Notes for *statics of a body* slide set

All of the examples use a 5-ft grid.

The "rigid" bodies in the examples are modeled using stiff beam elements and very large superimposed mass. The added mass gives slow smooth movement and helps with numeric stability.

body-1.rcd

Illustrates that when a force is applied at the center of mass, a body moves as a particle would, but if the force is applied away from the center of mass, the body rotates. The rate of rotation is bigger when the force is farther from the center of mass.

moment-1.rcd

Illustrates that when equal and opposite forces are applied to a body, the body rotates about its center of mass, while that point remains stationary.

moment-2.rcd

Illustrates that a couple has the same effect regardless of where the two forces are applied (counter-intuitive for most people.)

moment-3.rcd

Illustrates that the moment produced by a couple is equal to the magnitude of the force times the perpendicular distance between the lines of action. Note that there is a graphic interpretation of the size of a moment when forces are drawn to scale. The moment magnitude can be viewed as the area of a rectangle where one dimension of the rectangle is the force magnitude, and the other dimension is the distance between the force lines of action. For the example, each moment has an area of 4 grid squares, where one grid square equals 25 k-ft (5 kips times five feet).

moment-4.rcd

Illustrates that a couple has the same effect as a concentrated moment, which is drawn as a curved arrow. The concentrated moment in the example has the same effect as any 100 k-ft clockwise couple.

moment-5.rcd

Illustrates how different-looking force systems can produce the same resultant. The upper left body has a simple couple of 50 k-ft clockwise. The upper right body is equivalent, with 150 k-ft clockwise, and 100 k-ft counterclockwise. The lower right body shifts the 15-kip couple to the right, which maintains equivalence. Finally the forces on the lower right body are derived from those of the lower left, combining the upward 5-k force and downward 15-k force into a single 10-k downward force. All four bodies respond in the same way, because all four force systems are equivalent.