Signal Optimization and Analysis Using PASSER V-07
Training Workshop: Code IPR006

Nadeem Chaudhary (n-chaudhary@tamu.edu)
Chi-Leung Chu (clchu@tamu.edu)
Steve Venglar (s-venglar@tamu.edu)

TxDOT Implementation Project 5-5424-01
Product 5-5424-01-P1
Session 0: Preliminaries

• Self Introductions
• Workshop Objectives
• Workshop Outline
**S0—Workshop Objectives**

- Learn Use of PASSER V for Analysis and Optimization of Traffic Signals:
  - Isolated TWSC Intersections
  - Isolated Signals
  - Arterials and Sub-arterials
  - Isolated Diamond Interchanges
  - Diamonds + Adjacent Signals
**S0—Workshop Outline**

- **S1: Introduction to PASSER V**
  - Features
  - Basic Operations
- **S2: Isolated TWSC Intersections**
  - Review of Theory
  - Exercise
- **S3: Isolated Signals**
  - Review of Theory
  - Exercise
S0—Workshop Outline (continued)

- **S4: Signal Systems**
  - Review of Theory

- **S5: Arterial Analysis**
  - Analyze Simple Arterials
  - Review Additional Features

- **S6: Diamond Interchange Analysis**
  - Additional Discussion
  - Exercise
S0—Workshop Outline (continued)

• S7: Diamond and Adjacent Signals
  ✓ Coordinating Diamond with Adjacent Signals

• S8: Workshop Conclusion
  ✓ Question/Answer Session
  ✓ Workshop Survey
Session 1: Introduction to PASSER V

- Background
- Features
- Input Data Requirements
- User Interface
S1 – PASSER V Background

- Funded by TxDOT and TTI
- Applications
  - Isolated Signals (Building Blocks)
  - Isolated TWSC Intersections
  - Signalized Arterials
  - Isolated Diamond Interchanges
  - Diamond + Adjacent Signals
**S1–PASSEr V Features**

- **Graphic User Interface**
  - ✓ Multiple Document Architecture
- **Mesoscopic Delay/Traffic Model**
- **Can Coordinate Signals to Provide**
  - ✓ Maximum Progression
  - ✓ Minimum Delay
- **Graphic Time-Space Diagram**
S1—Using PASSER V

- Draw the Facility
- Select Intersection or Link
- Enter Corresponding Data
- View Signal MOEs
- Analyze/Optimize Signal Systems
  - Select and Run Tool
  - View/Print Results
S1–Tools in PASSER V

- PASSER II Optimizer
- PASSER III Optimizer
- GA-Based Optimizer
- Time-Space Diagram Generator
- Volume Analysis
- Delay Analysis
S1–PASSER V Limitations

- Coordination Requires Same Cycle Length at All Signals
  - No Double-Cycling or Conditional Service
- Cannot Handle Following Cases
  - One-Step Network Optimization
  - All-way Stop-controlled Intersections
Session 2: Isolated TWSC Intersections

• Input Data Needs
• Overview of Theory
• Isolated Intersection Exercise
**S2–PASSE V Data Needs**

- **Turning Movement Counts (TMC)**
  - Collect 15-Minute Data and Calculate PHF
  - AM, PM, and Off-Peak
  - Collect Vehicle Mix Information

- **Intersection Configurations**
  - Number of Lanes, Lane Use, Lane Widths, Turn Bays and Lengths, Median Type, etc.

- **Can Apply Growth Rates to Older Counts as Long as Traffic Patterns Haven’t Changed**
**S2—Exercise**

### Node Data

<table>
<thead>
<tr>
<th>Node</th>
<th>Intersections</th>
<th>Controller Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>Artery 1 at Artery 2</td>
<td>Unsignalized-TWSC</td>
</tr>
</tbody>
</table>

### Artery Data

<table>
<thead>
<tr>
<th>Artery</th>
<th>Movement</th>
<th>Lane Assignment</th>
<th>Volume (vph)</th>
<th>Sign</th>
<th>Channelized Right Turn</th>
</tr>
</thead>
<tbody>
<tr>
<td>Artery 1</td>
<td>EBL</td>
<td>3 &gt; 1</td>
<td>149</td>
<td>Free</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>EBT</td>
<td>&lt; 1</td>
<td>676</td>
<td>Free</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>EBR</td>
<td>1</td>
<td>147</td>
<td>Free</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>W3L</td>
<td>3 &gt; 1</td>
<td>44</td>
<td>Free</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>WBT</td>
<td>&lt; 1</td>
<td>635</td>
<td>Free</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>W3R</td>
<td>21</td>
<td>21</td>
<td>Free</td>
<td>Yes</td>
</tr>
</tbody>
</table>

### Diagram

- Artery 1
- Artery 2
S2—Exercise (User Guide, p. 91)

Transportation Operations Group

S.W. Military

Bay is 148' long

AM
L 13
T 52
R 74
Truck% 2

PM
L 19
T 68
R 150
Truck% 1

Bay is 91' long

AM
L 24
T 386
R 16
Truck% 3

PM
L 44
T 635
R 21
Truck% 1

Bay is 153' long

S. Presa

Bay is 126' long

AM
L 88
T 397
R 86
Truck% 3

PM
L 149
T 676
R 147
Truck% 1

Bay is 126' long

AM
L 113
T 85
R 45
Truck% 8

PM
L 113
T 80
R 49
Truck% 1

Bay is 91' long

Bay is 126' long

Bay is 153' long
**S2—Gap Acceptance**

- **Movement Ranks**
- **Process**
  - ✓ Observe Headways
  - ✓ Accept Gap
**S2—Channelized Rights**
S2—Two-Stage Process

Enter Storage Capacity
**S2—Two-Stage Process** (continued)

Enter Storage Capacity
S2—Flared Approaches

Specify How Many
S2–Model Parameters

- Critical Headway
- Follow-up Time
Session 3: Isolated Signals

- Overview of Theory
- PASSER V Input Data Needs
- Input Data Considerations
- Signal Exercise
S3–PASSER V Data Needs

• Turning Movement Counts (TMC)
  ✓ Collect 15-Minute Data and Calculate PHF
  ✓ AM, PM, and Off-Peak
  ✓ Collect Vehicle Mix Information

• Can Apply Growth Rates to Older Counts as Long as Traffic Patterns Haven’t Changed
S3–PASSE R V Data Needs
(continued)

- Number of Lanes
- Lane Use
- Lane Widths
- Turn Bays and Lengths
S3–Input Considerations

• Left-turn Treatment
  ✓ Number of Opposing Lanes
  ✓ Overlapping Turning Paths (may need to split phase)
  ✓ Type of Signal Heads (3, 4, or 5 Section)

• Pretimed, Semi-actuated, or Fully Actuated

• Priority or Preemption
S3–Performance Data

- Delay, Stops, Queue Information for Existing Conditions
- Collection Can Be Costly
**S3–NEMA Phase Numbering**

- **NEMA Dual-Ring Phasing** (leading lefts, no overlap)
  - Time:
    - 1
    - 2
    - 3
    - 4
    - 5
    - 6
    - 7
    - 8

- **Main Street Lead-Lag, Cross Street “Split Phased”**

- Diagram:
  - Main Street
  - Cross Street
  - Arrows indicating phase sequences
S3–Cycle Length vs. Delay and Capacity

- Critical Cycle Length, $C_c$
- Minimum-Delay Cycle Length, $C_m$

Delay/Capacity vs. Cycle Length
S3–Cycle Length vs. Delay and Stops
S3–Cycle Length vs. Delay

Delay Comparison

Queue
S3—Timing Isolated Signals

• Select Best Timings
  ✓ Cycle
  ✓ Splits (or max, min, gap setting)
  ✓ Clearance Intervals

• To Provide
  ✓ Safe
  ✓ Efficient Operation
S3—Safety Issues

- Space Conflicts inside Intersection
  - Use of Split Phasing
- Minimum Greens
  - Based on Driver Expectancy
- Vehicle Clearance Intervals
- Pedestrian Requirements
- Yellow Trap
**S3—Clearance Intervals**

- **Proper Settings Avoid a “Dilemma Zone”**

<table>
<thead>
<tr>
<th>Speed (mph)</th>
<th>Yellow Change sec (level grade)</th>
<th>Red Clearance sec (60' wide crossing)</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>2.84</td>
<td>2.18</td>
</tr>
<tr>
<td>35</td>
<td>3.57</td>
<td>1.55</td>
</tr>
<tr>
<td>45</td>
<td>4.31</td>
<td>1.21</td>
</tr>
<tr>
<td>55</td>
<td>5.04</td>
<td>0.99</td>
</tr>
<tr>
<td>65</td>
<td>5.78</td>
<td>0.84</td>
</tr>
</tbody>
</table>
**S3–Pedestrians**

\[ G_p = (4 \text{ to } 7 \text{ seconds}) + \frac{\text{Distance}}{W} \]

- **Pedestrians**
  - "WALK" Flashing "DON’T WALK"
  - 4 to 7 Distance / W
  - Minimum Pedestrian Time
- **Vehicles**
  - Min. Green
  - Minimum Vehicle Time
  - Yellow + All Red Clearance
- **Signal Timing**
  - "WALK" Flashing "DON’T WALK"
  - Vehicular Green
  - (Minimum Pedestrian Time Controls)

Location of yellow + all red depends on policy as to allowing pedestrian flashing “DON’T WALK” to occur simultaneously with vehicular clearance.
S3—Best Isolated Operation

• What is Good Operation?
  ✓ Minimum Delay
  ✓ Shortest Queues per Cycle
  ✓ Minimum Stops
  ✓ Compromised Combination

• User Decides Based on Situation
  ✓ Approach Speeds
  ✓ Traffic Counts
  ✓ Driver Perception
S3–Isolated Signal Exercise

• Draw an Isolated Signal
• Enter Data
• Analyze
### S3–Intersection Data

S.W. Military at S. Presa, San Antonio, Texas

#### AM
- **L**: 13
- **T**: 52
- **R**: 74
- **Truck%**: 2%

#### PM
- **L**: 19
- **T**: 68
- **R**: 150
- **Truck%**: 1%

#### AM
- **L**: 88
- **T**: 397
- **R**: 86
- **Truck%**: 3%

#### PM
- **L**: 149
- **T**: 676
- **R**: 147
- **Truck%**: 1%

#### Bay Dimensions
- Bay is 148' long
- Bay is 126' long
- Bay is 91' long
- Bay is 153' long

#### Additional Notes
- S.W. Military at S. Presa, San Antonio, Texas
- Transportation Operations Group
**S3—Data Entry**

- Draw Links
- Define Lanes
- Enter PM-peak Volumes
  - i.e., 149, 676, and 147 for EB
- Select Movement Type
  - EB and WB Prot (why?)
  - NB and SB Prot/Perm


S3—Data Entry (continued)

• Adjust Right-turn Volumes for RTOR
• Overlap (Yes for Lefts)
• Min Splits

✓ Peds if No Buttons (Assumed)

✓ EB, WB, NB, SB: 23, 23, 29, 29
✓ Clearance Times
S3—Data Entry (continued)

- Adjustments to Flows
- Trucks
- Ideal Saturation Flow
- Click Update Button
S3—Analysis/Results

- Delay vs. Cycle Analysis
- Controller: Ring-Barrier Display
- MOEs
Session 4: Signal Systems

• Overview:
  ✓ Engineering Theory
  ✓ Analysis Tools
S4–Flow Stability between Adjacent Systems

Min. Acceptable System Cycle Length

Signal 3: Highest v/c Ratio
Signal 2: Medium v/c Ratio
Signal 1: Lowest v/c Ratio
S4—Signal Offset and Flow between Adjacent Signals
S4—Flow vs. Bands
**S4—Effects of Changes in Offset**
S4—Cannot Get Two-way Bands? Change Phasing!
$S4$—Changing Phasing Can Improve 2-way Progression
S4—Yellow Trap

Demonstration of Lead-Lag “YELLOW TRAP”
S4—Yellow Trap (continued)
S4—Yellow Trap (continued)
S4–Timing Adjacent Signals

• Objectives of Coordination
  ✓ Provide/Maintain Safety
  ✓ Maintain Stable Flow
  ✓ Minimize Systemwide Delay
  ✓ Minimize Queues and Spillback
  ✓ Maximize System Throughput
  ✓ Minimize Number of Stops
  ✓ Maximize Arterial Progression
**S4—Types of Models**

- **Traffic Simulation Model**
  - Evaluates a Specified Scenario
  - Generates Performance Measures

- **Optimization Model**
  - Systematically Generates Scenarios
  - Evaluates Using Simulation
  - Selects the Best Scenario
  - Usually Applicable to Traffic Signals
**S4—Simulation Models**

- **Microscopic**
  - Keeps Track of Each Vehicle
  - Time Consuming

- **Mesoscopic**
  - Analyzes Flow Profiles
  - Faster Calculations

- **Macroscopic**
  - Analyzes Platoons
  - Fastest Calculations
**S4—Simulation Models** (continued)

- **Microscopic**
  - Keeps Track of Each Vehicle
  - Time Consuming

- **Mesoscopic**
  - Analyzes Flow Profiles
  - Faster Calculations

- **Macroscopic**
  - Analyzes Platoons
  - Fastest Calculations

- **Stochastic**

- **Deterministic**
**S4—Simulation Accuracy**

- **Realistic Queues**
  - ✓ Microscopic: CORSIM, Vissim, SimTraffic
  - ✓ Mesoscopic: new T7F, PASSER V, Synchro

- **Upward Queue Stack**
  - ✓ Mesoscopic: old T7F, S5 and P3
  - ✓ Macroscopic: P2, P4
S4—Spillback & Starvation
S4–Blocking and Starvation

Transportation Operations Group
S4—Blocking and Starvation
(continued)
S4–Starvation May Not Be Bad (Unused Capacity)
**S4—Optimization Criteria**

- Maximize Arterial Progression
- Minimize Systemwide Delay
- Minimize Stops
- Minimize Queues
- Maximize Throughput
- Minimize Blocking and Spillback
**S4—Magnitude of Problem**

**Fixed Cycle = 100 Sec**

1. **100 Plans**

2. **Depends**
   - 200, or
   - 10,000 Plans

3. **200 X 64 = 12,800 Plans**

**2-Phase Signals**

**3: 2a with Phase Optimization**
S4—Optimization Methods

- Exhaustive Search
- Smart Search Techniques
  - Hill-climbing
  - Heuristic
  - Mathematical Programming
  - Genetic Algorithms
- Most Signal-Timing Programs Use a Combination
Delay-Based

- Minimizes Delay (+Qs and Stops)
- Evaluates/Simulates Each Plan
- Examples:
  - TRANSYT 7F: Exhaustive, Hill-climbing, GA
  - Synchro: Exhaustive + Heuristic Search
  - PASSER III: Exhaustive Search
  - PASSER V: Exhaustive, GA
**S4—Optimization Tool Types (continued)**

- **Bandwidth-Based**
  - Maximizes Arterial Progression
    - Simple Objective Function
  - Simulates Traffic after Optimization
  - Examples:
    - PASSER II: Exhaustive and Heuristic
    - PASSER IV: Mathematical Programming
    - PASSER V: Exhaustive, Heuristic, GA
**S4–PASSER V Data Needs**

- Signal Spacing
- Link Speeds
- Types of Link

Intersection Spacing (in feet)

Stop bar

Intersection 1

Stop bar

Intersection 2
S4–Input Performance Data

• Speed, Travel Time, or Delay Information for Existing Conditions
• May Need to Measure Speed for Use in PASSER V
• Can Be Used to Calibrate or Validate Your Base Model
• Collection Can Be Costly
Session 5: Arterial Analysis

• Arterial Exercise 1
  ✓ Load and Review Data
  ✓ Apply Various Tools
  ✓ Review/Interpret Output

• Arterial Exercises 2 and 3
  ✓ TWSC Intersections
  ✓ Sub-nets
  ✓ Phasing Options
  ✓ Bandwidth-constrained Delay Minimization
  ✓ Adjusting Bands
S5–Arterial Exercise 1

S.W. Military Drive, San Antonio, Texas

* Assume all lanes at Somerset are 12' wide

New Laredo Highway

Bay is 161' long

Bay is 160' long

Bay is 168' long

Bay is 140' long

Bay is 145' long

3425'

* Texas Transportation Institute

Transportation Operations Group
**S5—Performance Measures**

- **Cycle Length, C**
- **Shortest green time among all the signals on A-direction, \( G_{\text{min}}(A) \)**
- **Bandwidth on A-direction, \( Band(A) \)**
- **Bandwidth on B-direction, \( Band(B) \)**
- **Shortest green time among all the signals on B-direction, \( G_{\text{min}}(B) \)**

\[
\text{Total Band} = Band(A) + Band(B)
\]

\[
\text{Efficiency} = \frac{\text{Total Band}}{2 \times C} \times 100
\]

\[
\text{Attainability} = \frac{\text{Total Band}}{G_{\text{min}}(A) + G_{\text{min}}(B)} \times 100
\]
**S5–NTCIP Coord Phase**

```
DIAL 1 SPLIT 1 PHASE PARAMETERS
PHASE......1...2...3...4...5...6...7...8
TIME 0 0 0 0 0 0 0 0
MODE 0 0 0 0 0 0 0 0
MODE: 0-ACTUATED 1-COORD PH 2-MIN REC
      3-MAX REC 4-PED REC 5-MX+P REC
      6-PH OMIT 7-DUAL COORD PHASE
A-UP B-DN C-LT D-RT E-ENTER F-PRIOR MENU
```

```
Spl-32 Ø...1...2...3...4...5...6...7...8 ->
Coor-Ø . X . . . . . .
Mode  NON MAX NON NON NON MAX NON NON NON
```
S5–NTCIP Coord Phase (continued)

Coordinate Phase: 2

Offset Reference Phase
S5–Offset Adjustments

- Lead-Lead Example
  - Offset 10 Sec
  - Phase 2

- Lag-Lead Example
  - Offset 10 Sec
  - Phase 2
### S5–Programming Sequences

<table>
<thead>
<tr>
<th>Seq#</th>
<th>Ring</th>
<th>Sequence of Phases</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>1 2 3 4 0 0 0 0</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>5 6 7 8 0 0 0 0</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td>0 0 0 0 0 0 0 0</td>
</tr>
<tr>
<td>1</td>
<td>4</td>
<td>0 0 0 0 0 0 0 0</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>1 2 3 4 0 0 0 0</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>6 5 7 8 0 0 0 0</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>0 0 0 0 0 0 0 0</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td>0 0 0 0 0 0 0 0</td>
</tr>
<tr>
<td>16</td>
<td>1</td>
<td>2 1 4 3 0 0 0 0</td>
</tr>
<tr>
<td>16</td>
<td>2</td>
<td>6 5 8 7 0 0 0 0</td>
</tr>
<tr>
<td>16</td>
<td>3</td>
<td>0 0 0 0 0 0 0 0</td>
</tr>
<tr>
<td>16</td>
<td>4</td>
<td>0 0 0 0 0 0 0 0</td>
</tr>
</tbody>
</table>
**S5—Programming Sequences**
(continued)

<table>
<thead>
<tr>
<th>PHASE</th>
<th>SEQUENCE</th>
<th>RING</th>
</tr>
</thead>
<tbody>
<tr>
<td>R1</td>
<td>01-02</td>
<td>03-04</td>
</tr>
<tr>
<td>R2</td>
<td>05-06</td>
<td>07-08</td>
</tr>
<tr>
<td>R3</td>
<td>00-00</td>
<td>00-00</td>
</tr>
<tr>
<td>R4</td>
<td>00-00</td>
<td>00-00</td>
</tr>
<tr>
<td>A-UP</td>
<td>B-DN</td>
<td>E-EDIT F-PRIOR MENU</td>
</tr>
</tbody>
</table>
## S5—Example Phase Sequences

<table>
<thead>
<tr>
<th>Sequence Name</th>
<th>Ring</th>
<th>Phase Order</th>
<th>Sequence # Eagle/Naztec</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lead-Lead</td>
<td>1</td>
<td>1 2 3 4</td>
<td>0/1</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>5 6 7 8</td>
<td></td>
</tr>
<tr>
<td>Lag-Lead</td>
<td>1</td>
<td>1 2 3 4</td>
<td>1/2</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>6 5 7 8</td>
<td></td>
</tr>
<tr>
<td>Lead-Lag</td>
<td>1</td>
<td>2 1 3 4</td>
<td>2/3</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>5 6 7 8</td>
<td></td>
</tr>
<tr>
<td>Lag-Lag</td>
<td>1</td>
<td>2 1 3 4</td>
<td>3/4</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>6 5 7 8</td>
<td></td>
</tr>
</tbody>
</table>
S5—How Genetic Algorithm (GA) Works

- Randomly Generate Population
- Perform Reproduction Operation
  ✔ Select Pairs/Parents and Generate Offspring
  
  ![Diagram showing parents and offspring]

- Evaluate Each Using Simulation
  ✔ Note Population Has Doubled
S5—How GA Works (continued)

- Keep Best Half of New Population

Parents

Offspring

- Perform Mutation Operation

Next
Generation
S5—How GA Works (continued)

- Stop If
  - No Improvement Possible or Maximum Generations Reached
  - Report the Best Plan

- Else
  - Repeat Process
S5–Arterial Exercise 2
S5—More Theory

• Handling of TWSC Intersections on Arterial
  ✓ Upstream Signals
    » Platoon Dispersion
  ✓ Handling in Various Tools
    » PASSER II
    » Other Tools (Except P3)
S5–Arterial Exercise 3

SH 71, Bastrop, Texas
S5—Bandwidth vs. Efficiency

Total Band (sec) vs. Total Efficiency (%) for different cycle lengths.
S5—Delay and Attainability

- Total Band (sec)
- Total Efficiency (%)
- Total Attainability (%)
- Avg. Delay (sec/veh)
S5—Tradeoffs in Performance

- Total Band (sec)
- Total Efficiency (%)
- Total Attainability (%)
- Avg. Delay (sec/veh)
Session 6: Diamond Interchange Analysis

- Background and Operational Issues
- Diamond Exercise
  - Create Interchange
  - Apply Optimization Tools and View Output
    - PASSER III
    - GA-Based Optimizer
- Apply Other Tools
  - Volume Analysis
  - Time-Space Diagram
  - Delay Analysis
S6—Background on Diamonds

• Two Closely Spaced Intersections
• Flow Characteristics Very Different from Arterials
  ✓ Significant Turning Traffic
• Types
  ✓ Conventional (More than 800 ft)
  ✓ Compressed (400-800 ft)
  ✓ Tight (Less than 400 ft)
S6—Background on Diamonds

(continued)

- Often Experience Operational Problems
- Capacity Dependent on
  - Splits at Both Intersections
  - Queuing and Spillback
- TxDOT/Texas Diamond Controller
  - Basic Three-Phase
  - TTI Four-Phase
  - Separate Intersection Mode
S6–NEMA Phase Numbering

- Overlap A ($\phi_1 + \phi_2$
- Overlap B ($\phi_5 + \phi_6$

$\phi_X$ - NEMA Phase
S6—Three-Phase Operation

or

Lag-Lag
S6—Four-Phase Operation

- Lead-Lead Phasing
- Phase Times and Offset Calculated Simultaneously
- Needs Longer Cycle
S6—Other Options

• Separate Intersection Control under Diamond Mode
  ✓ Restricted to Lead-Lead Phasing
  ✓ Can Provide Ring-lag/Offset

• User Programmed Mode
  ✓ Difficult Programming
  ✓ Flexibility of Operation

• Use Two Controllers
**S6–Phasing Selection Guidelines**

- **Conventional Diamonds**
  - ✓ Three-Phase
  - ✓ Four-Phase Not Recommended
- **Compressed Diamonds**
  - ✓ Three-Phase with Short Cycle
  - ✓ Four-Phase
- **Tight Diamonds**
  - ✓ Four-Phase
  - ✓ Three-Phase for Light Traffic
S6–Diamond Exercise (User Guide, p. 119)

- Speed = 40 mph
- Bay Length = 300 ft
- All lanes 12 ft

SH 6 (East Bypass)

Protected + Permitted

Protected Only

Harvey Rd.

720 ft

Transportation Operations Group
S6—Data Entry/Analysis

- Draw Links/Define Interchange
- Load Data
- Select Tool and Analyze
- Review Results
S6—More Tools in PASSER V

- Volume Analysis
- Time-Space Diagram
- Delay Analysis
Session 7: Diamond and Adjacent Signals

• Exercise Using Existing Data
• Apply Various Tools
• Review Output
S7–SH 195 Data

Interchange
Session 8: Workshop Conclusion

• Additional Topics and QA Session
  ✓ Any Features Not Covered
  ✓ Networks

• Survey
  ✓ Tell Us How We Did
  ✓ Feedback about PASSER V