2024 ATLANTA REGIONAL FREIGHT MOBILITY PLAN

Freight Design Guidelines

December 2024

Cover photo: Alta Planning + Design

Contents

List of Figures

List of Tables

1. Introduction

Purpose of the ARC Freight Design Guidelines

Based on industry best-practices and tailored to the needs of the Atlanta region, the Freight Design Guidelines serve as a reference and resource for both local government staff and private developers. This document is not intended to replace design policies, such as the AASHTO "Green Book" or GDOT roadway design manuals, which should be followed for actual roadway and site design projects. Instead, these guidelines are designed to assist the planning and zoning community in effectively planning for freight in the early stages of development. The primary objective of these guidelines is to support local governments in developing context-sensitive roadways, site design, and related standards which accommodate and integrate freight movement in a context-sensitive and efficient manner. Recommendations within the design guidelines will vary based on the specific roadway types and site designs in each area. The guidelines are intended to be used for local planning work related to new developments, including during the zoning approval process, with DRIs, and for improving site design. Additionally it will be useful in the development of freight cluster plans and other local planning efforts.

How to Use this Document

The guidelines are grouped into three chapters: (1) Industrial, (2) Downtowns/Small Regional Centers, (3) Major Activity Centers. Each chapter covers the same topics, but with information relevant to each context. At the beginning of each chapter, an introduction outlines the associated land use and design principles, provides examples of these principles, and provides representative images. The first half of each chapter largely focuses on public right-of-way and the latter half emphasizes site/building design, though many topics require consideration of both public and private space. Each chapter covers:

- Lane Widths and Roadway Design
- Multimodal Access
- Vertical Grades
- Intersection Design
- Access Management
- Railroad Crossings
- Employee Access
- Curbside Management
- Loading Dock Requirements
- Truck Parking Requirements
- Delivery Times
- Wayfinding

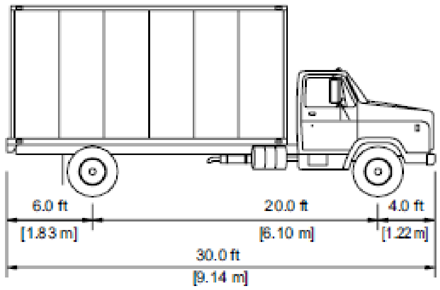
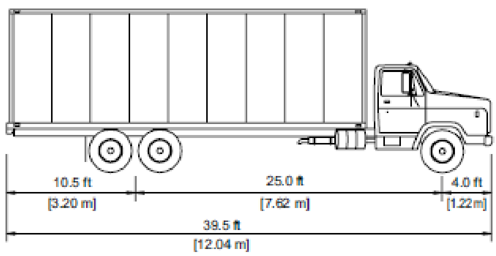
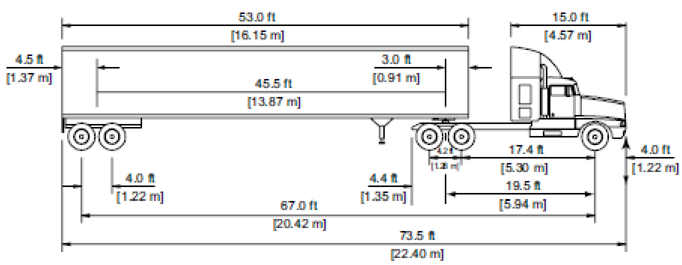
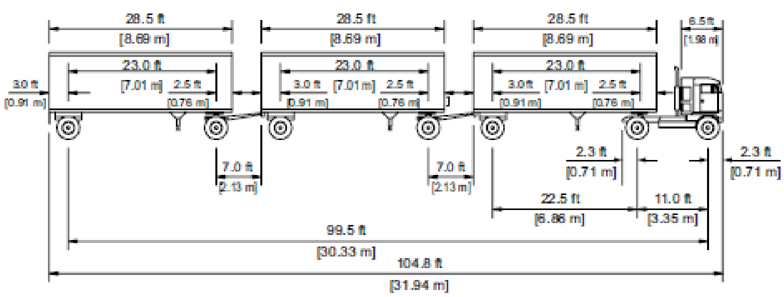
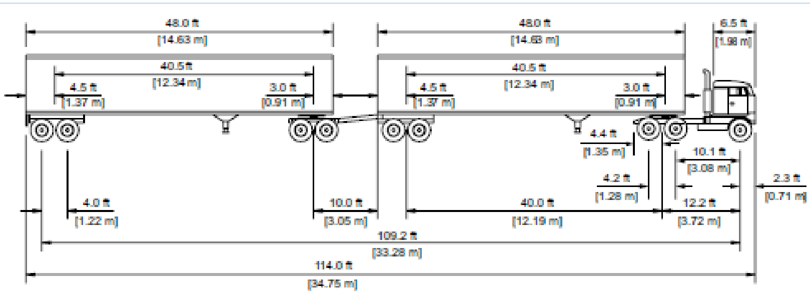
- Visual and Noise Buffers
- Emerging Design and Infrastructure Needs
- Sustainable Warehouse Design

Overview of Different Truck Types

Trucks require more room to turn and maneuver than standard passenger vehicles because they have a wider and longer frame. According to the AASHTO 2018 Green Book, the two primary types of freight to consider are a Single Unit Truck (SU) and a combination truck.

Single unit trucks are smaller trucks such as delivery trucks and smaller box trucks. These trucks are directly connected to the cab and do not detach. In contrast, a combination truck includes a detachable trailer which is usually longer. Combination trucks may also carry up to three attached trailers. Longer combination vehicles, which have multiple trailers, need even more room to turn than their smaller counterparts. These trucks are denoted by the length in feet between the front and back wheels of the truck, also known as the wheelbase (WB). For example, the third vehicle depicted in Table 1 has a wheelbase of 67 feet. Therefore, the truck is identified as WB-67. Single unit trucks are denoted either simply as SU or by SU followed by wheelbase length (e.g. SU-30). Table 1 shows all truck designs relevant to these design guidelines, with SU-30, SU-40, and WB-67 the types of trucks relevant across the three contexts. In downtowns, small activity centers, and major activity centers, single unit trucks will be most common, with some single-trailer semis present as well. For the contexts relevant to this guide, trucks with multiple trailers (such as the WB-100T or WB-109D below) will, in most cases, only be present in industrial areas.

Table 1: Truck Types and Descriptions

<table>
<tr><th>Truck Image</th><th>Truck Name and Description</th></tr>
<tr><td>
</td><td>The SU-30 vehicle represents a small single-unit truck</td></tr>
<tr><td>
</td><td>The SU-40 vehicle represents a larger single-unit truck.</td></tr>
<tr><td>
</td><td>The WB-67 represents a larger truck with one trailer attached to it.</td></tr>
<tr><td>
</td><td>The WB-100T represents a truck with a combination of three trailers attached.</td></tr>
<tr><td>
</td><td>The WB-109D represents a larger truck with a combination of two trailers attached.</td></tr>
</table>

Source: Green Book Section 2.8, AASHTO, 2018

2. Industrial Land Uses

Industrial land uses include warehouses, distribution centers, manufacturing facilities, and other types of production activities. Industrial uses vary in intensity, impact, and land requirements based on the types of activities that take place in each use. Differences between the types of uses may include some of the following characteristics:

Intensity and Scale: Industrial uses involve large-scale operations that require substantial infrastructure, machinery, and resources. In the Atlanta area, warehousing accounts for over two-thirds of all industrial development. Warehouses, distribution centers, and e-commerce fulfillment centers are large scale and moderately resource intensive among industrial uses, though they still require significant infrastructure. Truck depots that service freight vehicles, as well as other truck stops and parking areas, are industrial areas that typically have a large scale and less resource intensity. More traditional heavy industrial uses like heavy manufacturing, chemical processing, mining, or power generation tend to be both large scale and very resource intensive.

Environmental Impact: Industrial uses tend to have a high environmental impact due to factors such as carbon emissions, air and water pollution, waste generation, and noise pollution. These activities often require extensive environmental management and mitigation measures to minimize their effect on surrounding areas. Smaller scale industrial operations may have a lessened environmental impact but still require careful management to mitigate any negative impacts on surrounding communities.

Applicable Industrial Uses

- Warehouse and storage
- Distribution centers
- E-commerce fulfillment centers
- Wholesale-trade
- Manufacturing
- Truck depots
- Film production studios
- Motor vehicle sales and services
- Landscaping services
- Electrical, plumbing, and carpentry
- Laboratories
- Breweries and distilleries

Zoning and Land Requirements: Industrial uses typically require large plots of land and are often located in designated industrial zones that are separated from residential or commercial areas. These zones have specific zoning regulations and infrastructure requirements to support industrial activities. In general, industrial land uses should be located near interstates and major roadways and not be developed within established residential areas. Similarly, new residential should not be developed within established industrial areas. Some limited, small-scale industrial may be appropriate near other uses including residential. When possible, however, industrial properties should be developed as part of an overall master-planned industrial park.

The Atlanta region is home to a variety of industrial uses, the majority of which are either warehousing or manufacturing. Figure 1 shows a major industrial site in Buford, Georgia, that houses multiple major warehouses, distribution centers, and manufacturers. Figure 2 shows a recent logistics hub development in Chamblee, Georgia.

Figure 1: Aerial View of a Large Industrial Site

Source: Google Earth Image, 2024

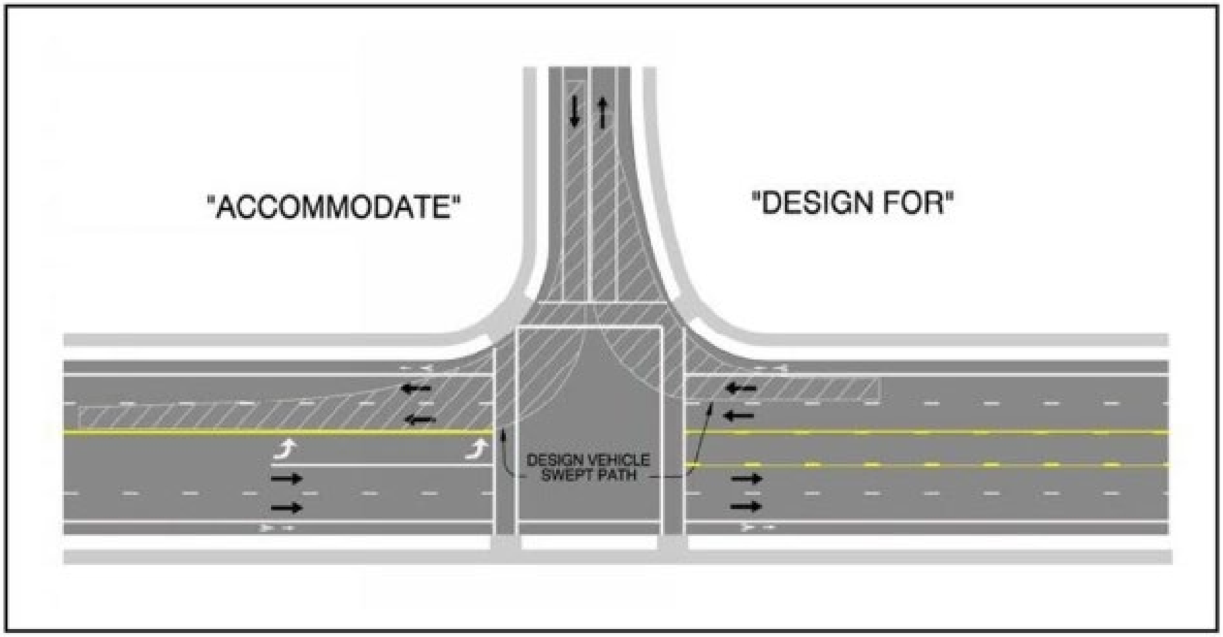
Figure 2: Perspective View of an Industrial Park

Source: "Rare ITP logistics hub opens near historic downtown, finds success," Urbanize Atlanta c/o Stonewall Financial Group, 2024

Roadway Design Concept

The concept of a roadway design makes a distinction between the vehicle for which you design and the vehicle for which you accommodate (as shown in Figure 3). A design vehicle is the largest vehicle that typically travels on a road. The designed vehicle should be able to navigate and turn on the roadway without crossing into adjacent lanes or mounting curbs and sidewalks. For an industrial area, the design vehicle is typically a WB-67 (Wheelbase of 67 ft.), which is a large semitruck with an attachable trailer. The vehicle that should be accommodated for in an industrial area is typically a WB-109D, a combination semitruck with two trailers attached to it.

Figure 3: Comparison of "Design for" Versus "Accommodate"



Source: Design Policy Manual, GDOT, 2024

While this document covers a wide range of design considerations for freight, there are some elements of roadway design that are not included here. Consult the American Association of State Highway and Transportation Officials (AASHTO) *A Policy on Geometric Design of Highways and Streets*, also known as the *Green Book*, and other appropriate GDOT design manuals for topics not covered here.

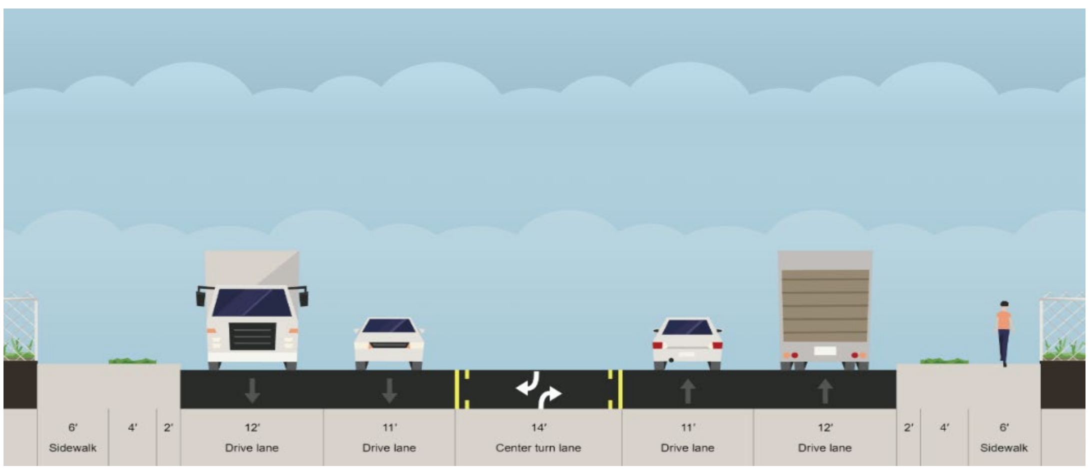
Roadway Design and Lane Widths

When designing heavy trucks on roadways within industrial areas, the makeup of the roadway plays an important role in overall mobility, access, and safety. Considerations for design are included below.

Lane Widths

In industrial areas with large volumes of trucks traffic, 12 feet is the standard design lane width to give trucks enough space to comfortable maneuver. However, if there are multiple lanes in each direction, the inside lane can be 11 feet wide, if needed. Lane widths should only stray from the standard 12-foot lanes in industrial areas when necessary, as 11-foot lanes sacrifice some comfort and safety for freight operators. Lane widths of 10 feet or narrower should never be considered in industrial areas due to their likelihood to increase crash risk. Figure 4 below shows the concept of a four-lane divided road that has a 12-foot outside lane and inside 11-foot lane. On curved segments of roadways, it is recommened that lane widths are widened slightly to accommodate the additional horizontal space that trucks occupy when making turning movements. Standard pavement widening for curves based on radius, length of roadway, and the speed on the turns can be referenced in Table 4.2 of the GDOT *Design Policy Manual*.

Figure 4: Potential Four-Lane Divided Typical Section



Source: Kimley-Horn, Streetmix, 2024.

Medians/Center Turn Lanes

The median type for a roadway in an industrial area should be determined based on the current and the expected volume on the roadway. Typically, a two-way left-turn lane is appropriate for roadways with current annual average daily traffic (AADT) under 18,000 vehicles per day. Roadways with AADT greater than 18,000 daily will likely warrant a raised median, such as a planting strip, with openings in the median for turning movements at key locations. On divided high-speed highways, the GDOT *Regulations for Driveway & Encroachment Control Manual* requires that median openings are spaced at least 1,000 feet apart. On lower speed divided roads or divided roads with high driveway densities, particularly non-state routes, the median openings may be spaced closer together to maintain access. In these scenarios, median opening locations should consider design speed, visibility, and nearby intersections to ensure that turning movements will not substantially increase crashes or congestion. Medians and center turn lanes (Figure 5) provide two important benefits for roadway operations: separation between opposing directions, which helps reduce head-on vehicle collisions, and removal of left-turning vehicles from the through lane, which allows the through lane of traffic to move through the intersection without being delayed by left-turning vehicles.

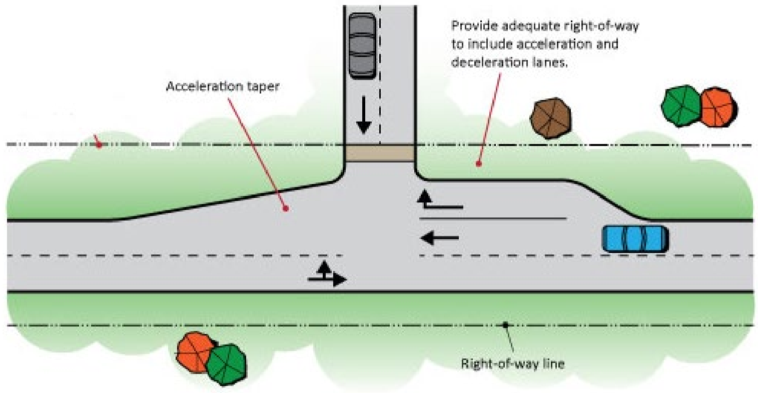
Figure 5: Examples of Center Turn Lanes and Medians

Sources: HRT-08-042, FHWA, 2008; Google Street View, 2022

Acceleration Lanes

An acceleration lane is the section of the road where vehicles can merge onto a major road when they are coming from a smaller or lower speed road. These lanes should only be considered in an industrial area where right turns are frequent. Acceleration lanes should not be added unless they also provide enough length for a loaded tractor trailer to get to the speed of the vehicles in the adjacent lane. Acceleration lanes should not be built in areas with routine pedestrian activity. A diagram of an acceleration lane can be found in Figure 6 below.

Figure 6: Acceleration Lane Diagram



Source: *Multi-Modal Handbook*, Chester County Planning Commission, 2016

Shoulders

A shoulder on a roadway is the space on the outside of a road where vehicles can pull over in case of an emergency, and where first responder vehicles can travel in emergency situations. If there is enough right-of-way, at minimum, 10-foot paved shoulders should be provided to allow room for drivers drifting off the road and pulling over for vehicle failures and issues. Frequently, shoulders are used for temporary truck parking and on-street staging. However, trucks parked in shoulders on the side of the road, like the truck shown in Figure 7, often create safety issues for other drivers: they have a higher chance of being rear ended, take up turning space for other trucks, and reduce sight distance for drivers on perpendicular side streets and driveways. While off-street truck parking should ideally always be provided in industrial areas, on-street parking may be improved through the provision of a buffered truck parking lane, as shown in Figure 8. A 10- to 14-foot parking lane with a 2- to 4- foot painted buffer provides some separation for trucks to park on-street and for drivers to recover after veering out of their lane. Vehicles on adjacent side may also stop at the edge of the buffer area to improve sight distance on turning movements. Separated on-street parking should always be implemented over unseparated parking when feasible, though designers should keep in mind that off-street parking is always preferred over any on-street option in industrial areas.

Figure 7: Truck Parked On-Street in Shoulder

Source: Google Street View Image, 2024

Figure 8: Buffered Parking Lane with Bike Lane

Source: Urban Bikeway Design Guide, NACTO, 2014

Signal Design

Properly timed signal phases and well-designed signal heads are crucial to ensuring efficient roadway operations and safety. Signals on roadways with high percentages of trucks should receive additional timing and design considerations compared to other roadways to accommodate freight operations.

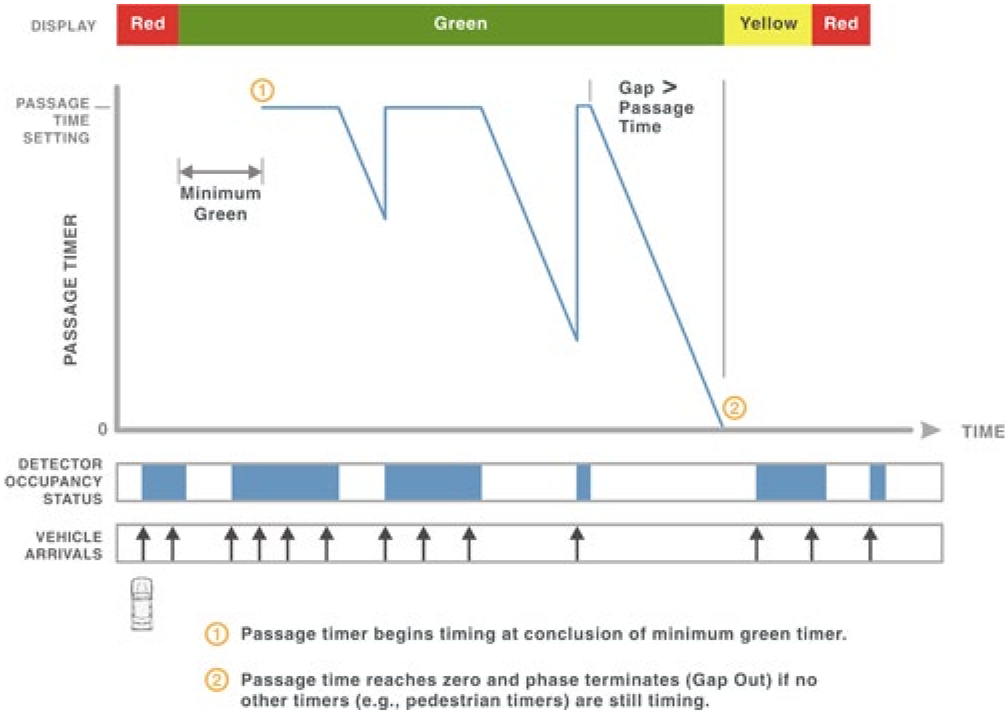
Signal Timing

Signal timing refers to the lengths and patterns of green, yellow, and red lights at each leg of an intersection. Due to the unique physical characteristics of trucks compared to passenger vehicles, signal timing needs are changed at intersections with high percentages of trucks.

When trucks are queued at a red light, they accelerate more slowly than passenger vehicles once the green phase begins. This slower acceleration increases the amount of time it takes for the queue to clear, which may result in queues not being able to clear completely before the green phase ends. The minimum green phase length may be extended for through phases and protected left-turn phases at intersections with high truck volumes if it is observed that queues often are unable to fully dissipate in a single phase. Additionally, longer red clearance intervals may be considered for phases with high volumes of truck traffic. A red clearance interval is the time after one red phase begins and before another green phase begins, and sufficiently long red clearance intervals help to clear traffic out of intersections before allowing other approaches to go. Increased red clearance intervals may be considered at industrial intersections with high truck percentages, as trucks take longer to clear intersections due to lower speeds and longer vehicle length. However, it should be noted that longer red clearance intervals may increase the incidence of running red lights, and they have not been proven to positively affect crash rates in the long-term. See *NCHRP Report 812: Signal Timing Manual* for more information on this topic.

Traffic signal controllers often determine when to end one green phase and begin another phase based on a parameter called passage time. Passage time, also referred to as gap time, is a maximum value for vehicle headways that is determined separately for each intersection and each approach. Modern signal controllers are constantly tracking passage time; they begin counting down as soon as a vehicle leaves the detector and reset the passage time counter once another vehicle crosses the detector, as demonstrated in Figure 9. Once vehicle headways at an approach exceed the passage time, traffic is no longer operating at a minimum efficient flowrate, and the green phase terminates, or "gaps out." Due to the longer vehicle lengths and shorter speeds and accelerations of trucks, it may be desirable to increase passage time at intersections with high truck percentages to reduce premature gap outs.

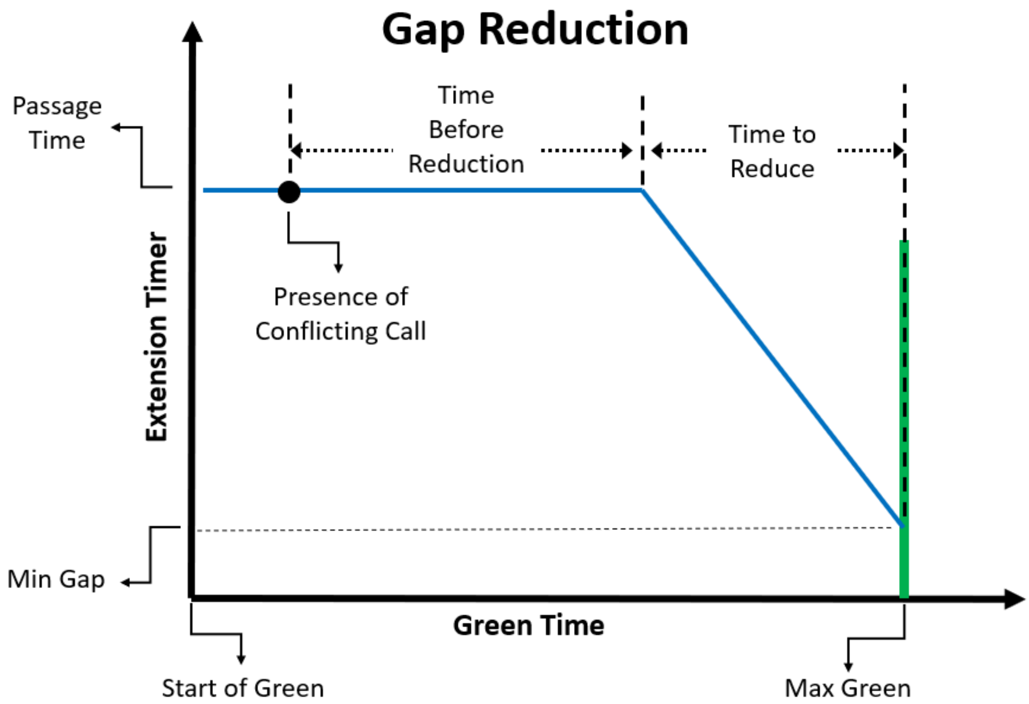
Figure 9: Visualization of Passage Time Countdown



Source: *Traffic Signal Timing Manual*, FWHA, 2008

While it is sometimes desirable to increase passage times for truck traffic, excessively long passage times can cause phases to frequently run for the maximum allowable green time, causing delay on other approaches. To combat this, signal controllers can be programmed to dynamically reduce the passage time mid-phase in order to increase the likelihood of a gap out. Figure 10 shows how gap reduction can be implemented to reduce passage time. After a vehicle or pedestrian is detected on a conflicting phase, gap reduction will be initiated. The passage time will remain constant until a set amount of time has passed after a conflicting call. Then, it will continually reduce until it reaches a minimum gap value, thereby lowing the threshold for a gap out. Generally, the passage time should be constant after a conflicting call for 2/3 as long as the maximum green time, and then it should reduce in the remaining green time. Consult the FHWA *Traffic Signal Timing Manual* for guidance on selecting a minimum green time and other related parameters based on intersection conditions.

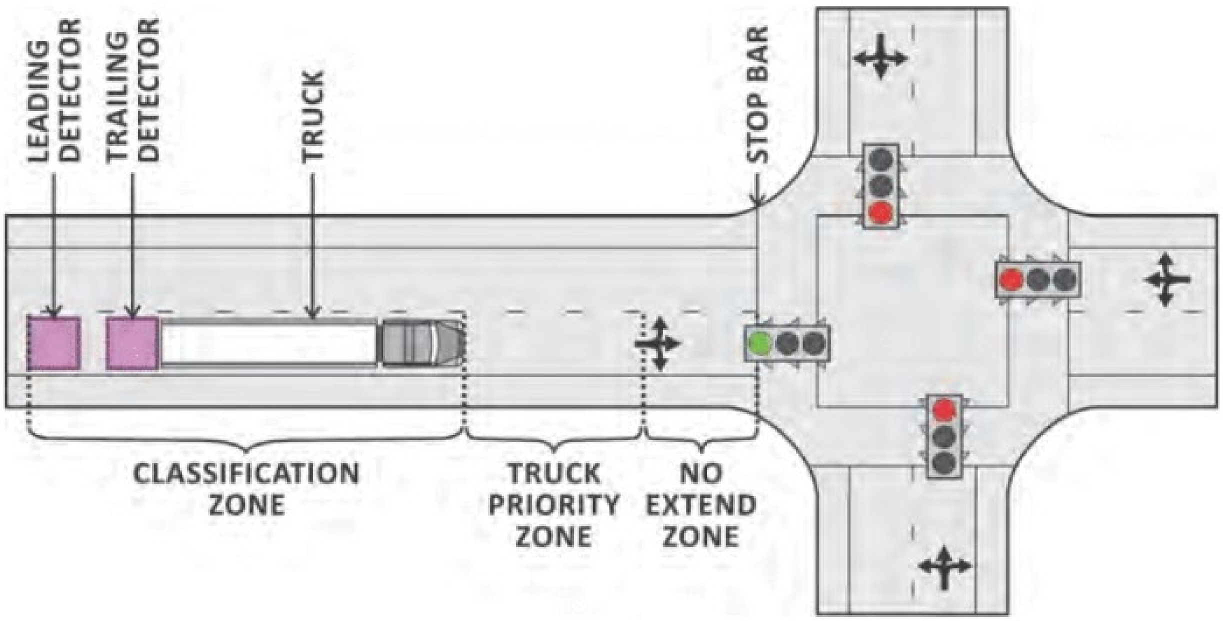
Figure 10: Gap Reduction Diagram



Source: Kimley-Horn

Signal priority is a tool used to give priority to certain vehicles by preempting the typical signal timing pattern. In industrial zones, it may be desirable implement truck signal priority to reduce frequent deceleration and acceleration. This can be done by installing two detectors in advance of a truck's decision zone that can detect and classify vehicles, as shown in Figure 11. When a truck drives over these detectors, they send a message to the signal controller to preempt the current pattern and give preferential treatment to the arriving truck. This is typically done by extending the green time at the truck's approach to prevent green phases from terminating while trucks are in the decision zone. Truck signal priority is a low-priority form of signal priority and as such will never provide an early green phase or insert a green phase for a truck out of order. In industrial areas where trucks are common and freight efficiency is especially important, truck signal priority may be considered at key intersections. See the FHWA report *Design and Installation Guidelines for Advance Warning Systems for End-of-Green Phase at High-Speed Traffic Signals* for more direction on implementing truck signal priority.

Figure 11: Example Design of Truck Signal Priority Detection



Source: *NCHRP Report 812: Signal Timing Manual*, NCHRP adapted from Northwest Signal Supply, 2015

Supplemental Signal Faces

Signal head visibility is of vital importance to the safe and smooth operation of a roadway intersection. On some roadways, horizontal or vertical alignments or an increased presence of large trucks may obscure the primary signal head from arriving vehicles. In these situations, a supplemental signal head is warranted. Because trucks require a longer stopping sight distance than passenger vehicles, designers in industrial areas should evaluate signal visibility based on the largest expected truck's stopping sight distance. If signals are not visible for at least this distance due to roadway geometry, supplemental signal heads should be placed both in advance of the intersection, such as on a curve on an intersection approach, and immediately before the intersection. High truck percentages on roadways may also obscure signal heads from passenger vehicles, in which case supplemental signal heads should at least be placed immediately before the intersection. GDOT recommends supplemental signal heads when primary signal visibility is limited, roadway design speeds are 45 miles per hour or faster, and/or truck percentages are high; the Ohio DOT recommends considering supplemental signal heads on roads whose traffic is at least 10% trucks. In general, supplemental signals should be placed to provide optimum visibility to road users, meaning ideal placement varies between intersections. Supplemental signal heads may be supported by the signal span wire or mast arm, as shown in Figure 12 and Figure 13, or they may be pedestal-mounted with the lowest part of the signal between 12 and 19 feet above the sidewalk. See the FHWA *Manual on Uniform Traffic Control Devices* for more guidance on the design and installation of supplemental signal heads.

Figure 12: Supplemental Signal Head on Left Supported by Mast Arm

Source: Google Street View

Figure 13: Supplemental Signal Head on Right Supported by Mast Arm

Source: Google Street View

Roadway Lighting

Proper roadway illumination significantly reduces crash risk and increases comfort for vehicle operators. Because trucks have longer stopping sight distances than passenger vehicles, proper lighting is especially important on roadways with high truck volumes. Further, truck stops and rest areas should be lit well to ensure safety and comfort for freight operators. While little guidance exists regarding lighting roadways specifically for trucks, the FHWA *Lighting Handbook* should be consulted for specific guidance on keeping roads safely lit.

Multimodal Access

Multimodal transportation access includes public transportation such as buses, heavy rail, and streetcars, bicycle facilities such as bike lanes and cycle tracks, and pedestrian walkways such as sidewalks and multi-use paths.

Pedestrians

Pedestrian activity in industrial areas is typically low due to its separation from other land uses. Additionally, industrial areas are often not designed with pedestrians and multimodality in mind. Transit, bicycle, and pedestrian infrastructure may be insufficient or altogether nonexistent, and pedestrians and bicyclists may feel unsafe traveling in areas where truck infrastructure and mobility take precedence. As a result, when planning industrial areas, it is important to consider how employees access these facilities and to ensure that pedestrians are separated from truck traffic as much as possible. If it is necessary for pedestrians and trucks to mix, there must be appropriate safety measures in place. Safety measures to consider where pedestrians and trucks interact include:

- Sidewalks buffered from the curb on both sides of the road to separate pedestrians and vehicles
- Marked crosswalks at intersections, as shown in Figure 14
- Medians or pedestrian islands on wider roads that allow pedestrians to cross in smaller distance intervals
- Separate truck and pedestrian paths through major intersections
- Raised right-turn islands at channelized right-turns that allow pedestrians to cross in two separate movements

Figure 14: Pedestrians Crossing in Front of Truck at Marked Crosswalk

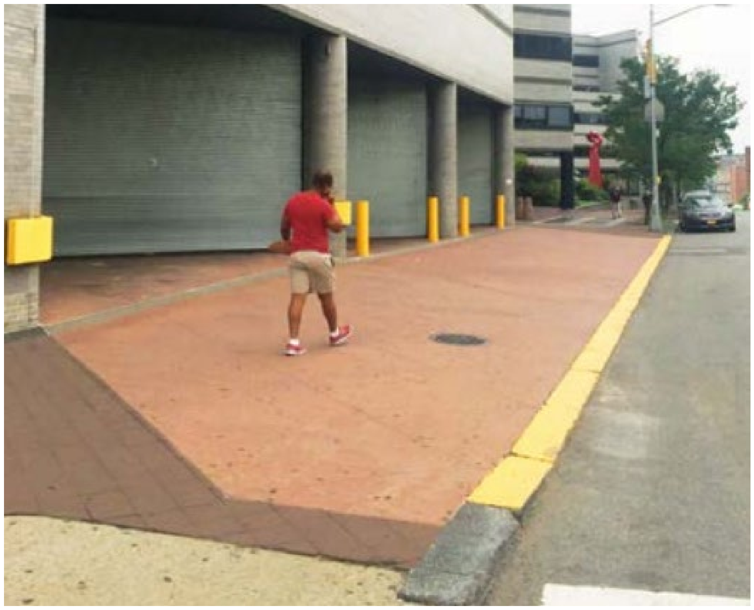
Source: *Construction Trucks Toolbox Talks: Pedestrians*, CLOCS-A, 2023

Sidewalks

Since larger trucks have a limited view, it is important to make sure that sidewalks in industrial areas have a buffer, such as a planting strip or trees, in between the sidewalk and the roadway.

Based on the AASHTO *Green Book* criteria, a buffer of at least 2 feet between the roadway and the sidewalk is preferred, as is the provision of sidewalks on both sides of the street. It is also important to demarcate stretches of sidewalk which also serve as loading dock entrances, as seen in Figure 15.

Figure 15: Painted Sidewalk at Loading Dock Entrance

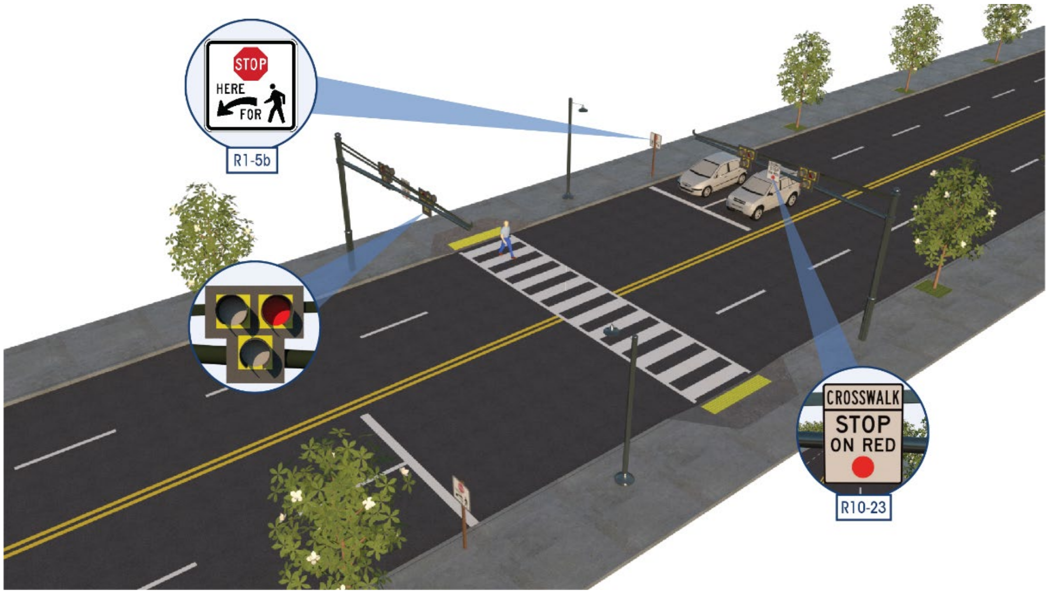


Source: *Accommodating Freight in Complete Streets*, NYSERDA, 2019.

Crosswalks

Signalized intersections in industrial areas should be equipped with pedestrian crossing infrastructure. At a minimum, this means providing pedestrian signals and painted crosswalks, though additional treatments such as raised crosswalks and crosswalk beacons may be considered at intersections with high volumes of pedestrians. Mid-block crossings should also be considered at key locations, such as transit stops, if they are not near a signalized intersection. Pedestrian hybrid beacons, as shown in Figure 16, significantly reduce crash risk for crossing pedestrians and as such should be considered at mid-block crossings.

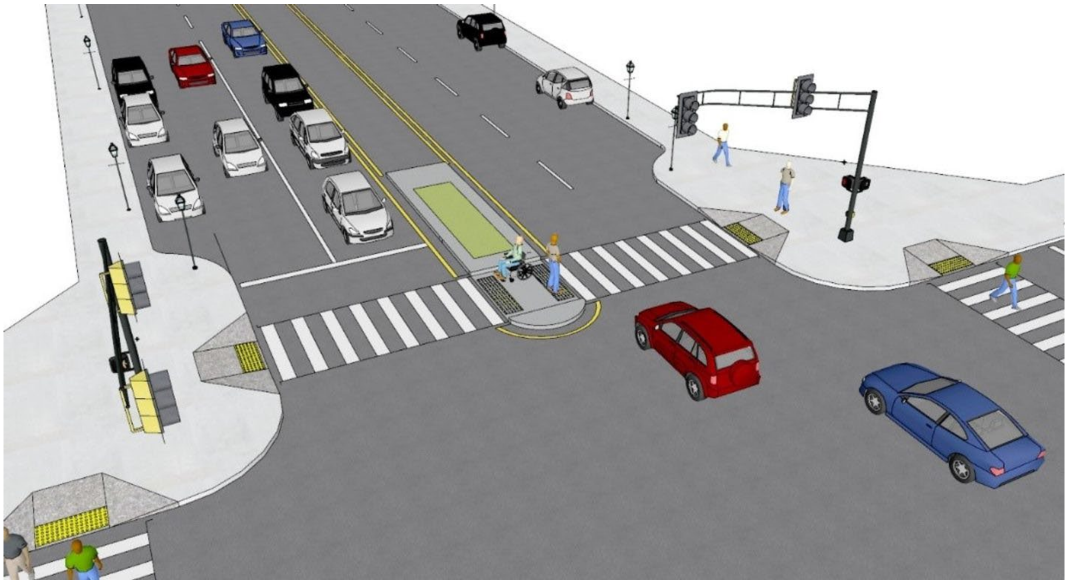
Figure 16: Rendering of a Pedestrian Hybrid Beacon at at Mid-Block Crossing



Source: *Pedestrian Safety Guide and Countermeasure Selection System*, FHWA, 2013

Since intersections in industrial areas tend to have wider turning radii to allow trucks to turn and maneuver safely, crosswalks at these intersections are longer than normal. An effective approach to minimize the time pedestrians spend in a crosswalk, making the pedestrian experience safer and more comfortable, is to separate longer crosswalks into two movements. This can be done by adding a pedestrian refuge island which lets the pedestrian cross the intersection in two phases. If there is a large number of trucks turning right, a dedicated right turning lane, also known as a channelized right turn lane, can be added with a crosswalk to allow pedestrians to cross in two or more phases. An example of a pedestrian refuge island can be found in the Figure 17 below.

Figure 17: Pedestrian Refuge Island in Median



Source: *Bicycle and Pedestrian Treatments,* Virginia DOT, 2024

Bike Facilities

Bicycle facilities should be provided whenever possible in industrial areas. While not often present in industrial areas, safe bicycle infrastructure can be an effective way to offer increased mobility options while also managing the demand for car traffic. To promote safe and comfortable biking, bike lanes, cycle tracks, and multi-use paths should always be separated from the roadway by a vertical barrier like a curb or bollard. All separated bike facilities should have at least a 1.5-foot buffer from travel lanes. Because of the increased risk to bicyclists posed by heavy truck traffic, striped and shared on-street bike lanes should not be considered in industrial areas. Figure 18 shows an example of a curbed and buffered multi-use path that bicyclists might use on Peachtree Industrial Boulevard in Peachtree Corners, GA.

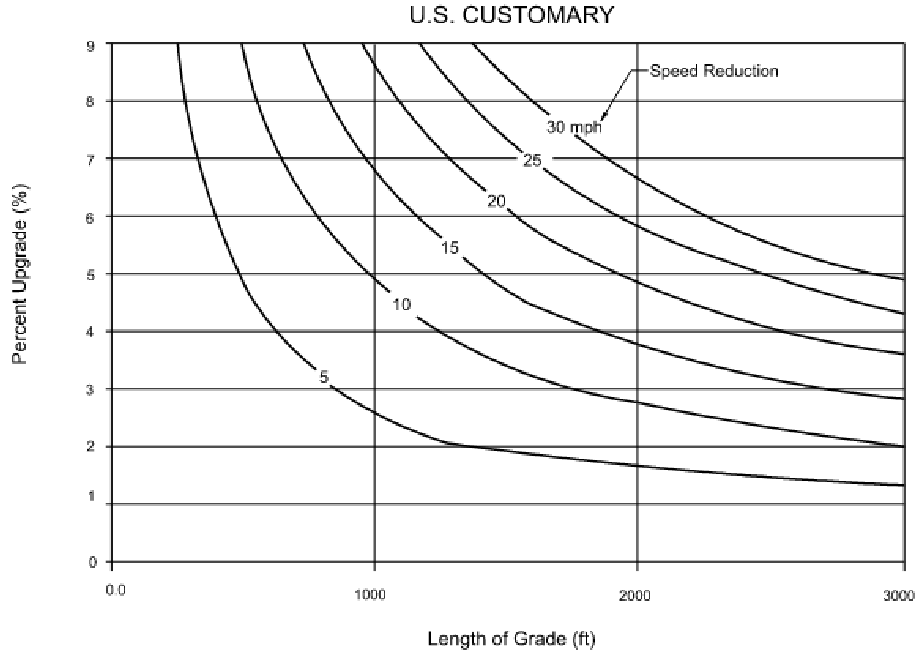
Figure 18: Buffered Multi-Use Path on Peachtree Industrial Boulevard

Source: https://www.nycstreetdesign.info/geometry/grade-separated-bike-lane, Google Street View

Vertical Grades

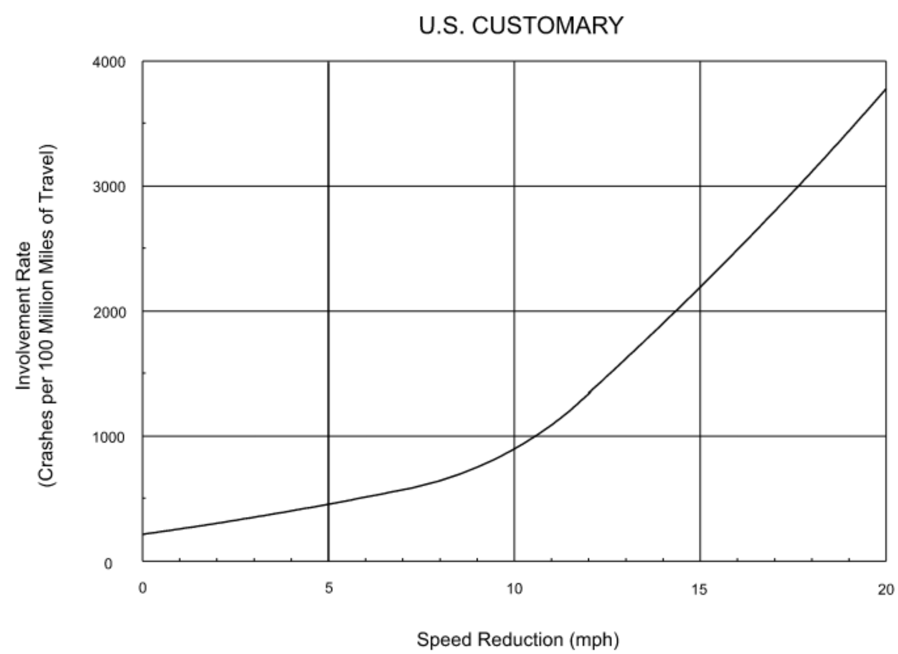
Vertical grade refers to the slope and elevation of a road. In general, flatter vertical grades are preferred for roadways, but even more so in industrial areas. A maximum grade of 6% is recommended in industrial areas. Another important factor to consider for trucks is the concept of critical length of grade. As a loaded truck travels up an extended positive grade, it loses speed. The longer the grade, the greater the reduction in speed; and the greater the speed differential between a truck and other traffic, the greater the risk of a crash. AASHTO recommends limiting the speed differential to 10 MPH or less. The speed reduction by the steepness and length of grade is shown in Figure 19 below. Figure 20 shows the crash rate by the speed reduction involving trucks.

Figure 19: Acceptable Grade by Grade Length



Source: A Policy on Geometric Design of Highways and Streets, AASHTO, 2018

Figure 20: Critical Lengths of Grade for Design, Assumed Typical Heavy Truck of 200 lb/hp [120kg/kW]

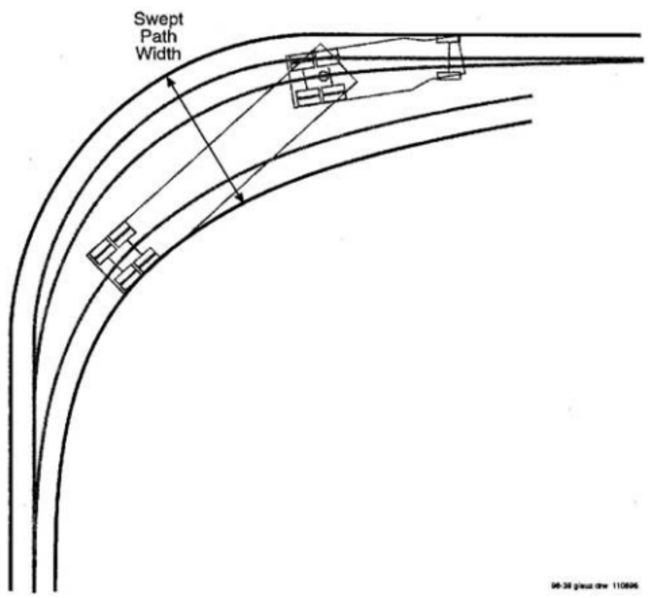


Source: A Policy on Geometric Design of Highways and Streets, AASHTO, 2018

Intersection Design

Determining the appropriate design vehicle and check vehicle (a larger vehicle which the roadway can accommodate as needed) is a critical decision for intersection design. For an industrial district or area, a WB-67 is a typical design vehicle. As a result, the area of roadway over which the vehicle drives in a turning movement, known as the swept path (illustrated in Figure 21), of the WB-67 controls intersection design.

Figure 21: Illustration of Swept Path Width

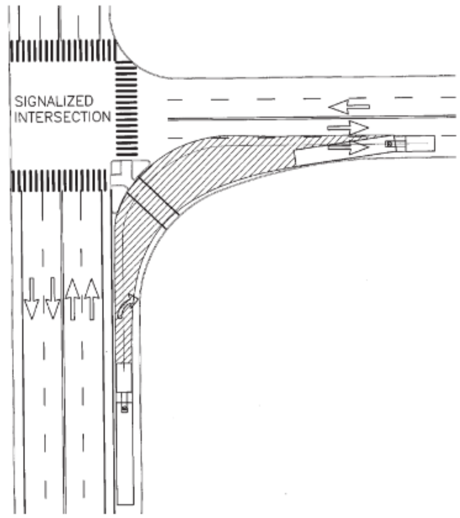


Source: Report 505 - Review of Truck Characteristics as Factors in Roadway Design, NCHRP, 2003

Right Turns

Intersection design should allow for a right turn to be made into the outside lane without encroaching on an adjacent lane or over a curb. For WB-67, the design vehicle typical of industrial areas, the curb radius ideally should be 75 feet. The larger curb radius can make pedestrian crossing distance undesirably long, so raised and curbed channelization islands - also known as corner islands – should be considered to break up pedestrian crossings into smaller segments, as shown in Figure 22. Curb radius can be less than 75 feet if a striped area with a taper is used (as shown in Figure 23), or a paved shoulder is constructed. Mountable curbs allowing a truck trailer to track over the curb should only be used in areas where pedestrian activity is rare. Due to the load put on sidewalks and gutters from over tracking freight, 8-inch-thick concrete should be used at intersections.

Figure 22: Suggested Design Practice for Corner Islands



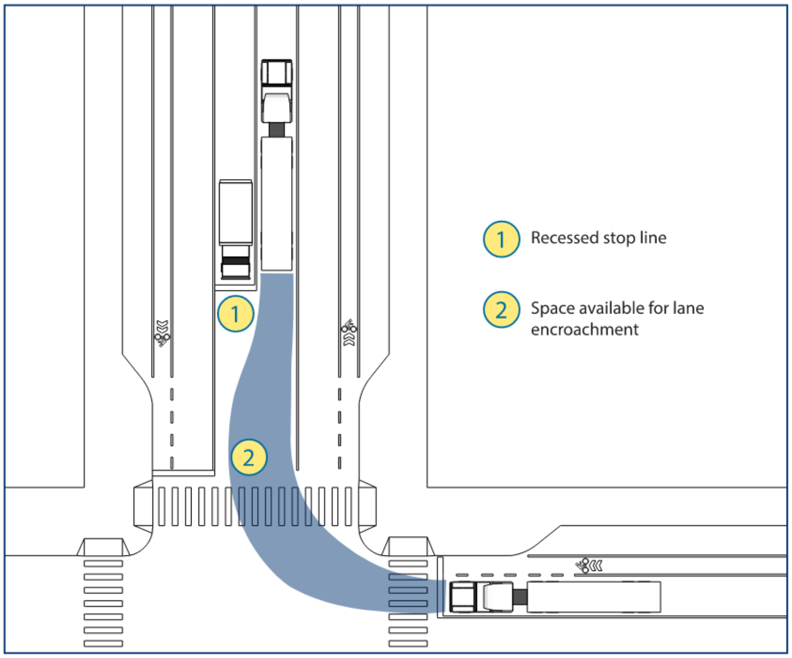
Source: Designing for Truck Movements and Other Large Vehicles in Portland, City of Portland Office of Transportation, 2008

Figure 23: Tapers Used to Reduce Corner Radii and Channelization Islands to Reduce Pedestrian Crossing Distance

Source: Google Earth Image, 2024

Where right-of-way is limited, a right turning tractor trailer may have to encroach onto the opposite side of the road. In places where this is common, the stop bar should be set farther back from the intersection to accommodate the wide turning radius of the tractor trailer, as shown in Figure 24 below.

Figure 24: Recessed Stop Line Diagram



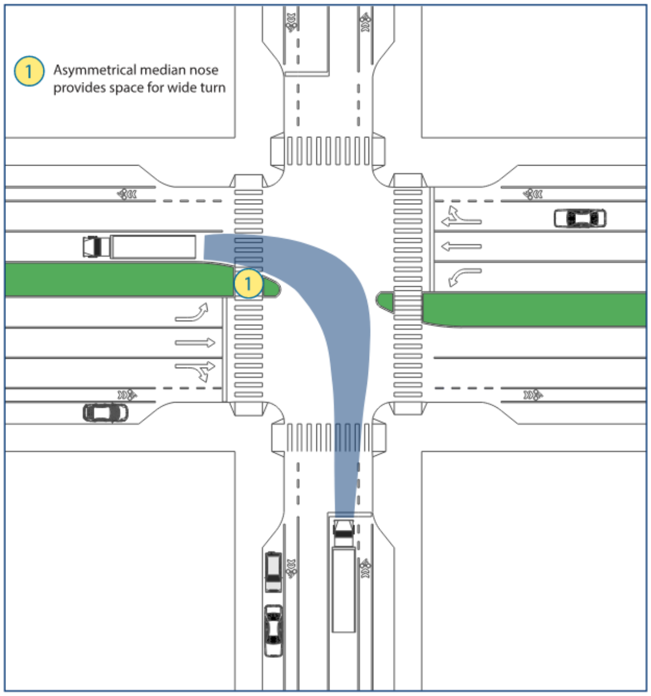
Recessed stop line diagram

Source: Accommodating Freight in Complete Streets, NYSERDA, 2019

Left Turns

Careful analysis is needed when laying out left turn lanes so a WB-67 can make the movement without tracking over a median end, or nose. Asymmetrical median noses, such as the one shown in Figure 25, are recommended to avoid trailers over-tracking median noses.

Figure 25: Asymmetrical Median Nose Diagram



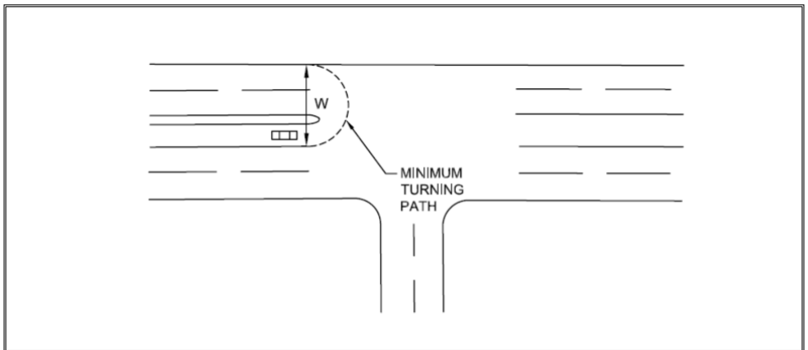
Source: Accommodating Freight in Complete Streets, NYSERDA, 2019

Stop bars on intersecting streets must be set back enough so a stopped vehicle does not block left turning trucks. When designing dual left-turn lanes, trucks will typically use the right lane in the dual left. The receiving road likely will need to be wider than 24 feet at the intersection to receive dual left-turn lanes.

U-Turns

WB-67s require a substantial amount of pavement to execute a U-turn. The GDOT Regulations for Driveway and Encroachment Control recommends a minimum diameter of 90 feet for a WB-67 (as shown in Figure 26) from the right side of the left turn lane to the outside edge of the receiving roadway. The preferred design is to locate driveways and side-street serving industrial uses where U-turns will not be necessary for trucks.

Figure 26: Minimum Road Width for U-Turns



DESIGN VECHICLE	MINIMUM WIDTH (W), FT.
PASSENGER CAR	48
WB - 50 TRUCK	80
WB – 62/WB - 67 TRUCK	90

Source: Regulations for Driveway & Encroachment Control Manual, GDOT, 2024

Roundabouts

Roundabouts are rare in industrial areas but can have several positive impacts on roadway safety and operations if implemented correctly. The main limiting factor for roundabouts in industrial areas is the space requirement: roundabouts must have a large enough diameter to accommodate trucks without requiring them to drive on the apron, and that amount of space is often not available in industrial sites. If space allows, however, roundabouts are safer and more efficient than signalized intersections. Further, trucks specifically benefit from the ability to more easily make a U-turn at roundabouts than they can at signalized intersections. On the kinds of multi-lane divided roadways that are often the major thoroughfares in industrial areas, the ability to easily turn around without waiting for gaps in oncoming traffic is a major boon to freight operators.

When high volumes of truck traffic are expected at a roundabout, the intersection geometry should be designed to allow trailer trucks like the WB-67 truck to maneuver the roundabout without regularly using the truck apron. Wide lanes, a large roundabout diameter, uncurbed centers, and mountable aprons are design elements that help to accommodate large trucks at intersections. See the *Kansas Roundabout Guide Roundabout Guide, Second Edition* from the Kansas DOT for further guidance on designing roundabouts for truck traffic.

Access Management

Access management refers to how properties and other developments are connected to roadways. Typically, developments in an industrial area are accessed by large driveways.

Driveways

Similar to intersection design, driveways in industrial areas must be designed to account for the design vehicle based on the driveway's curb radius to ensure a smooth entry and exit for large trucks. A 75-foot radius is typical for driveways within industrial land uses, as shown in Table 2.

Other driveway design considerations include:

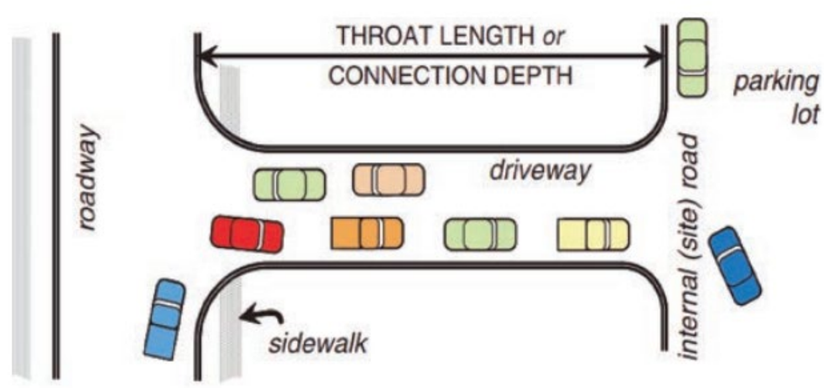
- Ensuring guard or gate houses should not cause trucks to back onto public roadways.
- Providing sidewalks or other pedestrian infrastructure to keep pedestrians out of the driveway when walking from the roadway to the development.
- Separating employee driveways from truck driveways so that employee traffic does not interfere with truck traffic into and out of the property.
- Ensuring driveways are long enough, or have a long enough "throat" (Figure 27), that a truck can completely vacate the public roadway before needing to make turns or parking maneuvers.
- Ensuring guard or gate houses should not cause trucks to back onto public roadways.
- Providing sidewalks or other pedestrian infrastructure to keep pedestrians out of the driveway when walking from the roadway to the development.

Table 2: Minimum Corner Radii Determined by the Development Use Typical Design Vehicle

Driveway Use	Minimum Radius, Feet
Residential	15
Commercial	35
When Designed for Trucks	75

Source: Regulations for Driveway & Encroachment Control Manual, GDOT, 2024

Figure 27: Illustration of Driveway Throat Length or Connection Depth



Source: Report 943- Design and Access Management Guidelines for Truck Routes: Planning and Design Guide, NCHRP, 2020

Pavement Maintenance

Roads with high volumes of truck traffic may need more frequent pavement maintenance due to the extra pavement stress caused by heavy vehicles. Roadway owners should closely monitor high truck volume routes for any necessary resurfacing, restriping, pothole filling, and curb repair. If a curb requires frequent repair, consider moving the curb location to decrease the likelihood of off-tracking.

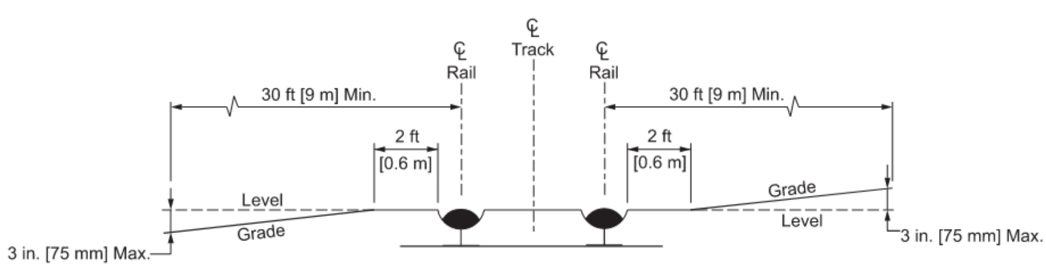
Railroad Crossings

For safety reasons, railroad owners and transportation agencies limit at-grade rail crossings on roadways as much as possible while concentrating traffic on crossings with the highest levels of traffic control and safety features. According to the FRA/FHWA *Highway-Rail Crossing Handbook (3rd Edition)*, the closure of one or more crossings should be considered whenever a new crossing must be established. Due to this consideration, the engineering analysis and permitting from a railroad can be time-consuming.

Design

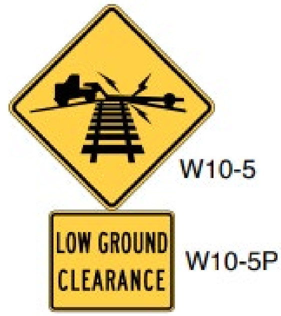
At-grade railroad crossings should be reviewed so that low clearance trucks do not result in trailers getting stuck on the tracks. The difference in grade on roadway approaches should not exceed 3 inches within 30 feet of the tracks (Figure 28). Existing grade crossings not allowing proper clearance for truck traffic should be clearly signed, as in Figure 29.

Figure 28: Railroad-Highway Grade Crossing



Source: A Policy on Geometric Design of Highways and Streets, AASHTO, 2018

Figure 29: Low Railroad Clearance Warning Sign



Source: A Policy on Geometric Design of Highways and Streets, AASHTO, 2018

Pedestrian Considerations

At-grade railroad crossings should also have pedestrian crossing infrastructure where pedestrian activity is common. Often, pedestrian railroad crossings can simply consist of sidewalks next to the road that ramp down to the railroad pavement, as shown in Figure 30. With this configuration, pedestrian movements are controlled by the same gate that controls vehicle movements when trains are approaching. Pedestrian crossings may also be implemented separately from roadways where pedestrians need to cross railways, such as at multi-use paths. Standalone pedestrian stop gates like those shown in Figure 30 can be implemented to both physically control the movements of pedestrians and to alert pedestrians that they are walking near a railroad. Regardless of crossing location, at-grade railroad crossings must have safe and accessible pedestrian infrastructure if walking traffic is anticipated.

Figure 30: Pedestrian Railroad Crossing on Sidewalk in Duluth, GA

Source: Google Street View, 2019

Figure 31: Standalone Pedestrian Railroad Crossing with Pedestrian Oriented Signal and Signage in Woodstock, GA

Source: Atlanta Regional Commission

Employee Access

Employee access points to industrial facilities should be designed with safety as the most important consideration. Employee entrances to facilities should be separated from truck access points as much as possible to reduce potential conflicts and ensure efficient freight movement, as shown in Figure 32. Ideally, employee access points should be designed to accommodate employees arriving through various transportation modes. Reviewing and understanding employee commute patterns, as well as local transportation plans, can assist in access point design and provide seamless integration with surrounding land uses. Many of the elements described in the **Multimodal Access** section (page 18) apply to employee access as well.

Figure 32: Separated Employee and Truck Access

Source: Google Earth Image, 2024

Pedestrian Facilities

At a minimum, facilities should include sidewalk coverage, both connecting to the primary roadway and within the property itself. New industrial developments should build sidewalks along the edge of the property along all roadways. Sidewalks on the property should connect any parking lots with employee entrances to provide a separate pathway for employees to safely access the facility. Employees arriving on foot should have safe sidewalk access connecting to public sidewalks. All sidewalks should be at least 5 feet wide, set 2 feet back from the curb, have adequate lighting, and comply with all other provisions of the Americans with Disabilities Act (ADA). Figure 33 shows an example of a sidewalk that meets all minimum design requirements outlined above. Additionally, crosswalks should be placed where pedestrians are expected to cross areas with vehicular traffic, especially driveways carrying truck traffic. Bicycle facilities, including bike lanes, bike parking, and bike lockers, should be considered if nearby roadways contain bike facilities.

Figure 33: Properly Designed Sidewalk in Mableton, GA

Source: Google Street View

Public Transit

As some employees may require or prefer transit, transit connectivity should be considered in site design and freight planning more broadly. Comfortable and accessible connections from existing transit to industrial sites should be provided. If a facility is not served by a transit line and a transit system is present in the area, a facility owner or tenant may consider coordinating with the local transit agency to discuss the possibility of providing future service. Transit stops should be ADA compliant.

To improve transit access, industrial sites should consider coordinating with local transit agencies to add a transit stop on-site rather than on adjacent roadways. Stops at industrial sites should also be sheltered to protect employees waiting for transit. Figure 34 shows the MARTA bus stop at the UPS Distribution Center on Fulton Industrial Boulevard. The stop is sheltered located on site with nearby sidewalks for employees to get from the stop to buildings. Additionally, the location of the stop is designed to allow for buses to easily and quickly turn around, which demonstrates beneficial cooperation between site owner and transit operator. Site designers should consider emulating the properties of the stop to provide safe and accessible transit stops for employees.

Figure 34: On-Site Bus Stop

Source: Google Earth Image

If stops must be placed along roadways, the stops should be as close to the employee buildings as possible and have a direct, paved sidewalk path with painted crosswalks to employee entrances. Figure 35 shows the MARTA bus stop on Derrick Industrial Parkway at the Walmart Distribution Center off of South Fulton Boulevard. This stop has numerous desirable properties: it is sheltered and has benches for employee comfort; it is on the edge of the site; it is illuminated by a lamp post at night; and it has a ramp nearby that leads directly to an employee entrance to the site. Further, there are sidewalks and crosswalks from the site entrance to the building entrance to protect employees walking from the bus stop. This kind of transit stop is a good option for industrial sites that control site access with physical elements like fences.

Figure 35: Sheltered Bus Stop with Ramp to Site Entrance

Source: Google Street View

Employee Parking

Employee parking lots should be kept separate from truck parking and staging areas so that employees do not have to interact with trucks while walking from their cars to the building. To maintain this separation and provide a pleasant employee experience, employee lots should incorporate landscaping elements and street trees. This is not only aesthetically pleasing but will provide shade for employees and create a positive environmental impact. In Figure 36 below, access to the employee parking lot is restricted to three driveways while trucks enter the site at a separate driveway at the back of the building. The truck driveway is separated from the nearby parking lot driveway through a large landscaped area that also serves to enhance the environment. Ensuring that any needed employee overflow parking incorporates pervious pavement will also create a positive environmental impact. Driveways used for employee parking lots that connect roadways to industrial sites should be a minimum of 20 feet in length to reduce traffic backups onto the main roadway.

Figure 36: Separated and Landscaped Employee Access

Source: Google Earth Image

Curbside Management

Although curbside management is a bigger consideration in urban areas and small downtowns, there are still important aspects of it to consider in industrial areas. Curbside management in industrial areas should consider the usage of curb space by multiple users and the design of the industrial site with respect to roadways. Industrial sites should locate loading areas interior to the site and not facing public roadways, as shown in Figure 37. Curbside management is especially important for light industrial spaces mixed with other uses. These properties should create and maintain designated loading zones that minimize impacts to public rights-of-way and surrounding uses.

Figure 37: Loading Area Located Away from Roadway

Source: Google Earth Image, 2024

Loading Dock Requirements

In industrial areas, loading docks are designed to make freight handling smooth and efficient. In heavy industrial areas, loading dock requirements are often less of an issue because these facilities are usually self-contained. The greater distance of heavy industrial areas from the roadway differs from light industrial areas, where buildings may be closer to the roadway. Common light industrial buildings include automobile repair garages, office spaces, and industrial machinery testing laboratories.

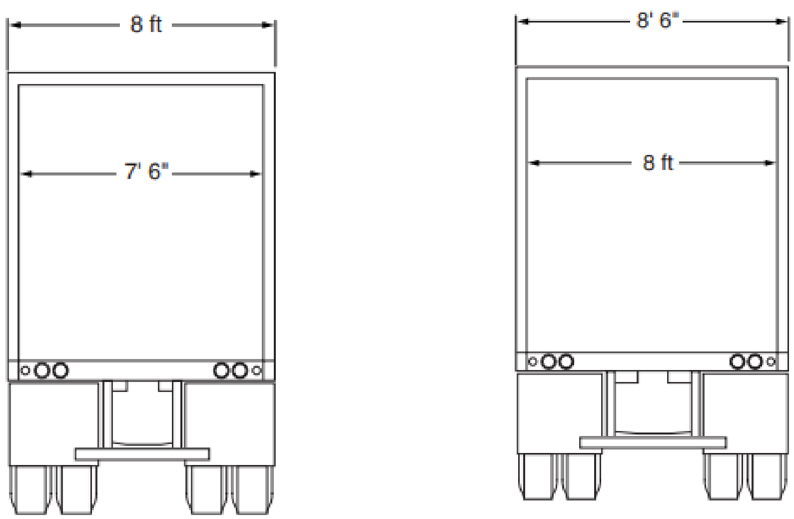
Light industrial spaces may need stricter loading dock regulation due to their proximity to roadways and areas with high passenger vehicle or pedestrian traffic. If light industrial loading docks cannot be accessed within on-site parking areas, it is necessary to allow turning movements from the public right-of-way. These turning movements in turn need to be designed to have curb radii and driveways that support truck maneuverability – see the Intersection

Design (page 24) and Access Management (page 29) sections for more information on those design considerations. Additionally, if pedestrians walk near light industrial loading docks, it is important to size docks such that parked trucks do not block pedestrian pathways.

Dock Doors and Aprons

Each loading dock in industrial areas should have a 48-inch door leading to bays (synonymous with docks). This size accommodates most delivery trucks and equipment. The apron—the truck loading and maneuvering area in front of the dock—should be made of concrete and slope away from the building at 1%. This gentle slope helps ensure proper drainage, preventing water from pooling. It is also a good practice for the unloading process of both freight workers and equipment. Apron length should be 60 feet long to provide enough space for loading and unloading activities. Additionally, 75 feet of space is recommended for truck maneuvering and parking. As illustrated in Figure 38, common dock door dimensions are 8 feet in width but can be as wide as 8'6' to accommodate maximum trailer size limits.

Figure 38: Typical and Maximum Trailer Widths

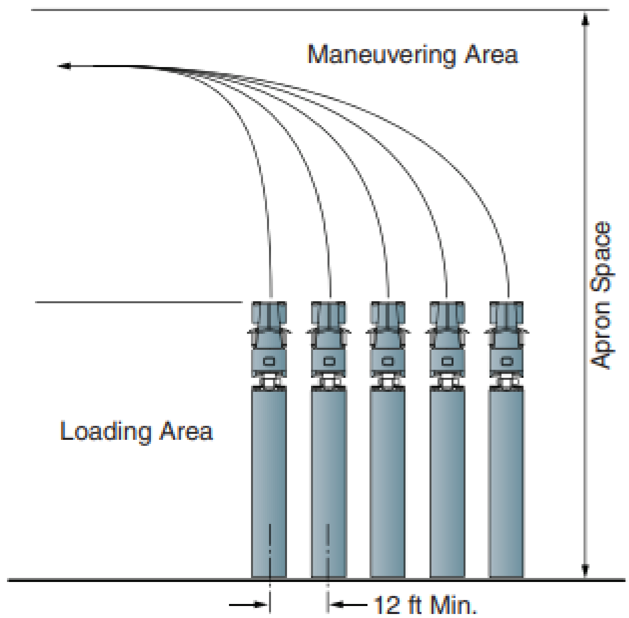


Source: *Dock Planning Standards*, NOVA Technology, 2013

Dock-to-Space Ratio

Typically, a site will need one loading dock for every 5,000 to 15,000 square feet of warehouse space. This ensures there are enough docks to handle the volume of shipments. The width of the loading dock itself should be approximately 10 feet, which is standard for fitting and unloading equipment, with an additional two feet between each dock. The Apron Space Diagram in Figure 39 highlights the recommended 12 foot minimum per truck spacing within the loading area, allowing for easier maneuvering.

Figure 39: Apron Space Diagram

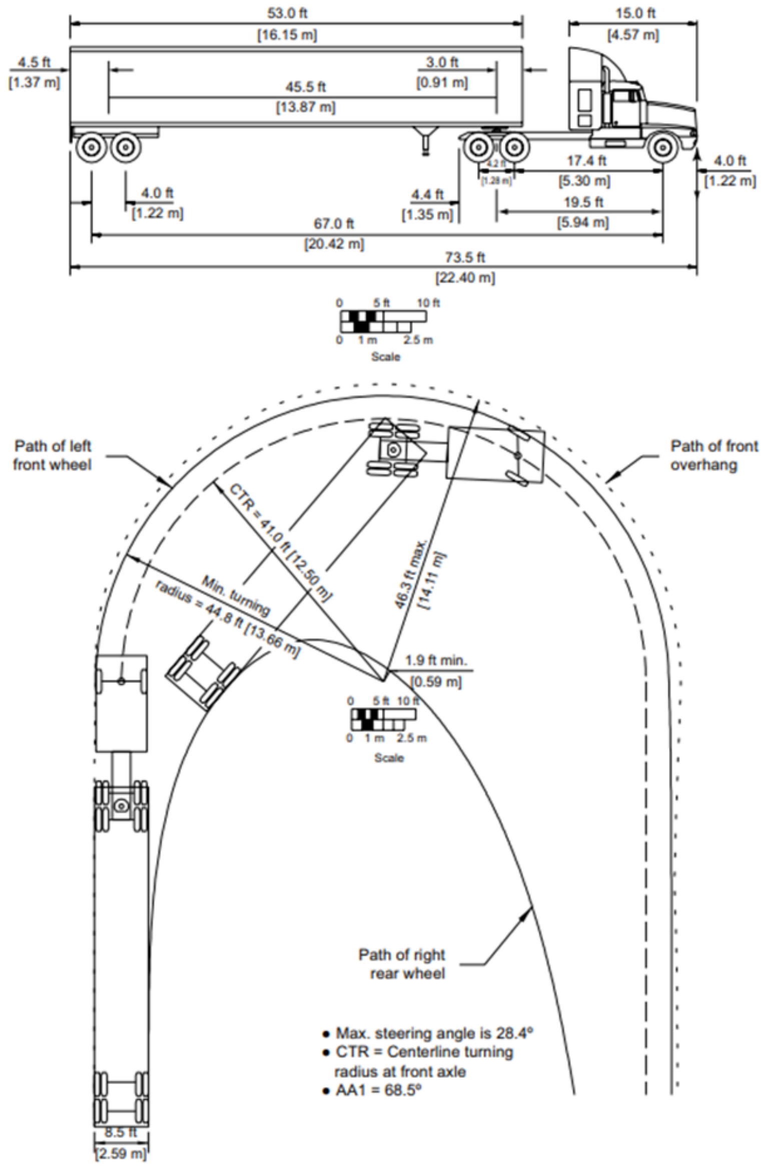


Source: *Dock Planning Standards*, NOVA Technology, 2013

Truck Parking Requirements

For industrial land uses, any truck parking provided should meet standard size requirements to easily accommodate truck traffic. As detailed in Figure 40 below, truck parking spaces should be 80 feet in length and 12 feet in width, with a vertical clearance of 14 feet to accommodate standard trucks parked at a 90-degree angle. A 10- to 15-foot-wide concrete gear landing pad or dolly strip is required for stability and durability. If parking includes vehicles other than trucks, ADA requirements must be met to ensure accessibility for all users.

Figure 40: Minimum Turning Path for Interstate Semitrailer (WB-67 [WB-20]) Design Vehicle



Source: *Green Book*, Figure 2-24, AASHTO, 2018

Truck Staging Requirements

Truck staging areas are spaces for trucks to park and wait prior to a scheduled delivery or pickup. Staging trucks will often idle to keep heating or cooling systems running, causing emissions and noise pollution. On-site staging areas are needed to prevent trucks from idling on public roadways and other locations that negatively impact the public and neighboring land uses. New manufacturing, warehousing, and distribution facilities must have a minimum of one 10-foot by 80-foot temporary truck staging space for every two loading docks on site. If possible, 12-foot by 80-foot spaces are preferred to provide comfort to truck operators. These spaces must be available to drivers while industrial facilities are open, though they may be located outside of access-controlled areas.

Because truck staging areas are typically located on-site in industrial areas, design guidance beyond the minimum requirements described above is broad. Spaces should have room to maneuver without impacting nearby parking and traffic movements, and no spaces or maneuvering areas should be located within public rights-of-way or required buffer areas and setbacks. Street access should be provided to the staging areas, and all staging areas should meet any applicable paving, grading, drainage, and lighting standards.

Another option for truck staging areas is a shared staging facility. Neighboring industrial facilities may choose to form shared staging agreements to consolidate truck staging space to a single, underutilized lot. Local authorities may encourage the development of these agreements to allow flexibility for facility owners in providing stages spaces. In areas of high demand, local authorities may also consider partnering with local private industrial facilities to develop shared truck staging facilities themselves. This may be a consideration where insufficient staging areas has a negative impact on surrounding communities due to the need for temporary truck parking to overflow into non-industrial areas.

Delivery Times

Restrictions on delivery times may not be crucial in heavy industrial areas that are separated from other land uses and that have ample space for truck parking and staging on the property. However, delivery time restrictions should be considered if freight deliveries routinely impact local roadways or surrounding properties, especially for industrial uses that are mixed or in close proximity to other uses. Many communities across the region have set specific time limits for trucks parked on any public street or highway. For example, a common restriction (and one set by the City of Atlanta) is that trucks or freight-carrying vehicles exceeding a one-half ton capacity may not park or stand on public streets for longer than one hour during the day. Some jurisdictions also prohibit delivery vehicle parking on public streets during set times; for instance, the City of Atlanta prohibits overnight parking on public streets. Deliveries at all properties should be planned outside of peak traffic times, when possible, to minimize congestion.

Wayfinding

In industrial areas, wayfinding signage is usually located on private property and is therefore less restrictive than wayfinding guidelines on public roads. Signage regulations are typically determined by the local Authority Having Jurisdiction (AHJ). Although private wayfinding signage is more common, clear and frequent signage is an important tool on public roadways as well. Effective wayfinding plays a crucial role in ensuring efficient and safe movement of employees, trucks, and visitors. On public roadways, designated truck routes indicate through-routes for trucks, but additional roadway signage may be necessary for ensuring low-conflict connections between truck routes and industrial sites. The following guidelines should be considered to enhance navigation within industrial zones.

Directional Signage

To maintain safety and operational efficiency, employees and trucks should be clearly directed to their designated areas, as shown in Figure 41. Clear and strategically placed directional signage should indicate distinct routes for trucks and passenger vehicles, minimizing the risk of crashes and ensuring smooth traffic flow.

Figure 41: Example of Directional Signage at a Factory Entrance

Source: Kimley-Horn

On public roadways, directional signage should be used to provide key information about local conditions and roadways to freight operators. The kind of signage and necessary information to convey will vary between industrial areas, but common signs indicate unusual roadway geometries, unexpected roadway connections, points of insufficient vertical clearance, and locations for U-turns. Local authorities should consider the conditions in their industrial areas and communicate with key stakeholders, including businesses and freight operators, about what kinds of signage may be necessary.

Internal and External Signage

Wayfinding signage should be strategically placed at facility access points and internally at intersections within the industrial site. To ensure that vehicles enter the industrial site in the correct direction, signage indicating the direction of traffic flow should be placed before the entrance. Signage should utilize a clear and consistent design with readily recognizable symbols or text to ensure that they are as user-friendly as possible.

Turn-around Options

Industrial areas often require large trucks to navigate tight spaces and maneuver safely, leaving little room for directional changes or correction of missed turns. Businesses should designate and clearly mark turn-around zones or routes. A minimum turning radius of 50 feet is required for cul-de-sacs, with a preferred radius of 60 feet to accommodate tractor trailers.

Additional Considerations

Wayfinding signage should use large, clear fonts and high-contrast colors to enhance visibility and readability, as displayed in Figure 42. Regular maintenance and updates to signage is also recommended.

Figure 42: Truck Loading Zones Signs

Source: Accommodating Freight in Complete Streets, NYSERDA, 2019

Visual and Noise Buffers

Visual and noise buffers are essential to minimize the impact of industrial use on the surrounding area. Noise levels at property lines must comply with local AHJ noise ordinances, and operations must not exceed allowable decibel levels. To reduce visual and auditory disturbances, truck docks should be oriented away from public spaces. Additionally, areas storing vehicles outside must be screened from view from highways or major streets along the entire property frontage. Figure 43 shows various options for buffering industrial areas from other land uses.

Figure 43: FHWA Barriers

Source: FHWA, 2021

Noise Buffers

To effectively manage noise levels, businesses should ensure that the volume of operations is minimized beyond the property. Performing a sound study can help identify potential noise issues and guide the implementation of appropriate measures to mitigate them. Noise buffers may include sound walls separating residential and industrial areas, as shown in Figure 44. Examples of sound walls include vegetative screening, masonry walls, or a combination of both.

Figure 44: Sound Wall

Source: Kimley-Horn

Visual Buffers

Appropriate vegetative opaque screening is recommended to maintain the visual appeal of industrial sites. By implementing effective visual buffers such as natural vegetation (shown in Figure 45), earthen berms, opaque solid wood fences or walls, or a combination of these elements, industrial sites can ensure a cleaner and more attractive frontage, particularly in areas where vehicle storage is visible from highways or major streets. These screening measures not only serve as a visual barrier, but also help to mitigate any potential negative impacts that may arise from the industrial operations, such as noise or unsightly equipment. Furthermore, industrial properties can explore the use of art installations or murals as visual buffers. These creative elements can be strategically placed on fences, walls, or as standalone structures to add a touch of artistry while effectively screening the site from public view. Art installations can also serve to engage the local community and foster a sense of civic pride or brand identity. By investing in appropriate buffers, industrial sites can demonstrate their commitment to community integration.

Figure 45: Vegetative Screening Around an Industrial Property

Source: Google Earth Image, 2024

Emerging Design and Infrastructure Needs

Emerging design and infrastructure needs in industrial areas and freight transportation are crucial for supporting economic growth and ensuring efficient operations as the market and government incentives evolve to reflect new technologies.

As industry trends reflect advances in electric or hydrogen fueled vehicles, related infrastructure should be considered. Charging stations can be placed on individual sites or grouped at charging hubs. Federal and state subsidies should be explored in charging infrastructure development. The large area covered by many industrial sites also provides opportunities for larger solar installations which can cover some of the power generation needed for high-capacity electrical charging and should be explored.

Another important consideration is the planning for connected, autonomous vehicles in industrial areas and freight transportation. "Platooning" of connected freight vehicles will increase fuel efficiency, while autonomous freight may decrease the need for long-haul truckers and allow for narrower traffic lanes. Regarding industrial area design, autonomous vehicles are perhaps most relevant to truck yards. In an autonomous truck yard, autonomous vehicles manage trailers between dock doors and on-site storage. These are already in use and may be developed in the Atlanta region in the coming years. The management of these yards occurs through a combination of AI, machine learning, and computer vision, aided by human support. Designing autonomous truck yards with advanced technologies and infrastructure, such as charging stations, maintenance facilities, and smart traffic management systems, is crucial to support the safe and seamless operation of autonomous freight vehicles.

Additionally, the concept of multi-story industrial developments is an emerging approach in American markets. Previously seen in Asia and Europe, increasing land values and the need for smaller industrial spaces near urban centers are making multi-story industrial developments competitive options in parts of the United States. Multistory warehouses often utilize truck ramps and docks on multiple floors to maximize floor area ratio within a constrained building footprint. These developments can house manufacturing facilities, warehousing spaces, and logistics operations, enabling businesses to operate efficiently. Multi-story developments complement retrofitted or newly multi-use retail spaces (e.g. a Wal-Mart Supercenter doubling as retail and storage/distribution) in filling the need for e-commerce distribution hubs (*The Evolution of the Warehouse: Trends in Technology, Design, Development and Delivery*, NAIOP, 2020).

In summary, emerging design and infrastructure needs in industrial areas and freight transportation encompass the development of alternate fuel infrastructure, planning for autonomous vehicles, and the utilization of multi-story industrial developments. Addressing these needs is essential for promoting sustainability, improving operational efficiency, and optimizing land utilization in the industrial and freight sectors.

Sustainable Warehouse Design

Most aspects of sustainable industrial design fall outside of typical zoning ordinances. This limits the impact the public sector can have on these developments. Therefore, these design guidelines do not provide specific recommendations for sustainable industrial developments.

Instead, the following links to reference information is provided:

- https://www.energystar.gov/buildings/tools-and-resources/warehouse-best-practices-checklist
- https://support.usgbc.org/hc/en-us/articles/12089652865683-Applying-LEED-to-warehouse-and-distribution-center-projects
- https://www.prologis.com/what-we-do/resources/elements-of-a-sustainable-warehouse
- https://www.srsi.com/7-elements-of-a-sustainable-warehouse/

3. Downtowns/Small Regional Centers

Downtowns and small regional centers contain a variety of land uses, often including a mix of retail spaces, restaurants, offices, residential, and community-focused spaces. These areas typically include some of the following characteristics:

Applicable Downtown/Small Regional Center Uses

- Retail Stores
- Restaurants and Cafes
- Shops and Services
- Office Spaces
- Residential
- Libraries
- Art and Entertainment Venues
- Cultural Festivals and Markets
- Parks and Public Spaces
- Recreational Facilities

Intensity and Scale: Downtowns and small regional center intensities vary based on the primary activities taking place. Retail stores are generally small- to medium-sized, attracting high volumes of foot traffic for product displays and customer interactions. Restaurants and cafés also occupy small- to medium-sized spaces, but can range from small, quiet establishments to busy restaurants. Office spaces typically occupy medium-sized spaces and experience moderate traffic. Residential uses vary in intensity and scale, with single-family and townhome developments occupying smaller spaces and apartment/condo residential developments having larger footprints. Community services like healthcare clinics, government offices, and recreational facilities focus on public interaction with low to moderate traffic.

Environmental Impact: The activities associated with downtowns and small regional centers have varying degrees of environmental impact. Retail stores, office spaces, and community services have a low impact with minimal pollution and basic waste management practices. Restaurants and cafés have a moderate impact due to food preparation and waste, requiring adherence to health regulations and energy efficiency measures. Apartments and condos typically have moderate environmental impacts from waste and water usage, but their impacts are lower per capita than single-family and townhome residential development.

Zoning and Land Requirements: The zoning and land requirements for downtowns and small regional centers are shaped by their specific functions. Retail stores are typically located in commercial or mixed-use zones, requiring small- to medium-sized spaces in high-traffic areas. Restaurants and cafés also fit into commercial or mixed-use zones and require space for dining, food preparation, and possibly outdoor seating. Office spaces and community services are found in commercial or mixed-use zones and require functional work environments and public service areas. Residential development in downtowns and small regional centers is typically located in mixed-use zones, though single-family and townhome development may infrequently be in residential zones.

This chapter is primarily applicable to historic and newer suburban downtowns and activity centers in Metro Atlanta. These areas outside the Atlanta region's urban core are hubs of commercial, office, and residential activity for their local areas but draw fewer trips from across the Atlanta region. Compared to the major activity centers discussed in Chapter 4, the downtowns and small regional centers discussed here are quieter and bring in less traffic. For example, McDonough, Duluth, and Douglasville (Figure 46) are home to historic downtowns with a mix of existing development and the potential for redevelopment.

Newer downtowns, like in Alpharetta (Figure 47), Suwanee, and Town Brookhaven (a commercial and residential development in the City of Brookhaven), have recently gone through major development or redevelopment, making them local activity hubs. These guidelines will also be applicable to some new mid-rise developments along vital metro Atlanta corridors outside of activity centers, similar to recent mixed residential and commercial developments on Cobb Parkway in Cobb County, Roswell Road in the City of Sandy Springs and Peachtree Boulevard/SR 141 (Figure 48) in the City of Chamblee. Conducting loading/unloading activities on-site as part of the development, rather than on busy travel corridors, is important for both safety and operations. Redevelopments of this type are likely to continue along major corridors in the region, and good design for loading and curb management is relevant here just as it is in historic downtowns and existing activity centers.

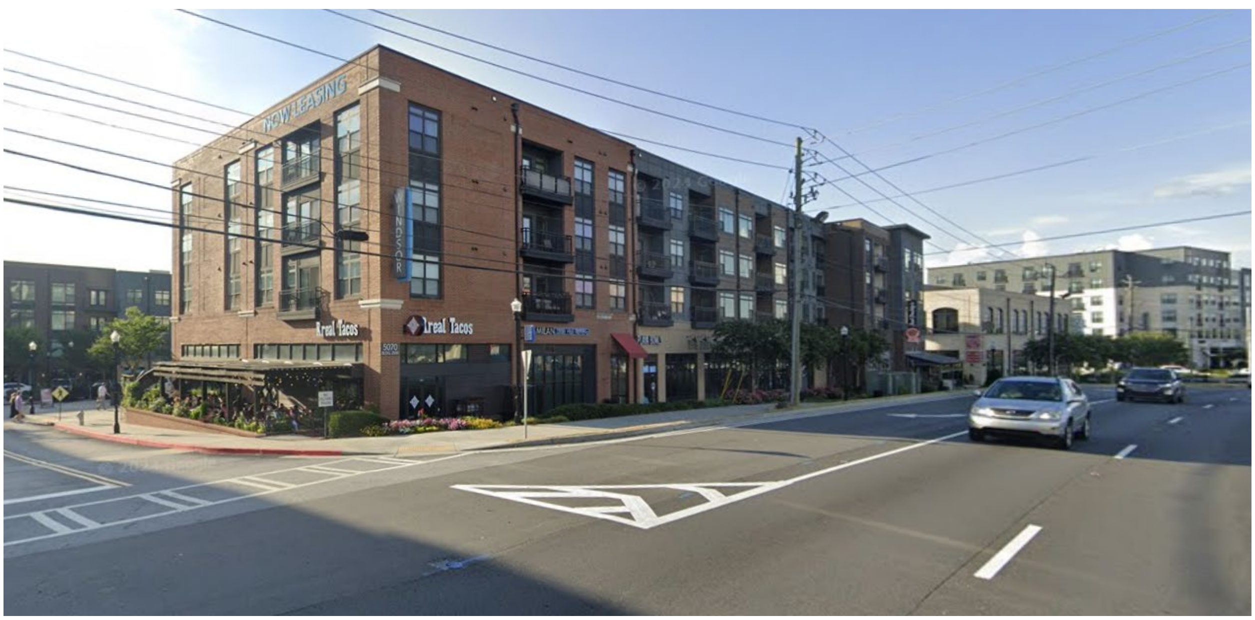
Figure 46: Downtown Douglasville

Source: https://visitdouglasville.wordpress.com/2022/10/07/fall-in-love-with-douglasville-top-things-to-do-in-and-around-douglasville-this-fall/, Visit Douglasville, 2022

Figure 47: Downtown Alpharetta

Source: https://www.exploregeorgia.org/article/guide-to-alpharetta, Explore Georgia and Jason Getz, 2024

Figure 48: Mixed-Use Developments, Peachtree Boulevard/SR 141, City of Chamblee

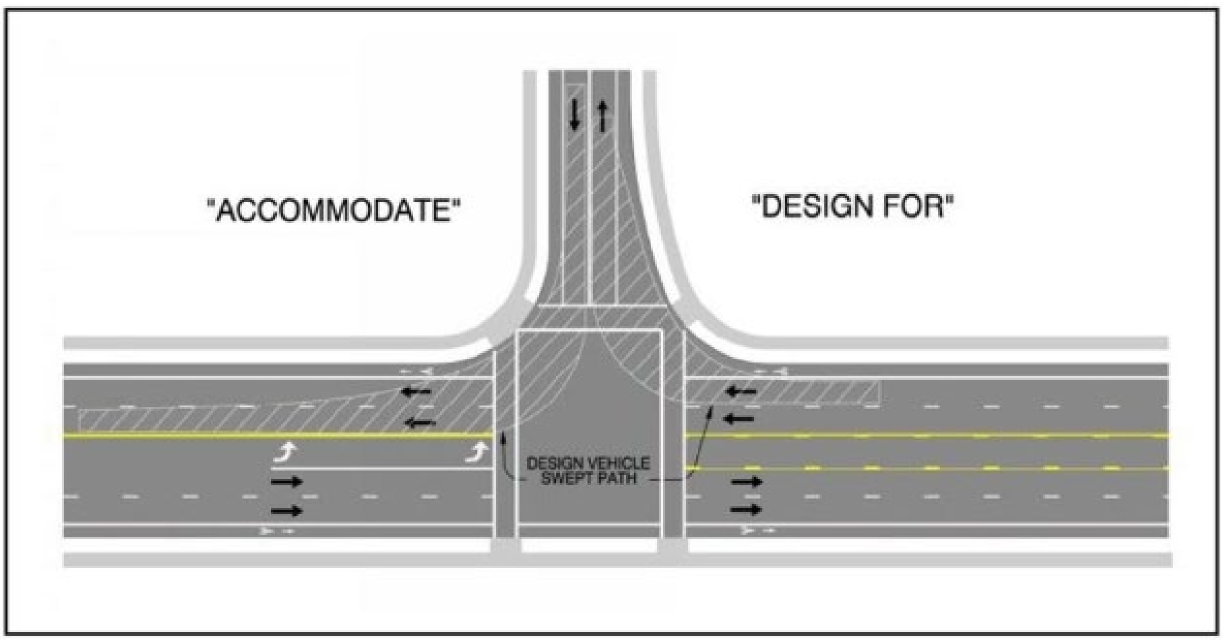


Source: Peachtree Boulevard/SR 141, Google Maps

Roadway Design Concept

The concept of a roadway design makes a distinction between the vehicle for which you design and the vehicle that you accommodate, demonstrated in Figure 49. See the Introduction chapter of these guidelines for more information on truck types. A design vehicle is the largest vehicle that frequents a roadway facility and should be able to maneuver the roadway and intersections without encroaching on adjacent lanes or over tracking curbs and sidewalks. For downtowns and small regional centers, the design vehicle is typically a single unit delivery truck (SU-40). A check vehicle is the largest vehicle that sometimes uses a roadway. A combination truck (WB-67) is likely appropriate to be a check vehicle that should be accommodated in this setting. Sometimes, though, local authorities may limit the size of incoming trucks to no larger than a 62-foot wheelbase, depending on local context, in which case the WB-62 would become the check vehicle. Transit and emergency vehicles are often somewhere between the SU-40 and WB-67 in size, meaning that the range of SU-40 to WB-67 trucks also encompasses many buses, fire trucks, and ambulances. However, transit and emergency vehicle dimensions vary by jurisdiction, so designers should consult local authorities to confirm these dimensions.

Figure 49: Comparison of "Design for" Versus "Accommodate"



Source: *Design Policy Manual*, GDOT, 2024

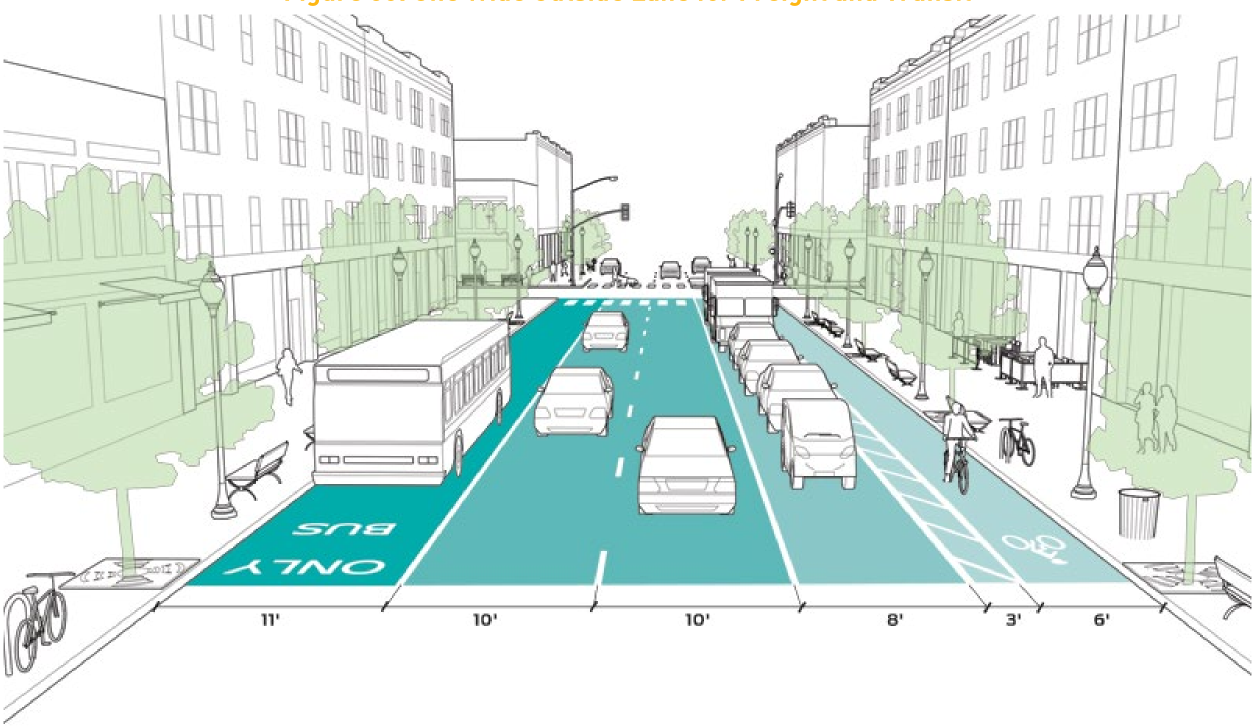
Roadway Design and Lane Widths

Roadway design for freight within downtowns and small regional centers requires careful consideration of a mix of transportation modes and limited right-of-way.

Lane Widths

In downtowns and small regional centers, traffic operates at slower speeds than in less dense environments, and vehicles are frequently in close contact with pedestrians and bicyclists. It is crucial for lane widths to be designed with multimodal safety in mind. When designing for single unit delivery trucks, a lane width of 11 feet is preferred, providing adequate space for smaller delivery trucks while also accommodating the occasional large, multi-unit truck. Lane widths of 10 feet may be acceptable in especially restricted settings where right-of-way is limited, but they may require some trucks to use adjacent lanes for maneuvering near intersections. When lane widths of 10 feet are used, the space outside of travel lanes must be available for off-tracking (when a truck's rear wheels follow a different, tighter path than its front wheels). Alternatively, lane widths can vary between the inside and outside lane on multilane roads. For example, a 10-foot inside lane combined with an 11-foot outside lane can conserve space while still accommodating freight well. Figure 50 demonstrates how narrow inside lanes can be combined with an 11-foot outside lane to accommodate freight and transit.

Figure 50: One Wide Outside Lane for Freight and Transit



Source: Urban Street Design Guide, NACTO, 2013

Lane widths smaller than 10 feet should not be considered on any roadway open to truck traffic. Furthermore, while lane widths greater than 11 feet may provide improved maneuverability for trucks, they often do so at the cost of encouraging higher speeds or infringing upon pedestrian and bicycle right-of-way. Designers should consider the level of multimodal activity when designing lane widths for truck traffic. On curves, some pavement widening may be necessary to ensure trucks that take up more horizontal space can maneuver safely. Table 4.2 of GDOT's *Design Policy Manual* should be referenced when designing curves for trucks.

Other Considerations

Medians/Center Turn Lanes

GDOT provides design guidance and requirements for medians that must be considered on state roads. GDOT suggests a 24-foot median on all multilane arterials, but this is often unfeasible in downtowns and small regional centers due to space constraints. In practice, medians of 14 feet or narrower are more feasible in these areas. More generally, GDOT prefers positive separation – a median type that physically divides the road via a longitudinal barrier, such as a concrete or metal barrier – whenever possible on all high-speed arterials. The GDOT *Design Policy Manual* Section 6.12.2 has more detailed information on arterial medians.

Additional median design guidelines apply to roads that are not state-owned. In downtowns and small regional centers, right-of-way constraints often require a choice between medians and other road elements like sidewalks or turn lanes. If space allows, however, a median separating opposing traffic directions can provide improvements to safety and operations. Paint-striped separation between 2 feet and 4 feet wide can provide adequate separation in areas with less frequent left turns.

In areas with frequent left-turning movement, installation of center two-way left-turn lanes can improve safety by removing turning vehicles from through lanes. Figure 51 shows an example of what a two-way turn-lane implementation may look like in downtown areas. Trucks especially benefit from center turn lanes by reducing the need to maneuver around turning vehicles on through lanes.

Two-way left-turn lanes may not always be appropriate, however, as they do not provide refuge to crossing pedestrians nor do they restrict access opportunities. When either or both of these qualities are desirable, raised curb medians may also be considered as a way to separate opposing traffic and create space for left-turning vehicles to wait to turn. Curbed medians are generally desirable on arterial roadways if space allows, though flush medians are also common. In downtowns and small regional centers, physical medians are not commonly found on local roads except where buffer strips have been installed.

Figure 51: Example Two-Way Turn-Lane in Downtown Setting

Source: Kimley-Horn; Streetmix

Shoulders

Shoulders are uncommon in downtowns and small regional centers. Space limitations often prevent even small shoulders from being feasible. On-street parking is common in downtowns and can provide areas for trucks to pull over in emergencies to not impede through traffic, but they should not be relied on for this purpose. Similarly, curb and gutter sections can provide a few feet of additional pavement in emergencies. Gutters can be between 1 and 6 feet wide, and curbs should be placed 2 feet away from the traveled way when possible. Slow-moving freight vehicles can mount sloping curves at the edge of travel ways as necessary. Because the pavement space is likely to be used often in downtown areas, curb and gutter pavement should be strong enough to withstand regular use by vehicles.

In many historic downtowns, header curbs made from stone and marble are common roadway elements that contribute to the local historic character. These kinds of curbs are not ideal for streets with heavy truck traffic as they are not easily mountable or strong enough to withstand frequent heavy truck traffic. Cities should prohibit truck traffic on streets with these kinds of curbs whenever possible to maintain pavement condition while preserving the character of the area. Access to adjacent land uses should be provided by nearby minor roadways. If trucks must operate on roadways with header curbs, historic downtowns should consider providing loading zones outside of the travel way to accommodate them. This could be accomplished by converting on-street parking to truck loading zones if necessary.

Truck Restricted Roads

Truck routes define the road network that trucks may use to navigate between destinations. Trucks are also typically permitted to utilize non-designated truck routes for the purpose of making deliveries. Sometimes, local jurisdictions will completely prohibit truck traffic above a certain size on some streets, even for deliveries. These kinds of restrictions are permittable and may even be encouraged, depending on the context of the area. On these kinds of streets, tighter turning radii, narrower lanes, and smaller shoulders can be designed.

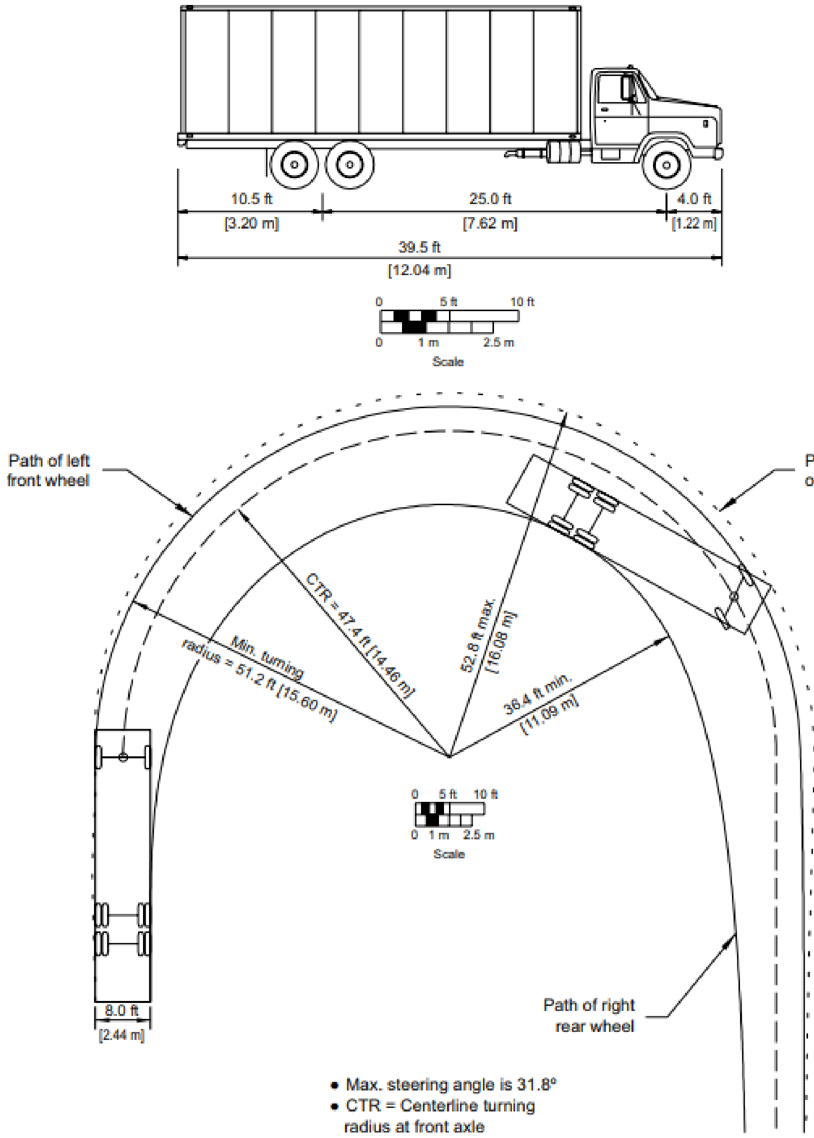
However, even when trucks are prohibited on a street, there is still a possibility that trucks may end up on the street at some point. Because of this possibility, street infrastructure should not be designed in such a way that a truck would cause damage if it were to drive through. This includes considering impacts on utility or signal poles that may protrude into the street, double high curbs, vegetation, and other design elements that could be damaged by trucks. Even on streets that are not designed for trucks, infrastructure should still be designed to avoid damage from the occasional truck driving through.

Other elements of roadway design, like multimodal considerations, on-street parking, and loading will be addressed in later sections of this document.

Intersection Design

Intersection design in small downtowns and regional centers must balance the unique needs of freight traffic with pedestrian-friendly environments and efficient vehicle flow. According to AASHTO's *Policy on Geometric Design of Highways and Streets* (commonly known as the *Green Book*), intersections in these areas should be designed in such a way that large trucks, particularly semi-trailers, can maneuver safely without causing excessive disruption. This often requires wider turning radii of at least 30 feet based on the maneuverability of the SU-40 design vehicle, as shown in Figure 52.

Figure 52: Swept Path of SU-40 Truck



Source: *Green Book*, AASHTO, 2018

The AASHTO *Green Book* emphasizes the importance of designing intersections that accommodate different modes of transportation, including freight, by ensuring appropriate lane widths and shoulder provisions. Intersections should be designed with clear sightlines and gradual curves on intersection legs to facilitate smooth truck movements. When roadways are sharply curved leading into intersections, stopping sight distance and available reaction time are reduced for all drivers, including trucks. Thus, sharply curved intersection legs should be avoided whenever possible to ensure driver and pedestrian safety at intersections. These principles collectively inform a comprehensive approach to intersection design in small downtowns, ensuring that freight traffic is effectively managed while maintaining the urban fabric and safety for all users.

Left Turn Lanes

The need for a left turn lane is based on traffic volumes on the roadway and left turn volume (LTV) at a location. GDOT provides left-turn warrant criteria for state-owned routes, as shown inTable 3. This can take place through physical medians with turn lanes cut into them, allowing for turning movements only in specified locations. Consideration should be given to where potential turning conflicts may arise and accommodate for those areas in the design. Where feasible, new driveways or side streets should be at existing median breaks or across from an existing driveway or side street. When raised medians are implemented, it is also recommended to provide median islands that provide refuge for pedestrians at locations with frequent crossings.

Table 3: Left-Turn Lane Warrants on State-Owned Roads

Left Turn Requires - Full Construction				
Posted Speed	**2-Lane Routes**		**More than 2 Lanes on Main Route**	
	ADT		**ADT**	
	<6,000	**>=6,000**	**<10,000**	**>=10,000**
35 MPH or Less	300 LTV a day	200 LTV a day	400 LTV a day	300 LTV a day
40 to 50 MPH	250 LTV a day	175 LTV a day	325 LTV a day	250 LTV a day
>= 55 MPH	200 LTV a day	150 LTV a day	250 LTV a day	200 LTV a day

Source: Regulations for Driveway & Encroachment Control Manual, GDOT, 2009

Even when a left turn lane is not required by GDOT, they may be considered at driveways and intersections with high truck volumes to improve truck safety. *NCHRP Report 745* provides recommended left-turn lane warrants for unsignalized three- and four-leg arterial intersections, as shown inTable 4. The decision to implement a left-turn lane should consider both GDOT requirements and the local context, such as available space, pedestrian activity, and design speeds.

Table 4: Left Turn Lane Recommended Warrants at Unsignalized Intersections

Left-Turn Lane Peak-Hour Volume (veh/hr)	Three-Leg Intersection, Major Urban and Suburban Arterial Volume (veh/hr/ln) That Warrants a Left-Turn Lane	Four-Leg Intersection, Major Urban and Suburban Arterial Volume (veh/hr/ln) That Warrants a Left-Turn Lane
5	450	50
10	300	50
15	250	50
20	200	50
25	200	50
30	150	50
35	150	50
40	150	50
45	150	<50

Left-Turn Lane Peak-Hour Volume (veh/hr)	Three-Leg Intersection, Major Urban and Suburban Arterial Volume (veh/hr/ln) That Warrants a Left-Turn Lane	Four-Leg Intersection, Major Urban and Suburban Arterial Volume (veh/hr/ln) That Warrants a Left-Turn Lane
50 or more	100	<50

Source: Report 745, NCHRP, 2013

Multimodal Access

Multimodal transportation access includes public transportation (e.g. buses, bus rapid transit, and street cars), active transportation (walking and biking), and micromobility (e.g. e-scooters). These modes require specialized infrastructure, such as bus lanes, bus shelters/platforms, bike lanes and other bicycle facilities, and pedestrian walkways including sidewalks and multi-use paths. In downtowns and small regional centers, multimodal mobility tends to be prioritized more than in less-dense environments. Slower speeds that support a mix of modes and user groups disincentivize truck traffic through downtown areas unless necessary. Additionally, some pedestrian- and bike-oriented areas of downtowns prohibit heavy vehicle traffic.

Pedestrians

Pedestrian activity is higher in downtowns and small regional centers than in most other contexts, and pedestrian-truck conflicts must be more carefully considered than in industrial areas. General safety measures to consider where pedestrians and trucks interact include:

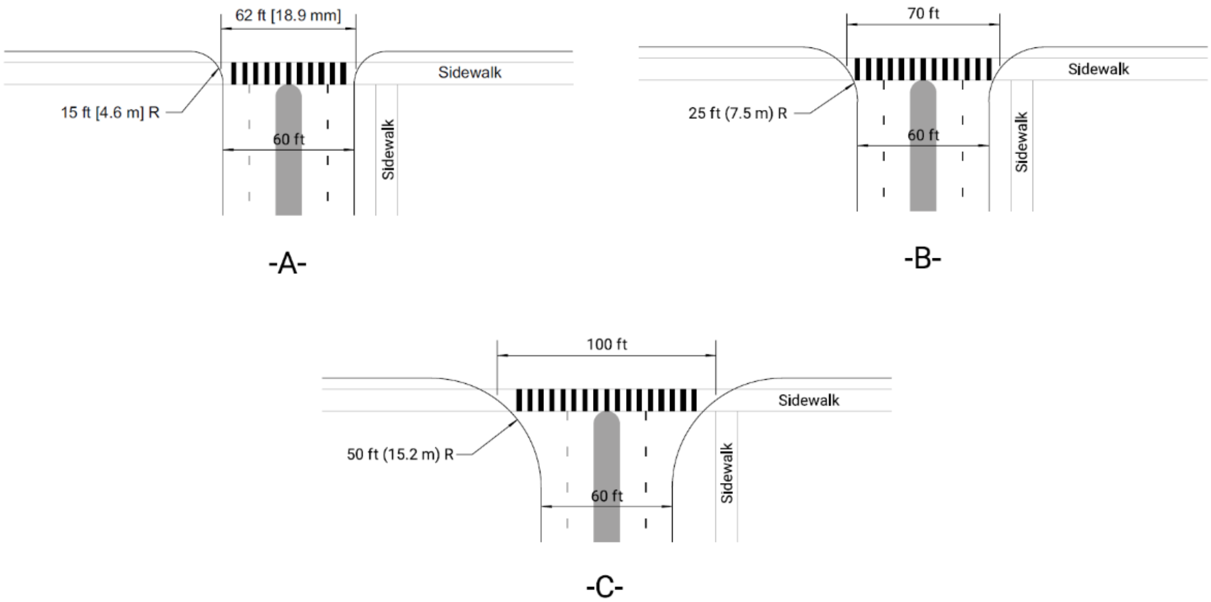
- Sidewalks buffered from the curb on both sides of the road to separate pedestrians and vehicles
- Marked crosswalks at intersections
- Medians or pedestrian islands on wider roads that allow pedestrians to cross in smaller distance intervals
- Separate truck and pedestrian paths through major intersections
- Raised right-turn islands at channelized right-turns that allow pedestrians to cross in two separate movements

Specific guidelines for pedestrian facilities on roads with truck traffic are given below.

Crosswalks

Crosswalks tend to be shorter in downtowns and small regional centers due to the prioritization of pedestrian and bicyclist mobility. This can be an issue at intersections with many truck turning movements, as shorter crosswalks correspond with smaller curb radii that impede freight maneuverability. Trading a longer crosswalk for a larger curb radius may be a consideration when truck turning movements are frequent to provide improved freight mobility. Figure 53 shows examples of how crosswalk length may vary with curb radius.

Figure 53: Example Crosswalk Lengths with Varying Curb Radii



Source: *Green Book*, AASHTO, 2018

Due to the high volumes of pedestrian traffic and high density of pedestrian destinations, mid-block crossings are more common in downtowns than in industrial contexts. Because trucks decelerate more slowly than cars, proper signage and sufficient stopping sight distance are important at mid-block crossings where pedestrian-truck conflicts may be common. Further, pedestrian refuge areas in medians can improve safety for those crossing by allowing them to traverse one side of the street at a time.

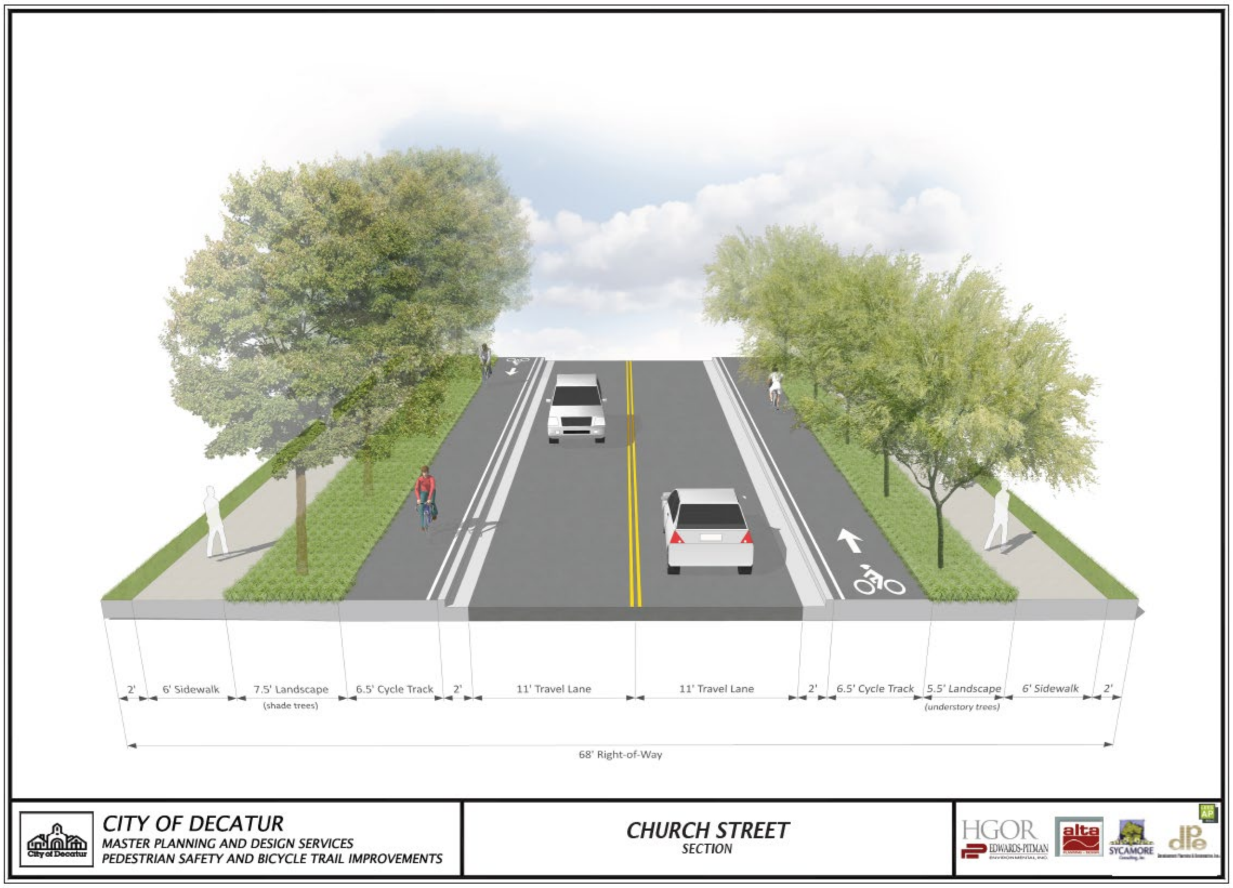
Sidewalks

Sidewalks play a vital role in city life. As conduits for pedestrian movement and access, they enhance connectivity and promote walking. Safe, accessible, and well-maintained sidewalks are a fundamental and necessary investment for cities and have been found to enhance public health and maximize social capital. Prevailing design guidelines recommend a minimum sidewalk cross-section of 5 feet, though they are often larger in downtowns with many storefronts and high pedestrian activity. However, truck mobility is often impeded due to the emphasis on sidewalk accessibility. Larger sidewalks and other multimodal elements result in narrower lanes, as shown in Figure 54. On roadways with expected truck traffic, it is important to give extra consideration to sidewalks and curbs near intersections to ensure trucks can safely off-track when necessary.

An important aspect of pedestrian travel ways in downtowns and small regional centers is the buffer zone. Pedestrian buffer zones create separation from motorways and the sidewalk, improving safety and enhancing the quality of walkways. Buffer zones can be created via on-street parking lanes, planter zones, and/or landscaping zones (as shown in Figure 54).

Whenever feasible in a road's right-of-way, roads with high truck volumes should include pedestrian buffer zones to protect and enhance walkways.

Figure 54: Example Multimodal Street with Small Travel Ways

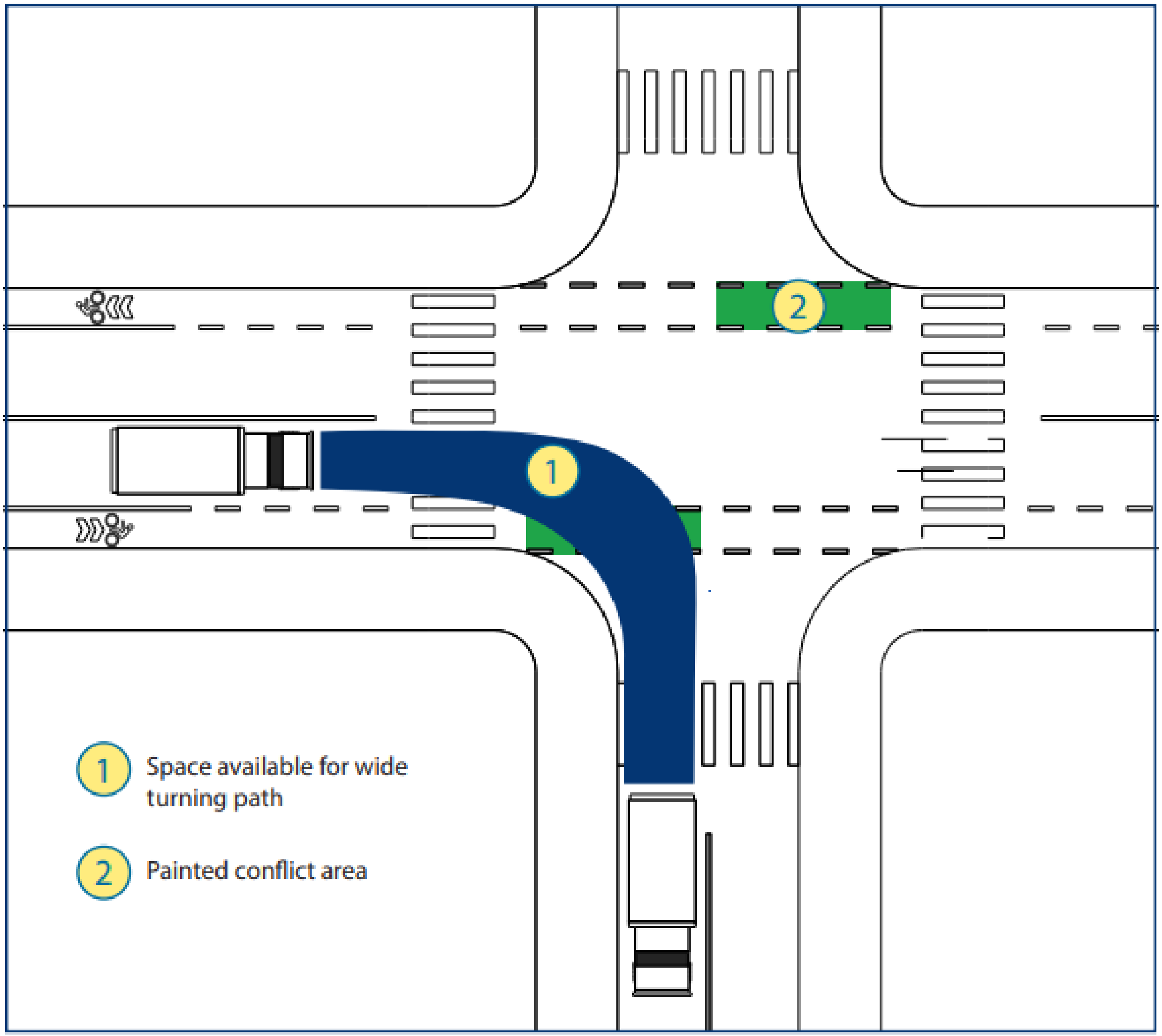


Source: Pedestrian Safety and Bicycle Trail Improvements Church Street Section, City of Decatur, 2014

Bike Facilities

In downtowns and small regional centers, bicycles usually travel in mixed traffic when dedicated bike lanes are not provided. On roads with a high percentage of truck traffic, this can be especially dangerous, as the wide turns and large blind spots of freight vehicles can put bicyclists at risk. Separated bike lanes can be mutually beneficial for trucks and bicyclists. Dedicated lanes remove bicyclists from mixed traffic while also providing additional space outside the travel lane for trucks to make turning movements. Roadway markings such as bright paint can be provided at conflict locations between bikes and trucks to increase truck drivers' awareness of bicyclists and improve bicyclists' safety. Figure 55 demonstrates how bike lanes can benefit trucks by effectively increasing curb radii for turns. It also provides an example of how bike lanes can be marked to alert road users at bike-truck conflict locations.

Figure 55: Example Design for Bike Lanes on Truck Travel Ways



Source: Accommodating Freight in Complete Streets, NYSERDA, 2019

When space permits, bike buffers are ideal to provide separation from trucks in the travel lanes. Bike lanes should be buffered at a minimum by a striping, but striping alone may not offer substantial protection from trucks and other vehicles. Without physical barriers, trucks and other vehicles can easily encroach on bike lanes, and trucks often do illegally park in non-buffered bike lanes. The FHWA *Separated Bike Lanes on Higher Speed Roadways* toolkit provides examples of physical buffers that may be used to protect bike lanes. In downtowns and small regional centers, some appropriate buffers may include raised curbs, vertical barriers, and on-street parking lanes. The presence of vertical buffer elements improves both safety and comfort for bicyclists by preventing vehicle encroachment on bike lanes. Figure 56 demonstrates how even a rubber raised curb can protect bike lanes from truck traffic. Vertical buffers, along with regular maintenance to keep bike lanes clear of debris and other obstacles, keep bicyclists safe and separated from truck traffic.

Figure 56: Raise Bike Lane Barriers

Source: Kittelson & Associates, Inc.; FHWA (2024). Separate Bike Lanes on Higher Speed Roads: A Toolkit and Guide. Retrieved from https://www.fhwa.dot.gov/environment/bicycle_pedestrian/publications/separated_bike_lanes/.

Mobility On Demand

With the rise of ridesharing apps like Uber and Lyft, mobility on demand (MoD) has become a major alternative mode of transportation in the Atlanta region. In traffic, MoD operates identically to typical vehicle traffic and as such does not warrant additional consideration here. However, MoD differs from typical vehicle traffic at pickup and drop-off points. Passengers board and exit MoD at the curb, ideally in designated areas or wherever drivers can find space. On roads where truck traffic is common, trucks and MoD may compete for curb space. Further, passengers waiting for rides may be waiting near the edge of curb, presenting additional safety risks near loading zones. To minimize MoD and truck conflicts, designated loading zones for trucks should be clearly marked both to drivers and to pedestrians. This will ensure MoD operations and truck loading/unloading are separated, efficient, and safe. On roads with many MoD pickups and drop-offs, designated curb space for these operations may be desirable to further manage and delineate curb space. Loading zones and MoD zones may even share spaces at different times of day in response to varying demand for commercial delivery and rideshare activity. See the Curbside Management section for further discussion of shared loading zones.

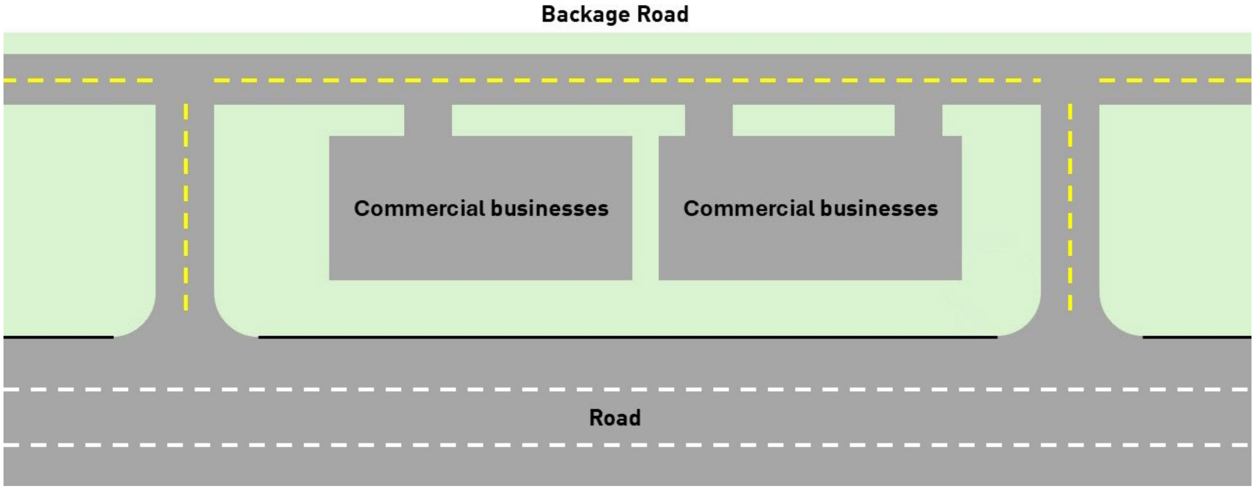
Access Management

Driveway density in downtown areas and small regional centers is typically low due to space constraints and parking needs for passenger vehicles. However, where driveways are feasible, they should be spaced to ensure that truck drivers can safely perceive and react to each driveway or intersection sequentially. The spacing should be calculated based on the distance a truck travels at the posted speed limit during the driver's normal perception and reaction time, plus the distance needed for the truck to decelerate to a stop. This is particularly important for freight vehicles due to their longer stopping distances and slower maneuverability compared to passenger vehicles. Proper driveway spacing reduces the potential for conflicts, allowing trucks to make safe turning and stopping maneuvers, which is critical in areas with high pedestrian activity and limited space. Further driveway design guidelines are available below.

Where medians limit access along divided roadways, openings should be carefully considered at major driveways and side streets. Key freight destinations should receive increased priority for median openings, especially in downtowns and small regional centers where driveway access is already sparse. Further median design guidelines are available below.

Backage roads and alleys are important access management features when driveway density is low. These features allow freight vehicles to access loading zones behind buildings, as shown in Figure 57, and to smoothly move between adjacent land uses away from the main road. Local jurisdictions should revise their municipal code with access management standards that require the shared use of backage roads and alleys in new developments. Further, local authorities should communicate and foster collaboration with nearby businesses to encourage the shared use access roads. If roads undergoing redevelopment have multiple existing driveways for adjacent land uses, it may be worthwhile to review access on that road and consider closing some driveways or redesigning the driveway configuration.

Figure 57: Backage Road to Commercial Loading Zone



Source: ARC, derived from *Engineering Policy Guide*, Missouri DOT, 2007

Driveway Design for Freight

For intersections and driveways where semi-trailer combination trucks are expected to regularly operate, the design must accommodate truck movements, especially in industrial and many commercial settings. This includes ensuring that heavy-duty pavement is provided for truck access to loading docks and that the driveways associated with these docks are designed with appropriate truck turning radii. For minor driveways, especially those allowing only right turns, the design typically caters to passenger vehicles; however, where trucks are involved, the turning radii and pavement strength must be enhanced to prevent damage and ensure smooth operations. On driveways that expect frequent truck traffic, the pavement should be strengthened based on expected truck volumes. Curbs should also be strengthened on such driveways due to the increased strain that turning trucks will put on them. Continuously reinforced concrete (CRC) is one option for heavy-duty pavement that may be preferred to asphalt on these driveways due to its ability to provide long-term strength with fewer maintenance costs, according to the FHWA *Continuously Reinforced Concrete Pavement Manual*.

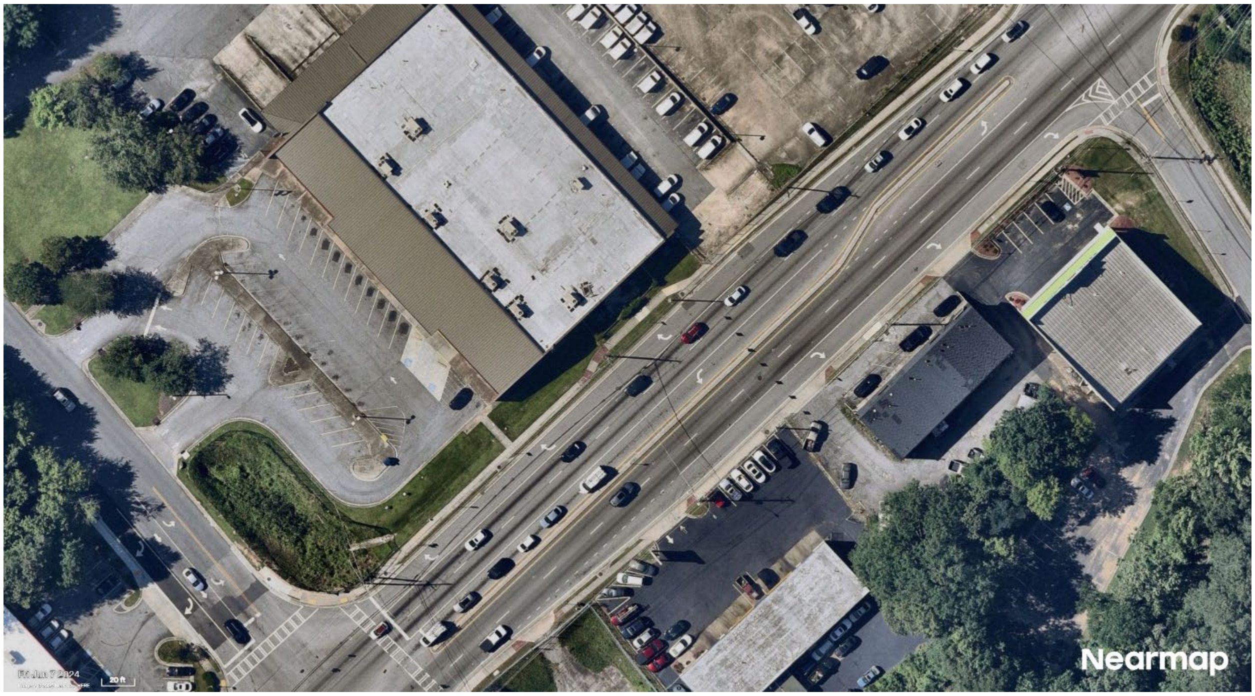
Median Opening Design

Medians are uncommon in small downtowns as speeds are typically slower and roads have fewer lanes in these contexts. When medians are present, such as on wider roads, higher speed roads, and/or state or US routes, they are often narrower than is typical in other contexts. Median design in downtowns is context sensitive and can take many forms. Figure 58 is an example of a median design on US-29 in downtown Fairburn. Due to the close spacing of intersections in downtown areas, left turn bays can be shorter than is typically prescribed. These medians also have a painted nose protruding into the intersection, which can be a good design feature when truck traffic is heavy as they require much less maintenance than raised median noses. Figure 59 is a median design on Buford Highway in Norcross. This median is very thin due to limited right-of-way. Left-turn bays are also longer in this example due to higher left turn volumes at the intersections. These medians end well before intersections to allow additional room to maneuver turning movements.

Figure 58: Median Design on US-29 in Fairburn, GA

Source: Nearmap, 2024

Figure 59: Median on Buford Highway in Norcross, GA



Source: Nearmap, 2024

Vertical Grades

In downtowns and small regional centers, managing vertical grades—referring to the slope of roadways—is crucial for ensuring smooth traffic flow and safety. While flatter vertical grades are generally preferred, a maximum grade of 8% is recommended to accommodate the needs of various vehicles, including trucks. Whereas in industrial areas, continuous, uninterrupted grades may be of greater concern, more frequent stopping and starting bears more consideration in downtowns or small activity centers. By minimizing extremely steep grades, traffic flow will be interrupted less frequently and differences in traffic speed between trucks and other vehicles will be less severe. Collectors and local roadways should generally be as level as is feasible in the given terrain. For further guidance on vertical grades in downtown contexts, refer to Table 7-4a in the AASHTO "Green Book."

Railroad Crossings

When addressing railroad crossings, it is essential to review the crash history to identify any safety concerns and improve the design accordingly. Adequate vertical clearance must be provided for lowboy trailers (trailers with a lower deck and less ground clearance) and other oversized vehicles. Specifically, the highway surface should be level with the top of the nearest rail within a 30-foot distance from the rail, ensuring that it does not deviate more than three inches higher or lower. Adjustments should be made for track superelevation (i.e., banking), if necessary, to maintain proper alignment and safety. These considerations, as outlined in the GDOT *Design Policy Manual*, Section 7.6.2, help ensure safe and efficient railroad crossings for all types of vehicles.

Special considerations must also be made when at-grade crossings occur near intersections. If a vehicle must enter a signalized intersection immediately after crossing railroad tracks, the stop bar for that approach should be located before the crossing rather than after, as shown in Figure 60. This configuration prevents vehicles from crossing and then getting stopped at a red light, which causes queues to spill out onto the railroad tracks. Coordination between the vehicular signal and the rail crossing signal may also be desirable to prevent traffic from getting stuck in the middle of the intersection when the rail crossing signal activates.

Figure 60: Signal Stop Bar Ahead of At-Grade Railroad Crossing

Source: Seleno Ave in Napa, CA, Google Maps

At stop-controlled intersections, traffic should not stop after crossing railroad tracks. The other intersection approaches need clear signage to alert them that crossing traffic is not stopping. Figure 61 shows an example of this kind of signage from downtown Norcross. These signs should be present and easily visible at all approaches besides the crossing approach.

Figure 61: Proper Signage at Stop-Controlled Intersection near At-Grade Crossing

Source: Downtown Norcross, Google Maps

Pedestrian Considerations

At-grade railroad crossings should also have pedestrian crossing infrastructure where pedestrian activity is common. Often, pedestrian railroad crossings can simply consist of sidewalks next to the road that either ramp down to the railroad pavement or remain level, as shown in Figure 62. With this configuration, pedestrian movements are controlled by the same gate that controls vehicle movements when trains are approaching. Pedestrian crossings may also be implemented separately from roadway crossings where pedestrians need to cross railways, including both sidewalks and separated pedestrian infrastructure like multi-use paths. At a minimum, static signage alerting pedestrians to railroad crossings should be present on sidewalks and multi-use paths. Standalone pedestrian stop gates like those shown in Figure 30 can be implemented to both physically control the movements of pedestrians and to alert pedestrians that they are walking near a railroad. The FHWA *Manual on Uniform Traffic Control Devices for Streets and Highways* (MUTCD) requires separate pedestrian gates wherever trains are permitted to travel at 80 mph or higher.

Regardless of crossing location, at-grade railroad crossings must have safe and accessible pedestrian infrastructure if walking traffic is anticipated. Crossing gate arms should not protrude into sidewalks such that they reduce the effective sidewalk width to less than five feet. Sidewalk ramps to railroad crossings should not be sloped at more than a 1:12 grade, and the crossing should be as flat as possible (see Figure 63) to accommodate those with mobility impairments. Additionally, pedestrian rail crossing gates should be signaled with flashing lights and sound components to accommodate the visually and hearing impaired.

Figure 62: Pedestrian Railroad Crossing on Sidewalk in Woodstock, GA

Source: Atlanta Regional Commission

Figure 63: Pedestrian Railroad Crossing with Pedestrian-Oriented Signal and Signage in Woodstock, GA

Source: Atlanta Regional Commission

Employee and Resident Access

In downtowns and small regional centers, access for employees and residents is typically separated from trucks. Truck parking for loading and unloading is usually found in off-street dedicated loading areas, like docks or alleys, while parking for employees and residents takes place in surface lots, on-street spaces, or vehicular parking decks. In some larger residential and mixed-use developments, truck access will be located at the bottom of the vehicular parking deck. Here, signage should clearly indicate where trucks should park and which areas are reserved for residents and customers.

When trucks park on-street, they can sometimes interfere with employee and resident mobility during loading and unloading activities. In particular, deliveries made with hand trucks take up more sidewalk space and can interfere with pedestrians. Sidewalks should be sufficiently wide to accommodate both hand trucks and other pedestrians. Further, loading zones should be placed as near to where packages will be delivered as possible. See the Curbside Management section for more information on how to mitigate conflicts with loading and unloading activities.

Curbside Management

For effective curbside management in downtowns and small regional centers, it is crucial to prioritize the creation of adequate off-street facilities for the loading and unloading of goods. These facilities should be located within delineated loading areas or adjacent to buildings to minimize disruptions to both vehicular and pedestrian traffic. Off-street loading frees curb space for other uses and reduces traffic congestion caused by trucks parked in travel lanes. In downtowns with large new developments or redevelopments, off-street loading should be prioritized to preserve high-demand curb space for other activities. When off-street options are not feasible, such as in areas that are not suited for large-scale new development or redevelopment, well-designed loading and unloading zones should be established to ensure that they do not impede the flow of other transportation modes.

Curbside management should be a consideration from the very beginning of site development. Site developers should select a building orientation that minimizes freight's impact on and interaction with other modes of traffic. If a site has the option to locate loading zones on either a busy multimodal street or on a quiet, less trafficked road, the latter is always the preferred choice. Carefully considered building orientation can help to cut down on freight conflicts with other modes and to reduce congestion and waiting time.

In downtowns and small regional centers where driveways are typically limited and often serve parking lots or decks for passenger vehicles, delivery trucks usually need to park on the street. To manage this effectively, loading zones should be carefully situated to avoid conflicts with bike lanes and pedestrian pathways, ensuring safety and accessibility for all users. Loading zones should also be clearly signed and enforced to prevent drivers from using them as regular parking spaces, as shown in Figure 64.

Figure 64: Loading Zone Signage

Source: "Modernizing Commercial Loading," Kyle Rowe and International Parking & Mobility Institute

It is also important to consult with local businesses to understand the frequency and duration of deliveries, allowing for better planning of loading zones. To minimize disruptions and maintain smooth traffic flow, consider restricting loading and unloading activities to off-peak times when traffic is lighter. The optimal time to schedule off-peak deliveries varies based on business type. For some businesses that are less busy in the mornings, like restaurants and non-grocery retailers, early morning before the morning rush hour may be a good time to receive deliveries. Mid-day deliveries between the AM and PM peaks may be suitable for businesses that do not have staff available to receive deliveries in the morning. Late night deliveries, while possible, are challenging to coordinate due to staffing requirements and noise curfews. If local jurisdictions wish to restrict delivery times, they should consider how the restrictions will impact businesses.

Loading zones must also be sized to accommodate both the trucks themselves and loading/unloading activities. Many trucks use ramps to unload goods, which adds additional length to the effective size of the truck, as shown in Figure 65. If loading zones are not properly sized, ramps may encroach on nearby on-street parking, crosswalks, or sidewalks.

Figure 65: Truck Ramp Encroaching on Other Curb Spaces

Source: Atlanta Regional Commission

The PacTrans report *Developing Design Guidelines for Commercial Vehicle Envelopes on Urban Streets* measured the additional space required to accommodate various delivery tools. They found that ramp assisted deliveries require an additional 158 inches (about 13 feet) of loading space, increased to 227 inches (about 19 feet) when accounting for the use of a handcart. Taking this into consideration, the most common truck in downtown areas, the SU-30, a loading zone that accommodates both the truck and its ramp should be about 50 feet long. The typical delivery vehicles and additional space requirements of delivery tools should be taken into consideration when designing load zones. See Table 5.29 of *Developing Design Guidelines for Commercial Vehicle Envelopes on Urban Streets* for further guidance on sizing loading zones.

Other than ramps, handcarts are a common tool used to assist in the unloading process. Handcarts have additional space requirements as well, but they can also benefit from other infrastructural changes. For example, NCFRP Report 33: *Improving Freight System Performance in Metropolitan Areas* notes the past success of initiatives to build sidewalk ramps near loading zones for handcarts. The ramps improve efficiency of loading and unloading activities while also reducing the amount of time that trucks need to be parked in loading zones. Encouraging the use of handcarts increases the distance truck operators can make deliveries in from a single parking space, which also reduces the frequency of illegal truck parking.

Consolidating deliveries into a single location whenever possible can also reduce the amount of time that trucks need to be parked in a space, opening up the loading zone for others. Some parcel delivery companies have implemented parcel lockers to reduce the time it takes to make deliveries and for customer security/convenience. UPS provides parcel lockers at select UPS Store locations, as shown in Figure 66. Amazon has installed parcel lockers at some Whole Foods stores, as shown in Figure 67, and at various other locations. These lockers allow delivery drivers to quickly make numerous deliveries while stopped at one location. They also provide a secure delivery location for customers who may be concerned about parcel theft, and often provide access 24/7 for convenient customer pickup.

Figure 66: Parcel Lockers at The UPS Store, Sandtown Shopping Center

Source: The UPS Store. *24/7 Locker Service*. https://locations.theupsstore.com/ga/atlanta/5829-campbellton-rd-sw/locker-service

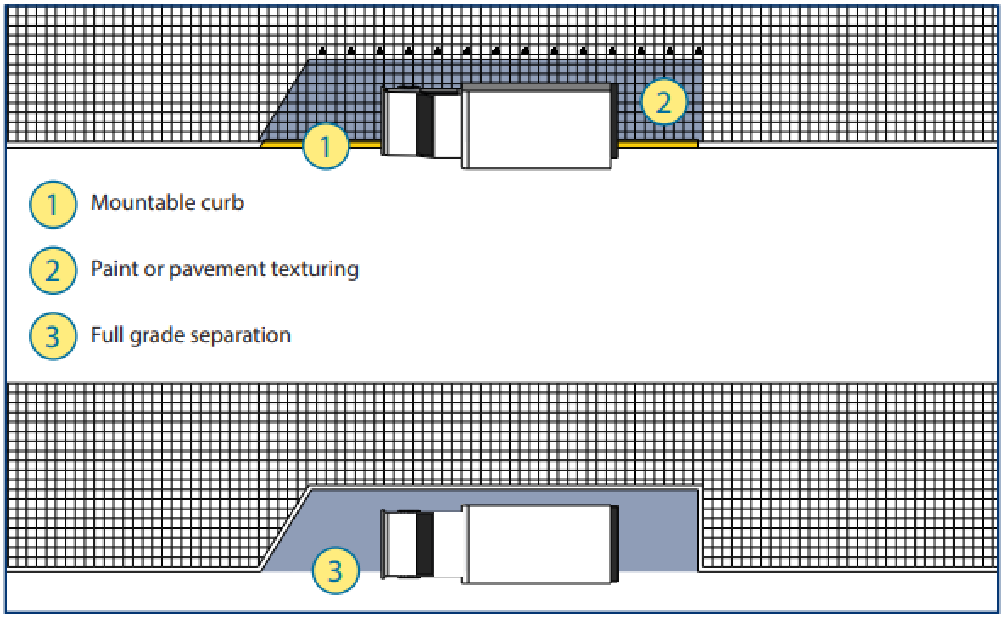
Figure 67: Amazon Lockers at Whole Foods, Midtown Place Shopping Center

Source: Atlanta Regional Commission

In large residential and office developments without off-street loading, local jurisdictions may want to require shared parcel lockers. Parcel lockers reduce the amount of time that deliveries take by up to 78%, according to a study performed by the University of Washington Urban Freight Lab. Together, improved on-street and on-site freight infrastructure can help to reduce the amount of time trucks need to be parked in loading zones.

When loading zones must be placed on busier streets, implementing features such as mountable sidewalks or cutout sidewalks as shown in Figure 68 can also enhance functionality in constrained spaces. Additionally, incorporating vegetative screening or buffer elements around parking areas can help maintain aesthetic appeal by concealing these areas from public view.

Figure 68: Dedicated On-Street Loading Zone Diagram

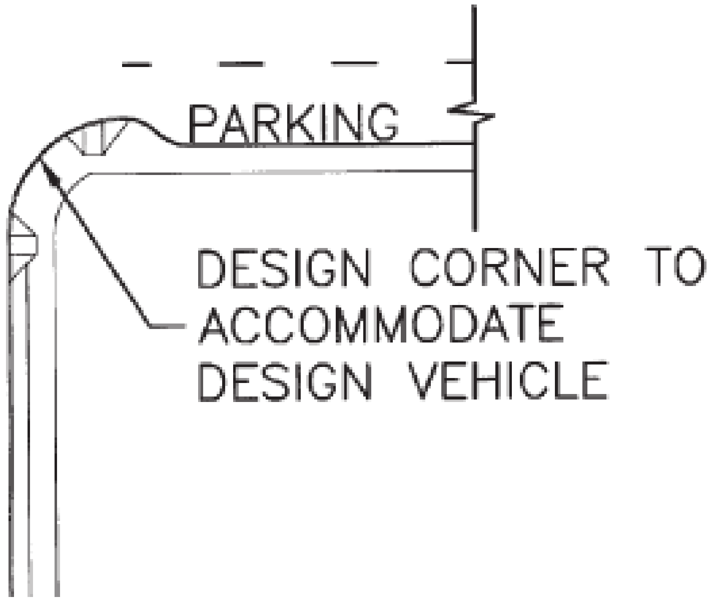


Source: *Accommodating Freight in Complete Streets*, NYSERDA, 2018

Figure 68 demonstrates the difference between the different mountable sidewalk options. Option 1 is a mountable curb, where the curb is low enough with a slope that a truck can easily mount to be out of the street. Option 2 includes paint or pavement texturing which denotes where the truck is allowed to park and where pedestrians should be cautious of freight vehicles. Option 3 shows full grade separation, where the sidewalk has a cutout the size of the truck, with grade separation for pedestrians on the sidewalk. Even when sidewalk cutouts are included for the benefit of trucks, sidewalk width should never be narrower than 5 feet to comply with ADA regulations and to ensure pedestrian comfort and safety. The decision to implement a sidewalk cutout should be made with available sidewalk space in mind.

Sidewalk cutouts can be implemented in tandem with curb extensions to clearly delineate on-street truck parking and loading zones while also providing shorter crosswalks for pedestrians. Figure 69 shows an example of this curbside management technique and also notes the need for wider curb radii when this tool is implemented. (Note that "Parking" in the figure refers to truck parking.)

Figure 69: Example Curb Extension with Sidewalk Cutout



Source: *Designing for Truck Movements and Other Large Vehicles in Portland*, City of Portland Office of Transportation, 2008

On roads where curb space is limited and/or is in high demand, flexible loading zones can help to manage curb activities effectively. It is especially important for the available curb space to be flexible in downtown areas where curb space is limited and activities are dense. Loading zones like that shown in Figure 70 can serve loading and unloading activities, parcel delivery, on-demand food pickup and delivery, and residential delivery. These uses often vary in time of day, meaning that the use of the loading zone can vary throughout the day. For example, in the evening and night when parcel delivery and commercial loading/unloading activities are less frequent, the space can shift to primarily serve MoD pickup and drop-off as well as app-based delivery services, like Doordash and UberEats. Allowing for and encouraging the flexible usage of loading zones while keeping activities like garbage pickup off the street maximizes the utility that loading zones can provide for curbside management.

Figure 70: Flexible Loading Zone on Andrew Young International Boulevard

Source: Atlanta Regional Commission

Beyond physical infrastructure, new virtual tools may help to better manage curb space in downtowns and small regional centers. Loading zone reservation systems have been piloted before in cities across the country using apps such as curbFlow, OpenPark, and Coord. While these apps have since become unavailable, initial results for their impact on truck parking were positive. Positive results included reduction of double parking by over half and high levels of participation in the pilot programs. Allowing truck operators to reserve loading zones in advance could reduce the amount of time spent driving looking for parking spots, which is a major contributor to congestion. Jurisdictions and businesses in the Atlanta area should continue to monitor new developments in similar app-based systems for use in curbside management.

Collaboration is imperative for the successful implementation of all the above curbside management tools. Businesses, local governments, freight operators, and delivery companies should determine together which curbside management tools will be most effective in the local context.

Loading Dock Requirements

Loading docks and off-street loading zones in general are preferred in downtowns and small regional centers to prevent commercial loading and unloading activities from interfering with traffic operations and other curbside activities. While loading docks may be infeasible in some downtowns – particularly in historic downtowns and downtowns that are not good candidates for redevelopment – new developments and redevelopments should be planned with off-street loading in mind.

When provided, loading docks must be designed to adequately handle the largest truck that is expected to make deliveries there. If loading docks are too small, they cause trucks to spill out of the off-site loading areas. Trucks then may block travel for other modes of travel on sidewalks, bike lanes, and roadway lanes (as shown in Figure 71) or even lead truck operators to choose to park on the street instead. This can lead to increased congestion, negating the positive impacts of loading docks. When loading docks are properly designed (as shown in Figure 72), they take trucks off the street and eliminate conflicts with other modes of transportation while loading and unloading activities take place.

Figure 71: Truck in Loading Dock Spilling onto the Sidewalk and Street

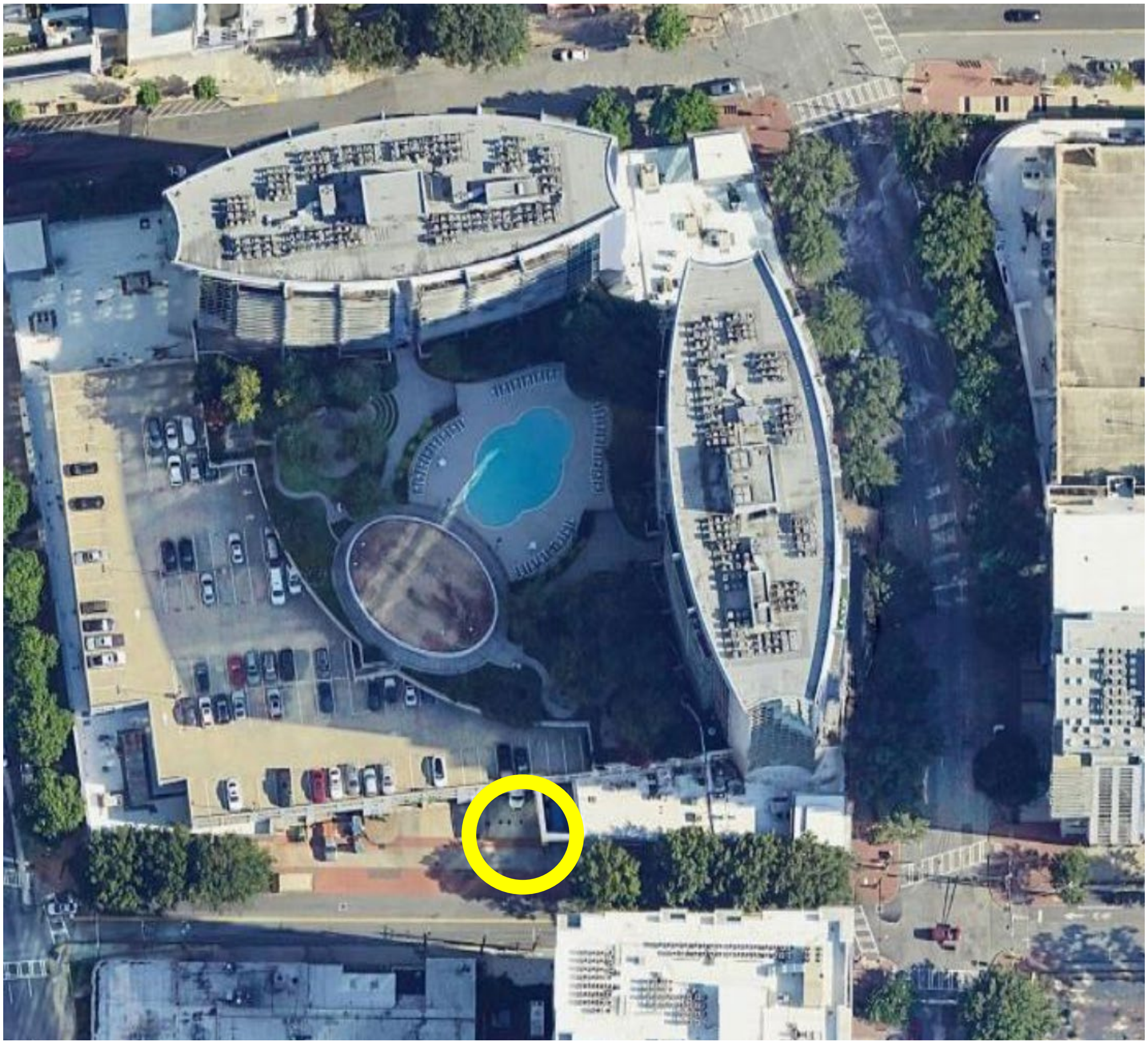
Source: Atlanta Regional Commission

Figure 72: Truck Parked in Properly Sized Loading Dock

Source: Atlanta Regional Commission

The location of loading docks is also an important consideration. Whenever possible, loading dock entrances should be located on minor streets or alleys instead of major streets. Keeping access points off higher traffic, higher speed streets minimizes the impacts of trucks pulling in and out of loading docks on congested roadways. A good example of this design principle can be seen at Plaza Midtown in Atlanta in Figure 73, where loading zone access is located on the lower volume 8th Street rather than the much larger and busier Spring Street or West Peachtree Street. This design principle should also be applied to downtowns and small regional centers to minimize the impact of commercial vehicle activity.

Figure 73: Loading Zone Access on a Minor Street at Plaza Midtown



Source: Google Maps

Off-Street Loading Spaces

An off-street loading space should have the minimum dimensions of 12 feet by 35 feet. It should also be free of obstacles. Every lot where a downtown business is located should provide loading spaces for freight alongside alley or street access to preserve the flow of pedestrian and vehicular traffic. Where possible, loading spaces should be 100 feet long and near the center of the block to limit impacts on nearby intersection operations.

When space is limited, neighboring businesses may consider making timeshare agreements for loading spaces. This would reduce the amount of total space required for both businesses' freight needs. An effective timeshare loading space agreement should include planning for delivery timings to ensure that deliveries to the two buildings do not exceed the amount of loading spaces available at any single time.

Alleys

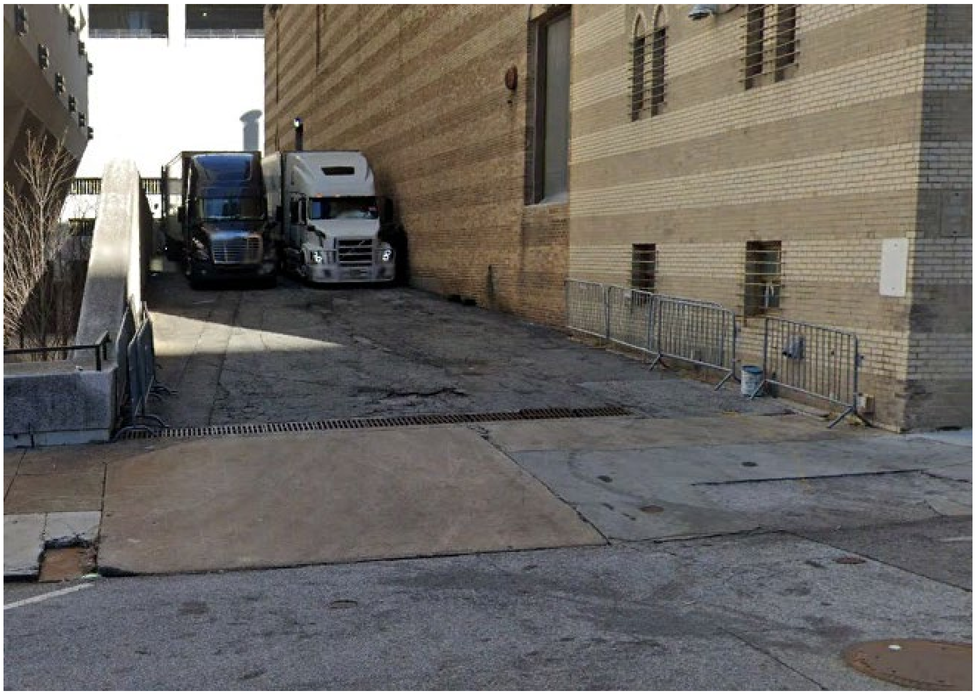
Alleys are effective tools to provide off-street loading zones for businesses that are not able to utilize loading docks. To effectively replace on-street loading zones for a business, alleys should be placed near building entrances – ideally, an alley should have direct access to the building(s) it is meant to serve. For example, the alley in Figure 74 provides direct access to the back of a plumbing business. The alley in Figure 74 also exemplifies how alleys in small downtowns can serve multiple purposes within a small space; the alley provides some vehicle parking, access to truck loading zones, and connectivity between parallel streets.

Figure 74: Alley in McDonough, GA

Source: Google Maps

Alleys should be sufficiently wide for both truck parking and for drivers to maneuver around the truck during loading and unloading activities. In small downtowns, alleys are often only a single lane wide due to space constraints. This can sometimes cause issues while deliveries take place, though, as a single parked truck blocks the entire alley. If space allows and frequent activity is expected in alleys, they should be made two lanes wide whenever possible. Figure 75 is an example of an alley with truck loading spaces that is two lanes wide. Additionally, alleys specifically intended for use by trucks may require stronger pavement and more frequent maintenance to prevent pavement deterioration from interfering with loading and unloading. When alleys are well-located, sufficiently wide, and well-maintained, they are a preferable alternative to on-street loading zones that also help to manage curbside activity.

Figure 75: Two Lane Wide Alley



Source: Kimley-Horn

Truck Parking Requirements

Many municipalities have specific requirements for truck parking based on land use and floor space. For example, retail businesses, offices, wholesale facilities, industrial spaces, government buildings, and institutions like hospitals and schools located in Alpharetta must provide one truck parking space for every 25,000 square feet of floor space. Beyond 25,000 square feet of floor space, they need to provide additional loading spaces based on the ratio shown in Table 5.

Table 5: Example Off-Street Loading and Unloading Space Requirements

Floor Space (sq ft.)	Amount of Spaces
<25,000	1
25,000—99,999	2
100,000—159,99	3
160,000—239,999	4
240,000—349,999	5
For each additional 100,000 or fraction thereof	1 additional

Source: Alpharetta, Georgia Unified Development Code Sec 2.5.3

Municipalities should determine if their current truck parking requirements make sense for the local freight context and adjust them as necessary. Any municipalities that do not have codified truck parking requirements should consider adopting some to promote smoother freight operations in their jurisdiction. Local context is important in determining the appropriateness of such requirements. For example, historic downtowns with smaller parcel sizes may not have space available to accommodate mandated parking spaces. In new developments, however, off-street parking should be planned on all parcels that will receive frequent deliveries.

If parking includes vehicles other than trucks, ADA requirements must be met to ensure accessibility for all users. Alley access to loading and unloading spaces is preferred, with street access provided as an alternative.

Delivery Times

In downtowns and small regional centers, managing delivery times is necessary to maintain smooth traffic flow and minimize disruptions. It is recommended to consider parking and delivery during non-peak hours. As dicussed in the Curbside Management section, off-peak delivery scheduling has different considerations between businesses. Some businesses would be best served by early morning deliveries and some by mid-afternoon deliveries in between the AM and PM peak hours. Overnight deliveries would help reduce the impact of commercial activities on daytime traffic but comes with its own set of challenges for businesses and communities, including a lack of staffing and noise concerns. Local jurisdictions need to consider the needs of local businesses if they choose to develop delivery time restrictions.

Small downtown areas where freight deliveries impact local roadways or surrounding properties should consider implementing delivery time restrictions due to the mingling of uses and road users alongside limited space. Blocking traffic lanes for loading and unloading should be minimized, and jurisdictions should restrict the permissible duration of on-street truck parking to one hour or less. If time restrictions do not provide sufficient turnover in truck parking, metering curb space may be an option to create additional incentives to limit time spent unloading on-street. Local jurisdictions that choose to meter curb space must also enforce the meters consistently for effective results.

On especially congested roadways in small downtowns and regional centers, peak hour clearways may be considered to increase vehicle throughput. Peak-hour clearways prohibit curbside parking, including truck loading and unloading, during peak hours. While this can improve congestion and safety on busy roadways, it is not the right choice for every community. Peak-hour clearways work best when local businesses and residences have alternative parking options, either on-site on on a minor street nearby. If deliveries are not prohibited during peak hours, there will also need to be alternative off-street or side street loading zones that businesses can use to receive deliveries. Local jurisdictions should consider off-street parking and loading, competing demand for curb space, and nearby land uses if they wish to implement peak hour clearways.

Wayfinding

In small downtown areas, effective wayfinding is essential to facilitate smooth traffic flow and efficient use of space. Effective wayfinding plays a crucial role in ensuring efficient and safe movement of employees, trucks, and visitors. The following guidelines should be considered to enhance navigation within these areas.

Directional Signage

To maintain safety and operational efficiency, clear and adequate striping is recommended. Loading zones must be clearly designated by appropriate signage, indicating the presence of the zone and specifying the hours during which loading and unloading are permitted, as displayed in Figure 76. This helps to prevent congestion between commercial activities and other modes of transportation.

Figure 76: Loading Zone Signage

Source: Commercial Loading Zone Management Program in Washington, DC, FHWA, 2018

Internal and External Signage

Wayfinding signage should be strategically placed both on the public right-of-way and internally at alleys, loading docks, and other truck parking areas within the downtowns and small regional centers. Signage should indicate the direction of traffic flow in alleys and off-street loading areas and be placed before the entrance to the loading area to ensure that trucks enter correctly. Utilizing clear and consistent signage design that includes recognizable symbols or text, enhances user-friendliness and navigational efficiency.

Turn-Around Options

Tight downtown streets and small operating areas often make it difficult for trucks to easily operate and manuever. Trucks should make any necessary turn-around maneuvers outside of downtown areas where roads have more available room.

Additional Considerations

When planning wayfinding, consider the visibility and readability of signs. Use large, clear fonts and high-contrast colors. Regular maintenance and updates to signage is also recommended. Figure 77 is an example of well-maintainted, updated, and easily readable signage for trucks. Local jurisdictions may consider creating an overall plan for wayfinding and circulation to standardize local practices and signage.

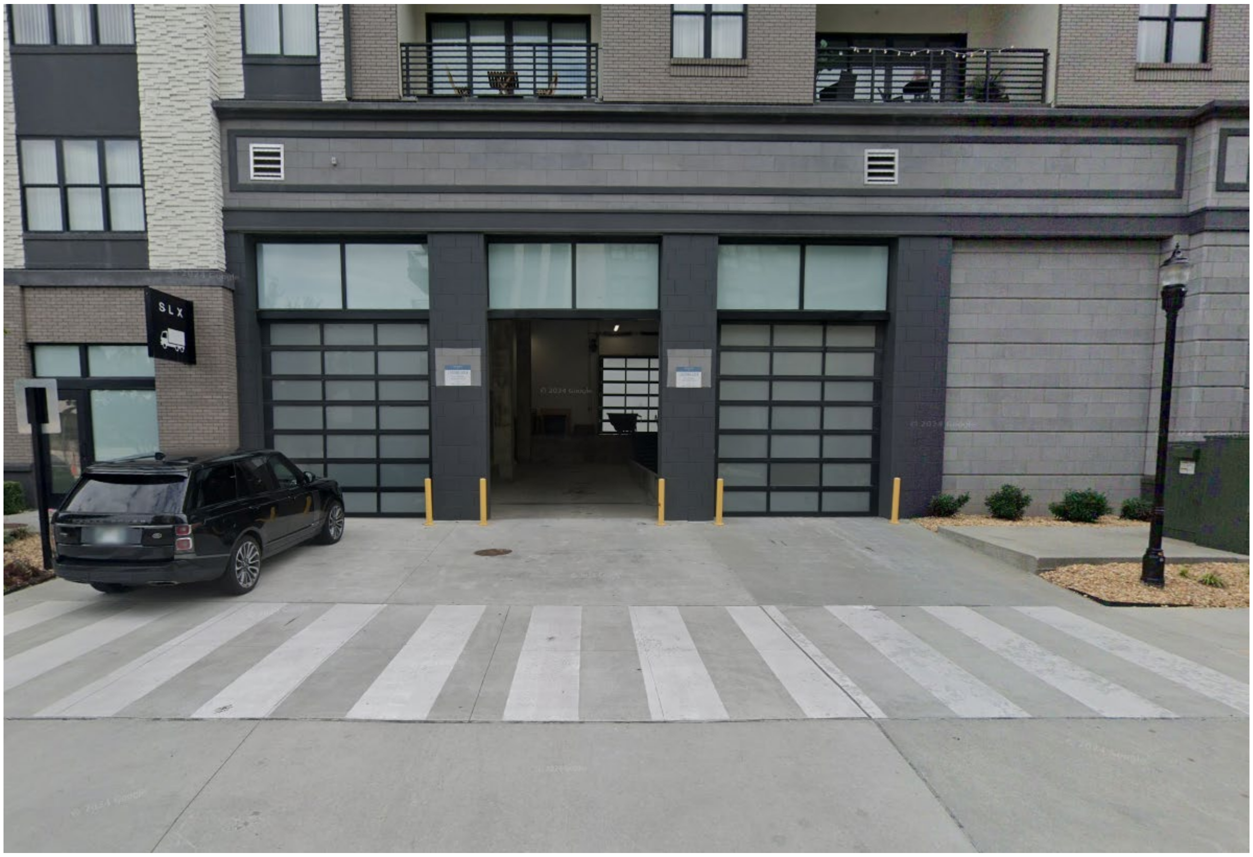
Figure 77: Loading Zone Signage

Source: *Accommodating Freight in Complete Streets*, NYSERDA, 2019

Visual and Noise Buffers

Loading areas in downtowns and smaller activity centers areas should be screened from public open spaces or sidewalks, where practical. Buffers are typically created using plant or natural existing materials, either alone or in combination with berms, fencing, or walls. These mechanisms block both the visual of loading operations, and some of the noise. In more space-constrained areas where sidewalks run alongside loading areas, rolling doors can be used to screen unloading activity both visually and aurally. For additional aesthetic screening, these rolling doors can feature designs that are visible when closed, as shown in Figure 78.

Figure 78: Designed Rolling Door Screen in Chamblee, GA



Source: Google Street View

More operational measures can be taken to improve noise pollution, such as adjusting the time of day in which deliveries are allowed to off-peak times (see the Curbside Management and Delivery Times sections for more discussion on this topic). Mid afternoon and early morning (in less residential areas) are possible windows to schedule deliveries when fewer pedestrians and vehicles are on the street. These measures ensure that loading operations do not detract from the aesthetic appeal of the downtown environment and help maintain a pleasant atmosphere for pedestrians and visitors.

4. Introduction: Major Activity Centers

Major activity centers include a medium- to high-intensity mix of uses that include office, residential, large retail, commercial, and entertainment. While the areas discussed in Chapters 2 and 3 are also activity centers, what sets a *major* activity center apart is specifically the mix of uses and the intensity of development.

Applicable Major Activity Center Uses

- Offices
- Apartments/Condos
- Large Shopping Areas
- Restaurants and Cafes
- Storefronts
- Hospitals
- Art and Entertainment Venues
- Sports Arenas
- Parks and Public Spaces
- Recreational Facilities

Intensity and Scale: Major activity centers can vary based on their primary activity type. Office spaces are typically high intensity and may house multiple businesses, attracting a significant number of commuters. Residential uses are medium- to high-intensity and house many residents. Commercial areas are typically medium- to large-sized and generate a large amount of foot and vehicular traffic. Storefronts at the street level of mixed-use developments have varying footprints based on their purpose. For example, restaurants may need more space and garner more traffic than retail spaces, which require smaller footprints and fewer services.

Environmental Impact: Because of the high concentration of workers, residents, and shoppers, major activity centers often have a larger total environmental impact than other areas due to high water and power demands. However, the density of development and lack of sprawl can help to mitigate environmental impacts per capita. Further, offices, restaurants, and retailers in major activity centers may have higher environmental standards than in other areas.

Zoning and Land Use Requirements: In major activity centers, offices and mixed-use and commercial zones are the most common land uses. Frequently, sites will include a storefront - such as a retailer, restaurant, or small business - at the street level, with the higher stories being occupied by residential or office spaces. Some large retailers and entertainment uses may have dedicated zones, but these zones are not the predominant land use in major activity centers. Single-family housing and other low-density, low-intensity uses should not be included in major activity centers and should be reserved for the surrounding areas. In mixed uses, the high intensity of commercial, residential, and office developments may require more parking than less dense areas. This need is often handled by internal parking garages, on-street parking, and travel demand management, though some land uses like large retailers may have dedicated surface lots that occupy nearby land.

The most obvious major activity centers in Metro Atlanta are the Downtown and Midtown neighborhoods of Atlanta, shown in Figure 79 and Figure 80, respectively. The guidelines in this chapter are also applicable to large suburban activity centers that will likely shift to medium/high density in the coming years – for example, the Perimeter Center (Figure 81) and Cumberland areas (Figure 82).

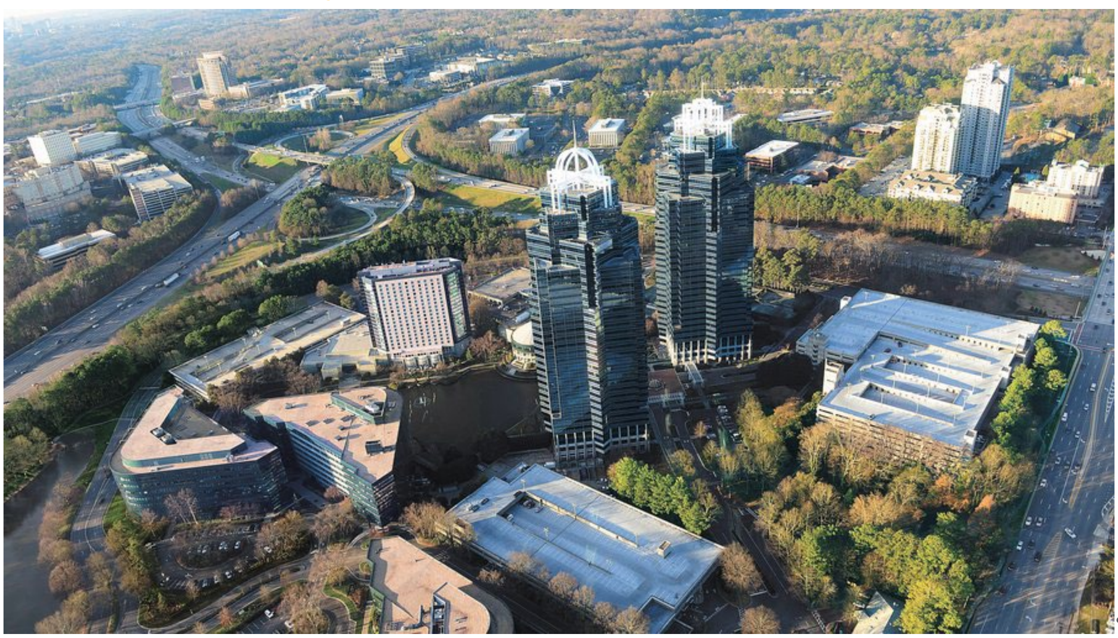
Figure 79: Midtown Atlanta

Source: https://www.midtownatl.com/40, Midtown Alliance

Figure 80: Downtown Atlanta

Source: https://www.metroatlantachamber.com/about-the-chamber/news-and-events/, Metro Atlanta Chamber

Figure 81: Perimeter Center Activity Center



Source: "Central Perimeter area marks 50 years of development," Byron E. Small and *Atlanta Business Chronicle*, 2021

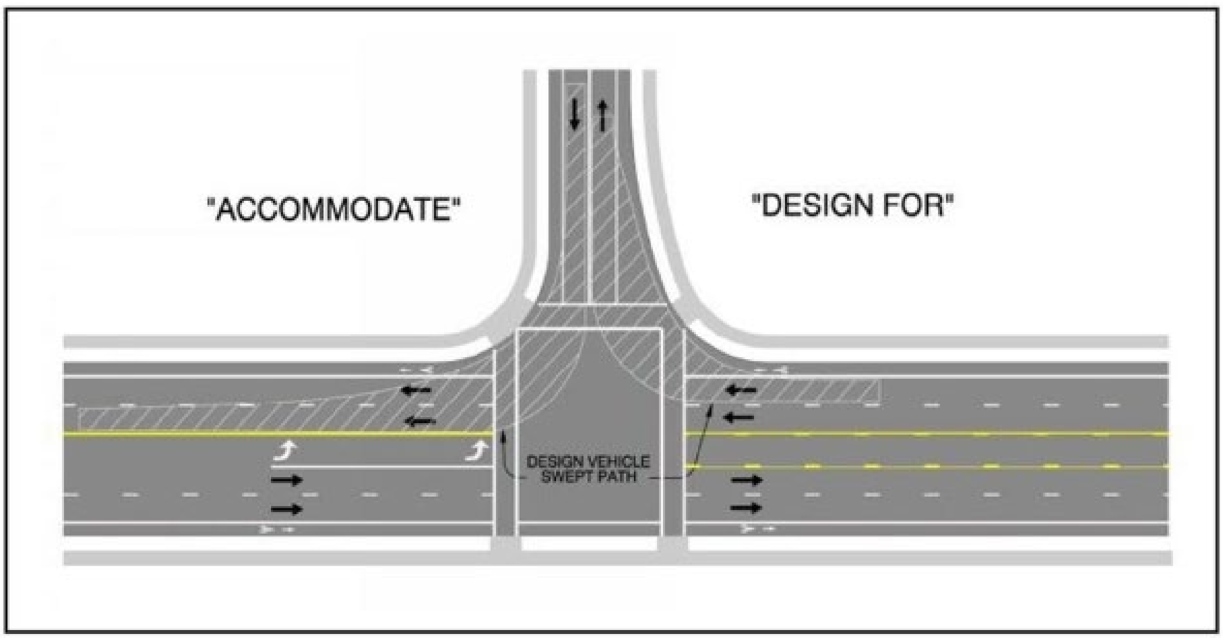
Figure 82: Cumberland Activity Center

Source: https://cumberlandcid.org/, Cumberland CID, 2024

Roadway Design Concept

The concept of roadway design makes a distinction between the vehicle for which you design and the vehicle for which you accommodate, as demonstrated in Figure 83. A design vehicle is the largest vehicle that frequents a roadway facility and should be able to maneuver the roadway and intersections without encroaching on adjacent lanes or over tracking curbs and sidewalks. See the Introduction to these design guidelines for more information on truck types. In major activity centers, all roads classified as collectors or arterials that are open to truck traffic should be designed with combination trucks (WB-67) in mind. It is unlikely that any larger trucks will frequently need to travel in major activity centers, but site designers who anticipate oversized trucks should work with local authorities to accommodate those vehicles. Local roads that handle deliveries can be designed for single-unit delivery trucks (SU-40) with accommodations for combination trucks (WB-67). Emergency and transit vehicles are generally the same size as or smaller than WB-67 trucks, so roads are also designed for them. However, emergency and transit vehicle dimensions may vary by jurisdiction; local planning authorities should ensure that roadway design is also able to accommodate their emergency and transit vehicles.

Figure 83: Comparison of "Design for" Versus "Accommodate"



Source: *Design Policy Manual*, GDOT, 2024

Roadway Design

In major activity centers, roadway design should consider the context of high pedestrian activity, heavy transit usage, traffic congestion, and larger retail and commercial areas that require combination truck deliveries.

Lane Widths

Lane widths should be a minimum of 11 feet on collector and arterial streets with higher percentages of truck traffic. On principal arterials that operate at high speeds with mostly free flow, lane widths of 12 feet are desirable if feasible, especially when high truck volumes are anticipated. A lane width of 10 feet, while sometimes used on more constrained streets, should be avoided if possible unless truck volumes are low and speeds are under 35 miles per hour. While narrower lanes are often unavoidable in major activity centers due to space constraints, roadway designers can make accommodations for trucks on these streets. Narrowing the inside lanes while widening the outside lanes is one such accommodation, as seen in Figure 84; providing suitable space for off-tracking is another. Narrower lanes can also be acceptable on local streets that are used for deliveries provided that they 1) meet the design criteria for single-unit truck travel, and 2) have suitable accommodations for combination truck travel.

Figure 84: One Wide Outside Lane for Freight and Transit

Source: *Urban Street Design Guide*, NACTO, 2013

On curves, some pavement widening may be necessary to ensure that trucks that take up more horizontal space can maneuver safely. Table 4.2 of GDOT's *Design Policy Manual* should be referenced when designing curves for trucks.

Medians/Center Turn Lanes

Additional median design considerations must be made for state-owned roads. On multi-lane arterials, GDOT prefers a 24-foot raised median wherever practical. These larger median sizes may be infeasible in some parts of major activity centers where space is more limited, but they should be a consideration on major multi-lane thoroughfares especially when speeds are high. On all multi-lane roadways with design speeds greater than 50 miles per hour, GDOT requires medians that provide positive separation except in the case of low-volume roads (less than 10,000 ADT), in which case flush medians are acceptable.

On roads that are not state-owned, more general median design guidelines apply. Medians are desirable on arterials in major activity centers whenever possible, especially when they operate at higher speeds. Median openings should be considered primarily for intersections and major developments. For example, Figure 85 shows a median opening on Peachtree Road in Buckhead to allow left turns into shops at Buckhead Square. The separation of flow provided by medians can make freight travel more efficient, while turn lanes at openings can make turns safer for freight vehicles. As can be seen in Figure 86, arterial medians can also include pedestrian refuge areas that make crossing the arterials safer and more comfortable for pedestrians.

Figure 85: Median Opening on Peachtree Road in Buckhead

Source: Nearmap

Figure 86: Arterial with Median and Pedestrian Refuge

Source: *Making Our Roads Safer: One Countermeasure at a Time*, FHWA, 2021

If speeds are high while left turns are infrequent, designers may consider adding a median barrier to multi-lane arterials. Median barriers improve safety on high-speed arterials by reducing the frequency of cross-median crashes, which are particularly dangerous. On the other hand, if speeds are low and left turns are frequent, a median may be eschewed for a two-way left-turn lane for practical reasons. On collector roads, two-way left-turn lanes are the most common median choice when left turns are frequent – otherwise, a painted median may suffice. As mentioned in Chapter 3, two-way left-turn lanes provide safety and efficiency benefits to freight vehicles by reducing weaving movements. Local roads rarely have or need medians except as environment enhancement tools.

Shoulders

It is rarely practical to have large shoulders for trucks to pull over onto in major activity centers except on high-speed (50 to 60 mph) arterials. When space is available on high-speed roads, shoulders should be between 4 and 8 feet. Due to space limitations, a small shoulder or no shoulder is often the best option on lower-speed roads. Besides shoulders, on-street parking can provide a place for trucks to pull over in emergencies so through traffic can continue, but they are not a reliable place to pull over. Similarly, curb and gutter sections can provide a few feet of additional pavement. Gutters can be between 1 and 6 feet wide, and curbs should be placed 2 feet away from the traveled way when possible. In emergencies, slow-moving freight vehicles that need to exit the travel way can mount sloping curves. Curb and gutter pavement should be strong enough to withstand regular use by vehicles.

Other elements of roadway design, like multimodal considerations, on-street parking, and loading will be addressed in later sections of this chapter.

Signal Design

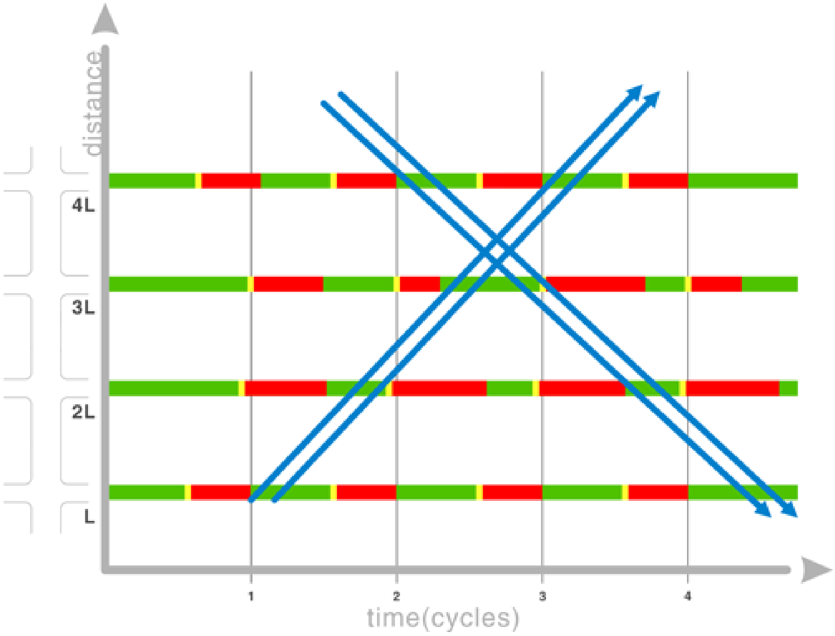
Properly timed signal phases and well-designed signal heads are crucial to ensuring efficient roadway operations and safety. Signals on roadways with high percentages of trucks should receive additional timing and design considerations compared to other roadways to accommodate freight operations.

Signal Timing

In major activity centers, signalized intersections often run in coordination to improve progression throughout a corridor. Figure 87 demonstrates how vehicles can progress smoothly through a coordinated series of intersections without hitting any red lights. Trucks may benefit from traffic signal coordination on roadways with few locations for turning movements or other causes for acceleration/deceleration. Signal offsets (a timing parameter controlling the relationships between signals) may be designed differently on roads with high heavy vehicle percentages to better accommodate the flow differences caused by trucks.

However, designers should understand that coordination may not always be ideal when operating conditions include high percentages of heavy vehicles. Trucks affect platooning behavior for vehicles, potentially diminishing the ability to move platoons quickly through a corridor – one of the major benefits of coordination. Further, on corridors with truck turning movements, frequent acceleration/deceleration may make the benefits of coordination insignificant. Coordination may be undesirable on corridors with high pedestrian volumes, as the lack of stopping and starting often encourages speeding that is dangerous to pedestrians. Alternately, the signals can be timed in such a way to slow the travel of vehicles along the roadway. Designers should consider local operating characteristics and the goals of signal timing along a corridor when considering signal timing.

Figure 87: Example Time-Space Diagram for a Coordinate System



Source: Traffic Signal Timing Manual, FHWA, 2008

Signals also run in free timing in off-peak hours and on smaller roadways in major activity centers, meaning that the signal timings are dictated by vehicle detection at each intersection. Under this signal setting, it may be desirable to adjust signal timings at intersections with high heavy vehicle percentages to better accommodate truck traffic.

On approaches with significant truck queueing, it may be desirable to increase minimum green times to allow slow-accelerating queues to fully clear. Increasing minimum green time on protected left turn phases should be given extra consideration where opposing through traffic makes permissive left turns difficult for trucks. This adjustment will help to prevent both trucks and the passenger vehicles queued behind them from getting stuck at intersections for more than one cycle. If permissive-only left turning movements with high truck volumes are especially delayed at an intersection, designers should consider adding a protected left-turn phase to allow truck queues to clear.

Signal timing in major activity centers is typically not designed with trucks in mind, prioritizing other more common modes of transportation. When implementing any signal changes aimed at benefiting trucks, designers should carefully consider potential effects on passenger vehicles, transit, and pedestrians and bicyclists. Designers must implement signal timings with the overall goals of the corridor in mind, not just trucks.

Supplemental Signal Faces

Signal head visibility is of vital importance to the safe and smooth operation of a roadway intersection. Because roadway geometry is typically uniform in major activity centers, signal visibility is rarely impeded by horizontal or vertical alignments. However, at intersections with high percentages of trucks, signal faces are often obscured from passenger vehicles by large trucks ahead of them. When this is the case, supplemental signal heads should be placed at the intersection to provide optimal visibility to vehicles. This may be achieved through additional signal heads on span wire or through signal heads on pedestals at the side of the road, as shown in Figure 88. Signal heads mounted on pedestals should have their lowest parts between 12 and 19 feet above the sidewalk. Designers should consider the operating environment as a whole when determining if supplemental signal heads are necessary, but general benchmarks for where they may be desirable include roadways whose traffic is at least 10% heavy vehicles (trucks and buses) and/or roads with design speeds of 45 miles per hour or faster. See the FHWA *Manual on Uniform Traffic Control Devices* for more guidance on the design and installation of supplemental signal heads.

Figure 88: Supplemental Signal Heads on Pedestals in Downtown Atlanta

Source: Google Street View

Multimodal Access

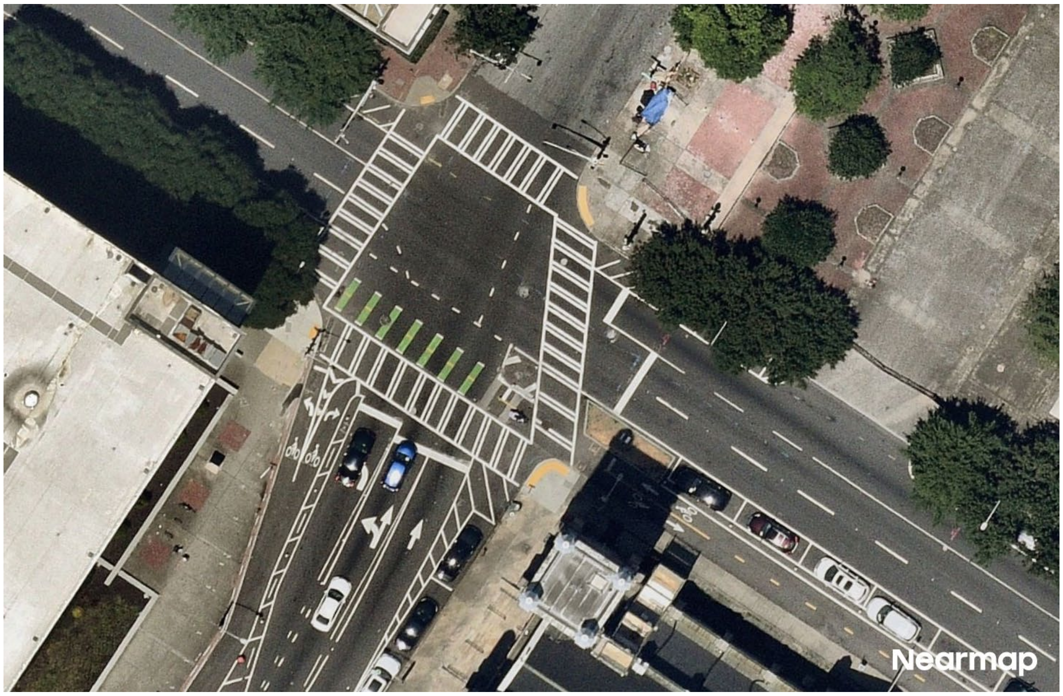
Multimodal transportation access includes public transportation like buses, heavy rail, and streetcars; bicycle facilities like bike lanes; and pedestrian walkways like sidewalks and multi-use paths. In major activity centers, pedestrian and bike facilities are often separated from vehicle traffic. Further, transit usage is much higher in these areas than in small downtowns or industrial areas. At the same time, larger retailers in major activity centers require combination trucks to make deliveries. This context should factor into design to provide both freight mobility and multimodal access.

Pedestrians

Major activity centers have very high pedestrian activity. The density of uses and storefronts, short lot frontages, and low driveway density encourage walking to destinations within the area. As a result, pedestrians and trucks frequently interact at crosswalks and on sidewalks at loading zones and loading docks. Guidance on designing each of these areas for trucks and pedestrians can be found later in this document. More generally, safety measures to consider where pedestrians and trucks interact include:

- Sidewalks buffered from the curb on both sides of the road to separate pedestrians and vehicles
- Marked crosswalks at intersections, as shown in Figure 89
- Medians or pedestrian islands on wider roads that allow pedestrians to cross in smaller distance intervals
- Separate truck and pedestrian paths through major intersections
- Raised right-turn islands at channelized right-turns that allow pedestrians to cross in two separate movements

Figure 89: Typical Major Activity Center Intersection

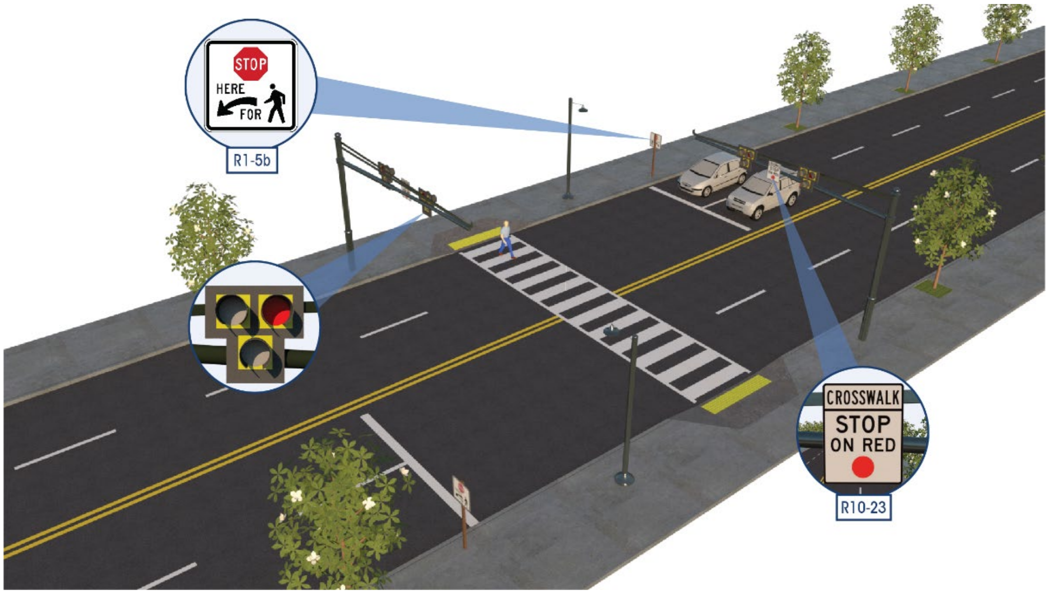


Source: Nearmap

Crosswalks

To create safe crosswalks, it is important to design the roads they cross with clear visibility and a minimum stopping sight distance appropriate for trucks. Most crosswalks are located at intersections, so visibility and stopping sight distance are already taken into account. However, mid-block crossings are another location for crosswalks where these considerations must be taking into account. Mid-block crossings are common in major activity centers on corridors with few intersection crossing opportunities. These crossings should be well-marked and clearly visible for at least the minimum stopping sight distance of the design vehicle WB-67. Pedestrian hybrid beacons, as shown in Figure 90, should be considered at all mid-block crossings to improve visibility and reduce crash risk for pedestrians.

Figure 90: Rendering of a Pedestrian Hybrid Beacon at a Mid-Block Crossing



Source: Pedestrian Safety Guide and Countermeasure Selection System, FHWA, 2013

Sidewalks

Like in industrial areas, it is important to make sure that sidewalks in major activity centers have a buffer, such as a planting strip or trees, in between the sidewalk and the roadway. (Refer to local regulations and the AASTHO *Roadside Design Guide* for more guidance on vegetation in road buffers.) Based on the "AASHTO Green Book" criteria, a buffer of at least 2 feet between the roadway and the sidewalk is preferred, as is the provision of sidewalks on both sides of the street. Unlike in downtown areas, major activity centers often have dedicated loading areas for large retailers. In major activity centers, loading docks are typically on the backside of their respective businesses. Loading dock driveways should be designed to accommodate the expected vehicle making deliveries, as discussed further in the Access Management section. Loading areas should be properly signposted for freight vehicles and pedestrians near the loading dock. Where sidewalks become flush at loading docks, they should preferably have a demarcated sidewalk area and pavement markings indicating the area as a loading zone. For example, a painted sidewalk like that seen in Figure 91 alerts pedestrians to the fact that they are walking near a loading zone while also improving visibility for freight vehicles.

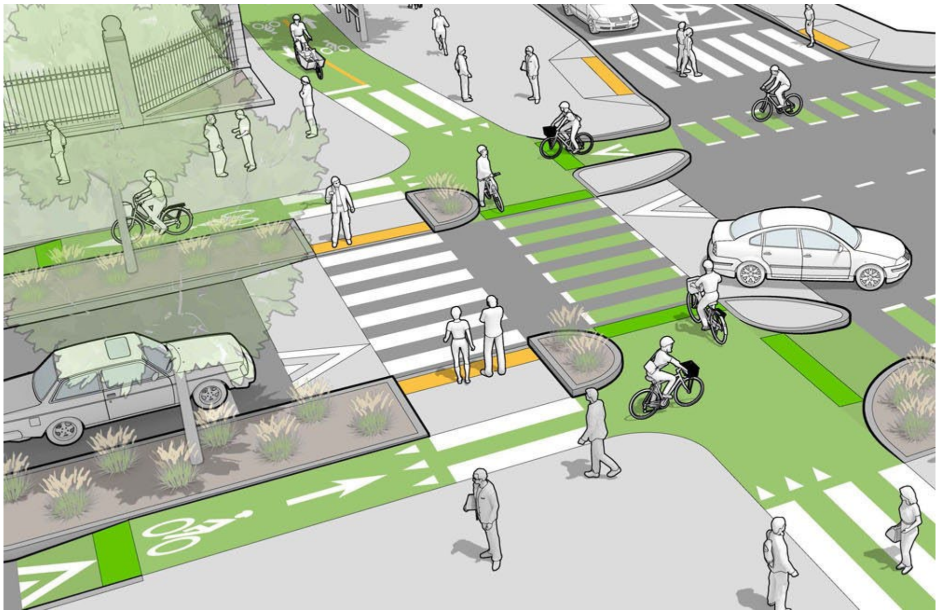
Figure 91: Painted Sidewalk at Loading Dock Entrance, Midtown Atlanta

Source: Google Street View, 2024

Bike Facilities

In major activity centers, bicyclists often operate in dedicated facilities separate from vehicle traffic. However, bike-truck conflicts can still arise at intersections when bicyclists must cross a road onto which a truck is turning. As mentioned in Chapter 3, providing additional pavement markings where conflicts with bicyclists are more likely can help to improve bike safety when truck volumes are high. The green bike crosswalks between dedicated and separated lanes in Figure 92 are an example of desirable infrastructure where bike-truck conflicts may arise in major activity centers.

Figure 92: Example Bike Infrastructure at Intersections



Source: *Contextual Guidance for Protected Intersections*, Toole Design, 2024

In addition to roadside dedicated bike lanes as shown above, separated cycle tracks and multi-use paths are alternative facilities to accommodate bicycles (and pedestrians, in the case of multi-use paths). These options further separate bike traffic from trucks, improving safety for bikes and efficiency for trucks. Cycle tracks may be considered in major activity centers with high volumes of bicyclists, and multi-use paths may be considered where pedestrians and bicyclists are common, but space is more limited.

Bike buffers are preferred to provide separation from trucks in the travel lanes in major activity centers. Bike lanes should be buffered at a minimum by a striping, but striping alone may not offer substantial protection from trucks and other vehicles. Without physical barriers, trucks and other vehicles can easily encroach on bike lanes, and trucks often do illegally park in non-buffered bike lanes. The FHWA *Separated Bike Lanes on Higher Speed Roadways* toolkit provides examples of physical buffers that may be used to protect bike lanes. In major activity centers, some appropriate buffers may include raised curbs, vertical barriers, and on-street parking lanes. The presence of vertical buffer elements improves both safety and comfort for bicyclists by preventing vehicle encroachment on bike lanes. Figure 93 demonstrates how vertical barriers can protect bike lanes from truck traffic. Vertical buffers, along with regular maintenance to keep bike lanes clear of debris and other obstacles, keep bicyclists safe and separated from truck traffic.

Figure 93: Illustration of a Vertical Buffer for Bike Lane

Source: *Separated Bike Lanes on Higher Speed Roadways*, FHWA, 2024

Transit

Transit usage is typically higher in major activity centers than in other areas. While separated transit facilities, like heavy rail, have little to no conflict with trucks, transit that runs in traffic, like buses, must be considered when designing for freight. To avoid conflicts, bus stops should be separated from any loading zones either at sufficient distance or through the use of curb extensions, as discussed further in the Curbside Management section. Sufficient separation between loading zones and bus stops also ensures that freight will not be slowed at loading zones by buses and that buses will not have stop locations blocked by freight.

Mobility On Demand

With the rise of ridesharing apps like Uber and Lyft, mobility on demand (MoD) has become a major alternative mode of transportation in the Atlanta region. In traffic, MoD operates identically to typical vehicle traffic and as such does not warrant additional consideration here. However, MoD differs from typical vehicle traffic at pickup and drop-off points. Passengers board and exit MoD at the curb, ideally in designated areas or wherever drivers can find space. On roads where truck traffic is common, trucks and MoD may compete for curb space. Further, passengers waiting for rides may be waiting near the edge of curb, presenting additional safety risks near loading zones. To minimize MoD and truck conflicts, designated loading zones for trucks should be clearly marked both to drivers and to pedestrians. On roads with many MoD pickups and drop-offs, designated curb space for these operations may be desirable to further manage and delineate curb space. Loading zones and MoD zones may even share spaces at different times of day in response to varying demand for commercial delivery and rideshare activity. See the Curbside Management section for further discussion of shared loading zones.

Vertical Grades

When designing roadways and driveways in major activity centers, especially those used by trucks, it is crucial to consider vertical grades or slopes to ensure safety and accessibility. Generally, it is desirable for roads to be as flat as possible to minimize traffic impacts. If flat roads are infeasible due to local conditions, the maximum allowable grade on lower speed roads should be 8%, while higher speed roads should not exceed a 5% vertical grade. This limit helps prevent excessive steepness, which can be challenging for trucks to navigate, especially under load. Frequent stops and accelerations due to major activity center traffic are also made easier for trucks to handle when grades are kept low. A sufficiently flat grade allows trucks to maintain control and stability while reducing the risk of crashes and mechanical strain on vehicles. For further guidance on vertical grades in downtown contexts, refer to Table 7-4a in the AASHTO "Green Book".

Intersection Design

Intersection design in major activity centers must balance the unique needs of freight traffic with pedestrian-friendly environments, dense land uses, and efficient vehicle flow. According to the "AASHTO Green Book", intersections in these areas should be designed in such a way that large trucks, particularly semi-trailers, can maneuver safely without causing excessive disruption. This typically requires wider turning radii of at least 30 feet on truck travel ways based on the maneuverability of the WB-67 design vehicle, as shown in Figure 94.

Figure 94: Swept Path of WB-67 Truck

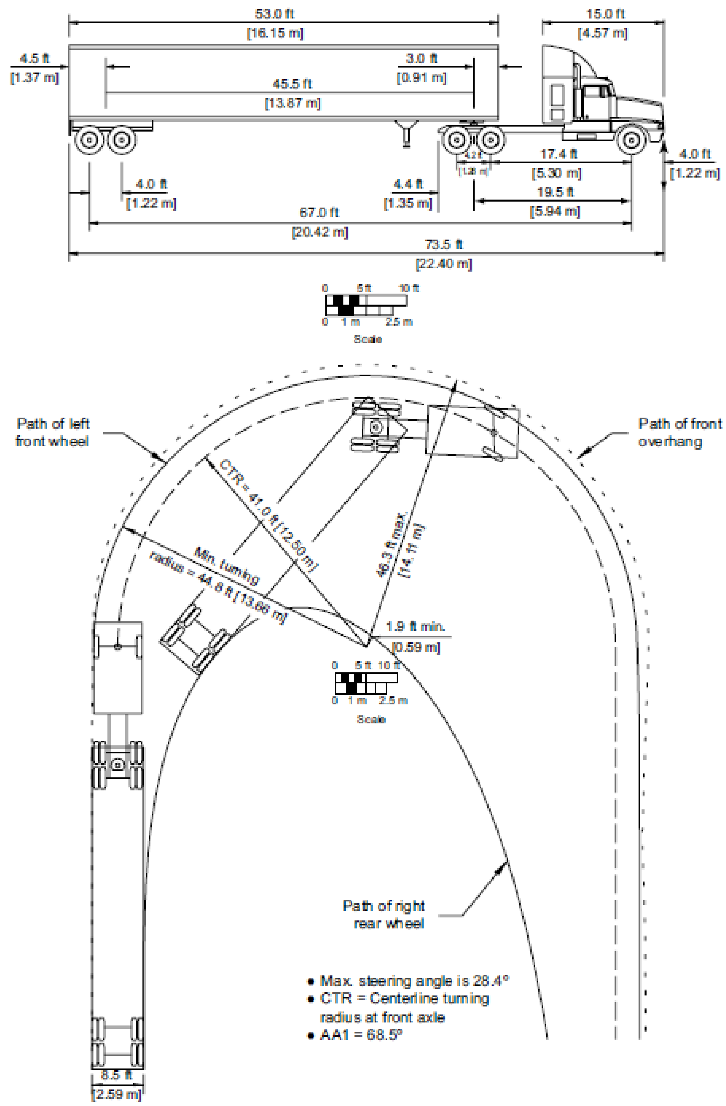


Figure 2-24. Minimum Turning Path for Interstate Semitrailer (WB-67 [WB-20]) Design Vehicle

Source: *Green Book*, AASHTO, 2018

The AASHTO Green Book emphasizes the importance of designing intersections that accommodate different modes of transportation, including freight, by ensuring appropriate lane widths and shoulder provisions. Intersections should be designed with clear sightlines and gradual curves on intersection legs to facilitate smooth truck movements. When roadways are sharply curved leading into intersections, stopping sight distance and available reaction time is reduced for all drivers, including truck drivers. Thus, sharply curved intersection legs should be avoided whenever possible to keep drivers and pedestrian safe. Additionally, clear and well-placed signage is crucial for indicating both truck routes and areas where trucks are prohibited.

Proper signage helps prevent congestion and enhances safety by directing truck traffic along suitable routes and avoiding restricted zones. Where wider curb radii for trucks lengthen pedestrian crosswalks, median and channelizing islands can be used to reduce crossing distances as shown in Figure 95 and Figure 96. These islands guide pedestrians to designated crossing points, minimizing the distance they need to travel across the intersection.

Figure 95: Pedestrian Refuge Area in Median at Intersection

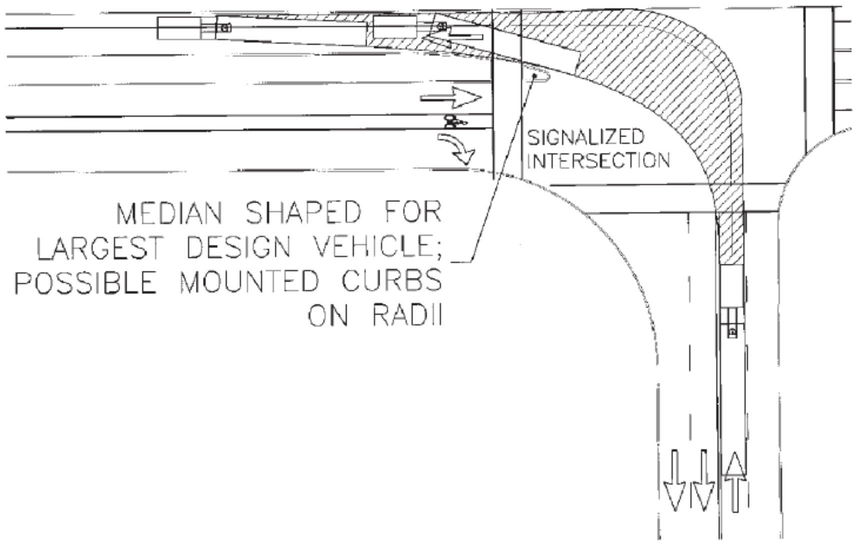
Source: *Urban Street Design Guide*, NACTO, 2013

Figure 96: Channelized Right Turn Pedestrian Refuge Island

Source: *Pedestrian Safety Guide and Countermeasure Selection System*, FHWA, 2013

Asymmetrical median noses can benefit both trucks and pedestrians by both accommodating the swept paths – or the area that any part of the truck will occupy while turning, as shown in Figure 97 – of turning trucks and providing pedestrian refuge areas. However, when considering asymmetrical median noses, it is important to be cautious as they reduce the protected area for pedestrians compared to symmetrical noses. While these designs can help manage traffic flow and potentially reduce vehicle speeds, ensuring there is adequate space for pedestrians to wait safely is crucial. Additional considerations include maintaining clear sightlines for pedestrian and cyclist visibility, designing intersections to be accessible for all users, and ensuring efficient traffic flow by providing safe, direct paths for pedestrians and cyclists. Installing sufficient lighting at intersections is also important to improve visibility during nighttime and adverse weather conditions

Figure 97: Asymmetrical Median Nose Implementation



Source: *Designing for Truck Movements and Other Large Vehicles in Portland*, City of Portland Office of Transportation, 2008

These principles collectively inform a comprehensive approach to intersection design in major activity centers, ensuring that freight traffic is managed while maintaining the urban fabric and safety for all users.

Access Management

Access management for major activity centers where truck traffic is common involves several key strategies. Driveways used by trucks should be designed with a radius that accommodates their wide turning paths, typically a 30-foot radius. This allows trucks to enter and exit driveways smoothly without encroaching on adjacent lanes or causing disruptions. Further truck design considerations are available in the following subsections.

Access to off-street loading docks should not be provided on major streets, if possible. Diverting access to minor streets and alleys allows major streets to maintain high throughputs and minimal flow disruptions. Truck operations are also safer when drivers do not have to navigate turns onto high-volume, high-speed roads when exiting loading areas.

Trucks and general traffic may share driveways, especially at larger developments and on major roads. Shared driveways consolidate access points along a corridor and allow trucks and vehicles to navigate to their destinations on-site rather than on the main road. For example, most non-emergency traffic to Northside Hospital enters the site via Hollis Cobb Circle on either Johnson Ferry Road or Peachtree Dunwoody Road. Hollis Cobb Circle then provides access to a loading dock area for trucks (on the left of Figure 98) and to multiple parking decks for visitors. The shared driveway keeps most navigation and maneuvering on-site rather than on the major roads adjacent to the site.

Figure 98: Shared Driveway at Northside Hospital

Source: Google Maps

Driveway Design for Freight

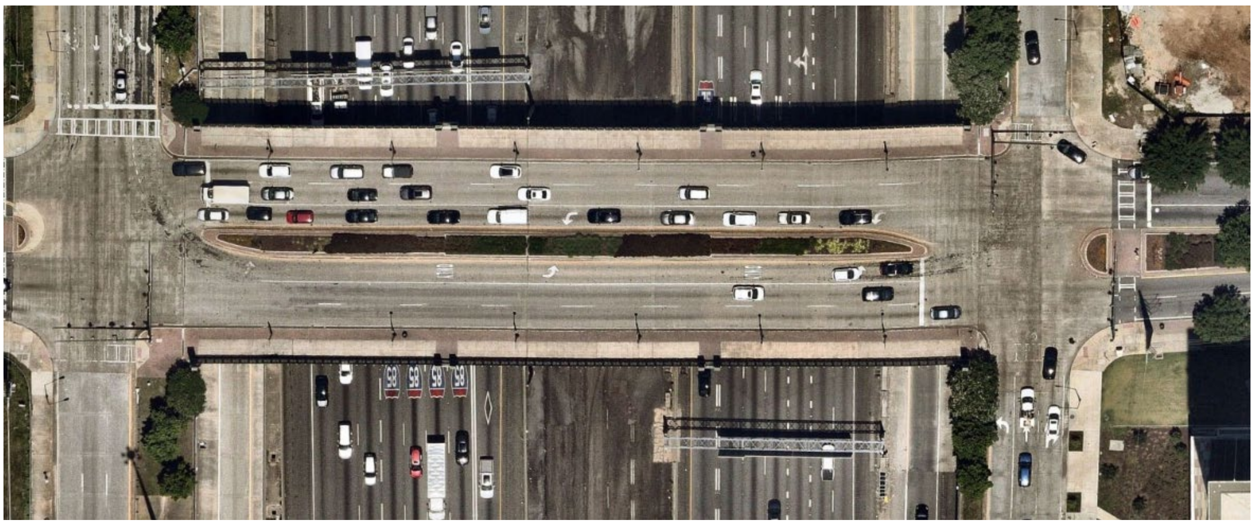
For intersections and driveways where semi-trailer combination trucks are expected to regularly operate, the design must accommodate truck movements. This includes ensuring that heavy-duty pavement is provided for truck access to loading docks and that the driveways associated with these docks are designed with appropriate truck turning radii. For minor driveways, especially those allowing only right turns, the design typically caters to passenger vehicles; however, where trucks are involved, the turning radii and pavement strength must be enhanced to prevent damage and ensure smooth operations. On driveways that expect frequent truck traffic, the pavement should be strengthened as prescribed in the **Error! Reference source not found.** section based on expected truck volumes. Curbs should also be strengthened on such driveways due to the increased strain that turning trucks will put on them. Continuously reinforced concrete (CRC) is one option for heavy-duty pavement that may be preferred to asphalt on these driveways due to its ability to provide long-term strength with fewer maintenance costs, according to the FHWA *Continuously Reinforced Concrete Pavement Manual*.

Median Opening Design

Medians are uncommon in major activity centers. Roads in these areas generally have lower speeds, higher access requirements, and less available right-of-way than their available counterparts, making medians either unnecessary or infeasible. Where they do exist, they rarely have mid-block openings. Instead, they serve to restrict access, increase safety by separating opposing travel directions, and improve the aesthetics of the area via vegetation and landscaping.

The median on 14th Street between West Peachtree Street and Fowler Street is landscaped and only allows for left turns at intersections. On the portion of 14th Street that crosses I-75/85, shown in Figure 99, the median has asymmetrical noses at the interstate exits. As discussed in the Intersection Design section, asymmetrical median noses benefit trucks making turning movements by accommodating their swept paths. While medians are rarely necessary in major activity centers, designing them to accommodate trucks where truck traffic is high is a good practice.

Figure 99: Median on the 14th Street Bridge in Midtown



Source: Nearmap

Pavement Maintenance

Roads with high volumes of truck traffic may need more frequent pavement maintenance due to the extra pavement stress caused by heavy vehicles. Roadway owners should closely monitor high truck-volume routes for any necessary resurfacing, restriping, pothole filling, and curb repair. If a curb requires frequent repair, consider moving the curb location to decrease the likelihood of off-tracking.

Railroad Crossings

When addressing railroad crossings, it is essential to review the crash history to identify any safety concerns and improve design accordingly. Adequate vertical clearance must be provided for lowboy trailers (trailers with a lower deck and clearance) and other oversized vehicles. Specifically, the highway surface should be level with the top of the nearest rail within a 30-foot distance from the rail, ensuring that it does not deviate more than three inches higher or lower. Adjustments should be made for track superelevation (i.e. banking), if necessary, to maintain proper alignment and safety. These considerations, as outlined in the GDOT *Design Policy Manual* Section 7.6.2, help ensure safe and efficient railroad crossings for all types of vehicles.

Special considerations must also be made when at-grade crossings occur near intersections. If a vehicle must enter a signalized intersection immediately after crossing railroad tracks, the stop bar for that approach should be located before the crossing rather than after, as shown in Figure 60. This configuration prevents vehicles from crossing and then getting stopped at a red light, which causes queues to spill out onto the railroad tracks. Coordination between the vehicular signal and the rail crossing signal may also be desirable to prevent traffic from getting stuck in the middle of the intersection when the rail crossing signal activates.

Figure 100: Signal Stop Bar Ahead of At-Grade Railroad Crossing

Source: Seleno Ave in Napa, CA, Google Maps

At stop-controlled intersections, traffic should not stop after crossing railroad tracks. The other intersection approaches need clear signage to alert them that crossing traffic is not stopping. Figure 101 shows an example of this kind of signage from downtown Norcross. These signs should be present and easily visible at all approaches besides the crossing approach.

Figure 101: Proper Signage at Stop-Controlled Intersection near At-Grade Crossing

Source: Downtown Norcross, Google Maps

Pedestrian Considerations

At-grade railroad crossings should also have pedestrian crossing infrastructure where pedestrian activity is common. Often, pedestrian railroad crossings can simply consist of sidewalks next to the road that either ramp down to the railroad pavement or remain level, as shown in Figure 102. With this configuration, pedestrian movements are controlled by the same gate that controls vehicle movements when trains are approaching. Pedestrian crossings may also be implemented separately from roadway crossings where pedestrians need to cross railways, including both sidewalks and separated pedestrian infrastructure like multi-use paths. At a minimum, static signage alerting pedestrians to railroad crossings should be present on sidewalks and multi-use paths. Standalone pedestrian stop gates like those shown in Figure 103 can be implemented to both physically control the movements of pedestrians and to alert pedestrians that they are walking near a railroad. The MUTCD requires separate pedestrian gates wherever trains are permitted to travel at 80 mph or higher.

Regardless of crossing location, at-grade railroad crossings must have safe and accessible pedestrian infrastructure if walking traffic is anticipated. Crossing gate arms should not protrude into sidewalks such that they reduce the effective sidewalk width to less than five feet. Sidewalk ramps to railroad crossings should not be sloped at more than a 1:12 grade, and the crossing should be as flat as possible (see Figure 102) to accommodate those with mobility impairments. Additionally, pedestrian rail crossing gates should be signaled with flashing lights and sound components to accommodate the visually and hearing impaired.

Figure 102: Pedestrian Railroad Crossing on Sidewalk in Woodstock, GA

Source: Atlanta Regional Commission

Figure 103: Pedestrian Railroad Crossing with Pedestrian-Oriented Signal and Signage in Woodstock, GA

Source: *Compilation of Pedestrian Safety Devices In Use at Grade Crossings*, FHWA, 2008

Employee/Resident Access

In urban centers, it is often beneficial to provide separate access points for employees and residents and trucks to improve safety and efficiency. Employee and resident parking areas are usually accommodated in parking garages or nearby surface lots. Truck parking often takes place in off-street loading docks, though on-street loading zones and alleys also serve as truck parking in major activity centers.

Whenever possible, on-street freight loading zones should be on side streets away from employee/resident access points. The path from employee parking areas to building entry points should not pass through the loading zones to both preserve employee/resident safety and improve unloading efficiency. To consolidate access points, loading docks may be located at the bottom of employee/resident parking decks. In a shared deck, the loading zones should be separate from the rest of the parking spaces, and there should be clear signage at the entrance to the deck directing trucks and all other vehicles to their respective parking locations. Figure 104 is an example of this kind of signage at Midtown Union Apartments. Employees, residents, and shoppers must have walking access to the street and/or to the connected building that do not require them to pass through loading zones.

Figure 104: Combined Truck and Vehicle Parking in Midtown Atlanta

Source: Google Maps

Alternatively, truck loading docks may be separate from vehicular parking garages. This design requires an additional driveway or other access point compared to the combined access design. However, separate loading docks may be beneficial to sites that need to receive a lot of deliveries and/or sites that need to receive deliveries from larger tractor trailer trucks.

Separated loading docks also obviously prevent loading and unloading activities from interfering with employee and resident access. Whether a site utilizes a combined or separated parking and loading design should be determined considering the operations of the adjacent streets and expected truck activity at the site.

Curbside Management

Curbside management in major activity centers requires careful planning to secure efficient delivery operations while minimizing disruption. Off-street loading is preferred for freight as it frees up curb space for other uses and reduces traffic congestion caused by trucks parked in travel lanes. Large scale new developments and redevelopments should always include off-street loading spaces that are large enough to accommodate the vehicles they serve. While off-street loading docks are often available at sites such as large retailers, grocers, or healthcare facilities, smaller businesses and smaller parcels will often require curbside loading zones. At these sites, on-street loading zones should be designed to avoid impeding the flow of other transportation modes.

Curbside management should be a consideration from the very beginning of site development. Site developers should select a building orientation that minimizes freight's impact on and interaction with other modes of traffic. If a site has the option to locate loading zones on either a busy multimodal street or on a quiet, less trafficked road, the latter is always the preferred choice. Delivery operations should occur on a minor street or in an alley, avoiding loading areas adjacent to busy thoroughfares. Carefully considered building orientation can help to cut down on freight conflicts with other modes and to reduce congestion and waiting time.

Curb space is limited and in high demand in major activity centers. Trucks using on-street loading zones both compete for curb space and interact with all other modes. To manage this effectively, loading zones should be carefully situated to avoid conflicts with bike lanes and pedestrian pathways, ensuring safety and accessibility for all users. Loading zones should also be clearly signed and enforced to prevent drivers from using them as regular parking spaces, as shown in Figure 105.

Figure 105: Loading Zone Signage

Source: "Modernizing Commercial Loading," Kyle Rowe and International Parking & Mobility Institute

It is also important to consult with local businesses to understand the frequency and duration of deliveries, allowing for better planning of loading zones. To minimize disruptions and maintain smooth traffic flow, consider restricting loading and unloading activities to off-peak times when traffic is lighter. The optimal time to schedule off-peak deliveries varies based on business type. For some businesses that are less busy in the mornings, like restaurants and non-grocery retailers, early morning before the morning rush hour may be a good time to receive deliveries. Mid-day deliveries between the AM and PM peaks may be suitable for businesses that do not have staff available to receive deliveries in the morning. Late night deliveries, while possible, are challenging to coordinate due to staffing requirements and noise curfews. If local jurisdictions wish to restrict delivery times, they should consider how the restrictions will impact businesses.

Loading zones must also be sized to accommodate both the trucks themselves and loading/unloading activities. Many trucks use ramps to unload goods, which adds additional length to the effective size of the truck, as shown in Figure 106. If loading zones are not properly sized, ramps may encroach on nearby on-street parking, crosswalks, or sidewalks.

Figure 106: Truck Ramp Encroaching on Other Curb Spaces

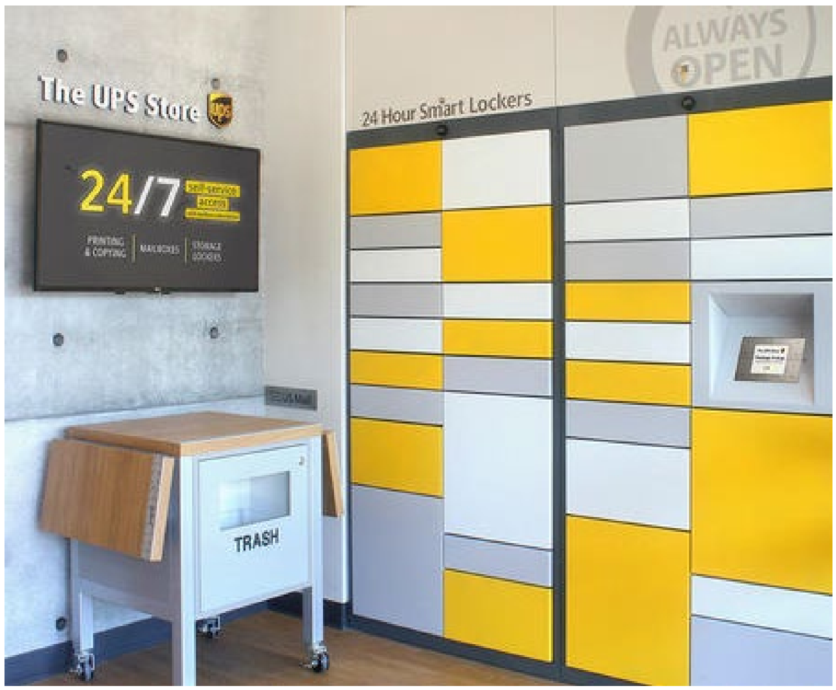
Source: Atlanta Regional Commission

The PacTrans report *Developing Design Guidelines for Commercial Vehicle Envelopes on Urban Streets* measured the additional space required to accommodate various delivery tools. They found that ramp assisted deliveries require an additional 158 inches (about 13 feet) of loading space, increased to 227 inches (about 19 feet) when accounting for the use of a handcart. Taking this into consideration, the most common truck in downtown areas, the SU-30, a loading zone that accommodates both the truck and its ramp should be about 50 feet long. The typical delivery vehicles and additional space requirements of delivery tools should be taken into consideration when designing load zones. See Table 5.29 of *Developing Design Guidelines for Commercial Vehicle Envelopes on Urban Streets* for further guidance on sizing loading zones.

Other than ramps, handcarts are a common tool used to assist in the unloading process. Handcarts have additional space requirements as well, but they can also benefit from other infrastructural changes. For example, the NCFRP report *Improving Freight System Performance in Metropolitan Areas* notes the past success of initiatives to build sidewalk ramps near loading zones for handcarts. The ramps improve efficiency of loading and unloading activities while also reducing the amount of time that trucks need to be parked in loading zones. Encouraging the use of handcarts increases the distance truck operators can make deliveries in from a single parking space, which also reduces the frequency of illegal truck parking.

Consolidating deliveries into a single location whenever possible can also reduce the amount of time that trucks need to be parked in a space, opening up the loading zone for others. Some parcel delivery companies have implemented parcel lockers to reduce the time it takes to make deliveries and for customer security/convenience. For example, UPS provides parcel lockers at select UPS Store locations, as shown in Figure 107. Amazon has installed parcel lockers at some Whole Foods stores, as shown in Figure 108, and at various other locations. These lockers allow delivery drivers to quickly make numerous deliveries while stopped at one location. They also provide a secure delivery location for customers who may be concerned about parcel theft, and often provide access 24/7 for convenient customer pickup.

Figure 107: Parcel Lockers at The UPS Store, Sandtown Shopping Center



Source: The UPS Store. *24/7 Locker Service.* https://locations.theupsstore.com/ga/atlanta/5829-campbellton-rd-sw/locker-service

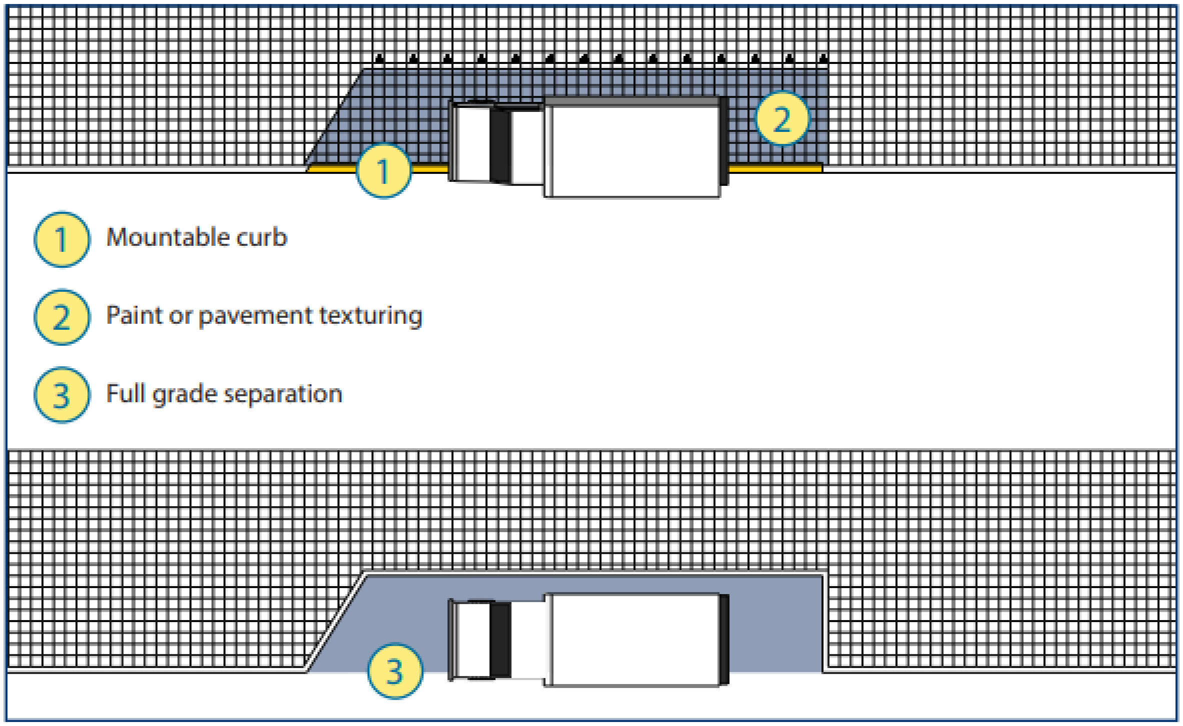
Figure 108: Amazon Lockers at Whole Foods, Midtown Place Shopping Center

Source: Atlanta Regional Commission

In large residential and office developments without off-street loading, local jurisdictions may want to require shared parcel lockers. Parcel lockers reduce the amount of time that deliveries take by up to 78%, according to a study performed by the University of Washington Urban Freight Lab. Together, improved on-street and on-site freight infrastructure can help to reduce the amount of time trucks need to be parked in loading zones.

When loading zones must be placed on busier streets, consider implementing longer loading bays, mountable sidewalks, or cutout sidewalks as shown in Figure 109. (Note that Historic Preservation should be taken into account when altering sidewalks in areas with historic designs or materials.) These measures will help maintain a smooth flow of traffic and enhance the urban environment for all users.

Figure 109: Dedicated On-Street Loading Zone Diagram

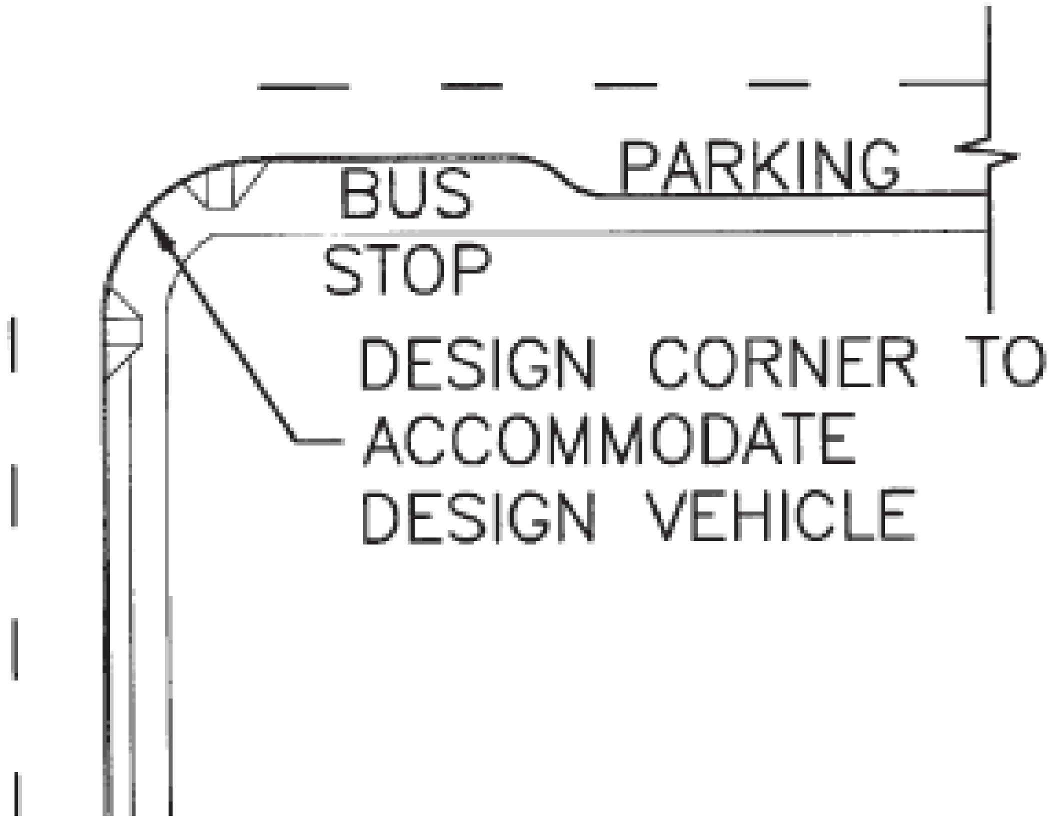


Source: *Accommodating Freight in Complete Streets*, NYSERDA, 2019

Figure 109 demonstrates the difference between the different mountable sidewalk options. Option 1 is a mountable curb, where the curb is low enough that a truck can park on it to be out of the street. Option 2 includes paint or pavement texturing, denoting where the truck can park and where pedestrians should be cautious of freight vehicles. Option 3 shows full grade separation, where the sidewalk has a cutout the size of the truck parking space, with grade separation for pedestrians on the sidewalk. Even when sidewalk cutouts are included for the benefit of trucks, sidewalk width should never be narrower than 5 feet to comply with ADA regulations and to best secure pedestrian comfort and safety. The decision to implement a sidewalk cutout should be made with available sidewalk space in mind.

Where space allows, curb extensions with sidewalk cutouts can be beneficial to freight, transit, and pedestrians. As shown in Figure 110, a sidewalk cutout (labeled in the figure as "PARKING") creates a clearly delineated, dedicated loading zone for freight traffic that is separate from the travel lanes. This treatment has the added benefit of both shortening crosswalks for pedestrians and allowing buses to pick up passengers without the need to pull in and out of traffic. Note that this may slow traffic when buses are picking up passengers, so take the local context and traffic patterns into consideration before implementing this design.

Figure 110: Freight-Supportive Curb Extension with Transit



Source: *Designing for Truck Movements and Other Large Vehicles in Portland*, City of Portland Office of Transportation, 2008

Loading zones can serve a multitude of purposes, including large deliveries for retail and grocers, smaller parcel delivery, pickup and drop-off for app-based companies, and pickup and drop-off for rideshares and taxis as shown in

Figure 111 Allowing these loading zones to have multiple uses makes the most of the available curb space and may reduce congestion and improve safety. On very busy streets, loading zones can be managed by an app-based reservation system that allows freight operators to "book" a loading zone for a given time. This can help to reduce double or illegal freight parking and prevent unnecessary freight miles spent circling and looking for parking.

Figure 111: Flexible Loading Zone, Downtown Atlanta

Source: Atlanta Regional Commission

A lack of loading zones, or a lack of enforcement, can impact not just freight and other service vehicles, but other modes as well. Figure 112 shows where a loading zone is full, but not all vehicles are freight or service vehicles. The vehicle nearest to the intersection is partially blocking the crosswalk. This could result in pedestrians walking in a travel lane, creating a safety issue. A vehicle parked adjacent to the curb in a crosswalk may also block the ramp needed by individuals with mobility issues, preventing access to the sidewalk. Due to these related safety issues, adequate space for freight and service vehicles, as well as regular enforcement, are both needed in major activity centers.

In locations where adequate space is available, it is also beneficial to move non-freight curbside uses on-site if feasible. This includes locations for rideshare/taxi pickup and drop-off, as well as pickup and delivery spaces for app-based delivery companies. Shifting this demand on-site reduces the demand at the curb, which can then be used for bicycle, pedestrian, and transit demand, as well as additional freight activity if needed. Note that this is typically not feasible on small parcels or at developments that do not have parking on-site or very close by.

Figure 112: Service Vehicle Blocking Crosswalk, Downtown Atlanta

Source: Atlanta Regional Commission

An example of this is the designated rideshare location at Ponce City Market in Midtown Atlanta, shown in Figure 113. Ponce City Market is located on a superblock with multiple parking lots/decks, so there is adequate space on site for this use. It is bordered on the east by the Beltline, which does not allow cars. It is bordered by Ponce De Leon Avenue on the north and North Avenue on the south, both of which are major roadways where regular rideshare stops would potentially create safety issues. Shifting this use on-site, along with freight deliveries which also take place on-site, frees up these roadways for other uses.

In higher density locations, these pick-up and delivery spaces can be included in parking decks and garages, with appropriate design. Figure 114 shows a designated pick-up space for restaurants inside a parking deck in a mixed-use development on Peachtree Road in Buckhead. This is a condo building with street level retail. Customers can enter the retail part of the parking deck without having to pay or pass through a security gate but must validate their parking space once inside. The designated restaurant spaces allow delivery drivers to skip parking validation, speeding up their stop. Drivers can also walk into the retail part of the building from the parking deck near these spaces, eliminating the need to walk around to the front of the building, which also speeds up the pick-up process. Separate loading areas are provided for freight on-site, and there is also adequate space on-site for rideshare/taxi pickups and drop-offs. This convenient and safe design makes drivers for all of these operations more likely to use these spaces, and less likely to park on a major roadway like Peachtree Road.

Figure 113: Rideshare Pick-Up Signage, Ponce City Market, Midtown Atlanta

Source: Google Street View, 2019

Figure 114: Designated Restaurant Pick-Up Space, Condo Building, Buckhead, Atlanta

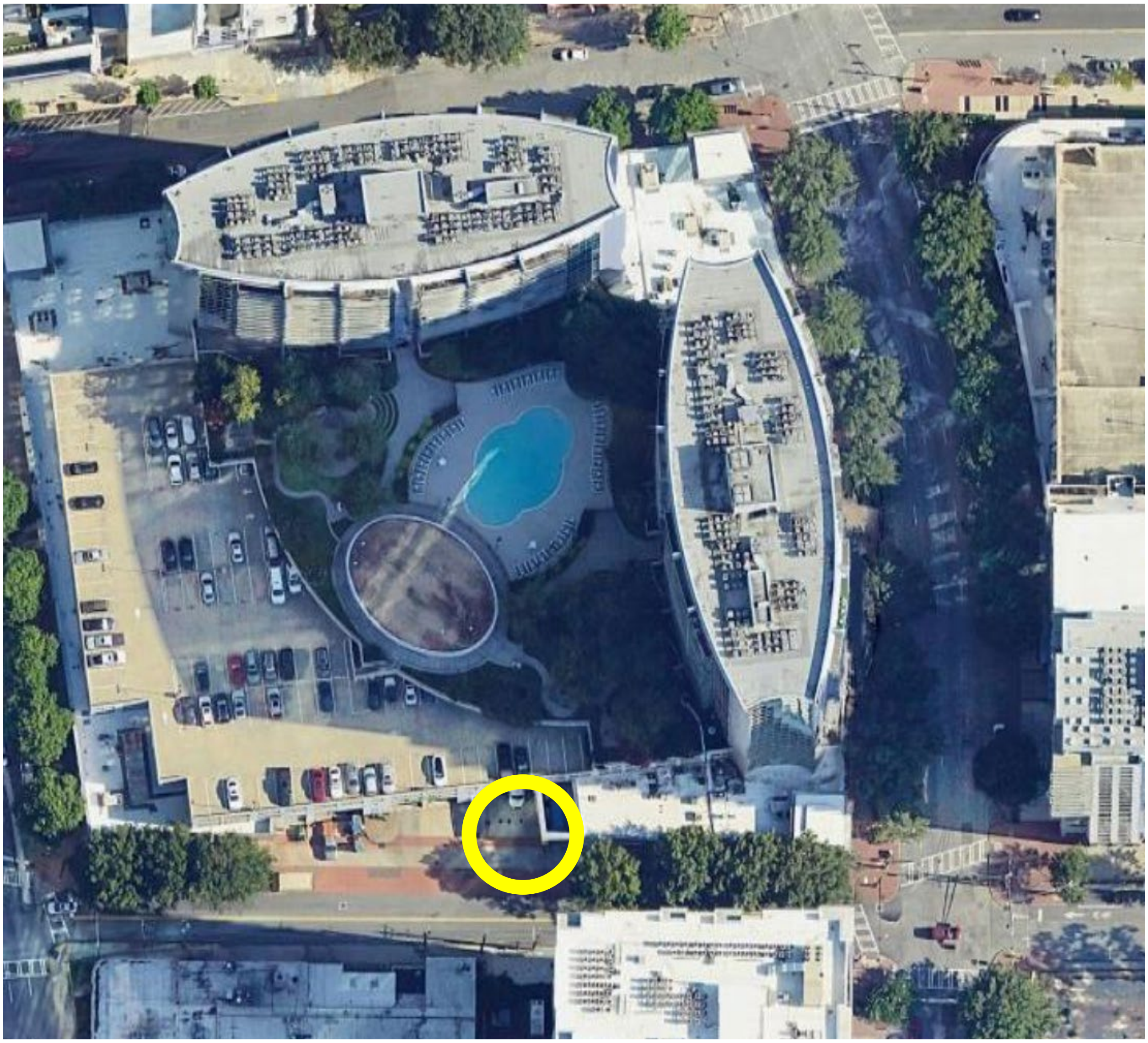
Source: Atlanta Regional Commission

Beyond physical infrastructure, new virtual tools may help to better manage curb space in major activity centers. Loading zone reservation systems have been piloted before in cities across the country using apps such as curbFlow, OpenPark, and Coord. While these apps have since become unavailable, initial results for their impact on truck parking were positive. Positive results included reduction of double parking by over half and high levels of participation in the pilot programs. Allowing truck operators to reserve loading zones in advance could reduce the amount of time spent driving looking for parking spots, which is a major contributor to congestion. Jurisdictions and businesses in the Atlanta area should continue to monitor new developments in similar app-based systems for use in curbside management.

Loading Dock Requirements

Both major activity centers and downtowns must navigate the challenge of accommodating freight in high-traffic, high-density areas. Unlike downtowns, major activity centers are home to many high-intensity developments such as large retailers, commercial businesses, apartment complexes, and offices. As such, loading docks are more commonly found in these areas to support high freight demand. Entrances to loading docks should be placed away from major streets to mitigate congestion effects from freight ingress and egress. Figure 115 demonstrates how this is done at Plaza Midtown, where loading docks are located on 8th Street while West Peachtree Street and Spring Street have no driveways or loading docks. Loading docks should also be placed away from locations with frequent pedestrian usage whenever possible.

Figure 115: Loading Zone Access on a Minor Street at Plaza Midtown



Source: Google Maps

Property owners should design loading docks with the largest expected truck dimensions in mind. All trucks delivering to a site should be able to fit completely in the loading dock to avoid infringing on pedestrian and/or travel way space. Sidewalks near loading docks should either be made of different materials or be painted a different color to help pedestrians identify loading areas; see the Sidewalks subsection for further discussion of this topic. Figure 116 shows a truck using a loading dock that is blocking a sidewalk, bike lane, and travel lane, while Figure 117 shows examples of a well-designed, properly sized loading dock in a major activity center.

Figure 116: Truck Blocking Other Modes, Downtown Atlanta

Source: Atlanta Regional Commission

Figure 117: Major Activity Center Buildings with a Flush Dock, Downtown Atlanta

Source: Atlanta Regional Commission

If available space on-site is limited, the loading dock can be consolidated to serve multiple purposes. For example, it can handle loading and unloading operations while also housing trash facilities and a compacter. However, adequate space is needed so that freight loading and unloading are not impacted by trash pickup and operations, and vice versa.

Off-Street Loading Spaces

Off-street loading spaces reduce the impact of freight on traffic operations. Providing off-street locations for trucks to park reduces the frequency of illegal parking and parking in travel lanes. All loading areas should have a vertical clearance of at least 14 feet, and the loading space should be big enough so that parked trucks do not obstruct neighboring sidewalks. To accommodate operations efficiently, each loading space should be at least 12 feet wide and 35 feet long. Local jurisdictions will have specific minimum requirements for off-street loading spaces based on land use, zoning, and building types. An example of these requirements for the City of Atlanta is shown in Table 6 below, but developers should consult local ordinances for specific requirements for their site.

Table 6: Example Off-Street Loading Requirements

Building Type	Unit of Measure	Required Loading Spaces (min. 12' x 35')
Residential Dwellings and Lodging	50 units or less	None
	51 to 200 units	1
	201 units and above	2
All Other Uses	Up to 15,000 sq. ft. floor area	None
	15,001 sq. ft to 250,000 sq. ft floor area	1
	250,001 sq. ft and above	2

Source: Code of Ordinances Sec. 150-97, City of Atlanta

Minimum loading space requirements provide a baseline for what should be provided on sites receiving freight deliveries. However, for buildings expecting higher daily freight activity, more spaces may be desirable. Appendix Tables D-1a through D-4e of *NCHRP Synthesis 298: Truck Trip Generation Data* may be a valuable tool for estimating daily freight vehicle trips. Daily freight vehicle trips can be estimated based on site land use and either number of employees or site area. Table 7 is an example table that can be used to estimate daily freight traffic for retail uses based on total building area. This estimate can be used to develop freight delivery schedules and inform the number of loading spaces a building should have. The data in the table is based on truck traffic studies at each location listed; site developers should use their judgment to determine which trip generation data to use for their own site.

Table 7: Daily Commercial Vehicle Trips per 1,000 Square Feet of Building Space for Retail Trade

Location	Land Use Type (SIC)	4-Tire Commercial Vehicles	Single Unit	Combination Unit	All 6+ Tire Commercial Vehicles	All Commercial Vehicles
Knoxville, Tennessee	Retail – Downtown (52 – 59)	0.062	0.026	0.007	0.033	0.095
Rochester, New York	Retail – Downtown (52-59)	0.065	0.028	0.008	0.035	0.100
Saginaw, Michigan	Retail – Downtown (52 – 59)	0.078	0.033	0.009	0.042	0.12

Source: Adapted from Synthesis 298: *Truck Trip Generation Data*, NHCRP, 2001

If space constraints limit the amount of loading spaces that can fit into off-street loading docks, loading spaces in alleys and on-street can supplement off-street loading.

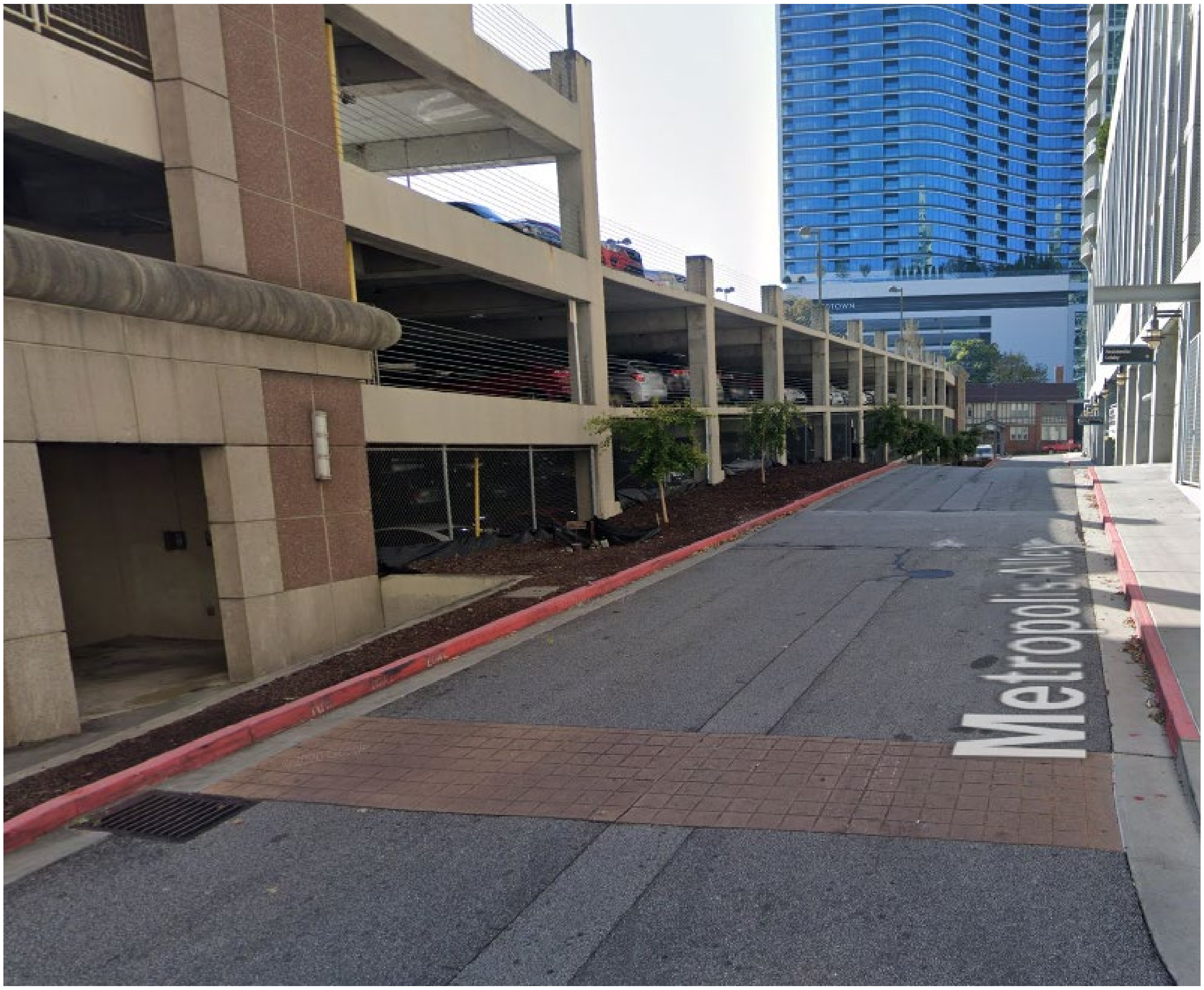
On-Street Loading Spaces

Off-street loading spaces are preferred for most freight deliveries and should be included in all new, large developments. On-street loading zones should also be provided wherever feasible to accommodate package delivery, app-based pickup and delivery, and rideshare/taxi pickup and drop-off. On-street loading zones should be directly next to the property they belong to and exist within the width of public right-of-way.

Alleys

Alleys are effective tools to provide off-street loading zones for sites that are not able to utilize loading docks or do not have enough space in loading docks. To replace on-street loading zones for a business, alleys should be placed near building entrances – ideally, an alley should have direct access to the building(s) it is meant to serve. Alleys can also serve multiple purposes. For example, the Metropolis Alley in Figure 118 provides access to resident and shopper parking decks as well as providing some truck loading zones.

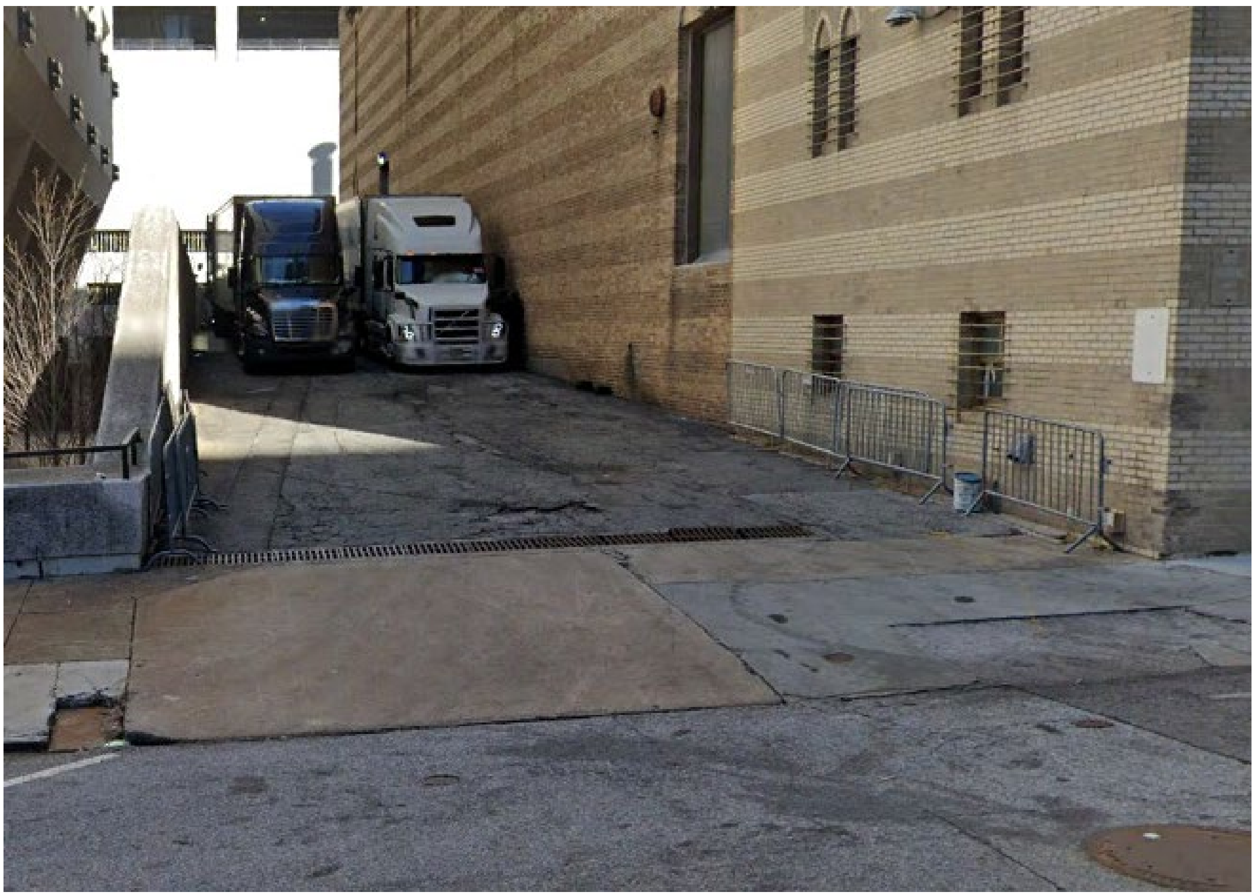
Figure 118: Metropolis Alley in Midtown



Source: Google Maps

Alleys should be sufficiently wide for both truck parking and for drivers to maneuver around the truck during loading and unloading activities. In small downtowns, alleys are often only a single lane wide due to space constraints. This can sometimes cause issues while deliveries take place, though, as a single parked truck blocks the entire alley. If space allows and frequent activity is expected in alleys, they should be made two lanes wide whenever possible. Figure 119 is an example of an alley with truck loading spaces that is two lanes wide. Additionally, alleys specifically intended for use by trucks may require stronger pavement and more frequent maintenance to prevent pavement deterioration from interfering with loading and unloading. When alleys are well-located, sufficiently wide, and well-maintained, they are a preferable alternative to on-street loading zones that also help to manage curbside activity.

Figure 119: Two Lane Wide Alley



Source: Kimley-Horn

Delivery Times

In major activity centers, delivery times should be managed to mitigate the impact on nearby activities. Some jurisdictions restrict the times of day that trucks can park on streets. For example, Section 150-96 of the Atlanta Code of Ordinances lays out regulations that govern truck deliveries. On-street parking for trucks is prohibited from 6:00 p.m. to 8:00 a.m. during standard time and from 8:00 p.m. to 7:00 a.m. during daylight savings time. Moreover, trucks must adhere to strict limits on idle times, which should not exceed 15 minutes, and restrictions on parking times at loading sites, which are restricted to one hour. Local jurisdictions may consider metering curb space if time restrictions do not provide sufficient turnover in truck parking. Enforcement is key to reap the benefits of metering curb space.

As in small downtown areas, it is recommended that major activity centers consider scheduling deliveries during non-peak hours. Municipalities should review existing or develop new delivery time restrictions based on their local needs. For example, early morning deliveries may be permitted in areas with mostly commercial activity to encourage off-peak deliveries, while mid-afternoon deliveries may be encouraged in areas with more residential development. Overnight deliveries would help reduce the impact of commercial activities on traffic but comes with its own set of challenges for businesses and communities, including a lack of staffing and an excess of noise. Local jurisdictions need to consider the needs of local businesses if they choose to develop delivery time restrictions.

Off-peak delivery programs have been attempted in New York City before. Notable results of a 2010 pilot include difficulties getting businesses to participate due to opposition to allowing vendors to have access to facilities unaccompanied at night. New York has since expanded the program and now offers one-time monetary incentives to encourage businesses to transition to and adopt off-hour deliveries (https://ohdnyc.com/incentiveprogram), citing larger economic benefits from off-hour deliveries as justification. Rensselaer Polytechnic Institute has partnered with NYC to develop this program and has also developed the *Off-Hour Deliveries Guidebook* to help other metropolitan areas implement their own program. One of the recommendations in the guidebook is to first partner with large retailers due to the benefits they can receive, increased feasibility of off-hour delivery programs, and their influence in the region.

On especially congested roadways in major activity centers, peak hour clearways may be considered to increase vehicle throughput. Peak hour clearways prohibits curbside parking, including truck loading and unloading, during peak hours. While this can improve congestion and safety on busy roadways, it is not the right choice for every community. Peak hour clearways work best when local businesses and residences have alternative parking, either on-site on on a minor street, for vehicular traffic to use. If deliveries are not prohibited during the peak hour, there will also need to be alternative off-street or side street loading zones that businesses can use to receive deliveries. Local jurisdictions must consider off-street parking and loading, competing demand for curb space, and nearby land uses if they wish to implement peak hour clearways.

Signage

In major activity centers, signage is vital due to the high density and complexity of traffic. The following guidelines should be considered to enhance navigation within major activity centers.

Loading Zone Signage

Freight curb loading zones should be clearly indicated with signs that clearly indicate the extents of the zone and the hours of operation, as displayed in Figure 120. These signs help manage the high volume of freight activity in major activity centers.

Figure 120: On-Street Loading Zone Signage

Source: https://atldot.atlantaga.gov/services-3, ATLDOT c/o Ryan Griffin-Stegink/Walker Consultants, 2019

Loading Dock Signage

Wayfinding signage should be present along roads and as necessary at intersections and driveways within major activity centers. Entrances to loading docks should be clearly identified for trucks. For example, the loading dock entrance to Northside Medical Midtown has an overhead sign stating the name of the site as well as indicating that the entrance is for shipping and receiving. Further, a sign posted to the right of the entrance shows an easily visible picture of a truck and restates that the entrance is for shipping and receiving. Signage like this makes navigation easier for truck operators and reduces the amount of time spent looking for loading dock entrances.

Figure 121: Signed Loading Dock at Northside Medical Midtown

Source: Google Maps

Low Clearance Signage

Low clearage signage must be provided at low bridges in major activity centers. Figure 122 is an example of what good low bridge clearance signage looks like. The signpost on the left clearly indicates the height of the bridge, the overhead sign is attention-grabbing and also automatically alerts overheight vehicles, and the yellow strip on the bridge and black and yellow strips on the supports provide an additional visual warning. Additionally, low clearance signage is recommended at low site entrances and driveways due to the high density of buildings, driveways, and parking garages in major activity centers. Using consistent signage design with recognizable symbols or text makes navigation simpler and easier for truck operators.

Figure 122: Low Bridge Clearance Signage

Source: *Overheight Detection and Alerts*, FHWA, 2018

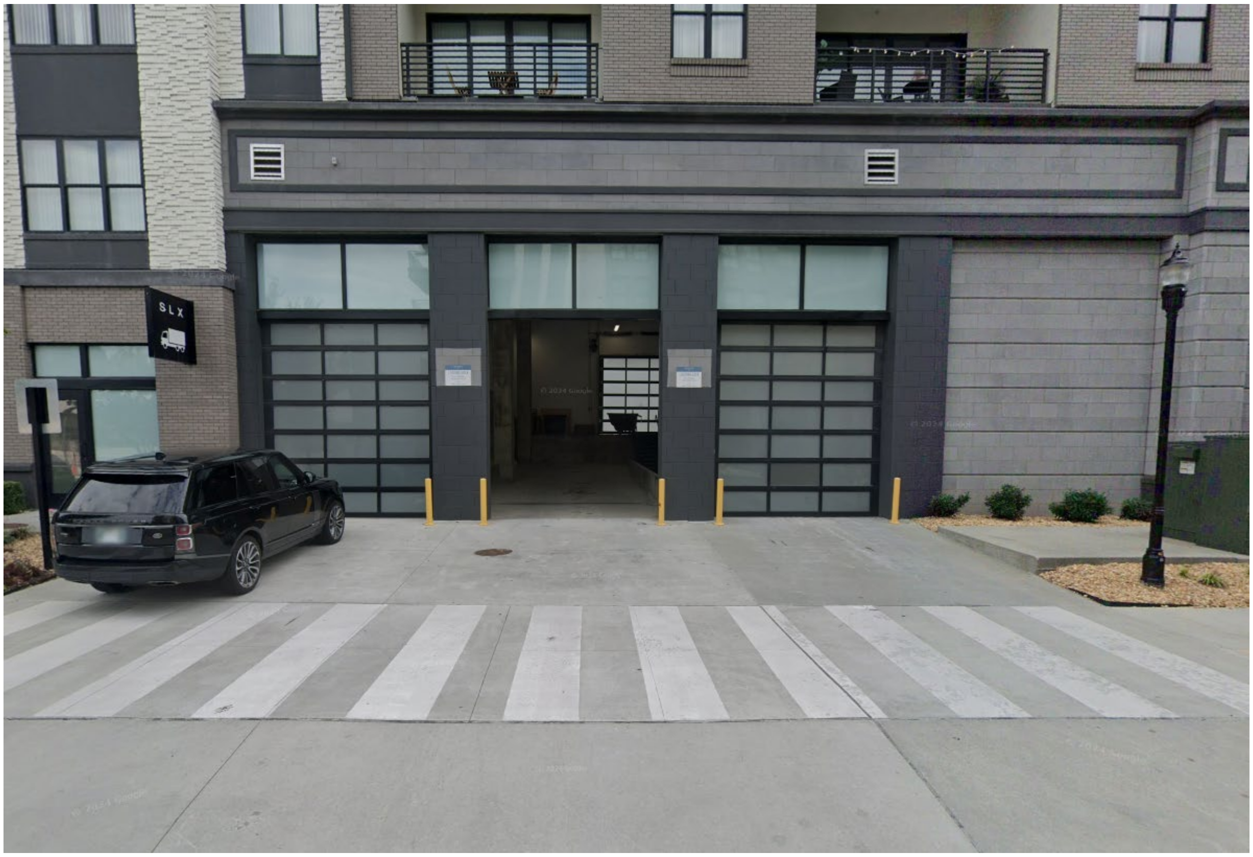
Additional Considerations

Signage in major activity centers should be highly visible and readable, using large, clear fonts and high-contrast colors. Regular maintenance and updates to signage is also recommended. For all signs described in this section, refer to the *Manual on Uniform Traffic Control Devices* for further details on design specifications. Adherence to this manual keeps signage consistent and effective across locations and jurisdictions.

Visual and Noise Buffers

Loading docks in major activity centers should be screened from the view of any public open space or sidewalk area, where practical. Buffers are typically created using plants or natural existing materials, either alone or in combination with fencing or walls. These mechanisms block both the visuals of loading operations and some of the noise. However, due to space constraints, typical buffer solutions may not be feasible in major activity centers. Placing loading docks away from busy pedestrian and vehicle areas can screen the visibility and noise of loading operations from most of the public. When loading docks must be located near areas with high pedestrian traffic, rolling doors can help to screen loading operations from those on the street. Designs on the outside of rolling doors, like those in Figure 123, can further screen loading areas visually by helping them blend into the surrounding area when closed.

Figure 123: Designed Rolling Door Screen in Chamblee, GA



Source: Google Street View

Beyond physical buffer treatments, operational measures can be taken to mitigate the aesthetic impacts loading operations. Scheduling deliveries outside of peak hours is one of the most effective operational measures that can be taken to screen truck loading and unloading. Off-peak times like mid-afternoon and early morning are often less busy for pedestrians and businesses. Restricting deliveries to only these times mitigates the visual and sound impact that loading operations have on the aesthetics of the surrounding community. However, off-peak deliveries can be difficult to implement and may conflict with existing overnight freight restrictions. See the Delivery Times section for further discussion of this topic.