

Stephen Robinson and the Facet Kite

George Webster and John Dobson

In August 2013 J.D. received an email from Stephen Robinson (S.R.) who, having read our history of kites on our website (www.johndobson.info), asked whether his name could be “pulled out of obscurity” as the inventor of the Facet kite. If we take the key feature of his Facet kite to be the exoskeletal structure, *i.e.* the shape is given by the rods around the perimeter under compression and fabric points under tension, then this was indeed a breakthrough which led to a range of complex cellular kites developed since the 1980’s.

Clearly by his own account in a letter to us, S.R. was fundamentally influenced by the architect/designer Buckminster Fuller’s concept of *tensegrity* (short for ‘tensional integrity’). This is defined in Wikipedia as “a structural principle based on the use of isolated components in compression inside a net of continuous tension, in such a way that the compressed members (*exoskeletal rods in the case of kites*) do not touch each other and the tensioned members (*fabric in the case of kites*) delineate the system spatially”. To our knowledge one of the earliest examples was the Wellington bomber of World War 2 and a more recent example is the domes at the Eden Project. Perhaps the simplest way of explaining tensegrity in kite design is that while a spar is needed to withstand compression, it is more efficient to use the fabric itself to take the stretching forces. The spars do not touch each other, but are suspended in a continuous network of integrated tension lines. A good example is shown in Illustration 1, which shows the Synergy 333 (a three line kite).



Illustration 1: Synergy 333

S.R. was unaware of the Rogallo corner kite of 1958 (Illustration 2), and Rogallo in turn did not know of the late 19th century Flaix kite (which can have any number of blades — Illustration 3 shows an 8-bladed Flaix, though the original had 4), nor of the Wise Fin Keel kite (Illustration 4) or the Cruciform kite (Illustration 5). Although the Flaix and the Wise kites had the single cell ‘feathers of a dart’ shape it was only the Rogallo which used the exoskeleton principle. (All this is spelled out in Chapter 4 of *Kites on a Line* which may be found on our website.) It is clear from his correspondence with us that he ‘invented’ the exoskeletal kite himself (rediscovering the method used by Rogallo) and it was his single celled Facet, rather than Rogallo’s two cells, which influenced subsequent kite designers.

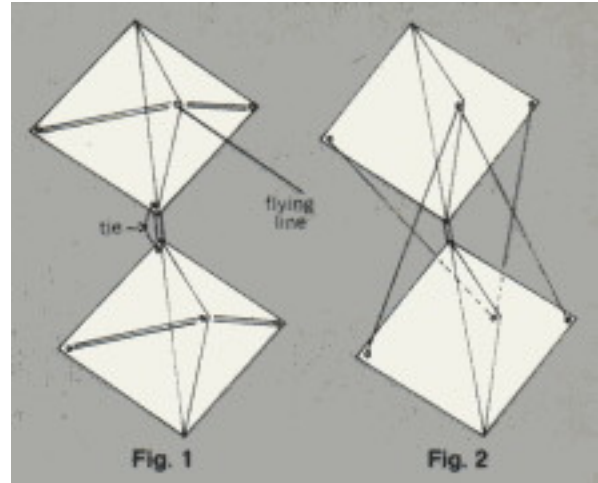


Illustration 2: Rogallo corner kite



Illustration 3: Flaix kite

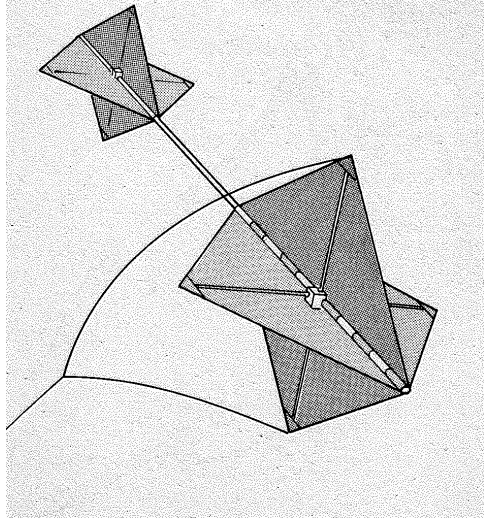


Illustration 4: Wise Fin Keel kite

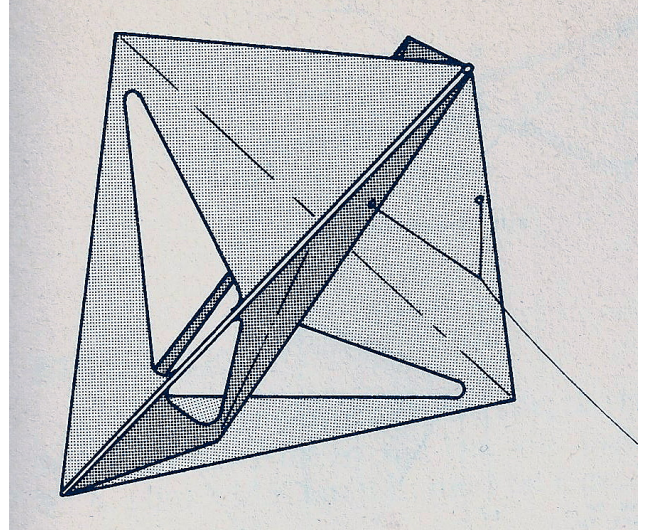


Illustration 5: Cruciform Kite

We have set out what is new to us below, though Maurizio Angeletti wrote an article in *Drachen Magazin* in 1993 which had a contribution from S.R. and which traces a line from Hargrave via Lecornu to the Facet kite. We understand that Rolf Maserski and his son are in the process of translating the article so that it can be republished in English.

S.R. was a student of architecture at Liverpool University in 1976 when he read a Sunday Times review of Pelham's classic book and bought a copy. Inspired by designs in Pelham, he made several types of cellular kite including Bell's boxes which used triangles (as being very strong) but linked together very sparingly (as in tetrahedrals). Another immediate influence on Stephen was the kites of Lecornu, the Bookcase or Ladder kite (Illustration 6) and the Gauffre or Waffle design (his own Waffle kite is shown in Illustration 7).

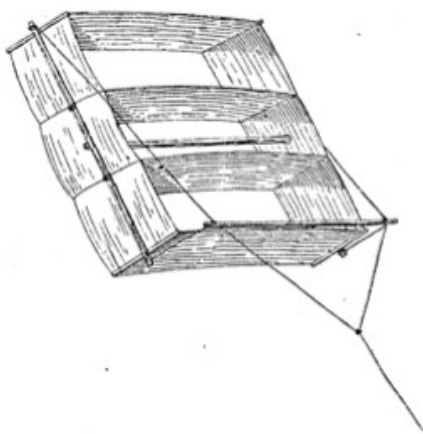


Illustration 6: Lecornu Bookcase kite



Illustration 7: Stephen Robinson's Lecornu Waffle kite

His breakthrough was to realise that he needed only one front-to-back spar in the middle of the Waffle design and that a perimeter of single spars (the exoskeleton) could support a complicated star structure. His first attempts were based on a triangular structure (Illustration 8).



Illustration 8: an early version of what became the Facet kite

S.R. knew and liked the Professor Waldof box kite (Illustration 9) with its triangular wings braced at their tips to keep what was basically a hexagonal box kite in shape, but felt that the mix of spars and bracing was ‘fussy’ and it shared the problem of many other box kite designs of requiring spars to pass through holes in the sails.



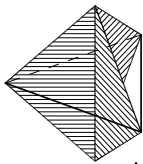
Illustration 9: Professor Waldof box kite

Similarly he rejected his own earlier version because it was getting too complicated and lacked what he called 'purity'. He then realised that basing it on squares (after Lecornu) had the advantages of minimum framing to maximum sail area ratio, and could be made from square pieces of material with no fussy triangular bits, thus reducing wastage and achieving total purity. Illustration 10 is his own explanation of the design transition from the original (triangular) concept to the final (square) concept.

He also found that the Lecornu tended to be unstable in flight, which he thought was due to the ratio between span width and cell depth being too high so the kite needed to be deeper. Imagine pushing out the middle of a Lecornu in both directions along an axis perpendicular and central to the square grid and you nearly have a Facet kite. The three sizes of square give the deeper centre section which he felt would improve the Lecornu's stability. Thus the tensioned triangular wings of the Waldof kite and the deeper cells of the Lecornu kite and the tensegrity structure of the whole thing combined to give the Facet Kite. He produced the first Facet in 1978, and named it "Facet" because it reminded him of a rhombus with faceted sides. He was encouraged by John Spendlove to send plans to *Kitelines* (Winter 1979/80). (Older readers will remember J.S. as a prolific source of small framed, often indoor, kites in the 1970's). The original kite is shown after some recent repairs to the sellotape. It also used dowel, curtain rings, plastic tube, electrical tape and drafting film (Illustration 11). And Stephen's groundbreaking innovation was finished with a coat of gold spray paint. (Illustration 12).

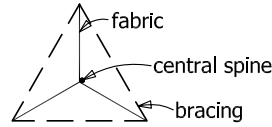
Acknowledgement. We are very grateful to Stephen for his initial contact and contribution and help with this article and providing Illustrations 7, 8, 10 11 and 12. We hope in return we have done something to pull his name out of obscurity.

The Facet Kite is basically a 'tensegrity' structure with the rods in compression and the material in tension

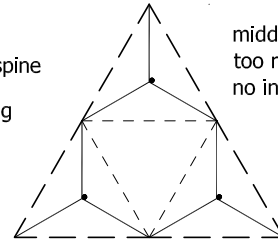


the initial design was based on triangles to form the most rigid structure with a minimum of framing

1 unit

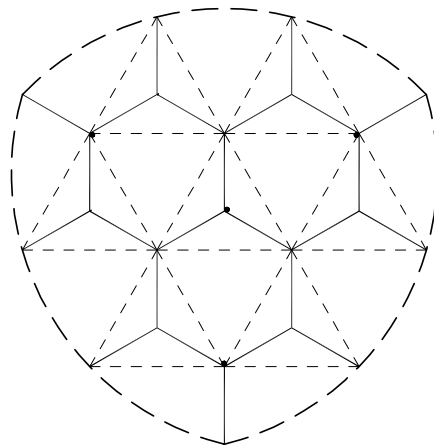


i.e. in plan



middle braces removed, too many vertical spines, no inherent strength

3 units together

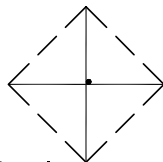


3 extra triangular wings
1 central spine
3 secondary spines
3 curved braces
(see photo)

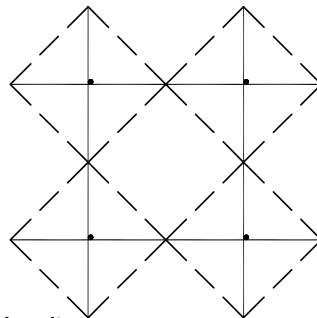
minimal framing but complicate;
extra triangular wings
string to hold thing in place
tensioning of baces complicated
good flier ,but lacked purity

7 units together

the next idea was to use squares

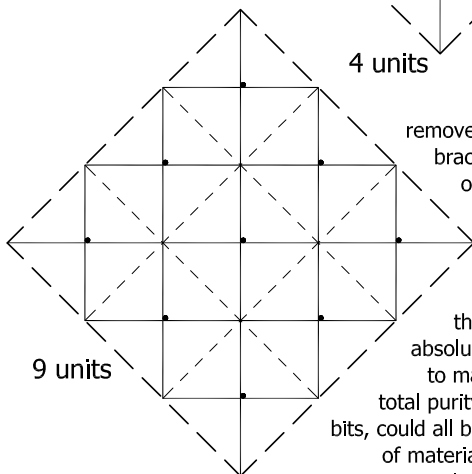


1 unit in plan



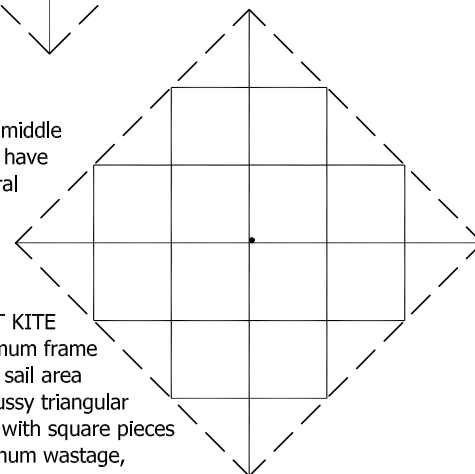
4 units

too much framing and vertical spines
no inherent stability



9 units

remove all the middle bracing and have one central spine



the FACET KITE
absolute minimum frame to maximum sail area
total purity - no fussy triangular bits, could all be made with square pieces of material, minimum wastage, clarity of structure

Stephen Robinson

Illustration 10: FACET kite

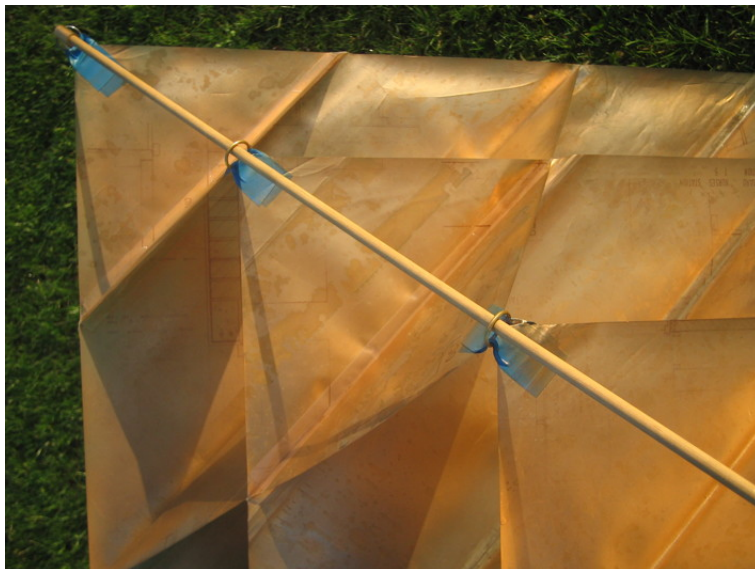


Illustration 11: construction details



Illustration 12: Stephen Robinson and the original Facet kite