

# The Theory of Slow Turns

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This paper describes the theory of slow turns in automobile racing. I hope that my sessions at the ELF/Renault Ecole du Pilotage at Paul Ricard taught by Simon De La Tour and his co-instructor Reni in 1989, and the decades of practice since, have not been for naught.

## Prerequisite:

This theory accepts as correct the force diagrams in “The Technique of Motor Racing”, Piero Taruffi, 1959. <https://www.amazon.com/Technique-Motor-Racing-Driving/dp/0837602289> Taruffi was an engineer before he was a grand prix racer. In this book, he lays out the force diagrams showing braking and turning. The reader will picture a right angle made by the braking force vector, which is parallel to the longitudinal axis of the car, and the turning force vector, which has the same starting point as the former but is perpendicular to it, and when the vector sum of these two exceeds the available traction, the car will leave the road as the hypotenuse, if with the direction of the braking force reversed.

## Background:

In motor racing:

- A fast turn is a turn for which one does not lift.
- A medium turn is one for which one lifts and perhaps brakes lightly or moderately
- A slow turn is one for which one brakes hard and deep; up to  $\frac{1}{3}$  -  $\frac{1}{2}$  way into the turn

## Part I - General Theory of Turning

**Postulate 1.** At the end of the straightaway you have to be braking as hard as you can/as is possible; in other words, with 99.9% of your available traction.

**Proof of Postulate 1:** If you did not, then you could have braked harder, and thus it would have taken less time and you could have waited longer to begin, and driven more of the straight at top speed.

**Postulate 2.** At the apex of the turn you should be using 99.9% of your available traction due to turning.

**Proof of Postulate 2:** If you are not, then you could be going faster and getting a lower E.T. through the turn.

## General Theory of Turning:

The role of the driver between the beginning of the turn and the apex is to let off the brakes in a way that mirrors the increasing demand for traction due to turning, and in doing so keeps the vector sum of the two forces adding up as close as possible to 99.9% of the available traction.

## **Part II Racer's abstraction**

### **Racer's Abstraction of Weight Transfer: The Theory of Increasing Traction**

- 2a. You can effectively turn the car into a slot car - pinned to the road at the front - by pushing down on the front end... -if- you push hard enough.
- 2b. You can push down on the front wheels as hard as you like by braking correspondingly hard.
- 2c. You can brake as hard as you like by going correspondingly fast beforehand.
- 2d. Therefore the front end of the car will turn arbitrarily sharply.

## **Part III Racing Car Design**

### **Theory of Mid-Engine Requirement**

- 3a. The theory of slow turns works best with mid-engine cars as both axles of a mid-engine cars will experience loading during braking
- 3b. A front engine will lend its mass to pivoting around the front axle or spindles and tending to lift the rear of the car
- 3c. Rear-engine: Do not try this in your Porsche