Parking Options

Parking can be divided into five categories: on-street, individual surface lot, shared surface lot, garage and underground.

Individual Private Surface Lot

Individual private surface lots are parking lots that are dedicated to one specific site. Following are pros and cons for individual private surface lots:

Pros
- Serves site specific needs
- Convenient for vehicles
- Reduced conflict points with travel way
- Usually provides ADA accessibility

Cons
- Parking spaces and access to the spaces take up a large portion of developable land
- Encourages lower density development
- Only used for specific business, unoccupied otherwise
- Auto-oriented detracting from use of other modes of transportation

On-Street Parking

On-street parking is most often found within the public right of way. Three types are explained in the box below - parallel, angled & back-in angled parking. Following are general pros and cons for on-street parking:

Pros
- Provides shared parking
- Cheapest per space parking option
- Uses 1/4 land of off-street parking
- One space equivalent to 2-3 off-street spaces
- Patrons' most valued parking space - convenient, direct access
- Often in higher demand than off-street parking
- Encourages park-once vehicular activity
- Can help stimulate more pedestrian activity compared with private parking
- Provides safety buffer for pedestrian realm
- Calms traffic
- Reduces roadway fatalities by 1/2 compared with roads without on-street parking

Cons
- Safety concerns adjacent to roadway
- Can generate congestion
- Does not provide site specific ADA accessibility
- Takes up space within the public right of way

On-Street Parking Options Comparison

<table>
<thead>
<tr>
<th></th>
<th>Parallel Parking</th>
<th>Angled-in Parking</th>
<th>Back-In Parking</th>
</tr>
</thead>
<tbody>
<tr>
<td>User Famillarity</td>
<td>✔</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>Parking Difficulty</td>
<td>HIGH</td>
<td>LOW</td>
<td>MODERATE</td>
</tr>
<tr>
<td>Convenient Vehicle Entry</td>
<td>✔</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>safer Vehicle/Bicycle Conflict</td>
<td>✔</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>Convenient Vehicle Exit</td>
<td>✔</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>Safer Vehicle/Bicycle Exit</td>
<td>✔</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>Driver Exiting Visibility</td>
<td>MODERATE</td>
<td>LOW</td>
<td>HIGH</td>
</tr>
<tr>
<td>No Cyclist/Car Door Conflict</td>
<td>✔</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>Load Required Space</td>
<td>✔</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>Causes Traffic Congestion</td>
<td>✔</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>No Trunk Loading of Goods</td>
<td>✔</td>
<td>✔</td>
<td></td>
</tr>
</tbody>
</table>

Parking Options Comparison Table:

- User Famillarity: ✔
- Parking Difficulty: HIGH, LOW, MODERATE
- Convenient Vehicle Entry: ✔
- Safer Vehicle/Bicycle Conflict: ✔
- Convenient Vehicle Exit: ✔
- Safer Vehicle/Bicycle Exit: ✔
- Driver Exiting Visibility: MODERATE, LOW, HIGH
- No Cyclist/Car Door Conflict: ✔
- Load Required Space: ✔
- Causes Traffic Congestion: ✔
- No Trunk Loading of Goods: ✔
**Parking**

**Shared Surface Lot**

Shared surface lots are lots that serve multiple properties. The three diagrams (right) illustrate strategies for shared surface lot development. Following are pros and cons for shared surface lots:

**Pros**
- Stimulates pedestrian activity when strategically located
- Enhance economy of retail development
- More effectively uses property so more development area is available
- Reduced conflict points with travel way
- Encourages park-once vehicular activity
- Usually provides ADA accessibility
- Can stimulate use of transit system when incorporated
- Overall reduction of costs for construction and maintenance of parking areas
- 10-30% reduction in parking per business

**Cons**
- Shared parking agreements are required
- Shared access agreements are required
- Reduced convenience for individual businesses

**Garage Parking**

Garage parking is a building or portion of a building designated to parking. Following are pros and cons for garage parking:

**Pros**
- Stimulates pedestrian activity when strategically located
- Enhance economy of retail development
- More effectively uses property so more development area is available
- Reduced conflict points with travel way
- Encourages park-once vehicular activity
- Usually provides ADA accessibility
- Can stimulate use of transit system when incorporated
- Overall reduction of costs for construction and maintenance of parking areas
- 10-30% reduction in parking per business
- Aesthetic contribution to streetscape
- Possible incorporation of street level retail

**Cons**
- Parking structures viable when price of land for development is reasonable
- Expensive to construct and maintain structures
- Shared parking agreements are required
- Shared access agreements are required
- Reduced convenience for individual businesses

**Underground Parking**

Underground parking is located under buildings designed for office, retail and residential uses as part of the overall building amenities. Topography, access and site size may discourage this type of parking development. Following are pros and cons for underground parking:

**Pros**
- Serves site specific needs
- More effectively uses property so more development area is available
- Minimal detraction from developable land
- Usually provides ADA accessibility
- Reduced conflict points with travel way
- Can stimulate use of transit system when incorporated
- Does not aesthetically detract from streetscape

**Cons**
- Parking structures viable when price of land for development is reasonable
- Expensive to construct and maintain structures
- Shared parking agreements are required
- Shared access agreements are required
- Reduced convenience for individual businesses
Roundabouts


Users may be unfamiliar with roundabouts design & function

For pedestrians, constant stream of traffic can cause fewer down stream gaps in traffic

Pedestrians have less direct crossing route

May utilize more land than traditional intersections

Pros

- Improvement in overall safety performance
- Crash reductions for motorists & pedestrians
- Lower speeds result in a 37% reduction in total crashes, 51% reduction in injury related crashes
- Fewer conflict points than signalized intersections
- Shorter pedestrian crossing distances
- Pedestrians have fewer directions to look while interacting with conflicting vehicles
- Splitter islands act as refuges for pedestrian crossings and can provide green elements at the intersection
- Bicycles can mix with traffic easier in a roundabout due to lower speeds

Cons

- Users may be unfamiliar with roundabouts design & function
- For pedestrians, constant stream of traffic can cause fewer down stream gaps in traffic
- Pedestrians have less direct crossing route
- May utilize more land than traditional intersections

Intersection Comparison

Roundabouts simplify traffic flow through an intersection creating fewer conflict points.
- Roundabout
  - 4 vehicular conflicts
  - 2 pedestrian conflicts at each crossing
- Three lane intersection
  - 26 vehicular conflicts
  - Greater than 2 pedestrian conflicts at each crossing

Roundabout Intersection

Traditional Intersection

Three lane intersection

Bicycles can mix with traffic easier in a roundabout due to lower speeds

Pros

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- Users may be unfamiliar with roundabouts design & function
- For pedestrians, constant stream of traffic can cause fewer down stream gaps in traffic
- Pedestrians have less direct crossing route
- May utilize more land than traditional intersections
Road Diet

Excess Capacity?

As arterial roadways grow, technology that moves people becomes more accessible and communities evolve socially and economically, the use of existing infrastructure will change. Some roadways grow to sizes that deter pedestrian & bicycle use and may even prohibit users other than vehicles. Some formerly major thoroughfares become underutilized expanses of pavement. In the former case, the businesses supported by the roadway usually suffer. A road diet is a tool that can right-size the roadway, stimulate modes of transport other than vehicular through reduced travel speeds and create interesting places that encourage the economy.

National Example

Pottstown, PA
Goal: Increase transportation modes and parking
Measures:
1. Roadway resurfacing
2. Convert five lanes to three
3. Add bicycle lanes
4. Convert parallel parking to angled back-in parking on one side

Restructuring

Achieving community and project goals within the confined space of a public right of way is a balancing act. In some situations rebuilding the roadway will achieve the goals of the project. In this example (left) the vehicular roadway within the five lane section is rebuilt to a 3 lane section.

Results
- Addition of bicycle lanes
- Larger pedestrian realm
- Pedestrian crossing distance decrease
- Vehicle/Vehicle conflicts decrease
- Pedestrian/Vehicle conflicts decrease
- Larger pedestrian buffer
- Sufficient room for trees
- More transportation modes accommodated
- Increased quality of life for areas adjacent to vehicular travelway
- Could provide area for on-street parking

Inefficient Operation?

Road diets may help four-lane roadways function more effectively without adversely hampering traffic flow. Traditionally, adding lanes was thought to help move more vehicles often resulting in increases speeds. But in locations where many unsignalized left hand turns occur, traffic can become congested and less safe for vehicles, bicyclists and pedestrians. In such cases, a road diet may calm traffic, bolster modes of transport other than vehicular and elevate points of conflict creating a safer more inviting roadway for all users.

Restrriping

A road diet may be achieved by simply restriping the roadway. In this example (right) a four lane section is converted to a three lane section.

Results
- Addition of bicycle lanes
- Traffic flow efficiency increased
- Vehicle/Vehicle conflicts decrease
- Pedestrian/Vehicle conflicts decrease
- More transportation modes accommodated
- Increased quality of life

Valencia Street - San Francisco, CA
Goal: Encourage cycling as a viable transportation option
Measures:
1. Convert four lanes to three lanes
2. Changed Signal Timing
3. Changed Speed Limits
4. Restriped the roadway with bike lanes included

Results:
- Minimal change in traffic flow
- Vehicles collisions reduced 20%
- Bicycles and increased 147%
- Pedestrian collisions reduced 31%
- Pedestrian accidents reduced 36%
Traffic Calming

- Slows vehicles on streets where drivers travel at higher speeds than is desirable
- Reduces the negative effects of automobile use
- Alters driver behavior
- Improves conditions for the property owner, retailer, pedestrian and bicyclist.

**Textured Pavement**

Textured pavement often is a change in material and/or color that creates a sound and vibration when driven over.

**On-street Parking**

On-street parking provides a vertical element to the roadside that drivers have to recognize because a door could open or a car pull out into the travel lane. It also provides a safety buffer to the pedestrian realm.

**Bump-outs**

Bump-outs are narrowed points at intersections and/or along the roadway where the curb adjacent to the travel lane edge.

**Benefits**

- Slows vehicles at intersection and/or mid-point along street
- Improves safety for pedestrians & motorists at intersection
- Increases visibility for pedestrians & motorists
- Encourages pedestrians to cross at designated locations
- Prevents motorists from parking at corners
- Improves ADA accessibility
- Improves public space

**Pedestrian Accident Survival Rate vs. Vehicular Speed**

<table>
<thead>
<tr>
<th>Speed</th>
<th>% Survive</th>
<th>% Die</th>
</tr>
</thead>
<tbody>
<tr>
<td>20mph</td>
<td>95%</td>
<td>5%</td>
</tr>
<tr>
<td>30mph</td>
<td>90%</td>
<td>10%</td>
</tr>
<tr>
<td>40mph</td>
<td>65%</td>
<td>35%</td>
</tr>
</tbody>
</table>

**Medians**

Medians are raised or depressed areas separating traffic traveling in opposite directions. They may be paved or planted and help to reduce the width of the roadway.

**Changing Traffic Patterns**

- Reduce Lanes (Road Diet)
- Partial Closure of Roadway
- Traffic Diversion

**On-street Parking**

On-street parking provides a vertical element to the roadside that drivers have to recognize because a door could open or a car pull out into the travel lane. It also provides a safety buffer to the pedestrian realm.
**Traffic Calming**

**Vertical Elements**

Vertical elements reduce the apparent width of the roadway causing 'visual friction.'

- Street Trees/Tree Canopy
- Low Vegetation
- Monument Signage
- Bollards
- Pedestrian Lighting
- Banners
- Fencing/Walls
- Site Furnishings
- Building Edge

**Intersection Layout**

There are multiple tools that can be used to calm traffic at intersections.

- Curb Radius Reduction
- Right Turn Slip Lane
- Roundabout or Mini-Roundabout
- Traffic Circle
- Raised Intersection
- Bump-outs
- Textured Crosswalks
- Tabled Crosswalks

**Narrowing Pavement**

Narrow pavement constricts drivers forcing them to pay attention negotiating oncoming traffic and the street edge. For speeds under 35 mph studies have shown minimal safety differences in lanes 10.5 feet and larger.

**Island/Pedestrian Refuge**

- Enhances pedestrian & bicycle crossings, particularly at un-signalized crossing points
- Establishes 'Safe Route to School' crossing
- Reduces left turn crashes
- Simplifies pedestrian decision-making
- Channelizes traffic

**Signage/Enforcement**

Signage can alert traffic to the community's traffic laws and provide drivers extra awareness of the surrounding environment. Signage along with law enforcement is the simplest form of traffic calming.
There are many different experience levels among the bicyclists who use our public infrastructure. Considerations for design of bicycle facilities is based on skill, experience and age.

**Bike Lane**
A bike lane is a portion of the roadway designated by pavement markings as shown left and/or signs for exclusive use of bicyclists. Bike lanes are likely used by Group A and B riders.

**Separated Bicycle Lane**
Separated bicycle lanes are one or two-way bicycle paths directly adjacent to a roadway, protected from vehicles and separated from the pedestrian realm. Separated bicycle lanes are likely used by Groups A and B, possibly C. In Europe they are called ‘cycle tracks.’

**Sharrow/Shared Lane**
Shared lanes or sharrows are travel lanes open to vehicles and bicycles. These types of lanes are likely used by Group A.

**Bike Boulevard**
Bike Boulevards are roadways where traffic patterns have been changed to reduce vehicle use and provide higher priority to bicycles and denoted with the symbol to the right. They are designed to offer advantages to experienced bicyclists in addition to the ease of use of a bicycle path which appeals to less experienced and younger riders. In contrast to other shared lanes, they discourage cut through vehicular traffic serving only local traffic needs. Bike boulevards are likely used by Groups A, B and C.

**Shared-Use Path**
Shared-use paths are bikeways physically separated from vehicular traffic by an open space or barrier. They may be shared by pedestrians. Shared-use paths are likely used by Groups B and C.
Economic Development & Land Use Planning

- Understand market opportunities
- Strengthen existing community
- Protect & integrate green space/natural resources
- Provide a variety of transportation options
- Encourage mixed-use development
- Stimulate pedestrianism & safety
- Efficient parking strategies
- Create a sense of place & identity

Sources: Smartcode; DPZ, Spring 2005.
Pedestrian Realm

Pedestrians

Streets not only move traffic, but also serve as public places supportive of a variety of activities. Quality environments are created when right-of-way is appropriately allocated to accommodate all modes of travel and create comfortable and enjoyable public spaces.

Creating a safe and inviting pedestrian environment entails more than just providing sidewalks - it is important to recognize that people walk for different reasons in various types of places, and that a number of specific components influence the pedestrian-friendliness of an area.¹

Pedestrian Intolerant Environments

• Unsafe
• Inaccessible
• Unattractive

Pedestrian Tolerant Environments

• Technically safe
• ADA Accessible
• Minimal accommodations
• Land use patterns generate little activity

Pedestrian Supportive Environments

• ADA Accessible
• Well-designed continuous walk
• Buffered from street
• Wide enough to pass or walk side by side

Pedestrian Places

• ADA Accessible
• Located in mixed land-uses of moderate to high density
• Good transit service
• Extensive pedestrian amenities
• Highly identifiable areas

Roofs occupy 30% of surface area in urban environments. Green roofs utilize light-weight materials that capture and/or slow rain water. The water is absorbed, evaporates or is filtered before leaving the roof. Green roofs can last three times as long as conventional roofs and also can be enjoyed as gardens.

Porous Pavement

Water immediately penetrates and is stored underneath porous pavement. After being filtered it either infiltrates the soil or is released into the city pipe system. Porous pavement is low maintenance and its life cycle cost is comparable to conventional pavement. Examples include porous asphalt, concrete, decorative pavers and grass pave.

Green Roof

Roofs occupy 30% of surface area in urban environments. Green roofs utilize light-weight materials that capture and/or slow rain water. The water is absorbed, evaporates or is filtered before leaving the roof. Green roofs can last three times as long as conventional roofs and also can be enjoyed as gardens.

Low Impact Development

- Low Impact Development (LID) mimics natural processes to minimize or negate the impacts of development.
- Natural systems aren’t always considered in developments.
- Water often is treated as a problem and is quickly removed from sites, sent underground and piped long distances.
- Runoff pollutes lakes and streams

Hydrological Cycle

- Precipitation
- Evaporation
- Lake Storage
- Ocean Evaporation
- Ground Water
- Soil Infiltration
- Percolation
- Surface Runoff
- From Vegetation
- From Streams
- From Soil Transpiration
- From Ocean
- Deep Percolation

How do we make this... work like this?
Rain Gardens are commonly placed at low points to collect stormwater. That water either evaporates or is filtered by infiltrating the soil or being absorbed by plants before entering a city pipe system.

Rain Planter are placed near impervious surfaces such as paved areas or buildings. Runoff is trapped in these planters and, like a rain garden, evaporates or is filtered.

Bio-swales slow stormwater, filter sediment and cool runoff. Little water infiltrates the bio-swale, but it is an important tool for reducing erosion and flooding.

Green gutters function similar to conventional gutters by channeling and directing runoff. However, it acts like a bio-swale in treating water.

If you have ever gone rafting, you know the current slows where the river widens. A tree well gutter works the same way. Water running along the gutter spreads out into the tree well, pools, slows and infiltrates the soil in the well. Pedestrians can walk on the grate while water flows beneath.

Vegetative filter strips work as buffers to slow and cool surface runoff. Little water is absorbed, but the strips are valuable for erosion control.

Wetlands are known as the “lungs” of a hydrological cycle, or water cycle. They act as sponges; water is held for long periods of time, during which it is purified by flora and fauna. Wetlands also prevent flooding. Unfortunately, they are becoming endangered because of encroaching development.
Native Plants

Non-Natives

- Low maintenance
- Less water required
- Ground water replenished
- Soil conservation
- Fertilizer unnecessary
- Resistant to destructive insects and disease
- Winter resilient
- Supportive of diverse wildlife

Natives

- Dry-Average Soil Moisture
- Moderate Soil Moisture
- High Soil Moisture

In Your Back Yard

Missouri has a rich diversity of plant life for every season of the year.
A 50 year old tree can generate in a lifetime:
- $30,000 in oxygen
- $35,000 in recycled water
- $60,000 in air pollutant cleaning
not including intangible benefits

Average urban tree age: 10 years

A healthy tree can store 13 lbs. of carbon annually or 2.6 tons/acre

Urban trees reduce up to 60% of street level impurities

Three well-located trees can cut a residential AC bill by 15-50%

San Antonio, TX increased urban tree cover by 8% as an alternative to a $200 M stormwater facility