Contradictions
Y = Driving Speed
What are the Knobs?

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

- Driving Speed is Slow
- Ground is Hard
- Pile Diameter is Large
- Tip Shape is Sharp
- Tip Shape is Blunt
- Support is Poor

Contradiction

Use a knob and a setting

Pile Diameter

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

- Conflicting Requirements
- Time Consuming
- Guarantees Risk
- Delays the Solution
Idealized Solutions

Conflicting Requirements

Supporting

Blunt

Sharp

Driving

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)

- Round View
- Square View
- Stiff
- Flexible
- Red View
- Green View
- Allowed to turn while driving
- Constrained while supporting
Separation by Scale or Between the Parts and the Whole

Blunt & Sharp

Square & Round

Chain is Flexible
The Links are Stiff

Massive and Light Table

Thin

Thick

Counter Weight

Object

Heavy & Light Object

Sand Paper:

Smooth Object made from from Partially Rough Objects

Inflexible Particles on a Flexible Carrier
Separation in Time

- Abradeable Material
- Concrete
- Drive
- Sharp
- Copy
- Pumped Concrete
- Cut & Not Cut
- Shaping Cap
- Abradeable Material
- Concrete
- Drive First Pile
- Drive Sharp Copy
- Remove Sharp Copy
- Drive Blunt Pile
- Second Pile Catches Lip Edge of First Pile
- 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 $\times$ 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 $12 \times 2 = 24$
• The winning team shares their results with the rest of the class