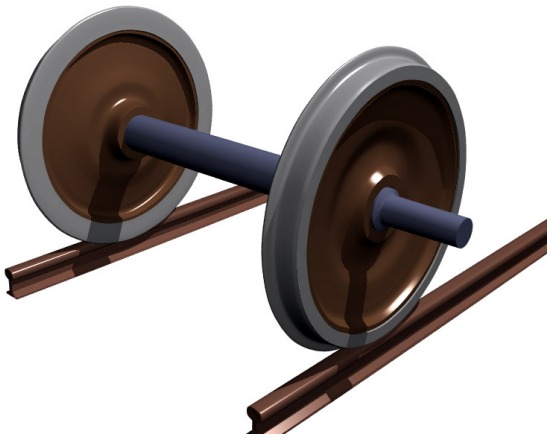
Axle

An **axle** is a central shaft for a rotating wheel or gear. In some cases the axle may be fixed in position with a bearing or bushing sitting inside the hole in the wheel or gear to allow the wheel or gear to rotate around the axle. In other cases the wheel or gear may be fixed to the axle, with bearings or bushings provided at the mounting points where the axle is supported. Sometimes, especially on bicycles, the latter type is referred to as a spindle.



Train wheels are affixed to a straight axle, such that both wheels rotate in unison. This is called a wheelset.

Vehicle axles

Axles are an integral structural component of a wheeled vehicle. The axles maintain the position of the wheels relative to each other and to the vehicle body. Since for most vehicles the wheels are the only part touching the ground, the axles must bear the weight of the vehicle plus any cargo, as well as acceleration and braking forces. In addition to the structural purpose, axles may serve one or more of the following purposes depending on the design of the vehicle.

- **Drive**: One or more axles may be an integral part of the drivetrain. A mechanical system (typically a motor) exerts a rotational force on the axle, which is transferred to the wheel(s) to accelerate the vehicle.
- **Braking**: Conversely a vehicle may be slowed by applying force to brake the rotation of the axle. Most vehicles' brakes are part of the wheel assembly and then exert torque to the wheels directly, but engine braking may still be effected via the axle.
- **Steering**: The front axle of most automobiles is a **steering axle**. The vehicle is maneuvered by controlling the direction of the front wheels' rotational axis relative to the body and rear wheels.

Structural features

A straight axle is a single rigid shaft connecting a wheel on the left side of the vehicle to a wheel on the right side. The axis of rotation fixed by the axle is common to both wheels. Such a design can keep the wheel positions steady under heavy stress, and can therefore support heavy loads. Straight axles are used on trains, for the rear axles of commercial trucks, and on heavy duty off-road vehicles. The axle can be protected and further reinforced by enclosing the length of the axle in a housing.

0 Series Shinkansen Wheel

In split-axle designs, the wheel on each side is attached to a separate shaft. Modern passenger cars have split drive axles. In some designs, this allows independent suspension of the left and right wheels, and therefore a smoother ride. Even when the suspension is not independent, split axles permit the use of a differential, allowing the left and right drive wheels to be driven at different speeds as the automobile turns, improving traction and extending tire life.

A tandem axle is a group of two or more axles situated close together. Trucks designs will use such a configuration to provide a greater weight capacity than a single axle. Semi trailers usually have a tandem axle at the rear.

Drive axles

Splines on a front drive axle.

An axle that is driven by the engine is called a **drive axle**.

Modern front wheel drive cars typically combine the transmission and front axle into a single unit called a transaxle. The drive axle is a split axle with a differential and universal joints between the two half axles. Each half axle connects to the wheel by use of a constant velocity (CV) joint which allows the wheel assembly to move freely vertically as well as to pivot when making turns.

In rear wheel drive cars and trucks, the engine turns a driveshaft which transmits rotational force to a drive axle at the rear of the vehicle. The drive axle may be a live axle, but modern automobiles generally use a split axle with a differential.

Some simple vehicle designs, such as go-karts, may have a single driven wheel where the drive axle is a split axle with only one of the two shafts driven by the engine, or else have both wheels connected to one shaft without a differential.

Dead axles/lazy axles

A **dead axle**, also called **lazy axle**, is not part of the drivetrain but is instead free-rotating. The rear axle of a front-wheel drive car may be considered a dead axle. Many trucks and trailers use dead axles for strictly load-bearing purposes. A dead axle located immediately in front of a drive axle is called a **pusher axle**. A **tag axle** is a dead axle situated behind a drive axle. On some vehicles (such as motorcoaches), the tag axle may be steerable.

This dump truck has an airlift pusher axle, shown in the raised position.

Some dump trucks and trailers are configured with **lift axles** (also known as airlift axles or drop axles), which may be mechanically raised or lowered. The axle is lowered to increase the weight capacity, or to distribute the weight of the cargo over more wheels, for example to cross a weight restricted bridge. When not needed, the axle is lifted off the ground to save wear on the tires and axle and to increase traction in the remaining wheels. Lifting an axle also makes the vehicle perform better on tighter turns.

Several manufacturers offer computer-controlled airlift, so that the dead axles are automatically lowered when the main axle reaches its weight limit. The dead axles can still be lifted by the press of a button if needed.

Full-floating vs. semi-floating

The full-floating design is used in heavy duty applications as opposed to many of the lighter-duty differentials that are semi-floating. A full-floating differential can be identified by the large hubs that stick out the end of the axle and have the axle shafts bolted to them. These axles are able to carry more weight then a comparable semi-floating differential because the hubs on the ends of the axle have their own bearings that carries the load of the vehicle. The semi-floating design carries the weight of the vehicle on the axle shaft, there is simply one bearing on the end of the axle tube that carries the load from the axle and that the axle rotates through. In the full-floating design the hubs carry the weight of the vehicle while the axles are only used to transmit torque and rotation from the carrier in the

differential to the hubs on the ends of the axle. Full-floating axles are held in place by bolting a flange on the end of the axle to the hub. With a semi-floating axle, the axles are held in place by c-clips that are in the differential carrier. If an axle or c-clip ever breaks it is possible that the wheel of the vehicle could leave the vehicle. The full-floating designs, however, do not have c-clips, but can still break axles. If the axle shaft breaks, the wheel will not go anywhere since it is still bolted to the hub.

See also

- Klien-Lindner axle
- Portal axle
- Wheel and axle
- All pages beginning with "Axle"
- All pages with titles containing "Axle"