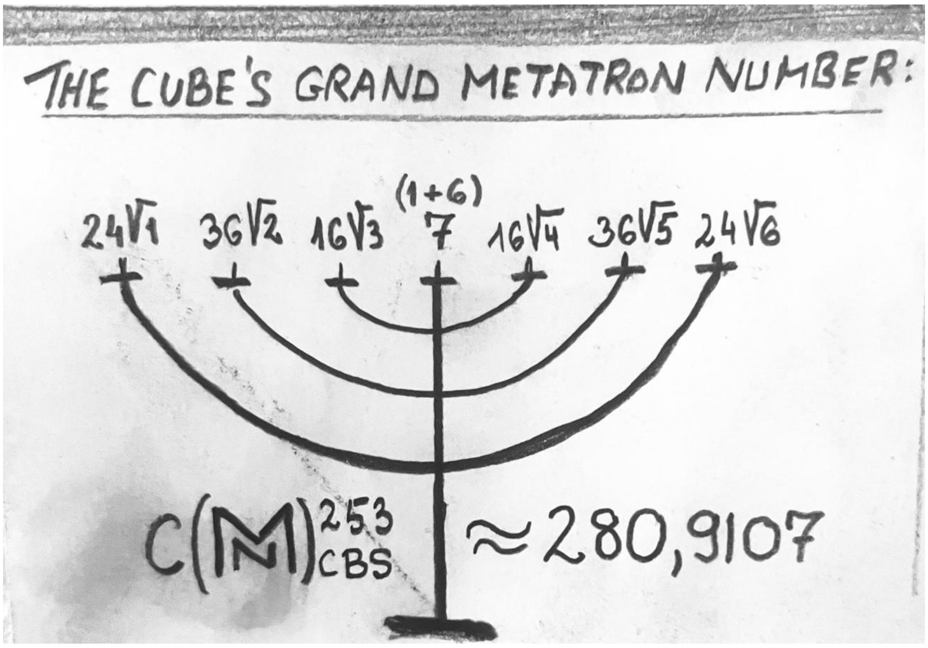


Figure 10. The grand Metatron Number as a menorah, the 7 at the centre stem and the surds paired outwards.

6 Notation

In front of the (MN) symbol's left bracket stands a capital letter code for the polyhedron: C cube, T tetrahedron, O octahedron, D dodecahedron, I icosahedron, CO cuboctahedron, SnC snub cube, RhCO rhombicuboctahedron, RhD rhombic dodecahedron — that is, the Platonic, Archimedean and Catalan solids and others. Where applicable a lower case attribute follows it, such as g for the overall, grand constant.

The right bracket is followed by a small superscript giving the number of segments counted, and a subscript letter code giving their composition: s on the surface, b in the body, c through the centroid, v between vertices, e between edges, f between faces, and ve, vf, ef between combinations of two. A further subscript number indicates the inclusion of the frame, that is the number of unit edges. Thus $C(\mathrm{MN})^{253}_{cbs,12}$ reads: the cube's grand Metatron Number over 253 segments through the centroid, in the body and on the surface, the 12 edges included.

In the original 2025 post subscripts were not available and the codes were written on the line. They are set properly here.

7 Other polyhedra: the regular tetrahedron

For a regular tetrahedron of unit edge, with 14 elements — 4 vertices, 6 edges and 4 faces — the Metatron Numbers come out as follows.

Constant	Segments	Value	Meaning
$T_g(\mathrm{MN})^{55}_{vef,6}$	55	35.7796	all segments, collinear ones subtracted
$T(\mathrm{MN})^{24}_{s}$	24	16.3923	on the surface, without the edges
$T(\mathrm{MN})^{31}_{b,6}$	31	19.3873	inside the body, edges included
$T(\mathrm{MN})^{7}_{c}$	7	5.3873	the 7 rotational symmetry axes

Table 3. The regular tetrahedron of unit edge.

The same partition check works here: 24 + 31 = 55 segments, and 16.3923 + 19.3873 = 35.7796. The digits of the rounded 5.3873 add up to 26, leading on to the cube.

8 Interpolated Metatron Numbers

A whole alternative sub-class arises when the calculation rests on comparative ground: when one polyhedron is nested in another, or when one is the convex hull of another. In such cases we set the unit base and use the adequate annotation. OnC(MN) means the constant for an octahedron (O) nested (n) inside a unit cube (C). The letter h denotes that the segments counted belong to the polyhedron preceding the subset indicator, which is the convex hull of the one named after it, the latter's side being the unit base for all calculations.

9 An invitation

Aside from the many potential practical uses — in architecture, engineering, construction and procurement — comparing the absolute values and the ratios between the various Metatron Numbers and the segment counts of a given polyhedron, of pairs, or even of groups of polyhedra, can provide an almost inexhaustible treasure trove for analysis and further geometric discoveries related to polyhedral structures.

I kindly invite the reader not only to double check the results of the examples above, but to calculate and share Metatron Numbers for other polyhedra. As for the English Cube, there is no doubt in my mind that this labelling system of the cube's elements can serve as a highly effective tool in education at any level.

Grego

26 January 2025

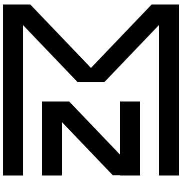
Appendix A Segment abbreviations

CBD cube body diagonal · CFD cube face diagonal · HC half cube · QC quarter cube · EC eighth cube · CE cube edge

VV, VE, VF vertex to vertex, edge, face · EE, EF edge to edge, face · FF face to face

Appendix B The (MN) sign

The symbol was drawn for this purpose in 2025–2026: a capital M with a capital N beneath it, sharing one baseline, no stroke shared between the letters. Its two left stems, its two right stems and the M's descending arm with the N's diagonal form three parallel pairs, and the perpendicular gap is the same for all three. That condition alone fixes the angle at 43.82° from the vertical. The construction sheet follows on the next page; the full design notes are a separate document.



The five rules of the drawing

1 The N sits under the M. Neither letter borrows a stroke from the other; every stroke is drawn once and belongs to one letter only.

2 Three pairs run parallel: the two left stems, the M's descending arm with the N's diagonal, and the two right stems. The M's rising arm has no partner, since nothing in an N can match it.

3 All six strokes carry the same perpendicular width, so the diagonals are cut wider horizontally and read at the same weight as the stems.

4 The perpendicular gap is the same for all three parallel pairs, and the vertical gap between the vee's flat bottom and the N's cap line matches it. Stroke and gap are equal.

5 The M and the N stand on one baseline. The N has no descender and the M no overshoot; both are cut flat at top and bottom.

Rule 4 over-determines the drawing, so the angle is not a free choice. With $a = t + g$ and $s = \sec\theta$, the four gap conditions collapse into $a(1 + 3s) = k(H + 2g)$, which fixes $k = \tan\theta$. On a cap height of 700 units with stroke and gap both 80, that gives $k = 0.95959$ and $\theta = 43.82°$. The gap is the only dial.

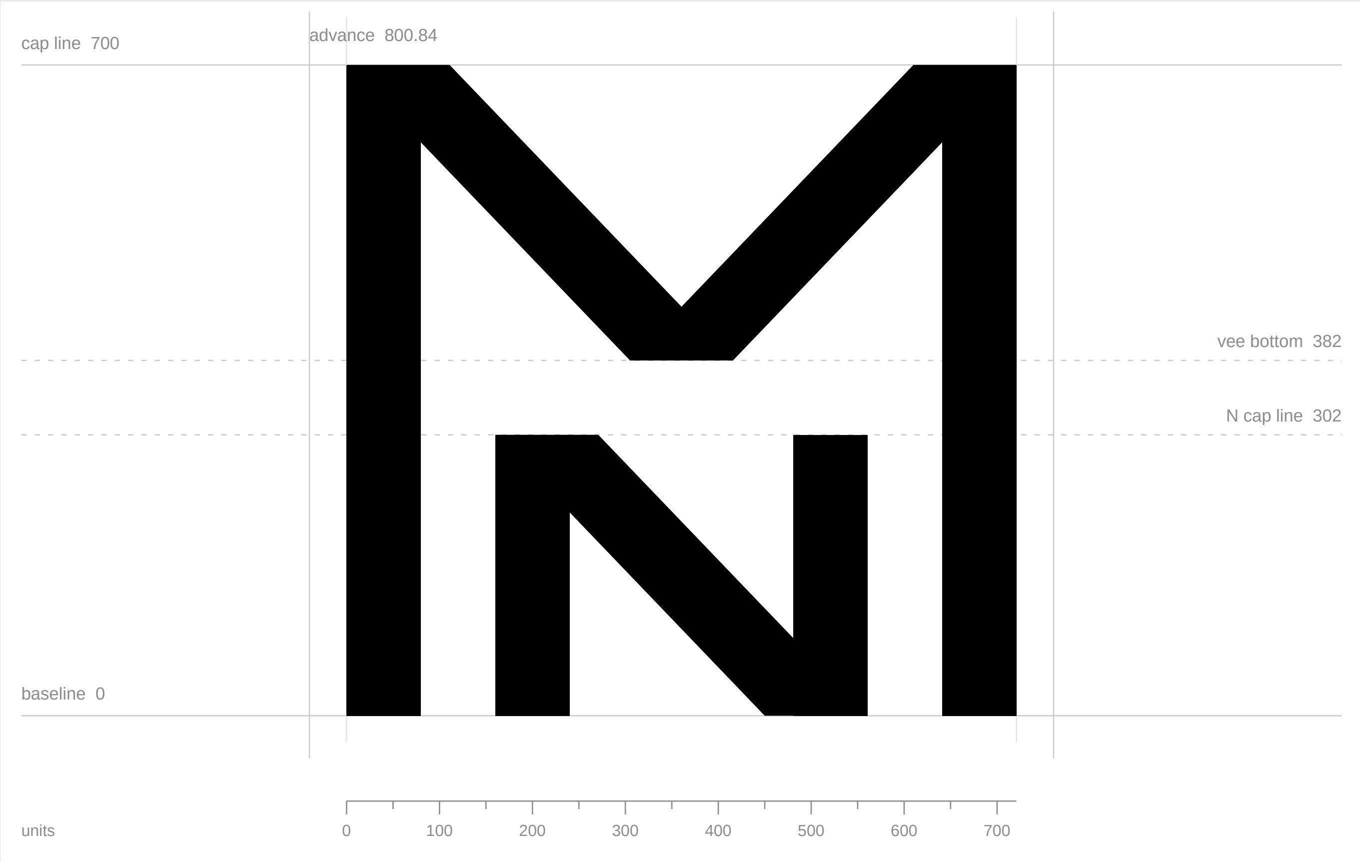
Turned a quarter to the left the mark reads as a sigma with a Z inside it, which suits a sign that denotes a sum.

MN Metatron Number sign

Geometric constant mark · single weight · 1000 upm

Construction sheet

designed by Grego · 2025–2026



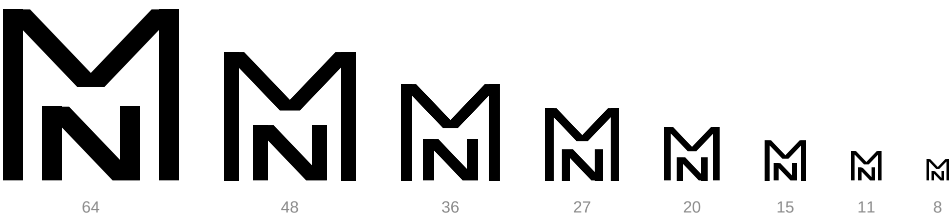
METRICS	
units per em	1000
cap height	700
ink width	720.84
sidebearings	40 / 40
advance width	800.84
descender	0

CONSTRUCTION	
stroke t	80
gap g	80
angle from vertical	43.82°
slope k = tan θ	0.95959
diagonal cut width	110.87
vee bottom width	110.87

THE N	
cap line	397.83
height	302.17
ink width	400.84
offset from M left	160
offset from M right	160
vee clearance	64.98

SIZE LADDER

cap height in points

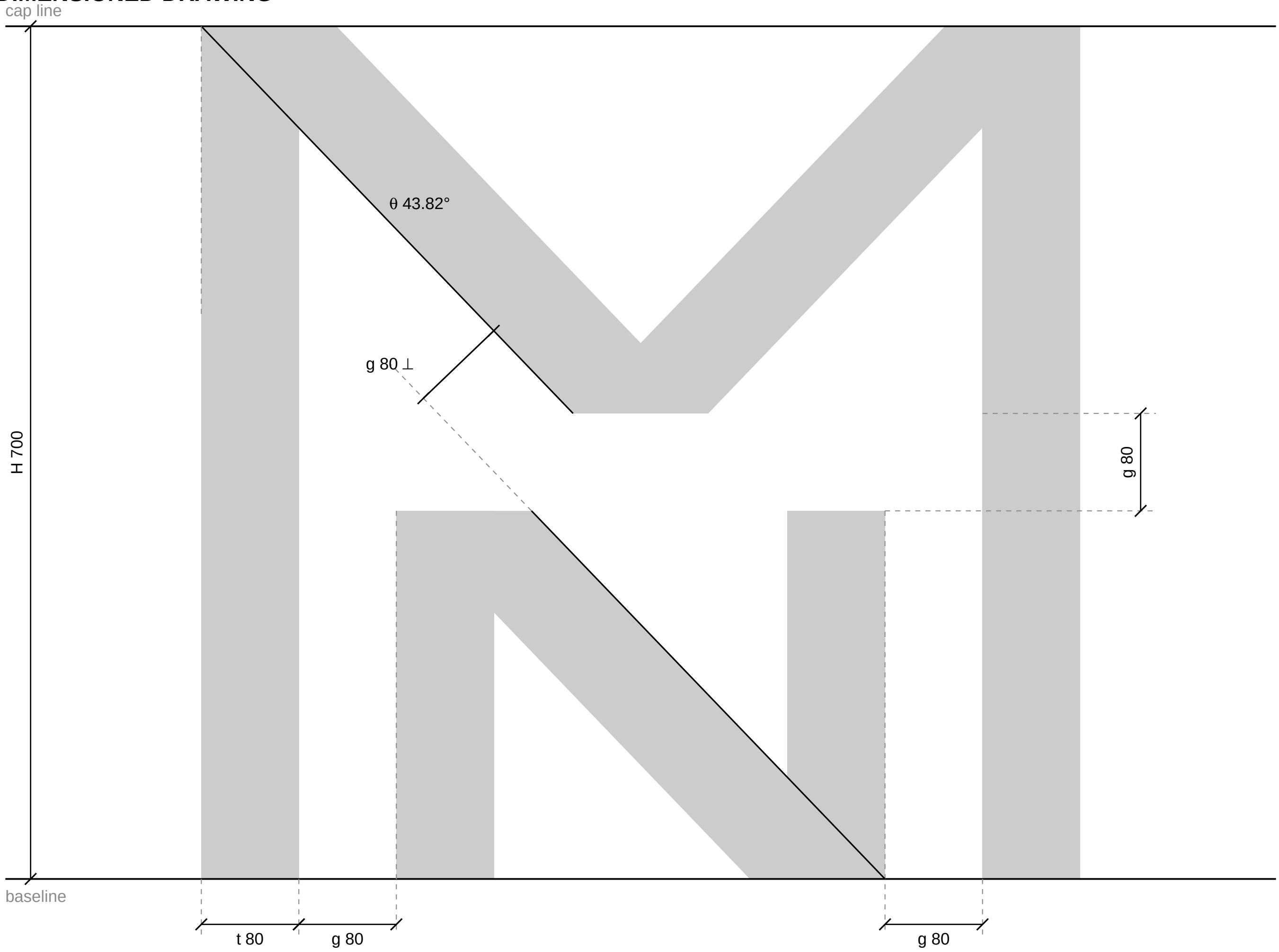


PROOFS

the cube's grand MN ≈ 280.9107	11 pt
the cube's grand MN ≈ 280.9107	9 pt
the cube's grand MN ≈ 280.9107	7 pt

Construction

DIMENSIONED DRAWING



THE FIVE RULES

1. The N sits under the M. Neither letter borrows a stroke from the other; every stroke is drawn once and belongs to one letter only.
2. Three pairs run parallel: the two left stems, the M's descending arm with the N's diagonal, and the two right stems. The M's rising arm has no partner — nothing in an N can match it.
3. All six strokes carry the same perpendicular width t, so the diagonals are cut wider horizontally, $t \cdot \sec\theta$, and read at the same weight as the stems.
4. The perpendicular gap is the same for all three parallel pairs, and the vertical gap between the vee's flat bottom and the N's cap line matches it. Here stroke and gap are equal: $t = g = 80$.
5. The M and the N stand on one baseline. The N has no descender and the M no overshoot; both are cut flat at top and bottom.

WHY THE ANGLE IS NOT A FREE CHOICE

Rule 4 over-determines the drawing. Writing $a = t + g$ and $s = \sec\theta = \sqrt{1 + k^2}$, the four gap conditions collapse into a single equation, which fixes k for any given cap height, stroke and gap:

$$\mathbf{a \cdot (1 + 3s) \;=\; k \cdot (H + 2g)}$$

Everything else follows from k. The N's cap line sits $a(1 + s) / k$ below the M's; the ink width is $kH + a(1 - s) + ts$; the vee's flat bottom lands at $(W - ts) / 2k$. With $H = 700$ and $t = g = 80$ this gives $k = 0.95959$, that is $\theta = 43.82°$ from the vertical. A wider gap opens the angle, a narrower one closes it. The gap is the only dial.

Coordinates, variants, use

OUTLINE — SEVEN CLOSED CONTOURS, Y MEASURED UP FROM THE BASELINE

CONTOUR	POINT 1	POINT 2	POINT 3	POINT 4
M left stem	0.00 700.00	80.00 700.00	80.00 0.00	0.00 0.00
M right stem	640.84 700.00	720.84 700.00	720.84 0.00	640.84 0.00
M left arm	0.00 700.00	110.87 700.00	415.86 382.17	304.98 382.17
M right arm	609.96 700.00	720.84 700.00	415.86 382.17	304.98 382.17
N left stem	160.00 302.17	240.00 302.17	240.00 0.00	160.00 0.00
N right stem	480.84 302.17	560.84 302.17	560.84 0.00	480.84 0.00
N diagonal	160.00 302.17	270.87 302.17	560.84 0.00	449.96 0.00

Fill rule non-zero. The contours overlap by design: the two arms share the vee, the N's diagonal meets both N stems.

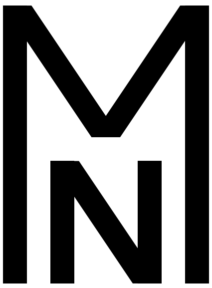
CLEARANCES, MEASURED

M left stem ↔ N left stem	80.000	vee bottom ↔ N cap line	80.000
M left arm ↔ N diagonal (⊥)	80.000	vee bottom ↔ N left stem	64.982
M right stem ↔ N right stem	80.000	vee bottom ↔ N right stem	64.982

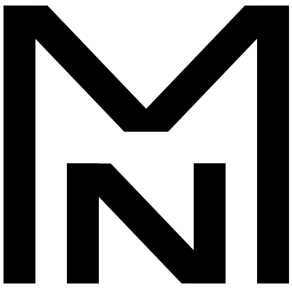
The first four are held equal by rule 4. The last two are not imposed — they come out symmetric on their own.

THE GAP IS THE ONLY DIAL

t = g = 40
θ 23.68°
width 343.3



t = g = 60
θ 34.07°
width 521.0

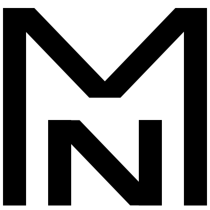


t = g = 80
θ 43.82°
width 720.8

Stroke and gap are locked together, so a single number drives the whole drawing. Raising it widens the letter and opens the angle; lowering it narrows and steepens. Only t = g = 80 is released.

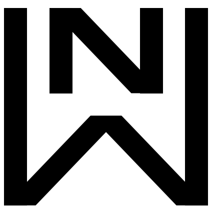
FOUR READINGS, ONE PER QUARTER TURN

The N has half-turn symmetry, so it survives the 180° rotation unchanged while the M becomes a W. Turned a quarter to the left the M lands as a sigma — two bars with the arms running in from the left edge to a vertex pointing right — and the N as a clean Z. Turned the other way the sigma mirrors into a 3. A fitting set of second readings for a sign that denotes a sum: 253 segments totalling 280.9107 units.



0°
M with N

90° left
Σ with Z



180°
W with N

270°
3 with Z

SETTING NOTES

Set the mark at the cap height of the surrounding face, on the baseline, with the 40 unit sidebearings intact. Do not letterspace into it, do not outline it, and do not scale the M and the N independently — the equal-gap solution holds only for the drawing as a whole. At 7 pt cap the stroke lands near half a point; below that, set MN as two ordinary letters instead.

Files: mn-glyph.svg (outlines, 1:1) · mn-construction.svg (dimensioned) · mn-designer-sheet.pdf (page 1 alone)