Chapter 3: Complete Streets Concepts

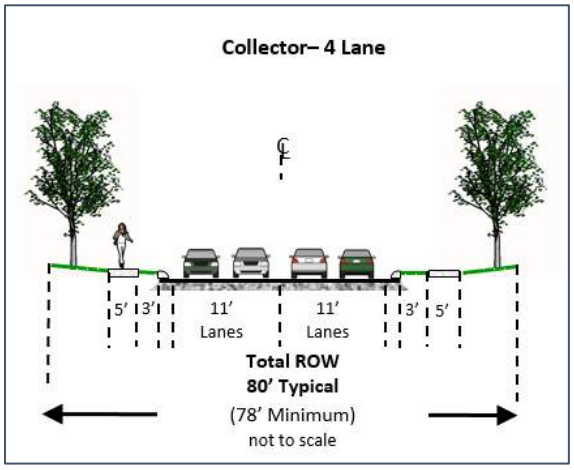
CHAPTER HIGHLIGHTS

- **Complete Streets**
- **Vision Zero**
- **Road Diets & Traffic Calming**
- **Common Street & Sidewalk Treatments**
- **Common Intersection Treatments**

Introduction

It has already been recognized that people and industries are rethinking their transportation needs, preferences, and habits. To accomplish the needed shift in transportation planning to consider all modes within an **integrated transportation system**, a suite of planning concepts should be considered. The consideration of the **Complete Streets** movement in transportation planning has defined a set of tools and priorities that impact how streets are designed. Similar movements for **Vision Zero**, **Road Diets**, and **Traffic Calming** have consistent and compatible goals of providing increased support for other modes of travel and promoting street safety. With similar goals, they also share a set of common treatments for streets, sidewalks, and intersections. Taken together, Complete Streets movement and its associated movements contribute a more multimodal and more livability-oriented approach to street design.

Complete Streets Concepts



Historically, a city would adopt standard cross sections for each street functional class. While it was recognized that the cross sections were "typical" and each street had unique context and constraints, the general purpose was to define consistent characteristics for streets. In practice, this has led to streets being optimized for the automobile mode over other transportation modes, and automobile throughput has been the controlling priority. Pedestrians, bicyclists, and transit riders are theoretically able to use the streets, but those modes are seen as incidental and are not prioritized or supported. The unintended consequences of these over-optimized streets is that they can limit transportation choices by making walking, bicycling, and using transit inconvenient, unattractive, or dangerous. These types of streets can be called "incomplete streets" in that they do not accommodate all transportation modes. To remedy this, a movement has emerged to encourage a new way of designing roadways called **Complete Streets**.

The concept of Complete Streets gives pedestrians, bicyclists, and transit modes the same priorities in street design that automobiles have traditionally had, so that the street can routinely support safe and convenient uses for all modes of transportation within an integrated multimodal system.

Elements of Complete Streets treatments are designed to make the street more supportive of all modes. Operating within an integrated multimodal system, the specific mix of modes that are appropriate to a street and the treatments used to make it a complete street vary with the function of the street, its Functional Class, and characteristics such as right-of-way, lane width, speed, and topography.

There is no singular design prescription for complete streets; each one is unique and responds to its context.

The concept of Complete Streets may be seen as a comprehensive suite of design requirements and priorities to be considered for all streets. The primary source for guidance on street design remains the Institute of Transportation Engineers' (ITE) *Highway Design Manual*, which is the most widely accepted standard for roadway design. The many different additional publications providing guidance for complete streets approaches illustrate just how widely the concept has been accepted. Publications include the ITE *Walkable Urban Thoroughfares: a Context-Sensitive Approach*, which has been endorsed by TxDOT. The ITE *Road Diet Handbook: Setting Trends for Livable Streets* and the FHWA *Road Diet Informational Guide* both provide guidance for "right-sizing" streets to re-purpose right-of-way for Complete Streets treatments. FHWA guidance also includes *Roundabouts: an Informational Guide*, dealing with this particular type of intersection treatment. The National Association of City Transportation Officials (NATCO) has published several manuals to provide "a blueprint for designing 21st century streets", with focus on urban streets, transit streets, bikeways, and bike share.

Vision Zero

The **Vision Zero** movement complements Complete Streets concepts with a focus on adapting street design to reduce fatalities. Many of the same street treatments associated with Complete Streets are also supported by the Vision Zero movement. While road safety depends on many factors, the thrust of the Vision Zero movement is that redesigning streets and lowering speed limits are vital elements that can reduce the chance of crashes and also reduce their severity. While people will inevitably make mistakes while driving, the goal of Vison Zero is that those mistakes do not inevitably lead to crashes and loss of life.

Excessive speed is typically a factor in about a third of all traffic fatalities, so controlling vehicle speeds in areas with multimodal uses is a critical strategy. Speed reductions in areas where vehicles mix with vulnerable street users such as bicyclists and pedestrians are therefore an important element of Vision Zero.

The Vision Zero movement often uses the term **dangerous by design** to describe streets that are over-optimized for automobile throughput. This term is inaccurate and often wrongly applied, but the general point is valid: if streets are designed so that people are comfortable driving at excessive speeds, then crashes are more likely, fatalities are more likely, and vulnerable street users are disproportionally at risk.

All I know is just what I read in the papers. And there is something that we all read in the papers every morning of our lives, no matter what paper it is we pick up, and it has generally happened right in the town that particular paper is printed in. It's in there every morning "Four Killed and Three Wounded Yesterday by Automobiles in This Town." Maybe it's more; maybe it's less, but it's there every day. In another part of the paper it tells that 22 thousand met their death last year by auto and that we are well on our way to beat that record.

Suppose around 25 years ago when automobiles were first invented, that a man had gone to our government, and he had put this proposition up to them: "I can in 25 years' time have every person in America riding quickly from here to there. Shall I go ahead with it?"

"Why sure, if you can accomplish that wonderful thing, why we are heartily in accord with you."

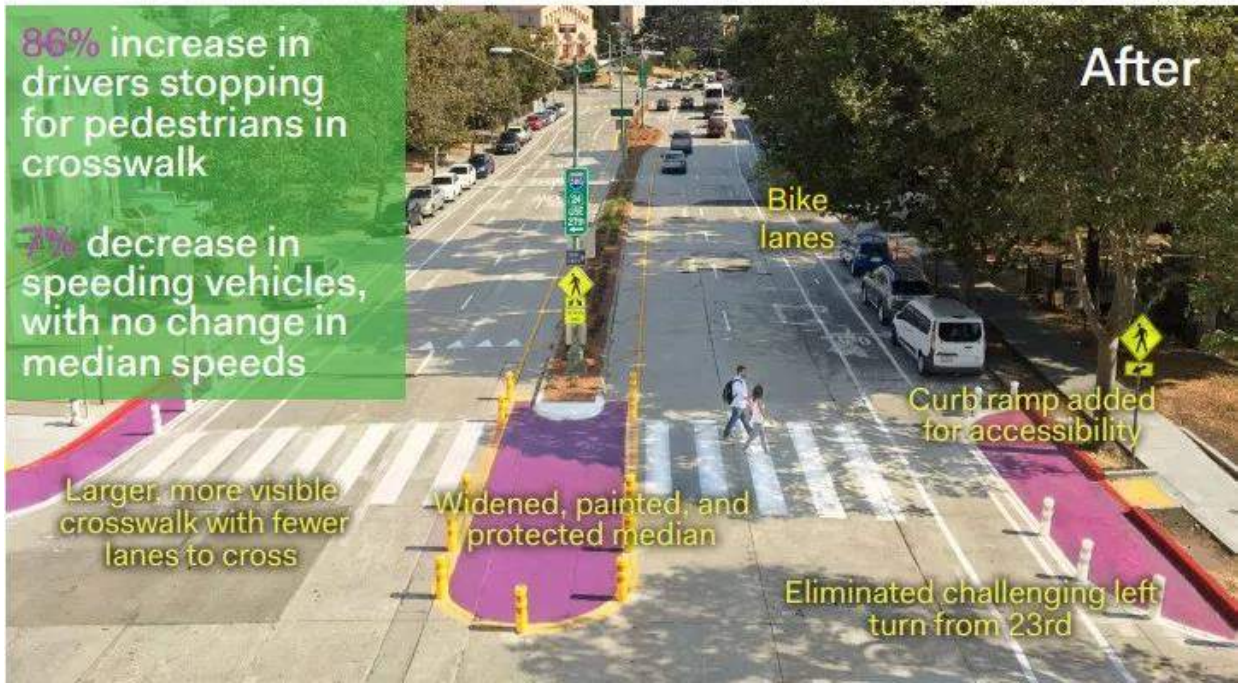
"But," he says, "I want you to understand it fully, in order to accomplish it and when it is in operation it will kill 20 to 25 thousand a year of your women and children and men."

Now they call all these accidents PROGRESS. Well maybe it is Progress. But I tell you it certainly comes high priced.

Will Rogers
Syndicated newspaper column
April 4, 1926

An example from Oakland, California illustrates some elements of Vision Zero and how it complements Complete Streets concepts with some of the same implementation strategies.

Figure 3.1: Before and After Example of Vision Zero Treatments



Following a pedestrian fatality at the intersection of 23rd Street and Harrison Street, the Oakland Department of Transportation (DOT) reviewed how changes in street design might be used to slow traffic and increase the safety of vulnerable users. As shown in **Figure 3.1**, multiple elements were positioned to heighten drivers' awareness of their environment and reduce their comfort with excessive speeds. A feature of this example is that it was implemented in a very short time frame, with low-cost infrastructure such as paint, bollards, and other simple fixes. After the area is made safe and drivers are used to the changes, the DOT plans to implement more permanent fixes.

Data collected by the Oakland DOT before and after implementation of the Vision Zero fixes shows their effectiveness. It is interesting to note that median vehicle speeds are unchanged, but that the outlier speeding vehicles saw a 7% drop. The 86% increase in drivers stopping for pedestrians in the crosswalk is a testimony not only to the design of the crosswalks, but also to the design of the street environment that makes drivers more aware of their surroundings, with a slower-speed regime that gives them more time to stop.

Other safety elements in addition to street design are considered in Vision Zero treatments. One element of concern is that large trucks pose a disproportionate threat to people biking and walking. Large trucks are hindered by their height, larger blind spots, and larger turning radii, making the risk of conflicts with all road users greater. At the same time, bicyclists and pedestrians are particularly vulnerable to the open wheels which are a feature of large trucks. The Volpe Center, a research institute of the US Department of Transportation, has studied the issue of vulnerable road users and heavy trucks. Their study cites a statistic that nearly half of bicyclist fatalities and more than one quarter of pedestrian fatalities from heavy trucks first impacted the side of the truck and were swept under the wheels. By attaching a side guard that runs along the gaps in the side of the truck similar to those shown in **Figure 3.2**, a person who is hit by a truck has a better chance of being pushed out of the way of the following wheels.

Figure 3.2: Examples of Truck Side Guards

A study cited by the Volpe Center notes that implementation of truck side guards in London reduced fatalities by 61% for people biking and 20% for pedestrians.

Cities of course do not have the legal authority to require side guards for all trucks operating in their area. However, they do have control over their own municipal fleets of large trucks, box trucks, garbage trucks, and trailers. Some cities in the United States were cited in the Volpe Center study as requiring side guards on trucks for contractors who do business with the city.

Vision Zero treatments may also focus on street operations. Leading Pedestrian Intervals (LPIs) are an approach to reduce the conflict between pedestrians and vehicles at crosswalks by configuring traffic signals for a 7- to 10-second head start for pedestrians before the signal turns green for vehicles. This interval gives pedestrians time to enter into the crosswalk, where they are more visible to drivers, before cars get a green signal. The small interval increases pedestrian visibility enough that crash rates decline significantly. A study in *Transportation Research Record 22198* concluded that a 46% reduction in crashes can generally be expected with the installation of LPIs. Installation requires simply re-programming the signal, so no trenching, concrete pouring, or lane closures are required, and implementation costs are low. LPIs have been called "Dollar for dollar…a really smart, life-saving investment that ought to be a part of any city's effort to eliminate traffic deaths."

Road Diets & Traffic Calming

One of the issues with implementing Complete Streets and Vision Zero treatments on existing streets is the limitations of the available street right-of-way. The concept of a **road diet** addresses this issue by "right-sizing" a street where the current and projected traffic volumes permit. Right-sizing involves narrowing or removing travel lanes and re-purposing them for bicycle lanes, sidewalks, sidewalk bulb-outs, and other Complete Streets elements. As shown in **Figure 3.3**, the classic configuration of a road diet converts a 4-lane undivided street into a street with 2 travel lanes and a continuous center turn lane, with bicycle lanes on each side.

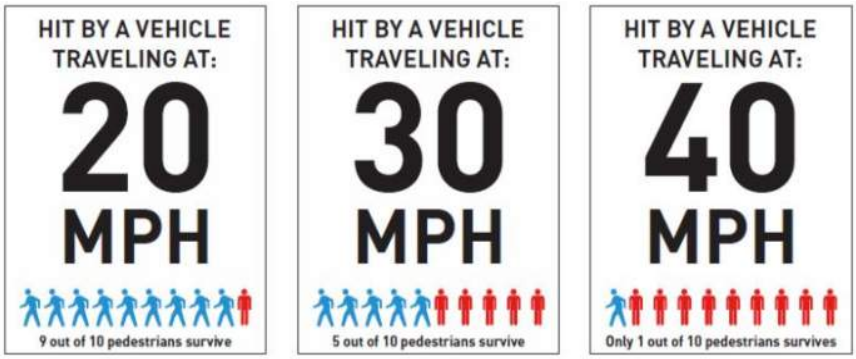
Figure 3.3: Road Diet Implemented on a 4-Lane Street

Other configurations of road diets vary the mix of bike lanes and parking lanes, sometimes placing the bike lanes on the curb side so that the parking lanes buffer them from moving traffic. Another configuration creates a two-way cycle track on one curb side of the street, protected from traffic by a buffer strip and a parking lane.

Traffic Calming is a similar concept, with treatments complementary to Complete Streets concepts that are primarily aimed at reducing vehicle speeds by addressing drivers' perceptions and behavior. Speeds in residential areas and other places with vulnerable road users are a particular focus of traffic calming.

Small differences in speed can make a big difference in safety and survivability. VisionZeroNetwork.org reports the survivability chances of a person hit by an automobile, as shown in **Figure 3.4**. The position of the traffic calming movement is that the proper balance of vehicle speeds and safety can reduce traffic violence and eliminate traffic fatalities.

Figure 3.4: Speed and Vulnerable User Survivability



The basis for traffic calming is that people naturally tend to drive at a speed that they are comfortable with. Traffic calming treatments take advantage of this trend by placing physical or perceptual barriers in the driver's sight to shift their comfort level to a lower speed.

Common Street & Sidewalk Treatments

With the commonality in purpose among the Complete Streets, Vision Zero, Road Diets, and Traffic Calming movements, it is not surprising that they share a common set of street and sidewalk treatments that contribute towards the goals of each movement. Treatments include reduced lane widths, in-lane treatments, median islands, curb extensions, sidewalk and parking lane treatments, parklets, bike lanes, and crosswalk treatments.

Reduced Lane Widths run contrary to the historic practice of lane widths of 12 to 13 feet. The wide traditional lane widths create an in-lane buffer that is more forgiving to drivers, particularly for higher-speed streets. However, these widths also make drivers more comfortable with higher speeds, even when it is not appropriate within the street context of bicycle and pedestrian activity, intersections, and sight lines. Reducing lane widths to 10 or 11 feet has been shown to reduce speeds and improve safety without a reduction in capacity. Lanes wider than 11 feet are not recommended, but may be necessary locally to accommodate trucks and buses.

In-Lane Treatments are also called vertical speed control, in that they place one of several forms of humps in the travel lane to slow traffic speeds. Common types include speed humps, which are 12 – 14 feet long to raise one axle at a time; and speed tables, which are long enough that the entire vehicle is raised at one time. Stormwater drainage and street cleaning are issues with any in-lane treatment.

Median Islands are refuge spots for pedestrians in the center of the street, so that they don't have to cross the full width of the street without protection. They are most useful for multi-lane streets where traffic volumes and total street width makes the crossing a safety issue. Median islands can be emphasized with landscaping or textured surfaces to highlight their role as part of the pedestrian realm. The purple painted areas in **Figure 3.1** show an example of a median island treatment.

Curb Extensions function to narrow the width of the street in particular locations. They may include pinch points, bulb-outs, and bus bulb-outs. In addition to slowing vehicle speeds, curb extensions increase safety by reducing the length of the pedestrian path crossing the street. The purple painted areas in **Figure 3.1** show an example of curb extensions treatments. A chicane can be built from a set of staggered curb extensions that further reduce speeds by shifting the street path from one side of the street to the other.

Sidewalk and Parking Lane treatments are part of Complete Streets and Traffic Calming for their definitions of space and use as buffers from traffic. Increasing activity in the sidewalk zone heightens drivers' awareness, and helps define a pedestrian realm adjacent to and intersecting with the street. Wider sidewalks, distinct paving, pedestrian-scaled lighting, and buffering with landscaping are all treatments intended to promote pedestrian visibility and activity.

Parklets extend the sidewalk activity area to temporarily or permanently use parking spots for seating areas. Parklets provide additional sidewalk space and increase the visibility of the pedestrian realm. This treatment enhances the use of parking as a buffer for the sidewalk. Potential issues with parklets include stormwater drainage, street cleaning, and possible interruption of bike lanes.

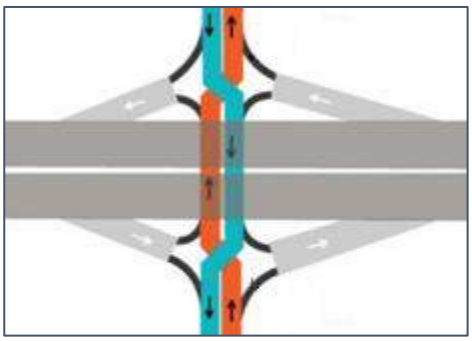
Bike Lanes address safety and smooth traffic flows by placing the flow of bicycles outside the flow of automobiles. Several striped bike lanes have already been developed in the KTMPO region. Numerous configurations of bike lanes are in common use, with notable variations including striped lanes, striped lanes buffered by parking, protected bike lanes, and cycle tracks. Bicycle traffic may also be routed off of high-volume arterials, with equivalent paths provided on a system of lower-volume streets designated as **bicycle boulevards**. Issues with curbside bike lanes include people parking in the lanes, obstruction by garbage bins on pickup days, and street cleaning.

Crosswalk Treatments use color and design to highlight the presence of a crosswalk. The concept of **creative crosswalks** uses distinct and sometimes whimsical designs to capture drivers' attention. Crosswalks are considered a traffic control device, and guidelines for their colors and designs are specified in the FHWA's *Manual on Uniform Traffic Control Devices* (MUTCD), but US cities have not always strictly followed MUTCD guidelines with their creative crosswalks. Maintenance of the painted designs of creative crosswalks has been an issue.

Common Intersection Treatments

Accommodating the safe interaction of the numerous modes and users in the integrated multimodal network is essential. The most interactions within and between the transportation modes occurs at street intersections.

Two general types of intersection treatments are in use: those that seek to increase the efficiency of vehicle throughput, and those that seek to increase the safe accommodation of all transportation modes. Both general types of intersection treatments are consistent with the goals of Complete Streets and its associated movements.



Intersection Efficiency Treatments often include designs that limit the conflict between through movements and turning movements. In a Diverging Diamond Interchange, the left turn movement is physically displaced from the intersection by crossing over the travel lanes before the turn. All turns at the remaining intersection are through movements, eliminating the need to accommodate turns in the traffic signal cycle and therefore increasing the green time. With fewer vehicle conflict points, the remaining intersection is more safe as well. The Displaced Left Turn Intersection is a modified intersection treatment with the same theme, which has the left turn crossing, but keeps the through movements on the right side of the road. Other similar treatments include the Super Street and the Michigan Left intersections, which accomplish traffic signal cycle simplification by completely prohibiting left turns, replacing them with a right turn followed by a U-turn.

Roundabouts are a type of intersection offering dramatic improvements in safety and vehicle throughput under favorable conditions. Where a conventional intersection with its numerous vehicle crossings and turnings has 32 conflict points, a roundabout reduces the number of conflicts to only 8 points. Additionally, the 8 remaining conflict points are merging movements rather than head-on or right-angle conflicts, so crashes in a roundabout tend to be less serious than crashes in a conventional intersection. Roundabouts reduce vehicle speeds while preserving throughput, and can be more efficient than stop signs or traffic signals at lower-volume intersections.

Accommodating All Modes is a general type of intersection treatment that concentrates on safety. A typical intersection with a bike lane forces a vehicle making a right turn to cross over the bike lane at an angle that creates visibility issues for both the driver and the bicyclist.

The protected intersection is designed to address this issue by continuing the bike lane through the intersection for both through movements and turning movements. With this design, the lane-changing conflict before the intersection is eliminated. Splitter islands at the corners protect bicyclists on the curve and slow vehicle speeds. The vehicle and bicycle crossing conflict is placed so that they meet at a right angle within the turn, which increases the visibility to reduce the risk of crashes.

Summary

The Complete Streets, Vision Zero, Road Diets, and Traffic Calming movements contribute to planning for an integrated multimodal system with a compatible focus on supporting and protecting all transportation modes and users. The street, sidewalk, and intersection treatments proposed by each movement are similar and consistent. Consideration of these types of treatments is a valuable addition to the concept of typical street cross sections which have historically been used.