

Creative Cardboard Engineering

Introduction

An I-Beam is used to build bridges, skyscrapers, houses, patio decks, billboard signs, and truck trailers; to name a few structures. These beams are commonly made from steel, aluminum, wood and concrete. In this activity students will explore the strength of different beam designs.

Grade Level

4th and up

Object

To see the effects of a structural failure, beams made from cardboard (poster board or corrugated fiberboard will also work) will be loaded until they fail. After seeing the failure, students or student teams will create a stronger beam. To complete this activity in one class period have students work as teams.

One of the main failure points is where the string goes over the beam. As the load increases, the string deforms the top flange making it weaker. Maybe it would be better to poke holes through the top and bottom flange by running the string through the holes. (See Figure F)

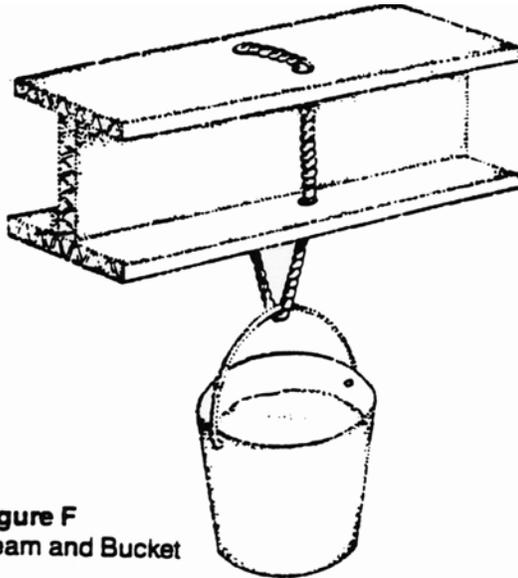


Figure F
Beam and Bucket

This technique will reduce the deformity of the top flange, thus allowing it to carry more weight.

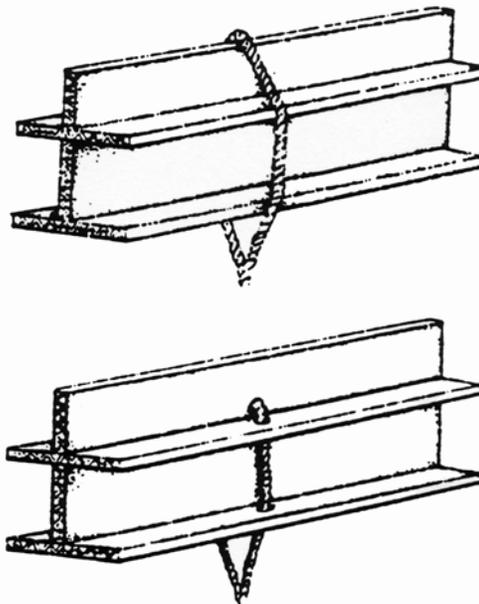
Another problem is the roll-over syndrome. As the load increases, the beam tends to roll over or twist as the top flange is being pulled towards the bottom flange. The web keeps the two flanges apart. As long as the web stays square, it will be strong. Gluing some small pieces on each end will help prevent roll-over. (Figure G)



Figure G
Beam with End Supports

Gluing a piece on the edge to the top flange will make it stiffer, but where does the string go? (See Figure H)

Figure H
2 Beams with String Demo



A combination of many techniques can be used to build a structure to carry the load. Experimenting will determine what works best.

For older grades (6th and up) introduce the concept of weight saving - cost saving. This concept is used in the trucking, shipping and aircraft industries where there is a cost-per pound charge to transport cargo. To reward the designer for reducing weight, award a bonus. Give the students four strips to make their designs but for every inch of unused cardboard, give a three-pound bonus. This bonus will be added to the load capacity of their structures.

By analyzing a beam that has failed, you can see that portions of the beam didn't experience much load. This would be the material to eliminate.