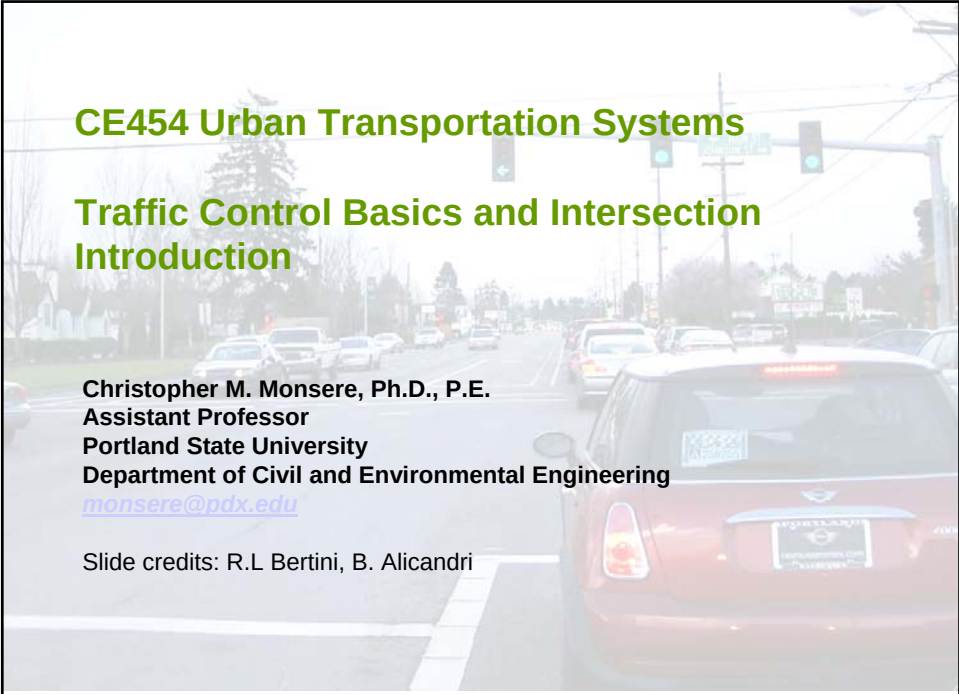




CE454 Urban Transportation Systems

Traffic Control Basics and Intersection Introduction

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Urban Transportation Systems



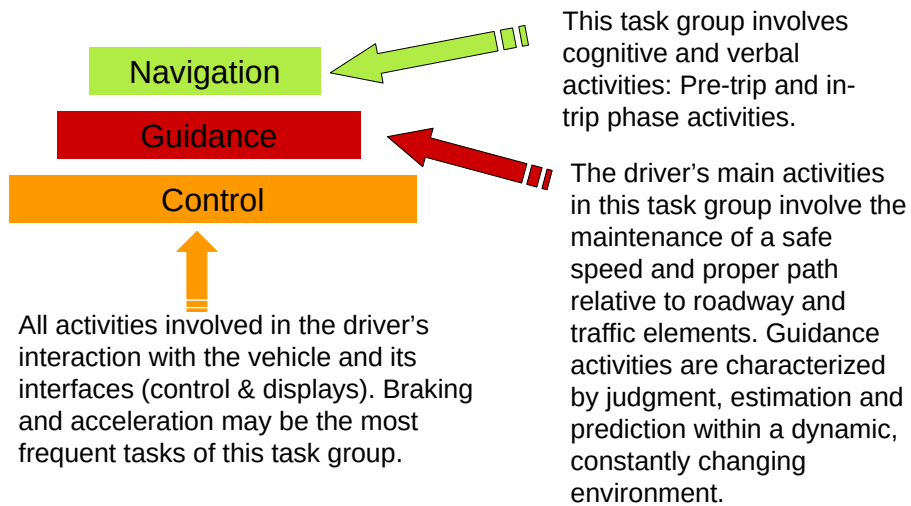
Background

- CE 351 left off dealing with capacity and level of service for uninterrupted flow facilities
 - freeways, rural two lane highways
- Next look at interrupted flow facilities
- First must understand design and control principles of intersections

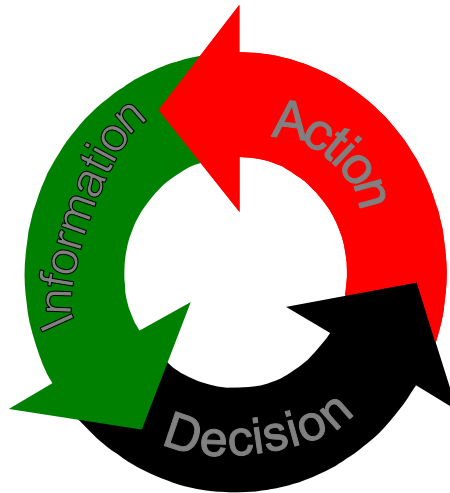
Today

- Driving model and human factors
- Traffic control
- Signs / markings
- Types of intersections
- Warrants

Elements of the driving task



Human Skills and Capabilities - Driving Task Model

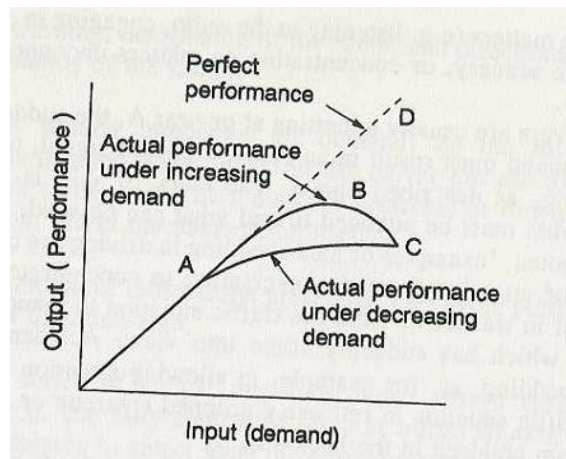


Driver's information handling

- Mostly visual data acquisition
- “Time-sharing” processing
- Short-term memory (30sec) and long-term memory storage
- Primacy (relative importance) of information prioritize the pieces of information given

At any instant, drivers generally gather information from more than one source, establish priorities relative to what information to attend to and process, make decisions, and perform control actions – often under a time pressure

Information Processing



Driver expectancy

- Expectancy: relating to a driver's readiness to respond to situations, events, and information in predictable and successful ways.
 - A priori expectancy: widely held expectancies (based on a life-time experience and habit)
 - Ad hoc expectancy: short-term location and site specific, formulated while traversing a given geographic area
- Expectancy influences the speed and accuracy of driver information processing
 - Violated expectancies lead to longer reaction time, confusion, inappropriate responses, and errors.
 - It is a major factor in design, operation, and traffic control.

Specific information display techniques

Spreading	Reduce the chance of overload at high processing demand locations by moving lower primacy information sources upstream or downstream
Coding and chunking	Coding: Translates verbal information to drivers into symbols (Color, shape, and number) Chunking: Merging two or more codes into larger units
Repetition	Repeat the same information in the same format A subset of redundancy
Redundancy	Give the same kind of information in more than one way or more than one carrier
Navigation information presentation aids	Mid-block signs, trail blazers Navigation aids like variable message signs ITS – in-vehicle navigation equipment, kiosks, etc.

We want to avoid this...



Traffic Control Devices

- Control may be achieved by using traffic signals, signs, markings, or markers that regulate, guide, warn, and/or channel traffic.
- Manual on Uniform Traffic Control Devices (MUTCD)
 - Detailed standards for the physical design of the device, covering size, shape, colors, legend types, and specific legend.
 - Detailed standards and guidelines on where devices should be physically located or placed in relationship to the roadway.
 - Warrants, or conditions which justify, the use of a particular device.
 - History
 - 1927 for Rural Roads
 - 1930 for Urban Streets
 - 1935 – 1st MUTCD



Traffic Control Devices

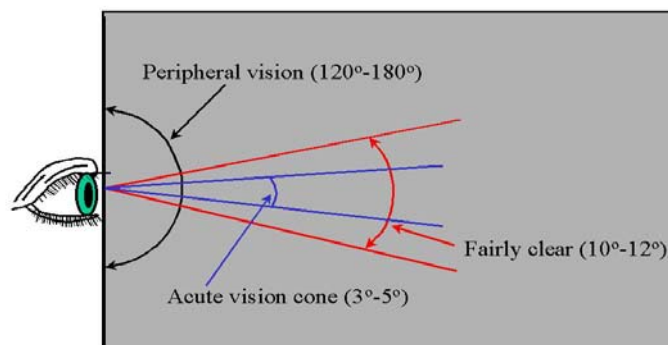
- Requirements to make a traffic control device effective:
- Fulfill a need
 - Place proper device, only the one needed
- Command attention
 - Make device stand out by color, shape, etc. (design)
- Convey a clear simple meaning
 - Do not confuse driver with wordy legends; only one instruction per device. (design)
- Command the respect of road users
 - When you place it, you really mean it. (placement)
- Give adequate time for proper response
 - Make it visible well in advance of decision point (placement)



Control Devices

- Design
 - color, size & shape to meet requirements above
- Placement
 - within cone of clear vision,
- Operation
 - right device at the right place
- Maintenance
 - to maintain legibility
- Uniformity
 - provide uniformity in use of control devices

Visual Field - Cone of Vision



Sign Classifications

- Regulatory Signs
- Warning Signs
- Guide Signs



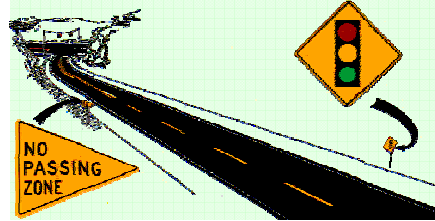
Regulatory Signs

- Inform roadway users of traffic laws or regulations and indicate the applicability of legal requirements that would not otherwise be apparent.



Warning Signs

- Used to call attention to conditions on, or adjacent to, a highway or street that are potentially hazardous to traffic operations.



Guide Signs

- Show route designation, destinations, directions, distances, services, points of interest, and other geographical, recreational, and cultural information.



Design

- Sign
 - Shape
 - Color
 - Message content and format
 - Dimensions (letter height)
 - Illumination and reflectorization
- Placement on roadway

Shapes

- Octagon
- Triangle
- Round
- Pennant
- Diamond
- Shield
- Rectangle (portrait)
- Rectangle (landscape)
- Trapezoid
- Pentagon (point up)
- Crossbuck



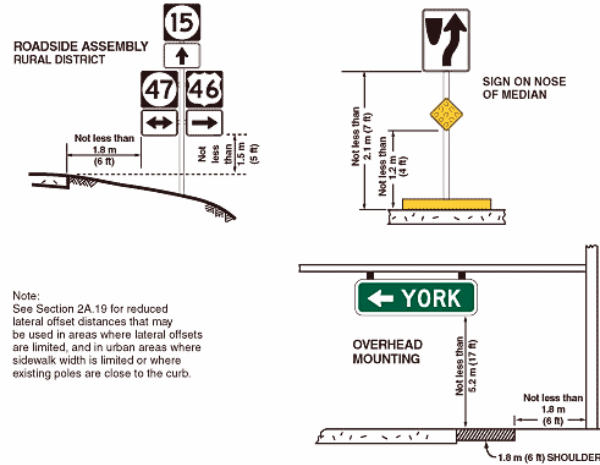
Sign Colors

- **Red**
- **Green**
- **Yellow**
- **Blue**
- **Fluorescent Yellow-Green**
- **Brown**
- **Orange**
- **Black**
- **White**
- **Fluorescent Pink**

Placement of Signs

- A regulatory sign normally is placed where its mandate or prohibition applies
- A warning sign is placed in advance of the condition to which it calls attention
- Guide signs are placed to keep drivers informed on the route to their destination

Placement of Signs



Typical Locations Hazards for Warning Signs

- Changes in horizontal alignment
- Intersections
- Advance warning or control devices
- Converging traffic lanes
- Narrow roadways
- Changes in highway design
- Grades
- Roadway surface conditions
- Railroad crossings
- Entrances and crossings
- Miscellaneous

Placement of Warning Signs

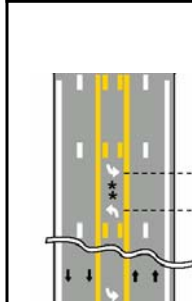
Table 2C-4. Guidelines for Advance Placement of Warning Signs
(English Units)

Posted or 85th- Percentile Speed	Condition A: Speed reduction and lane changing in heavy traffic ²	Advance Placement Distance ¹							
		Condition B: Deceleration to the listed advisory speed (mph) for the condition ³							
		0 ⁴	10	20	30	40	50	60	70
20 mph	225 ft	N/A ⁵	N/A ⁵	—	—	—	—	—	—
25 mph	325 ft	N/A ⁵	N/A ⁵	N/A ⁵	—	—	—	—	—
30 mph	450 ft	N/A ⁵	N/A ⁵	N/A ⁵	—	—	—	—	—
35 mph	550 ft	N/A ⁵	N/A ⁵	N/A ⁵	N/A ⁵	—	—	—	—
40 mph	650 ft	125 ft	N/A ⁵	N/A ⁵	N/A ⁵	—	—	—	—
45 mph	750 ft	175 ft	125 ft	N/A ⁵	N/A ⁵	N/A ⁵	—	—	—
50 mph	850 ft	250 ft	200 ft	150 ft	100 ft	N/A ⁵	—	—	—
55 mph	950 ft	325 ft	275 ft	225 ft	175 ft	100 ft	N/A ⁵	—	—
60 mph	1100 ft	400 ft	350 ft	300 ft	250 ft	175 ft	N/A ⁵	—	—
65 mph	1200 ft	475 ft	425 ft	400 ft	350 ft	275 ft	175 ft	N/A ⁵	—
70 mph	1250 ft	550 ft	525 ft	500 ft	425 ft	350 ft	250 ft	150 ft	—
75 mph	1350 ft	650 ft	625 ft	600 ft	525 ft	450 ft	350 ft	250 ft	100 ft

Markings

- Purposes:
 - Delineate the movement of traffic
 - Provide the public with a multiple message with appropriate redundancy and reinforcement of other controls (e.g., no-passing zones)
- Placement
 - Placed directly on the pavement
 - Reflectorized if they must be visible at night unless adequately illuminated

Types of Lines



1. A normal, broken white line
2. A normal, broken yellow line
3. A normal, solid white line
4. A double solid white line
5. A double line consisting of a normal, broken yellow line and a normal, solid yellow line
6. A double line consisting of two normal solid lines
7. A double, normal, broken yellow line
8. A normal dotted line (the same color as the line it extends)
9. A solid yellow line

- Shoulder markings, word & symbol markings, stop lines, crosswalk lines, parking space markings, etc. → White
- Transverse edge lines for crosswalk near school buildings and grounds → Yellow
- Markings visible to only those in the wrong direction may be → Red

Curb markings

Delineation and parking regulations → Red and White

Intersection Philosophy

- Minimize potential conflicts
 - Vehicles—all modes
 - Pedestrians
 - Bicyclists
- Considerations
 - Human
 - Driving habits, decision/reaction time
 - Traffic
 - Demand, capacities, turning movements, delay, vehicle speeds, size and types of vehicles
 - Physical
 - Adjacent property, sight distance, geometric features, aesthetics, air quality, environmental
 - Economic
 - Cost, benefits, energy consumption

Hierarchy of Intersection Control

- Passive control – basic rules of the road apply
 - No control
 - Guide signs only
 - Warning signs with or without guide signs
- Assignment of ROW to major street or rotational ROW
 - YIELD control
 - Two-way STOP control
 - All-way STOP control
- Positive alternate assignment of exclusive ROW
 - Traffic signals: 2-phase, multiphase
- Remove ROW conflict
 - Grade Separation

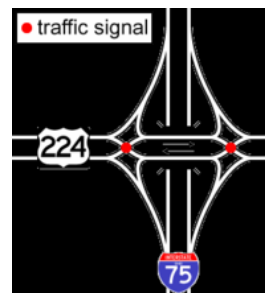
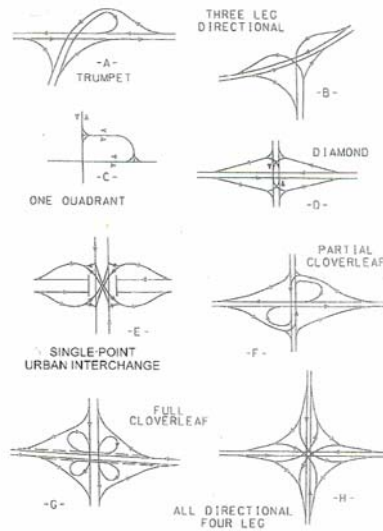
Types of Intersections

- At-grade
 - Three leg
 - Four leg (simplest: two one way streets)
 - Multi-leg
 - Rotary
 - Roundabout
- Grade separation
 - Crossing separated without connection
- Interchange
 - Diamond (also tight diamond)
 - Urban (single point urban)
 - Directional
 - Cloverleaf
 - Partial Cloverleaf (parclo)
 - Trumpet

Roundabouts vs Rotary

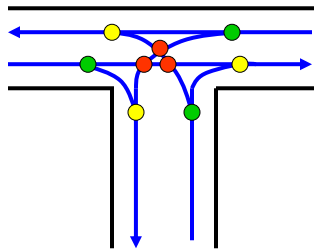


Interchange Types



Conflict Points at Unsignalized Intersections

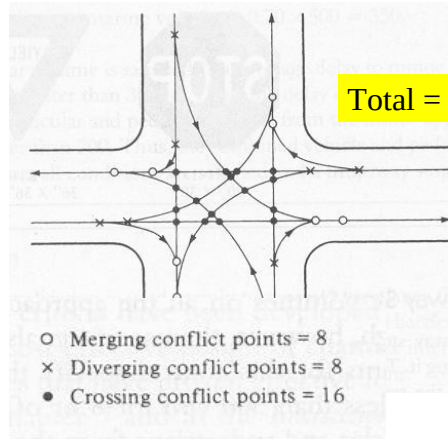
T intersection



- Crossing = 3
- Merging = 3
- Diverging = 3

Total = 9

4-leg intersection



Total = 32

Design Parameters

- Type of intersection control
- Number of lanes
- If signal, many signal parameters
- Accommodate all users (cars, bus, bike, ped)
- Operations
 - Delay
 - Safety