Wheels

History
- 3500 BCE - The oldest wooden wheel was made of oak. Found in Mesopotamia.
- 2000 BCE - Spoked wooden wheel invented. Used for war chariots.
- Middle East and Northern Africa between 6th and 5th Century AD - Camel replaced wheels.

Basic Forces

Structure the Front Wheel

Measuring the Offset, removing the spokes, and cleaning the spokes

Reinforcing the Spokes, Axle, and Axle Housing

Locking the Wheel, putting in the Bearings, and fixing the wheel

Bibliography
Evolution of the Wheel

• 10000 BCE - Logs helped transport heavy objects as rollers
• 4000 BCE - Potter’s wheel invented is Mesopotamia (First Official Wheel)
• 3500 BCE - wheels were wooden discs but with a square hole in middle for axle
• Also used for Chariots
History

- 3300 BCE - The oldest wooden wheel was made of oak. Found in Slovenia
- 2000 BCE - Spoked wooden wheel invented. Used for War Chariots
- Classical Greece between 6th and 4th Century BC - First wheelbarrows appear
- Middle East and Northern Africa between 2nd and 6th Century AD - Camels replaced wheels
More History

- 1800s - Steam Locomotive Wheel (introduction of metal rims, with metal tracks)
- 1800s - Wire Spokes Introduced (our favorite!)
- 1920s - Steel Rims and Disc Wheels
- 1960s - Alloy Wheels introduced to reduce wheel weight
Structure: The Front Wheel
Structure: The Rear Wheel

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"In a car you're always in a compartment, and because you're used to it you don't realize that through that car window everything you see is just more TV. You're a passive observer and it is all moving by you boringly in a frame.

On a cycle the frame is gone. You're completely in contact with it all. You're IN the scene, not just watching it anymore, and the sense of presence is overwhelming. That concrete whizzing by five inches below your foot is the real thing, the same stuff you walk on, it's right there, so blurred you can't focus on it, yet you can put your foot down and touch it anytime, and the whole thing, the whole experience, is never removed from immediate consciousness."

-Robert Pirsig, Zen and the Art of Motorcycle Maintenance
The Wheels of our Bike: a Journey
The first few weeks:

Removing the wheels
Once the wheels are removed from the bike it's time to start taking them apart!
Removing the Brake Assemblies, Tires, and Inner tubes
Measuring the Off-set, removing the spokes, and cleaning the spokes
Cleaning the Spokes!!
Lacing the wheel, putting in the bearings, and truing the wheel
Truing the Wheel

Truing a wheel involves loosening and tightening the spokes so that the rim moves laterally or concentrically until it spins smoothly.
"It is not the wheel itself, but the problem of rotation, that's dogged our minds for thousands of years."

-John Lienhard, University of Houston
Basic Forces

- **Compression**: forces that are aligned laterally push inward. Spokes are compressed at the bottom of the wheel.
- **Tension**: forces that are aligned laterally pull outward. Spokes are in tension at the top of the wheel.
- **Shear Forces**: asymmetrical because metal will bend. These are avoided.
Forces on the Wheel

- Gravity: Top spokes carry the force of gravity. It compresses the bottom spokes because it pulls on the hub.
- Impact: Tire hits impact pieces and a force moves up and away from the piece. A normal force is then generated that acts opposite to it.
- During acceleration and deceleration, only half the spokes are working.
- Acceleration: Acts clockwise around the hub. Reaction forces act counterclockwise.
- Deceleration: Friction between road and tire.
Materials

Each of the materials involved in the motorcycle has unique properties which make it uniquely suited to its role. This chart shows the materials used in a wheel.
Young's Modulus

- Describes the breaking point of the material
- After the working strength, the material will deform or break
- There is a correlation between strain and stress
Mathematical Calculations:

Determining the minimum diameter for a spoke if each wheel had only one spoke.

\[ A = \frac{\pi d^2}{4} \]
\[ f = \frac{T}{A} \]
\[ T = Af = \frac{\pi d^2}{4} \times 60,000 \]

Since \( T = 200 \) lbs

\[ \frac{\pi d^2}{4} \times 60,000 = 200 \]
\[ \pi d^2 = \frac{8}{6000} \]
\[ d = \frac{8}{6000} \] \( \left( \frac{20 \pi}{3} \right) \)

\[ d \approx 0.063 \text{ inches} \]
Acknowledgments:

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Structure the Front Wheel

Basic Forces

Measuring the Offset, removing the spokes, and cleaning the spokes

Revising the Brake Suspension. Toe and Knee Issues

Locking the wheel, putting in the Bearings, and fixing the wheel.