# CE 430
# Transportation Systems

## Tutorial #3

**(Ch. 2: Equations of motion and human factors)**

2.3 Human Factors

*Prepared by*
*Eng. Mohammed Alhozaimy*

**Determine if the following intersection has a dilemma zone:**

**Comfortable deceleration $a_2$=8 ft/s$^2$, intersection width w=65 ft, vehicle length L=15 ft, amber duration τ=4.5 sec, PRT $\delta_2$=1 sec and an approach speed of 60 mph. Note, if there exists a dilemma zone, determine it's length.**

$v_0 = 60\ mph = 60 \times \frac{5280}{3600} = 88\ ft/s$

$x_c = v_0 * \delta_2 + \frac{v^2}{2*a_2}$

$x_c = 88 \times 1 + \frac{88^2}{2*8} = 572 ft$

$x_0 = v_0\tau - (w + L)$

$x_0 = 88 \times 4.5 - (65 + 15) = 316 ft$

$\tau_{min} = \delta_2 + \frac{v0}{2*a_2} + \frac{w+l}{v0}$

$\tau_{min} = 1 + \frac{88}{2*8} + \frac{65+15}{88}$

$\tau_{min} = 7.41$ sec $> \tau = 4.5$

There is a dilemma zone

$X_c > X_0 \rightarrow$ There is dilemma zone

$X_c - X_0 = (v_0 * \delta_2 + \frac{v^2}{2a_2}) - (v_0\tau - w - L)$

$X_c - X_o = (88 \times 1 + \frac{88^2}{2*8}) - (88 \times 4.5 - 65 - 15)$

$X_c - X_0 = 256 ft$

→ The length of the dilemma zone is 256 $ft$

**Calculate the length of the dilemma zone in the following intersection. Moreover, select an appropriate yellow interval for the intersection**

**Driver and intersection properties:**

- **Comfortable deceleration rate $a_2$=2.5 m/s$^2$**
- **Intersection width w=35 m**
- **Design vehicle length L=3 m**
- **Yellow duration τ=4.5 sec**
- **PRT $\delta_2$=1 sec**
- **Speed limit: 60 km/h**

$$v = 60 \text{ km/hr} = 60 \times \frac{1000}{3600} = 16.67 \text{ m/s}$$

$$X_c - X_0 = (v_0 * \delta_2 + \frac{v^2}{2a_2}) - (v_0\tau - w - L)$$

$$X_c - X_0 = (16.67*1 + \frac{16.67^2}{2*2.5}) - (16.67*4.5 - 35 - 3)$$

$X_c - X_0 = 35.23$ m. → The length of the dilemma zone is 35.23 m

$$\tau_{min} = \delta_2 + \frac{v_0}{2a_2} + \frac{w+l}{v_0}$$

$$\tau_{min} = 1 + \frac{16.67}{2*2.5} + \frac{35+3}{16.67}$$

$\tau_{min} =$ *6.61 sec*

**Vehicles must reduce speed from 100 km/h to 60 km/h to negotiate a tight curve on a rural highway. A warning sign is clearly visible for a person with 6/6 from a distance of 50m. Calculate the distance at which the sign should be place before the curve for the design driver. Given the design driver has 3/6 vision, PRT δ= 2 sec and decelerates comfortably at the rate of a=3 m/s².**

$\frac{6}{6}: \ 50\,m$

$\rightarrow x = 25\,m$

$\frac{3}{6}: \ x$

$D_s = D_{PR} + D_b$

$D_s = v_0 * \delta + \frac{{v_0}^2 - v^2}{2a}$

$Ds = 27.78 \times 2 + \frac{27.78^2 - 16.67^2}{2*3}$

$Ds = 137.86\,m$

100 km/hr = 27.78 m/s

60km/hr = 16.67 m/s

$\rightarrow The\ sight\ must\ be\ located\ at\ least = 137.86 - 25 = 112.86\,m$

*round up = 113 m*

**Ex.10/P.96**

**A driver with 20/40 vision and a sixth-grade education needs 2 sec to read a directional sign. The letter size in such that the sign can read by a person with 20/20 vision from a distance of 200 ft. Does the subject driver have enough time to read the sign at the speed of 30 mi/h ?**

$$\frac{20}{20} : \ 200\ ft$$

$$\frac{20}{40} : \ x \qquad \rightarrow x = 100\ ft$$

$$D_{PR} = v * \mathrm{t}$$

$$t = \frac{d}{v} = \frac{100}{44} = 2.27\,\mathrm{sec} > \ 2\,\mathrm{sec}\ (\,time\ required\ to\ read\ the\ sign)$$

$\rightarrow$ So the driver have enogh time to read the sign.