

# Re: physics of anti topple devices

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- *From:* "Androcles" <[Headmaster@xxxxxxxxxxxxxxxxxx](mailto:Headmaster@xxxxxxxxxxxxxxxxxx)>
  - *Date:* Thu, 6 Nov 2008 19:08:36 -0000
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<sam.n.seaborn@xxxxxxxxxx> wrote in message  
[news:fca7e840-4d59-485a-adb2-49ef65126971@xx](mailto:news:fca7e840-4d59-485a-adb2-49ef65126971@xx)

Hi all,

I've got a basic question about physics in this (offbeat perhaps) situation.

I am building a "rack" for some computer servers. The basic structure for the rack is the IKEA GORM shelving unit (see note [1]). I have the following equipment to place on the rack.

two servers, each is a rectangular box about 6"x16"x18" (width, depth, height), weighing about 20 lbs each.

LCD monitor about 17"x17"x6" (WxDxH) weighing about 10 lbs.

one printer, a rectangular box about 14"x12"x10" (WxDxH) weighing 20 lbs.

4-5 stacks of standard letter paper (each is about 2 lbs) and miscellaneous office supplies

[1] Link to IKEA GORM unit:

<http://www.ikea.com/us/en/catalog/products/S59850857>

My main requirement is that this shelf should not topple. So, my questions are:

Q1 Unit stability. The bottom shelf of GORM bolts into the legs about 2 inches above the floor, so the unit rests on the legs. (The pic at [1] shows this.) I am thinking I should saw off the legs so the bottom shelf sits flush on the floor. I am also thinking of placing 10lb workout discs on the top shelf, at the rear corners; this seems intuitive, but is it a sensible topple preventor?

Q2 Equipment placement. The shelves will be at the following locations: bottom, top, table level (29" above the floor) and mid (about 55" above the floor). I'm obviously going to put the servers on the bottom shelf, towards the rear. The LCD monitor and printer will

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be at table level shelf and the letter paper will be on the mid level shelf. I suppose this makes for a visually sensible arrangement, but is it better, for example, to put the servers at the mid level or top shelf?

Q3 I've got a few more 10lb workout discs. I'm thinking of putting them at the rear corners of the mid level shelf as well. Does this make sense?

Q4 (Inevitable) What would it take, after all these steps, to topple it? I'm thinking of the most common occurrences: people leaning on it, a sudden jerk of a wire or cord or a hasty action on my part.

I realize there must be a physically/mathematically optimal solution (involving free body diagrams and moments of forces if I recall...) but I am really after a simplistic macro level solution. I would gratefully appreciate any suggestions (thanks in advance), and perhaps if the responder/s have questions about computer/hardware/software/programming, then I can help there too :-)

TIA,  
-Sam

You realize there is a physically/mathematically optimal solution (involving free body diagrams and moments of forces if you recall...) but you are really after a simplistic macro level solution, so I'll give you a simplistic macro level solution.

It will topple if you push it over. Adding weight higher up will aid it by raising the centre of gravity, so put the heaviest, most expensive and fragile items at the top and give it a really good push, that should do the trick. Or you could pull the bottom out from under it, that should work too. You could stand a vase of flowers at the top (filled with water of course). I know someone that did that with her television set and only the vase toppled, producing a delightful sizzling sound from the TV which unfortunately died. With any luck some 10lb workout discs should fall off and smash your toes if they fall from a great enough height.