Geometric considerations

Basic motorcycle geometry

The elements of this are shown in figure 3.1.

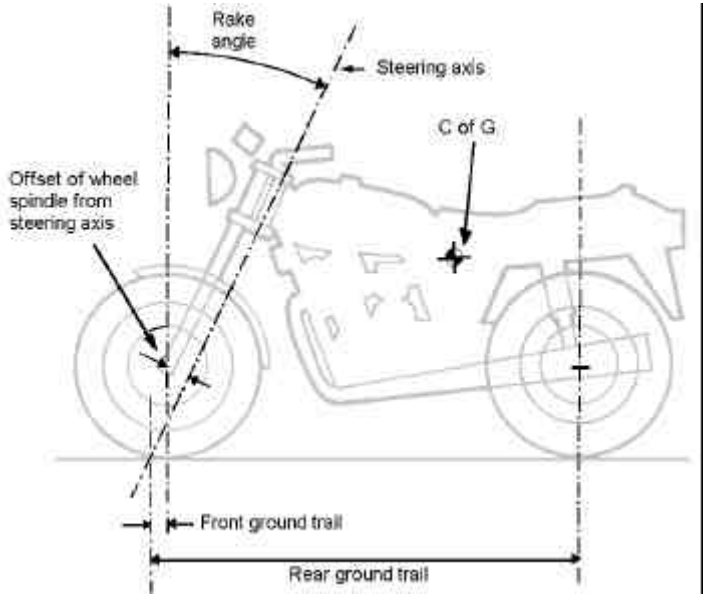

Fig 3.1 **The steering axis is the line about which the steering system turns. Rake or castor angle is the rearward inclination of the steering axis.**
Ground trail is the amount by which the centre of the tyre contact patch *trails* behind the point where the steering axis meets the ground.
Back and front wheels each have their own value of trail. Offset of the wheel spindle from the steering axis is measured at right angles to that axis.
CofG is the centre of gravity and for most purposes, we are concerned with the combined CofG of rider and machine.

Trail

The primary function of trail is to build in a certain amount of steering stability, and it also is of great importance to the lean-in phase when cornering. We can see that both front and rear tyres contact the ground behind the point where the steering axis meets it, this gives rise to a castor (self-centering) effect on both wheels. The linear measurement of this castor along the ground (steering axis to centre of contact patch) is usually called the trail.
However, it would be more logical to use the distance between the ground contact patch and the steering axis as measured at right angles to that axis. This is the distance that creates a torque about the steering axis from any forces at the tyre, to distinguish between these two trail definitions, when necessary, I suggest that we call them *ground trail* and *real trail*. *Real trail* is approximately 90% of the *ground trail* for bikes with a normal rake angle, and is equal to the *ground trail* for zero rake. Compare figs. 3.1 and 3.2 to see the difference. The importance of this distinction will become clear later in this chapter.

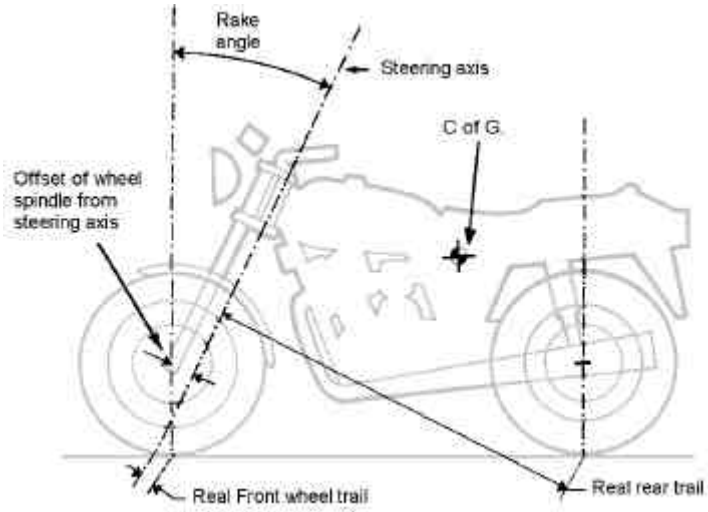

Fig. 3.2 **Real trail is measured at right angles to the steering axis. Real trail is reduced from the ground trail by the cosine of the rake angle. For typical rake angles this is approx. 90%**
Compare this with the ground trail as shown in fig. 3.1.

How the trail causes a self-centering effect can be understood from figure 3.3 which is a plan view of a wheel displaced from the straight-ahead position.

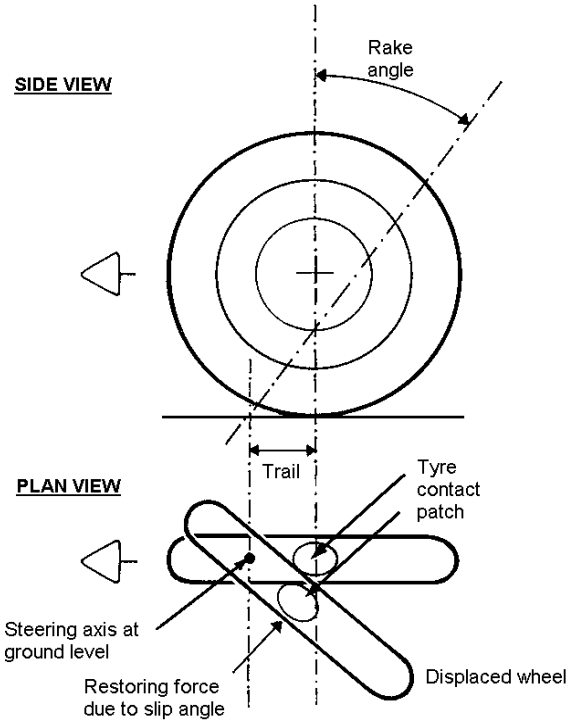

Fig 3.3 **Positive trail and the side force due to slip angle combine to produce a steering torque tending to restore deflected steering to the straight ahead position. This gives a certain degree of straight line stability.**