# TENsegrity-based DEployable Kite (TENDEK Project)

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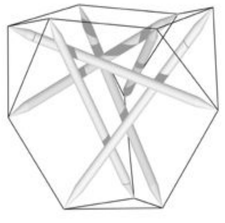
## ABSTRACT

In the duration of the REU academic year program, the scope of this project involved the exploration of applications of tensegrity-based morphing structures. Tensegrity systems are easily manipulated, robust, and stable. These properties allow for engineers to create cost-effective and unique solutions to existing problems. This project aims to use the properties of tensegrity and apply them to flight, namely kite flying, in order to solve some frequently-encountered problems associated with flying kites. A tensegrity configuration would allow the collapse of the kite in such a way that it can be deployed back to its operating shape in a matter of seconds, and also compressed into a compact form conducive to launching from a device which employs a propulsion mechanism.

## TENSEGRITY

Structures with *tensegrity* are said to have both tensile and compressive members in a specific configuration that it is held stable solely from internal forces. Tensegrity structures are:

- Stable without outside forces
- Lightweight, robust systems
- Economically advantageous
- Morphable
- Aesthetically pleasing



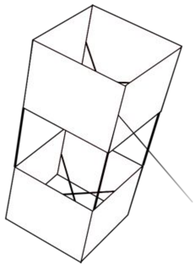
For tensegrity systems to be stable, six degrees of freedom must be controlled (tranlation and torque in all three dimensions).

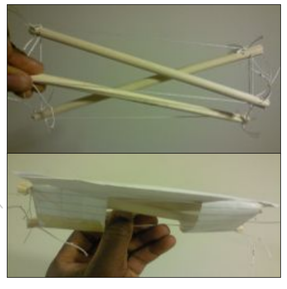
## DESIGN DEVELOPMENT

Using tensegrity concepts, a deployable box kit was developed. This system was:

- Compact
- Morphable
- Lightweight
- Stable
- Storable
- Simple

The results were reached through extensive trial-and-error testing of tensegrity systems. Models made in a multitude of shapes and materials were attempted.





With the assistance of Graduate Assistant Phillip Italiano, the TENDEK Team was able to develop a working, collapsible box kite. Utilizing unique connection techniques and state-of-the-art materials, the initial kite design was developed for test flight.

## FLIGHT TESTING

TENDEK Team test flying took place at the University of Cincinnati football stadium and at the Airwaves Kite Fest held at Voice of America Park in Cincinnati, OH. Test flights proved successful. The tensegrity kite was able to maintain flight for a period of time. Minor kinks need to be worked out to sustain flight.

## CONCLUSIONS

There is still work and further research to be done on this project. The major outcomes of the tasks so far include the literature review, idea generation, concept investigation and final concept selection, material selection, and initial testing. The box kite is popular even still because of its simplicity and stability. The intent of this project was to address some of the timeless design's shortcomings, without introducing new ones. The concept of tensegrity was integrated with the current design because of its ability to morph and the ability to economize weight while maintaining structure and stability. The tensegrity design also lends itself to the collapse and mechanical launch of the kite, thus solving the problem of needing another person for launch.