Module 8: Rear Spring Suspension

Terms and Definitions

- Axle alignment refers to the adjustments made in the relationship between the axles, steering and suspension components, and tires to bring them into correct positions.
- Axle spacing is the center-to-center (CC) distance between the rear axles on a tandem suspension.
- Drive line angularity refers to the angles between drive/suspension components and the frame.
- The equalizer is the device that distributes a force or weight evenly or uniformly.
- Load rating is the grade classification of a material according to how much force or weight it can carry.
- The slipper is the device used on the ends of leaf springs that allows the spring to slide freely in the hanger.

- Spring rate is the amount of load that will deflect the spring 1 inch (2.5 cm).
- Sprung weight is the weight of the vehicle that is supported by the springs.
- The torque rod is the separate suspension component that transfers braking and driving forces to the frame and maintains drive line angularity.
- A torque leaf is a part of some spring assemblies that acts as a torque rod.
- Unsprung weight is the weight that is not supported by the springs and includes the axle, tires, rims, brakes, and some of the steering components.

Purposes of Rear Suspension

- There are five main purposes of rear suspension:
  1. To support the weight of the vehicle and its load.
  2. To cushion the frame and cab of the vehicle from road shocks.
  3. To transfer braking forces and driving forces from the axle to the frame.
  4. To maintain axle alignment.
  5. To maintain drive line angularity.

Types of Springs

- Constant-rate spring.
  - A spring that deflects at a constant rate as load is added. For example, if 3000 lbs (1361 kg) deflects the spring 1 inch (2.5 cm), then 6000 lbs (2722 kg) would deflect the same constant-rate spring 2 inches (5 cm).
  - May be used in both front and rear axle applications.

- Vari-rate (progressive-rate) spring.
  - A spring that deflects at a slower rate as load is added. For example, if 3000 lbs (1361 kg) deflects the spring 1 inch (2.5 cm), then as the rate increases, 6000 lbs (2722 kg) would deflect the same spring 1½ inches (3.8 cm).
  - Provides a soft, easy-riding spring rate when the vehicle is empty, while also providing enough spring rate when fully loaded to function without sagging.
  - Several schemes are used to cause springs to vary the rate as load is applied. If the spring mounts are cam-shaped, then the effective length of the spring will change as load is applied.

- Auxiliary spring.
  - Used to increase spring rate when the vehicle is loaded.
  - Does not contact the mount until the vehicle is partially loaded and the main spring is partially deflected.
  - Usually mounted on top of the main spring assembly.
  - Sometimes known as the helper or overload spring.
# Rear Spring Suspension Components

**READY FOR REVIEW**

- Spring assembly.
- Equalizer.
- Front hanger brackets.
- U-bolt.
- Center hanger brackets.
- Torque rod.
- Top plate.
- Bottom plate.

## Functions of Rear Spring Suspension Components

**READY FOR REVIEW**

- **Front hanger bracket.**
  - Attaches the front of the forward spring assembly to the frame.
  - Anchors the front torque rod (or torque leaf) to the frame.
  - May have a cam-shaped spring contact surface to provide progressive spring rate.

- **Center hanger bracket.**
  - Attaches the rear of the forward spring and the front of the rear spring to the frame.
  - Provides a pivot point for the equalizer.
  - Anchors the rear torque rod (or torque leaf) to the frame.

- **Rear hanger bracket.**
  - Attaches the rear of the rear spring to the frame.
  - May have a cam-shaped spring contact surface to provide progressive spring rate.

- **Spring assembly.**
  - Absorbs, stores, and then releases energy as the vehicle passes over bumps.
  - The individual leaves that make up the assembly are held together with a center bolt to keep the leaves in alignment before the spring assembly is installed in the vehicle.
  - After the assembly is in place, the tension of the U-bolts maintains the spring assembly alignment.
  - The head of the center bolt is round (rather than hexagonal) and serves as a locating dowel for the rear axle.
  - The spring seat has a hole to receive the head of the center bolt.

- **Equalizer.**
  - Oscillates inside the center hanger bracket.
  - “Equalizes” the weight supported by each axle of a tandem assembly, even as the vehicle passes over bumps.
  - As the forward rear axle begins to go over a bump, the equalizer will tip up at the forward end (and down at the rear), thus allowing the forward axle to “step” up and over the bump.
  - At the same time, the rear axle is pushed down and continues to support its share of the load.

- **Equalizer bushing or bearing.**
  - Reduces friction and prevents wear between the equalizer and the pivot shaft.
  - Usually constructed of rubber or urethane bonded to a steel bushing.

- **Torque rod.**
  - Used with slipper-type springs to transfer braking and driving forces from the axle to the frame.
  - Will have some means of adjustment to provide a means of adjusting the axle alignment.
  - Used in pairs, with two torque rods per axle.
  - May be adjustable or rigid-type.

- **Torque leaf (radius leaf).**
  - Used in spring suspensions in place of torque rods.
  - Part of the spring assembly, but does little to support weight.
  - Locates the alignment of the axle and transfers the braking and driving forces to the frame.
  - Attaches to the frame with eccentric bushings, which allow for adjustment of the axle alignment.

- **Torque rod bushing.**
  - Reduces friction and prevents wear between the torque rod and the hanger brackets, and between the torque rod and the axle seat.
  - Constructed of urethane or rubber bonded to a steel bushing.
  - May be straddle-mounted (adjusted with shims) or solid concentric.

- **Alignment shim(s).**
  - Installed between the torque rod and the hanger brackets, or between the torque rod and the axle seat.
  - Changes the effective length of the torque rod to provide a means to align the rear axle to the frame.

- **U-bolts.**
  - Hold the spring assembly to the axle seat.
  - Maintain leaves in alignment when properly torqued.
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Top plate.
- Sometimes known as a U-bolt saddle.
- Contains a groove for each U-bolt.
- Locates the tops of the U-bolts and distributes their clamping force over a larger area.
- Also provides a place to anchor the torque rod to the axle.
- A hole drilled in the axle seat receives the head of the spring center bolt and thus locates the spring assembly in the correct position on the axle.

Axle seat.
- Located between the axle and the bottom of the spring assembly.
- The angle of the axle seat will determine the pinion angle of the rear axle.
- Also provides a place to anchor the torque rod to the axle.
- A hole drilled in the axle seat receives the head of the spring center bolt and thus locates the spring assembly in the correct position on the axle.

Bottom plate.
- Located underneath the axle.
- Provides a clamping surface for the U-bolt nuts.
- The U-bolt holes in the bottom plate will be drilled at the same angle as the axle seat pinion angle.

Types of Rear Spring Assembly Ends

- Eyes on both ends are used on single-axle suspensions.
- Eye-and-slipper design is used on single-axle and tandem-axle suspensions.
- Slipper-type ends slide (slip) back and forth and must use torque rods to maintain axle alignment.
- A slipper with a torque leaf is used on single and tandem suspensions.
- A camelback is used on Mack vehicle tandem suspensions. It uses two springs instead of four, and the spring itself acts as the equalizer.

Dimensions Required for Ordering Spring Assemblies

- Axle spacing, the common spacing dimension, which is 50 and 52 inches (127 and 132 cm, respectively) CC.
- Spring width common dimensions, which are 3, 3 ½, and 4 inches (7.6, 8.9, and 10.2 cm, respectively).
- Number of leaves.
- Length of long end (from the rear of the spring to the center bolt).
- Length of short end (from the front of the spring to the center bolt).
- Thickness of the pad.
- Arch.

Load Rating of Spring Assemblies

- The following must be known about the load rating of spring assemblies:
  - Load rating is a function of length, width, number of leaves, and type of steel.
  - Load rating is often stenciled on new springs.
  - May be rated by the manufacturer at the axle (unsprung weight) or at the ground (sprung plus unsprung).
- Common capacities range from 5000 to 20,000 lbs (2268 to 9072 kg).

Note: The letter “M” is often used to abbreviate thousand, so a spring labeled 8 M has an 8000-lb capacity.

Failure of Spring Assemblies

- All springs will eventually fail from fatigue due to repeated flexing.
- Corrosion, such that proper paints and care will slow the spread of corrosion.
- Shock absorbers, because shock absorbers slow the rate of jounce and rebound, and the spring is deflected less every time the vehicle hits a bump; therefore, the springs will last longer.
- Factors that affect spring life include:
  - Load factor, which means the greater the load, the shorter the life of the spring.
  - Maintenance, such that U-bolts must be retorqued after the initial installation and at specified service intervals in order for the springs to last as long as possible.