Flextegrity: a new structural paradigm

A review of *Flextegrity: equilibriated polyhedral structures* by Sam Lanahan

It is not often that a new way of thinking about structure and form crystallises. Even less often does such a paradigm stretch from the atomic scale to the architectural. Flextegrity brings just this, applicable at all scales from modern molecular nano-materials such as buckyballs and graphene composites, through human scales creating responsive or damage-resistant structures, on up to gross architectural forms in the mould of Fuller, Pearce and Archigram.

The paradigm, the forms and and the book are the brainchild of Sam Lanahan, a lifelong follower of Bucky Fuller. The development of flextegrity begins where Fuller's famous work on tensegrity leaves off. Conventional structures comprise an overall form in compression with tension members added to brace and stiffen it. Tensegrity reverses this, with compression members inserted here and there to brace and stiffen an overall tensile form. Flextegrity takes tensegrity a step further by designing-in controlled deformation of an otherwise rigid construction.

While experimenting with tensegrity forms, Lanahan inevitably came up against its weaknesses: its strictly efficient form demands a rigid perfection of structure that restricts the designer, while the practicalities of construction tend to demand an equally strict and impractically expensive process. Lanahan set out to remedy these weaknesses, and out of this grew a new way of thinking.

Flextegrity forms are rooted in geometry. A typical structure comprises rigid compression members after the manner of tensegrity, typically icosahedral. But the linking tensile members introduce a degree of springiness that allows controlled stretching yet may be tailored to withstand shear and other mechanical stresses. Individual members are first manufactured, then assembled to form two- and three-dimensional arrays of repetitive modules, in similar manner to a spaceframe. Any given application may vary the mechanical properties of individual members to provide varying properties in different directions - say rigidity in one direction but flexibility in another - or localised properties such as stiffness in one location but yield in another.

Lanahan's book, written with the acknowledged help of LaJean Lawson, is a self-published paperback. It is large enough to grace a coffee table and full of fascinating and beautiful illustrations. In it Lanahan chronicles the development of flextegrity from his early tensegrity sculptures, through classic Flextegrity™ designs with icosahedral compression modules and flexible strip connectors, to tubular forms betraying little outward resemblance to their origins. Like many such works, Lanahan's brims with passion and enthusiasm rather than logical rigour, sometimes dreaming those impractical and seemingly inevitable dreams of icosahedral living modules, sometimes laying down sharp little epigrams from the Buddhist *"All things break, no matter how revered (this is particularly true of belief structures)"* to the practical *"the icosahedron ... provides natural facets and edges for attaching things"*. The narrative itself comes across as a flextegrity structure - full of loosely connected nuggets creating an overall harmony of purpose.

The book works on several levels - as a flextegrity primer, as the story of an inventor full of object lessons and historical anecdotes, and as a technology ideas source book. Though rooted in geometry, flextegrity transcends its roots. Researchers and designers in many fields will find inspiration and new ways of thinking about their own work: molecular and nano engineering, smart and engineered materials, mechanical and structural engineering, even robotics. So too will downstream technologists in areas of application such as durable electronic devices, smart fabrics, tough porous membranes, bullet-proof vests, crash barriers and architecture to name but a few. This book should be on such faculty reading lists for every first-year student.

Lanahan, S.; *Flextegrity: equilibriated polyhedral structures*, Lanahan, 2010.
Available from *www.flextegrity.com*

Guy Inchbald studied architecture at Cambridge and the Bartlett before moving to other engineering and design disciplines. While at Cambridge he also studied philosophy and picked up a lifelong interest in polyhedra and spacefilling. He currently works in corporate communications and IT, while in his spare time is reworking the mathematical foundations of polyhedron theory.