

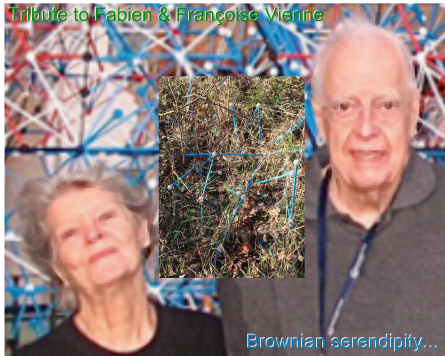
Zometool Tribute to Fabien Vienne at Bridges Finland 2016

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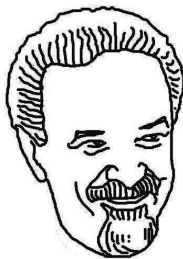
Abstract

During Bridges 2016, a sad year for the Bridges Organization with the loss of Fabien Vienne and Reza Sarhangi, also an avid Zometooler therefore remembered here too, we honored these emblematic figures by giving a special didactical character to the Zometool project, for the third time a part of Fabien's quasi-periodic 'universe' based on his 'Cubic Fuzzy Precision' theory. There was thus an educational need to properly report this event in some detail.

Fabien Vienne as an Instrumental Zometool Contributor to Bridges Conferences



One year following the loss of his supporting sweetheart Jacqueline, our friend Fabien Vienne passed away, after a long life that culminated for the general public with a French national tribute offered to him in the Cité de l'Architecture museum (Chaillot Palace) in Paris in 2015-2016 [1]. He devoted his post-professional life being deeply embedded in Zometool, a color-coded plastic geometric construction system: he co-designed with artist Jean Baudoin the signature shape of the Zometool 'green struts' invented by fellow artist Clark Richert [2,3] and spent years developing his 'Cubic Fuzzy Precision theory' (in short 'CFP theory'), that he was finally fully happy with during the last year of his life. Jim Hausman, his longstanding friend and coworker for many years (who is also active in TubeSpace--another system and one of the many games and systems Fabien designed--which allows structures impossible to construct with Zometool to be tackled [3,4]) helped Fabien bring on-line his mountains of carefully handwritten French documents, often with English translations [5], and produced with him a paper for Bridges Coimbra 2011 [6].



A few months after Fabien's, Reza Sarhangi's much too early passing away last year came as a shock to the Bridges community he founded [7]. I like to bring up this noble man here again with respect as he was also an avid Zometooler who, year after year, encouraged the playing of a masterpiece on this magnificent art-math instrument in his Bridges conferences, an idea that Paul Hildebrandt (co-inventor with Marc Pelletier of the technologically advanced Zometool connector ball, both of them also co-founders of the Zometool company, after a concept by Steve Baer et al), outlined in paper '*Zome-inspired Sculpture*' [2, already mentioned above] for Bridges London 2006.

This CFP theory [5] describes a structured five-fold symmetry 3D 'universe' centered on a single point around which it develops to infinity through successive concentric icosidodecahedra partitioned in a fractal way that can be perfectly built up by regular 'blue' Zometool inventory. Two large structures cut out in this universe became Bridges Coimbra 2011 barn-raising event called the 'Pentigloo' kiosk, unfortunately destroyed (Fig.1a) and Bridges Enschede 2013 'PentiDisc' hanging permanently from the ceiling at the Bridges premises in the tall hallway leading to the conference rooms, the tallest Zometool structure ever (Fig.1b).

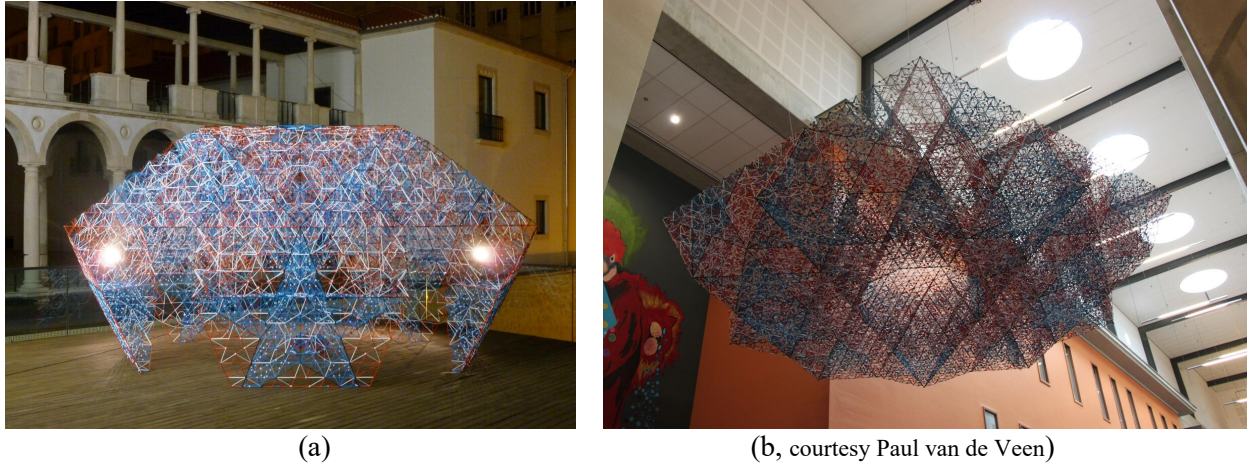


Figure 1: (a) *Pentigloo*, (b) *PentiDisc*.

For Bridges Finland 2016, Fabien was considered again for designing a project, but due to economic realities he advocated the 'Penticosido', an earlier 'cutout' of his 'universe' significantly smaller, with a dodecahedral outside shape that Paul Hildebrandt constructed, dense on the inside, in Colorado Springs in 2013 (Fig.2a). The inventory was still too important and when Fabien's fading health obliged him to take more rest, Jim Hausman, took charge of establishing the blueprint of the final selection between different variations, for which he had to decide to remove the internal subdivisions between the main diametrical planes containing the nodes of the successive icosidodecahedra and forming triangular and pentagonal 'carrots'. Scott Vorthmann made a starting initial simple vZome model of this (Fig. 2b).

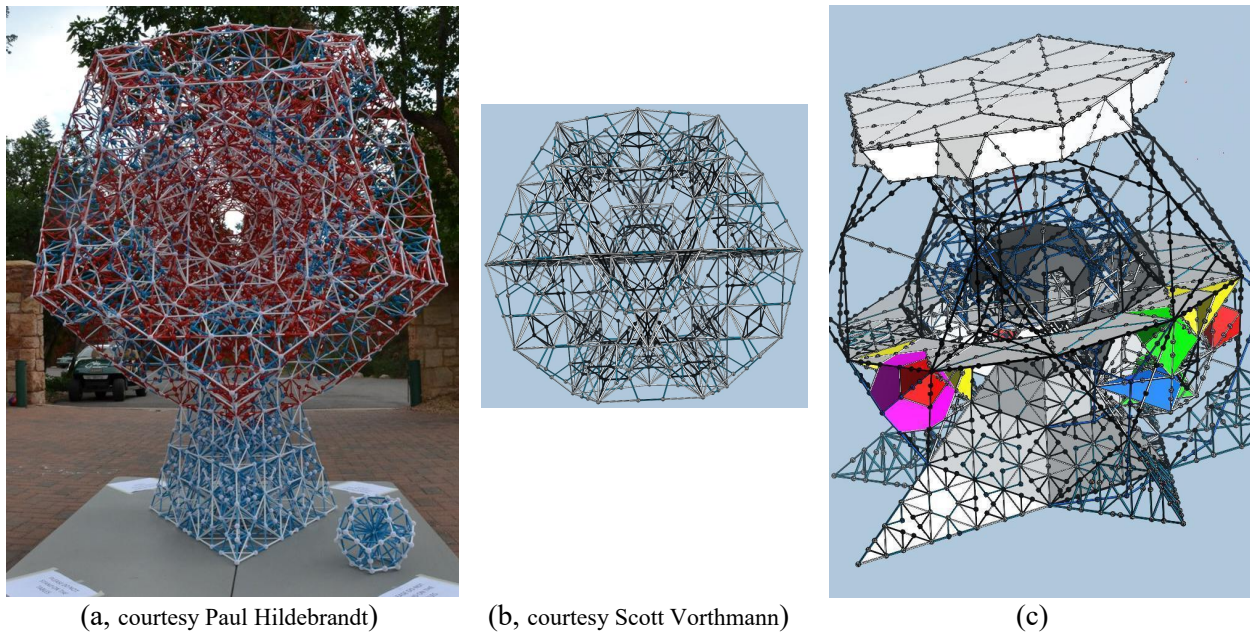


Figure 2: *Penticosido's*: (a) *Original*, (b) *Scott's vZome base model (Jim's idea)*, (c) *vZome model*.

The resulting openness of the remaining skeleton suggested to Jim the idea to take advantage of it by making use of colored off-the-shelf inventory to convey an educational edge to the sculpture: white radial lines would so be clearly differentiated versus the black 'circumferential' icosidodecahedral layers also easily identified. As Paul and Jim became unable to attend the conference, I was asked to take over the helm to bring the project to completion.

Study and Evolution of the Design of the Penticosido as an Open Book to Fabien's Theory

My help in the different previous Zometool barn-raising events essentially consisted, like for the many other contributors, to carefully follow the building instructions without having a clear view of the theoretical meaning of the multitude of tiled panels to mount and assemble, yet using my engineering skills to assess and help improve the stability of the structures. This time I would become the one who tries to understand the intimate geometry Fabien developed, to design and plan proper building strategies. This happened at home, using my extensive Zometool inventory gathered over the years for my personal models and the organization and animation of Zometool workshops for schools and family events. And so I created scale models of different sizes, up to the real one.

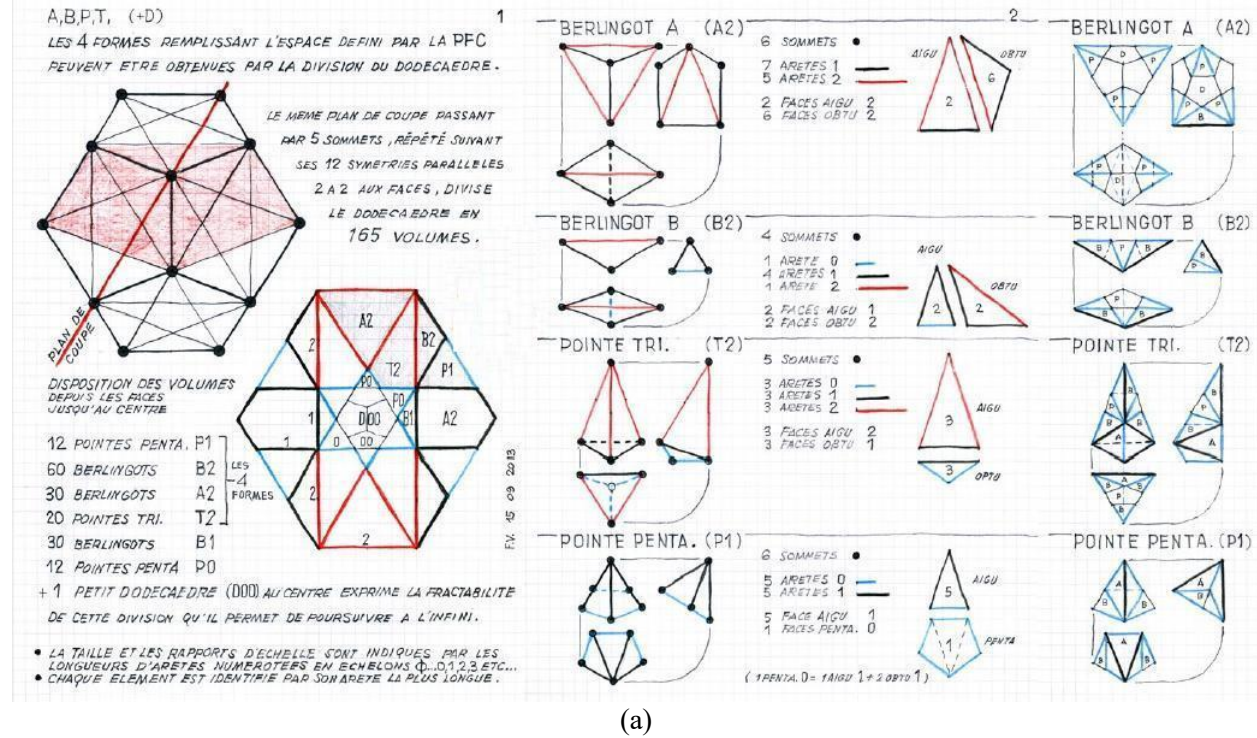
Need for stability: The large structure eventually collapsed, as the 'steel' content of rather long non-supported chains of struts was weak, so a stability challenge surfaced and had to be carefully taken care of, again based on engineering judgment. And so I constructed five slender pyramidal structures to support five zones around the large icosidodecahedral 'sphere' that bent downwards under the weight of structures above. This setup eventually was modified into a large star-shaped base for being visually, structurally, and above all more evidently as being an inherent part of the 'universe' ...which I later recognized as remarkably identical to the initial stage of the construction of the PentiDisc in Enschede as can be seen in an accelerated 3min movie Paul organized in Enschede by taking one hourly picture frame during the assembling of the scores of all sorts of panels Paul van de Veen had accumulated at home during the weeks before the conference. (See Fig.2c, as I started a Vzome model from Scott's Fig2b).

Need for remembrance: Meanwhile, thinking of this sudden special tribute role, also historic and educational, that the project would now play, the idea occurred to me that it could be opportune and even spectacular to enrich a bit the somehow stripped down sculpture for a reasonable additional expense in populating Fabien's 'universe' with models of the two previous sculptures, i.e. the Coimbra Pentigloo and the Enschede PentiDisc. Taking into account the fact that the Pentigloo was made with the previous Zometool inventory and the PentiDisc with the current, one ϕ smaller, I decided with the agreement of the team members regularly informed on the progress of the project, to have a blue Pentigloo and a white Pentidisc models at the same dimensional scale (similar outer diameters) to sit on the Penticosido equator plane, all three being thereby concentric but in two Fabien 'universes' one ϕ different. In addition I then placed another black Pentigloo covered with black silk paper with the same strut inventory as the white PentiDisc. As a last model added at very end, I 'crowned' the Penticosido with another, ϕ larger, white PentiDisc with the same strut inventory as the blue Pentigloo and wrapped in white, to complete the double pair with this last one on top, as a hint to the high position of its original in Enschede.

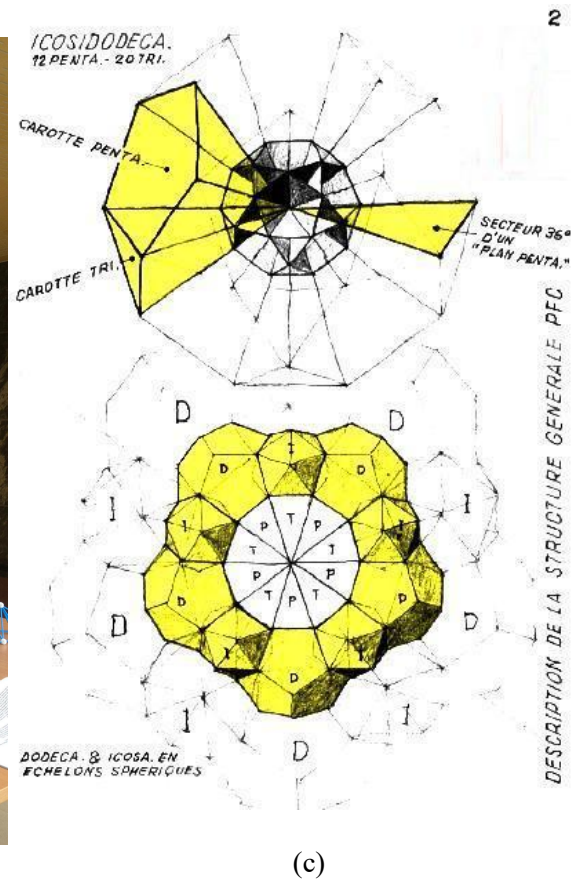
Need for tessellations detail: Parts of a few outer inter icosidodecahedra diametrical rings and the complete equator one are filled with the proper fractal tessellations to *didactically* show what they'd look like if filled everywhere, and so are the faces of one of the five support star branches.

Need for illustrating fractal components: Fabien found later that 4 different polyhedral elements, sitting between the dense families of parallel 'sub-planes' filled by fractal quasi-periodic tilings so nicely visualized in the large PentiDisc hanging in the SAXON school in Enschede (which are thus filling the 'carrots'), are obtainable by the division of a dodecahedron in 164 such elements (Fig.3a). For illustration I placed some of all 4 kinds in fitting positions scattered over different locations in the Penticosido lower 'hemisphere', inducing a tedious study to determine the proper sub-plane involved. Those elements were finally filled with crumpled silk paper one color per type of element, and a portion of a pentagonal carrot has also been filled by a cluster of one of each in their respective contiguous places (Fig.2c).

Need for reuse: This ultimate real structure has been completed (Fig 3b) on the second floor hallway giving passage to the upper entries of the two main auditoria in front of a large window, by very few people, ...*without any glue*, as the conference chairman, our friend Kristóf Fenyvesi [8] asked us to try, in order to save the precious inventory for further use in workshops for students.



(b, courtesy Amina Buhler)



(c)

Figure 3: (a) CFP building blocks, (b) Realized Penticosido, (c) Cluster of alternating dodeca and icoosa around the central icosidodeca.

Welcome serendipity: discovering David Koski, a new colleague who likewise displayed a Zometool construction made of a set of small polyhedral building blocks, here with 'red' and 'yellow' struts (Fig. 4b)

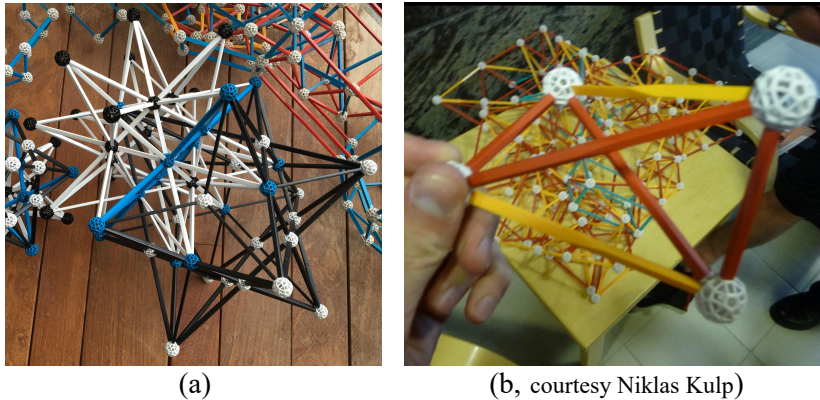


Figure 4: (a) *Contiguous icosahedra and dodecahedra in Zometool*, (b) *Koski's building blocks*.

Some Interesting New Thoughts that Appeared After the Conference...

There was another geometrical feature in Fabien's latest CFP theory findings I unfortunately overlooked and didn't include in the realized didactical setup: a cluster of alternating dodecahedra and icosahedra around the central icosidodecahedron (Fig.3c and Fig.4a) is hidden in the complex lattice of struts, and is worth mentioning here, additionally as it triggered a potential problem the resolution of which is interesting [9].

Alarm readily discarded: In order to visualize the missed feature, back home I started modeling again, this time with left over black and white inventory and it seemed to appear, while intensely building in an 'automatic' mode, that Fabien's 'universe' might have different central origins, even an infinity (Fig.5a).

Fortunately, this strange idea was readily discarded, when re-discovering quasi-periodicity through a detailed study of one of Fabien's precise hand drawings of which Paul van de Veen had included a copy in his large image book (on display at the conference) personally edited in a small number of copies [10] where the inherent quasi-periodic nature of the fractal plane tessellations manifested itself (Fig. 5b).

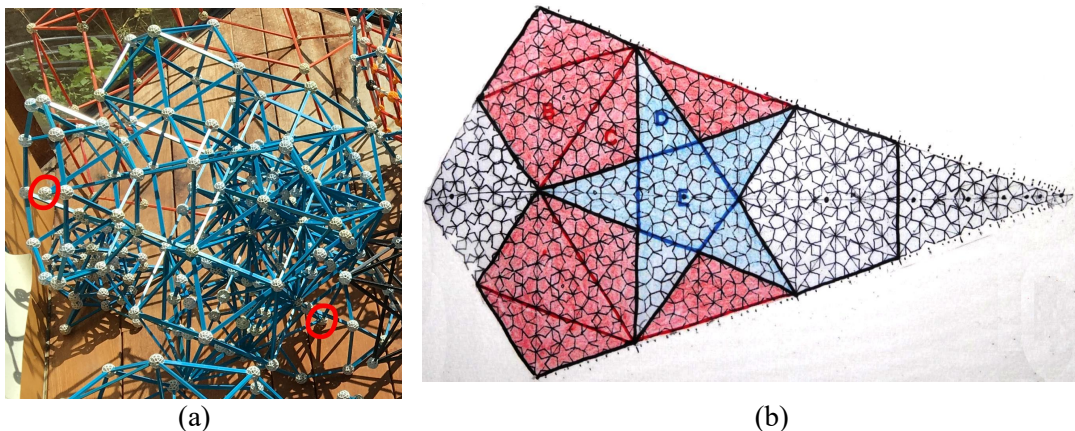


Figure 5 : (a) *Icosidodecahedra centers as several origins?*, (b) *Fabien's solving clue: quasi-periodic fractal tiling*.

Yet, this triggered an interesting private communication by Jim : "The actual last line of Fabien's text is "The origin is omnipresent and so is infinity." The notion remains the same, however. Although cubic

fuzzy precision is built from an exceptionally singular center, and there is one and only one absolutely precise center (origin), when viewed from higher order of abstraction any arbitrary center can be regarded as an exceptionally singular center (origin) with the same effects radiating outward from there (i.e. "*the origin is omnipresent*"). Similarly, a given center (origin) could be regarded as an infinitesimal microcosm of the whole fractal pattern but at a granularity below the level of resolution of the model (i.e. "*infinity is omnipresent*").

Conclusion

Again a very pleasant subject to address, this time with love and respect in memory of outstanding friends we'll always miss. May this publication still arouse the curiosity of some expert mathematicians studying and incorporating this magnificent theory Fabien envisioned as a lay person in mathematics in the proper category of the Geometry. This would constitute the most beautiful tribute to his patient work.

Acknowledgments

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