Lecture 1

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Introduction

- This course spans two disciplines: fluid mechanics and thermodynamics. The fluid mechanics portion is further broken down into incompressible and compressible fluid mechanics.

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Introduction

- These disciplines span a very large part of industry & nature.

Black espresso maker with cup
Image source: Pexels
Image by: Viktoria Alipatova

`https://tinyurl.com/7pmetwu2`

White and Gray Airplane
Image source: Pexels
Image by: Jimmy Chan

`https://tinyurl.com/k7aryasy`

Red and White Train in Train Station
Image source: Pexels
Image by: Yelena Odintsova

`https://tinyurl.com/nhhvcxzx`

Introduction

- Broadly, any system that converts energy from one form to another.

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Introduction

- Can you think of a device where there is a direct & continuous production or absorption of mechanical or electrical power under steady state conditions without using a *fluid*?

This is why Fluid Mechanics is so important.

- Can you think of a device where there is a direct & continuous production or absorption of mechanical or electrical power under steady state conditions without involving *heat transfer*?

This is why Thermodynamics is so important.

Introduction

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First, we shall study this!

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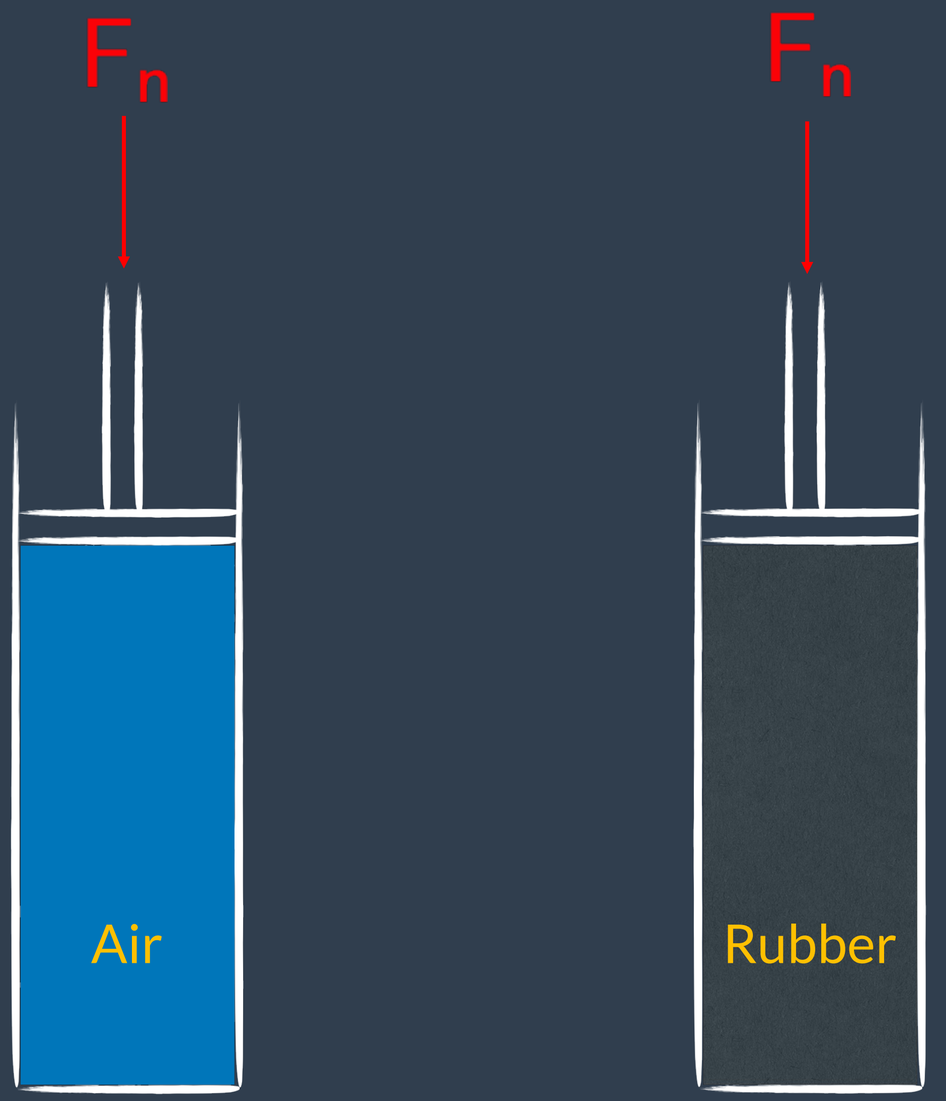
- Can you think of a device where there is a direct & continuous production or absorption of mechanical or electrical power under steady state conditions without involving *heat transfer*?

This is why Thermodynamics is so important.

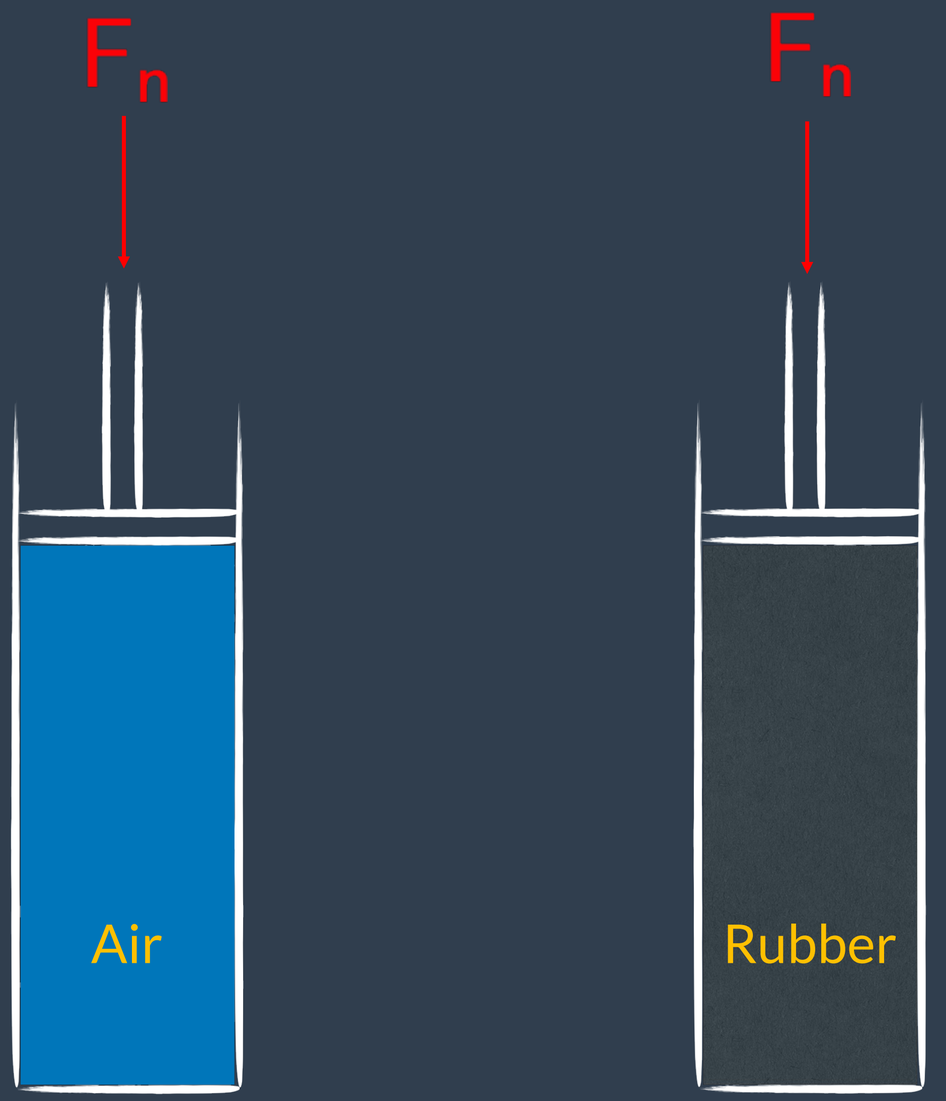
Fluids vs. Solids

- Consider two piston cylinders shown to the right. One is filled with air and the other with an elastic solid, e.g., rubber.
- A normal force (perpendicular) to the top surface is applied to each. What happens?



Fluids vs. Solids

- In both case the piston will descend by a small amount and then stop.
- The pressure inside both containers has increased by the same amount F_n/A.
- This is simply the applied force over the cross-sectional area of the piston.
- By inspection, it would appear fluids and solids behave in a similar way when subjected to a normal force.



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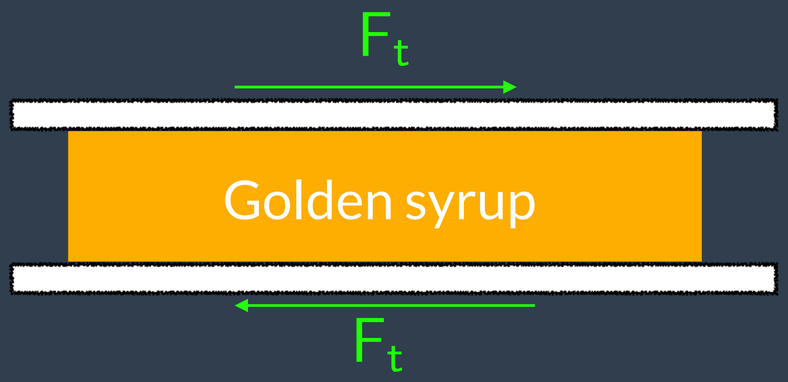
II.

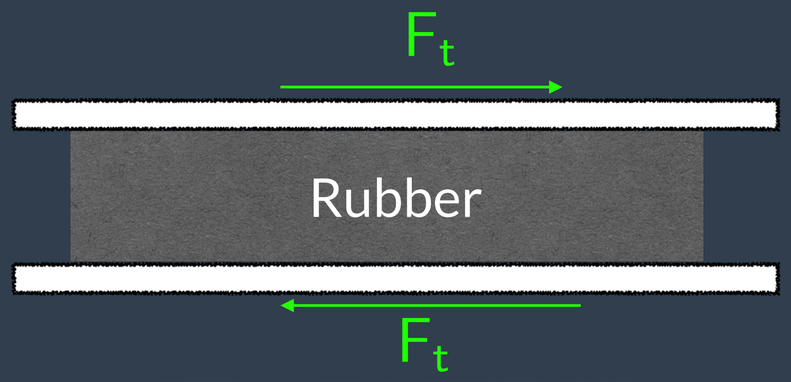
Fluids vs. Solids

- Now, consider a different arrangement with two parallel plates separated by a narrow gap. We fill one gap with golden syrup and the other with rubber.
- In both cases you can assume the molecules adjacent to the plates adhere to the plate surfaces.

Fluids vs. Solids

- Try to slide the plates relative to each other by applying a force tangential to the surface.





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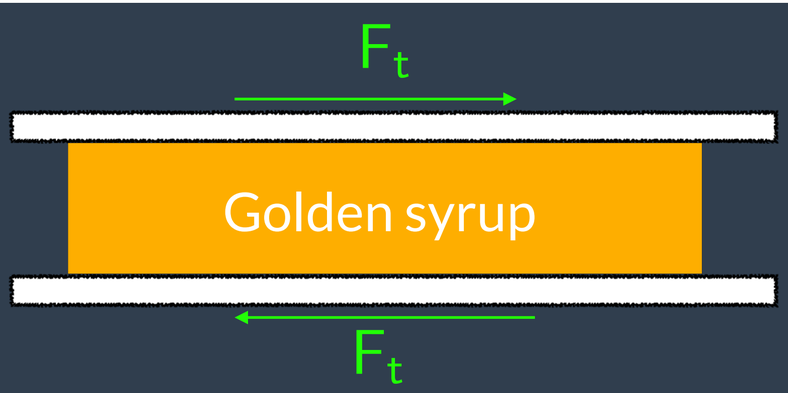

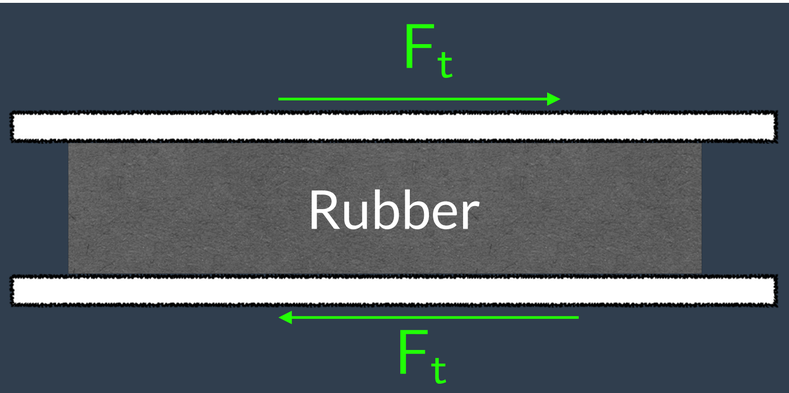

Definition of a fluid

- A fluid is a substance which, when at rest, cannot sustain shear stress.
- Shear stresses are sustained in fluids only when relative motion between fluid particles takes places.