Torque Generated by Driving and Braking Forces

Torque is 'the turning effect of a Force'. It is the vector product of an applied Force and the Distance over which the Force is applied. 'Vector' simply means that the product of the quantities takes account of their direction, as well as their size.

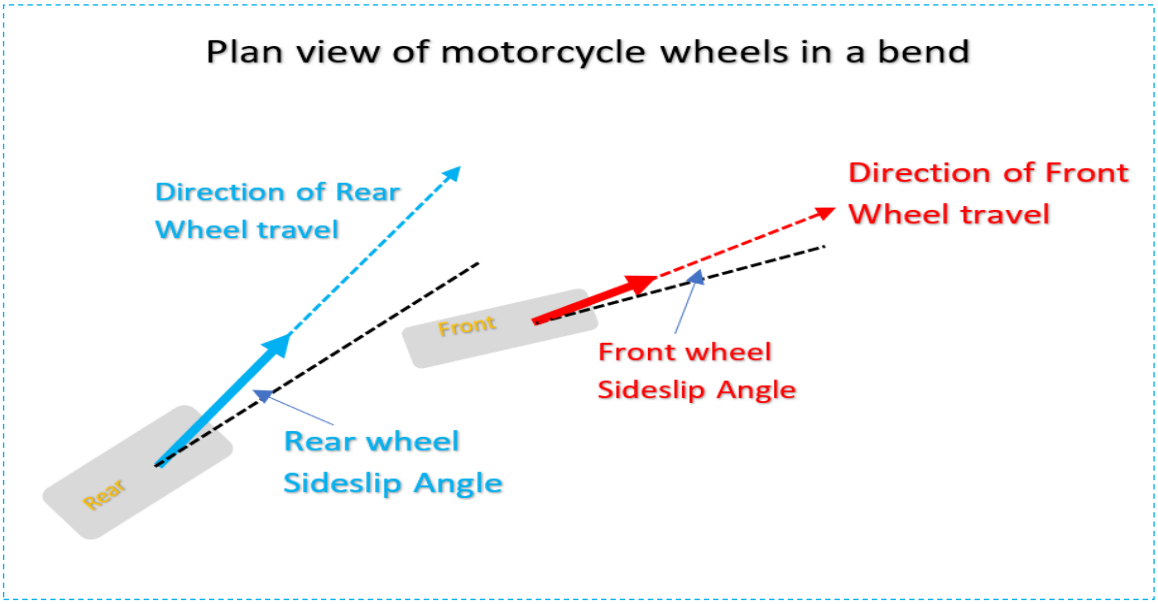
The units of Torque (Newton metres) are derived from the units of Force (Newtons) multiplied by the units of Distance (metres). Most people are familiar with distance being measured in metres, however, the unit of Force -the Newton- is less familiar. It may help to consider that a Force of '1 Newton' is approximately the weight of an apple.

Torque = F x d Newton metres

In the metric system it is conventional to use a lower case 'm' for metres.

In a bend, the wheels of a motorcycle are inclined off the vertical and they slip sideways, as such the plane of the wheel does not point in the direction in which the wheel travels.

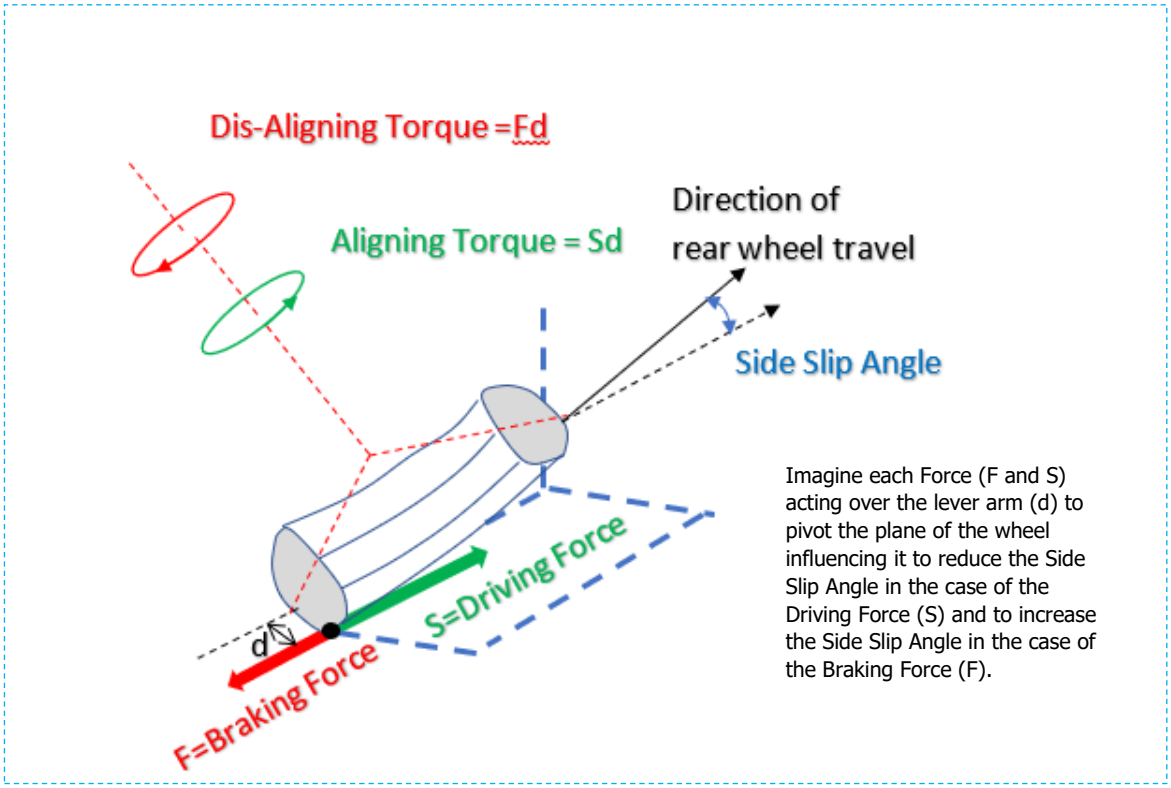
The angle between the direction in which the plane of the wheel points and the direction in which it travels is the Sideslip Angle.



The Driving Force, also known as the Traction Force, and the Rear Wheel Braking Force are both applied at the rear wheel Contact Patch: there is no Traction Force applied to the Front Wheel Contact Patch, although the Front Wheel Braking Force is applied there.

The Driving Force generates a Torque on the Rear Contact Patch that tends to align the plane of the wheel in the direction of its velocity. ***By applying gentle gas coming out of a bend, the Aligning Torque generated by the Driving Force makes the bike sit up.*** The Braking Force generates a Torque of the opposite sign that tends to move the plane of the wheel out of alignment with the direction of its velocity. ***When in a bend, if you feel the bike needs to lean a bit more to follow the desired line, gently apply the back brake;*** this effectively provides a little bit of 'rear wheel steering'!

The Torques generated by the Driving and Braking Forces are illustrated in the diagram below, where the Braking Force F Newtons is shown by the Red Arrow; the Driving Force S Newtons is shown by the Green Arrow; and the lever arm distance in each case, d metres, is the lateral displacement of the Contact Point when the bike leans off the vertical. Note that the size of d depends on the lateral deformation of the tyre.



George A Cairns
Carlisle and West Cumbria Advanced Motorists
Chief Observer