Build
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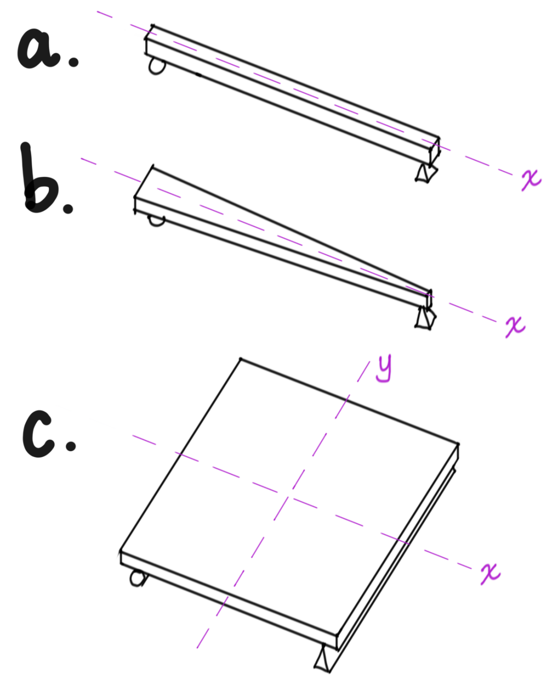
Connect

#05 Lateral Systems for Buildings

Braced frames, moment frames, and shear walls

Part I. Types of Structural Elements



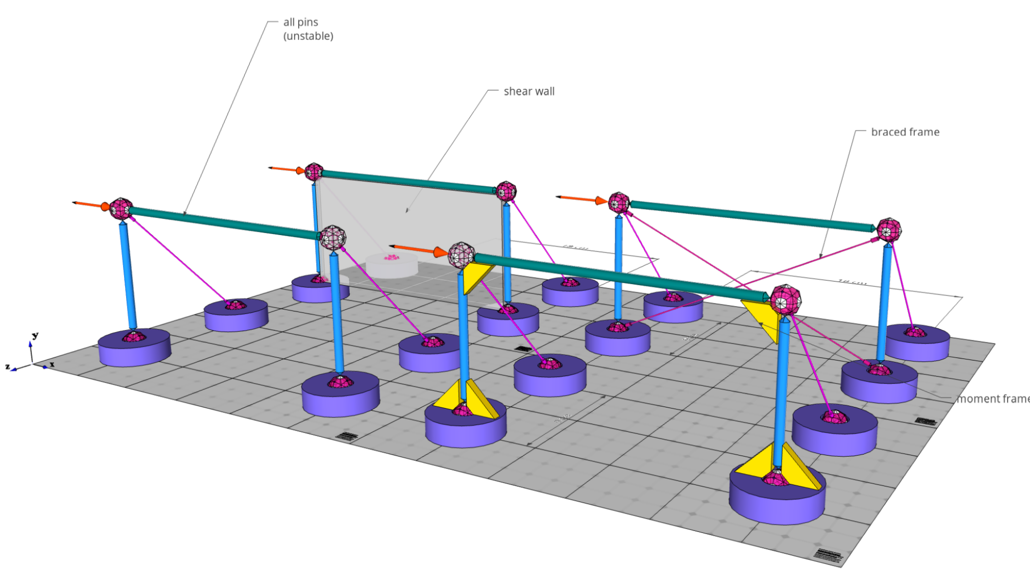
Structural engineers create analytical models that are intended to reasonably emulate reality. Of course, we use lots and lots of assumptions and simplifications as we set up our analytical model.

So far in this course, we have only been investigating one-dimensional elements (generically called "members"). One-dimensional members are typically drawn with a single line to show the length of the member. The cross-sectional dimensions are properties of that member that are extruded along its length, either prismatically, like (a) or quasi-prismatically like (b).

Today we will introduce a two-dimensional element - the plate element (c). In today's build we will use it as a so-called "shear wall."

Part II. Build Time

Open Structures-05-Lateral Systems for Buildings. Your job is to build four lateral systems (three that are stable plus one that is unstable … and therefore not something that we would actually build in the real world). After all four are built, apply a horizontal lateral load with your finger. This might simulate a diaphragm force that results from a wind or seismic load. Compare the flexibility and lateral drift (lateral deformation) of the four types of frames. Sketch the deformed geometry of each frame in your notebook. Thinking / sketching through the reactions and internal forces are recommended, although this is not required. The more you practice, the better you'll get.



Part III. Reflect

Why is the pin-pin frame unstable? Of the three stable configurations, which is the stiffest? Why? Which is the most flexible? Why?

In the real world, why do you think a structural engineer would pick one design over another? Obviously, cost is a factor, but let's not dwell on that because it's hard to quantify (market conditions change, different materials and trades are involved, some designs are more labor-intensive than others, and labor costs are higher than material costs in the US, etc.). Aside from cost, stiffness, and the cost-to-stiffness ratio, what other reasons might an engineer have for picking one of these forms over the others? I would prefer that you use your own head for this, thinking critically. If you get stuck, or want to explore further, you can search the internet, but please cite whatever source you end up referencing.

What were your big take-aways or Eureka moments from this exercise? What connections did you make to other classes and prerequisite studies?