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Ray Webb, PE, PTOE
Mid-America Regional Council
Operation Green Light
600 Broadway, Suite 300
Kansas City, MO 64105-1659

RE: Operation Green Light – Clearance Interval Calculation Methodology
        MoDOT traffic signals

Dear Mr. Webb,

As part of the coordination timing plans preparation, TranSystems has calculated clearance intervals and pedestrian times for locations included as part of the Operation Green Light traffic signal timing project. This letter is being provided as a summary of the methodology used for these calculations at locations within the MoDOT traffic signal system. It is intended to be a supplement to the calculation worksheets as an aid for MoDOT's review.

- ► **Equations** – The ITE formula for change interval times was utilized to calculate yellow and all red times. Guidance from the MUTCD was utilized to calculate pedestrian walk and flashing don't walk times.

$$Y = t + V / (2a + 2Gg)$$

$$R = (W + L) / V$$

Where:

t = perception-reaction time, 1.0 sec.
V = vehicle speed, ft/s
a = deceleration rate, 10 ft/s^2
G = deceleration due to gravity, 32.2 ft/s^2
g = percent grade (+ uphill, - downhill)
W = intersection width, ft
L = vehicle length, 20 ft

$$FDW = d_1 * s_1$$

$$WALK = 7.0 \text{ sec.} + Add'l$$

Where:

Add'l = $d_2 * s_2$ – FDW – 7.0 sec.
d_1 = distance along crosswalk from curb to curb
d_2 = distance along crosswalk from push button to far curb
    (where there is no push button, $d_2 = d_1 + 6$ ft)

s_1 = pedestrian walking speed, 3.5 ft/s
s_2 = reduced pedestrian walking speed, 3.0 ft/s

▶ **Speed, V** – Posted speed limits for each intersection approach were utilized for the vehicle speed.

▶ **Approach Grade, g** – The average of three grade measurements along each intersection approach within the normal stopping area was utilized as the approach grade. For locations that are currently under construction, or expected to be under construction in the immediate future, approach grades as provided in design drawings for the improvement plans were utilized.

▶ **Intersection Width, W** – Field measurements were taken for the intersection width using a wheel type device. For locations that are currently under construction, or expected to be under construction in the immediate future, intersection widths as measured on the design drawings for the improvement plans were utilized. In either case, two measurements were taken as described below; the highest measured value was utilized for the calculations. All intersection width measurements were made for through traffic only.

○ W_1 - Distance from stop bar to the edge of travelled way
○ W_2 - Distance from stop bar to far edge of crosswalk

▶ **Crosswalk Distance, d_1, d_2** - Field measurements were taken for the crosswalk distances using a wheel type device. For locations that are currently under construction, or expected to be under construction in the immediate future, intersection widths as measured on the design drawings for the improvement plans were utilized. d_2 values were measured in each direction for crosswalks; the higher of the two measured values was utilized for the WALK calculation. In the event that no push button is present for pedestrian phase actuation, d_2 was taken to be d_1 plus a distance of 6 ft.

▶ **Phase Aggregating** – Clearance intervals calculated for opposing approaches were adjusted to be equivalent by utilizing the higher yellow time and higher all red time of the two directions. No calculations were made for left turn phases; through movements clearance intervals were utilized for the adjacent left turning movements where separate left turn phasing is provided.

We trust that this summary adequately addresses concerns regarding the clearance intervals and pedestrian timings for traffic signals on the MoDOT traffic signal system. We appreciate this opportunity to be of service to the Mid-America Regional Council and MoDOT. As always, please feel free to contact us should you have any questions, comments, or concerns.

Sincerely,

Matthew P Parker, PE   Mike R Wahlstedt, PE, PTOE
Civil Engineer II   Vice President

MRW:mpp:P101090175