

FIRST[®] LEGO[®] League

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ROBOT DESIGN LESSON

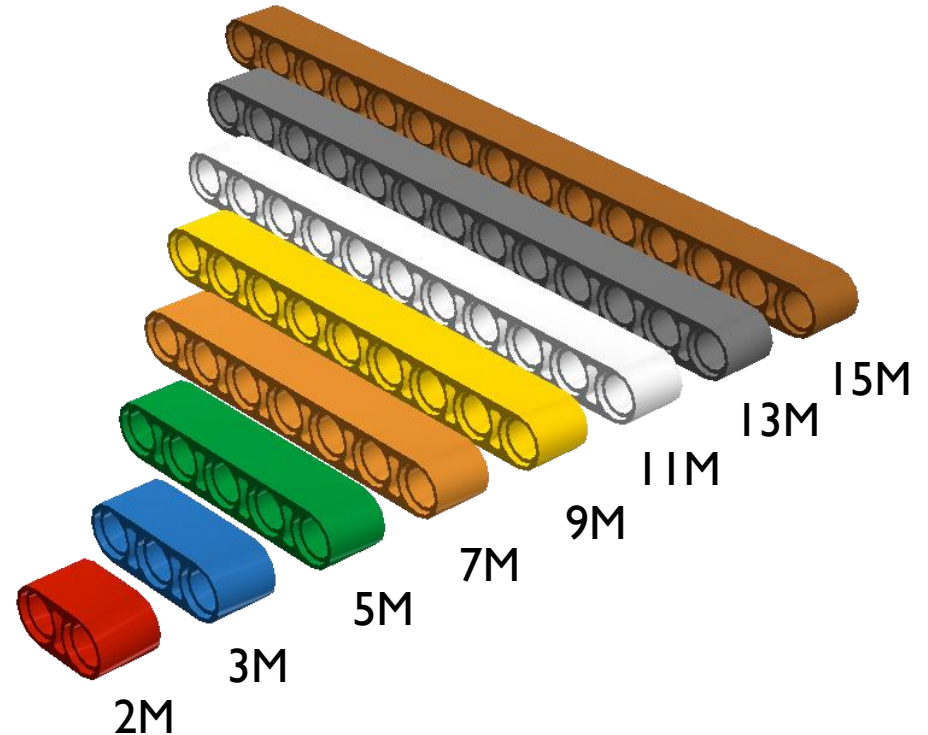
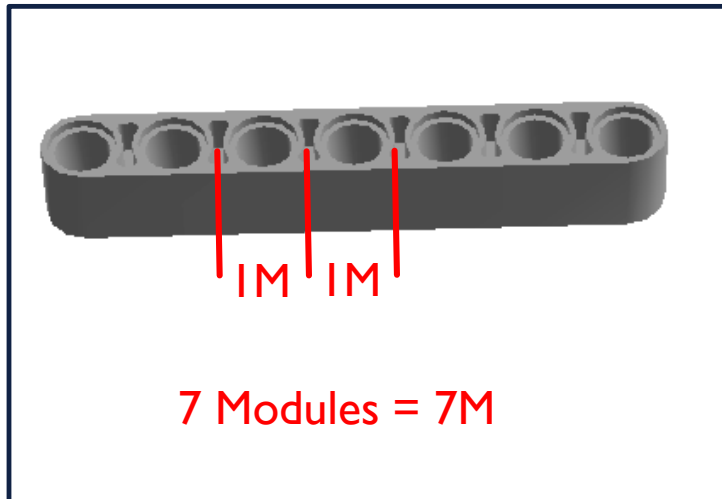
BASIC BUILDING TECHNIQUES FOR LEGO ROBOTS

ARE YOU NEW TO TECHNIC?

- This lesson is an introductory lesson to common technic pieces
- This lessons does not cover every Technic part. It is just an introduction to commonly used parts in MINDSTORMS robots

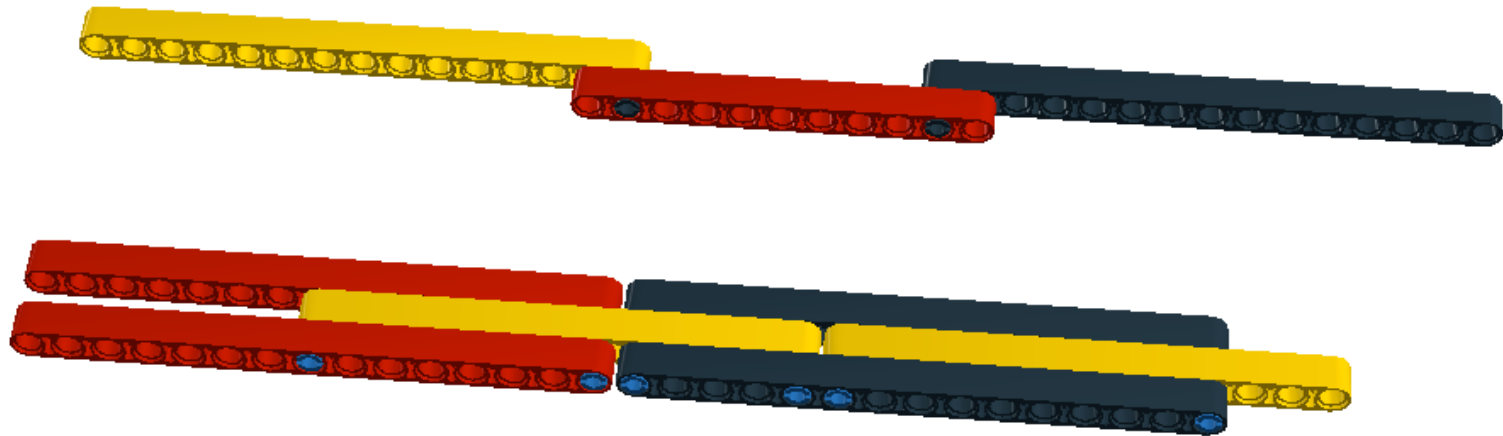
LIFTARMS

- Liftarms come in various sizes from 2M to 15M length
- Technic is measured in Modules (M)
- The number of holes corresponds to the Modules



TEST: MAKING SOMETHING LONG

- What if you want to build something long
- Build both models below. Which one is stronger?

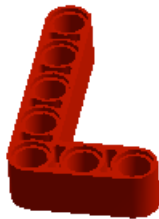




T-beam
3X3



4X2
90 degrees

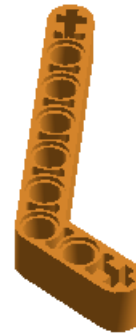


4X3
90 degrees

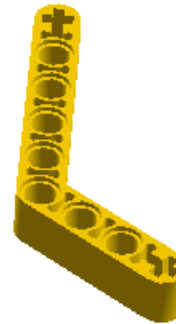
- Don't force LEGO into angles they are not meant for. You will put stress on the liftarms and the pegs



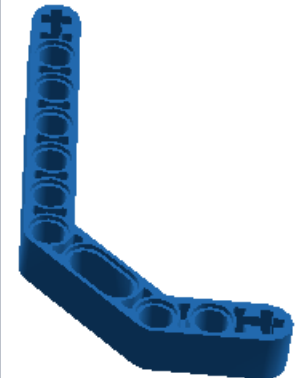
Angle
4X4



Angle
4X2

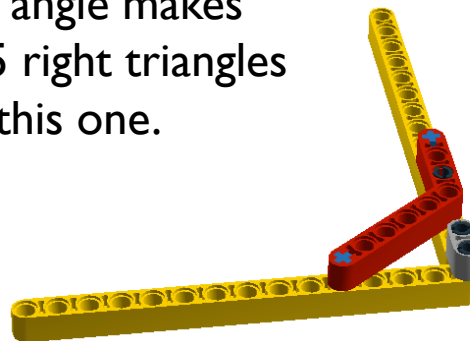


Angle
3X7



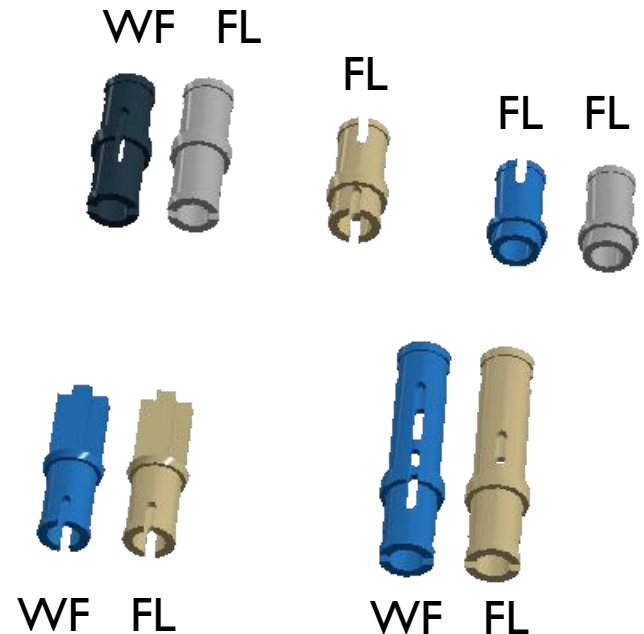
Double
Angle
3X7

These beams all have a 53.1° angle. This angle makes 3:4:5 right triangles like this one.



TECHNIC PEGS

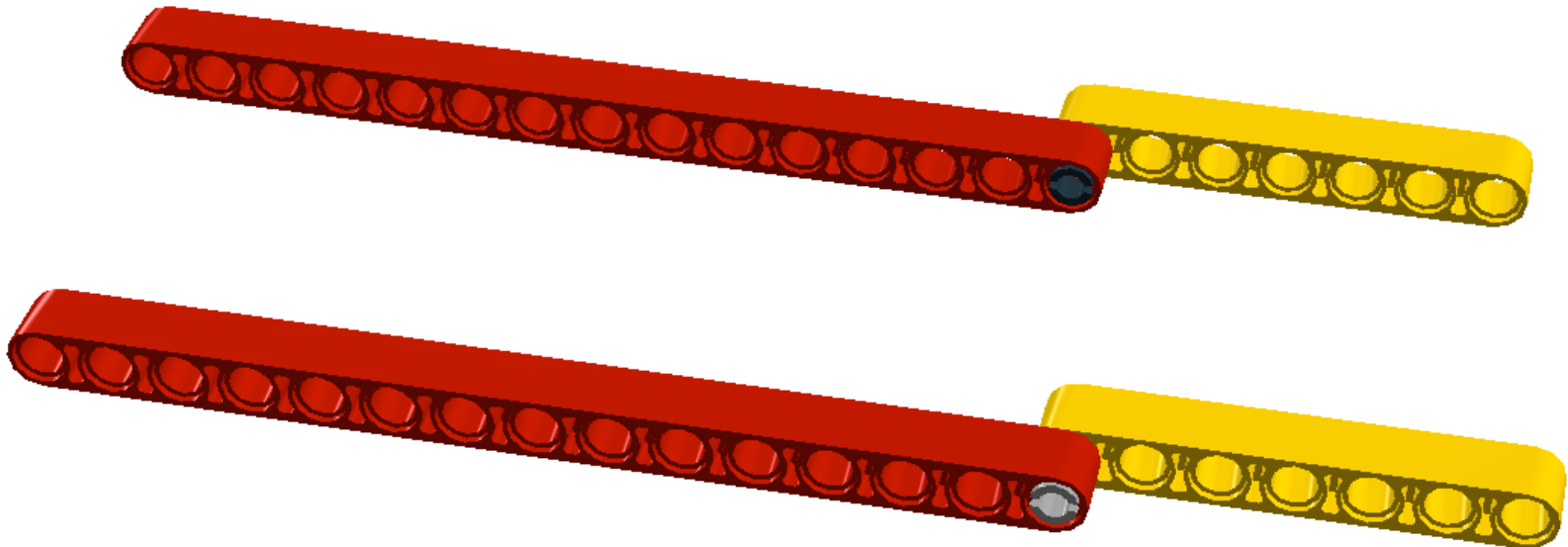
- LEGO makes two type of pegs:
With Friction and Frictionless pegs
- A common mistake is to use either
peg in builds
- However, which peg you use does
matter!



FL – Frictionless
WF- Friction

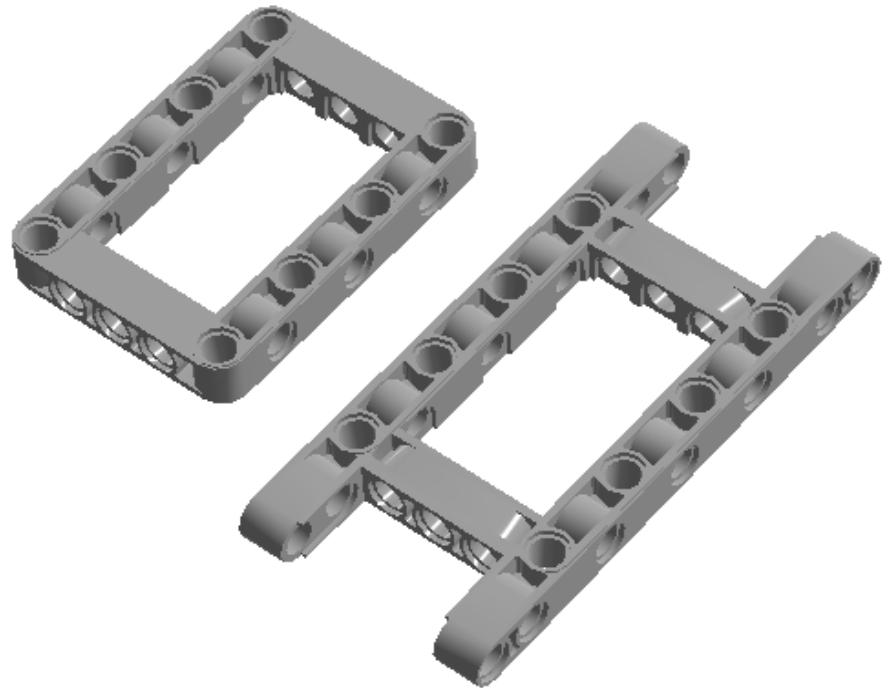
TECHNIC PEG TEST

- Build both these models. One uses a black peg with friction and the other uses the grey frictionless peg
- What is different?



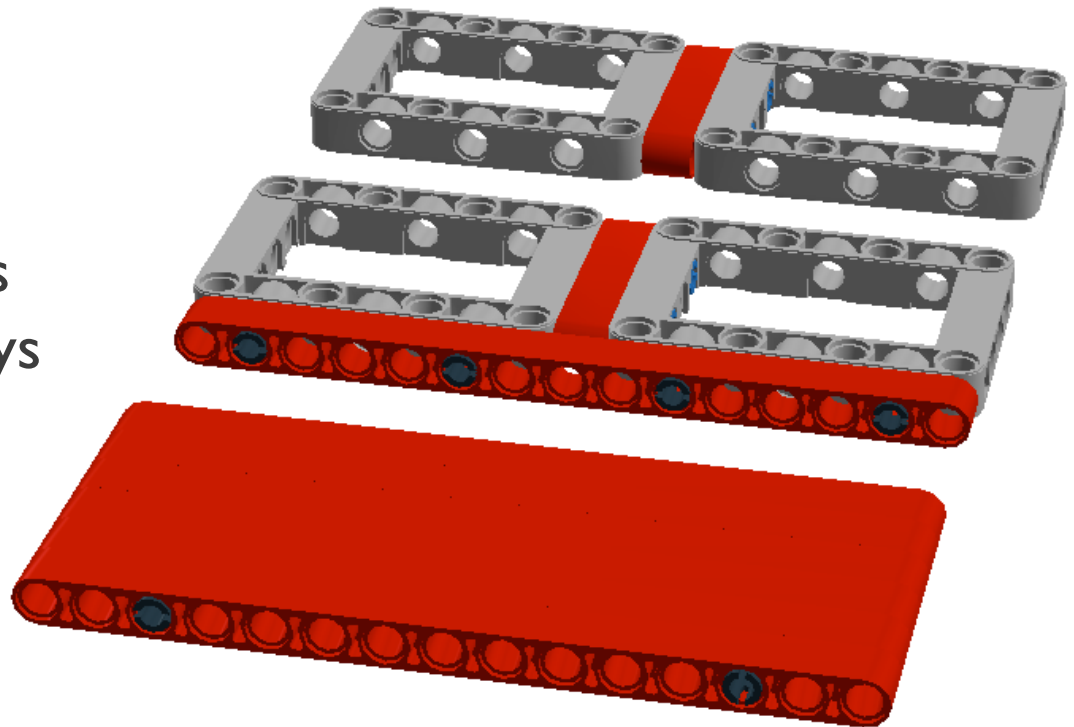
FRAMES

- Open frames and H-frames can add strength to your builds without as much weight



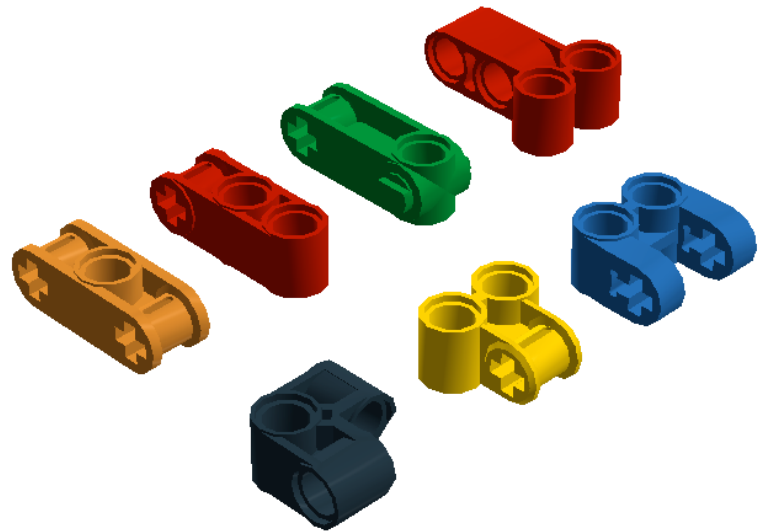
FRAMES TEST

- Build each of these.
- Compare them for weight and strength
- Try to pull the pieces apart. Which one stays together the best?



CHANGING DIRECTIONS

- These connectors can be used to change directions
- You might sometimes need to be a $\frac{1}{2}$ module off. Some of these connectors can come in handy for this.



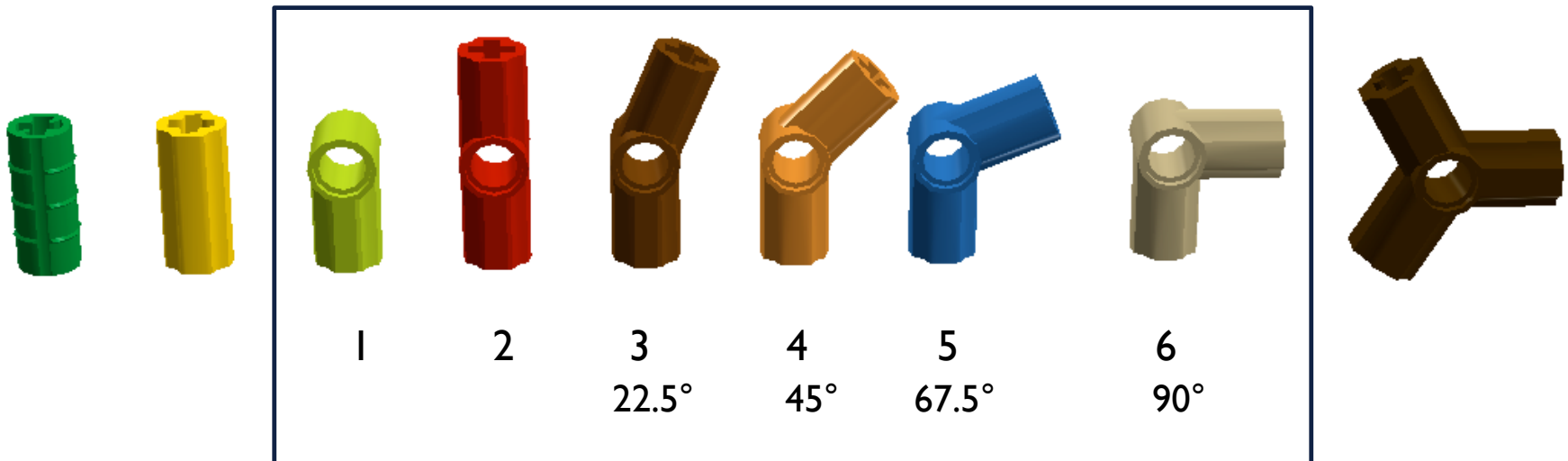
AXLES

- Axles come in lengths of 2M to 32M in various colors
- The MINDSTORMS set generally has black, red (2 length), and grey axles, but newer technic sets are changing to all red and yellow



AXLE CONNECTORS

- Axle connectors come in various angles. Many of them are labeled with a number
- Don't force LEGO into angles they are not meant for. You will put stress on the axles and connectors



AXLE TEST

- Sometimes, shorter axles with connectors are a lot stronger than one long axle
- Construct both builds below. Try bending/twisting them. Which one is stronger?

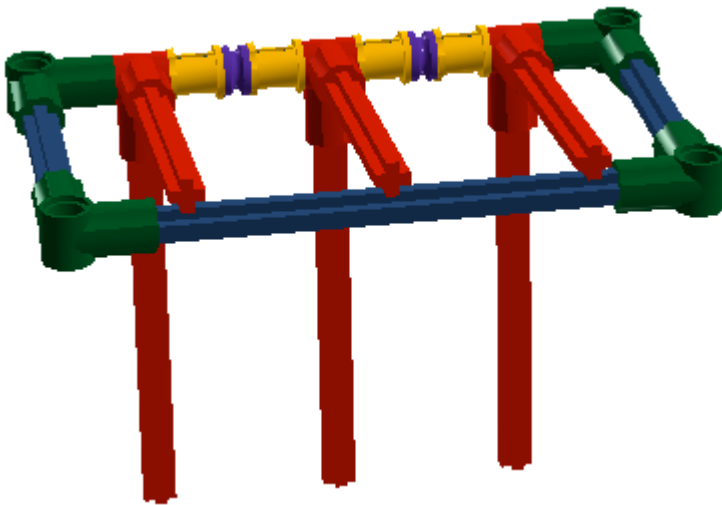
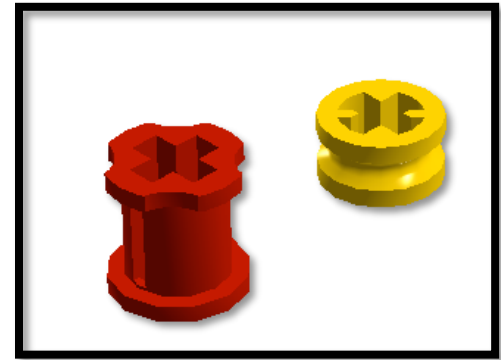
Three length axles with connectors



12 length axle

BUSHINGS

- Bushings can come in very handy
- They are used in axles like a space holder



CREDITS

- This tutorial was created by Sanjay Seshan and Arvind Seshan
- More lessons at www.ev3lessons.com and www.flitutorials.com



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