**Homework Key #1 - Phy 375R**

**Problem #1: How many cars drive over...**

For I-35 the limiting factor is the speed limit. In any lane of traffic with cars traveling at 65 $\text{mi/hr}$, there is $65 \times 5.3 \times 10^3 \ \frac{\text{ft}}{\text{car} \cdot \text{hr}}$. Thus you get $65 \times 5.3 \times 10^3 \ \frac{\text{ft}}{\text{car} \cdot \text{hr}} \times 8 \ \frac{\text{car}}{\text{hr}}$. I-35 is at capacity for about 10 hours so that the total is about $1.4 \times 10^5$ cars. Off peak traffic is negligible.

For the Drag, the capacity is limited by the light at the Co-op. The timing between lights is about $\frac{1}{2} \ \frac{\text{minute}}{\text{LiChange}}$. In each light change, there are about 12 cars that pass in each direction, 6 per lane and 2 lanes in each directions. Thus there are 24 cars per light change or $\frac{24}{2} \ \frac{\text{car}}{\text{min}}$. The street is operated at or near capacity for about 9 hours per day or $48 \times 60 \times 9 \ \frac{\text{car}}{\text{day}}$ or 27,000 cars per day.

**Problem #2: After a rain, the streets dry...**

The pattern that most fascinates me is the fact that the street dries first where the tires run. This pattern is seen in almost all streets with any traffic but the tire track parts dry faster on streets with heavy traffic. Also the drying is most rapid on streets where the speeds is greater, I-35 and Mopac. Obviously something about the passing cars is responsible. There are several possible mechanisms. Several that I can think of are the car's engine heat, the heat of the tires on the street, the transport of the water by the tires from the street surface to the wheel well, and the evaporation of the water picked up by the tires. If the mechanism was the car's engine heat you would expect the region between the tires to dry first. This is not supported by the observation. Although the tires are generally at a higher temperature than the road surface, the contact time is so short that no heat can be transferred. This could be tested by measuring the tire temperatures and seeing what the heat flow would be in the contact time. There is no question that the tires pick up a great deal of water from the streets. The inverse of our process is observed when a car goes over a local wet spot and produces tracks of water. If the dominant mechanism for removal of the water is the tires picking it up, how does it get off of the tire. Evaporation and just being thrown off by the tire rotation. Which mechanism could be dominant. Again we could measure tire temperatures and estimate the evaporation. This has been a neat exercise.