

Workshop 1 — Basic LEGO Structure and Bracing

Monday, January 3, and Tuesday, January 4, 2005

1 Items to Bring

- All of your LEGOs

2 Reading

- Section 6.3 of course notes

3 LEGO Measurements

- A Fundamental LEGO Unit (FLU) is equivalent to the length of a LEGO nub, as shown in Figure 1.

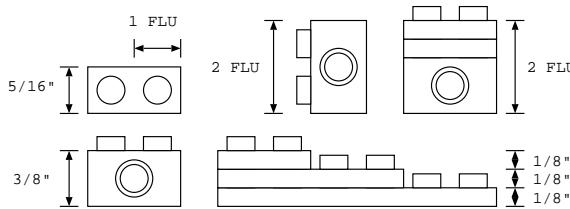


Figure 1: LEGO Dimensions (FLU)

4 LEGO Bracing

- **Vertical Bracing.** As discussed in lecture, to brace a Technic beam perpendicularly you need to sandwich two flat plates between two Technic beams, as shown in Figure 2. Remember the beam-flat-flat-beam or “3-2-3 rule” makes bracing easier.

There are several different vertical bracing arrangements possible. Figure 3 shows some unique examples. Although these examples work, they waste extra beams, and sometimes it can get hard keeping track of spacing. We highly recommended using the scheme shown in Figure 2 instead.

- **Diagonal Bracing.** Triangular trusses will only work if the number of nubs (FLUs) in the beam conform to Pythagoras’ theorem. Using Pythagoras’ theorem not only leads to stronger bracing, but also saves beams. For the purposes of LEGO, this means that the only useful combinations are 3-4-5, 5-12-13, and 6-8-10 (Figure 4).
- **Other Bracing.** Try experimenting with unconventional bracing. Many successful robots in 6.270 were based on designs that did not always have a perpendicular shape. Just remember that if there are angles in your chassis that are meant to be 90° , not following basic trigonometry adds unnecessary shear forces to your chassis. This is especially important when it comes to the gearbox.

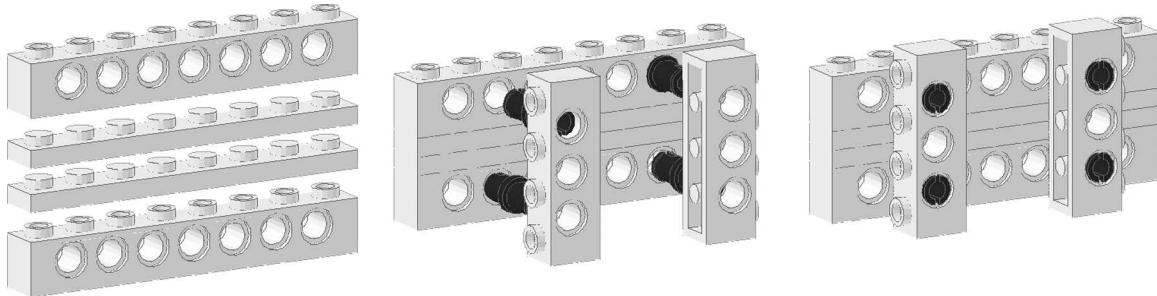


Figure 2: Bracing: 1 beam = 3 flat plates

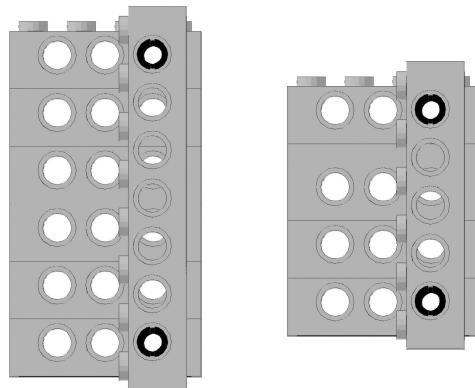


Figure 3: Other examples of perpendicular bracing

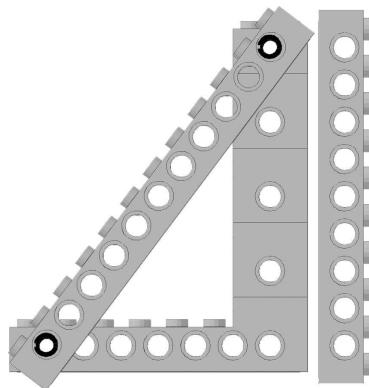


Figure 4: Using Pythagoras' Theorem for Diagonal Bracing

5 Activity

Construct a cube at least 10 FLUs on a side that can survive a 6' droptest.

For more practice, try constructing the motor jig as shown in Section 4.4. You will also see some creative uses of bracing when you complete Assignment 1.

6 A few things for the future

- **Drop Test Blues** Doing the drop test can really scary when it is nearing the deadline and you have become one with your robot. to reduce this stress, we recommend that you incrementally test your robot's structure. make sure each major component is structurally sound, especially your gearbox and motor mount assembly, and your container/mount for your hawker batteries.
- **Using Technic** Consider using the the rounded technic pieces for bracing in addition to normal lego bricks. it is easy to run out of bricks, and towards the end it can be difficult to free up more bricks from a well-braced robot.