# Highway Capacity Software 2010

Version 6.50
April 8, 2014

# Highway Capacity Software

## Developed and maintained by McTrans

- Originally founded by the FHWA in 1986 as the Center for Microcomputers in Transportation (McTrans)
- Now a full-service software support center, associated with the University of Florida

## HCS 2010

- HCS 2010 implements the procedures defined in the Highway Capacity Manual (HCM) 2010 published by the Transportation Research Board (TRB)
- This release includes the new Streets module that combines the Signalized Intersections with the Urban Streets Segments, Facilities and Multimodal procedures.

# Fourteen Modules


Intersection Module

Highway Module

# Street Module

Signalized Intersections

- Signal analysis
- Interchange analysis
- Multimodal analysis
- LOS

# Signalized intersections

- Capacity
  - Defined for each lane group
    - Lane group: one or more lanes that accommodate traffic and have a common stop-line and traffic move together
  - Lane group capacity: maximum rate of flow for the subject lane group that may pass through the intersection under prevailing traffic, roadway and signalized conditions

# Signalized intersections

- Traffic Conditions
  - Approach volumes (left, through, right)
  - Vehicle type
  - Location of bus stops
  - Pedestrian crossing flows
  - Parking movement

# Signalized intersections

- Roadway Conditions
  - Number and width of lanes
  - Grades
  - Lane use
    - Including parking lanes
- Traffic Signal Characteristics
  - Signal phasing
  - Signal timing
  - Type of control
  - Signal progression

# Signalized intersections

- Delay experienced by a motorist includes many factors:
  - Signal control
  - Geometrics
  - Incidents

# Signalized intersections

- Total delay:
  - Difference between actual travel time and ideal travel time
    - In the absence of traffic control, delay due to roadway geometries, incidents and when there are no vehicles on the road
  - In HCS control delay is quantified
    - initial deceleration delay
    - Queue move-up time
    - Stopped delay
    - Final acceleration delay

# Level of Service (LOS)

- Defined in terms of delay as a function of
  - driver discomfort
  - Driver frustration
  - Fuel consumption
  - Lost travel time

# Level of Service (LOS)

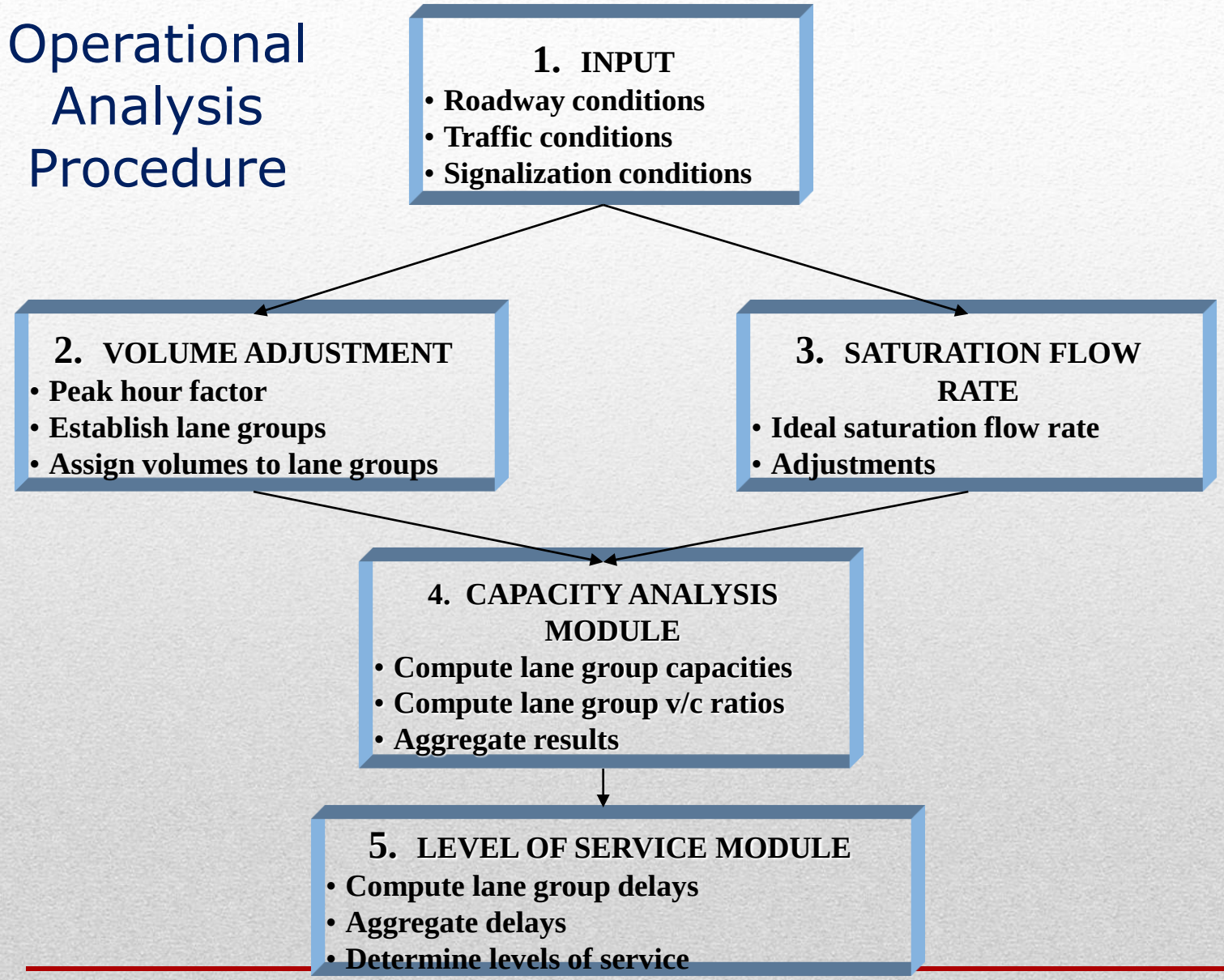
- LOS criteria are stated in terms of average control delay per vehicle
  - Delay on signal control depends on
    - Quality of progression
    - Cycle length
    - Green ratio
    - V/c ratio for lane group
- Designated by letters A - F

# Level of Service (LOS)

| LEVEL OF SERVICE | CONTROL DELAY PER VEHICLE (SEC/VEHICLES) |
|---|---|
| A | ≤ 10 |
| B | >10 and ≤ 20 |
| C | >20 and ≤ 35 |
| D | >35 and ≤ 55 |
| E | >55 and ≤ 80 |
| F | > 80 |

*Source: Highway Capacity Manual 2010*

# Operational Analysis Procedure

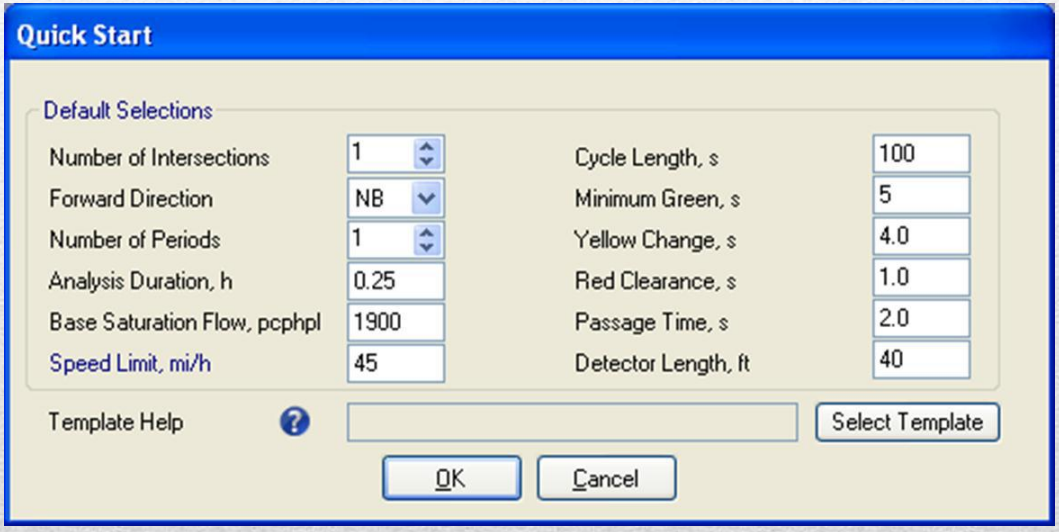


# Getting Started:

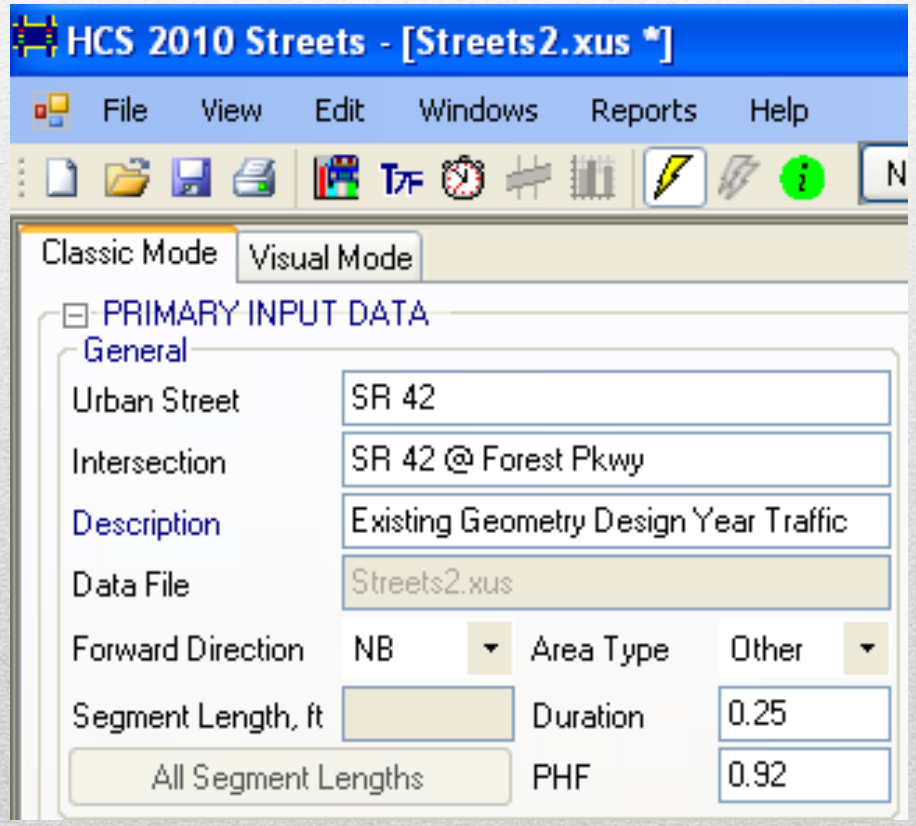
1. Open HCS 2010
2. Select the Streets *(handles signals and signalized corridors)*

# Getting Started:

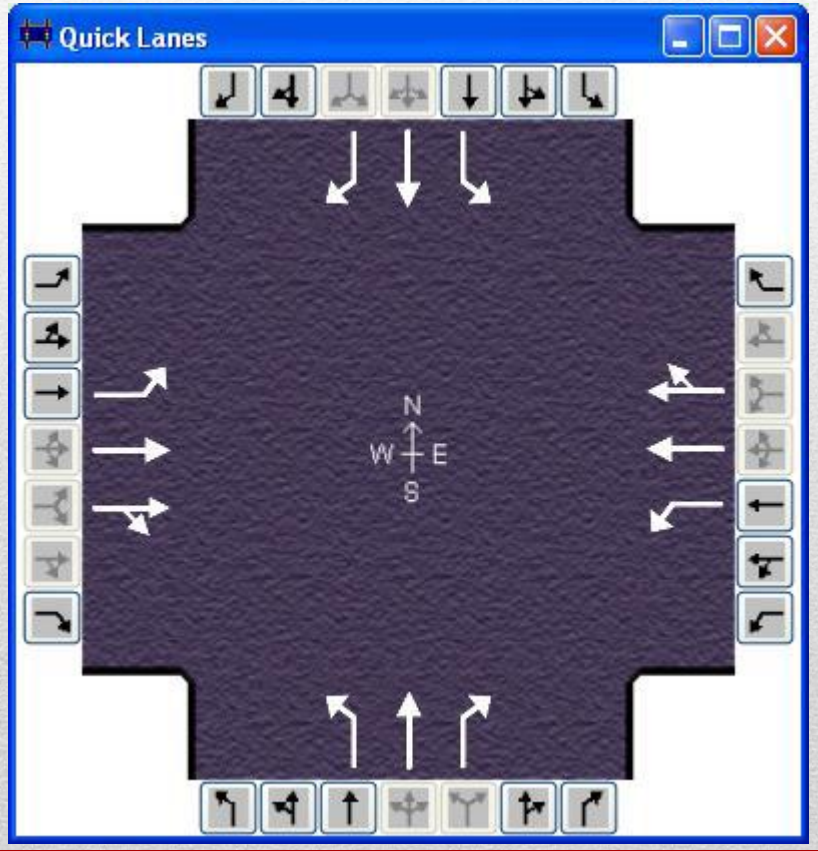
3. Complete The Quick Start Screen



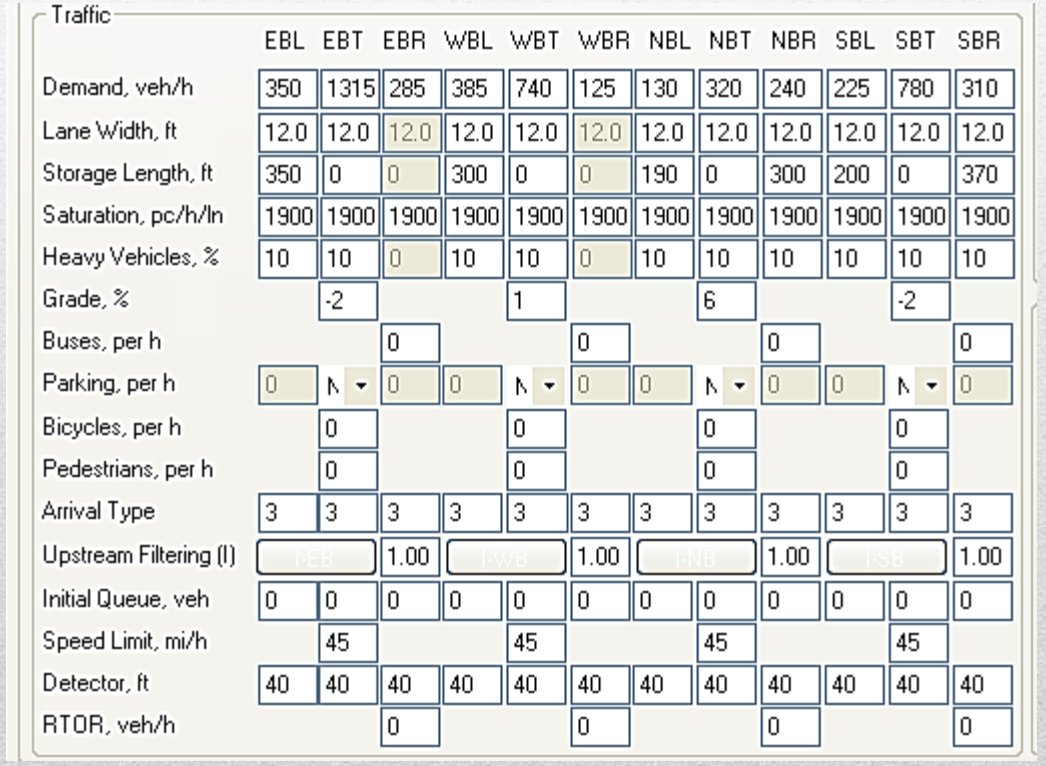
# 4. Enter Information in the **General** Section



5. Enter **Lane Configuration**



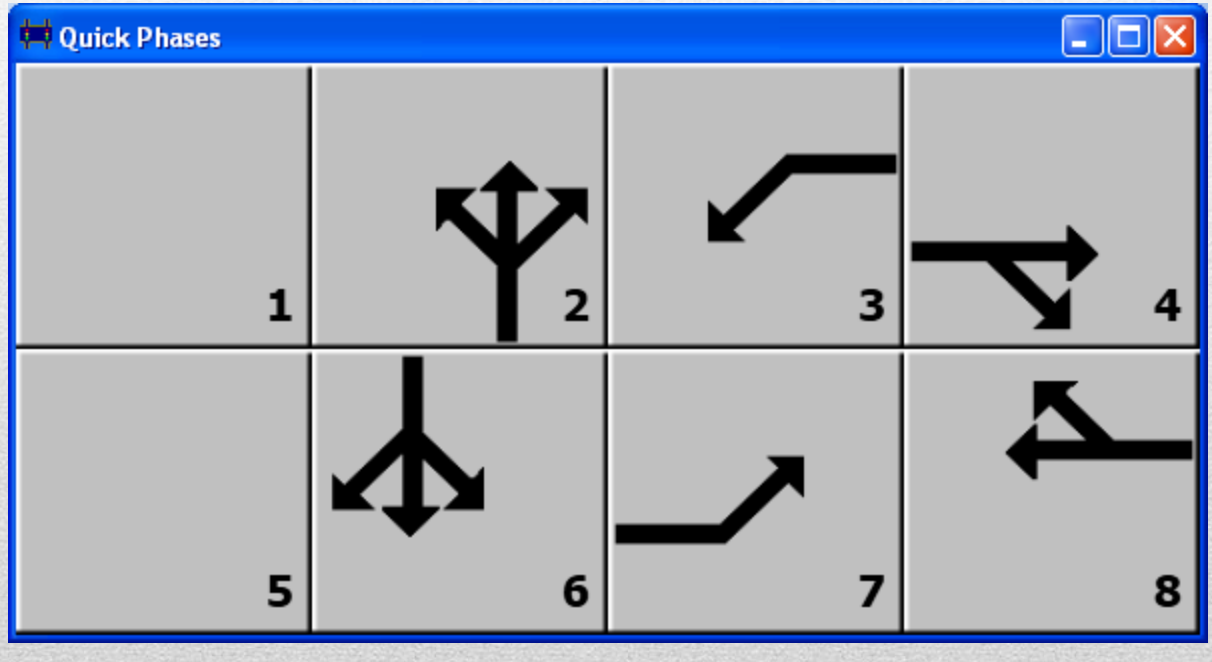
# 6. Enter **Traffic** Data



Traffic

| | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Demand, veh/h | 350 | 1315 | 285 | 385 | 740 | 125 | 130 | 320 | 240 | 225 | 780 | 310 |
| Lane Width, ft | 12.0 | 12.0 | 12.0 | 12.0 | 12.0 | 12.0 | 12.0 | 12.0 | 12.0 | 12.0 | 12.0 | 12.0 |
| Storage Length, ft | 350 | 0 | 0 | 300 | 0 | 0 | 190 | 0 | 300 | 200 | 0 | 370 |
| Saturation, pc/h/ln | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Heavy Vehicles, % | 10 | 10 | 0 | 10 | 10 | 0 | 10 | 10 | 10 | 10 | 10 | 10 |
| Grade, % | | -2 | | | 1 | | | 6 | | | -2 | |
| Buses, per h | | | 0 | | | 0 | | | 0 | | | 0 |
| Parking, per h | 0 | N | 0 | 0 | N | 0 | 0 | N | 0 | 0 | N | 0 |
| Bicycles, per h | | 0 | | | 0 | | | 0 | | | 0 | |
| Pedestrians, per h | | 0 | | | 0 | | | 0 | | | 0 | |
| Arrival Type | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| Upstream Filtering (I) | | 1.00 | | | 1.00 | | | 1.00 | | | 1.00 | |
| Initial Queue, veh | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Speed Limit, mi/h | | 45 | | | 45 | | | 45 | | | 45 | |
| Detector, ft | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 |
| RTOR, veh/h | | | 0 | | | 0 | | | 0 | | | 0 |

7. Enter **Phasing** data



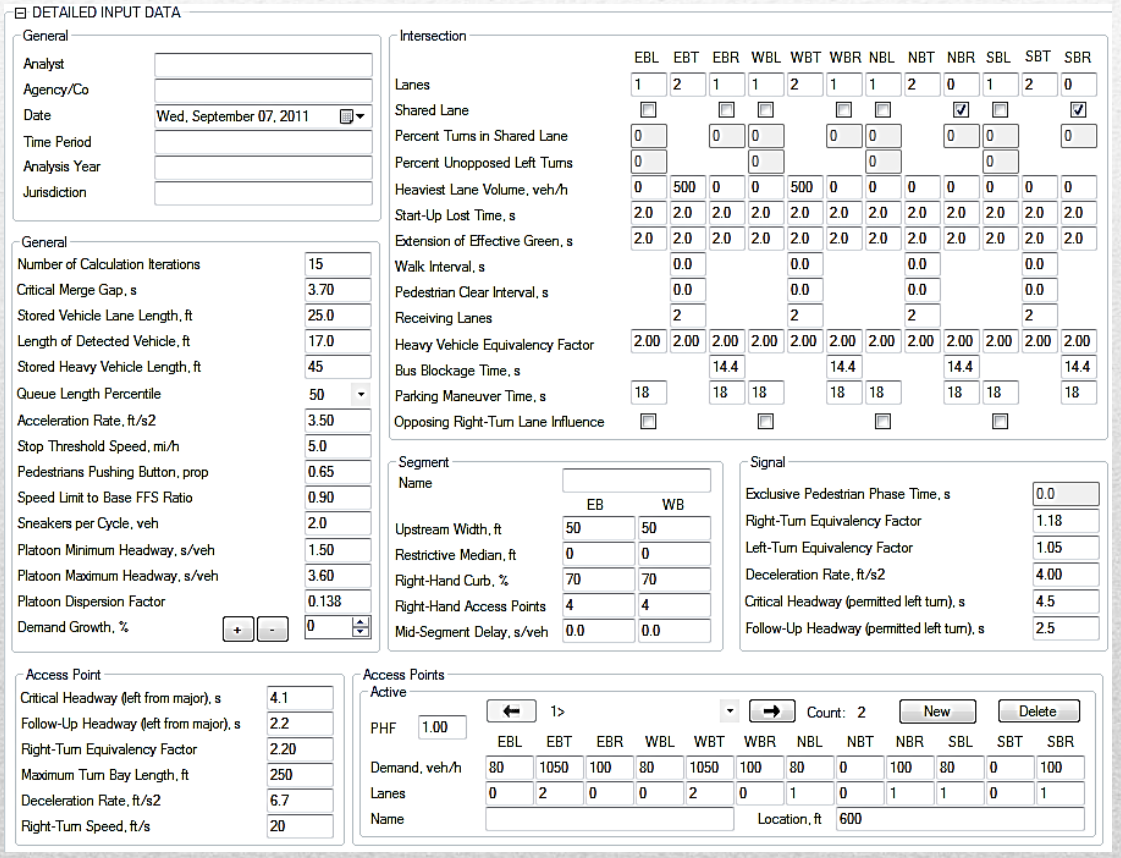
# 8. Enter **Timing**

Timing

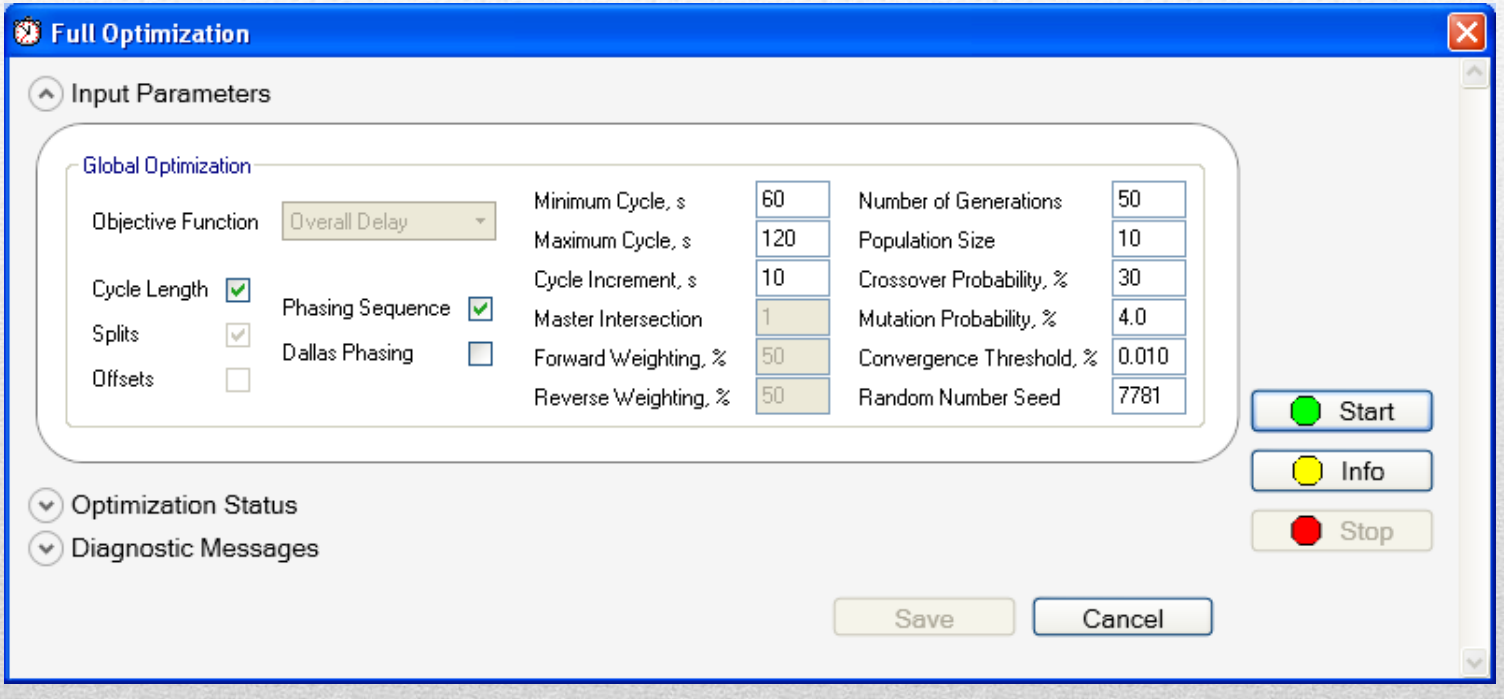
| | EBL | EBT | WBL | WBT | NBL | NBT | SBL | SBT |
|---|---|---|---|---|---|---|---|---|
| Phase Split, s | 15.0 | 40.0 | 15.0 | 40.0 | 0.0 | 45.0 | 0.0 | 45.0 |
| Yellow Change, s | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 |
| Red Clearance, s | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| Minimum Green, s | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| Lag Phase | ☐ EL | ☐ ET | ☐ WL | ☐ WT | ☐ NL | ☐ NT | ☐ SL | ☐ ST |
| Passage Time, s | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 |
| Recall Mode | Off | Off | Off | Off | Off | Min | Off | Min |
| Dual Entry | ☐ EL | ☑ ET | ☐ WL | ☑ WT | ☐ NL | ☑ NT | ☐ SL | ☑ ST |
| Dallas Phasing | ☐ E/W | ☐ N/S | Simultaneous Gap | ☑ E/W | ☑ N/S | | | |

| |  |  | | | | |
|---|---|---|---|---|---|---|
| Green | 40.0 | 10.0 | 35.0 | 0.0 | 0.0 | 0.0 |
| Yellow | 4.0 | 4.0 | 4.0 | 0.0 | 0.0 | 0.0 |
| Red | 1.0 | 1.0 | 1.0 | 0.0 | 0.0 | 0.0 |

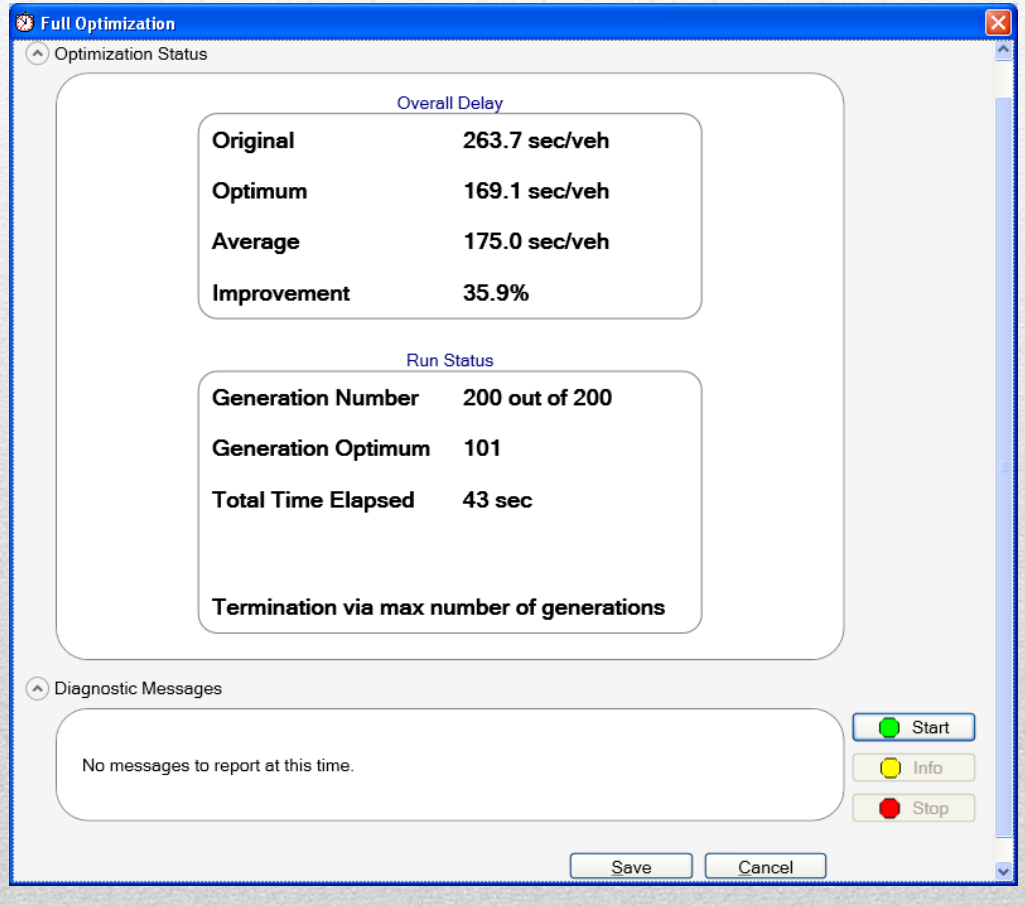
# 9. Enter the **Detailed** Data



# 10. Run **Full Optimization**



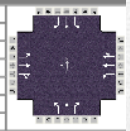
# 11. **Optimization** Results



# 12. View/Print **Results** Summary Report

## HCS 2010 Signalized Intersection Results Summary

| General Information | | | | Intersection Information | |
|---|---|---|---|---|---|
| Agency | GDOT | | | Duration, h | 0.25 |
| Analyst | Design Engineer | Analysis Date | Apr 12, 2012 | Area Type | Other |
| Jurisdiction | Clayton County | Time Period | 2032 PM | PHF | 0.92 |
| Intersection | SR 42 @ Forest Pkwy | Analysis Year | 2012 | Analysis Period | 1> 7:00 |
| File Name | pdt example.xus | | | | |
| Project Description | Existing Geometry Design Year Traffic | | | | |



| Demand Information | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Demand (*v*), veh/h | 350 | 1315 | 285 | 385 | 740 | 125 | 130 | 320 | 240 | 225 | 780 | 310 |

| Signal Information | | | |
|---|---|---|---|
| Cycle, s | 110.0 | Reference Phase | 2 |
| Offset, s | 0 | Reference Point | End |
| Uncoordinated | No | Simult. Gap E/W | On |
| Force Mode | Fixed | Simult. Gap N/S | On |

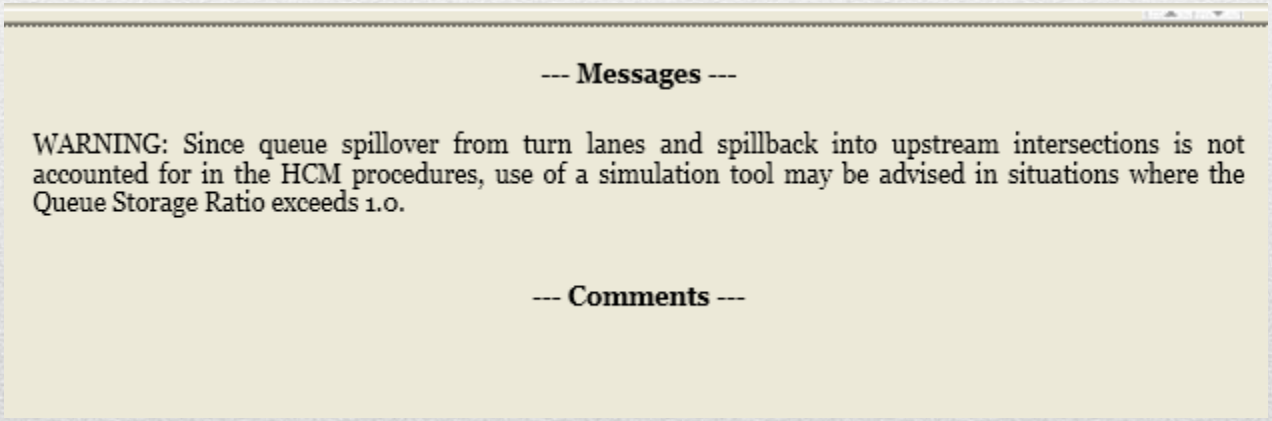
| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Green | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | | | | |
| Yellow | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | | | | |
| Red | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | | | | |

| Timer Results | EBL | EBT | WBL | WBT | NBL | NBT | SBL | SBT |
|---|---|---|---|---|---|---|---|---|
| Assigned Phase | 7 | 4 | 3 | 8 | | 2 | | 6 |
| Case Number | 2.0 | 4.0 | 2.0 | 4.0 | | 5.0 | | 5.0 |
| Phase Duration, s | 32.2 | 50.0 | 21.0 | 38.8 | | 39.0 | | 39.0 |
| Change Period, ($Y+R_c$), s | 5.0 | 5.0 | 5.0 | 5.0 | | 5.0 | | 5.0 |
| Max Allow Headway (*MAH*), s | 0.0 | 0.0 | 0.0 | 0.0 | | 0.0 | | 0.0 |
| Queue Clearance Time ($g_s$), s | 0.0 | 0.0 | 0.0 | 0.0 | | 0.0 | | 0.0 |
| Green Extension Time ($g_e$), s | 0.0 | 0.0 | 0.0 | 0.0 | | 0.0 | | 0.0 |
| Phase Call Probability | 0.00 | 0.00 | 0.00 | 0.00 | | 0.00 | | 0.00 |
| Max Out Probability | 0.00 | 0.00 | 0.00 | 0.00 | | 0.00 | | 0.00 |

| Movement Group Results | EB | | | WB | | | NB | | | SB | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Approach Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Assigned Movement | 7 | 4 | 14 | 3 | 8 | 18 | 5 | 2 | 12 | 1 | 6 | 16 |
| Adjusted Flow Rate (*v*), veh/h | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Adjusted Saturation Flow Rate (*s*), veh/h/ln | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Queue Service Time ($g_s$), s | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Cycle Queue Clearance Time ($g_c$), s | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Capacity (*c*), veh/h | 412 | 714 | 670 | 238 | 527 | 501 | 65 | 518 | 439 | 188 | 539 | 457 |
| Volume-to-Capacity Ratio (*X*) | 0.924 | 1.233 | 1.282 | 1.758 | 0.915 | 0.915 | 2.159 | 0.672 | 0.594 | 1.303 | 1.572 | 0.737 |
| Available Capacity ($c_a$), veh/h | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Back of Queue (*Q*), veh/ln (95th percentile) | 15.2 | 58.8 | 61.9 | 47.3 | 21.1 | 20.3 | 21.8 | 13.5 | 10.4 | 22.9 | 82.4 | 13.9 |
| Overflow Queue ($Q_3$), veh/ln | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Queue Storage Ratio (*RQ*) (95th percentile) | 1.17 | 0.00 | 0.00 | 4.25 | 0.00 | 0.00 | 3.09 | 0.00 | 0.94 | 3.09 | 0.00 | 1.01 |
| Uniform Delay ($d_1$), s/veh | 40.4 | 32.5 | 32.5 | 47.0 | 36.7 | 36.7 | 55.0 | 33.1 | 32.2 | 50.4 | 38.0 | 34.0 |
| Incremental Delay ($d_2$), s/veh | 3.9 | 116.9 | 138.0 | 357.7 | 20.2 | 21.0 | 568.5 | 6.8 | 5.8 | 169.7 | 266.4 | 10.2 |
| Initial Queue Delay ($d_3$), s/veh | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Control Delay (*d*), s/veh | 44.2 | 149.4 | 170.5 | 404.7 | 56.9 | 57.7 | 623.5 | 39.9 | 38.0 | 220.1 | 304.4 | 44.2 |
| Level of Service (LOS) | D | F | F | F | E | E | F | D | D | F | F | D |
| Approach Delay, s/veh / LOS | 139.1 | F | | 164.3 | F | | 149.2 | F | | 228.6 | F | |
| Intersection Delay, s/veh / LOS | 169.1 | | | | | | F | | | | | |

# 13. View Messages Report

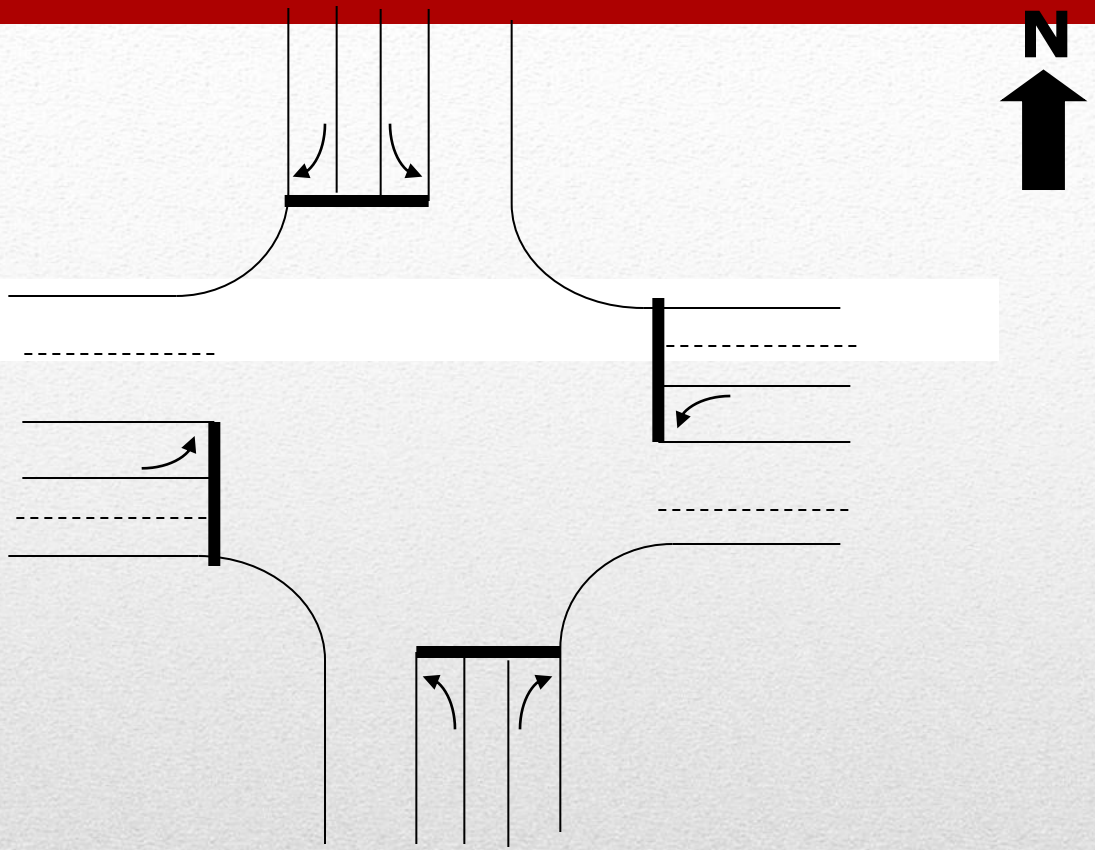
- Look for any warnings



--- **Messages** ---

WARNING: Since queue spillover from turn lanes and spillback into upstream intersections is not accounted for in the HCM procedures, use of a simulation tool may be advised in situations where the Queue Storage Ratio exceeds 1.0.

--- **Comments** ---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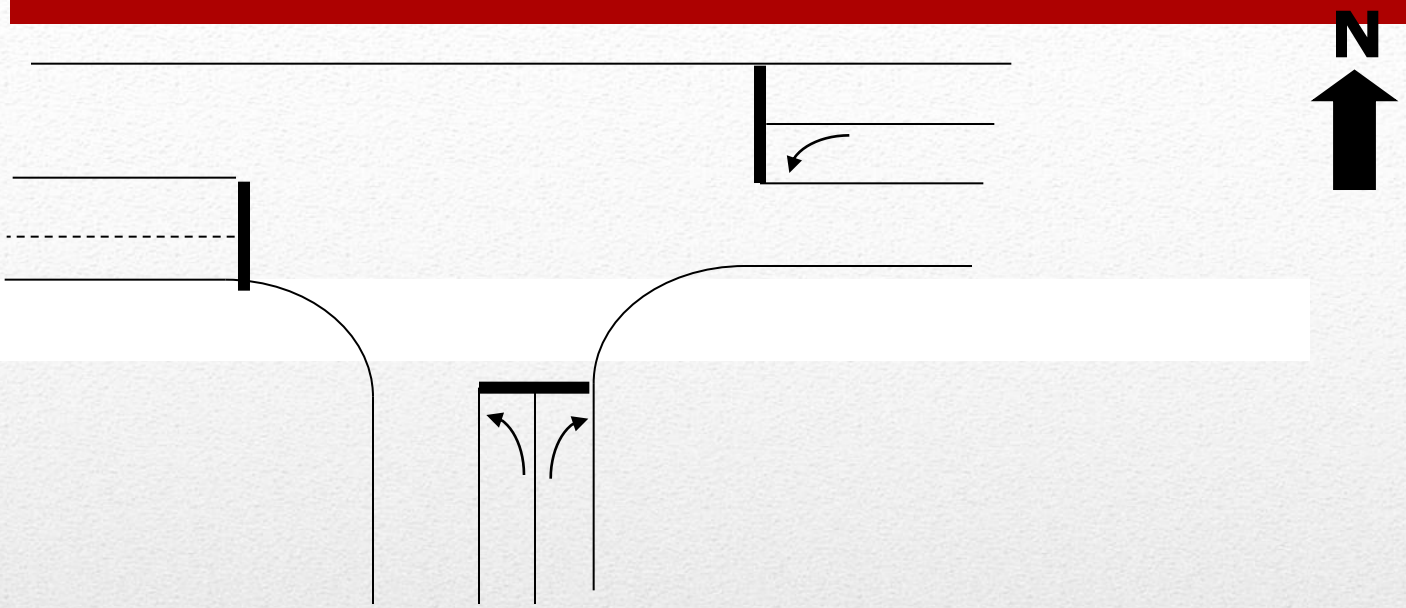
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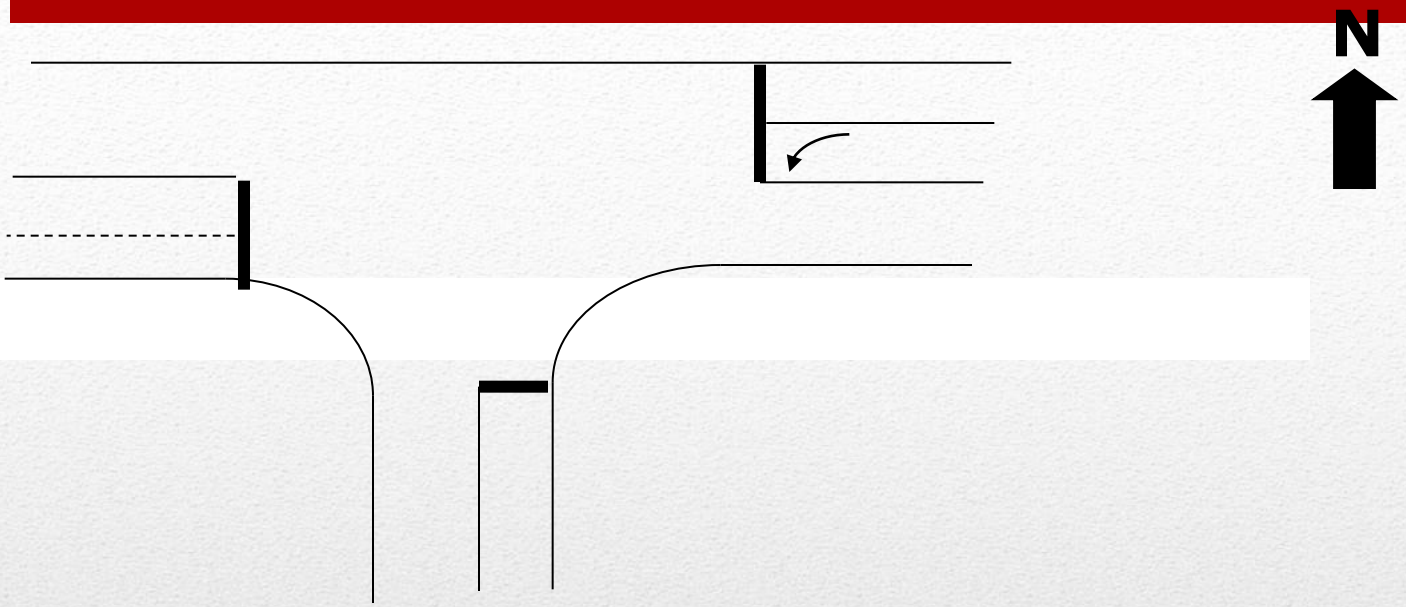
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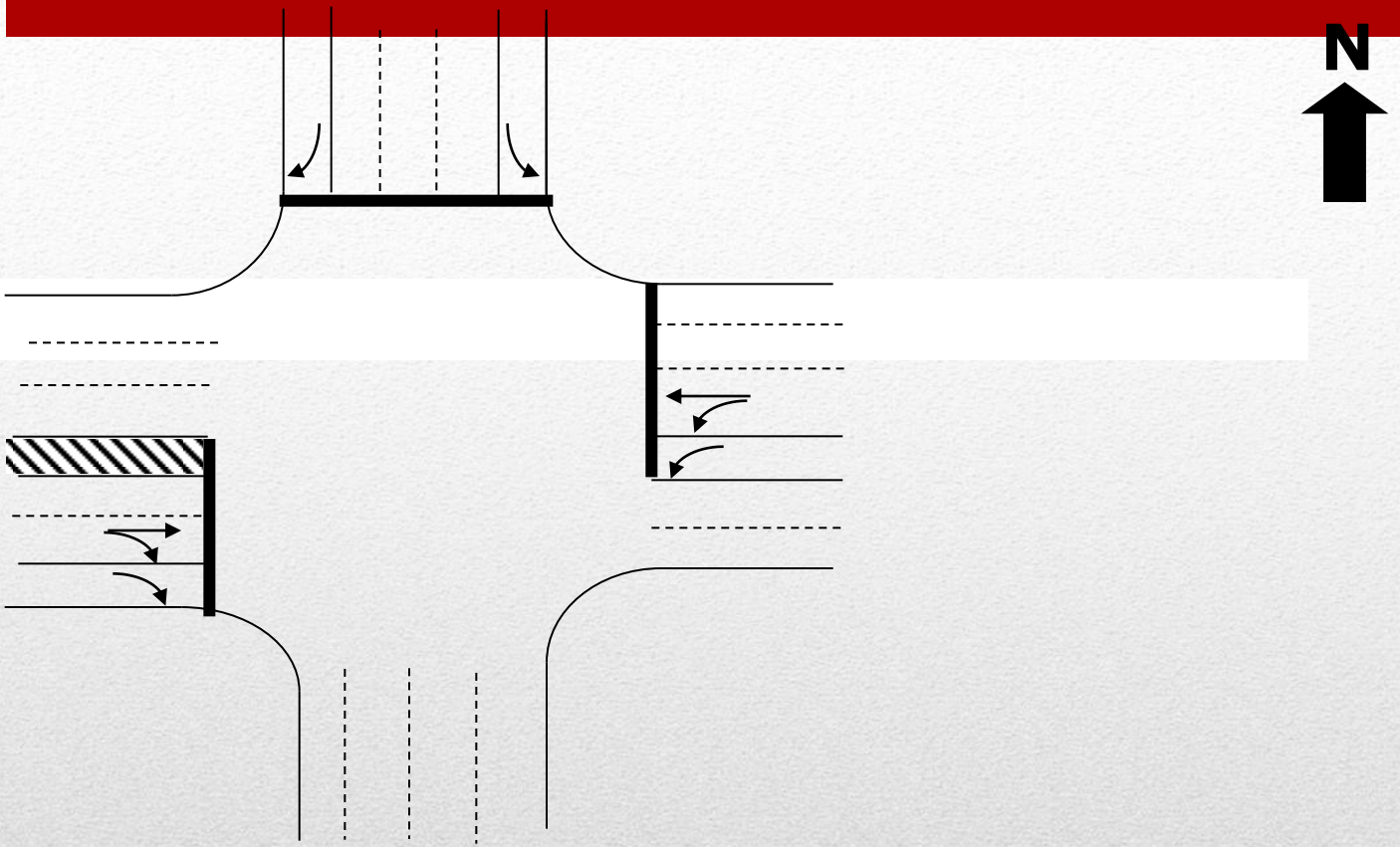
N

# RESULTS