Intersection design must balance the needs of drivers, transit users, pedestrians, and bicyclists. To improve safety for vulnerable road users, such as pedestrians and bicyclists, intersections should have short crossing distances, slow motor vehicle turning speeds, and good visibility. Context-sensitive design derives from key decisions made about intersection geometry. For example, the selection of design vehicle and the tolerance for vehicle encroachment into other lanes will help determine the necessary width of the intersection and impact pedestrian crossing distances.

Designers have flexibility in the selection of the design vehicle and how that vehicle will traverse the intersection. It is not always necessary to design an intersection for the largest vehicle that may ever use it or to oversimplify geometry with large sweeping curves. Designers should consider large vehicle frequency and other contextual factors when selecting a design vehicle. Designers also have flexibility in determining when it is appropriate for large vehicles to encroach into other travel lanes during turns—a key factor for designing tighter, pedestrian-friendly intersections. Design features, such as mountable truck aprons and stop bar placement, can help accommodate large vehicles and result in suitable intersection geometry for vulnerable road users.

The 2011 AASHTO Green Book recommends that designers select the largest vehicle that will use a facility with considerable frequency, but then goes on to provide more nuanced guidance and flexibility:

“If turning traffic is nearly all passenger vehicles, it may not be cost-effective or pedestrian friendly to design for large trucks. However, the design should allow for an occasional large truck to turn by swinging wide and encroaching on other traffic lanes without disrupting traffic significantly.”

AASHTO Green Book 2011, p. 9-80
APPLYING DESIGN FLEXIBILITY

LAYOUT
To the extent feasible, intersections should meet at right angles. This increases sight distance and can help lower vehicle speeds (AASHTO Green Book 2011, p. 9-25). Skewed intersections can increase pedestrians’ exposure to vehicle traffic, increase speeds for turning vehicles, reduce sight distance for some users, and may not provide clear orientation cues for pedestrians with visual disabilities. (AASHTO Pedestrian Guide 2004, p. 76)

TURN RESTRICTIONS
Consider turn restrictions at locations where turning volume is low and pedestrian crossing volumes are high. (NACTO Urban Street Design Guide 2013, p. 129)

DESIGN VEHICLE AND ENCROACHMENT
The design vehicle 1 should be the frequent user of the street and should dictate the lane widths and corner radii. Consider a control vehicle, an infrequent user of the intersection, to understand how larger vehicles will negotiate the intersection. Stop bars can be recessed from the intersection 2 to allow control vehicle encroachment (NACTO Urban Streets Design Guide 2013, p. 144). Assume emergency vehicles will use the entire right-of-way. See in the 2011 AASHTO Green Book Fig. 9-33 for design considerations when allowing encroachment.

CURB RADII AND CURB EXTENSIONS
Curb radii should be designed for the vehicle that turns at the intersection most frequently. Smaller curb radii and curb
INTERSECTION GEOMETRY

extensions position vulnerable users in a more visible location, reduce crossing lengths, reduce motor vehicle speeds, and provide additional space for curb ramps. Generally, for local urban streets, curb radii should be between 10–15 feet unless special circumstances require a larger radius. (AASHTO Green Book 2011, p. 9-92)

SPEED OF TURNING VEHICLE

The AASHTO Green Book assumes that vehicles are making turns between 0 and 10 mi/h (2011, p. 2-5). If designers anticipate turns at the lower end of that range, vehicle turning envelopes can be further reduced.

EFFECTIVE CURB RADII

Where on-street parking or bike lanes are present, designers should use the “effective” curb radii, rather than the actual, to create a more compact intersection that encourage slower speeds. (AASHTO Green Book 2011, Fig. 5-3)

MOUNTABLE TRUCK APRONS

In locations where large vehicles make occasional turns, designers can consider mountable truck aprons. Mountable truck aprons deter passenger vehicles from making higher speed turns, but accommodate the occasional large vehicle without encroachment or off-tracking into pedestrian waiting areas. Mountable truck aprons should be visually distinct from the adjacent travel lane and sidewalk.

LANE WIDTH

Lane widths are an important element of intersection design for vulnerable users. Narrower lanes reduce pedestrian crossing distances and encourage motorists to drive slower. For more information, refer to the design topic on Design Criteria and Lane Width.

CHANNELIZED RIGHT TURNS

Channelized right turns are typically less pedestrian friendly, but can be appropriate where large curb radii are needed, such as turns with a higher frequency of large vehicles, or at skewed intersections. A right-turn channelizing island can also break up longer crossing distances by providing refuge space and two shorter crossings (AASHTO Pedestrian Guide 2004, p. 78). Designs can be further developed with compound curves that slow vehicular speeds and prioritize pedestrian movements. (See Table 9-18 in the 2011 AASHTO Green Book for guidance on turning roadway lane widths.) Design speeds less than 10 mi/h should be used. (ITE Designing Walkable Urban Thoroughfares 2010, p. 187)

MEDIANS

The presence and shape of medians is dictated by factors such as design vehicle selection, turning speeds, and lane widths. Medians can be particularly useful for pedestrians crossing multilane roads if the median nose extends through the pedestrian crossing area and is sufficiently wide (a minimum of 6 feet wide). Crossings with four or more lanes of traffic should provide a pedestrian refuge as part of a continuous median or dedicated crossing island. (AASHTO Green Book 2011, p. 6-14)

Where they are intended to serve as a pedestrian refuge, medians and crossing islands should be a minimum of 6 feet. (ITE Designing Walkable Urban Thoroughfares 2010, p. 141)
CASE STUDIES

CORNER CURB RADII—BETTER STREETS PLAN
SAN FRANCISCO, CA

The San Francisco Better Streets Plan provides guidance on design vehicle selection given the type and frequency of vehicles. Specifically, the plan recommends that designers differentiate between the most frequent vehicle and a vehicle that may only use the intersection occasionally.

For example, a transit route may necessitate a design that allows a bus to turn within the travel lane. On the other hand, locations with higher pedestrian activity may be designed for a Single Unit truck (SU-30), requiring larger vehicles to encroach into adjacent or opposing lanes. Strategies such as allowing encroachment and locating stop bars farther from the intersection allow these intersections to accommodate occasional larger turning vehicles while providing shorter pedestrian crossings.

MOUNTABLE TRUCK APRONS
PORTLAND, OR

The City of Portland installed mountable truck aprons at an existing intersection where large turning vehicles were relatively frequent. The character of the neighborhood has changed from an industrial area in recent years and large vehicles are now less frequent.

The mountable truck aprons allow drivers of large vehicles to turn without entering the pedestrian zone or encroaching on vehicle lanes. The height of the mountable section discourages smaller vehicles from making the same turn, which reduces their speed through the intersection.

OUTSIDE TRUCK APRONS
BURLINGTON COUNTY, NJ

The Burlington County Engineer’s Office reconstructed the skewed intersection of County Route 528 and Old York Road (CR 660). Relatively high speeds were common on the main roadway. The two-way stop controlled intersection was replaced by a modern roundabout with a 15 mi/h circulating speed. The design includes outside truck aprons to achieve the desired entering speeds and roadway widths for cars and school buses, while providing a larger roadway width to accommodate tractor trailers (WB-67) and farm equipment.

The outside truck aprons include a mountable curb with a minimal 3 inch reveal and stamped red concrete. Observations have shown that drivers of small vehicles do not ride on the truck apron. As shown in the picture, pedestrians are accommodated in advance of the truck apron.