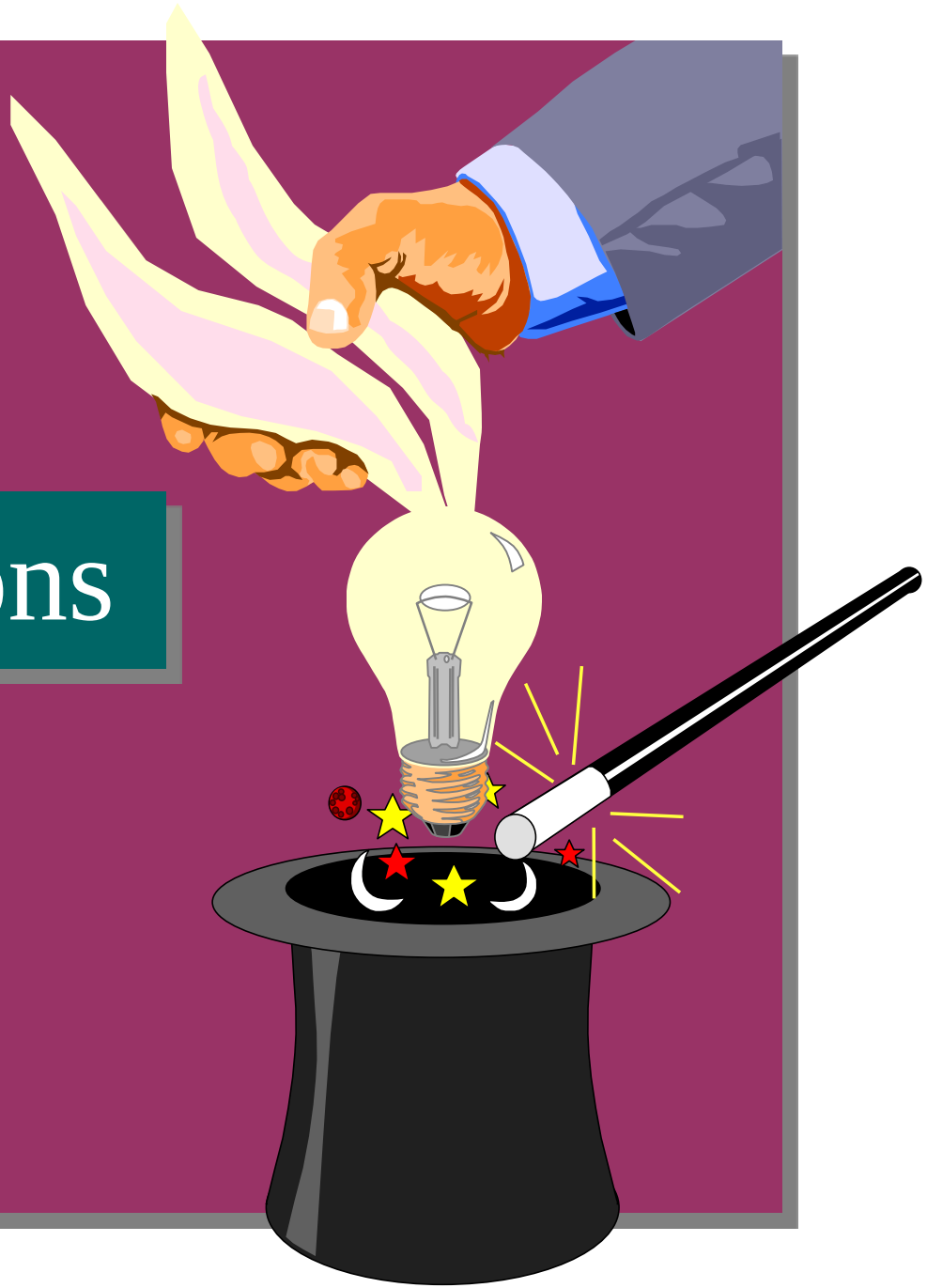
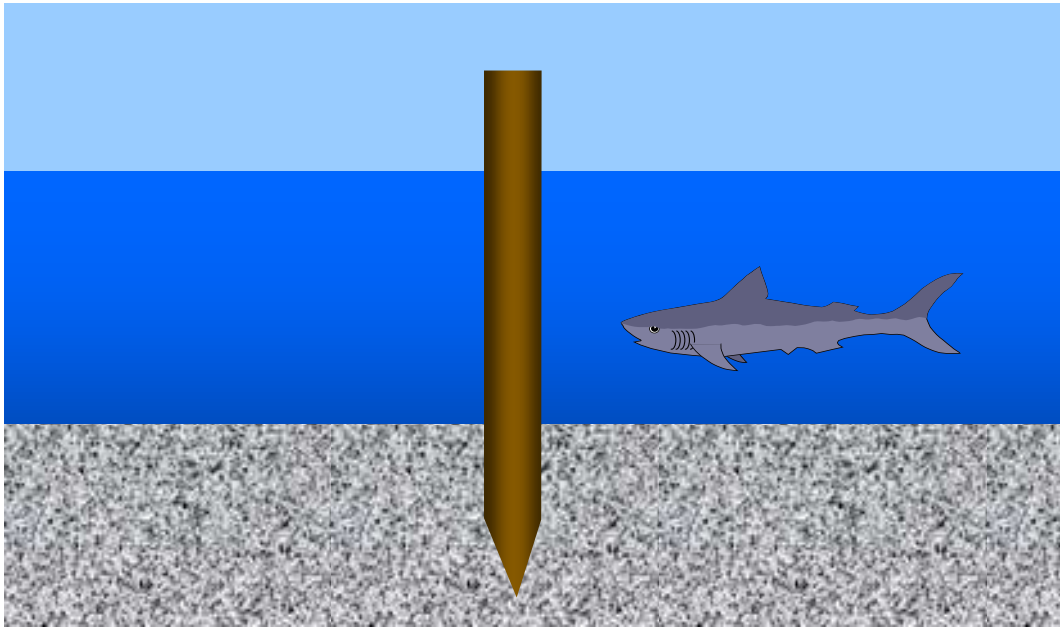
Contradictions



Pile Driving

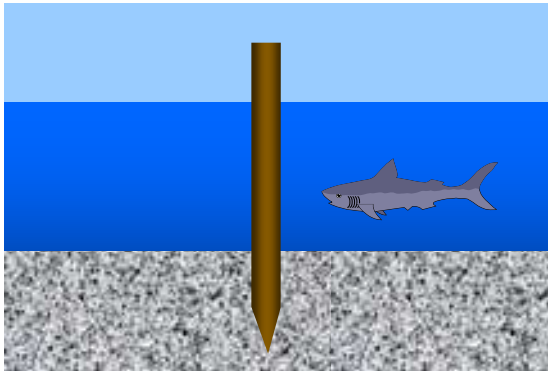


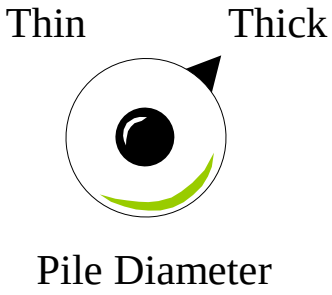
Y = Driving Speed

What are the Knobs?

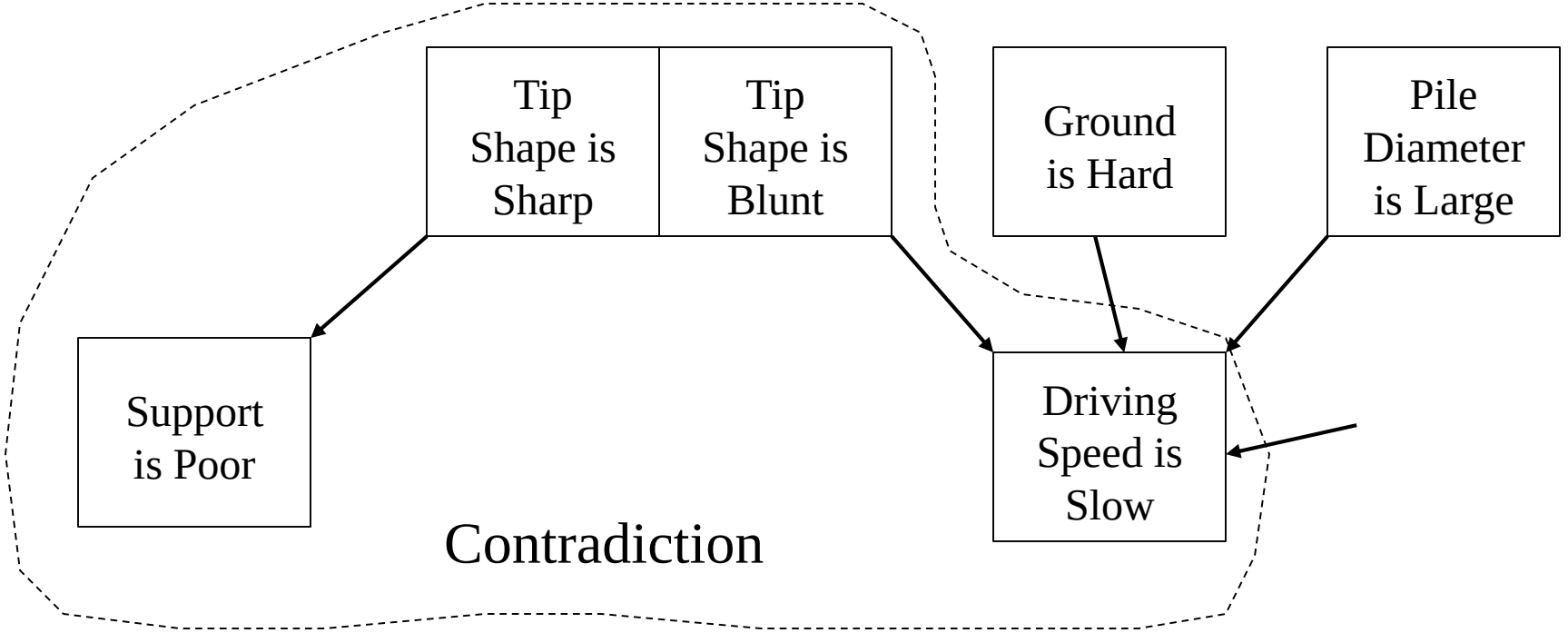
Driving Speed = f (Ground Hardness, Pile Diameter, Tip Angle …)

Pile Driving

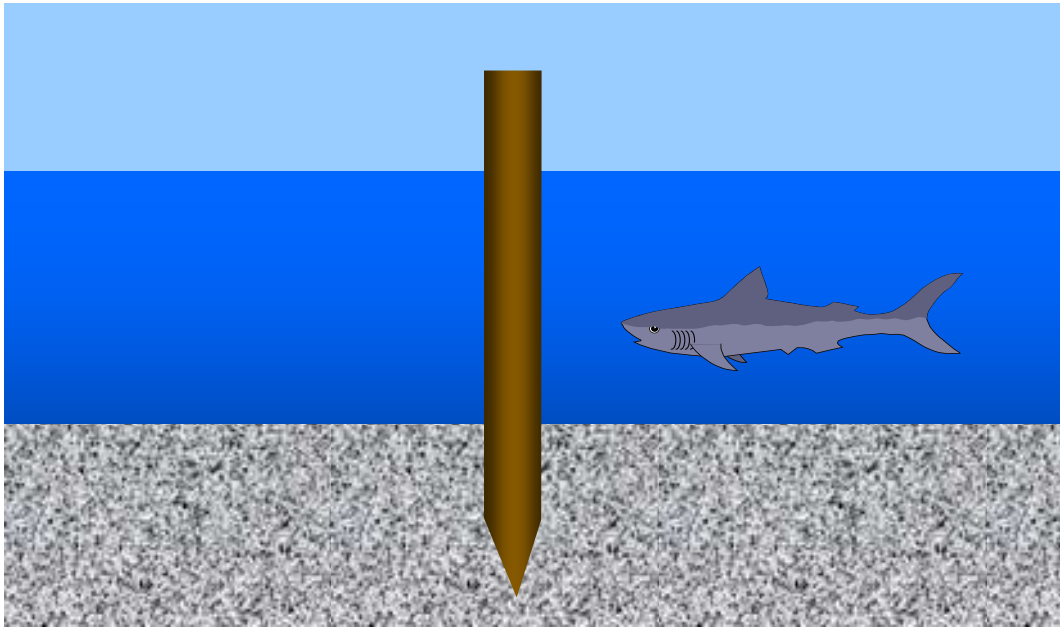




Use a knob and a setting

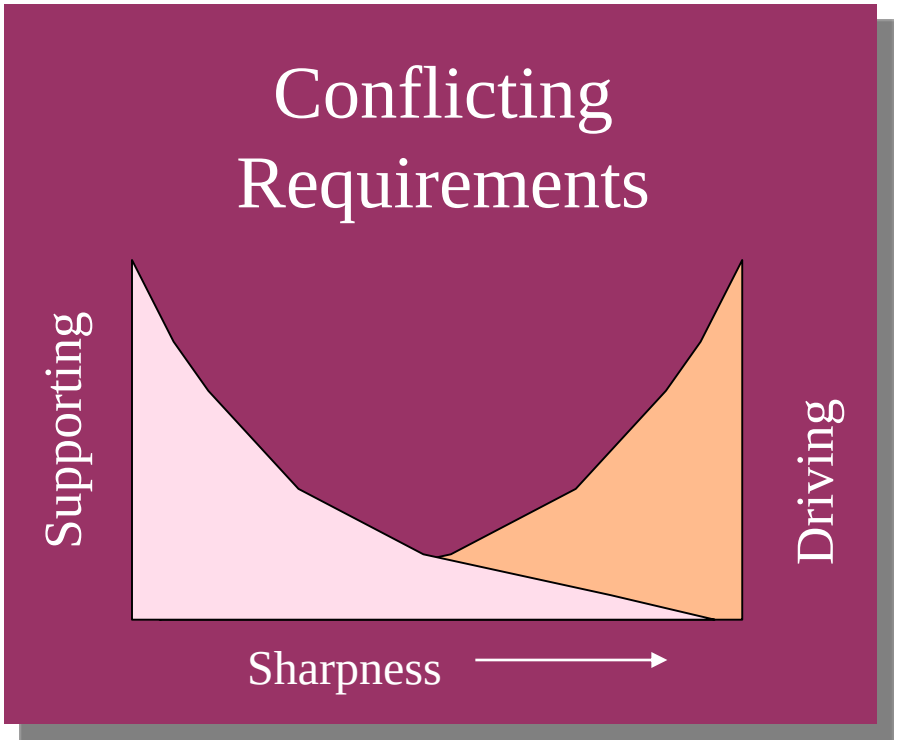


Pile Driving



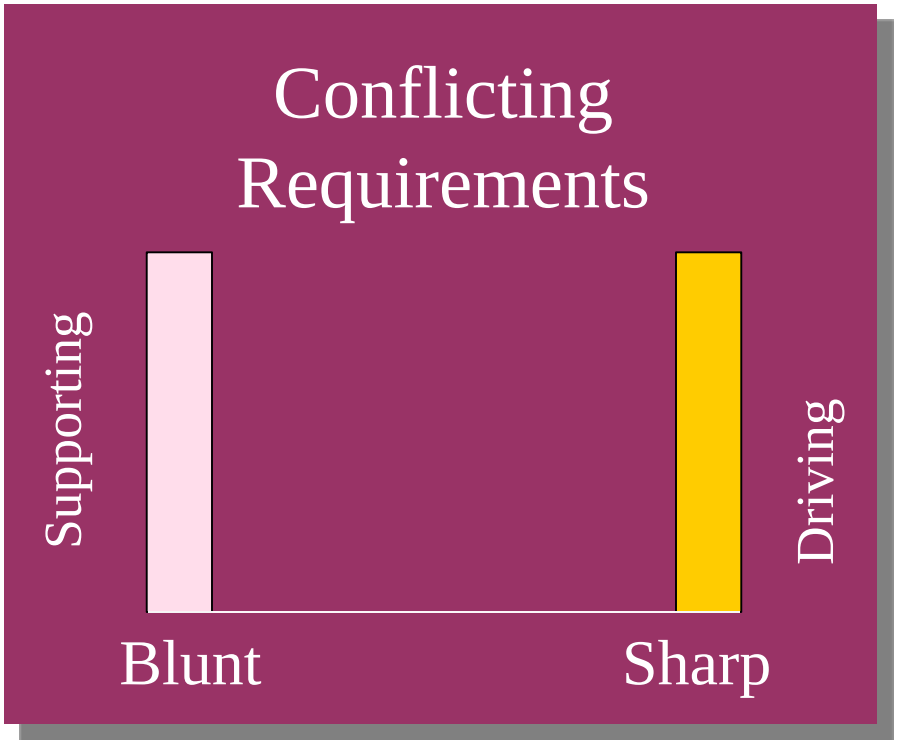
In order to drive fast, the pile must be **sharp**. In order to support heavy loads, the pile must be **blunt**

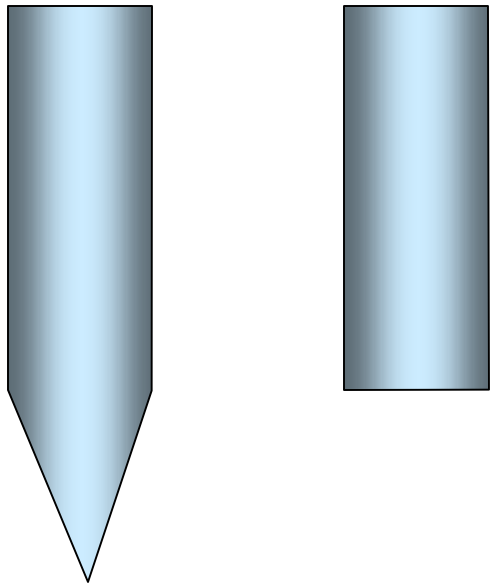
Compromise Solutions



- Time Consuming
- Guarantees Risk
- Delays the Solution

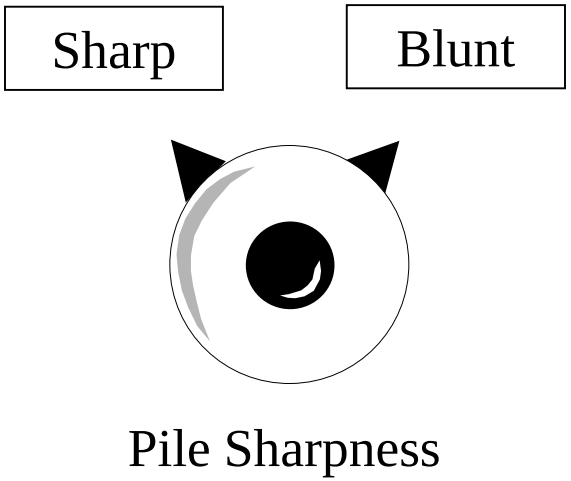
Idealized Solutions





It must be sharp and blunt

Setting the Knob to Both Settings



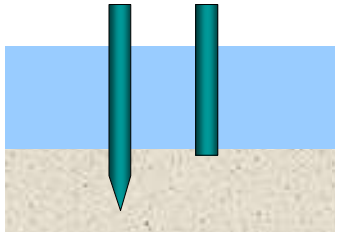
Rather than compromising, **Do both** (Resolve the Contradiction)

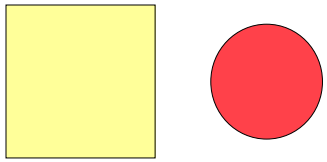
We will consider four ways:

Separation in Space
Separation by Direction
Separation by Scale
Separation in Time

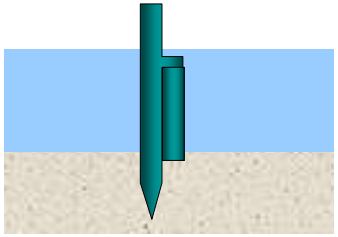
Separation in Space

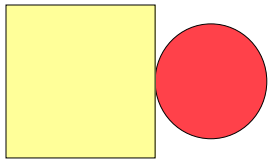
Completely Separate



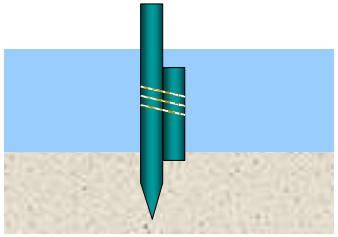


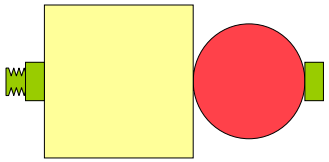
Touching



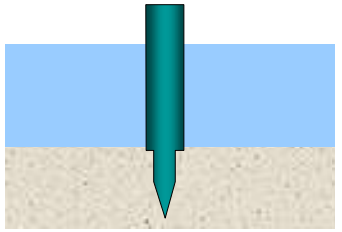


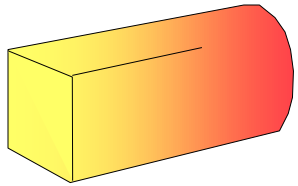
Carrier



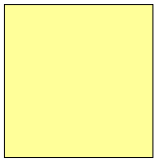


Non-Uniform

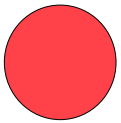




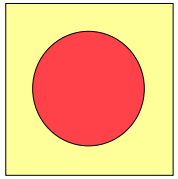
Copy



Real McCoy

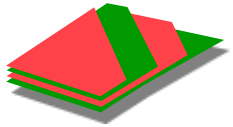


Nesting



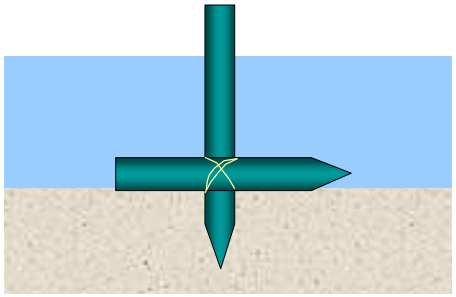
Round
inside Square

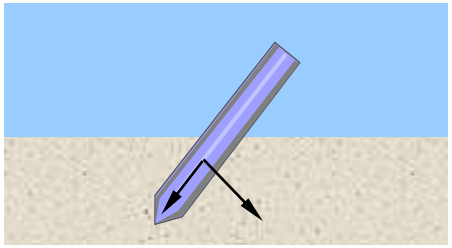
Composite or Mixture

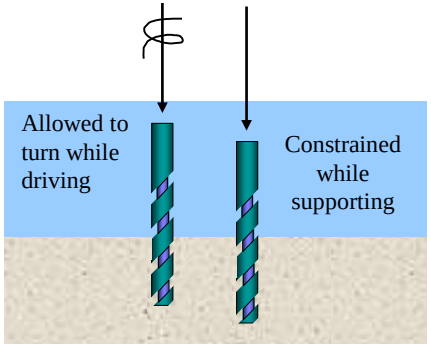


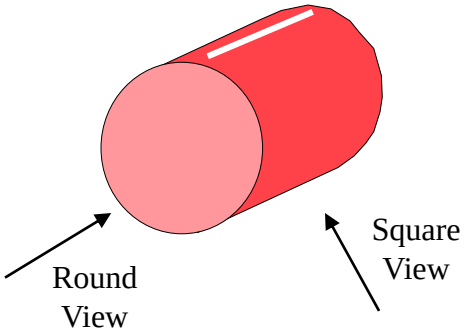
Red & Green

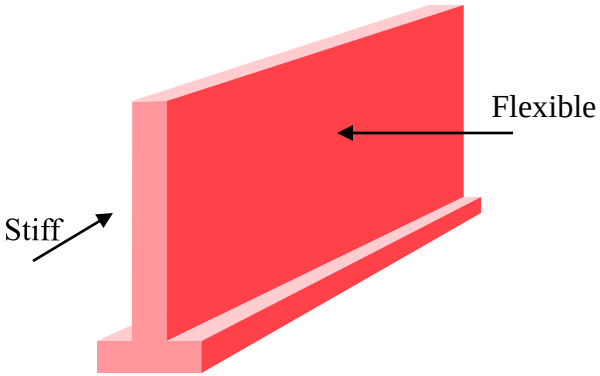
Separation by Direction, (Path or Plane)

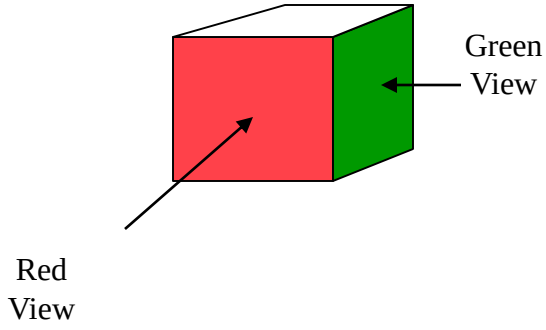




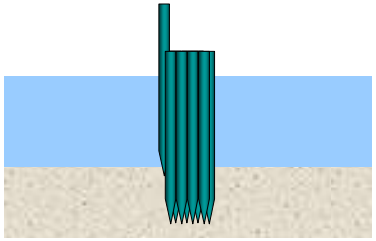




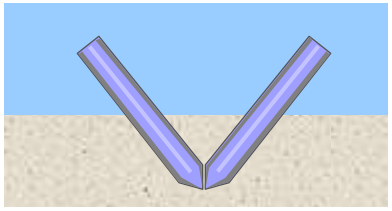




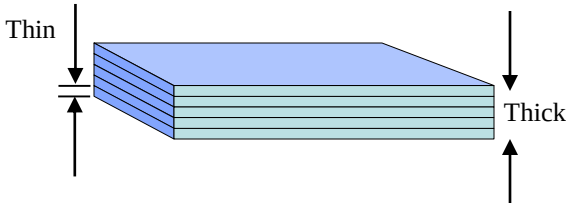
Separation by Scale or Between the Parts and the Whole

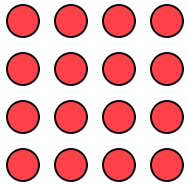


Blunt & Sharp

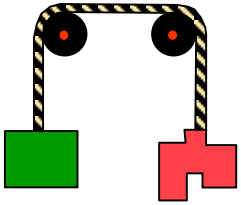


Blunt & Sharp

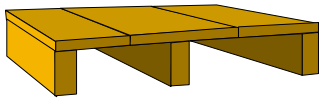




Square & Round

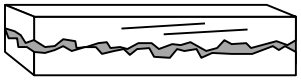


Heavy & Light Object



Massive and Light Table

Chain is Flexible
The Links are Stiff

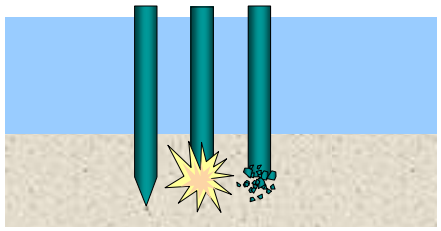


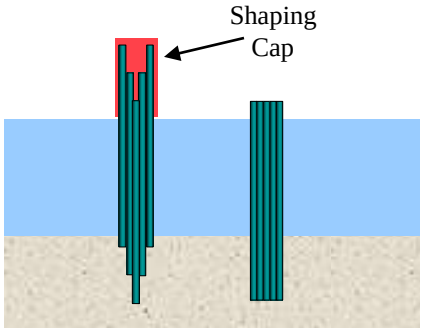
Smooth Object made from from Partially Rough Objects

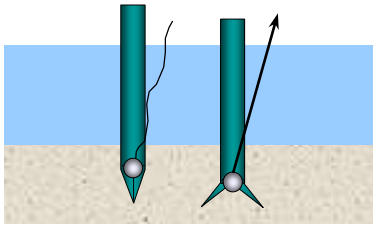
Sand Paper:

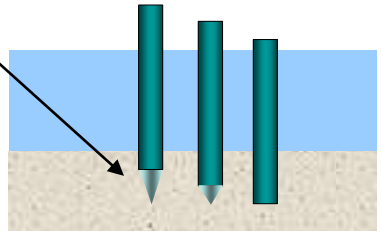
Inflexible Particles on a Flexible Carrier

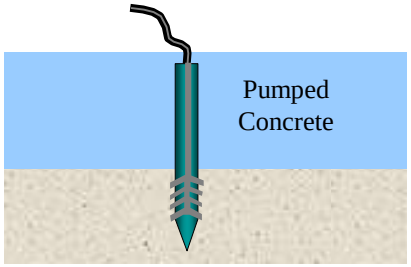
Separation in Time

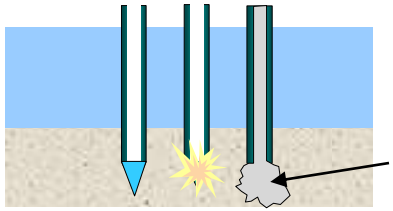


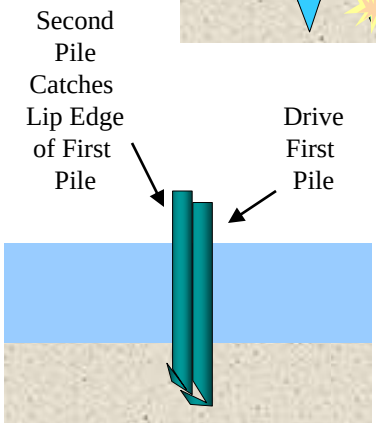


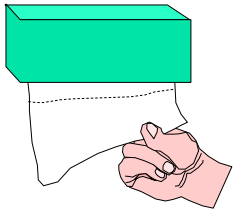




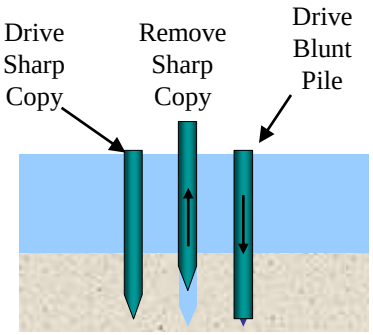








Cut & Not Cut



Contradiction Game

Game Rules

- A contradiction is given: Flexible and Rigid
- The team has 5 minutes to come up with examples of objects which have the contradictory properties. The examples may be real or made up, but they do need to be concrete and use actual physical phenomenon.
- The score is calculated as the total number of examples × the number of classes of methods used.
- For example: a team comes up with 12 total examples. Since they used only 2 separation classes (separation in space and separation in time) the final score is 12 x 2 = 24
- The winning team shares their results with the rest of the class