

Different cross-sections of a paper bridge

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Concept: sheets of newspaper when folded to bridges different cross-sections will carry different masses before failure.

Model: newspaper bridges

The diagrams below show bridges in four different forms: flat sheets of newspaper, concertina, loosely rolled sections and tightly rolled sections. Each bridge was tested by the addition of weight to discover the mass at which it failed.



Flat Sheets



Concertina



Large diameter cylinders



Small diameter cylinders

As can be seen below, the different bridges can carry significantly different masses.



Concertina



Large diameter cylinders



Small diameter cylinders

Bridge type	Flat sheets	Concertina	Large diameter cylinders	Small diameter cylinders
Number of DVDs before failure	0 (end support required to prevent collapse under self weight)	2	10	16

Six sheets of newspaper were used for each model, so the self-weight of the bridges is constant and therefore does not affect the results of this demonstration. The only difference in loading between the different bridges is the number of DVDs supported.

Stiffness is the governing factor of how much load the bridge can carry. The end supports used in each test are an equal distance apart, so the length of the bridge, L , is constant. The materials used are also the same, so the modulus of elasticity, E , is constant. The only factor changing the stiffness from bridge to bridge is the second moment of area, I , which is a geometric property i.e. it changes with the cross-section of the bridge.

As can be seen from the different loads supported, the second moment of area makes a large difference to the load at failure.