Relevant Forces (and Torques)

Identify all of the different forces and torques that might be important in this system. Be sure to think about forces between parts of the system, as well as forces between the system and the rest of the universe. Make a table of the symbols, descriptions, and dependencies of the forces and torques. In your dependencies, identify both state variable and parameter dependencies!

A good way to think about this is to imagine "cutting" each part of the system out of the rest of the universe, and then thinking about what interactions you had to "cut" in order to accomplish this.

For the skateboarder, if we cut him/her out of the universe, we clearly have to cut the gravitational interaction with the earth (i.e., gravity exerts a force on the sb), and we also have to account for the fact that the ramp holds the sb up (i.e., there is a normal force interaction between the sb and the ramp). It's possible that we'd also want to account for a frictional interaction between the sb and the ramp, but since skateboards typically have pretty good bearings in their wheels, my first model will ignore this effect.

For the ramp, we've already identified a normal force interaction between the ramp and the sb – i.e., at any given instant, the ramp might be supplying momentum to the sb, or vice-versa. In addition to this, we observe that the ramp is pinned through its center of mass. This implies that WHATEVER other forces are applied, the pin will resist the force with an equal and opposite force so that the center of mass stays fixed. So really, we only need to think about the torques acting on the ramp – i.e., what are the forces being applied away from the COM. Since we've already decided not to include friction, the normal force appears to be the only one. We also could imagine there being a fricitonal torque at the pin – i.e., the pin might be rusty. But let's ignore this for now too.

Thus, we have the following forces and torques that we think will be relevant:

Symbol	Meaning	Dependencies
$\vec{F}_G$	Gravitational force acting on the skateboarder	Depends on the sb mass; always points down.
$\vec{F}_N$	Normal force interaction between sb and ramp – constrains the sb not to fall through the ramp.	Always points normal to the ramp; pushes sb up, and ramp down. This is a constraint force, so it is whatever it needs to be given the current situation – i.e., it is likely to depend on pretty much everything!
$\vec{\tau}_N$	Torque exerted by normal force on ramp	This is a constraint torque, so it will depend on a lot of stuff. Clearly it directly depends on the position of the sb, and the normal force.