Texas Diamond Signalized Operations

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Texas Diamond Signal Operations

- Used exclusively for diamond interchanges with both ramps signalized.
- Developed at Tx DOT and refined by TTI.
- Two variations – 3 Phase & 4 Phase
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- The “usual” ODOT method
  - 2 signals therefore 2 controllers

- The “sometimes” ODOT method
  - 2 signals and 1 controller

- Texas Diamond = 2 signals & 1 controller
  - So what’s the big deal – why Texas Diamond?
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- Start with why “NOT” 2 controllers
  - Cannot control phases being skipped or gapping out.
  - This causes traffic to enter the interchange when it’s “not supposed to”
  - Can lock up the middle
- Cannot precisely control which phases are running at the same time at each intersection.
- Requires two offsets to adjust when timing plans change
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- 2 Intersections & 1 Controller
  - Can control the relationship of phases at both intersections.
  - Only 1 offset to adjust during timing plan changes
  - Basic controller/detector logic
  - Usually better than 2 controllers – except when you have a malfunction – both go on flash
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- 2 Intersections & 1 Controller (Texas Diamond)
  - Can control the relationship of phases at both intersections.
  - Very complicated detector and phase logic required.
  - Good news – the logic is “built” into the controller.

- Goal is to have heavy movements moving simultaneously.

- Travel time used to strategically start movements.

- 4 Phase can keep middle clear of cars.
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3 Phase or 4 Phase???

- **3 Phase - Most Effective When:**
  - Wide Interchanges 400’ + spacing (Adequate Internal Storage). Can stop people in middle.
  - Rural Areas with Light Overall Traffic
  - Heavy Through Movements
  - Does have simultaneous arterial green at both signals
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3 Phase or 4 Phase???

- **4 Phase Most Effective When**
  - Closely Spaced (less 400’ or inadequate storage in middle).
  - 4 phase stores ZERO cars in the middle unless over capacity.
  - Heavy ramp movements.
  - Only stop one time in the interchange
  - **Good way to avoid widening some bridges because of storage**
  - Note – does NOT have simultaneous arterial greens
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How do you analyze??

- Passer 3: Sole purpose is to analyze Texas Diamond operations.
- If coordinating interchange – figure out in Passer then input results into Synchro to include the other signals.
- Synchro 7.0 has a Texas Diamond “template”
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- Note – 3 Phase Texas Diamond typically has much shorter cycle lengths than 2 intersections + 2 controllers. Potential cycle length incompatibility for coordinated system.
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- Loops – placement is defined by the operation.
- Detector & Phase Logic – defined by the operation.
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Loops
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**LOOPS – 3 Phase**

<table>
<thead>
<tr>
<th>Detector Number</th>
<th>Associated Phase</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>Presence detector: Calls and Extends Phase 1</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>Setback detector: Extends Phase 2</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>Setback detector: Extends Phase 3</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>Setback detector: Extends Phase 4</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
<td>Presence detector: Calls and Extends Phase 5</td>
</tr>
<tr>
<td>6</td>
<td>6</td>
<td>Setback detector: Extends Phase 6</td>
</tr>
<tr>
<td>7</td>
<td>7</td>
<td>Setback detector: Extends Phase 7</td>
</tr>
<tr>
<td>8</td>
<td>8</td>
<td>Setback detector: Extends Phase 8</td>
</tr>
<tr>
<td>9</td>
<td>1</td>
<td>Calls phase 1 during phase 3 or 4; Extends phase 1 if phase 3 or 4 call exists</td>
</tr>
<tr>
<td>10</td>
<td>1</td>
<td>Calls phase 1 during phase 3 or 4; Extends phase 1 if phase 3 or 4 call exists</td>
</tr>
<tr>
<td>11</td>
<td>2</td>
<td>Stopbar detector: Calls Phase 2</td>
</tr>
<tr>
<td>12</td>
<td>4</td>
<td>Stopbar detector: Calls Phase 4</td>
</tr>
<tr>
<td>13</td>
<td>5</td>
<td>Calls phase 5 during phase 7 or 8; Extends phase 5 if phase 7 or 8 call exists</td>
</tr>
<tr>
<td>14</td>
<td>5</td>
<td>Calls phase 5 during phase 7 or 8; Extends phase 5 if phase 7 or 8 call exists</td>
</tr>
<tr>
<td>15</td>
<td>6</td>
<td>Stopbar detector: Calls Phase 6</td>
</tr>
<tr>
<td>16</td>
<td>8</td>
<td>Stopbar detector: Calls Phase 8</td>
</tr>
<tr>
<td>17</td>
<td>3</td>
<td>Stopbar detector: Calls Phase 3</td>
</tr>
<tr>
<td>18</td>
<td>7</td>
<td>Stopbar detector: Calls Phase 7</td>
</tr>
</tbody>
</table>
# Texas Diamond Signal Operations

## LOOPS – 4 Phase

<table>
<thead>
<tr>
<th>Detector Number</th>
<th>Associated Phase</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>Calls phase 6 if overlap A is not green and phase 7 or 8 is not called. Extends intervals 2516B, 2517B, 2518B, 4517B, 4518B, 3517B, and 3518B.</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>Setback detector: Extends Phase 2</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>Setback detector: Extends Phase 3</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>Setback detector: Extends Phase 4</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
<td>Calls phase 2 if overlap B is not green and phase 3 or 4 is not called. Extends intervals 1625B, 1635B, 1645B, 1735B, 1745B, 1835B, and 1845B.</td>
</tr>
<tr>
<td>6</td>
<td>6</td>
<td>Setback detector: Extends Phase 6</td>
</tr>
<tr>
<td>7</td>
<td>7</td>
<td>Setback detector: Extends Phase 7</td>
</tr>
<tr>
<td>8</td>
<td>8</td>
<td>Setback detector: Extends Phase 8</td>
</tr>
<tr>
<td>9 / 10</td>
<td>1</td>
<td>Extends phase 2 if phase 3 or 4 is called. Calls phase 6 if overlap A, if not green and phase 7 or 8 is not called.</td>
</tr>
<tr>
<td>11</td>
<td>2</td>
<td>Stopbar detector: Calls Phase 2</td>
</tr>
<tr>
<td>12</td>
<td>4</td>
<td>Stopbar detector: Calls Phase 4</td>
</tr>
<tr>
<td>13 / 14</td>
<td>5</td>
<td>Extends phase 6 if phase 7 or 8 is called. Calls phase 2 if overlap B, if not green and phase 3 or 4 is not called.</td>
</tr>
<tr>
<td>15</td>
<td>6</td>
<td>Stopbar detector: Calls Phase 6</td>
</tr>
<tr>
<td>16</td>
<td>8</td>
<td>Stopbar detector: Calls Phase 8</td>
</tr>
<tr>
<td>17</td>
<td>3</td>
<td>Stopbar detector: Calls Phase 3</td>
</tr>
<tr>
<td>18</td>
<td>7</td>
<td>Stopbar detector: Calls Phase 7</td>
</tr>
</tbody>
</table>
Conditional Service Intervals

3 Phase

Conditional Service Intervals
**4 Phase**

**Transition Interval 1+8 to 2+5 (Interval 2 + 8):**
This interval begins when phase 8 gaps out or maxes out and runs for the travel time entered in the timing plan. It allows the frontage road to continue while the opposite arterial is entering the interchange, thereby not wasting green time.

**Interval 2+5:**
This interval is driven by the arterial (phase 2). When phase 2 gaps out or maxes out, the arterial will go through a yellow and red clear but the right interior will stay green.

**Interval 4+5:**
This interval is driven by the frontage road (phase 4). The setback detectors on the frontage road will allow this interval to gap out while vehicles are still a travel time away from the intersection.

**Transition Interval 4+5 to 1+6 (Interval 4 + 6):**
This interval begins when phase 4 gaps out or maxes out and runs for the travel time entered in the timing plan.

**Interval 1+6:**
This interval is driven by the arterial (phase 6). When phase 6 gaps out or maxes out, the arterial will go through a yellow and red clearance but the left interior will stay green.

**Interval 1+8:**
This interval is driven by the frontage road (phase 8). The setback detectors on the frontage road will allow this interval to gap out while vehicles are still a travel time away from the intersection.
Controller Logic

Both the detector logic and controller logic (for both 3 & 4 phase) is “pre-programmed into the controller. Eagle currently pre-approved by Tx – Econolite is being reviewed.
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Just fill in the timing intervals
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- The “RULES”:
  - If you don’t change the number of lanes OR the lane use you do NOT need to do an IMS.
  - You can extend turn lanes up to the L&D Manual maximums.
  - If you extend the existing turn lanes – you must document what you did.
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Summary:
- Texas Diamond can potentially improve signalized operations at diamond interchanges.
- Tx spec’s makes programming as easy as possible (template in the controller)
- Should use Passer 3 to analyze
- ODOT plan insert sheets require that you only “fill in the blanks” for the timing intervals.
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QUESTIONS???