Flywheel Selection

- Need flywheel to simulate inertia of bus to model exactly how bus will react
- Option to manufacture our own flywheel or use existing flywheels available
- Available options:
  - Clark flywheel at EECL (5 ft diameter)
  - Trainwheel (3 ft diameter)
  - University of Wisconsin Flywheel (2 ft diameter)
- UW flywheel already mounted on test stand, able to mount rings on flywheel for extra inertia
Flywheel Selection

• Calculations done for bus weighing 7250 kg, rear differential gear ratio of 3.875
• Moment of Inertia seen on bus axle $I = 1197 \text{ kg-m}^2$
• Moment of Inertia through rear differential seen by driveshaft

\[
I_{\text{ref}} = \frac{I}{n^2}
\]

\[
I_{\text{ref}} = \frac{1197.4}{(3.875^2)}
\]

\[
I_{\text{ref}} = 79.75\text{kg-m}^2
\]
Flywheel Selection

- Modeling capability of flywheels determined by energy equation

\[
\frac{1}{2} m v^2 = \frac{1}{2} I \omega^2
\]
Flywheel Selection

- Gearing can make any flywheel look like bus inertia
- Limited by safe speed of flywheels

\[ N = \frac{CAMEK}{D} \]

Where:
- \( N \) - Max safe speed
- \( C \) - .9 for variable speed
- \( A \) - 1.5 for disk type (no spokes)
- \( M \) - 2.75 for plate/forged steel (60ksi)
- \( E \) - 1.0 for solid rim (no bolted joints)
- \( K \) - ~2000 for thickness of 5% outside diameter
- \( D \) - Outside diameter in feet

\[ N = \frac{7425}{D} \text{ RPM} \]
## Flywheel Selection

<table>
<thead>
<tr>
<th>Flywheel</th>
<th>Max Safe Speed (rpm)</th>
<th>Max Modeling Capability (mph)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clark</td>
<td>315</td>
<td>30</td>
</tr>
<tr>
<td>UW</td>
<td>3500</td>
<td>20</td>
</tr>
<tr>
<td>UW (rings)</td>
<td>3500</td>
<td>37</td>
</tr>
<tr>
<td>Trainwheel</td>
<td>2500</td>
<td>39</td>
</tr>
</tbody>
</table>
Flywheel Selection

- New Constraint: If building own test stand, moment of inertia must be under $4 \text{ kg-m}^2$ for safety purposes
- Decided to use UW test stand since it was professionally designed
- Will still allow for sufficient modeling capabilities when inertia rings are designed and added
- Flywheel is already mounted on shaft and bearings
- Will save time, money, and design effort