FUTURE OF DESIGN
20 . 04 . 2018

David Hewlett
Structural Engineer
Expedition Engineering
London, UK
David.h@expedition.uk.com

Laban Dance Icosahedron

David studied Mechanical Engineering at the University of Cambridge and MIT, and Maths & Economics at the Open University, before joining Expedition in 2015.

Keywords: Laban Dance Icosahedron Magnets Demountable Lightweight

1. An unusual brief

Students of Laban Dance sometimes train inside a 6ft tall icosahedron. They point to its vertices in turn to practice the theory's purest movements, much as a musician practices scales (Fig. 1c). A physical, rather than imagined, icosahedron greatly improves the quality of this training.

Our client wanted an icosahedron that: could be erected and demounted by one skilled and one unskilled person in about 3 minutes, regularly taken to classes by public transport (Fig. 1b), manufactured by a layperson, and complemented the elegance of a dancer.

These demands could not be reasonably met by a standard philosophy of 'heavier until strong and stiff, avoiding failure'. A philosophy of 'lighter until failure cannot cause harm' unlocked the rest of the brief, creating an object that is intrinsically safer than something heavier, however sturdy.

2. Defining an icosahedron in space using simple components and processes

An icosahedron can be defined by its vertices, edge or faces, and each of these options was initially explored. The final form used rods (edges) with wooden nodes. In parallel, detachable connections with mechanical and magnetic fixing were explored. Magnetic connections worked best: they can be reconnected very many times, allow easy fabrication and are self-locating, snapping together when the ends of the connection come close. The self-locating property reduces the number of people required to assemble the icosahedron from three to two, a significant benefit to the client.

However, magnetic connections are 'brittle', becoming less effective with lack of fit or an air gap. The full impact of this 'brittleness' was explored using a prototype (Fig. 1a). Embedding the magnets in a spherical node allows the magnets to be orientated to meet the incoming rods, which improved performance. The spherical node's geometry seems complex but can be generated by a simple process: take compasses set at one radius of the node, draw a circle, then 'walk' the compasses around the circle marking each 'step'. A magnet is installed at each mark (Fig. 1e).

3. Listen to feedback and iterate

The success of the first prototype has allowed experimentation and iterative improvement over later versions, with variations in size (Fig. 1d), stability system, materials and manufacture. These changes aim for more platonic and lighter forms, and ever easier fabrication and assembly.

Figures 1a-1e: Early 'brittle' model with spherical magnetic nodes and steel rods; Prototype ready for transport; First prototype in use; Second prototype; experimental resin node (nodes are wooden on prototypes)