# 9.8.3 Physics - Soft Body - Interior Forces



## Interior Forces

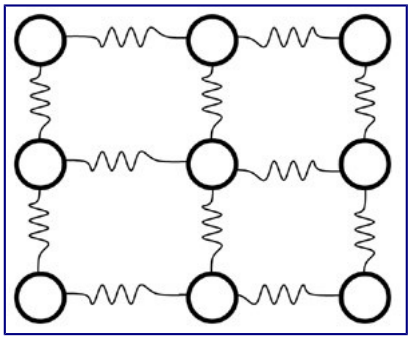

Image 1a: Vertices and forces along their connection edges.

To create a connection between the vertices of a Soft Body object there have to be forces that hold the vertices together. These forces are effective along the edges in a mesh, the connections between the vertices. The forces act like a spring. (*Image 1a*) illustrates how a 3×3 grid of vertices (a mesh plane in Blender) are connected in a Soft Body simulation.

But two vertices could freely rotate if you don’t create additional edges between them. Have you ever tried building a storage shelf out of 4 planks alone? Well - don’t do it, it will not be stable. The logical method to keep a body from collapsing would be to create additional edges between the vertices. This works pretty well, but would change your mesh topology drastically.

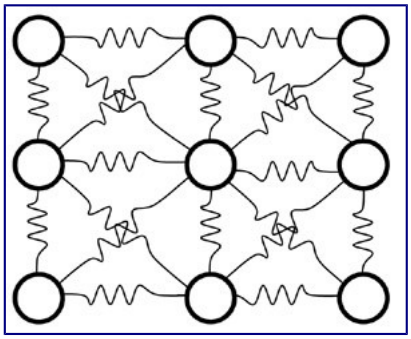

Image 1b: Additional forces with Stiff Quads enabled.

Luckily, Blender allows us to define additional *virtual* connections. On one hand we can define virtual connections between the diagonal edges of a quad face (*Stiff Quads*, *Image 1b*), on the other hand we can define virtual connections between a vertex and any vertices connected to it’s neighbors (*Bending Stiffness*). In other words, the amount of bend that is allowed between a vertex and any other vertex that is separated by two edge connections.

# Edges Settings

The characteristics of edges are set with the *Soft Body Edge* properties.

**Use Edges**
: Allow the edges in a Mesh Object to act like springs.

**Pull**
: The spring stiffness for edges (how much the edges are allowed to stretch). A low value means very weak springs (a very elastic material), a high value is a strong spring (a stiffer material) that resists being pulled apart. 0.5 is latex, 0.9 is like a sweater, 0.999 is a highly-starched napkin or leather. The Soft Body simulation tends to get unstable if you use a value of 0.999, so you should lower this value a bit if that happens.

**Push**
: How much the Softbody resist being scrunched together, like a compression spring. Low values for fabric, high values for inflated objects and stiff material.

**Damp**
: The friction for edge springs. High values (max of 50) dampen the *Push* / *Pull* effect and calm down the cloth.

**Plastic**
: Permanent deformation of the object after a collision. The vertices take a new position without applying the modifier.

**Bending**
: This option creates virtual connections between a vertex and the vertices connected to it’s neighbors. This includes diagonal edges. Damping also applies to these connections.

**Length**
: The edges can shrink or been blown up. This value is given in percent, 0 disables this function. 100% means no change, the body keeps 100% of his size.

**Stiff Quads**
: For quad faces, the diagonal edges are used as springs. This stops quad faces to collapse completely on collisions (what they would do otherwise).

**Shear**
: Stiffness of the virtual springs created for quad faces.

## Preventing Collapse

To show the effect of the different edge settings we will use two cubes (blue: only quads, red: only tris) and let them fall without any goal onto a plane (how to set up collision is shown on the page *Collisions*).

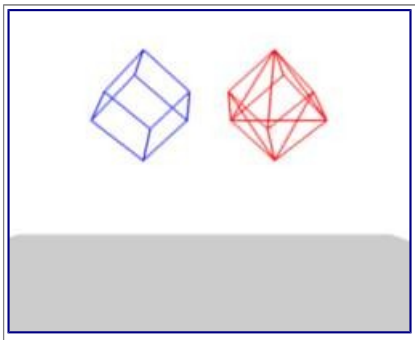

Image 3a: Frame 1 without Stiff Quads.

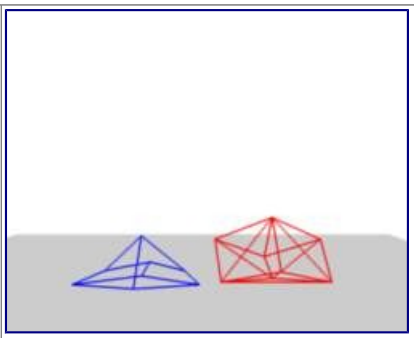

Image 3b: Frame 36.

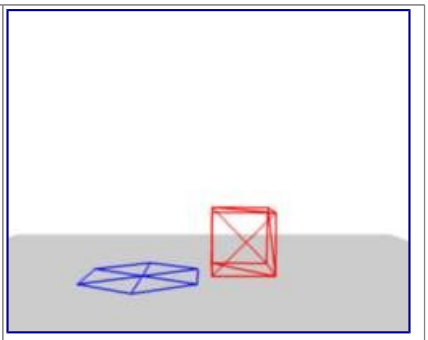

Image 3c: Frame 401.

In (*Image 3*), the default settings are used (without *Stiff Quads*). The “quad only” cube will collapse completely, the cube composed of tris keeps it’s shape, though it will deform temporarily because of the forces created

during collision.

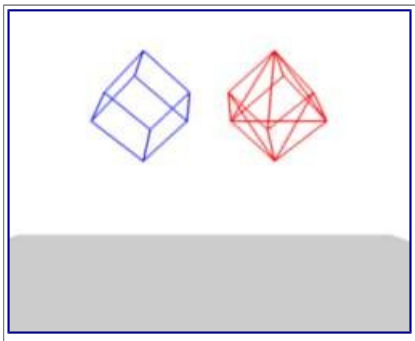

Image 4a: Frame 1 with Stiff Quads.

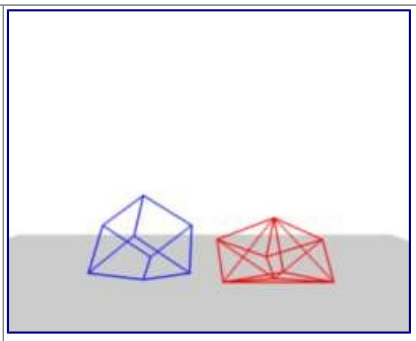

Image 4b: Frame 36.

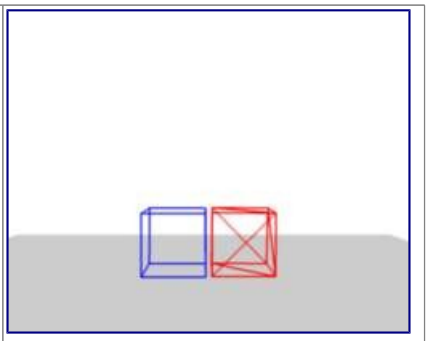

Image 4c: Frame 401.

In (*Image 4*), *Stiff Quads* is activated (for both cubes). Both cubes keep their shape, there is no difference for the red cube, because it has no quads anyway.

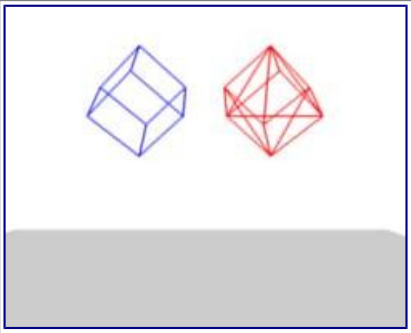

Image 5a: Frame 1 with Bending Stiffness. Blend file

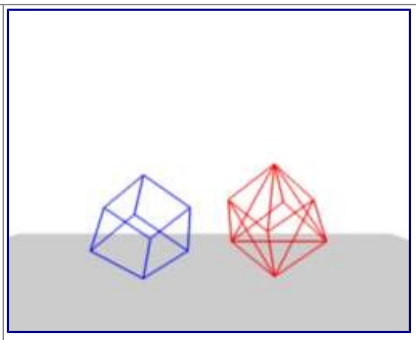

Image 5b: Frame 36.

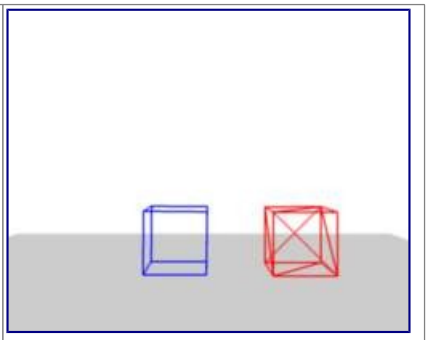

Image 5c: Frame 401.

The second method to stop an object from collapsing is to change it's *Bending Stiffness*. This includes the diagonal edges (Damping also applies to these connections).

In (*Image 5*), *Be* is activated with a strength setting of 1. Now both cubes are more rigid.

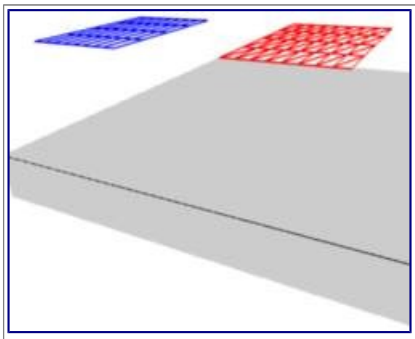

Image 6a: Two planes going to collide.

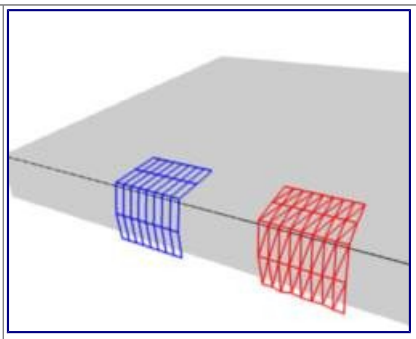

Image 6b: No bending stiffness, Frame 101.

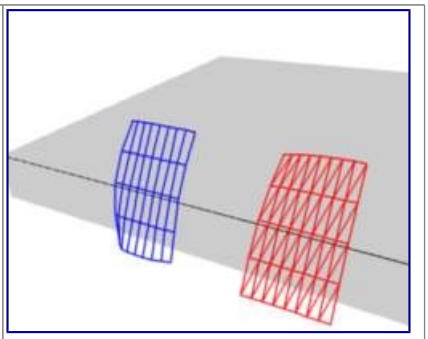

Image 6c: High bending stiffness (10), Frame 101.

Bending stiffness can also be used if you want to make a subdivided plane more plank like. Without *Be* the faces can freely rotate against each other like hinges (*Image 6b*). There would be no change in the simulation if you activated *Stiff Quads*, because the faces are not deformed at all in this example.

Bending stiffness on the other hand prevents the plane from being - well - bent.