Right Sizing Streets for People and Development

Kevin St. Jacques, P.E., PTOE, PTP

Randall Entz, AICP

Wendy Shabay, AICP
Objectives

This session focuses on balancing traffic engineering with urban design to create streets that function well for all users of the corridor.

More than just complete streets, our streets must work as a network of passageways that collectively serve the needs of the local community including daily commuting, commerce, deliveries, and special events.
Outline

- Overview of Complete Streets principles
- Tools for understanding traffic engineering principles and practices
- Tools for modifying existing streets
- Tools for planning future streets
Complete Streets

Complete Streets are safe, comfortable, and convenient for travel for everyone, regardless of age or ability - motorists, pedestrians, bicyclists, and public transportation riders.
Complete Streets Can Benefit Communities

- Increase capacity
- Improve safety
- Better health
- Economic growth
- Lower emissions
- Reduce costs
- Smarter growth
- Provide choices
Design Bicyclist

Bicycling Experience Continuum
Design Pedestrian
Design Vehicle

**AUTOS**
- 10-11’ Lane width
- Peak Hour volumes
- Special generators
- Parking needs

**BUSES**
- 11-12’ Lane width
- Bus stops & position

**TRUCKS**
- 11-12’ Lane width
- Loading zones
- Turning radius
Tools for Understanding Traffic Engineering & Transportation Planning

- Travel Demand Projections
- Traffic Operations Analysis
- Traffic Capacity and Level of Service
- Evaluation Criteria
Travel Demand Projections

- Regional Travel Demand models are great tool for assessing regional movements
  - Cube, TransCAD, VISSUM
- Use RTD volumes carefully when assessing arterial and collector roadways
- Use historical traffic counts carefully, accounting for changing conditions and forecast development
Traffic Volume Estimates

- Historical trends
- Area-wide forecasts
- Traffic impacts of proposed development
- Set horizon year (10-year, 20-year, build-out)
- Logical, defendable procedures
Peak Traffic Operations

- Typical week day
- 8 to 12% of daily traffic occurs in one peak hour
- Peak 15 minutes within peak hour -> pk hr factor
- Traffic engineers target the factored peak hour to be accommodated
- Traffic analysis tools used to determine operations performance
  - Synchro (most common)
  - TransModeler, VISSIM, others
Roadway Traffic Capacity and Level of Service (LOS)

- Number of travel lanes drives throughput
- Turning lanes enhance capacity of travel lanes
- Intersections constrain throughput
- Characteristics of Traffic Flow by LOS
  - **A**: free flow. Traffic flows at or above the posted speed. LOS A speeds are maintained, lane changes require Vehicle
  - **B**: reasonably free flow. Speeds slightly decrease as Flow becomes
  - **C**: stable flow, at or near free flow.
  - **D**: approaching unstable flow.
  - **E**: unstable flow, operating at capacity.
  - **F**: forced or breakdown flow.

Level of Service (Intersection Delay)
- **A**: < 10 sec/veh
- **B**: 10-20 sec/veh
- **C**: 20-35 sec/veh
- **D**: 35-55 sec/veh
- **E**: 55-80 sec/veh
- **F**: > 80 sec/veh

Level of Service (Free Flow Density)
- **A**: 0-11 veh/mi/ln
- **B**: 11-18 veh/mi/ln
- **C**: 18-26 veh/mi/ln
- **D**: 26-35 veh/mi/ln
- **E**: 35-45* veh/mi/ln
- **F**: >45* veh/mi/ln

*Highway Capacity Manual* (HCM) and *AASHTO Geometric Design of Highways and Streets* ("Green Book")
Example:
Ben Wilson Street, Victoria, TX

- UH-Victoria moving dorms from south of BUS 59 to east of Ben Wilson Street
- Plans to add more dorms, student center, parking garages
- Plans to grow to 6,000 students in next 10 years
Example:
Ben Wilson Street, Victoria, TX
Ben Wilson Street Corridor Network Function

- Important link in local arterial network

<table>
<thead>
<tr>
<th>Count Location</th>
<th>2012 (TxDOT)</th>
<th>2013 (MPO)</th>
<th>2015 (FNI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ben Wilson St. south of Red River St.</td>
<td>12,630</td>
<td>12,714</td>
<td>12,848</td>
</tr>
<tr>
<td>Ben Wilson St. north of Red River St.</td>
<td>n/a</td>
<td>n/a</td>
<td>13,277</td>
</tr>
<tr>
<td>Ben Wilson St. south of Airline Rd.</td>
<td>n/a</td>
<td>n/a</td>
<td>12,139</td>
</tr>
<tr>
<td>Ben Wilson St. north of Airline Rd.</td>
<td>7,970</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Red River St. west of Ben Wilson St.</td>
<td>9,120</td>
<td>9,170</td>
<td>8,499</td>
</tr>
<tr>
<td>Airline Rd. west of Ben Wilson St.</td>
<td>7,170</td>
<td>7,870</td>
<td>6,944</td>
</tr>
<tr>
<td>Ben Jordan St. south of Red River St.</td>
<td>12,760</td>
<td>11,478</td>
<td>n/a</td>
</tr>
<tr>
<td>Ben Jordan St. north of Red River St.</td>
<td>14,950</td>
<td>13,105</td>
<td>n/a</td>
</tr>
<tr>
<td>BUS 59, west of Ben Wilson St.</td>
<td>25,150</td>
<td>25,991</td>
<td>n/a</td>
</tr>
<tr>
<td>BUS 59, east of Ben Wilson St.</td>
<td>18,190</td>
<td>19,343</td>
<td>n/a</td>
</tr>
</tbody>
</table>

Table 1. Historical Daily Traffic Volumes on Roadways near the Ben Wilson Street Corridor

2-Year Crash Summary

<table>
<thead>
<tr>
<th>Crash Type</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disregarded red light</td>
<td>11</td>
</tr>
<tr>
<td>Failure to yield for left turn</td>
<td>4</td>
</tr>
<tr>
<td>Intoxication</td>
<td>1</td>
</tr>
<tr>
<td>Failure to yield to pedestrian</td>
<td>1</td>
</tr>
<tr>
<td>Failure to control speed</td>
<td>1</td>
</tr>
</tbody>
</table>

Total: 18
Ben Wilson St.
Future Traffic Volumes

- 2040 MTP projects 10% growth in 25 years
  - Included modest growth for UH-V
- UH-V growth to 6,000 students would increase traffic on Ben Wilson Street by about 20%
  - Parking garage at Red River Street important
  - High pedestrian volumes cross Ben Wilson Street
- Volumes for analysis:
  - BUS 59 to Red River: 13,000 -> 16,000 vpd
  - Red River to Airline: 13,000 -> 15,000 vpd
  - Airline to Sam Houston: 8,000 -> 9,000 vpd
- Constraining int’ns @ Airline Road, BUS 59
Ben Wilson St., Traffic Operations

- Existing Lanes
  - 2 lanes each way plus CTL
- Minimal Lanes
  - 1 lane each way plus CTL
  - Red River reduced
  - Airline reduced
- 2015 Traffic operates well, too well
- 20% Growth (@ Airline Road)

### Table 3. Intersection Capacity Utilization (2015 volumes)

<table>
<thead>
<tr>
<th>Intersection</th>
<th>ICU of Existing Lanes (LOS)</th>
<th>ICU of Minimal Lanes (LOS)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AM Peak Hr</td>
<td>PM Peak Hr</td>
</tr>
<tr>
<td>Ben Wilson @ Sam Houston</td>
<td>50% (B)</td>
<td>48% (B)</td>
</tr>
<tr>
<td>Ben Wilson @ Airline</td>
<td>52% (A)</td>
<td>50% (A)</td>
</tr>
<tr>
<td>Ben Wilson @ Red River</td>
<td>52% (A)</td>
<td>48% (A)</td>
</tr>
<tr>
<td>Ben Wilson @ BUS 59</td>
<td>53% (A)</td>
<td>57% (B)</td>
</tr>
</tbody>
</table>

PM Proposed 3-Lane

AM Proposed 3-Lane
Ben Wilson Street, Victoria

- Enhanced pedestrian walkways
- Minimal crossing lengths and refuges
- Room at intersection corners for ped landings
- Better traffic visibility at corners
- Room for corridor aesthetics
Utilities and Services, Deliveries and Parking

- Power lines
- Telephone/cable lines
- Gas lines
- Water lines
- Sewer lines
- Storm drainage
- Deliveries
- Parking on-street
- Driveways
- Aesthetics
Goal: Provide for Adequate Traffic Operations: (40 pts)
- Objective: Process future traffic with acceptable intersection LOS (20 pts)
- Objective: Provide for acceptable traffic speed and progression (10 pts)
- Objective: Accommodate train crossing interruptions (10 pts)

Goal: Provide for Pedestrian and Bicycle Mobility and Safety (30 pts)
- Objective: Minimize crossing distance for pedestrians (10 pts)
- Objective: Provide acceptable spacing of controlled ped. crossings (10 pts)
- Objective: Retain high quality sidewalk environment (10 pts)

Goal: Retain On-street Parking Supply (30 pts)
- Objective: Retain existing parking supply on Main and Gray Streets (15 pts)
- Objective: Simplify and support access to downtown parking supply (15 pts)
Initiation Considerations

1. Internal Review of Pros & Cons, Issues
   - History of installation (dates, supporters, funding, etc.)
   - Overview benefits/challenges of current configuration
   - Identification of city internal issues and concerns

2. Review the Pros and Cons with Stakeholders

3. Formally initiate transparent analysis
Tools for Retrofit and Rehab

- One-way to two-way conversion
- Two-way to one-way conversion
- Lane reductions
- Lane narrowing
- Lane sharing
- Parking for business and buffer
- Sidewalk Zone context
One-way Conversion to Two-way

P180
Walker Avenue

Benefits of Two-way/One-way Conversion

- Reduces pedestrian crashes
- Reduces speed
- Reduces travel distance
- Allows better local access and visibility
- Easier to understand

Before

After
One-way Conversion to Two-way

Benefits of Two-way/One-way Conversion

- Reduces pedestrian crashes
- Reduces speed
- Reduces travel distance
- Allows better local access and visibility
- Easier to understand
One-way Conversion to Two-way

Existing

| Two-Way (3) |  
| Two-Way (3) |  
| Two-Way (4) |  
| Two-Way (5) |  

Modified One-Way
Redistribution of Traffic

PM Peak Hour

Legend
Existing PM Peak Hour Volume
1/2 of SS LT Flood at Main moved to SS LT Flood at Gray
1/2 of WB Gray at Porter moved to WB Main at Porter
1/2 of NB RTs at Main moved to NB RT at Gray
1/2 of SS LTs at Main moved to SS LT at Gray
1/2 of NB LTs at Gray moved to NB LTs at Main
1/2 of SB RTs at Gray moved to SB RTs at Main

Note 1: Percentage turning movement split of approach volumes as per existing counts

Note 2: The westbound reduced volumes on Gray Street were assumed to be allocated at university Boulevard as follows:
- From Through - 36%
- From Left Turns - 70%
The 36% from the westbound through movement were taken equally from the left turns at Laemmle and Flood Avenues.
# Analysis of Existing vs Proposed

<table>
<thead>
<tr>
<th>Intersection</th>
<th>Existing One-Way Scenario 1.2 Growth Factor</th>
<th>Two-Way Conversion Scenario 1.2 Growth Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Control Delay (Sec/veh)</td>
<td>LOS</td>
</tr>
<tr>
<td>Gray Street at Flood Avenue</td>
<td>10.9 B</td>
<td>6.4 A</td>
</tr>
<tr>
<td>Gray Street at Lahoma Avenue</td>
<td>4.4 A</td>
<td>3.4 A</td>
</tr>
<tr>
<td>Gray Street at University Boulevard</td>
<td>10.2 B</td>
<td>12.2 B</td>
</tr>
<tr>
<td>Gray Street at Webster Avenue</td>
<td>10.5 B</td>
<td>6.8 A</td>
</tr>
<tr>
<td>Gray Street at Santa Fe Avenue</td>
<td>5.3 A</td>
<td>10.6 B</td>
</tr>
<tr>
<td>Gray Street at James Garner Boulevard</td>
<td>20.8 C</td>
<td>15.1 B</td>
</tr>
<tr>
<td>Gray Street at Jones Avenue</td>
<td>0.0 A</td>
<td>5.8 A</td>
</tr>
<tr>
<td>Gray Street at Peters Avenue</td>
<td>14.7 B</td>
<td>11.0 B</td>
</tr>
<tr>
<td>Gray Street at Crawford Avenue</td>
<td>1.4 A</td>
<td>5.4 A</td>
</tr>
<tr>
<td>Gray Street at Porter Avenue</td>
<td>17.8 B</td>
<td>20.3 C</td>
</tr>
<tr>
<td>Main Street at Flood Avenue</td>
<td>37.3 D</td>
<td>24.9 C</td>
</tr>
<tr>
<td>Main Street at Downtown Shopping Center</td>
<td>3.7 A</td>
<td>3.4 A</td>
</tr>
<tr>
<td>Main Street at University Boulevard</td>
<td>15.8 B</td>
<td>35.4 D</td>
</tr>
<tr>
<td>Main Street at Webster Avenue</td>
<td>23.2 C</td>
<td>50.8 D</td>
</tr>
<tr>
<td>Main Street at Santa Fe Avenue</td>
<td>4.2 A</td>
<td>20.8 B</td>
</tr>
<tr>
<td>Main Street at James Garner Boulevard</td>
<td>15.7 C</td>
<td>35.9 D</td>
</tr>
<tr>
<td>Main Street at Jones Avenue</td>
<td>1.0 A</td>
<td>10.6 B</td>
</tr>
<tr>
<td>Main Street at Peters Avenue</td>
<td>8.8 A</td>
<td>18.3 B</td>
</tr>
<tr>
<td>Main Street at Crawford Avenue</td>
<td>6.6 A</td>
<td>12.1 B</td>
</tr>
<tr>
<td>Main Street at Porter Avenue</td>
<td>17.3 B</td>
<td>37.7 D</td>
</tr>
</tbody>
</table>
Two-way Conversion to One-way

Positive attributes of one-way couplets:
- Distributes traffic off congested street
- Reduces crashes
- Allows for better signal progression
- Can reduce delay and emissions
- Expands traffic exposure for development
- Can allow room to retain/add parking on street
- Can allow room to retain/add pedestrian space along street
Project Goals:

- Congestion Mitigation
- Improve Railroad Safety
- Pedestrian Pathways
- Bicycle Routes
- Landscaping
- Intersection Enhancements
Project Goals

- Congestion Mitigation
- Improve Railroad Safety
- Sidewalk Enhancements
- Shared use Bike Lanes
- Landscaping Improvements
- Intersection Enhancements
- Railroad Safety Fencing
Downtown Edmund Plan - 2nd Street Split One-way Pair with 3rd Street
Lane Reductions (Road Diets)

Traffic Study associated with P180 Sheridan Avenue

Indicated that the majority of roads in downtown were overbuilt - some by a factor of 10

Decreasing lanes:
- Allowed excess pavement to used to increase parking & bike facilities
- Increases pedestrian safety by decreasing the number of lanes and length of crossings
Lane Reductions (Road Diets)

- Ben Wilson Street, Victoria, TX
  - 5-lane to 2-lane with medians
  - Enhanced Pedestrian and bicycle accommodations
  - Protected left turn bays
  - Bus stop pullovers
Lane Reductions (Road Diets)

- US Business 77, Waco, TX
  - 4-lane rural highway to 4-lane rural/urban boulevard
  - Enhanced Pedestrian and bicycle accommodations
  - Protected left turn bays
  - Access management
Lane Narrowing (Road Diets)

P180
Couch Drive

Typical adopted standards include 12’ lane width as minimum
- AASHTO guidance of “10’ to 12’ minimum”
- Misguided notion that wider is always safer

New research shows narrowing lanes:
- No increase in traffic accidents - some cases decreasing crash frequency
- No difference in capacity between a 10’ and 12’ lane.
- Lane width correlates to speed - lower speeds increased safety
Lane Narrowing (Road Diets)

Downtown Denton Improvement Program
Lane Sharing

Bike Routes with “BMUFL & Sharrows”
Lane Sharing

Bikes Sharing Lane with Buses
Downtown Fort Worth (Houston Street)
Benefits of on-street parking:
- Slows traffic
- Wall of steel
- Parking located close to businesses
- Leaves more developable space on parcel
Sidewalk Zone - Context

Downtown Development Framework
- Guidelines for different zones based on the expected/current land use
- Currently in place for downtown - being adapted to other districts
- Establishes level of importance of each element

DESIGN PREFERENCES
Minimum design preferences absent of restrictions.

<table>
<thead>
<tr>
<th>Minimum Width</th>
<th>10 feet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preferred Width</td>
<td>15+ feet</td>
</tr>
<tr>
<td>Storefront Zone</td>
<td>Yes</td>
</tr>
<tr>
<td>Sidewalk Zone</td>
<td>7 feet minimum, 5 feet if combined with a storefront zone.</td>
</tr>
<tr>
<td>Amenity Zone</td>
<td>5 feet, Hardscape</td>
</tr>
<tr>
<td>Clear Zone</td>
<td>6 feet</td>
</tr>
</tbody>
</table>
Tools for Thoroughfare Planning

BASICS

- Land Use Intensity Conformity
  - Development = Trips
- Trip Making Characteristics
  - Increased Density = Lower Auto Trips per Unit
- Classifications
  - Highway
  - Arterials (Major/Minor)
  - Collectors (Major/Minor, Commercial/Residential)
  - Local (Commercial/Residential)
  - Other (Main Street, Couplet, etc.)
Tools for Thoroughfare Planning

Context Sensitive Solutions

- Federal Highway Administration
- Environmental Protection Agency
- Institute of Transportation Engineers
- Congress for the New Urbanism

<table>
<thead>
<tr>
<th>Context Zone</th>
<th>Distinguishing Characteristics</th>
<th>General Character</th>
</tr>
</thead>
<tbody>
<tr>
<td>C-1 Natural</td>
<td>Natural landscape</td>
<td>Natural features</td>
</tr>
<tr>
<td>C-2 Rural</td>
<td>Agricultural with scattered development</td>
<td>Agricultural activity and natural features</td>
</tr>
<tr>
<td>C-3 Suburban</td>
<td>Primarily single family residential with walkable development pattern and pedestrian facilities, dominant landscape character</td>
<td>Detached buildings with landscaped yards</td>
</tr>
<tr>
<td>C-4 General Urban</td>
<td>Mix of housing types including attached units, with a range of commercial and civic activity at the neighborhood and community scale</td>
<td>Predominantly detached buildings, balance between landscape and buildings, presence of pedestrians</td>
</tr>
<tr>
<td>C-5 Urban Center</td>
<td>Attached housing types such as townhouses and apartments mixed with retail, workplace, and civic activities at the community or sub-regional scale</td>
<td>Predominantly attached buildings landscaping within the public right of way, substantial pedestrian activity</td>
</tr>
<tr>
<td>C-6 Urban Core</td>
<td>Highest-intensity areas in sub-region or region, with high-density high rise residential and workplace uses, entertainment, civic, and cultural uses</td>
<td>Attached buildings forming sense of enclosure and continuous street wall landscaping within the public right of way, highest pedestrian and transit activity</td>
</tr>
<tr>
<td>Districts</td>
<td>To be designated and described locally, districts are areas that are single-use or multi-use with low-density development patterns such as airports, business parks, universities, and industrial areas</td>
<td></td>
</tr>
</tbody>
</table>
Tools for Thoroughfare Planning

Design Standards Palette based on Context

Example: City of Fort Worth

Thoroughfare Plan
Tools for Thoroughfare Planning

Design Standards based on Context

Example: Western Avenue
Tools for Thoroughfare Planning

- Contextual approach to classifying roadways.
- Informs future improvements to the system.
- Includes considerations for all users.
- Based on LUTAs - the land uses anticipated to exist adjacent to each street.
UL Major Arterial

• Lane width of 10 to 13 feet wide.
• Typically 4 to 6 lanes.
• Parking off-street.
• Optional center median no less than 14 feet wide.

Bicycle
• 8-12 feet multi-use path is preferred, special precautions need to be taken at commercial drive crossings.
• 5 feet paved shoulders can be used in areas without curb.

Pedestrian Zone
• Width of 14 to 20 feet wide.
• Preferred sidewalk placement is at property line.
• Sidewalk width minimum 5 feet.

Transit
• Typically signed bus stops are sufficient.
• Shelters may be needed in high use areas near employment centers or high density residential.

Access Management
• Uniform signal spacing and left and right turn bays should be used to promote traffic flow.
• Driveways should be eliminated intersection functional area.
• Adequate commercial driveway throat length is needed to allow traffic to move off the roadway.
• Medians can be used to control left turn movements.
• Shared driveways should be used to reduce curb-cuts.

Land Use
• Building orientation to the street or side.
• Setbacks typically 30 feet from back of curb.
UM Major Arterial

Travel Way
- Lane width of 10 to 13 feet wide.
- Typically 4 to 6 lanes.
- Parking off-street.
- Optional center median no less than 14 feet wide.

Bicycle
- 8-12 foot multi-use path is preferred, special precautions need to be taken at commercial drive crossings.
- Bike routes/sharrows may be used in cases where ROW is insufficient to accommodate other facilities.

Pedestrian Zone
- Width of 10 to 16 feet wide.
- Preferred sidewalk placement is at property line.
- Sidewalk width minimum 5 feet.

Transit
- Bus shelter in high use areas, connected to back of curb and adjacent property.
- Bus stops used in low use areas.

Access Management
- Uniform signal spacing and left and right turn bays should be used to promote traffic flow.
- Driveways should be eliminated intersection functional area.
- Adequate commercial driveway throat length is needed to allow traffic to move off the roadway.
- Medians can be used to control left turn movements.
- Shared driveways should be used to reduce curb-cuts.

Land Use
- Building orientation to the street or side.
- Setbacks typically 30 feet from back of curb.