

9.9.4 Physics - Rigid Body - Rigid Body Constraints (old version)

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Rigid Body Constraints

Constraints (also known as joints) for rigid bodies connect two rigid bodies.

The physics constraints available in the non-game modes are meant to be attached to an *Empty* object. The constraint then has fields which can be pointed at the two physics-enabled object which will be bound by the constraint. The *Empty* object provides a location and axis for the constraint distinct from the two constrained objects. The location of the entity hosting the physics constraint marks a location and set of axes on each of the two constrained objects. These two anchor points are calculated at the beginning of the animation and their position and orientation remain fixed *in the local coordinate system of the object* for the duration of the animation. The objects can move far from the constraint object, but the constraint anchor moves with the object. If this feature seems limiting, consider using multiple objects with a non-physics *Child-of* constraint and animate the relative location of the child.

The quickest way to constrain two objects is to select both and click the *Connect* button in the *Physics* tab of the *Tool Shelf*. This creates a new *Empty* object (named “Constraint”) with a physics constraint already attached and pointing at the two selected objects.

Also you can create *Rigid Body Constraint* on of the two constrained objects with *Rigid Body Constraint* button of the *Physics* context in the *Properties* window. This constraint be depend on the object location and rotation which on it created. Thereafterat, there are no *Empty* object created for the constraint. The role of the *Empty* object is put on this object. The constrained object can be then set as *Passive* type for better driving the constrain.

Additional parameters appear in the *Rigid Body Constraint* panel of the *Physics* context in the *Properties* window for the selected *Empty* object or the one of the two constrained objects with the created constraint.

Constraint Types

The menu of available constraint types.

There are several constraint types available:

Fixed

Glue rigid bodies together. Fixes the relative position and orientation of two rigid bodies.

Point

Constrains rigid bodies to move around a common pivot point.

Hinge

Only allows rotation around the Z axis of the constraint object.

Slider

Limits movement to the X axis of the constraint object.

Piston

Restrict rigid body translation and rotation to the X axis of the constraint object.

Generic

Restrict rigid body translation and rotation to specified axes. Allows customizable constraint axes.

Generic Spring

Restrict rigid body translation and rotation to specified axes with springs. Like Generic with spring motion.

Motor

Drive rigid body around or along an axis.

Constraint options and settings

Rigid Body Constraint panel.

Enabled

Specifies whether the constraint is active during the simulation.

Disable Collisions

Allows constrained objects to pass through one another.

Object 1

First object to be constrained.

Object 2

Second object to be constrained.

Breakable

Allows constraint to break during simulation. Disabled for the *Motor* constraint.

Threshold

Impulse strength that needs to be reached before constraint breaks.

Override Iterations

Allows to make constraints stronger (more iterations) or weaker (less iterations) than specified in the rigid body world.

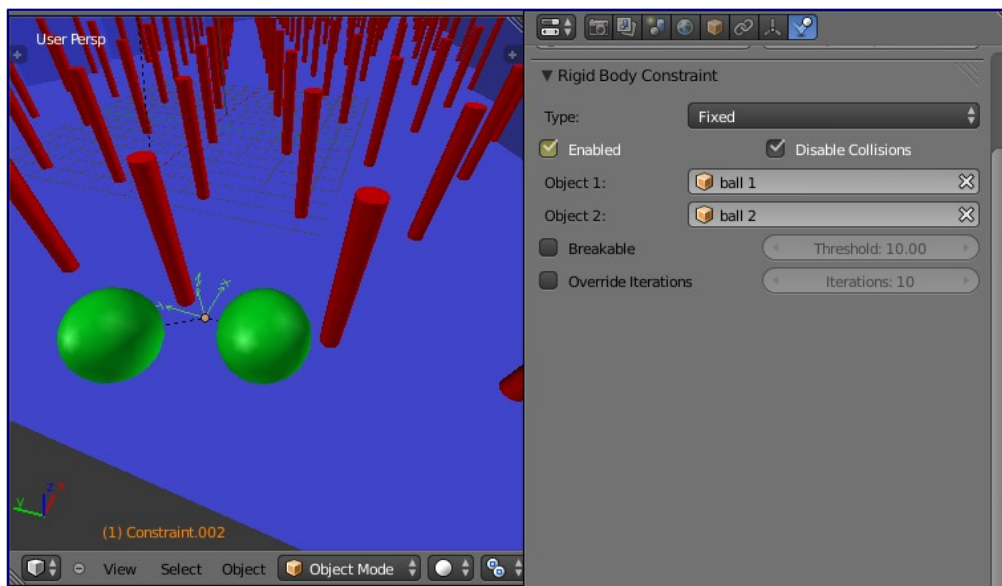
Iterations

Number of constraint solver iterations made per simulation step for this constraint.

Limits:

By using limits you can constrain objects even more by specifying a translation/rotation range on/around respectively axis (see below for each one individually). To lock one axis, set both limits to 0.

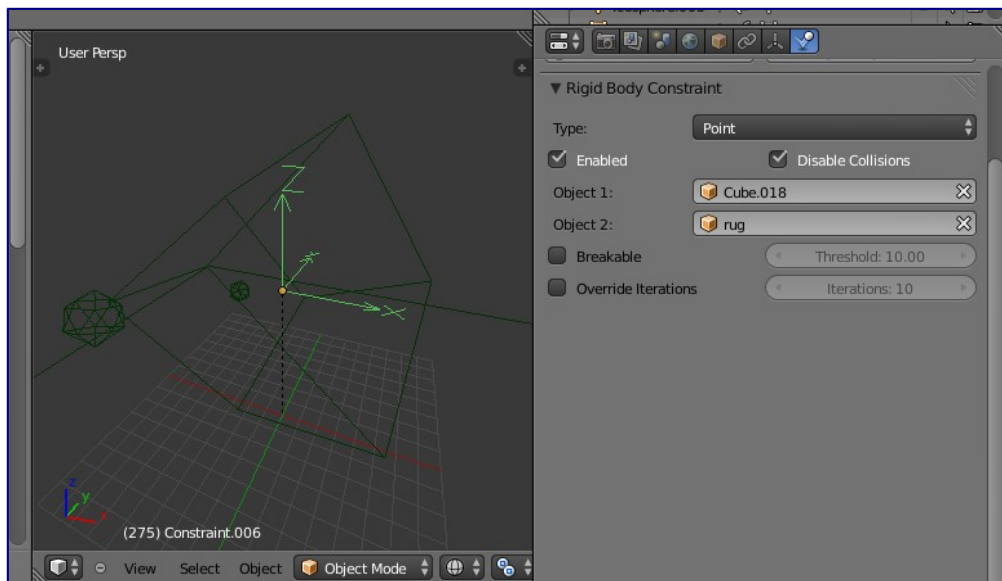
Fixed



Options available to a *Fixed* constraint.

This constraint cause the two objects to move as one. Since the physics system does have a tiny bit of slop in it, the objects don't move as rigidly as they would if they were part of the same mesh.

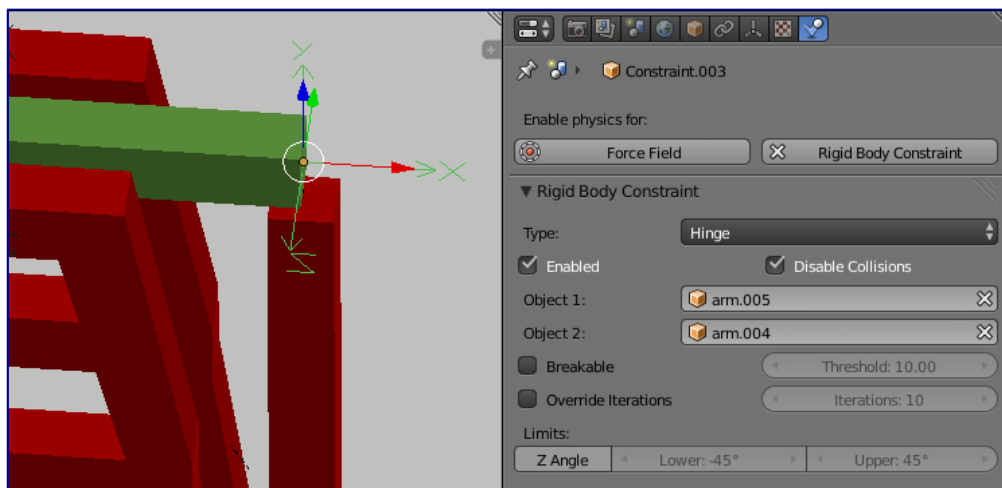
Point



Options available to a *Point* constraint.

The objects are linked by a point bearing allowing any kind of rotation around the location of the constraint object, but no relative translation is permitted. The physics engine will do its best to make sure that the two points designated by the constraint object on the two constrained objects are coincident.

Hinge



Options available to a *Hinge* constraint.

The hinge permits 1 degree of freedom between two objects. Translation is completely constrained. Rotation is permitted about the Z axis of the object hosting the Physics constraint (usually an Empty, distinct from the two objects that are being linked). Adjusting the position and rotation of the object hosting the constraint allows you to control the anchor and axis of the hinge.

The Hinge is the only 1-axis rotational constraint that uses the Z axis instead of the X axis. If something is wrong with your hinge, check your other constraints to see if this might be the problem.

Limits:

Z Angle

Enables/disables limit rotation around Z axis.

Lower

Lower limit of Z axis rotation.

Upper

Upper limit of Z axis rotation.

Slider

The Slider constraint allows relative translation along the X axis of the constraint object, but permits no relative rotation, or relative translation along other axes.

Limits:

X Axis

Enables/disables limit translation around X axis.

Lower

Lower limit of X axis translation.

Upper

Upper limit of X axis translation.

Piston

A piston permits translation along the X axis of the constraint object. It also allows rotation around the X axis of the constraint object. It's like a combination of the freedoms of a slider with the freedoms of a hinge (neither of which is very free alone).

Limits:

X Axis

Enables/disables limit translation around X axis.

Lower

Lower limit of X axis translation.

Upper

Upper limit of X axis translation.

X Angle

Enables/disables limit rotation around X axis.

Lower

Lower limit of X axis rotation.

Upper

Upper limit of X axis rotation.

Generic

The generic constraint has a lot of available parameters.

The X, Y, and Z axis constraints can be used to limit the amount of translation between the objects. Clamping the min/max to zero has the same effect as the Point constraint.

Clamping the relative rotation to zero keeps the objects in alignment. Combining an absolute rotation and translation clamp would behave much like the Fixed constraint.

Using a non-zero spread on any parameter allows it to rattle around in that range throughout the course of the simulation.

Limits:

X Axis/Y Axis/Z axis

Enables/disables limit translation on X, Y or Z axis respectively.

Lower

Lower limit of translation for X, Y or Z axis respectively.

Upper

Upper limit of translation for X, Y or Z axis respectively.

X Angle/Y Angle/Z Angle

Enables/disables limit rotation around X, Y or Z axis respectively.

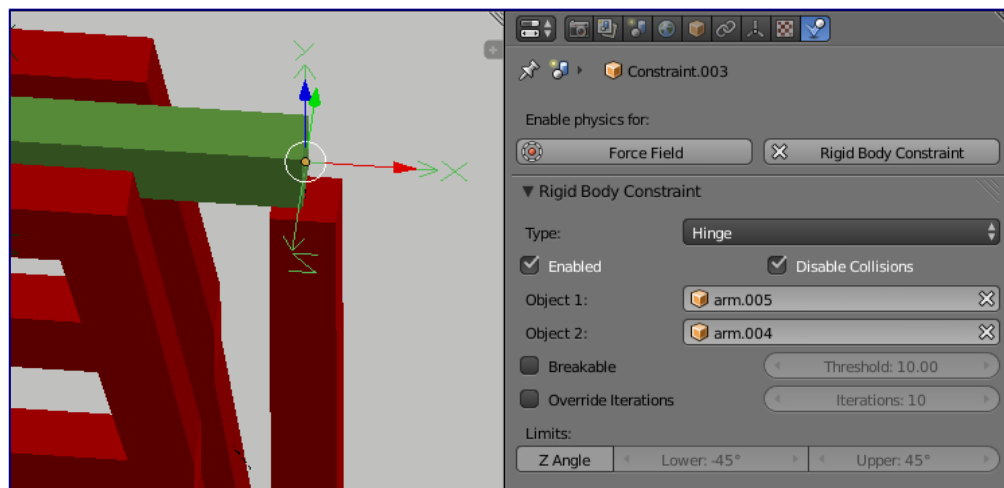
Lower

Lower limit of rotation for X, Y or Z axis respectively.

Upper

Upper limit of rotation for X, Y or Z axis respectively.

Generic Spring



Options available to a *Generic Spring* constraint.

The generic spring constraint adds some spring parameters for the X/Y/Z axes to all the options available on the Generic constraint. Using the spring alone allows the objects to bounce around as if attached with a spring anchored at the constraint object. This is usually a little too much freedom, so most applications will benefit from enabling translation or rotation constraints.

If the damping on the springs is set to 1, then the spring forces are prevented from realigning the anchor points, leading to strange behavior. If your springs are acting weird, check the damping.

Limits:

X Axis/Y Axis/Z axis

Enables/disables limit translation on X, Y or Z axis respectively.

Lower

Lower limit of translation for X, Y or Z axis respectively.

Upper

Upper limit of translation for X, Y or Z axis respectively.

X Angle/Y Angle/Z Angle

Enables/disables limit rotation around X, Y or Z axis respectively.

Lower

Lower limit of rotation for X, Y or Z axis respectively.

Upper

Upper limit of rotation for X, Y or Z axis respectively.

Springs:

X/Y/Z

Enables/disables springs on X, Y or Z axis respectively.

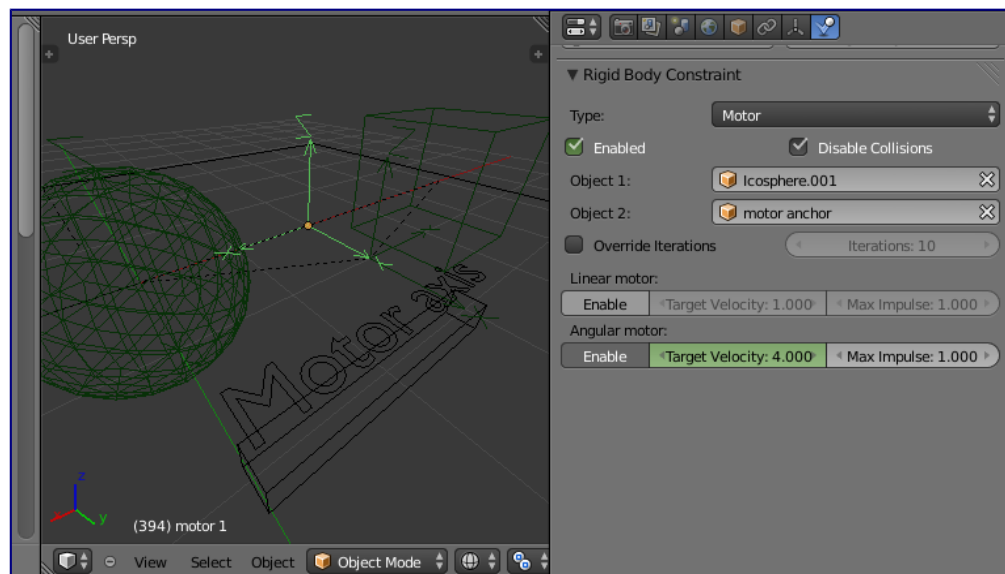
Stiffness

Spring Stiffness on X, Y or Z axis respectively. Specifies how “bendy” the spring is.

Damping

Spring Damping on X, Y or Z axis respectively. Amount of damping the spring has.

Motor



Options available to a *Motor* constraint.

The motor constraint causes translation and/or rotation between two entities. It can drive two objects apart or together. It can drive simple rotation, or rotation and translation (although it won't be constrained like a screw since the translation can be blocked by other physics without preventing rotation).

The rotation axis is the X axis of the object hosting the constraint. This is in contrast with the Hinge which uses the Z axis. Since the Motor is vulnerable to confusing perturbations without a matching Hinge constraint, special care must be taken to align the axes. Without proper alignment, the motor will appear to have no effect (because the hinge is preventing the motion of the motor).

Linear motor/Angular motor:

Enable

Enable linear or angular motor respectively.

Target Velocity

Target linear or angular motor velocity respectively.

Max Impulse

Maximum linear or angular motor impulse respectively.