Suspension System for Semi Low Floor Bus

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CITY BUS
Semi Low Floor - Entry + Two Steps

Cost effective unique solution pioneered by Ashok Leyland

860mm Floor Height
Notch (78mm) is given in frame at Front axle region for Ride clearance

Hump (120mm) is given in frame at Rear axle region for Ride clearance
Front - Rubber ended spring suspension

Rear - Air Suspension (Cowhorn type Suspension)
## Suspension Characteristics

<table>
<thead>
<tr>
<th>Sl.No</th>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>FAW-Kg</td>
<td>5460</td>
</tr>
<tr>
<td>2</td>
<td>RAW-Kg</td>
<td>10200</td>
</tr>
<tr>
<td>3</td>
<td>Front Leaf Spring Stiffness-Kg/mm</td>
<td>34.7</td>
</tr>
<tr>
<td>4</td>
<td>Rear Air Spring Stiffness-Kg/mm</td>
<td>15.42</td>
</tr>
<tr>
<td>5</td>
<td>Front Suspension Natural Frequency - Hz</td>
<td>1.7</td>
</tr>
<tr>
<td>6</td>
<td>Rear Suspension Natural Frequency - Hz</td>
<td>1.3</td>
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<tr>
<td>9</td>
<td>Front Suspension (Leaf Spring) Roll Stiffness-Nm/deg</td>
<td>1960</td>
</tr>
<tr>
<td>10</td>
<td>Rear Air spring Roll Stiffness-Nm/deg</td>
<td>7415.6</td>
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<tr>
<td>11</td>
<td>Rear ARB Roll Stiffness-Nm/deg</td>
<td>5554.7</td>
</tr>
<tr>
<td>12</td>
<td>Rear Suspension Roll Stiffness-Nm/deg</td>
<td>12970.3</td>
</tr>
</tbody>
</table>
Front Suspension

Rubber ended spring
1. Takes Vertical load and offers Stiffness
2. Takes driving, braking and cornering load

Advantages
- Leaf spring ends are connected to Frame brackets through Rubber pads. Rubber pads absorb vibrations.
- Weweller Spring helps the Axle to travel in Straight line path during Suspension travel articulation, which improves tyre life.

Shock absorber
Dampens Suspension travel
Front Spring

Rated Load- 2400 kg
Stiffness- 34.7 Kg/mm
Stress @ Rated load- 50 Kg/mm²
Rear Air suspension

- Bushes - to control low amplitude high frequency vibrations
- Air spring - to offer Variable stiffness for constant Natural frequency
- Radius rod (Top link) - to take driving, braking & Cornering forces
- Shock absorbers - to damp Suspension travel
- Radius rod (Bottom link) - to take driving & braking force.
- Levelling valve - to maintain constant Chassis height
- Anti roll bar - to offer Suspension Roll Stiffness
Frame is modified at Rear axle to have Ride clearance. Hump(124mm) is given in Frame.

Vehicle Frame height from Ground- 840 mm
Kinematic analysis is done for the following conditions to arrive forces at Suspension –Frame Reaction points.

- **Vertical**: 3g
- **Braking**: 0.8g
- **Cornering**: 0.6g
Vertical loading

- 6750 Kg (3g)
- 6750 Kg (3g)
- 6750 Kg (3g)
- 6750 Kg (3g)
Braking loading

- Top & bottom link will take Brake force.
- Top link will be in compression and bottom link will be in tension during Braking.
Cornering loading

Cornering load acting on Top links. One link will be Tension and other link will be compression.
Air Spring Data

Displacement in mm

Load in Kg

Rear Spring Variable Stiffness graph
Rear Air suspension Brackets FEA

**Cowhorn- Stress Analysis**

- Air spring load
- Symmetric constraints
- Fixed ends
- Vonmises stress plot

**Radius Rod Frame bracket- Stress Analysis**

- This face is fixed
- For all bolts 214 Nm preload is applied.
- 6566 kg load is applied.

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Rear Air suspension – Axle Bracket Analysis

Braking load of 1854 Kgf is applied normally on each of the selected faces.

Cornering load of 4040 Kgf is applied normally on each of the selected faces.
(pulling on one set of faces and braking on other set)

VONMISES STRESS

![Von Mises Stress Diagram]

- Maximum stress: 122.3 MPa
- Minimum stress: 118.4 MPa
Rear Air suspension – Rig testing

Air Suspension System Rig testing is done for the following conditions:

• Case-1: 0.5g-2g Vertical load for 1 Lac Cycles
• Case-2: 1g Vertical & 0.8g (+/-) Braking for 1 Lac Cycles
• Case-3: 1g Vertical & 0.6g (+/-) Cornering for 1 Lac Cycles
Summary

• Front engine SLF is the Cost effective solution offered by Ahokleyland for City bus application.

• Rubber ended Leaf spring suspension at Front and Air suspension at Rear is new concept driven by Ashokleyland.

Thank you