The *only* external forces acting on the vehicle in the XY plane are the four friction forces (one at the bottom of each wheel) of the floor pushing on the wheel in reaction to the driving torque being applied to the wheel. This friction force F at each wheel has a magnitude and direction, and can be decomposed into an Fx and an Fy component at each wheel as shown on the diagram.

Because of symmetry, all the Fx components are equal to each other in magnitude. All the Fy components are also equal to each other in magnitude, also due to symmetry.

Because the vehicle is in static equilibrium, the net torque on the vehicle in the XY plane must be zero. Thus, Fx·wheelbase must equal Fy·trackwidth, or Fx=f·Fy, where f=trackwidth/wheelbase.

The magnitude of the friction force F at each wheel is given by $F = \mathrm{sqrt}(F_x^2+F_y^2)$. Since Fx is equal to f·Fy, this simplifies to $F = \mathrm{sqrt}(F_y^2+f^2 \cdot F_y^2) = Fy \cdot \mathrm{sqrt}(1+f^2)$.

The maximum static friction at each wheel is given by Fmax = μ·N, where N is the normal force at each wheel. Therefore, solving F = Fmax => $Fy \cdot \mathrm{sqrt}(1+f^2) = \mu \cdot N$ for Fy gives the maximum magnitude of Fy which can be supported by static friction: maximum $Fy = \mu \cdot N/\mathrm{sqrt}(1+f^2)$.

Each wheel is also in static equilibrium, so the net torque on each wheel, in the plane of the wheel, must be zero. The only external torques acting on the wheel (in the plane of the wheel) are the driving torque **τ** being applied to the wheel, and the torque Fy·r produced by the Fy component of friction at that wheel. Thus, **Fy must equal τ/r**. Replacing Fy with **τ/r**, we get: $\boldsymbol{\tau = r \cdot \mu \cdot N/\mathrm{sqrt}(1+f^2)}$ as the maximum torque that can be applied to each wheel before the wheels start to slip and the vehicle starts to rotate.