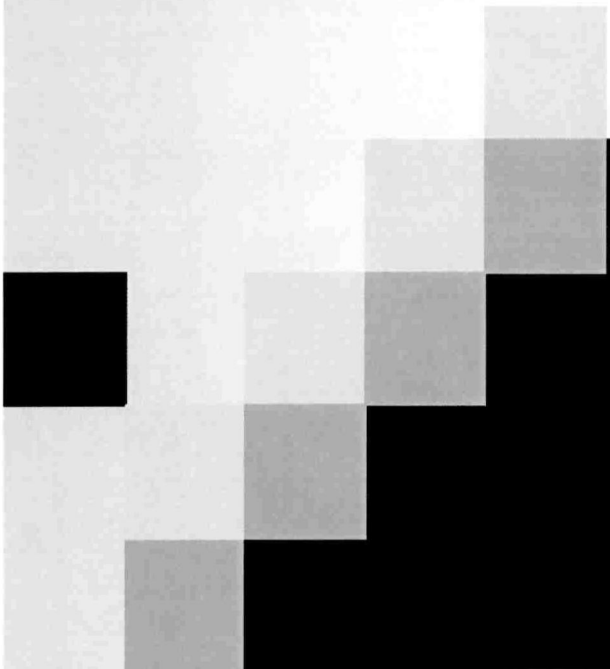


Separator

5-1752-01-P15

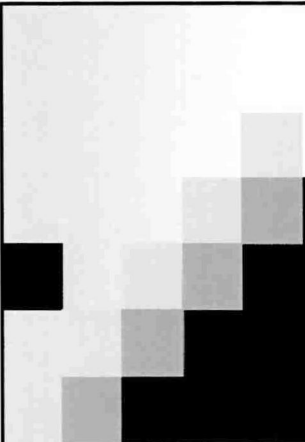


Hardware-in-the-Loop Demonstration/ Workshop

Presented to the TxDOT Ft. Worth District

Presented in partial completion of requirements of 5-1752-01
By the Texas Transportation Institute

August 22, 2005



Hardware-in-the-Loop Demonstration Workshop

Presented to the TxDOT Ft. Worth District

Presented in partial completion of requirements of 5-1752-01
By the Texas Transportation Institute

August 22, 2005

1



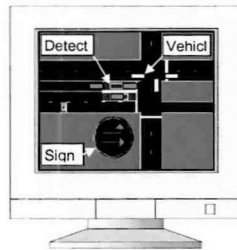
Purpose of Workshop

- Demonstrate HITL capabilities
- Show default files
 - ☐ T-Intersection
 - ☐ 4-leg
 - ☐ Diamond
- Step through modifying default files
 - ☐ Modifying volume
 - ☐ Modifying phasing
 - ☐ Modifying detectors
 - ☐ Modifying geometry
- Special Cases

2

Elements of HITL

Simulation Software



Controller Interface Device

CID

Controller Hardware



Detector
actuations

Phase
indications

Detector
actuations

Phase
indications

3

CID Interface Device

- Allows controller to communicate with simulation software
- Three interface devices
 - ☐ Eagle TS-2
 - ☐ Naztec TS-2
 - ☐ NIATT TS-1
- Two files
 - ☐ “.exe” file
 - ☐ “.ini” file

4

Simulation Files

- TSIS CORSIM files

- ☐ “.trf” files → actual simulation files
- ☐ “.sdi” files → maps approaches with phases

IMPORTANT

.trf and .sdi files **NEED** to have same file name!!!

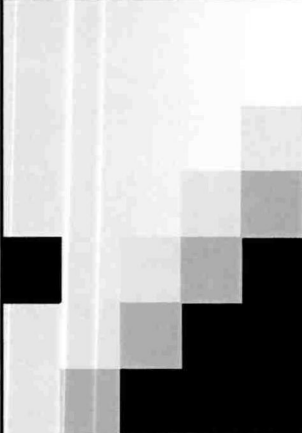
Example: “*Example_diamond.trf*” must have corresponding “*Example_diamond.sdi*” file

5

Look at files

- HITL CID .ini file
- TSIS CORSIM .sdi file
- TSIS CORSIM .trf file

6



Running HITL Scenario

7

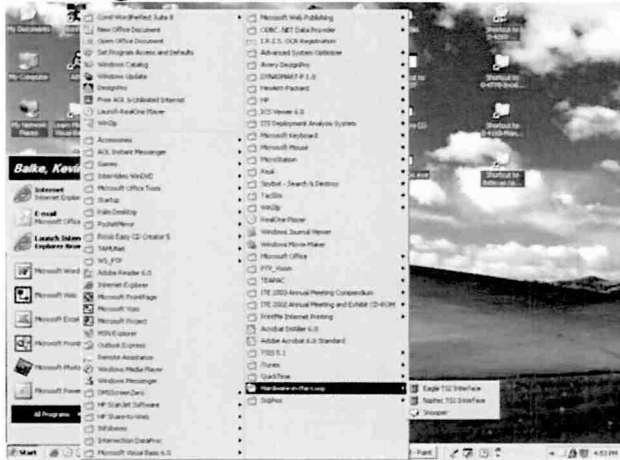


Sequence of Programs

- Step 1. Start CID Interface Program
 - ☐ EagleTs2Interface.exe
 - ☐ NaztecTs2Interface.exe
- Step 2. Open Snooper
- Step 3. Start TSIS
 - ☐ Real-Time CORSIM
 - ☐ TRAFVU (after equilibrium reached)

8

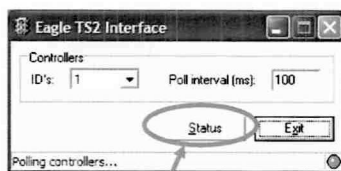
Step 1. Running CID Interface Program



- “Start”
- “All Programs”
- “Hardware-in-the-Loop” Folder
- Appropriate CID Interface Icon

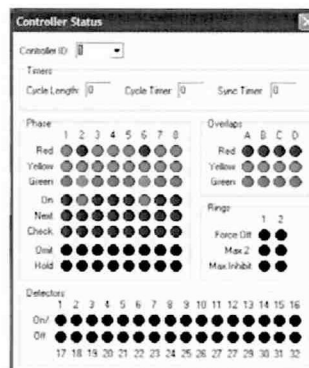
9

Step 1. Running CID Interface Program (cont.)



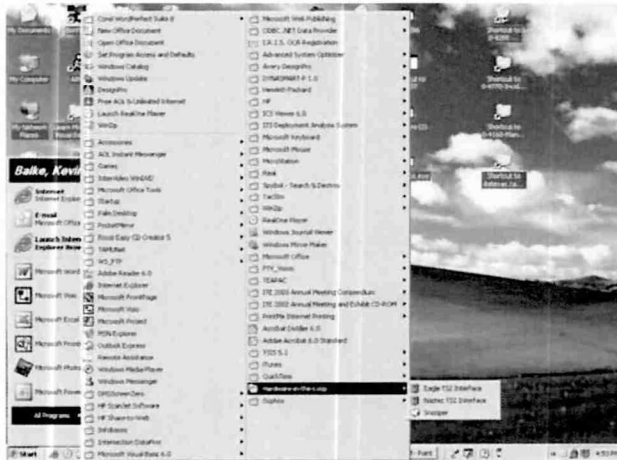
If you click on “Status”

Green Light means CID communicating with Controller



10

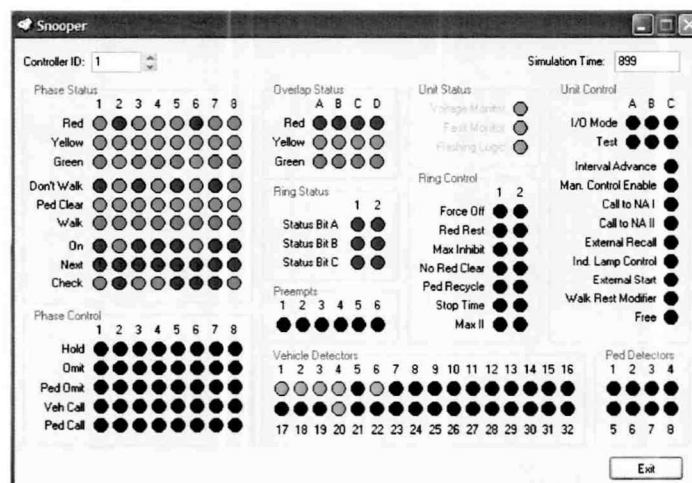
Step 2. Running Snooper



- "Start"
- "All Programs"
- "Hardware-in-the-Loop" Folder
- "Snooper" Icon

11

Step 2. Running Snooper (cont.)



12

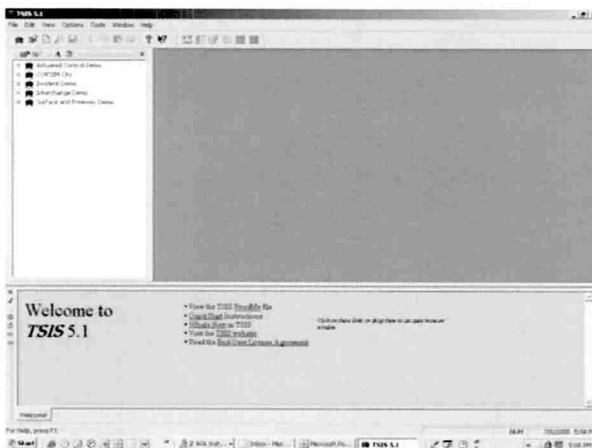
Step 3. Running Simulation



- “Start”
- “All Programs”
- “TSIS 5.1” Folder
- “TSIS 5.1” Icon

13

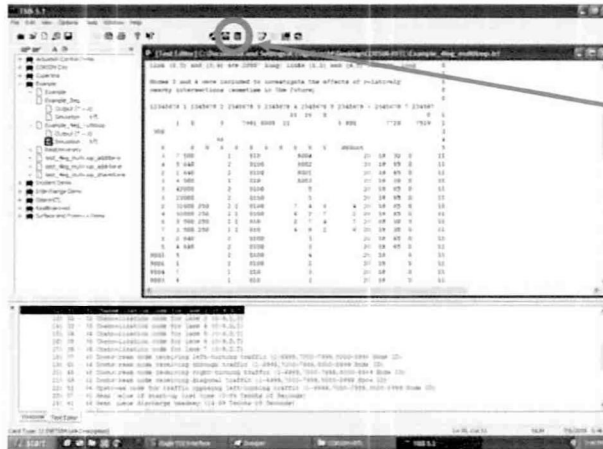
Step 3. Running Simulation



- “File”
- “Open”
- Navigate to folder and click on “.trf” file

14

Step 3. Running Simulation (Cont.)



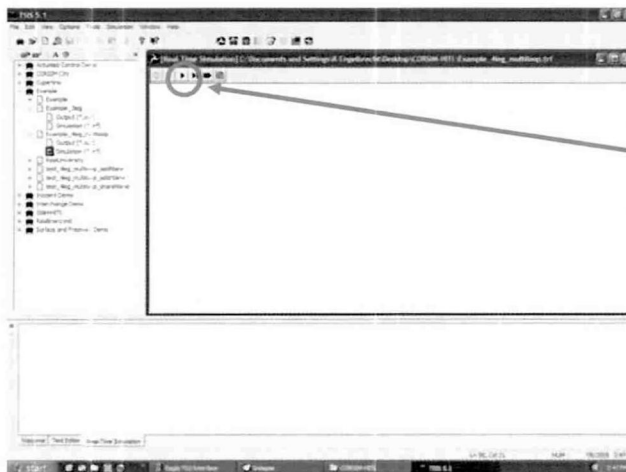
Click on



icon to run
Real-Time
TSIS

15

Step 3. Running Simulation (Cont.)



Click on



icon to
start real-
time
simulation

16

Step 3. Running Simulation (Cont.)



Once simulation finishes
initialization period:

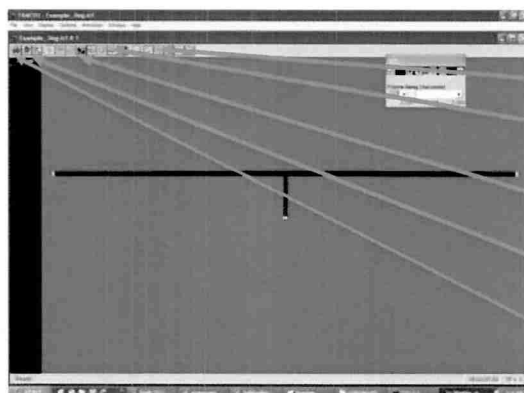
Click on



icon to run
animation

17

Step 3. Running Simulation (Cont.)



Click on :



To zoom in



To see detectors



To see markings



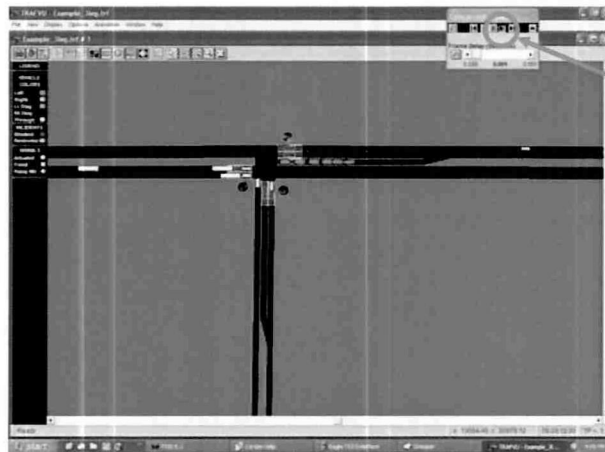
To see signals



To see vehicles

18

Step 3. Running Simulation (Cont.)



Click on

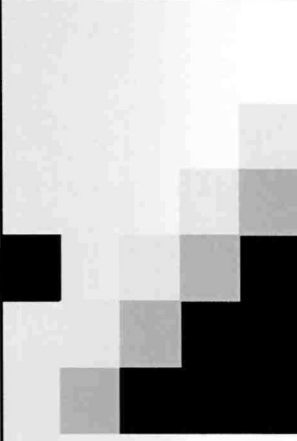
icon to
start real-
time
animation

19

Hands-On Practice

- Run Example_4leg_Multiloop.trf

20



Default intersections

21

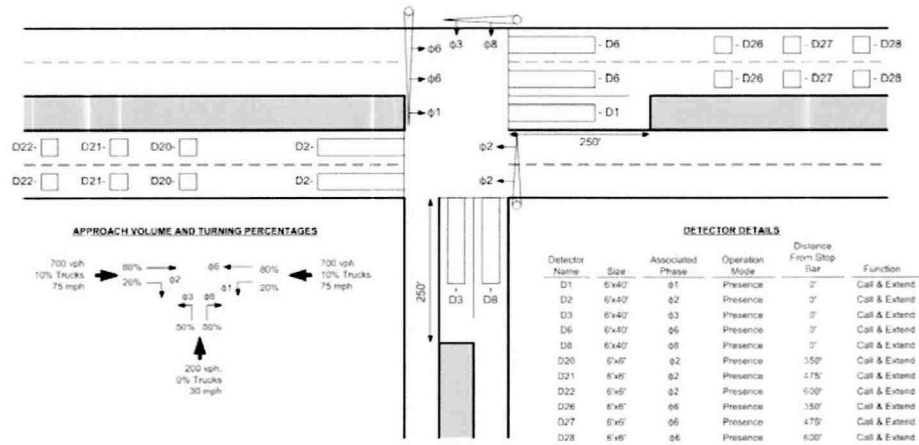


Default TSIS files

- T-intersection
- 4-leg intersection
- Diamond
 - Wide Diamond
 - Tight Diamond

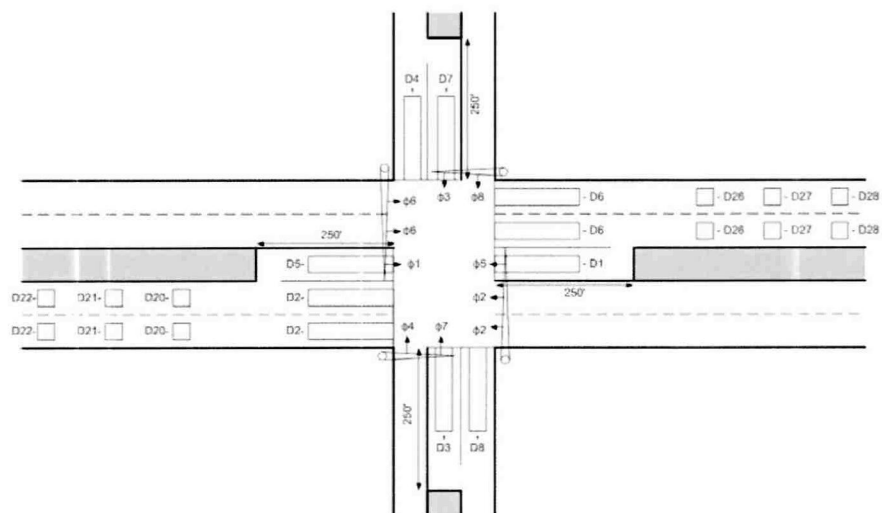
22

Default T-Intersection



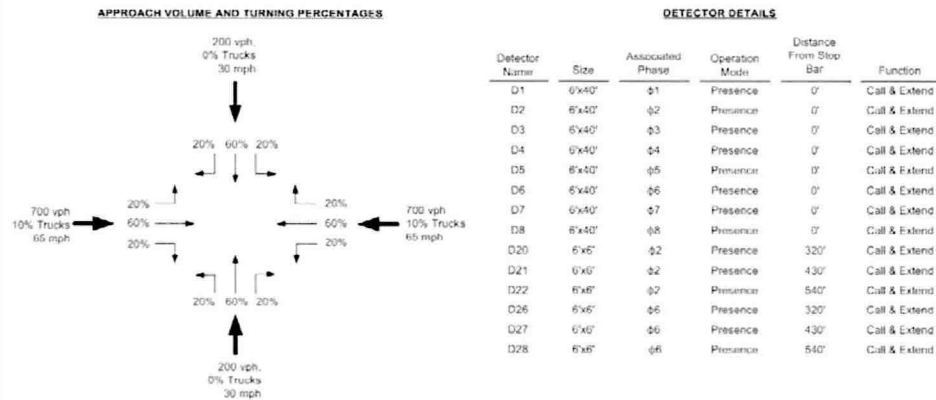
23

Default 4-leg Intersection



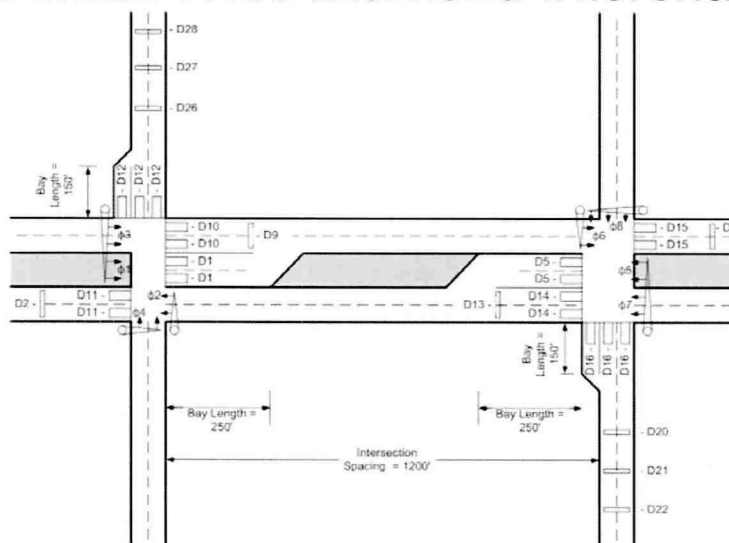
24

Default 4-Leg Intersection (Cont.)



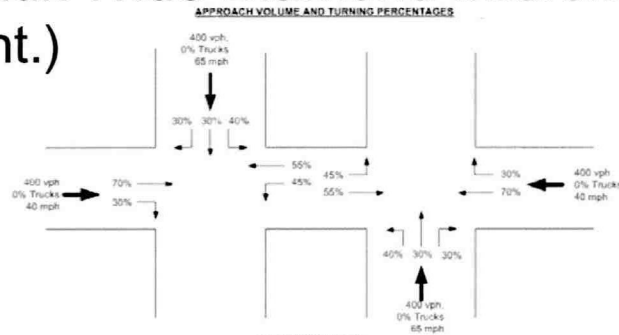
25

Default Wide Diamond Interchange



26

Default Wide Diamond Interchange (Cont.)

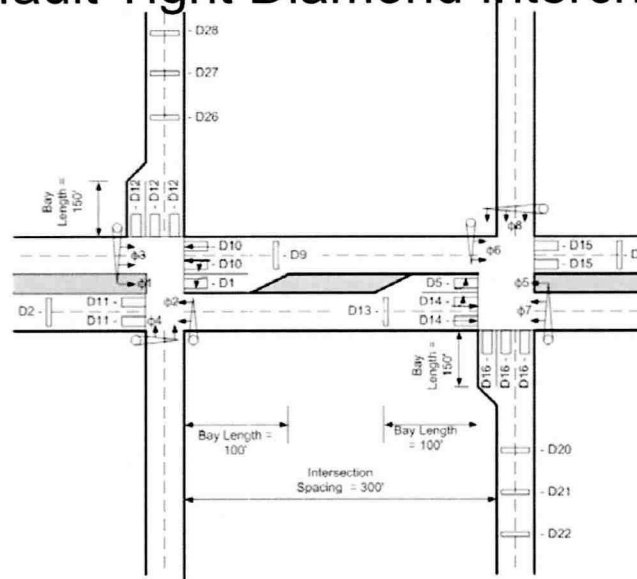


DETECTOR DETAILS

Detector Name	Size	Operation Mode	Distance From Stop Bar	Function
D1	1"x40"	Presence	0'	Call & Extend
D2	6"x6"	Presence	150'	Call & Extend
D5	1"x40"	Presence	0'	Call & Extend
D6	6"x6"	Presence	150'	Call & Extend
D9	6"x6"	Presence	150'	Call & Extend
D10	1"x40"	Presence	0'	Call & Extend
D11	1"x40"	Presence	0'	Call & Extend
D12	1"x40"	Presence	0'	Call & Extend
D13	6"x6"	Presence	150'	Call & Extend
D14	1"x40"	Presence	0'	Call & Extend
D15	1"x40"	Presence	0'	Call & Extend
D16	1"x40"	Presence	0'	Call & Extend
D20	6"x6"	Presence	320'	Call & Extend
D21	6"x6"	Presence	430'	Call & Extend
D22	6"x6"	Presence	540'	Call & Extend
D26	6"x6"	Presence	320'	Call & Extend
D27	6"x6"	Presence	430'	Call & Extend
D28	6"x6"	Presence	540'	Call & Extend

27

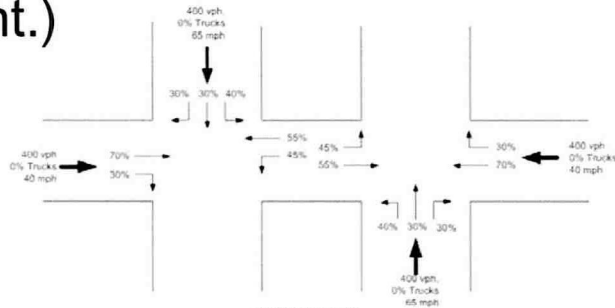
Default Tight Diamond Interchange



28

Default Tight Diamond Interchange (Cont.)

APPROACH VOLUME AND TURNING PERCENTAGES



DETECTOR DETAILS

Detector Name	Size	Operation Mode	Distance From Stop Bar	Function
D1	6'x40'	Presence	0'	Call & Extend
D2	6'x6'	Presence	150'	Call & Extend
D5	6'x40'	Presence	0'	Call & Extend
D6	6'x6'	Presence	150'	Call & Extend
D8	6'x6'	Presence	150'	Call & Extend
D10	6'x40'	Presence	0'	Call & Extend
D11	6'x40'	Presence	0'	Call & Extend
D12	6'x40'	Presence	0'	Call & Extend
D13	6'x6'	Presence	150'	Call & Extend
D14	6'x40'	Presence	0'	Call & Extend
D15	6'x40'	Presence	0'	Call & Extend
D16	6'x40'	Presence	0'	Call & Extend
D20	6'x6'	Presence	320'	Call & Extend
D21	6'x6'	Presence	430'	Call & Extend
D22	6'x6'	Presence	540'	Call & Extend
D26	6'x6'	Presence	320'	Call & Extend
D27	6'x6'	Presence	430'	Call & Extend
D28	6'x6'	Presence	540'	Call & Extend

29

Modifying Default Simulations

30



Modifying Defaults

- Change Volume Conditions
- Change Phasing Conditions
- Modify Detectors
- Change Intersection Geometry

IMPORTANT

Always rename “Example” files
(i.e., do not save over “Example” files)

31



Modifying Volumes

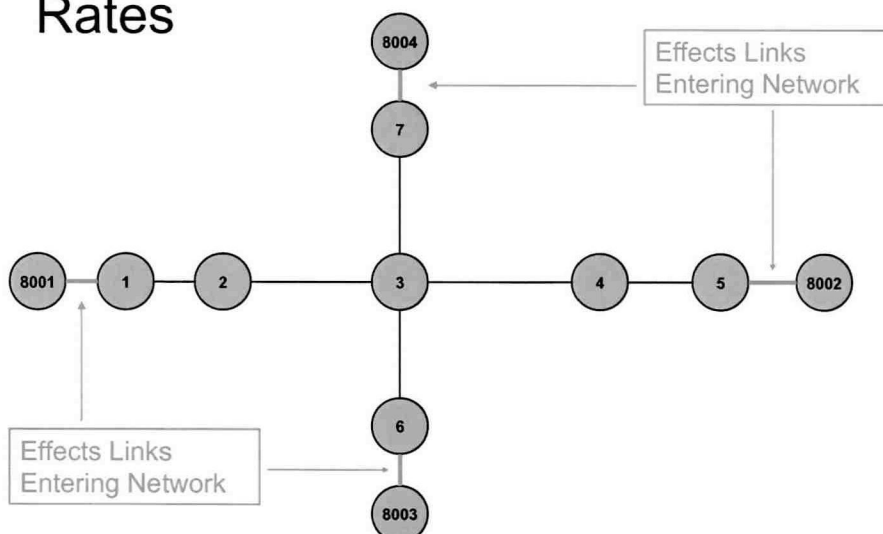
32

Volume-Related Cards

- Total Approach Flow Rate – Card Type 50
- % Trucks – Card Type 50
- Turning Movement Percentages – Card Type 21

33

Changing Total Approach Flow Rates



34

Flow Rates -- Card Type 50

8004	7	200	0	0	100	50
8002	5	700	10	0	100	50
8001	1	700	10	0	100	50
8003	6	200	0	0	100	50

Upstream Node

Downstream Node

Entering Flow Rate (vph)

% Trucks

Card Type

35

Changing Total Approach Flow Rates

8004	7	200	0	0	100	50
8002	5	700	10	0	100	50
8001	1	700	10	0	100	50
8003	6	200	0	0	100	50

Entering Flow Rate (vph)

Example:

8004	7	200	0	0	100	50
8002	5	1200	10	0	100	50
8001	1	700	10	0	100	50
8003	6	200	0	0	100	50

Changes Total Approach Flow Rate on WB Entering Link to 1200 vph

36

Changing % Trucks

8004	7	200	0	0	100	50
8002	5	700	10	0	100	50
8001	1	700	10	0	100	50
8003	6	200	0	0	100	50

% Trucks

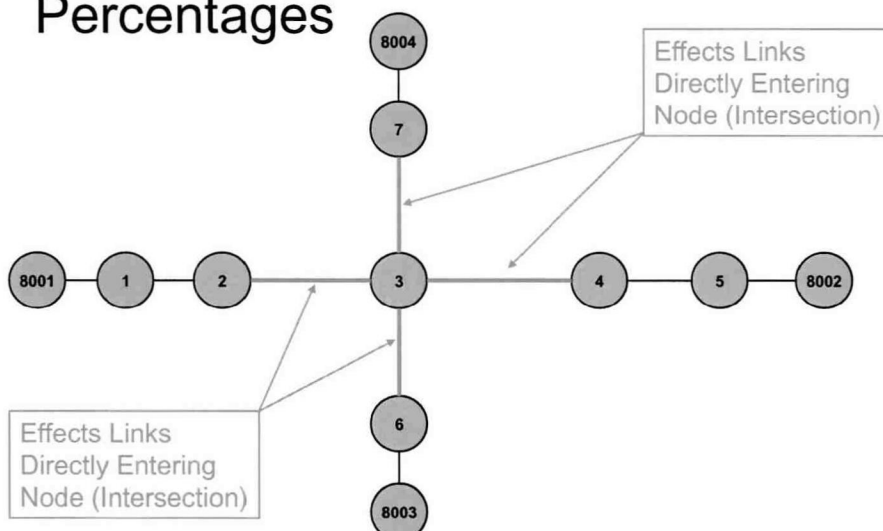
Example:

8004	7	200	0	0	100	50
8002	5	700	25	0	100	50
8001	1	700	10	0	100	50
8003	6	200	0	0	100	50

Changes % Trucks on WB Entering Link to 25%

37

Changing Turning Movement Percentages



38

Turning Movements -- Card Type 21

3	7	100					21
4	5	100					21
2	1	100					21
3	6	100					21
3	4	100					21
3	2	100					21
2	3	20	60	20	0		21
4	3	20	60	20	0		21
6	3	20	60	20	0		21
7	3	20	60	20	0		21
1	2	100					21
5	4	100					21
8002	5	100					21
8001	1	100					21
8004	7	100					21
8003	6	100					21

Entering Node

Card Type

Departing Node

39

Turning Movements -- Card Type 21 (Cont.)

3	7	100					21
4	5	100					21
2	1	100					21
3	6	100					21
3	4	100					21
3	2	100					21
2	3	20	60	20	0		21
4	3	20	60	20	0		21
6	3	20	60	20	0		21
7	3	20	60	20	0		21
1	2	100					21
5	4	100					21
8002	5	100					21
8001	1	100					21
8004	7	100					21
8003	6	100					21

% Left-Turn

% Diagonal

% Right-Turn

% Through

40

Changing Turning Movement Percentages

3	7	100				21
4	5	100				21
2	1	100				21
3	6	100				21
3	4	100				21
3	2	100				21
2	3	20	60	20	0	21
4	3	20	60	20	0	21
6	3	20	60	20	0	21
7	3	20	60	20	0	21
1	2	100				21
5	4	100				21
8002	5	100				21
8001	1	100				21
8004	7	100				21
8003	6	100				21

These cards describe turning movement percentages at the test intersection.

41

Changing Turning Movement Percentages -- Example

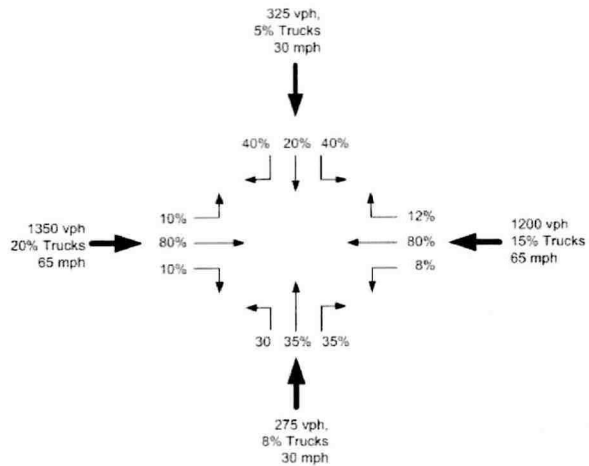
3	7	100				21
4	5	100				21
2	1	100				21
3	6	100				21
3	4	100				21
3	2	100				21
2	3	20	60	20	0	21
4	3	8	77	15	0	21
6	3	20	60	20	0	21
7	3	20	60	20	0	21
1	2	100				21
5	4	100				21
8002	5	100				21
8001	1	100				21
8004	7	100				21
8003	6	100				21

Changes turning movement distribution on WB approach to 8% Left-turns, 77% Through, and 15% Right-turns

42

Hands-On Practice

APPROACH VOLUME AND TURNING PERCENTAGES



43

Modifying Phasing

44

Default ".sdi" File

*	from	to	turn	type	cntl	phases
	7	3	T	Prot	1	P4
	7	3	R	Perm	1	P4
	7	3	L	P+P	1	P7 P4
	2	3	T	Prot	1	P2
	2	3	R	Perm	1	P2
	2	3	L	P+P	1	P5 P2
	4	3	T	Prot	1	P6
	4	3	R	Perm	1	P6
	4	3	L	P+P	1	P1 P6
	6	3	T	Prot	1	P8
	6	3	R	Perm	1	P8
	6	3	L	P+P	1	P3 P8

45

Protected Only Phasing

*	from	to	turn	type	cntl	phases
	7	3	T	Prot	1	P4
	7	3	R	Perm	1	P4
	7	3	L	P+P	1	P7 P4
	2	3	T	Prot	1	P2
	2	3	R	Perm	1	P2
	2	3	L	Prot	1	P5 
	4	3	T	Prot	1	P6
	4	3	R	Perm	1	P6
	4	3	L	Prot	1	P1 
	6	3	T	Prot	1	P8
	6	3	R	Perm	1	P8
	6	3	L	P+P	1	P3 P8

46

Permissive Only Phasing

*	from	to	turn	type	ctrlr	phases
	7	3	T	Prot	1	P4
	7	3	R	Perm	1	P4
	7	3	L	Perm	1	P4
	2	3	T	Prot	1	P2
	2	3	R	Perm	1	P2
	2	3	L	P+P	1	P1 P2
	4	3	T	Prot	1	P6
	4	3	R	Perm	1	P6
	4	3	L	P+P	1	P5 P6
	6	3	T	Prot	1	P8
	6	3	R	Perm	1	P8
	6	3	L	Perm	1	P8

47

Overlaps

*	from	to	turn	type	ctrlr	phases
	7	3	T	Prot	1	P4
	7	3	R	Perm	1	P4
	7	3	L	P+P	1	P7 P4
	2	3	T	Prot	1	P2
	2	3	R	Prot	1	O1
	2	3	L	P+P	1	P5 P2
	4	3	T	Prot	1	P6
	4	3	R	Perm	1	P6
	4	3	L	P+P	1	P1 P6
	6	3	T	Prot	1	P8
	6	3	R	Perm	1	P8
	6	3	L	P+P	1	P3 P8

48

Hands-On Practice

- E-W Protected Only Left-turn
- N-S Permissive Only Left-turn

Default:

* from	to	turn	type	ctrl	phases
7	3	T	Prot	1	P4
7	3	R	Perm	1	P4
7	3	L	P+P	1	P7 P4
2	3	T	Prot	1	P2
2	3	R	Perm	1	P2
2	3	L	P+P	1	P5 P2
4	3	T	Prot	1	P6
4	3	R	Perm	1	P6
4	3	L	P+P	1	P1 P6
6	3	T	Prot	1	P8
6	3	R	Perm	1	P8
6	3	L	P+P	1	P3 P8

Change to:

* from	to	turn	type	ctrl	phases
7	3	T	Prot	1	P4
7	3	R	Perm	1	P4
7	3	L	Perm	1	P4
2	3	T	Prot	1	P2
2	3	R	Perm	1	P2
2	3	L	Prot	1	P5
4	3	T	Prot	1	P6
4	3	R	Perm	1	P6
4	3	L	Prot	1	P1
6	3	T	Prot	1	P8
6	3	R	Perm	1	P8
6	3	L	Perm	1	P8

- Save as Pract2_Phasing

49

Modifying Detectors

50

Basic Detector Configuration

2	3	8	0	2	400	0	42
4	3	1	0	9999	10	0	42*
*This card is included as a work around for a programming error in TSIS.							
Do not remove.							
4	3	8	3200	26	60	0	42
4	3	8	4300	27	60	0	42
4	3	8	5400	28	60	0	42
4	3	8	0	6	400	0	42
4	3	7	0	1	400	0	42
2	3	8	3200	20	60	0	42
2	3	8	4300	21	60	0	42
2	3	8	5400	22	60	0	42
2	3	7	0	5	400	0	42
6	3	1	0	8	400	0	42
6	3	7	0	3	400	0	42
7	3	1	0	4	400	0	42
7	3	7	0	7	400	0	42

■ CORSIM Card Type 42

51

Basic Detectors Configuration

2	3	8	0	2	400	0	42
4	3	1	0	9999	10	0	42*
*This card is included as a work around for a programming error in TSIS.							
Do not remove.							
4	3	8	3200	26	60	0	42
4	3	8	4300	27	60	0	42
4	3	8	5400	28	60	0	42
4	3	8	0	6	400	0	42
4	3	7	0	1	400	0	42
2	3	8	3200	20	60	0	42
2	3	8	4300	21	60	0	42
2	3	8	5400	22	60	0	42
2	3	7	0	5	400	0	42
6	3	1	0	8	400	0	42
6	3	7	0	3	400	0	42
7	3	1	0	4	400	0	42
7	3	7	0	7	400	0	42

DO NOT REMOVE THESE LINES !!!

52

Basic Detector Configuration

2	3	8	0	2	400	0	42
4	3	1	0	9999	10	0	42*
*This card is included as a work around for a programming error in TSIS.							
Do not remove.							
4	3	8	3200	26	60	0	42
4	3	8	4300	27	60	0	42
4	3	8	5400	28	60	0	42
4	3	8	0	6	400	0	42
4	3	7	0	1	400	0	42
2	3	8	3200	20	60	0	42
2	3	8	4300	21	60	0	42
2	3	8	5400	22	60	0	42
2	3	7	0	5	400	0	42
6	3	1	0	8	400	0	42
6	3	7	0	3	400	0	42
7	3	1	0	4	400	0	42
7	3	7	0	7	400	0	42

Multi-Loop Detectors for High Speed Approach

53

Basic Detector Configuration

2	3	8	0	2	400	0	42
4	3	1	0	9999	10	0	42*
*This card is included as a work around for a programming error in TSIS.							
Do not remove.							
4	3	8	3200	26	60	0	42
4	3	8	4300	27	60	0	42
4	3	8	5400	28	60	0	42
4	3	8	0	6	400	0	42
4	3	7	0	1	400	0	42
2	3	8	3200	20	60	0	42
2	3	8	4300	21	60	0	42
2	3	8	5400	22	60	0	42
2	3	7	0	5	400	0	42
6	3	1	0	8	400	0	42
6	3	7	0	3	400	0	42
7	3	1	0	4	400	0	42
7	3	7	0	7	400	0	42

Long-Loop (40') Stop Bar Detectors

54

Modifying Detector Configuration

2	3	8	0	2	400	0	42
4	3	1	0	9999	10	0	42*
*This card is included as a work around for a programming error in TSIS.							
Do not remove.							
4	3	8	3200	26	60	0	42
4	3	8	4300	27	60	0	42
4	3	8	5400	28	60	0	42
4	3	8	0	6	400	0	42
4	3	7	0	1	400	0	42
2	3	8	3200	20	60	0	42
2	3	8	4300	21	60	0	42
2	3	8	5400	22	60	0	42
2	3	7	0	5	400	0	42
6	3	1	0	8	400	0	42
6	3	7	0	3	400	0	42
7	3	1	0	4	400	0	42
7	3	7	0	7	400	0	42

Lane Covered: 1=Through
7= Left-turn
8=All-lanes

Downstream Node

Upstream Node

55

Modifying Detector Configuration

2	3	8	0	2	400	0	42
4	3	1	0	9999	10	0	42*
*This card is included as a work around for a programming error in TSIS.							
Do not remove.							
4	3	8	3200	26	60	0	42
4	3	8	4300	27	60	0	42
4	3	8	5400	28	60	0	42
4	3	8	0	6	400	0	42
4	3	7	0	1	400	0	42
2	3	8	3200	20	60	0	42
2	3	8	4300	21	60	0	42
2	3	8	5400	22	60	0	42
2	3	7	0	5	400	0	42
6	3	1	0	8	400	0	42
6	3	7	0	3	400	0	42
7	3	1	0	4	400	0	42
7	3	7	0	7	400	0	42

Operating Mode: 0=Presence

Detector Length (tenths of feet)

Detector Number

Distance from
Stop Bar
(tenths of feet)

56

Deleting Detectors

2	3	8	0	2	400	0	42
4	3	1	0	9999	10	0	42*
*This card is included as a work around for a programming error in TSIS.							
Do not remove.							
4	3	8	3200	26	60	0	42
4	3	8	4300	27	60	0	42
4	3	8	5400	28	60	0	42
4	3	8	0	6	400	0	42
4	3	7	0	1	400	0	42
2	3	8	3200	20	60	0	42
2	3	8	4300	21	60	0	42
2	3	8	5400	22	60	0	42
2	3	7	0	5	400	0	42
6	3	1	0	8	400	0	42
6	3	7	0	3	400	0	42
7	3	1	0	4	400	0	42
7	3	7	0	7	400	0	42

Simply remove "42" from last column

57

Adding Detectors

2	3	8	0	2	400	0	42
4	3	1	0	9999	10	0	42*
*This card is included as a work around for a programming error in TSIS.							
Do not remove.							
4	3	8	3200	26	60	0	42
4	3	8	4300	27	60	0	42
4	3	8	5400	28	60	0	42
4	3	8	0	6	400	0	42
4	3	7	0	1	400	0	42
2	3	8	3200	20	60	0	42
2	3	8	4300	21	60	0	42
2	3	8	5400	22	60	0	42
2	3	7	0	5	400	0	42
6	3	1	0	8	400	0	42
6	3	7	0	3	400	0	42
6	3	8	1000	10	60	0	42
7	3	1	0	4	400	0	42
7	3	7	0	7	400	0	42

Example: Adds a 6' detector across all lanes 100 ft upstream of stop bar on NB approach. Label as Detector 10.

DON'T FORGET TO CHANGE .INI File !!!

58

Adding Detector – Changing .INI File

```
NumberOfMappedDetectors = 18
MappedDetector[1] = SimulationDetector[1]->RealDetector[1]
MappedDetector[2] = SimulationDetector[2]->RealDetector[2]
MappedDetector[3] = SimulationDetector[3]->RealDetector[3]
MappedDetector[4] = SimulationDetector[4]->RealDetector[4]
MappedDetector[5] = SimulationDetector[5]->RealDetector[5]
MappedDetector[6] = SimulationDetector[6]->RealDetector[6]
MappedDetector[7] = SimulationDetector[7]->RealDetector[7]
MappedDetector[8] = SimulationDetector[8]->RealDetector[8]
MappedDetector[9] = SimulationDetector[9]->RealDetector[6]
MappedDetector[10] = SimulationDetector[10]->RealDetector[8]
MappedDetector[11] = SimulationDetector[11]->RealDetector[11]
MappedDetector[12] = SimulationDetector[12]->RealDetector[12]
MappedDetector[13] = SimulationDetector[20]->RealDetector[2]
MappedDetector[14] = SimulationDetector[21]->RealDetector[2]
MappedDetector[15] = SimulationDetector[22]->RealDetector[2]
MappedDetector[16] = SimulationDetector[26]->RealDetector[6]
MappedDetector[17] = SimulationDetector[27]->RealDetector[6]
MappedDetector[18] = SimulationDetector[28]->RealDetector[6]
```

59

Changing Multi-Loop Spacing

2	3	8	0	2	400	0	42
4	3	1	0	9999	10	0	42*
*This card is included as a work around for a programming error in TSIS. Do not remove.							
4	3	8	2750	26	60	0	42
4	3	8	3750	27	60	0	42
4	3	8	4750	28	60	0	42
4	3	8	0	6	400	0	42
4	3	7	0	1	400	0	42
2	3	8	2750	20	60	0	42
2	3	8	3750	21	60	0	42
2	3	8	4750	22	60	0	42
2	3	7	0	5	400	0	42
6	3	1	0	8	400	0	42
6	3	7	0	3	400	0	42
7	3	1	0	4	400	0	42
7	3	7	0	7	400	0	42

- Default spacing for 65 mph
- Example: change for 60 mph

60

Hands-On Practice

- Add 6x6 loop on NB and SB approaches 150 ft from stop line
- Change spacing on dilemma zone loops to 60 mph
- Delete stop bar detectors on EB and WB through lanes
- Save as "Pract3_detectors"

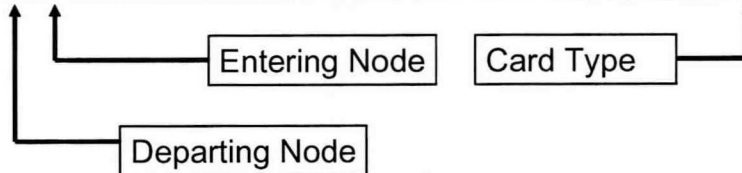
61

Modifying Geometry

62

Geometry -- Card Type 11

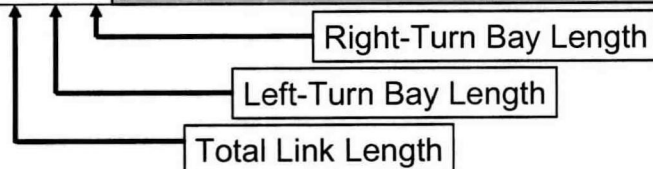
3	7	500	1	010	8004	20	18	30	0	11
4	5	640	2	0100	8002	20	18	65	0	11
2	1	640	2	0100	8001	20	18	65	0	11
3	6	500	1	010	8003	20	18	30	0	11
3	42000	2	0100	5		20	18	65	0	11
3	22000	2	0100	1		20	18	65	0	11
2	32000 250	2 1	0100	7 4 6	4	20	18	65	0	11
4	32000 250	2 1	0100	6 2 7	2	20	18	65	0	11
6	3 500 250	1 1	010	2 7 4	7	20	18	30	0	11
7	3 500 250	1 1	010	4 6 2	6	20	18	30	0	11
1	2 640	2	0100	3		20	18	65	0	11
5	4 640	2	0100	3		20	18	65	0	11
8002	5	2	0100	4		20	18	0	0	11
8001	1	2	0100	2		20	18	0	0	11
8004	7	1	010	3		20	18	0	0	11
8003	6	1	010	3		20	18	0	0	11



63

Lengths -- Card Type 11 (Cont.)

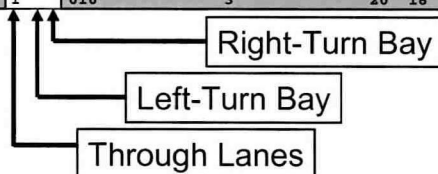
3	7	500	1	010	8004	20	18	30	0	11
4	5	640	2	0100	8002	20	18	65	0	11
2	1	640	2	0100	8001	20	18	65	0	11
3	6	500	1	010	8003	20	18	30	0	11
3	42000	2	0100	5		20	18	65	0	11
3	22000	2	0100	1		20	18	65	0	11
2	32000 250	2 1	0100	7 4 6	4	20	18	65	0	11
4	32000 250	2 1	0100	6 2 7	2	20	18	65	0	11
6	3 500 250	1 1	010	2 7 4	7	20	18	30	0	11
7	3 500 250	1 1	010	4 6 2	6	20	18	30	0	11
1	2 640	2	0100	3		20	18	65	0	11
5	4 640	2	0100	3		20	18	65	0	11
8002	5	2	0100	4		20	18	0	0	11
8001	1	2	0100	2		20	18	0	0	11
8004	7	1	010	3		20	18	0	0	11
8003	6	1	010	3		20	18	0	0	11



64

Number of Lanes -- Card Type 11 (Cont.)

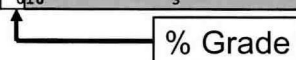
3	7	500	1	010	8004	20	18	30	0	11		
4	5	640	2	0100	8002	20	18	65	0	11		
2	1	640	2	0100	8001	20	18	65	0	11		
3	6	500	1	010	8003	20	18	30	0	11		
3	42000		2	0100	5	20	18	65	0	11		
3	22000		2	0100	1	20	18	65	0	11		
2	32000	250	2 1	0100	7 4 6	4	20	18	65	0	11	
4	32000	250	2 1	0100	6 2 7	2	20	18	65	0	11	
6	3	500	250	1 1	010	2 7 4	7	20	18	30	0	11
7	3	500	250	1 1	010	4 6 2	6	20	18	30	0	11
1	2	640	2	0100	3	20	18	65	0	11		
5	4	640	2	0100	3	20	18	65	0	11		
8002	5		2	0100	4	20	18		0	11		
8001	1		2	0100	2	20	18		0	11		
8004	7		1	010	3	20	18		0	11		
8003	6		1	010	3	20	18		0	11		



65

Approach Grade -- Card Type 11 (Cont.)

3	7	500	1	010	8004	20	18	30	0	11		
4	5	640	2	0100	8002	20	18	65	0	11		
2	1	640	2	0100	8001	20	18	65	0	11		
3	6	500	1	010	8003	20	18	30	0	11		
3	42000		2	0100	5	20	18	65	0	11		
3	22000		2	0100	1	20	18	65	0	11		
2	32000	250	2 1	0100	7 4 6	4	20	18	65	0	11	
4	32000	250	2 1	0100	6 2 7	2	20	18	65	0	11	
6	3	500	250	1 1	010	2 7 4	7	20	18	30	0	11
7	3	500	250	1 1	010	4 6 2	6	20	18	30	0	11
1	2	640	2	0100	3	20	18	65	0	11		
5	4	640	2	0100	3	20	18	65	0	11		
8002	5		2	0100	4	20	18		0	11		
8001	1		2	0100	2	20	18		0	11		
8004	7		1	010	3	20	18		0	11		
8003	6		1	010	3	20	18		0	11		



66

Queue Discharge and Start-up Lost Time -- Card Type 11 (Cont.)

3	7	500	1	010	8004	20	18	30	0	11				
4	5	640	2	0100	8002	20	18	65	0	11				
2	1	640	2	0100	8001	20	18	65	0	11				
3	6	500	1	010	8003	20	18	30	0	11				
3	42000		2	0100	5	20	18	65	0	11				
3	22000		2	0100	1	20	18	65	0	11				
2	32000	250	2	1 0100	7	4	6	4	20	18	65	0	11	
4	32000	250	2	1 0100	6	2	7	2	20	18	65	0	11	
6	3	500	250	1	1 010	2	7	4	7	20	18	30	0	11
7	3	500	250	1	1 010	4	6	2	6	20	18	30	0	11
1	2	640	2	0100	3				20	18	65	0	11	
5	4	640	2	0100	3				20	18	65	0	11	
8002	5		2	0100	4				20	18		0	11	
8001	1		2	0100	2				20	18		0	11	
8004	7		1	010	3				20	18		0	11	
8003	6		1	010	3				20	18		0	11	

Queue Discharges and Start-up Lost Time Distribution Characteristic Code

67

Permitted Movements by Lane -- Card Type 11 (Cont.)

3	7	500	1	010	8004	20	18	30	0	11				
4	5	640	2	0100	8002	20	18	65	0	11				
2	1	640	2	0100	8001	20	18	65	0	11				
3	6	500	1	010	8003	20	18	30	0	11				
3	42000		2	0100	5	20	18	65	0	11				
3	22000		2	0100	1	20	18	65	0	11				
2	32000	250	2	1 0100	7	4	6	4	20	18	65	0	11	
4	32000	250	2	1 0100	6	2	7	2	20	18	65	0	11	
6	3	500	250	1	1 010	2	7	4	7	20	18	30	0	11
7	3	500	250	1	1 010	4	6	2	6	20	18	30	0	11
1	2	640		2	0100	3				20	18	65	0	11
5	4	640		2	0100	3				20	18	65	0	11
8002	5		2	0100	4					20	18		0	11
8001	1		2	0100	2					20	18		0	11
8004	7		1	010	3					20	18		0	11
8003	6		1	010	3					20	18		0	11

Channelization Codes

SHARED LANES ONLY -- NOT NEEDED if turn pockets used!!

68

Channelization Codes

CODE	MEANING
0 (or blank)	Unchannelized
1	Left turn only
2	Buses only
3	Closed
4	Right turn only
5	Carpool only
6	Carpools and buses only
7	Right turns + right diagonal; right turns + through; also right turns + right diagonal + through if no other lane allows the through movement
8	Left turns + left diagonal; left turns + through; also left turns + left diagonal + through if no other lane allows the through movement
9	All movements permitted by the geometry and adjacent lane
D	Diagonal traffic only
T	Through traffic only

69

Receiving Nodes -- Card Type 11 (Cont.)

3	7	500	1	010	8004	20	18	30	0	11				
4	5	640	2	0100	8002	20	18	65	0	11				
2	1	640	2	0100	8001	20	18	65	0	11				
3	6	500	1	010	8003	20	18	30	0	11				
3	42000		2	0100	5	20	18	65	0	11				
3	22000		2	0100	1	20	18	65	0	11				
2	32000	250	2	1 0100	7	4	6	4	20	18	65	0	11	
4	32000	250	2	1 0100	6	2	7	2	20	18	65	0	11	
6	3	500	250	1	1 010	2	7	4	7	20	18	30	0	11
7	3	500	250	1	1 010	4	6	2	6	20	18	30	0	11
1	2	640		2	0100	3			20	18	65	0	11	
5	4	640		2	0100	3			20	18	65	0	11	
8002	5		2	0100	4				20	18		0	11	
8001	1		2	0100	2				20	18		0	11	
8004	7		1	010	3				20	18		0	11	
8003	6		1	010	3				20	18		0	11	

Left-Turns

Right-Turns

Throughs

70

Opposing Left-Turns -- Card Type 11 (Cont.)

3	7 500	1	010	8004		20 18 30 0	11
4	5 640	2	0100	8002		20 18 65 0	11
2	1 640	2	0100	8001		20 18 65 0	11
3	6 500	1	010	8003		20 18 30 0	11
3	42000	2	0100	5		20 18 65 0	11
3	22000	2	0100	1		20 18 65 0	11
2	32000 250	2 1	0100	7 4 6	4	20 18 65 0	11
4	32000 250	2 1	0100	6 2 7	2	20 18 65 0	11
6	3 500 250	1 1	010	2 7 4	7	20 18 30 0	11
7	3 500 250	1 1	010	4 6 2	6	20 18 30 0	11
1	2 640	2	0100	3		20 18 65 0	11
5	4 640	2	0100	3		20 18 65 0	11
8002	5	2	0100	4		20 18 0	11
8001	1	2	0100	2		20 18 0	11
8004	7	1	010	3		20 18 0	11
8003	6	1	010	3		20 18 0	11

Upstream node for traffic
opposing left-turn

71

Mean Values -- Card Type 11 (Cont.)

3	7	500	1	010	8004		20	18	30	0	11		
4	5	640	2	0100	8002		20	18	65	0	11		
2	1	640	2	0100	8001		20	18	65	0	11		
3	6	500	1	010	8003		20	18	30	0	11		
3	42000		2	0100	5		20	18	65	0	11		
3	22000		2	0100	1		20	18	65	0	11		
2	32000	250	2	1 0100	7	4	6	4	20	18	65	0	11
4	32000	250	2	1 0100	6	2	7	2	20	18	65	0	11
6	3	500	250	1 1 010	2	7	4	7	20	18	30	0	11
7	3	500	250	1 1 010	4	6	2	6	20	18	30	0	11
1	2	640	2	0100	3				20	18	65	0	11
5	4	640	2	0100	3				20	18	65	0	11
8002	5		2	0100	4				20	18	0	11	
8001	1		2	0100	2				20	18	0	11	
8004	7		1	010	3				20	18	0	11	
8003	6		1	010	3				20	18	0	11	

Start-Up Lost Time

Queue Discharge Headway

72

Link Speeds -- Card Type 11 (Cont.)

3	7	500	1	010	8004		20	18	30	0	11
4	5	640	2	0100	8002		20	18	65	0	11
2	1	640	2	0100	8001		20	18	65	0	11
3	6	500	1	010	8003		20	18	30	0	11
3	4	2000	2	0100	5		20	18	65	0	11
3	2	2000	2	0100	1		20	18	65	0	11
2	3	2000 250	2 1	0100	7 4 6	4	20	18	65	0	11
4	3	2000 250	2 1	0100	6 2 7	2	20	18	65	0	11
6	3	500 250	1 1	010	2 7 4	7	20	18	30	0	11
7	3	500 250	1 1	010	4 6 2	6	20	18	30	0	11
1	2	640	2	0100	3		20	18	65	0	11
5	4	640	2	0100	3		20	18	65	0	11
8002	5		2	0100	4		20	18		0	11
8001	1		2	0100	2		20	18		0	11
8004	7		1	010	3		20	18		0	11
8003	6		1	010	3		20	18		0	11

Desired Free-Flow
Speed (mph)

73

Fields Most Likely to be Changed

3	7	500	1	010	8004	20	18	30	0	11	
4	5	640	2	0100	8002	20	18	65	0	11	
2	1	640	2	0100	8001	20	18	65	0	11	
3	6	500	1	010	8003	20	18	30	0	11	
3	4	2000	2	0100	5	20	18	65	0	11	
3	2	2000	2	0100	1	20	18	65	0	11	
2	3	2000 250	2 1	0100	7 4 6	4	20	18	65	0	11
4	3	2000 250	2 1	0100	6 2 7	2	20	18	65	0	11
6	3	500 250	1 1	010	2 7 4	7	20	18	30	0	11
7	3	500 250	1 1	010	4 6 2	6	20	18	30	0	11
1	2	640	2	0100	3	20	18	65	0	11	
5	4	640	2	0100	3	20	18	65	0	11	
8002	5		2	0100	4	20	18		0	11	
8001	1		2	0100	2	20	18		0	11	
8004	7		1	010	3	20	18		0	11	
8003	6		1	010	3	20	18		0	11	

- Link and Turn Bay Lengths
- Number of Lanes and Bays
- Approach Speeds
- Channelization Codes (possibly)

Lines where most
changes will be
made.

74

Adding Right-Turn Lane

Example: Add Right-turn lane to NB Approach

3	7	500		1	010		8004		20	18	30	0	11		
4	5	640		2	0100		8002		20	18	65	0	11		
2	1	640		2	0100		8001		20	18	65	0	11		
3	6	500		1	010		8003		20	18	30	0	11		
3	42000			2	0100		5		20	18	65	0	11		
3	22000			2	0100		1		20	18	65	0	11		
2	32000	250		2	1 0100		7	4	6	4	20	18	65	0	11
4	32000	250		2	1 0100		6	2	7	2	20	18	65	0	11
6	3	500	250	1	1 010		2	7	4	7	20	18	30	0	11
7	3	500	250	1	1 010		4	6	2	6	20	18	30	0	11

Adds Right Turn Lane

Right-Turn Bay Length

75

Adding Dual Left-Turns

Example: Add Left-turn lane to WB Approach

3	7	500	1	010	8004			20	18	30	0	11	
4	5	640	2	0100	8002			20	18	65	0	11	
2	1	640	2	0100	8001			20	18	65	0	11	
3	6	500	2	010	8003			20	18	30	0	11	
3	42000		2	0100	5			20	18	65	0	11	
3	22000		2	0100	1			20	18	65	0	11	
2	32000	250	2	1 0100	7	4	6	4	20	18	65	0	11
4	32000	250	2	2 0100	6	2	7	2	20	18	65	0	11
6	3	500	250	1 1 010	2	7	4	7	20	18	30	0	11
7	3	500	250	1 1 010	4	6	2	6	20	18	30	0	11

Change number of
lanes in left-turn bay

NOTE: Destination link also
need to be changed to
accept dual lefts

ALSO NEED TO CHANGE .sdi FILE TO "PROTECTED ONLY"

76

Hands-On Practice

- Add right-turn lane to NB approach
- Make dual left-turns for WB/EB approach
- Save as Pract3_Geometry

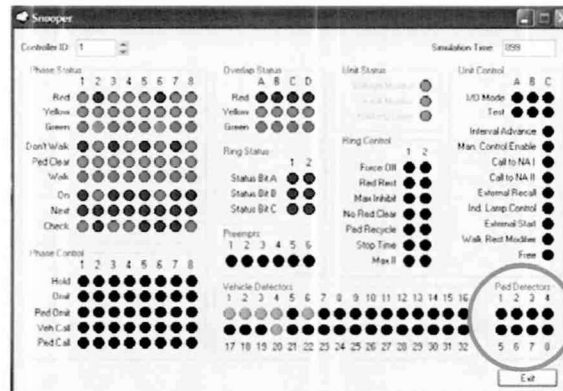
77

Special Operations

78

Pedestrians

- Use Snooper to manually toggle when pedestrian calls to controller

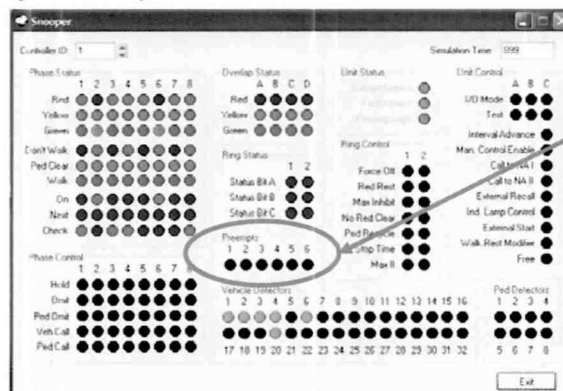


Click on appropriate *Ped Detector* to place ped call on associated with phase

79

Preemption

- Use Snooper to manually toggle when preemption to occur



Click on appropriate *Preempts* to place preempt call

Note: High Priority Preempts only

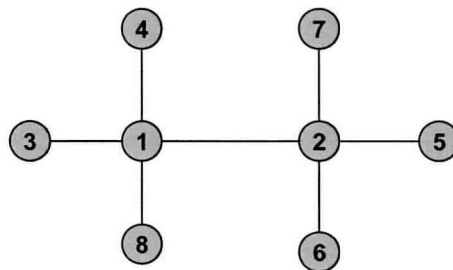
80

Diamond Interchanges

■ Two Sample Simulation Files

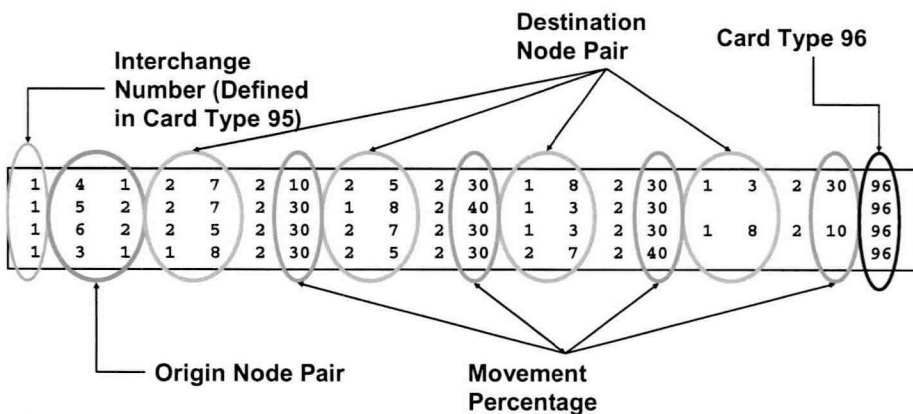
- Tight Diamond (300 ft)
- Wide Diamond (1200 ft)

■ Volume coded as Origin-Destination pairs



81

Diamonds –Volumes Based On Origin/Destinations



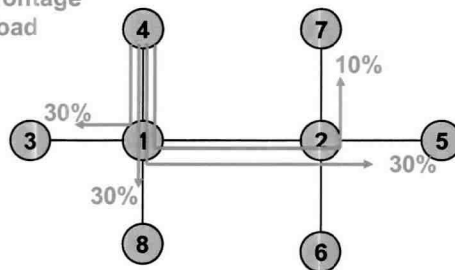
82

Diamonds – Modifying Volumes

SB Frontage Road

1	4	1	2	7	2	10	2	5	2	30	1	8	2	30	1	3	2	30	96
			U-Turns			Lefts			Through			Rights							

Origin-- SB
Frontage
Road



U-Turn (4→1→2→7) = 10%

Lefts (4→1→2→5) = 30%

Through (4→1→1→8) = 30%

Rights (4→1→2→7) = 10%

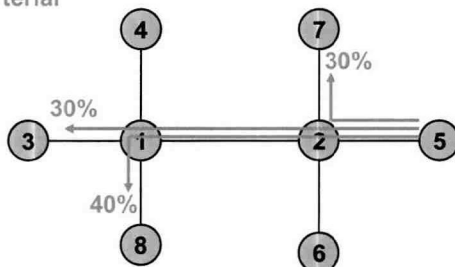
83

Diamonds – Modifying Volumes

WB Arterial Approach

1	5	2	2	7	2	30	1	8	2	40	1	3	2	30						96
			Rights			Lefts			Through											

Origin-- WB
Arterial



Rights (5→2→2→7) = 30%

Lefts (5→2→2→7) = 40%

Through (5→2→1→3) = 30%

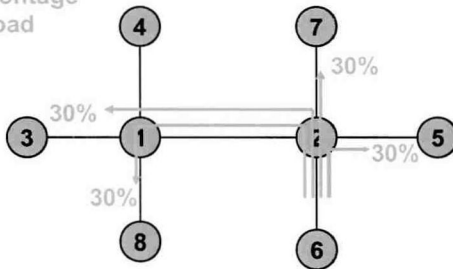
84

Diamonds – Modifying Volumes

NB Frontage Road

1	6	2	2	5	2	30	2	7	2	30	1	3	2	30	1	8	2	10	96
			Rights			Through			Lefts			U-Turns							

Origin-- NB
Frontage
Road



Rights (6→2→2→5) = 30%

Through (6→2→2→7) = 30%

Lefts (6→2→1→3)= 30%

U-Turns (6→2→1→8) = 10%

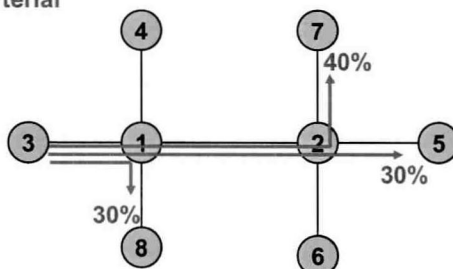
85

Diamonds – Modifying Volumes

EB Arterial Approach

1	3	1	1	8	2	30	2	5	2	30	2	7	2	40	96
			Rights			Through			Lefts						

Origin— EB
Arterial



Rights (3→1→1→8) = 30%

Through (3→1→2→5) = 30%

Left (3→1→2→7) = 40%

86

Running Diamond Simulations

- Set Controller in Diamond mode
- Modify .ini file to correct diamond configuration

- ☐ See Example: [NaztecTs2Interface_Diamond.ini](#)

- ☐ Rename

"Eagle[Naztec]Ts2Interface.ini"

to

"Eagle[Naztec]Ts2Interface_original.ini"

- ☐ Rename

"Eagle[Naztec]Ts2Interface_Diamond.ini"

to

"Eagle[Naztec]Ts2Interface.ini"

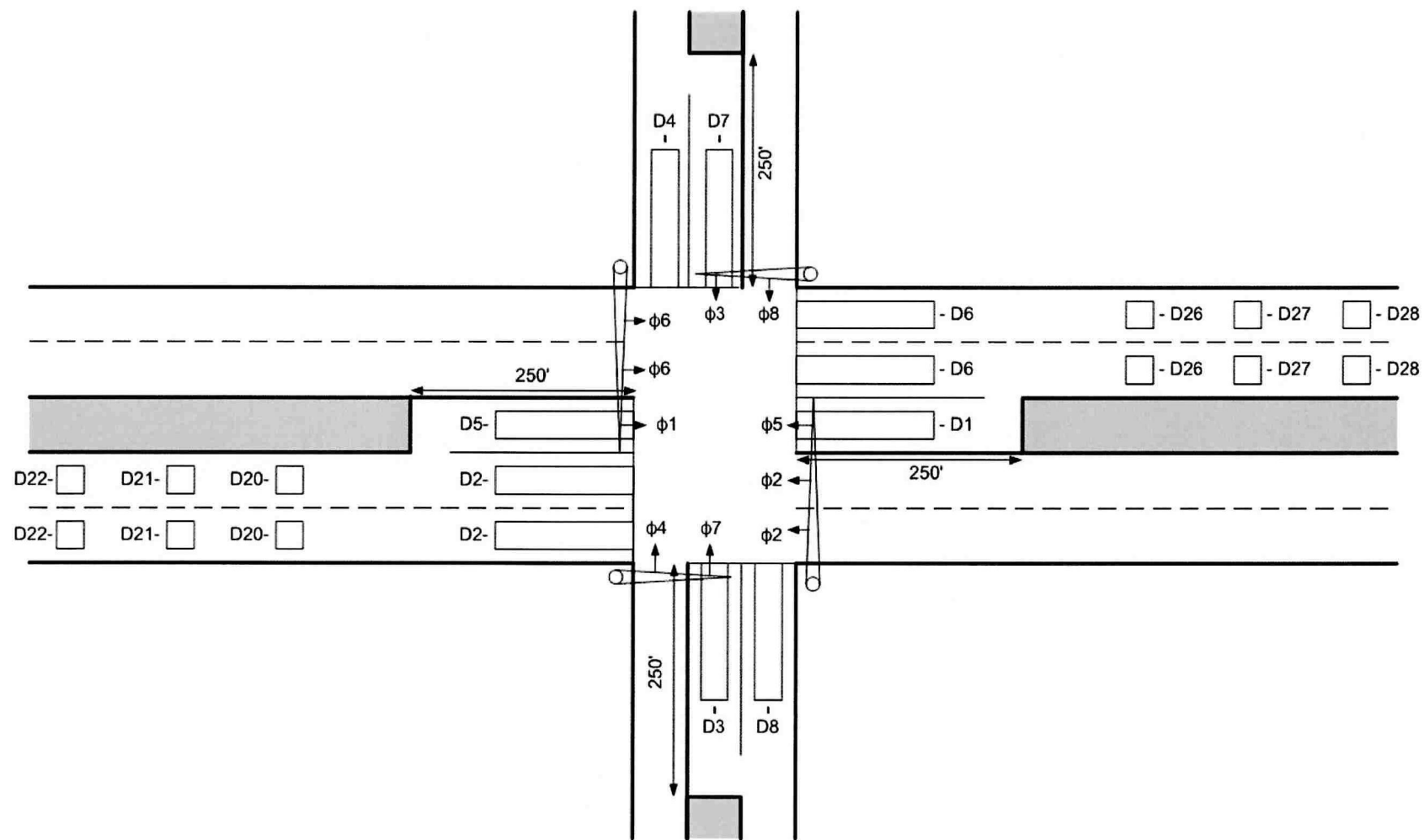
87

Questions

88

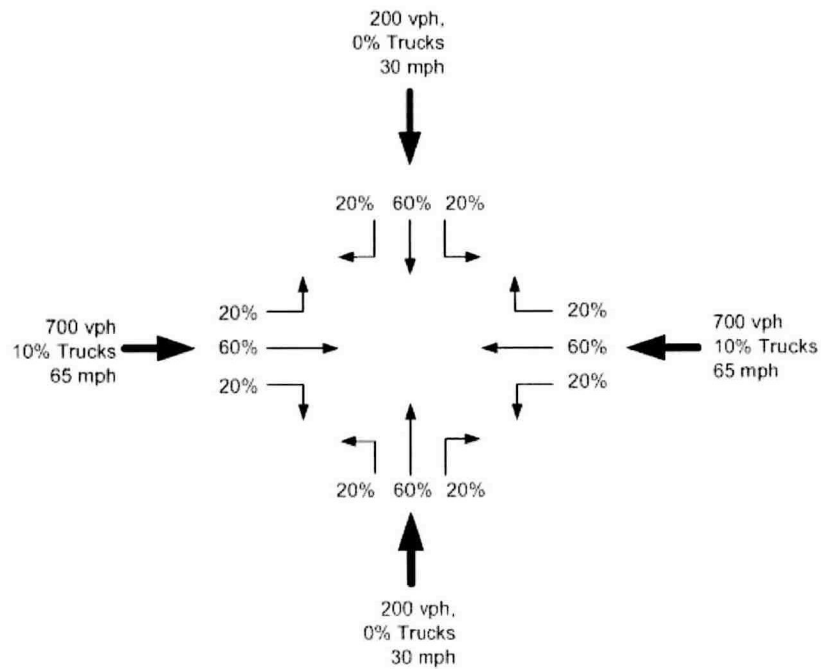
**SCHEMATIC AND
PRINTOUT OF SIMULATION FILE
FOR
STANDARD 4-LEG INTERSECTION**

SCHEMATIC OF EXAMPLE OF STANDARD 4-LEG INTERSECTION WITH MULTI-LOOP DETECTORS



SCHEMATIC OF EXAMPLE OF STANDARD 4-LEG INTERSECTION WITH MULTI-LOOP DETECTORS (CONT.)

APPROACH VOLUME AND TURNING PERCENTAGES

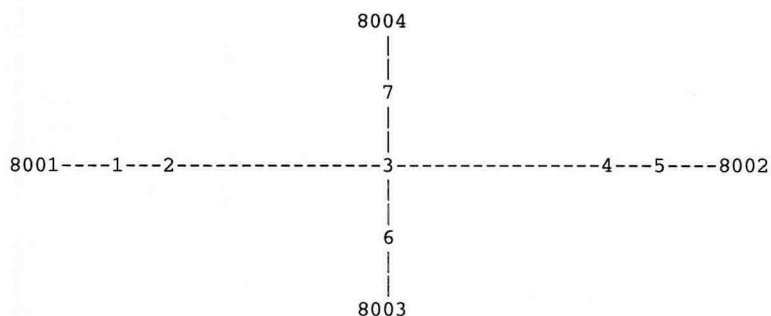


DETECTOR DETAILS

Detector Name	Size	Associated Phase	Operation Mode	Distance From Stop Bar	Function
D1	6'x40'	φ1	Presence	0'	Call & Extend
D2	6'x40'	φ2	Presence	0'	Call & Extend
D3	6'x40'	φ3	Presence	0'	Call & Extend
D4	6'x40'	φ4	Presence	0'	Call & Extend
D5	6'x40'	φ5	Presence	0'	Call & Extend
D6	6'x40'	φ6	Presence	0'	Call & Extend
D7	6'x40'	φ7	Presence	0'	Call & Extend
D8	6'x40'	φ8	Presence	0'	Call & Extend
D20	6'x6'	φ2	Presence	320'	Call & Extend
D21	6'x6'	φ2	Presence	430'	Call & Extend
D22	6'x6'	φ2	Presence	540'	Call & Extend
D26	6'x6'	φ6	Presence	320'	Call & Extend
D27	6'x6'	φ6	Presence	430'	Call & Extend
D28	6'x6'	φ6	Presence	540'	Call & Extend

Created by TSIS Wed Jan 29 09:27:16 2003 from TNO Version 52
ITRAF 2.6
This is a test configuration for algorithm testing,

The link-node diagram is shown below:



Link (2,3) and (3,4) are 2000' long; links (1,2) and (4,5) are 640' long

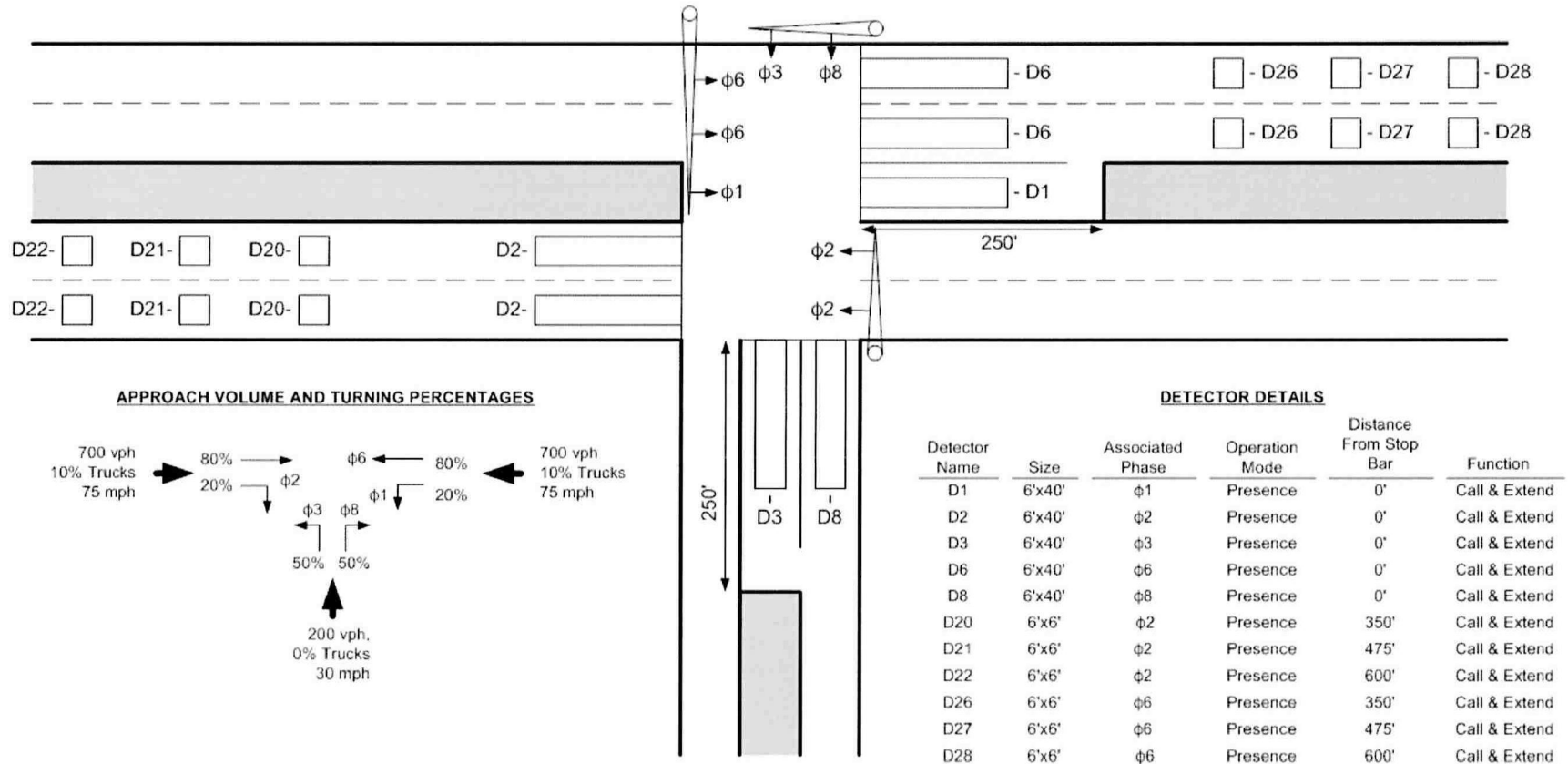
Nodes 2 and 4 were included to investigate the effects of relatively nearby intersections (sometime in the future).

[illegible]

[illegible]

**SCHEMATIC AND
PRINTOUT OF SIMULATION FILE
FOR
STANDARD T-INTERSECTION**

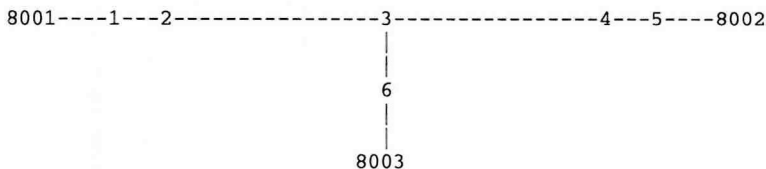
SCHEMATIC OF EXAMPLE OF T-INTERSECTION WITH MULTI-LOOP DETECTORS



Created by TSIS Wed Jan 29 09:27:16 2003 from TNO Version 52
ITRAF 2.6

This is a test configuration for algorithm testing,

The link-node diagram is shown below:



Link (2,3) and (3,4) are 2000' long; links (1,2) and (4,5) are 640' long

Nodes 2 and 4 were included to investigate the effects of relatively nearby intersections (sometime in the future).

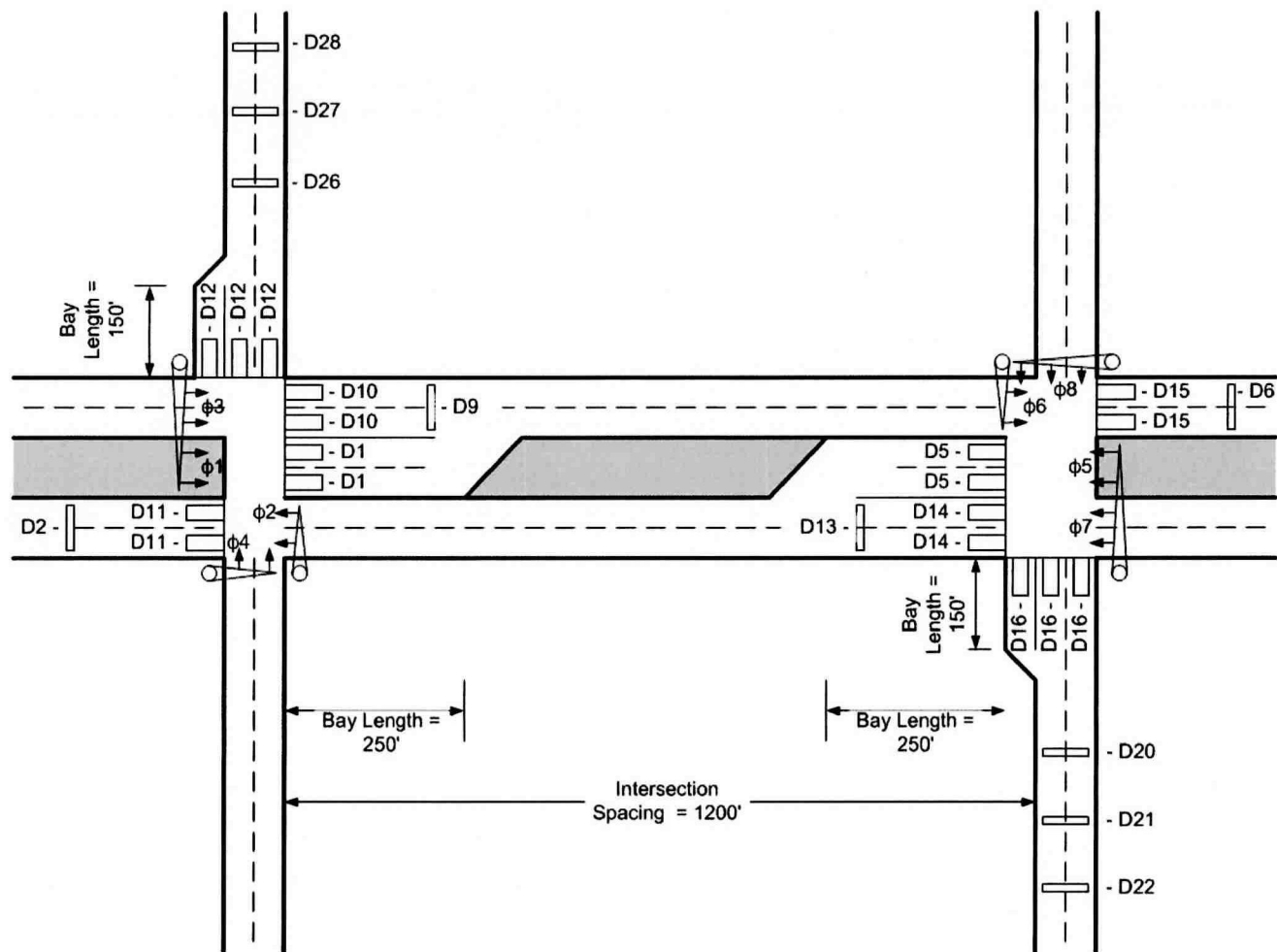
12345678	1	2345678	2	2345678	3	2345678	4	2345678	5	2345678	6	2345678	7	2345678	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
	1	0	3	7981	0000	21			3	800		7729	7529																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																													

included as a work around for a programming error in TSIS. Do not remove.

[illegible]

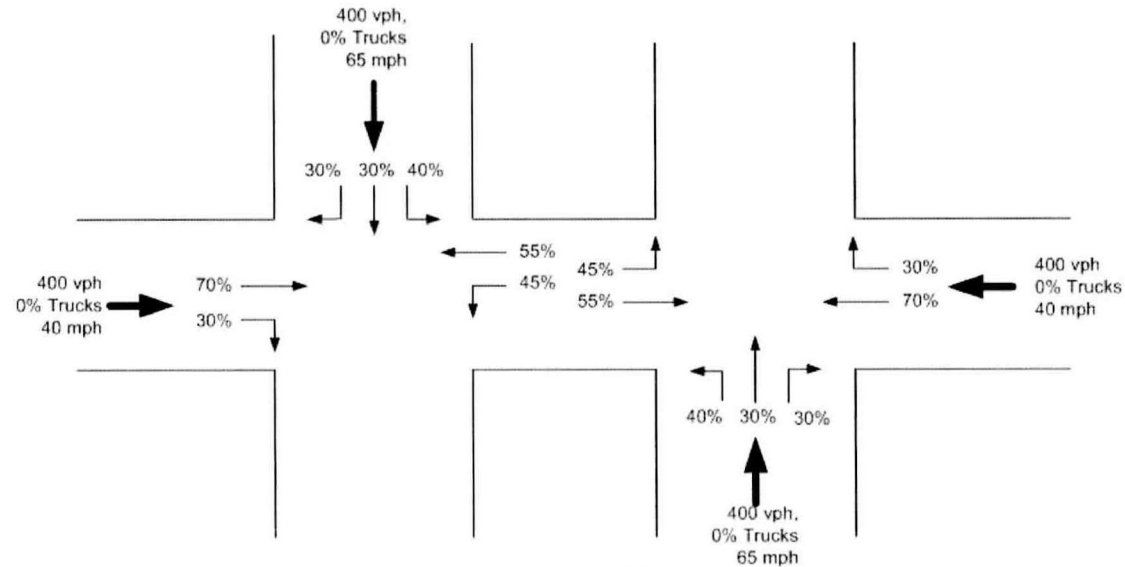
**SCHEMATIC AND
PRINTOUT OF SIMULATION FILE
FOR
WIDE DIAMOND INTERCHANGE**

SCHEMATIC OF EXAMPLE OF WIDE DIAMOND INTERCHANGE WITH MULTI-LOOP DETECTORS



SCHEMATIC OF EXAMPLE OF WIDE DIAMOND INTERCHANGE WITH MULTI-LOOP DETECTORS (CONT.)

APPROACH VOLUME AND TURNING PERCENTAGES



DETECTOR DETAILS

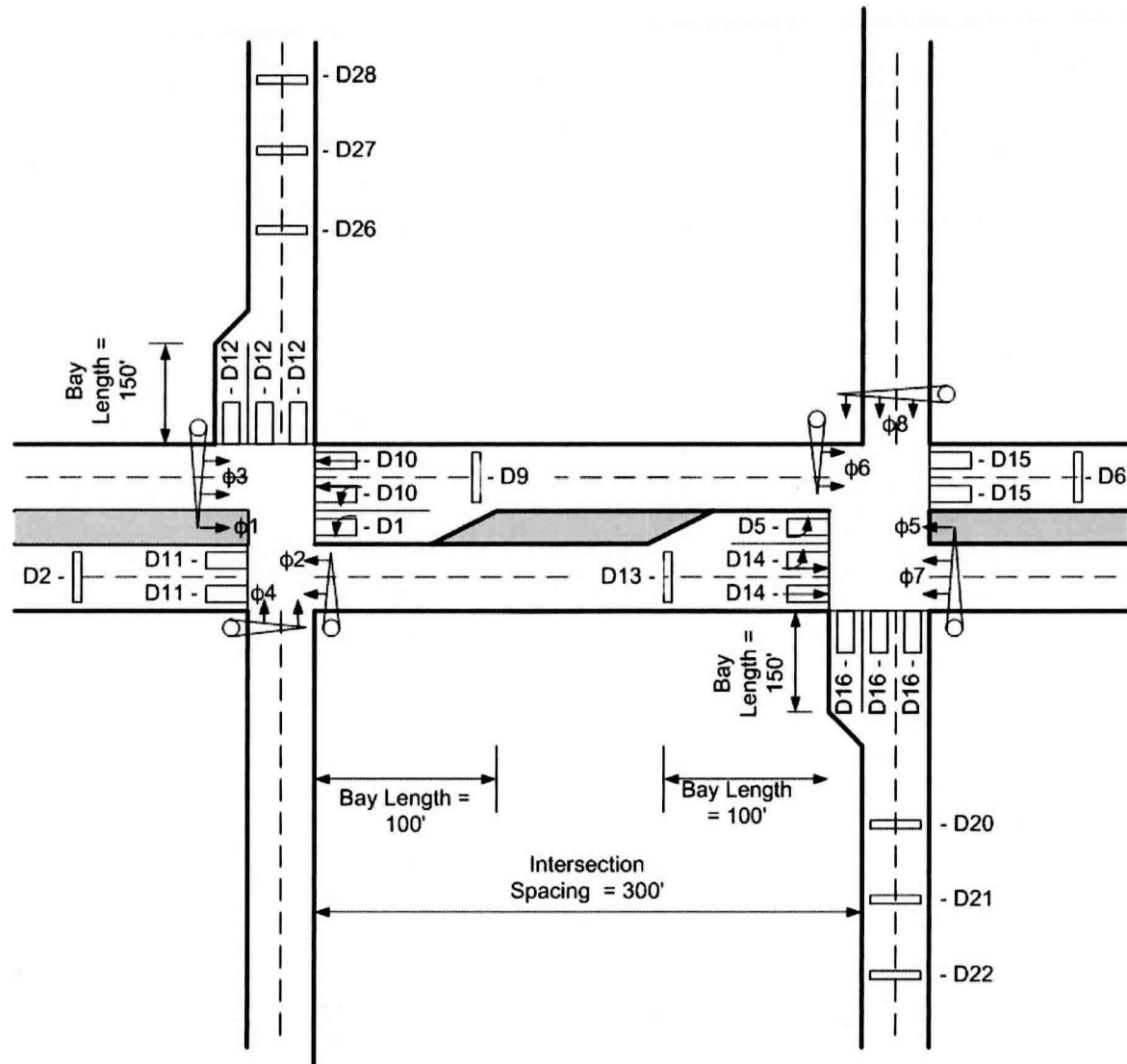
Detector Name	Size	Operation Mode	Distance From Stop Bar	Function
D1	6'x40'	Presence	0'	Call & Extend
D2	6'x6'	Presence	150'	Call & Extend
D5	6'x40'	Presence	0'	Call & Extend
D6	6'x6'	Presence	150'	Call & Extend
D9	6'x6'	Presence	150'	Call & Extend
D10	6'x40'	Presence	0'	Call & Extend
D11	6'x40'	Presence	0'	Call & Extend
D12	6'x40'	Presence	0'	Call & Extend
D13	6'x6'	Presence	150'	Call & Extend
D14	6'x40'	Presence	0'	Call & Extend
D15	6'x40'	Presence	0'	Call & Extend
D16	6'x40'	Presence	0'	Call & Extend
D20	6'x6'	Presence	320'	Call & Extend
D21	6'x6'	Presence	430'	Call & Extend
D22	6'x6'	Presence	540'	Call & Extend
D26	6'x6'	Presence	320'	Call & Extend
D27	6'x6'	Presence	430'	Call & Extend
D28	6'x6'	Presence	540'	Call & Extend

CORSIM SIMULATION FILE FOR WIDE DIAMOND INTERCHANGE WITH MULT-
LOOP DETECTORS

																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																								</
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	----

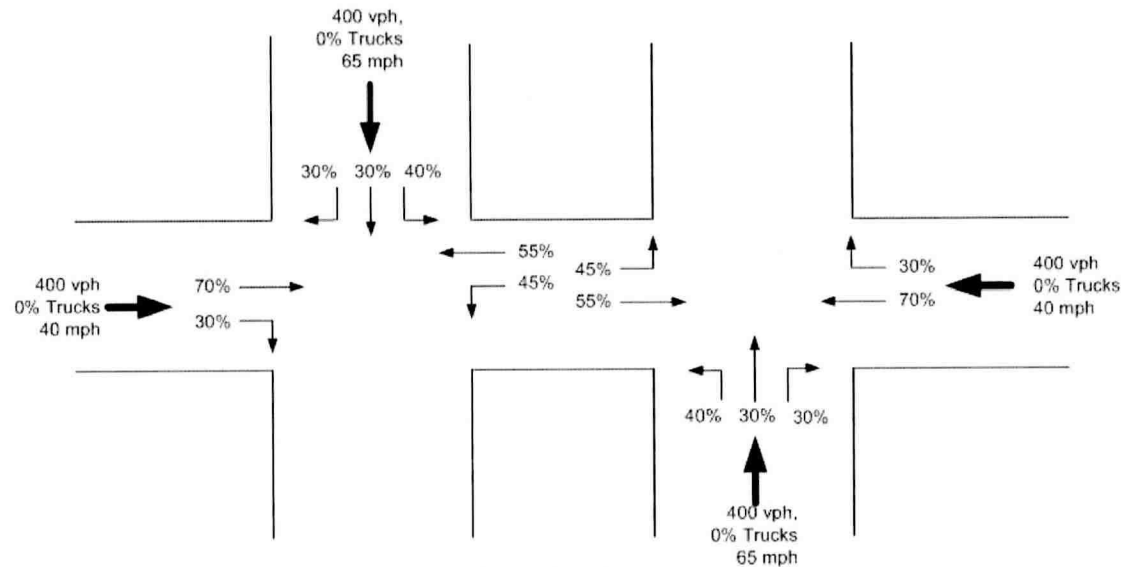
**SCHEMATIC AND
PRINTOUT OF SIMULATION FILE
FOR
TIGHT DIAMOND INTERCHANGE**

SCHEMATIC OF EXAMPLE OF TIGHT DIAMOND INTERCHANGE WITH MULTI-LOOP DETECTORS



SCHEMATIC OF EXAMPLE OF TIGHT DIAMOND INTERCHANGE WITH MULTI-LOOP DETECTORS (CONT.)

APPROACH VOLUME AND TURNING PERCENTAGES



DETECTOR DETAILS

Detector Name	Size	Operation Mode	Distance From Stop Bar	Function
D1	6'x40'	Presence	0'	Call & Extend
D2	6'x6'	Presence	150'	Call & Extend
D5	6'x40'	Presence	0'	Call & Extend
D6	6'x6'	Presence	150'	Call & Extend
D9	6'x6'	Presence	150'	Call & Extend
D10	6'x40'	Presence	0'	Call & Extend
D11	6'x40'	Presence	0'	Call & Extend
D12	6'x40'	Presence	0'	Call & Extend
D13	6'x6'	Presence	150'	Call & Extend
D14	6'x40'	Presence	0'	Call & Extend
D15	6'x40'	Presence	0'	Call & Extend
D16	6'x40'	Presence	0'	Call & Extend
D20	6'x6'	Presence	320'	Call & Extend
D21	6'x6'	Presence	430'	Call & Extend
D22	6'x6'	Presence	540'	Call & Extend
D26	6'x6'	Presence	320'	Call & Extend
D27	6'x6'	Presence	430'	Call & Extend
D28	6'x6'	Presence	540'	Call & Extend

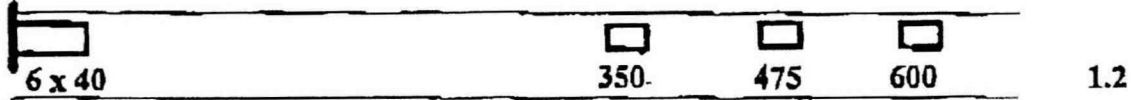
Diagram illustrating a 2D hexagonal lattice structure. The central node is labeled (1). The nodes are connected by dashed lines, forming a hexagonal pattern. The nodes are labeled with their coordinates in square brackets: [8003] for (4), [8005] for (2), [8001] for (3), [8002] for (5), [8006] for (8), and [8004] for (6). The connections are shown as dashed lines. The diagram is part of a larger figure showing the evolution of a system over time, with the top part showing the initial state and the bottom part showing the state after a perturbation.

Srinivasa Sunkari						06 28	05TTI							36		
1	0	3	7981	10000	31200	7111	7581							2		
3600													3			
		60											4			
					1								5			
1	2	300	100	2	1	T8	7	5		5	15	15	40	11	11	For 4 phase
2	1	300	100	2	1	T8	8	3		3	15	15	40	11	11	For 4 phase
1	3	600		2		9	8001			15	15	40	11	11		
1	8	600		2		TT	8006			15	15	40	11	11		
2	5	600		2		9	8002			15	15	40	11	11		
2	7	600		2		TT	8005			15	15	40	11	11		
3	1	600		2		7T	2	8		15	15	40	11	11		
4	1	600	150	2	1	T8	2	8	3	15	15	65	11	11		
5	2	600		2		7T	1	7		15	15	40	11	11		
6	2	600	150	2	1	78	1	7	5	15	15	65	11	11		
8001	3			2			1			15	15	0	11	11		
8002	5			2			2			15	15	0	11	11		
8003	4			2			1			15	15	0	11	11		
8004	6			2			2			15	15	0	11	11		
8001	3		100											21		
8002	5		100											21		
8003	4		100											21		
8004	6		100											21		
3		18001												35		
4		8003												35		
5		28002												35		
6		8004												35		
7		2												35		
8		1												35		
3	11													36		
4	1													36		
5	11													36		
6	1													36		
7	1													36		
8	1													36		
1	2	7	0	5	400	0								42	For 4 phase	
2	1	7	0	1	400	0								42	For 4 phase	
1	2	12	0	14	400	0										

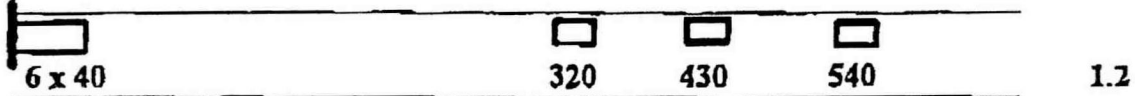
1 210

TxDOT DETECTOR LAYOUT
FOR
HIGH SPEED APPROACHES

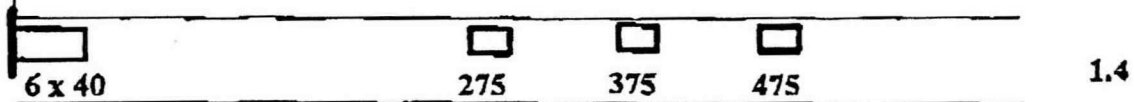
Extension



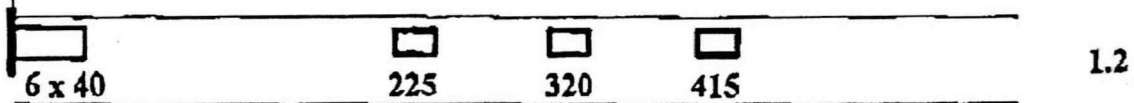
Detector Placement, 70 mph



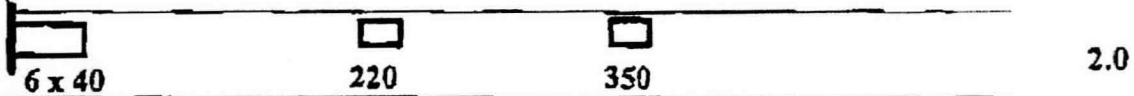
Detector Placement, 65 mph



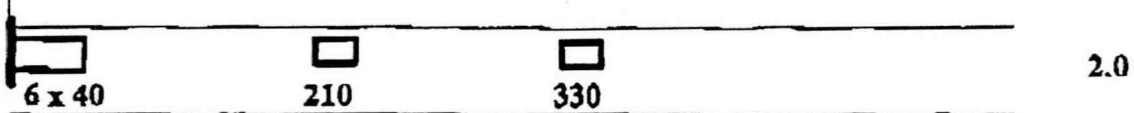
Detector Placement, 60 mph



Detector Placement, 55 mph



Detector Placement, 50 mph



Detector Placement, 45 mph

Link-Node Structure

