Topic 2

(Chapter 16)

Intersection Control
Intersection Control

Hierarchy of intersection control

- Unsignalized
  - Uncontrolled
  - Yield
  - Stop controlled
    - TWSC
    - AWSC
  - Roundabout

- Signalized
Traffic Signals

- Is signal control always better?
  - Advantages
  - Disadvantages

- MUTCD Signal Warrants
  - What does a warrant mean?
  - Eight signal warrants (pp.455 – 462)
    - #1: Eight-hour vehicular volume
    - #2: Four-hour vehicular volume
    - #3: Peak-hour vehicular volume
    - #7: Crash experience
    - Other (#4, #5, #6, #8)
Signal Warrants

- **Warrant #1: Eight-hour vehicular volume**
  - Volume: Major - both directions; Minor - highest approach
  - Any 8 hour, but the same period for both streets
  - Two conditions: A, B
    - Either A or B at 100% level
    - Either A or B at 70% level with rural communities
    - Both A and B at 80% level
### Table 4C-1. Warrant 1, Eight-Hour Vehicular Volume

**Condition A - Minimum Vehicular Volume**

<table>
<thead>
<tr>
<th>Number of lanes for moving traffic on each approach</th>
<th>Vehicles per hour on major street (total of both approaches)</th>
<th>Vehicles per hour on higher-volume minor-street approach (one direction only)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Major Street</td>
<td>Minor Street</td>
<td>100%$^a$       80%$^b$       70%$^c$</td>
</tr>
<tr>
<td>1.............. 1..............</td>
<td>500            400            350</td>
<td>150            120            105</td>
</tr>
<tr>
<td>2 or more... 1..............</td>
<td>600            480            420</td>
<td>150            120            105</td>
</tr>
<tr>
<td>2 or more... 2 or more...</td>
<td>600            480            420</td>
<td>200            160            140</td>
</tr>
<tr>
<td>1.............. 2 or more....</td>
<td>500            400            350</td>
<td>200            160            140</td>
</tr>
</tbody>
</table>

**Condition B - Interruption of Continuous Traffic**

<table>
<thead>
<tr>
<th>Number of lanes for moving traffic on each approach</th>
<th>Vehicles per hour on major street (total of both approaches)</th>
<th>Vehicles per hour on higher-volume minor-street approach (one direction only)</th>
</tr>
</thead>
<tbody>
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<td>Major Street</td>
<td>Minor Street</td>
<td>100%$^a$       80%$^b$       70%$^c$</td>
</tr>
<tr>
<td>1.............. 1..............</td>
<td>750            600            525</td>
<td>75             60             53</td>
</tr>
<tr>
<td>2 or more... 1..............</td>
<td>900            720            630</td>
<td>75             60             53</td>
</tr>
<tr>
<td>2 or more... 2 or more...</td>
<td>900            720            630</td>
<td>100            80             70</td>
</tr>
<tr>
<td>1.............. 2 or more....</td>
<td>750            600            525</td>
<td>100            80             70</td>
</tr>
</tbody>
</table>

$^a$ Basic minimum hourly volume.

$^b$ Used for combination of Conditions A and B after adequate trial of other remedial measures.

$^c$ May be used when the major street speed exceeds 70 km/h (40 mph) or in an isolated community with a population of less than 10,000.
Signal Warrants

- **Warrant #2: Four-hour vehicular volume**
  - Volume: Major - both directions; Minor - highest approach
  - Any 4 hour, but the same period for both streets
  - 100% level and 70% level (rural)
  - A minimum minor street volume threshold
Figure 4C-1. Warrant 2 - Four-Hour Vehicular Volume

MAJOR STREET - TOTAL OF BOTH APPROACHES - VPH

*Note: 115 vph applies as the lower threshold volume for a minor street approach with two or more lanes and 80 vph applies as the lower threshold volume for a minor street approach with one lane.
Figure 4C-2. Warrant 2 - Four-Hour Vehicular Volume (70% Factor)
(COMMUNITY LESS THAN 10,000 POPULATION OR ABOVE 70 km/h (40 mph) ON MAJOR STREET)

MAJOR STREET - TOTAL OF BOTH APPROACHES - VPH

*Note: 80 vph applies as the lower threshold volume for a minor street approach with two or more lanes and 60 vph applies as the lower threshold volume for a minor street approach with one lane.
Signal Warrants

- Warrant #3: Peak-hour
  - Volume Warrant
    - Similar to 4-hour volume
  - Delay Warrant (Stop Control) – All 3 Conditions
    - Minor Approach Delay: 4 veh-hr (one lane); 5 veh-hr (two lanes)
    - Minor Approach Volume: 100 vph (one lane); 150 vph (two lanes)
    - Total Entering Volume: 650 vph (3 leg); 800 vph (4 leg)
Figure 4C-3. Warrant 3 - Peak Hour

MAJOR STREET - TOTAL OF BOTH APPROACHES - VPH

*Note: 150 vph applies as the lower threshold volume for a minor street approach with two or more lanes and 100 vph applies as the lower threshold volume for a minor street approach with one lane.
Figure 4C-4. Warrant 3 - Peak Hour (70% Factor)
(Community less than 10,000 population or above 70 km/h (40 mph) on major street)

Major Street - Total of both approaches - VPH

*Note: 100 vph applies as the lower threshold volume for a minor street approach with two or more lanes and 75 vph applies as the lower threshold volume for a minor street approach with one lane.
Peak Hour Delay
(Single-Lane, 4 veh-hr)
Signal Warrant Example

East-west is the major street with two lanes on each direction. North-south is the minor street with one lane on each direction. Determine if the intersection meets the 4-hr volume warrant.

<table>
<thead>
<tr>
<th>Time</th>
<th>Major Street Volume, vph</th>
<th></th>
<th>Minor Street Volume, vph</th>
<th></th>
<th>Highest</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>EB</td>
<td>WB</td>
<td>Total</td>
<td>NB</td>
<td>SB</td>
</tr>
<tr>
<td>11 am-12</td>
<td>400</td>
<td>425</td>
<td>825</td>
<td>75</td>
<td>80</td>
</tr>
<tr>
<td>12-1PM</td>
<td>450</td>
<td>465</td>
<td>915</td>
<td>85</td>
<td>85</td>
</tr>
<tr>
<td>1-2 PM</td>
<td>485</td>
<td>500</td>
<td>985</td>
<td>90</td>
<td>100</td>
</tr>
<tr>
<td>2-3 PM</td>
<td>525</td>
<td>525</td>
<td>1050</td>
<td>110</td>
<td>115</td>
</tr>
<tr>
<td>3-4 PM</td>
<td>515</td>
<td>525</td>
<td>1040</td>
<td>100</td>
<td>95</td>
</tr>
<tr>
<td>4-5 PM</td>
<td>540</td>
<td>550</td>
<td>1090</td>
<td>90</td>
<td>100</td>
</tr>
<tr>
<td>5-6 PM</td>
<td>550</td>
<td>580</td>
<td>1130</td>
<td>110</td>
<td>125</td>
</tr>
<tr>
<td>6-7 PM</td>
<td>545</td>
<td>528</td>
<td>1070</td>
<td>96</td>
<td>103</td>
</tr>
<tr>
<td>7-8 PM</td>
<td>505</td>
<td>506</td>
<td>1011</td>
<td>90</td>
<td>95</td>
</tr>
<tr>
<td>8-9 PM</td>
<td>485</td>
<td>490</td>
<td>975</td>
<td>85</td>
<td>75</td>
</tr>
<tr>
<td>9-10 PM</td>
<td>475</td>
<td>475</td>
<td>950</td>
<td>75</td>
<td>60</td>
</tr>
<tr>
<td>10-11 PM</td>
<td>400</td>
<td>410</td>
<td>810</td>
<td>50</td>
<td>55</td>
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**Figure 4C-1. Warrant 2 - Four-Hour Vehicular Volume**

- **Major Street - Total of Both Approaches - VPH**
  - *Note: 115 vph applies as the lower threshold volume for a minor street approach with two or more lanes and 80 vph applies as the lower threshold volume for a minor street approach with one lane.*
Signal Warrants

- **Warrant #7: Crash experience**
  - Five or more crashes in a year
  - Warrant 1A or 1B at 80% level
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Detailed information about the MUTCD can be found in Chapter 4

Four Categories

- **Standard** – “Shall”
- **Guidance** – “Should”
- **Option** – “May be”
- **Support** – Fact
Traffic Signs

- Regulatory signs
- Warning signs
- Guide signs
Regulatory Signs – Right of Way

- STOP (R1-1)
- 4-WAY (R1-3)
- ALL WAY (R1-4)
- YIELD (R1-2)
- DO NOT ENTER (R5-1)
- WRONG WAY (R5-1a)
- ONE WAY (R6-1)
- ONE WAY (R6-2)
- NO TURNS (R3-3)
- R3-1
- R3-2
- Sect. 2B.15 to 2B.17
Regulatory Signs – Speed Limit

R2-4

MINIMUM SPEED 40 km/h

OR

R2-4a

SPEED LIMIT 50 km/h

MINIMUM 30 km/h

R2-4

MINIMUM SPEED 60 km/h

OR

R2-4a

SPEED LIMIT 80 km/h

MINIMUM 50 km/h
Regulatory Signs – Lane Use

- R3-5: ONLY
- R3-5a: ONLY
- R3-6: OR
- R3-8: ONLY
- R3-8a: ONLY
- R3-8b: ONLY
Warning Signs – Horizontal Change

W1-1
W1-2
W1-3
W1-4
W1-5
W1-6
W1-8
W1-10
W1-11
W1-13
W1-15
OR
W1-1a
OR
W1-2a
Warning Signs – Vertical Change

W7-1
W7-1a
W7-1b
W7-2
W7-2b
W7-3

W7-3a
W7-3b

W7-4
W7-4a
W7-4b
W7-4c
W7-4d
W7-4e
W7-4f

W7-6
Warning Signs – Advance Traffic Control

W3-1*  W3-2*  W3-3*  W3-4
BUMP  DIP  PAVEMENT ENDS  BE PREPARED TO STOP
W8-1  W8-2  W8-3  W8-4
LOOSE GRAVEL  ROUGH ROAD  SOFT SHOULDER
W8-5  W8-7  W8-9
SHOULDER DROP OFF  NO CENTER STRIPE  BRIDGE ICES BEFORE ROAD
W8-9a  W8-12  W8-13  W17-1
SPEED HUMP
Warning Signs – Others
Guide Signs

Phoenix 1 MILE

WEIGH STATION NEXT RIGHT

Bus

Fishing boat

Fishing line and hook

Fish

Boat
Dynamic Message Signs (DMS)