

© Copyright 2018

Manali Sheth

Observing Goods Delivery Activities and Identifying Opportunities to Improve the Design of Commercial Vehicle Load Zones in Seattle

Manali Sheth

A thesis

submitted in partial fulfillment of the
requirements for the degree of
Master of Urban Planning
University of Washington
2018

Committee:

Dr. Edward McCormack

Dr. Anne Goodchild

Program Authorized to Offer Degree:

Urban Design and Planning

University of Washington

Abstract

Observing Goods Delivery Activities and Identifying Opportunities to Improve the Design of Commercial Vehicle Load Zones in Seattle

Manali Sheth

Chair of the Supervisory Committee:

Dr. Edward McCormack

Department of Urban Design and Planning

The growth of freight activity is one of the results of urban population growth. The growth of freight means that more commercial vehicles must share finite infrastructure like alleys, loading docks, and yellow curb space. In this research project, curb space is studied in order to better understand the needs of commercial vehicles at the curb. Cities in the United States like Seattle have recognized that there are opportunities to better manage curb space, and have implemented programs such as the Flex Zone Program 2016 in order to do so. In this research paper, I have focused on just one aspect of the curb, which is the yellow curb space reserved for Commercial Vehicle Load Zones (CVLZ). The purpose of this thesis is to observe the needs and activities of courier drivers during deliveries/pickups in Seattle, and incorporate observations into a new design of freight curb space that may better respond to their needs. The new design suggests a system in which curb space is designed for different vehicle dimensions and activities. This is done by including paint, texture/pattern, and signage on the pavement and sidewalk that comfortably accommodate the vehicle and activities around the vehicle. By providing a better designed freight curb space that accounts for the needs and activities observed, the hope is that courier drivers will be less likely to partake in high-risk behavior such as double parking, and spilling over into adjacent transit lanes/pedestrian areas/bikes lanes, by providing better infrastructure for them.

Table of Contents

CHAPTER 1. Introduction.....	10
1.1 Purpose & Research Topic	11
1.2 Hypothesis	12
CHAPTER 2. Literature Review	13
2.1 Introduction.....	13
2.2 Curb Space Management Efforts in the United States.....	13
2.3 Commercial Vehicle Load Zone Design Standards in the United States	15
2.4 Commercial Vehicle Load Zone Design Standards in Seattle, Washington	18
2.5 Commercial Vehicle Load Zone Types	18
2.6 Commercial Vehicle Load Zones – State of Affairs in Seattle.....	23
2.7 Possible Outcomes of Poorly Designed Curb Space and Commercial Vehicle Load Zones	25
2.8 Vision Zero	25
2.9 Conclusion	26
CHAPTER 3. Research Methods.....	27
CHAPTER 4. Field Observations	29
4.1 4301 University Way NE, Seattle, WA 98105	29
CHAPTER 5. Research Findings.....	33
5.1 Major Takeaways from Field Observations.....	33
5.2 Discussion of an Improved CVLZ-Freight Curb Space	36
5.3 Rendering of Freight Curb Space	37
CHAPTER 6. Discussion and Future Research.....	41
REFERENCES	43
APPENDIX A.....	48
APPENDIX B	49
APPENDIX C	50
C.1 Pioneer Square, Seattle, WA 98104	50
C.2 710 2nd Ave, Seattle, WA 98104.....	53
C.3 999 Third Ave, Plaza 18, Seattle, WA 98104	55
C.4 1023 1 st Ave. Seattle, WA 98104	57
C.5 4201 University Way NE, Seattle, WA 98105.....	59

C.6 4311 University Way NE, Seattle, WA 98105 (Back Door - Alley Delivery)	62
C.7 4201 University Way NE, Seattle, WA 98105	66
C.8 1201 NE Campus Pkwy, Seattle, WA 98105	68
C.9 415 Pine St, Seattle, WA 98101	71
C.10 415 Pine St, Seattle, WA 98101	74
C.11 600 Pine St, Seattle, WA 98101	76
C.12 500 Olive Way, Seattle, WA	77
C.13 1601 5th Ave #100, Seattle, WA 98101	80
C.14 1628 5th Ave, Seattle, WA 98101	83
C.15 500 Olive Way, Seattle, WA	85
C.16 1200 5th Ave, Seattle, WA 98101	87
C.17 721 2nd Ave, Seattle, WA 98104	91
C.18 721 2nd Ave, Seattle, WA 98104	93
C.19 4140 Roosevelt Way NE, Seattle, WA 98105	96
C.20 4214 Roosevelt Way NE, Seattle, WA 98105	99
C.21 4300 Roosevelt Way NE, Seattle, WA 98105	101
C.22 4247 University Way NE, Seattle, WA 98105	104
C.23 4232 University Way NE, Seattle, WA 98105	105
C.24 Lander Hall, 1201 NE Campus Pkwy, Seattle, WA 98105	107

List of Figures

Figure 1 Seattle Flex Zone Land Use & Function (SDOT, 2018)	15
Figure 2 City of Seattle Commercial Vehicle Load Zone Sign (Seattle Department of Transportation, 2015).....	16
Figure 3 Urban Freight Vehicle Defined and Dimensions (NACTO, 2016)	17
Figure 4 Operating Envelope Deigned and Desired Box Truck Dimensions (NACTO, 2016) ...	17
Figure 5 CVLZ Type 1 - Transit Lane without Pavement Marking (Google, 2018) (Sheth, 2017-2018)	19
Figure 6 CVLZ Type 2 - Transit Lane with Pavement Marking (Google, 2018) (Sheth, 2017-2018)	20
Figure 7 CVLZ Type 3 - Curb Out (Google, 2018) (Sheth, 2017-2018).....	21
Figure 8 CVLZ Type 4 - Angled Parking (Sheth, 2017-2018).....	22
Figure 9 Map of Different Load Zone Types in Seattle 2017	24
Figure 10 High Risk Courier Driver Activity in Seattle during Delivery (Sheth, 2017-2018)	26
Figure 11 Parked Truck at CVLZ in the U-District, Seattle. Cargo compartments outlined (Sheth, 2017-2018).....	30
Figure 12 Beverage Vehicle Unloading (Sheth, 2017-2018).....	31
Figure 13 Beverage Vehicle Walking Along Road (Sheth, 2017-2018)	32
Figure 14 Seattle Yellow Curb Signage (Seattle Department of Transportation, 2018)	37
Figure 15 Rendering of Curb Space Redesigned for 27X8 ft. and 15x6 ft. vehicles (Toyota, 2018) UPS Truck Dimensions courtesy of Anna Alligood and Siqi Lu	38
Figure 16 USDOT FHWA Truck Classes (USDOT FHWA, 2014).....	49
Figure 17 Lift Gate Operations (Sheth, 2017-2018).....	50
Figure 18 Lift Gate Engaged (Sheth, 2017-2018)	52
Figure 19 FedEx Delivery Hand Truck Space (Sheth, 2017-2018).....	53
Figure 20 FedEx Office Van Delivery Vehicle	56
Figure 21 Courier of observed delivery waiting for traffic in adjacent transit lane to subside (Sheth, 2017-2018).....	57
Figure 22 Observed Amazon Commercial Vehicle (Sheth, 2017-2018).....	58
Figure 23 Observed Amazon Delivery Truck (Sheth, 2017-2018).....	60
Figure 24 Hamper (Accessory Used) Outlined in Yellow (Sheth, 2017-2018).....	61
Figure 25 Observed Sysco Vehicle, Ramp Engaged (Sheth, 2017-2018)	63
Figure 26 Courier Completes Extending Ramp and its Placement (Sheth, 2017-2018)	64
Figure 27 Courier Fully Rolling Up and Lifting Cargo Compartment (Sheth, 2017-2018).....	64
Figure 28 Courier Using Ramp to Deliver Goods using the Ramp and Hand Truck (Sheth, 2017-2018)	64
Figure 29 Additional Space Required to Maneuver Hand Truck (Sheth, 2017-2018)	65
Figure 30 Coca Cola Delivery Vehicle (Sheth, 2017-2018).....	66
Figure 31 Courier Driver Accessing Cargo Compartments (Sheth, 2017-2018).....	67
Figure 32 OnTrac Observed Delivery Vehicle with Extended Cargo Doors (Sheth, 2017-2018).....	69

Figure 33 Accessory for this Delivery - Bin on Wheels (Sheth, 2017-2018).....	70
Figure 34 Parcels Being Organized and Scanned Within the Cargo Compartment (Sheth, 2017-2018)	71
Figure 35 Observed UPS Vehicle - Cargo Compartment at Back End (Sheth, 2017-2018)	72
Figure 36 2-Way Convertible Hand rucks Used in Delivery (Sheth, 2017-2018).....	73
Figure 37 Newspaper Stand Adjacent to Observed Delivery Vehicle (Sheth, 2017-2018).....	74
Figure 38 Observed LOOMIS Delivery Vehicle (Sheth, 2017-2018).....	75
Figure 39 Observed FedEx Delivery Vehicle (Sheth, 2017-2018).....	76
Figure 40 Observed Vehicle (Sheth, 2017-2018)	78
Figure 41 Accessories Used and Placement (Sheth, 2017-2018)	79
Figure 42 Driver/Courier Observed in Adjacent Transit Lane (Sheth, 2017-2018).....	79
Figure 43 Courier Operating in Adjacent Transit Lane (Sheth, 2017-2018).....	80
Figure 44 Observed FedEx Ground Vehicle (Sheth, 2017-2018).....	81
Figure 45 2-Way Convertible Hand Truck Placed and Accessed on Sidewalk (Sheth, 2017-2018)	82
Figure 46 Courier Driver Managing Parcels (Sheth, 2017-2018).....	82
Figure 47 Observed Delivery Vehicle (Sheth, 2017-2018)	83
Figure 48 Hand Truck Observed in Delivery and Cross Walk (Sheth, 2017-2018).....	84
Figure 49 Wheelchair and Loading Parcels on Crosswalk (Sheth, 2017-2018).....	85
Figure 50 Observed Frito-Lay Vehicle Design (Sheth, 2017-2018).....	86
Figure 51 Hand Trucks Loaded and Placed on Crosswalk (Sheth, 2017-2018).....	86
Figure 52 Observed Coca-Cola Vehicle Design Elements (Sheth, 2017-2018).....	88
Figure 53 Courier Exiting Cargo Compartment with Loaded Forklift (Sheth, 2017-2018).....	89
Figure 54 Courier Street Crossing with Forklift (Sheth, 2017-2018).....	89
Figure 55 Portion of Lift Gate Manually Folded (Sheth, 2017-2018)	90
Figure 56 Courier Guiding Lift Gate Shut (Sheth, 2017-2018).....	90
Figure 57 Observed UPS Vehicle Design (Sheth, 2017-2018).....	91
Figure 58 Hand truck Resting at Angle on UPS Vehicle (Sheth, 2017-2018)	92
Figure 59 Courier Using Crosswalk & Stagnant Hand truck (Sheth, 2017-2018)	93
Figure 60 Observed Delivery Van Design (Sheth, 2017-2018).....	94
Figure 61 Courier Observed Loading 2- way hand truck (Sheth, 2017-2018)	95
Figure 62 Observed Costco Delivery Vehicle (Sheth, 2017-2018)	96
Figure 63 Courier Waiting for Crosswalk Signal in Passenger Load/Unload Zone (Sheth, 2017-2018)	97
Figure 64 Extended Lift Gate with Cone (Sheth, 2017-2018).....	98
Figure 65 Courier Operating Lift Gate - Standing in Transit Lane (Sheth, 2017-2018)	98
Figure 66 Observed Smith & Greene Vehicle (Sheth, 2017-2018).....	100
Figure 67 Hand Truck Placed Behind Cargo Compartment (Sheth, 2017-2018).....	100
Figure 68 Observed Office Depot Vehicle (Sheth, 2017-2018)	102
Figure 69 Tilted Hand truck Loaded (Sheth, 2017-2018).....	102

Figure 70 Driver/Courier Organizing Parcels in Cargo Compartment (Sheth, 2017-2018).....	103
Figure 71 UW Van Delivery (Sheth, 2017-2018).....	104
Figure 72 UPS Delivery Vehicle Type Observed (Sheth, 2017-2018).....	106
Figure 73 UPS Vehicle Type Observed (Sheth, 2017-2018).....	107

Acknowledgments

I would like to thank the delivery men and women who allowed me to observe their activities while on the job, and at times, discuss the technicalities of their job with me. The needs of a courier driver and courier are ill understood, and the time I spent at the curb observing deliveries in Seattle was informative and a crucial part of this research. Your presence on our streets is not overlooked, and as an Urban Planner, I intend to work hard to listen to you, understand you, and advocate for your needs.

This thesis has been written with the immense support of my Supervising Committee, Dr. Anne Goodchild and Dr. Edward McCormack. Under their guidance, I have been gently pushed towards an intellectual acumen for understanding and discussing freight activity in urban areas. Their involvement in my education has been integral to the high quality of my graduate experience, and I am grateful for their time, encouragement, and mentorship.

Thank you to my colleagues at the Supply Chain Transportation & Logistics Center, friends, and family for sharing your support, feedback, and expertise. I value all of the kind words and wisdom that you have shared with me over the years.

CHAPTER 1. Introduction

Cities are recognizing that curb space is valuable public real estate that must be better understood, managed, and designed to improve the quality of life for residents and the transportation system of a city. There is continued pressure for multiple modes to share urban streets and compete for curb space as urban population and truck activity grow. Urban Planners are responsible for strategizing how best to manage, regulate, and design curb space for different transportation modes and activities such as commercial vehicles and urban deliveries.

Curbs are a fundamental piece of infrastructure that helps to separate and organize roadways from sidewalks in the United States. Each city in the United States has its own design standards to construct and manage curbs. For example, in Seattle, Washington, the standard curb height is 6 inches, and curbs are managed by both paint and signage. (City of Seattle, 2017) White, yellow, and red paint each symbolize multiple uses. For example, yellow paint may indicate curb space reserved for either a commercial vehicle load zone requiring payment or a permit, load/unload zone for “people and goods from private vehicles” that require hourly payments, truck-only load zone for vehicles licensed as trucks that “deliver or pick up products, merchandise, or other objects,” taxi stand, or as clearance marking near driveways. (Seattle Department of Transportation, 2018), (Seattle Department of Transportation, 2018), (Seattle Department of Transportation, 2015) However, there is little information on how long along the curb or wide in to the road these curb paint markings should be to adequately meet the needs of curb users, more specifically, their vehicle characteristics and activities.

Curb space usage is competitive as it is, and the need for more efficient use of curb space is increasingly important, as we anticipate this competition to become fierce. Both urban population and the economy in the United States are projected to grow, and this growth will

certainly generate more freight. In fact, freight is “expected to increase by roughly 50 percent by the year 2040” in the United States at large. (Burnell, Santalucia, & Epstein, 2017) In Seattle alone, freight volumes are expected to grow by 60% by the year 2035. (Seattle Department of Transportation, September 2016) This growth is further compounded by the rise of online shopping and changing customer expectations for quicker deliveries.

City agencies are considering different approaches to managing and curtailing the negative impacts of growing competition for parking at the curb. However, before effectively implementing curb space management strategies, cities must understand the needs and activities of existing modes that compete for curb space, such as trucks, personal vehicles, transportation network companies, and buses. For example, what do urban delivery trucks generally look like, how much space is needed to load/unload, and how does competition for curb space vary at different times of the day and during different days of the week?

New uses of curb space further complicate the curb space landscape. Bike share programs, parklets, and cargo bikes are just a few of the disruptors that symbolize the transportation changes occurring in urban areas. (Marshall, 2017) Before cities can begin to understand the impacts of these new uses, cities must first understand the core activities that occurred at curb spaces over the last few decades, and that will continue to occur.

1.1 Purpose & Research Topic

In this research project, I will focus on just one type of curb space, which is commercial vehicle load zones (CVLZs). I will share findings from 25 field observations of freight activity in Seattle, specifically, about the vehicle and activity characteristics associated with each delivery. The goal of this research is to better understand the needs of *courier drivers - or someone who is*

both the truck driver and the person who makes the delivery, and to inform decision makers such as Urban Planners, about opportunities to improve the design of CVLZs. Ultimately, the intent is to dissuade courier drivers from partaking in high-risk behavior such as double parking, or having their vehicle or activities spilling over into adjacent transit lanes, pedestrian areas, and bike lanes, by providing better infrastructure for them. On a broader level, the purpose of this research is to spark a conversation amongst Urban Planners about curb space management and improving curb space design standards. Though the research findings may be applied to yellow curb space designated as load zones and truck load/unload zones, this paper will only focus on CVLZs.

1.2 Hypothesis

Improving the design of commercial vehicle load zones so that they adequately support loading/unloading activities will improve curb space management efforts in Seattle.

CHAPTER 2. Literature Review

2.1 Introduction

Commercial vehicle load zones are on-street, and are an integral part of the freight ecosystem that complements off-street freight infrastructure such as loading bays, loading docks, and alleys. Improving the design of commercial vehicle load zones alone may improve safety and freight traffic flow in urban areas. In this literature review, the current state of affairs regarding CVLZs will be explained and summarized.

2.2 Curb Space Management Efforts in the United States

Curb space management is defined as “the management of the portion of a road not used for vehicle travel, including parking spaces, bike lanes, shoulders, and curb cuts. Often synonymous with on-street parking management.” (District of Columbia) There are a handful of curb space management efforts in the United States that have been reviewed.

Move DC, Parking and Curbside Management Element is a multimodal long-range transportation plan published in 2014, which focuses on curbside parking in the District of Columbia. In the District of Columbia, a commercial vehicle is “defined as any vehicle with more than three wheels that is greater than 22 feet in length, or that is used or maintained for transporting freight, merchandise, or other commercial loads or property” (District Department of Transportation, 2014). As a loading zone strategy, it is suggested to “lengthen loading zones to 100 feet wherever possible” (District Department of Transportation, 2014).

Zalewski et al. examine how policies affect curb space management in 8 U.S. cities, including Seattle. The challenges in each city varies because each city has a different approach to curb space management. Some cities have increased paid parking at curbs to incentivize people to quickly move their vehicles from the curb, or have strict timing restrictions that dissuades

vehicles from parking at a curb for too long. Some cities are concerned with unmarked bus stops or low turnover rates. In general, these cities deployed one of the following strategies to curb space management: incremental, framework, and performance-pricing model. In the incremental model, cities cautiously and slowly develop curb space policies as issues presented themselves. The framework model requires getting community members involved to share their priority issues or concerns with the curb and creating policies and curb space management strategies that respond to these concerns. The performance-pricing model allocates a cost to the curb and uses fees to heavily influence the supply and demand of parking spaces at the curb. It concludes by acknowledging that curb space is part of a larger traffic ecosystem in cities, and should not be dealt in isolation on a curb-by-curb basis. (Zalewski, Buckley, & Weinberger, 2011)

Mackowski et al. examines the performance-pricing model on vehicles circulating, emissions, and traffic congestion. The idea is to have red and green lights placed along the curb space and have them light up when they are occupied (red) or available (green). A complex cost model is used to capture the dynamism of the curb space and ultimately controls and optimizes the price of each parking spot. These elements were tested and found that maintaining 85% or less occupancy of parking spots omits circulating vehicles. The authors recognize that these results are likely due to the controlled environment this pilot study was conducted, but it does serve as a proxy for the general positive impact performance-pricing models can have. (Bai, Mackowski, & Ouyang, 2015)

Holguin-Veras et al. conducted a study supported by the U.S. Department of Transportation's Integrative Freight Demand Management, in which there was a pilot test of four off-hour (7 PM – 6 AM) delivery alternatives in Manhattan, New York. Thirty-three companies participated in the off-hour delivery program for one month. This study found that off-hour

deliveries increased productivity, efficiency, reliability, and decreased total delivery time.

(Holguin-Veras, et al., 2011) Perhaps off-hour deliveries could be one of the ways to manage the curb space, and lower competition during peak periods.

NACTO’s white paper on curb space management includes policies and strategies cities are deploying to better manage their curb. These include displaying parking time limits, enforcing demand-based pricing, setting occupancy targets, setting fines, requiring paid permits, and increasing enforcement. (NACTO, 2017)

To improve curb space management, Seattle adopted policies to support their Flex Zone program in 2016, which helps organize curb space by acknowledging land use surrounding the curb, and then ranking the six priority functions from 1-6. One of the six functions is *access for commerce*, which means “goods and services reaching their customers and markets.” (SDOT, 2018) An example of curb space use is having a commercial vehicle load zone or truck load zone. As seen in Figure 1 below, residentially zoned areas rank access for commerce 3 out of 6; Commercial & Mixed Use zoned areas rank access for commerce 2 out of 6; and Industrially zoned areas rank access to commerce 2 out of 6.

Flex zone functions are prioritized based on surrounding land use

Land Use Type	Residential	Commercial & Mixed Use	Industrial
1	Support for Modal Plan Priorities	Support for Modal Plan Priorities	Support for Modal Plan Priorities
2	Access for People	Access for Commerce	Access for Commerce
3	Access for Commerce	Access for People	Access for People
4	Greening	Activation	Storage
5	Storage	Greening	Activation
6	Activation	Storage	Greening

Figure 1 Seattle Flex Zone Land Use & Function (SDOT, 2018)

2.3 Commercial Vehicle Load Zone Design Standards in the United States

There are many competing demands for the curb. This research project focuses on one feature of curb space, commercial vehicle load zones (CVLZs). In Seattle, a commercial vehicle load zone has yellow curb paint and signage that indicates the constraints of the CVLZ. “Commercial Vehicle Load Zones (CVLZ) were established to provide, on busy streets, a special parking space for service delivery vehicles to stop. Regular truck loading and unloading zones do not adequately meet the needs of these vehicles.” (SDOT, 2018) A CVLZ requires commercial vehicles to have a paid and displayed permit in order to use it. Figure 2 is an example of CVLZ signage in Seattle.



Figure 2 City of Seattle Commercial Vehicle Load Zone Sign (Seattle Department of Transportation, 2015)

There is little information about CVLZ design standards in the United States, and major traffic control or street design guidebooks do not discuss CVLZs in detail. Although the Manual on Uniform Traffic Control Devices (MUTCD) includes detailed information about appropriate signage and grade for commercial vehicles, it does not include clear standards for the design and dimension of a CVLZ. In work published by the American Association of State Highway and Transportation Officials (AASHTO), the following dimensions were suggested for urban parking lanes. Parking lanes in residential areas should be a minimum of 7 feet wide, and in commercial/industrial areas, parking lanes should be a minimum of 8 feet wide. However, in order for the parking lane to also serve as a transit lane, it should be 10-12 feet wide. (AASHTO,

2004) “This width is also sufficient to accommodate delivery vehicles and serve as a bicycle route, allowing a bicyclist to maneuver around an open door on a motor vehicle.” (AASHTO, 2004) The length of curb space allocated to each parking spot is not included. The National Association of City Transportation Officials (NACTO) identifies the general dimensions of commercial vehicles and light trucks as 7 – 10 m (23 - 33 ft.) long, and 2 m (6.5 ft.) wide. NACTO also recommends travel lanes be 3.3 m (11 ft.) wide for major truck or bus routes, and that box trucks with a width of 8 feet have a parking spot 11 feet wide to incorporate the buffer space required for the door zone. (NACTO, 2016) Although NACTO recognizes that additional space is required for freight parking to support freight loading/unloading activities, there is no additional information about the length of a commercial vehicle parking spot.

Commercial Vehicles and Light Trucks

These trucks are generally used for carrying goods from ex-urbanized logistic centers to the city. They are bigger in scale compared to motorized personal vehicles but do not require wider corner radii or bigger lanes.

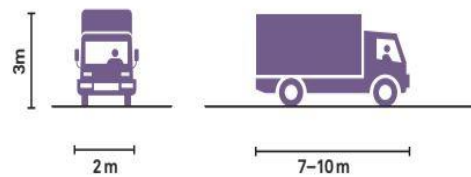


Figure 3 Urban Freight Vehicle Defined and Dimensions (NACTO, 2016)

Street users and vehicles occupy different amounts of space depending on their size and speed. Lane design should accommodate transit vehicles at a speed that is safe within the overall street context, supporting consistent and reliable operations.

Buffers shown here are not lane widths, but represent the operating envelope and minimum distance to adjacent objects when in motion, and can overlap with adjacent lanes.

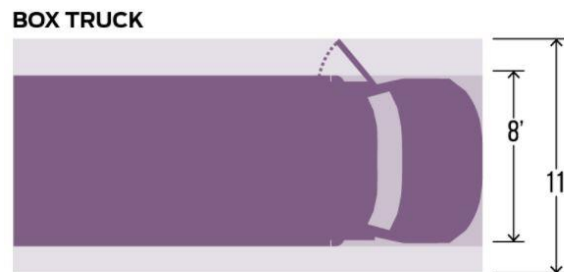


Figure 4 Operating Envelope Deigned and Desired Box Truck Dimensions (NACTO, 2016)

2.4 Commercial Vehicle Load Zone Design Standards in Seattle, Washington

At the state level, the Washington State Department of Transportation Design Manual acknowledges that freight loading areas must be designed to “consider both the delivery vehicle size and how the vehicle loading/unloading is done. Consult with business owners and freight carriers to locate and configure the freight loading areas” (WSDOT, 2017). This Manual does not recommend design or dimensions for a commercial vehicle load zone. Seattle Department of Transportation (SDOT) has outlined its strategic vision for transportation in two plans: Move Seattle 2015 and the City of Seattle Freight Master Plan 2016. Though both of these plans illuminate the many challenges associated with freight in Seattle such as managing curb space, parking rates, modifying streets into complete streets, and incorporating high tech solutions, these plans do not include any discussions regarding freight parking design standards.

2.5 Commercial Vehicle Load Zone Types

Different CVLZ types arise as a result of the street characteristics present because CVLZs are typically added to streets after streets have been built. Therefore, there are a variety of CVLZ types present in Seattle. Irrespective of the CVLZ type, they all have yellow curb paint and signage to indicate that it is a CVLZ, however, the pavement markings associated with the CVLZ may vary. “Marking of parking space boundaries encourages more orderly and efficient use of parking spaces where parking turnover is substantial. Parking space markings tend to prevent encroachment into fire hydrant zones, bus stops, loading zones, approaches to intersections, curb ramps, and clearance spaces for islands and other zones where parking is restricted.” (Manual on Uniform Traffic Control Devices (MUTCD)) The four observed types have been listed and shown below.

Transit Lane CVLZ without Pavement Marking



Figure 5 CVLZ Type 1 - Transit Lane without Pavement Marking (Google, 2018) (Sheth, 2017-2018)

This CVLZ type is along the curb, but does not have a defined width or separation from the adjacent transit lane. In Figure 5, the width from the curb to the center line marking is about 20 feet for two lanes. (Google, 2018) The CVLZ parking lane can also be used as a transit lane before/after CVLZ hours (before 7 AM, after 8 PM). See Figure 5 for an example of this CVLZ type.

Transit Lane CVLZ with Pavement Marking



Figure 6 CVLZ Type 2 - Transit Lane with Pavement Marking (Google, 2018) (Sheth, 2017-2018)

This CVLZ type is along the curb and has a solid white pavement marking that indicates the width of the CVLZ space, and clearly separates this space from the adjacent transit lane. This marking is present because the pavement marking of a white solid line and “Bus Only” pavement marking means that this CVLZ is in a Bus Only lane in Downtown Seattle. Despite this being a Bus Only lane, it accommodates curb activities like deliveries. This CVLZ is 11 feet wide. (City of Seattle, 2017) See Figure 6 for an example of this CVLZ type.

Curb Out CVLZ

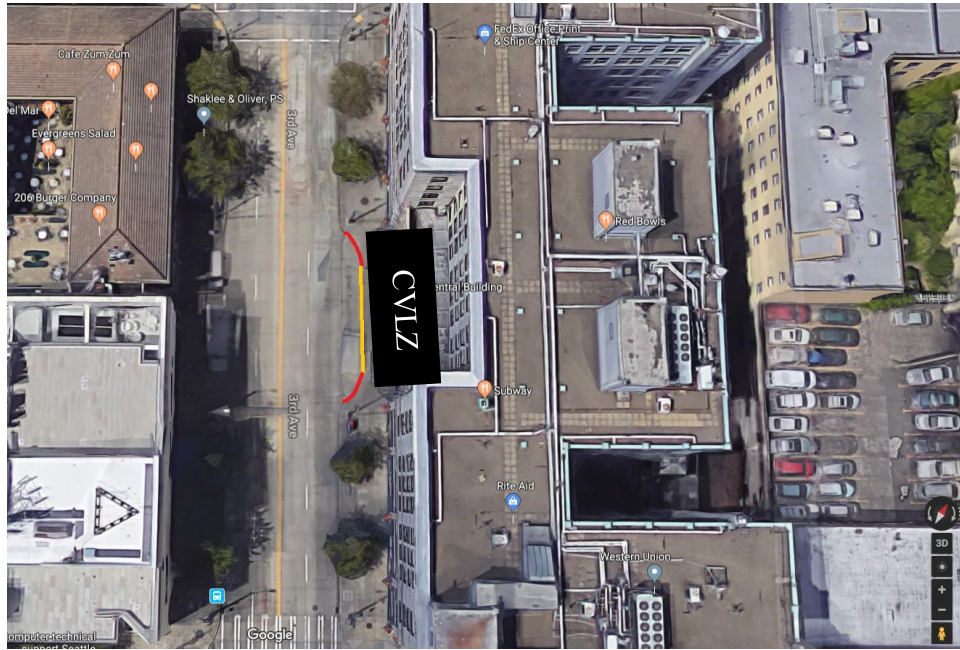


Figure 7 CVLZ Type 3 - Curb Out (Google, 2018) (Sheth, 2017-2018)

This CVLZ type is along a curb out, and does not have a solid white pavement marking to indicate the width of the CVLZ. Adjacent to the CVLZ is two transit lanes. The total width from the curb out to the center line marking is about 30 feet. (Google, 2018) Please see Figure 8 for an example of this CVLZ type. In addition to a Curb Out CVLZ being in the middle of the block, it can also be implemented at the front or back end of a block.

Angled Parking



Figure 8 CVLZ Type 4 - Angled Parking (Sheth, 2017-2018)

This CVLZ type is for a vehicle that must park perpendicular to the curb and at an angle.

Adjacent to or in front of this parking space is a transit lane. In figure 8, the total width from the curb out to the center line marking is about 31 feet. (Google, 2018) See Figure 8 for an example of this CVLZ type.

2.6 Commercial Vehicle Load Zones – State of Affairs in Seattle

The CVLZ program began in 1990 in Downtown Seattle to ensure that the yellow curb space is not misused. (SDOT, 2017) For a commercial vehicle to park at a CVLZ, they must either pay for parking when possible or display a permit for an annual permit fee of \$195.00. In a report published in 2014, SDOT aimed to improve the CVLZ program by “enabling commercial vehicle drivers to more easily find available CVLZs; providing enhanced parking enforcement of CVLZ spaces; and improving accessibility of CVLZs during major downtown construction projects.” (Transpo Group, 2014)

In 2017, the Seattle Department of Transportation (SDOT) worked with the Supply Chain Transportation and Logistics Center at the University of Washington to update and verify their inventory of CVLZs. The study area for this project is the Downtown Seattle area, which includes the following Urban Villages – Belltown, Chinatown-International District, Commercial Core, Denny Triangle, Eastlake, Pioneer Square, South Lake Union, and Uptown. University of Washington Master’s student, Pramod Chandra, organized the data collection method, in which the location, length, width, curb type, and picture of all load zones were collected. According to this data set, there are 269 CVLZs in the Downtown Seattle area.

Figure 9 is a map of all of the CVLZs in Seattle (Chandra, 2017). The high density of CVLZs in the Downtown area emphasizes the important role they play in facilitating urban logistics in Seattle, and is therefore a significant piece of infrastructure to understand and improve.

Load Zones in Downtown Seattle Area - 2017

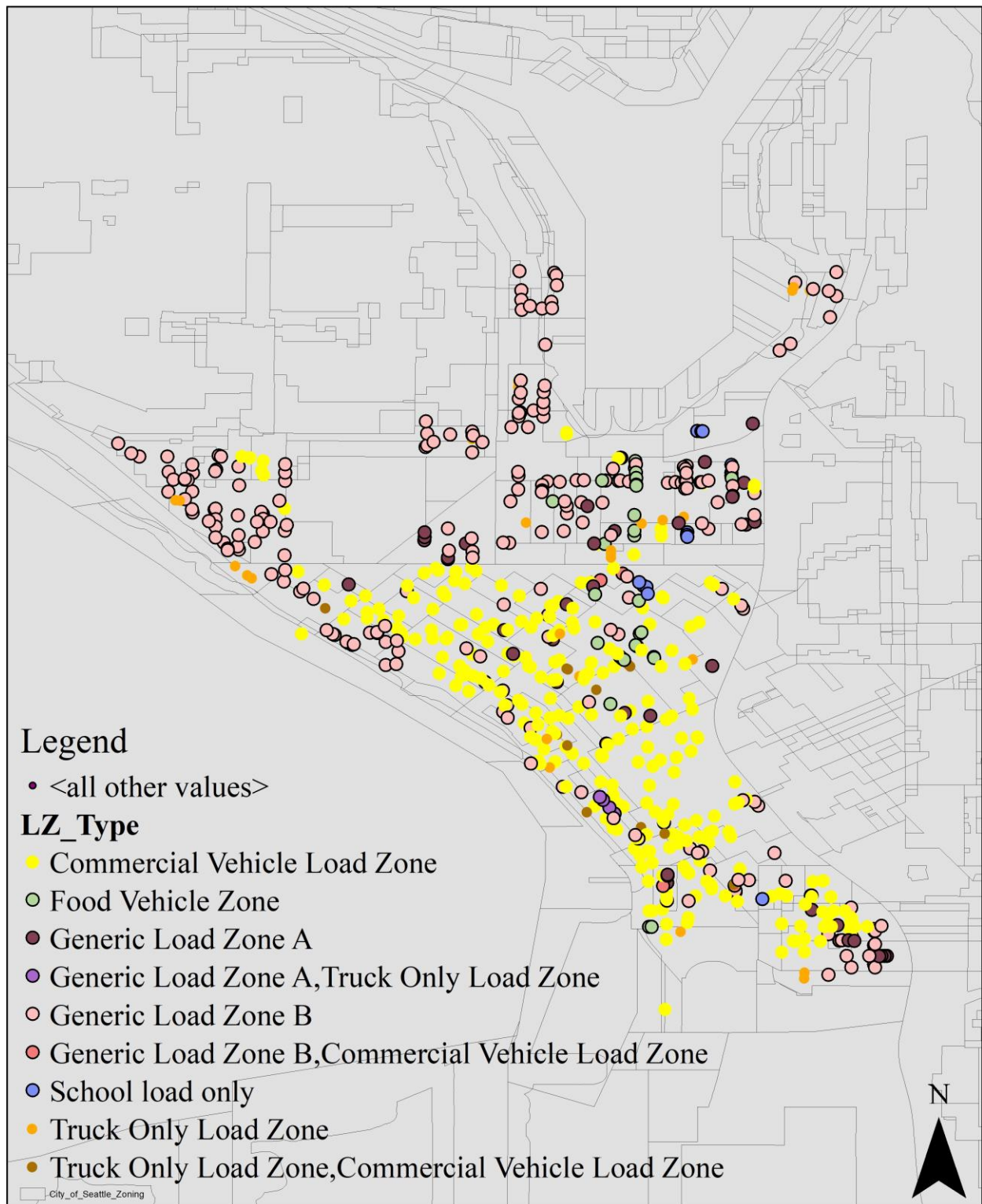


Figure 9 Map of Different Load Zone Types in Seattle 2017

2.7 Possible Outcomes of Poorly Designed Curb Space and Commercial Vehicle Load Zones

The reason that curb space is important to understand is because poorly managed curb space may result in blockages, congestion, double-parking, and may affect traffic patterns. (NACTO, 2017) & (Madrecki, 2018) “While truck traffic currently represents about 7 percent of urban traffic in American cities, it bears a disproportionate congestion cost of \$28 billion, or about 17 percent of the total U.S. congestion costs, in wasted hours and gas.” (Zaleski, 2017) There is no literature about the outcomes of on-street CVLZ design on safety or congestion.

2.8 Vision Zero

Vision Zero is an action plan that was published and launched in 2015 in Seattle. The purpose of Vision Zero is to “end all traffic deaths and serious injuries by 2030 through innovative engineering, enforcement and education” (Murray, 2015) New standards and policies have been adopted in Seattle due to the Vision Zero action plan. For example, the speed limit in Downtown Seattle has been reduced to 25 mph and to 20 mph in residential areas. The City is reviewing street conditions and investing in improving safety for all road users. Some programs supported by the Vision Zero plan are Greenways Program, Protected Bike Lanes, and Safe Routes to School.

In the Vision Zero plan, there is no mention of freight/commercial vehicle safety, despite the high-risk behavior courier drivers may engage in because of insufficient freight infrastructure or poor/lack of design standards. Figure 10 exemplifies the time of high-risk behavior drivers may be involved in. Though crashes with couriers may be low in number, data does not capture the near misses. There are preemptive measures that the City could take to improve safety for couriers.



Figure 10 High Risk Courier Driver Activity in Seattle during Delivery (Sheth, 2017-2018)

2.9 Conclusion

Downtown Seattle has 269 CVLZs, with different curb types. Through the literature review, an outstanding realization is that there are no clear standards on the design of CVLZs, and that there is little information about the activities and needs for a courier driver at a CVLZ. Though there is little information regarding the relationship between the design of CVLZs, from personal observations in Downtown Seattle, improving the design of CVLZs and other load zones may minimize trucks double parking and the safety of courier drivers, cyclists, pedestrians, and vehicles surrounding a parked commercial vehicle.

CHAPTER 3. Research Methods

To improve the design of CVLZs, the needs of courier drivers must be better understood. **Step 1** is to understand the general profile of the vehicle types and activities that may occur at a curb. *Observations* is the research method used for this project to systematically collect information. I will share findings from 25 field observations of freight activity in Seattle, specifically, about the vehicle and activity characteristics associated with each delivery. The 25 observations will serve as a sample and the summary of delivery and vehicle characteristics will inform the design recommendations in Chapter 5 of this paper.

For the purpose of this research, a sample size of 25 is sufficient to generally understand the vehicle and delivery characteristics in Seattle. There could certainly be a wide range of variability in vehicle and delivery characteristics per delivery.

Each observation will include the following factors bulleted below. These factors were chosen because during the pilot period for data collection, these were the main factors to influence the use of space for a truck at a curb. The data collection form was designed to reflect these factors, and can be seen in Appendix A. This information will serve as a proxy for courier driver needs.

- Commercial Vehicle Characteristics (truck class, passenger door type, cargo door type)
- Exiting/Entering Commercial Vehicle Behavior
- Accessory Used and Accessory Path
- Courier Path to Access the Cargo in and/ around vehicle
- Delivery Characteristics and Goods Described
- Courier Response to the Built Environment

Step 2 is an analysis and summary of these observations, in which impactful characteristics of each delivery are pulled out and compared to the other observations.

Step 3 is incorporating the findings from Step 2 into a rendering of an improved freight curb design.

CHAPTER 4. Field Observations

The 25 observations were completed in urban areas of Seattle, Washington. I decided to record an observation by standing at a block and waited for a commercial vehicle to park at that block and make deliveries or I would arrive at a block while a delivery was already happening and capture the remaining aspects of the delivery. This Chapter includes one observation and serves as an example of the type of qualitative information recorded. The remaining 24 observations are in Appendix C.

4.1 4301 University Way NE, Seattle, WA 98105

Delivery Location, Date, and Time

Delivery Coordinates	47.659869, -122.313333
Delivery at Yellow Curb	Yes
Observation Date & Time	Wednesday, November 15, 2017 2:00-3:00 PM

Commercial Vehicle Characteristics

A Pepsi delivery truck was observed at this location. This truck is a Class 5 truck.

The truck had a swing out door on both the driver and passenger side of the truck. The truck design was such that it did not have any back cargo doors, but instead, had five cargo compartments on both the passenger and driver side of the truck, resulting in 10 cargo compartments. These cargo doors must be manually lifted and rolled up to retrieve goods. An image of these cargo compartments have been outlined, and can be seen in Figure 11.



Figure 11 Parked Truck at CVLZ in the U-District, Seattle. Cargo compartments outlined (Sheth, 2017-2018)

Exiting/Entering Commercial Vehicle Behavior

The courier driver exited his truck from the driver side of the truck, which was flush against the curb. His exit point was directly onto the sidewalk.

Accessory Used and Accessory Path

The courier driver used a hand truck during this delivery. It is unclear where he retrieved it from, but the truck does have a space for the hand truck at the back of the truck (exterior). During the observed delivery, the courier driver had placed the hand truck on the sidewalk while he reviewed his inventory. He loaded the hand truck from the sidewalk and then walked with the hand truck around the back end of the vehicle to the passenger side to continue loading the hand truck with goods. He then proceeded to walk with the hand truck up along the passenger side of the vehicle to the front end of the vehicle to access the sidewalk again.

Courier Path to Access Cargo – Movements Described Around Truck

The courier driver exited his truck from the passenger side and into the sidewalk. It is presumed that he disengaged the hand truck from the back of the vehicle and was standing behind the vehicle at this time (he was out of the line of site to clearly capture this specific activity). He mainly stood on the sidewalk with his hand truck while reviewing his inventory list, organizing goods, and loading the hand truck from the cargo compartments located on the driver side. He walked around the back end of the truck to the cargo compartments on the passenger

side. He loaded the hand truck and then proceeded to with the hand truck up along the passenger side of the truck to the front end of the truck to access the sidewalk again.

After loading the hand truck with the appropriate items, he made a delivery, and returned to make another delivery. For the second delivery, he remained on the sidewalk with the hand truck and loaded the appropriate items onto the hand truck and walked to the next delivery destination.

The end of his delivery movements were not captured, as he did not return to his truck for over 20 minutes.

Delivery Characteristics and Goods Described

This delivery included just one driver who was also the courier, which is why the term courier driver is used. The items loaded and unloaded were invariably small pallets of Pepsi owned beverages/cans. The types of goods delivered can be seen in Figure 12.



Figure 12 Beverage Vehicle Unloading (Sheth, 2017-2018)

Courier Behavior in Response to Built (street, road, land use characteristics) Environment

This delivery took place in the University District of Seattle, which is mixed use and includes a mixture of restaurants, cafes, and specialty stores and residential units. Adjacent to the delivery location is a vehicle lane without any clear pavement marking separating the function and space of the delivery from the adjacent vehicle lane. Behind the delivery truck is a concrete parking

curb implemented to create a more noticeable and unavoidable separation between delivery area and bicycle parking spaces. There is not a designated bike lane present on this block.

The courier mainly conducted activities while standing and taking refuge on the sidewalk. The transit lane adjacent to the delivery location was not highly utilized at the time of delivery, and so the courier did not seem to significantly restrict his while conducting loading and unloading activities on the passenger side and while standing in the roadway. Figure 13 depicts the courier's movements on the roadway.



Figure 13 Beverage Vehicle Walking Along Road (Sheth, 2017-2018)

CHAPTER 5. Research Findings

From the 25 field observations, there are some takeaways that may help inform the elements included/excluded in the rendering of an improved freight curb space design.

5.1 Major Takeaways from Field Observations

Number of Deliveries at Yellow Curb Space

Of the observed deliveries, a majority of them occurred at a yellow curb, and some deliveries occurred along either unmarked curb space or in pedestrian vehicle load zones. One observed delivery occurred in an alley. These findings may allude to the fact that either the design or that there simply is not enough yellow curb space available to trucks or commercial vehicles in Seattle.

Yellow Curb Length Overhang

Of the observed deliveries occurring at a yellow curb, a majority of the vehicle's *open footprint - vehicle extensions engaged such as cargo doors/lift gates*, was longer than the yellow curb length provided by the City. The term open footprint is used to describe the features of a vehicle that must be engaged in order for the vehicle to function in the way it was designed to. This includes extending a ramp or having a lift gate that must be engaged in order to complete the delivery. These findings may suggest that the design of yellow curb space is generally insufficient for the majority of trucks observed using the yellow curb.

Observed Commercial Vehicle Classification

The majority of vehicles observed using the yellow curb are Class 5 vehicles. According to the Federal Highway Administration, this means that “**Two-Axle, Six-Tire, Single-Unit Trucks** – All vehicles on a single frame including trucks, camping and recreational vehicles, motor homes, etc., with two axles and dual rear wheels.” (USDOT FHWA, 2014) This may indicate that Class

5 vehicles are typically making urban deliveries, and to design a majority of curb space to accommodate the vehicle characteristics of a Class 5 truck.

Number of Delivery Company Staff

A majority of the deliveries were completed by a single person who was both the driver and courier. A few of the observed deliveries include two people; this may be due to the fact that observations were completed during the holiday season in the United States. Companies may have added staff to a route to off-set the larger number of deliveries occurring during the holiday season. These results may indicate that adequate door opening space be certainly provided on the driver's side of the vehicle for safe and comfortable ingress and egress.

Driver & Passenger Door Type

A majority of the observed vehicles had open out or swing out doors, which indicates that at a minimum, a commercial vehicle operating envelope should include additional space to accommodate a fully extended doors that opens out.

Cargo Compartment Location

A majority of the observed vehicles have cargo compartments located at the back end of the vehicle. This may indicate that additional space must be required for the driver/courier to organize goods, load accessories, and maneuver with accessories at the back end of a CVLZ. This may impact the design considerations and suggestions provided in this research project. Few of the observed vehicles have cargo compartments located on the driver's side of the vehicle. The vehicles that did have this amenity were beverage vehicles with side compartments. Close to half of the observed vehicles had cargo compartments on the passenger side.

Lift Gate Presence

A majority of the vehicles did not have a lift gate, but those that did have one needed significantly more space to operate. Curb cuts or narrow parking lanes were observed as a hindrance for the safe and comfortable use of the lift gate. Narrow parking lanes would mean that the lift gate would overhang into the adjacent transit lane. Curb cuts may obstruct the lift gate operations and may not allow for the lift gate to sit flush against the pavement. These findings may also indicate that on-street CVLZs could be mainly designed for commercial vehicles without lift gates, and that off-street parking could be maintained for commercial vehicles with lift gates.

Accessory Type

Hand trucks were most commonly used during deliveries. Note that the hand truck category includes both hand trucks and 2-way convertible hand trucks. This indicates that the turning radius of a hand truck around the vehicle is important to consider. Other accessories observed were ramps, cones, hampers, and bins.

Courier Movements Observed

Movements around the vehicle were observed and the possibilities included moving in front of the vehicle, at the back end of the vehicle, on the passenger side of the vehicle, and on the driver side of the vehicle. Most deliveries involved the driver side of the vehicle and back end of the vehicle being used.

Back End of Vehicle

A majority of the drivers/couriers accessed cargo behind the observed vehicle. This includes walking past the back end or participating in loading/unloading activities at the back end of the vehicle. This may impact the design considerations and suggestions provided.

Driver Side of Vehicle

One person who was both the driver and courier completed a majority of the observed deliveries. Therefore, it is not surprising that there a majority of the observed vehicles had activity on the driver side. This includes ingress/egress, walking past this side of the vehicle, or participating in any loading/unloading activities on this side of the vehicle.

Passenger Side of Vehicle

There was a general split between activities occurring on the passenger side of the observed vehicles. Some of these observed vehicles had cargo compartments on the passenger side. This may impact the design considerations and suggestions provided in this research project.

Front End of Vehicle

There was little to no activity observed in front of the observed vehicles. This includes walking past this side of the vehicle, or participating in any loading/unloading activities on this side of the vehicle. This may impact the design considerations and suggestions provided in this research project.

5.2 Discussion of an Improved ~~CVLZ~~Freight Curb Space

This research project focuses on understanding the needs and activities of deliveries and commercial vehicles in Seattle, and developing an improved CVLZ bearing the field observations in mind. However, from this research project, Field Observations about opportunities for improvement in the practice of transportation planning and freight literature must be addressed before sweeping changes in curb design and curb management can occur. These opportunities have been considered in the rendering of an improved freight curb space.

The first opportunity is that different vehicle types with vastly different dimensions and needs share the same curb color, but have different signage. Figure 14 shows the four different signs that may be present at a yellow curb in Seattle. Each sign has a different set of rules and

parameters for what vehicle and activity can occur at that parking spot. Depending on which sign is placed at a yellow curb, it could be permissible for a motorcycle delivering a pizza, or a large truck delivering furniture. I believe that curb space and curb color should be revisited so that the length, width, and purpose of a vehicle is paired with a color and texture/pattern, not solely matching the purpose/activity with the curb color as it is now in Seattle.



Figure 14 Seattle Yellow Curb Signage (Seattle Department of Transportation, 2018)

The second opportunity is the way USDOT FHWA has classified different vehicle types. The different vehicle classes are based on the number of axles and number of wheels associated with a vehicle. However, I believe it is more relevant for Urban Planners, Engineers, and Urban Designers to have a list of vehicles classified by their length (engaged – lift gate, back doors), width (engaged - doors fully extended), and turning radius. Please see Appendix B for USDOT FHWA’s current vehicle classification chart.

Having these metrics available to Urban Planners, Engineers, and Urban Designers is critical so that practitioners in the field can better consider and plan for freight needs at the neighborhood, city, and state level.

5.3 Rendering of Freight Curb Space

The renderings for the new design proposal is included below. The curb type used in this rendering is a parallel curb type, as this is how the majority of yellow curb space is categorized, according to the load zone inventory in Downtown Seattle area.

Please note that these design elements are suggested with the intent that all vehicles are categorized by their size, features, and activities and then paired with a curb color, texture/pattern, and signage. Observations and a study of the space required for each vehicle type and activity would have to be completed. The implementation of this system would be site specific and depend on block and neighborhood characteristics.

Findings from the literature review and 25 observations of deliveries in Seattle were included in the suggested redesign. This redesign can be seen in Figure 15.



Figure 15 Rendering of Curb Space Redesigned for 27x8 ft. and 15x6 ft. vehicles (Toyota, 2018) UPS Truck Dimensions courtesy of Anna Alligood and Siqi Lu

The main new design elements for freight curb space are:

- 1) Use paint, texture/patterns, and signage to pair curb space with vehicle type and activities associated with that vehicle type. For example, in this rendering, blue paint with circles would be the paint and pattern associated with curb space for 27 x 8 ft. vehicles. Signage indicates the dimensions of the vehicle, days and times of the week that it is enforced, and time limit spent at the curb. Please note that I have considered color accessibility in the rendering of the suggested redesign (Collinge, 2017).

- 2) Provide space around the vehicle so that vehicle features such as doors can fully engage, and accessories can be comfortably used as needed. As seen in the major takeaways from the field observations, most deliveries included using a hand truck as an accessory and most of the observed vehicles had a cargo compartment located at the back end of the vehicle. The design of the blue curb space in Figure 82 not only respond to these needs, but exceeds them by providing additional space on the sidewalk and driver's side for additional activities. It may also support the needs of a beverage truck seen in Figure 13 and a pick-up system in which high density office/residential buildings provide a staff member to meet the courier at the curb with a bin to consolidate and retrieve deliveries.
- 3) Signage that stipulates the dimensions of the permitted vehicle at that curb space and days/time of enforcement.

It is important that the three recommendations be implemented as a trio because they each complement each other and are integral for optimizing the efficacy of the freight curb design. The paint and texturing indicate to curb users the minimum and maximum length and width of that particular curb parking space. The paint and texturing on the curb indicates the minimum/maximum amount of space that may be needed for the activities occurring at the curb parking space. The signage clearly communicates the limitations and regulations of the curb parking space. These three items together serve as a holistic system.

The goal of these new design elements is to:

- 1) At the freight curb space level - Reduce double parking, circling, and high-risk environments for courier drivers as a result of poorly designed yellow curb space.

- 2) At the overall curb – Improve curb space design so that it better responds to the needs by prioritizing certain vehicle types and their activities, while also providing flexibility.

There are limitations to implementing this redesigned freight curb space in a city. The city would have to pilot test this system on a couple of blocks and create a method to compare the efficacy of the curb before and after the curb is redesigned. If the redesigned curb performs better than the current system in place, then the City would have to create a system to fairly allocate curb space to different vehicle sizes. There would also have to be flexible curb space to accommodate unexpected vehicle sizes or to support the dynamic activities of the City. In addition, the City would have to invest its resources to educate the public regarding curb use and the new design. A cost benefit analysis may be an effective tool to capture the number of variables that would have to be considered before the suggested curb redesign is implemented en masse.

CHAPTER 6. Discussion and Future Research

Through this research project, I have better understood the nuances of Urban Planning and the gaps that are present in freight literature, freight transportation planning practice, and freight management efforts and metrics. I have also understood the possible repercussions of poorly designed curb space for commercial vehicles. Trucks may resort to double parking for quick deliveries, circling the block until an appropriate yellow curb space becomes available, or parking in Passenger Load Zones because of poorly designed or unavailable yellow curb space.

My research suggests that curb space management is a powerful and effective tool that has been left as an untapped resource until recent years. Organizing curb space and designing the curb to 1) sufficiently meet the needs of different vehicles and users at different times of the day and week, and 2) meet the time needs required for different users, is essential to a well-planned city. The curb has to be reliable and flexible enough to support the dynamism at the curb. Improving the design of freight curb space at large using paint, signage, or any other medium is essential for supporting a fair system that reliably communicates the same message to all road users.

There is no one size fits all solution for curb space management or even design standards for a parking spot at the curb. The curb is a complex space, and each curb must be assessed at the block and neighborhood scale. Different cities in the United States and major cities around the world have different approaches to managing curb space, and there does not seem to be a premier way of managing curb space (District Department of Transportation, 2014) (SDOT, 2018) (NACTO, 2017). Perhaps the dynamism of activities at the curb does not allow curb design to be standardized within even the same neighborhood, as curb activity changes

depending on the zoning regulations, policies, length in time of curb activity, and street characteristics present at each block.

The purpose of this thesis is to understand the needs of courier drivers for freight activity at the curb through observations, and to design a new curb space that incorporates findings from these observations. Limitations of this research project include

The observations and research findings from this research project nicely supports future endeavors to understand the operations occurring at the curb in major cities like Seattle. Upon understanding the current use of curb space in detail, holistic solutions such as parking time limits and permit programs may be more effectively applied. This research may also encourage others to revisit USDOT FHWA's vehicle classification system and chart, and include more detailed design standards in the MUTCD and NACTO. As a Masters of Urban Planning student, I am looking forward to applying all that I have learned through this process for better curb space management efforts.

REFERENCES

- AASHTO. (2004). *A Policy on Geometric Design of Highways and Streets* (5th ed.). Retrieved April 01, 2018
- AASHTO. (n.d.). *AASHTO Overview*. Retrieved April 02, 2018, from AASHTO: <https://www.transportation.org/home/organization/>
- Bai, Y., Mackowski, D., & Ouyang, Y. (2015). *Parking Space Management via Dynamic Performance-based Pricing*. *Transportation Research Procedia*. Retrieved from <https://www.sciencedirect.com/science/article/pii/S2352146515000782>
- Berger, P. (2018, May 10). *New York City to Reduce Discounts on Parking Tickets for Commercial Vehicles*. Retrieved from The Wall Street Journal: https://www.wsj.com/articles/new-york-city-to-reduce-discounts-on-parking-tickets-for-commercial-vehicles-1525957200?shareToken=st5229ff69bd03487485f157633639816c&reflink=article_email_share
- Burnell, T., Santalucia, A., & Epstein, A. (2017, November 28). *Delivering The Goods*. Retrieved from USDOT Federal Highway Administration: <https://www.fhwa.dot.gov/publications/publicroads/18autumn/03.cfm>
- Calder, Rich. (2013, May 27). *FedEx, UPS owe \$2.8 million in parking tickets to city in first three months of 2013*. Retrieved May 18, 2018, from New York Post: <https://nypost.com/2013/05/27/fedex-ups-owe-2-8-million-in-parking-tickets-to-city-in-first-three-months-of-2013/>
- Chandra, P. (2017). *CVLZ Inventory for SDOT*. Seattle.
- City of Seattle. (2017, 06 17). *3.10 Freight*. Retrieved May 07, 2018, from Seattle Right-Of-Way Improvement Manual: <http://streetsillustrated.seattle.gov/design-standards/freight/>
- City of Seattle. (2017, June 09). *Curbs Design Criteria*. Retrieved from Seattle Right-of-Way Improvements Manual: <http://streetsillustrated.seattle.gov/design-standards/roadway-construction/curbs/>
- Collinge, R. (2017, January 17). *How to Design for Color Blindness*. Retrieved from Usabilla Blog: <http://blog.usabilla.com/how-to-design-for-color-blindness/>
- Delhi Development Authority. (n.d.). *Kerb Heights for Footpaths and Medians*. Retrieved from <http://uttipeec.nic.in/writereaddata/linkimages/3650683914.pdf>
- District Department of Transportation. (2014). *The District of Columbia's Multimodal Long-Range Transportation Plan, Parking and Curbside Management Element*. Washington, D.C.

- Retrieved from
http://wemovedc.org/resources/Final/Part%202_Plan_Elements/Parking_and_Curbside_Management.pdf
- District of Columbia. (n.d.). *D.C. Comprehensive Plan*.
- Google. (2018). *Google Maps*. Retrieved May 07, 2018, from https://www.google.com/maps/@47.6061978,-122.3374124,3a,60y,68.8h,72.89t/data=!3m6!1e1!3m4!1sM1cSCHRQX_peP7mSm6SFI A!2e0!7i13312!8i6656
- Heikkila, E. J. (2000). *The Economics of Planning*. New Brunswick: Center For Urban Policy Research.
- Holguin-Veras, J., Ozbay, K., Kornhauser, A., Brom, M., Iyer, S., Yushimito, W., . . . Silas, M. (2011). *Overall Impacts of Off-Hour Delivery Programs in New York City Metropolitan Area*. Transportation Research Board. Transportation Research Record: Journal of the Transportation Research Board.
- Madrecki, T. (2018, February 04). *Don't Curb Your Enthusiasm, Curbsides – yes, curbs – have the power to transform cities*. Retrieved May 12, 2018, from UPS Longitudes: <https://longitudes.ups.com/dont-curb-your-enthusiasm/>
- Manish, C., & Hou, J. (2016). *Messy Urbanism: Understanding the "Other: Cities of Asia*. Hong Kong University Press.
- Manual on Uniform Traffic Control Devices (MUTCD). (n.d.). *Section 3B.19 Parking Space Markings*. Retrieved from <https://mutcd.fhwa.dot.gov/htm/2009/part3/part3b.htm>
- Marshall, A. (2017, November 11). *To See the Future of Cities, Watch the Curb. Yes, the Curb*. Retrieved May 05, 2017, from WIRED: <https://www.wired.com/story/city-planning-curbs/>
- Murray, E. (2015, February 15). *Seattle Launches Vision Zero Plan to End Traffic Deaths and Injuries by 2030*. Retrieved May 05, 2018, from Seattle.gov: <http://murray.seattle.gov/seattle-launches-vision-zero-plan-to-end-traffic-deaths-and-injuries-by-2030/>
- NACTO. (2016). *Global Street Design Guide*. New York: Global Designing Cities Initiative, NACTO, Island Press.
- NACTO. (2016). *Transit Street Design Guide*. New York: Island Press.
- NACTO. (2017). *Curb Appeal - Curbside Management Strategies For Improving Transit Reliability*. Seattle. Retrieved from <https://nacto.org/wp-content/uploads/2017/11/NACTO-Curb-Appeal-Curbside-Management.pdf>

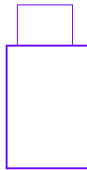
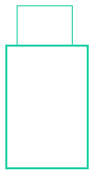
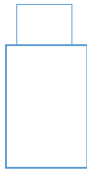
- NACTO. (n.d.). *About NACTO*. Retrieved April 02, 2018, from National Association of City Transportation Officials: <https://nacto.org/about/>
- One Center City. (n.d.). *One Region. One Plan. One Center City*. Retrieved May 05, 2018, from <http://onecentercity.org/about>
- SDOT. (2015). *Move Seattle - 10 -Year Strategic Vision for Transportation*. Seattle: SDOT. Retrieved from <https://www.seattle.gov/Documents/Departments/SDOT/About/DocumentLibrary/MoveSeattle-FinalDraft-2-25-Online.pdf>
- SDOT. (2016). *City of Seattle Freight Master Plan*. Seattle. Retrieved from https://www.seattle.gov/Documents/Departments/SDOT/About/DocumentLibrary/FreightMasterPlan/Freight_Master_Plan_CAC_February_2016V3.pdf
- SDOT. (2017, October 13). *Commercial Vehicle Loading Zone Pilot Pricing Project*. Retrieved May 05, 2017
- SDOT. (2018). *Commercial Vehicle Load Zone Permits*. Retrieved May 05, 2018, from Seattle Department of Transportation: <https://www.seattle.gov/transportation/permits-and-services/permits/parking-permits/commercial-vehicle-load-zone-permits>
- SDOT. (2018). *Flex Zone/Curb Use Priorities in Seattle*. Retrieved May 05, 2018, from <https://www.seattle.gov/transportation/projects-and-programs/programs/parking-program/parking-regulations/flex-zone/curb-use-priorities-in-seattle>
- SDOT. (n.d.). *About SDOT*. Retrieved from SDOT: <https://www.seattle.gov/transportation/about-sdot>
- Seattle Department of Transportation. (2015). *Can I Park Here?* Seattle: SDOT. Retrieved from <https://www.seattle.gov/Documents/Departments/SDOT/ParkingProgram/CanIParkHereBrochure.pdf>
- Seattle Department of Transportation. (2018, May 15). *Curb Colors*. Retrieved May 05, 2018, from SDOT: <https://www.seattle.gov/transportation/projects-and-programs/programs/parking-program/parking-regulations/curb-colors>
- Seattle Department of Transportation. (2018). *How Seattle Implements Complete Streets*. Retrieved 2018, from Seattle Department of Transportation: <https://www.seattle.gov/transportation/projects-and-programs/programs/urban-design-program/complete-streets-in-seattle/how-seattle-implements-complete-streets>
- Seattle Department of Transportation. (2018). *Load Zones*. Retrieved May 12, 2018, from Seattle.gov: <https://www.seattle.gov/transportation/projects-and-programs/programs/parking-program/parking-regulations/load-zones>

- Seattle Department of Transportation. (September 2016). *City of Seattle Freight Master Plan*. Seattle: SDOT. Retrieved from https://www.seattle.gov/Documents/Departments/SDOT/About/DocumentLibrary/FMP_Report_2016E.pdf
- Seattle Right of Way Improvement Manual. (2017, June 09). *3.9 Transit*. Retrieved May 15, 2018, from Seattle Streets Illustrated: <http://streetsillustrated.seattle.gov/design-standards/transit/>
- Seattle.Gov. (2007). *Office of the City Clerk*. Retrieved 2018, from City of Seattle Legislative Information Service, Council Bill Number: 115861, Ordinance Number: 122386: <http://clerk.seattle.gov/~scripts/nph-brs.exe?s1=&s3=&s4=122386&s2=&s5=&Sect4=AND&l=20&Sect2=THESON&Sect3=PLURON&Sect5=CBORY&Sect6=HITOFF&d=ORDF&p=1&u=%2F~public%2Fcbory.htm&r=1&f=G>
- Seattle.Gov. (2016). *Office of the City Clerk*. Retrieved 2018, from City of Seattle Legislative Information service, Resolution Number: 30915: <http://clerk.seattle.gov/~scripts/nph-brs.exe?s1=&s3=30915&s2=&s4=&Sect4=AND&l=20&Sect2=THESON&Sect3=PLURON&Sect5=RESNY&Sect6=HITOFF&d=RESF&p=1&u=%2F~public%2Fresny.htm&r=1&f=G>
- Sheth, M. (2017-2018). Personal Images. Seattle.
- Smart Growth America. (2018). *Complete Streets Policies Nationwide*. Retrieved April 13, 2018, from Smarth Growth America: <https://smartgrowthamerica.org/program/national-complete-streets-coalition/policy-development/policy-atlas/>
- Toyota. (2018, May 20). *2018 Prius Full Specs*. Retrieved from <https://www.toyota.com/prius/features/dimensions/1221/1223/1224>
- Transpo Group. (2014). *Commercial Vehicle Pricing Project Final Plan*.
- USDOT FHWA. (2014, November 07). *Policy and Government Affairs - Office of Highway Policy Information*. Retrieved from Traffic Monitoring Guide: https://www.fhwa.dot.gov/policyinformation/tmguidetmg_2013/vehicle-types.cfm
- USDOT FHWA. (2017, February 5). *2009 Edition Chapter 6H. Typical Applications*. Retrieved April 01, 2018, from MUTCD: <https://mutcd.fhwa.dot.gov/htm/2009/part6/part6h.htm>
- USDOT FHWA. (2017, February 05). *2009 Edition Part 3 Figure 3B-21. Examples of Parking Space Markings*. Retrieved April 02, 2018, from MUTCD: https://mutcd.fhwa.dot.gov/htm/2009/part3/fig3b_21_longdesc.htm

- WSDOT. (2017). *Design Manual*. Engineering and Regional Operations. Retrieved from www.wsdot.wa.gov/publications/manuals/fulltext/M22-01/design.pdf
- Zaleski, A. (2017, April 20). *Cities Seek Deliverance From the E-Commerce Boom*. Retrieved from City Lab: <https://www.citylab.com/transportation/2017/04/cities-seek-deliverance-from-the-e-commerce-boom/523671/>
- Zalewski, A. J., Buckley, S., & Weinberger, R. (2011). *Regulating Curb Space - Developing a Framework to Understand and Improve Curbside Management*. TRID. Retrieved from <http://libraryarchives.metro.net/DPGTL/studies/2011-regulating-curb-space.pdf>

APPENDIX A

Data Collection Form

<u>Delivery Location, Date, Time</u>	<u>Commercial Vehicle Characteristics</u>	<u>Exiting/Entering Vehicle Behavior</u>	<u>Accessory Used & Accessory Path</u>	<u>Courier Path to Access Cargo – Movements Described Around Commercial Vehicle</u>	<u>Delivery Characteristics & Goods Described</u>	<u>Courier Behavior in Response to Built Environment</u>
<i>Location</i>	<i>Delivery Company</i>	<i>Vehicle Exit/Enter Points</i>	<i>Accessory Used</i>		<i>Number of Courier</i>	<i>Description of Unique Movements Observed</i>
<i>Date</i>	<i>Vehicle Classification</i>		<i>Accessory Path</i>		<i>Goods Described</i>	
<i>Time</i>	<i>Driver & Passenger Entry/Exit Door Type</i>					
	<i>Cargo Compartment Door Location</i>					
	<i>Cargo Door Type</i>					

APPENDIX B




































Class 1 Motorcycles		Class 7 Four or more axle, single unit	
Class 2 Passenger cars		Class 8 Four or less axle, single trailer	
			
			
			
Class 3 Four tire, single unit		Class 9 5-Axle tractor semitrailer	
			
			
Class 4 Buses		Class 10 Six or more axle, single trailer	
			
		Class 11 Five or less axle, multi trailer	
Class 5 Two axle, six tire, single unit		Class 12 Six axle, multi-trailer	
			
		Class 13 Seven or more axle, multi-trailer	
Class 6 Three axle, single unit			
			
			
			

Figure 16 USDOT FHWA Truck Classes (USDOT FHWA, 2014)

APPENDIX C

C.1 Pioneer Square, Seattle, WA 98104

Delivery Location, Data, and Time

Delivery Coordinates	47.601521, -122.331742
Delivery at Yellow Curb	Yes
Observation Date & Time	Friday, November 17, 2017 9:00 – 10:00 AM

Commercial Vehicle Characteristics

This is a beverage delivery company named Columbia Distributing. This is a Class 5 truck.

This truck has a swing out door on both the driver and passenger side of the vehicle. The cargo compartment is at the back end of the truck and was a manual roll up door and an automatic lift.

Figures 17 and 18 exemplify the truck characteristics of the observed delivery.



Figure 17 Lift Gate Operations (Sheth, 2017-2018)

Exiting/Entering Commercial Vehicle Behavior

There was a courier driver and courier involved in this delivery. The courier driver exited from the driver side and the courier exited from the passenger side. The driver side was against a protected bike lane, the passenger side was adjacent to a transit lane.

Accessory Used and Accessory Path

Two hand trucks and a pallet jack were used in this delivery. Each hand truck was loaded within the truck with large barrels. The courier checked the delivery while standing on the automatic

lift. Both couriers pulled the hand trucks and pallet jack from the automatic lift along the parking lane onto the nearest crosswalk and then used the sidewalk ramp. As one of the hand trucks was pulled up on the sidewalk ramp, the slope from the ramp and the street in the general pushed one of the barrels into the transit lane. One of the couriers stabilized the hand truck while the other courier ran into the transit lane, stopped traffic, and rolled the barrel back to the sidewalk.

After making the deliveries, they cut through the sidewalk with the empty hand trucks to quickly reach the truck. This meant cutting through the bike lane as well. At the end of the delivery, one of the couriers stood on the manual lift with all three accessories and stored them in the cargo compartment.

Courier Path to Access Cargo – Movements Described Around Commercial Vehicle

Two deliveries were made from this location. The courier walked along the passenger side of the truck and the courier driver walked along the driver side of the truck to the back-end of the truck and operated the automatic lift. The first delivery was not captured in detail.

For the second delivery, once the lift was down, the passenger courier got on the lift, organized the barrels inside of the truck onto the hand trucks and pallet jack, and pulled them along the parking lane behind the truck over to the crosswalk and up the sidewalk ramp. They then followed the sidewalk and other crosswalks to their customers.

When they returned with the empty accessories, they crossed the bike lane from the curb. The driver courier went to the driver seat and the passenger courier loaded the accessories back into the cargo compartment and closed the automatic lift. He did this while standing in the adjacent transit lane. This action can be seen in Figure 17. He then walked in the transit lane to the passenger seat.

Delivery Characteristics and Goods Described

There were two couriers who made this delivery. One of the couriers was also the driver, and is referred to as the courier driver. The other courier was the passenger. Large metal barrels of beverages were delivered. These are large bulky items that required the automatic lift, hand trucks, a pallet jack, and easy access to a sidewalk ramp.



Figure 18 Lift Gate Engaged (Sheth, 2017-2018)

Courier Behavior in Response to Built (street, road, and land use characteristics) Environment

This delivery took place in Downtown Seattle, which is mainly mixed-use, commercial, and residential. This delivery involved delivering heavy, bulky goods. The automatic lift extended beyond the designated CVLZ and the space behind the CVLZ was used to transport the goods to the crosswalk and then to the sidewalk ramp. The couriers benefited from having the empty space behind them for the loading and unloading activities.

The angle of the sidewalk ramp and street itself made it challenging to push the hand truck up onto it while balancing the heavy goods on the hand truck.

The courier who sat on the passenger side had to wait for traffic in the adjacent transit lane to subside before entering and exiting his seat. He also stood in the transit lane while operating the automatic lift.

C.2 710 2nd Ave, Seattle, WA 98104

Delivery Location, Date, and Time

Delivery Coordinates	47.603352, -122.333357
Delivery at Yellow Curb	Yes
Observation Date & Time	Friday, November 17, 2017 10:00 – 11:00 AM

Commercial Vehicle Characteristics

A FedEx delivery truck was observed at this location. This is a Class 5 truck.

The driver and passenger door is a sliding door, and was open and shut upon entry and egress of the truck. The truck design included cargo compartments at the back end of the truck with two doors that opened out.



Figure 19 FedEx Delivery Hand Truck Space (Sheth, 2017-2018)

Exiting/Entering Commercial Vehicle Behavior

This delivery had a courier driver and courier. They both exited from their respective driver and passenger side sliding doors.

Accessory Used and Accessory Path

For this delivery, a 2-way convertible hand truck has been used. This 2-way convertible hand truck was stored in the cargo compartment and placed on the pavement next to the back end of the truck while the courier sorted parcels and loaded this hand truck. The courier had left enough

spaced between the truck and the hand truck to stand in between them with enough room to maneuver between the cargo compartment and loading the hand truck. There were a few deliveries made from this delivery point, and the 2-way convertible hand truck followed the courier from the back end of the vehicle around to the driver side of the vehicle, crossed two-way protected bike lanes and perched up onto the sidewalk.

Courier Path to Access Cargo – Movements Described Around Truck

There were two couriers who each exited from the driver and passenger side of the truck. The courier driver walked along the driver side to the back end of the truck where the cargo compartment is and the other courier walked along the passenger side of the truck and met the courier driver at the back end of the truck next to the cargo compartment.

The cargo compartment doors were open two doors out, and the 2-way convertible hand truck was taken out and placed behind couriers. While standing at the back end of the delivery truck, the couriers sorted packages and loaded one hand platform dolly.

The courier driver took the hand platform dolly from the back end to the driver side of the truck and cut the curb to access the sidewalk using the shortest route possible. The courier hand carried a parcel across the street to another building. She walking along the parking lane and then used the crosswalk to cross.

There were multiple deliveries made from this delivery point. The larger deliveries used the 2-way convertible hand truck and followed the path described. The smaller deliveries were hand carried and made while the 2-way convertible hand truck was kept out on the street behind the back end of the vehicle. This can be seen in Figure 19.

Delivery Characteristics and Goods Described

There were two couriers associated with this delivery. They worked together to make multiple deliveries at the same time, but to different buildings. Parcels of varying sizes were delivered by a hand platform dolly or simply by hand.

These parcels could be categorized as small, medium, and large sized items. Large bulky items were transported used the hand platform dolly.

Courier Behavior in Response to Built (street, road, land use characteristics) Environment

This delivery took place in Downtown Seattle which is mainly mixed use and includes a high density of office space. This delivery point occurred at a CVLZ along a renovated street that includes two bike lanes flush against the curb space, a buffer between the bike lane and the CVLZ and Passenger Vehicle Load Zones, and three transit lanes adjacent to the delivery point. The couriers had a generous amount of space behind the delivery to manage the deliveries, and this is where parcels were sorted and unloaded from the truck. The courier driver who used the 2-way convertible hand truck did cut through the buffer lane and bike lanes in order to access the curb. He cut through the curb and momentarily obstructed the bike lane while doing this.

C.3 999 Third Ave, Plaza 18, Seattle, WA 98104

Delivery Location, Date, and Time

Delivery Coordinates	47.604816, -122.334716
Delivery at Yellow Curb	Yes
Observation Date & Time	Friday, November 17, 2017 10:00 – 11:00 AM

Commercial Vehicle Characteristics

The observed delivery vehicle was a FedEx Office vehicle. This is a Class 3 vehicle that resembles a van more than it resembles a truck, and can be seen in Figure 20.



Figure 20 FedEx Office Van Delivery Vehicle

The driver and front passenger doors were both a swing out door. There was a second passenger door behind the front passenger side that was a sliding door. The back end of the vehicle had two swing out doors.

Exiting/Entering Commercial Vehicle Behavior

The courier driver exits and enters the commercial vehicle from the driver side. The door swings out next to a bicycle buffer lane, which the courier walked on.

Accessory Used and Accessory Path

No accessories were used to facilitate this pick-up.

Courier Path to Access Cargo – Movements Described Around Commercial Vehicle

The courier driver exited from the driver side and cut through the bike buffer lane and bike lanes adjacent to the driver side to quickly access the sidewalk. He eventually returned from his customer with a small parcel, cut through the bike lanes and bike buffer lane and stood behind the back-end of the truck and waited for flowing traffic in the transit lane next to the passenger side to subside. Figure 21 depicts the courier in the act of waiting at the back end of his vehicle with his customer's parcel for the traffic in the transit lane to subside.

After the traffic subsided, he walked from the back-end of the vehicle around to passenger side and placed the parcel in the back passenger compartment using the sliding. He then walked

around the front-end of the vehicle over to the driver door, opened the door, sat inside, and drove off.



Figure 21 Courier of observed delivery waiting for traffic in adjacent transit lane to subside (Sheth, 2017-2018)

Delivery Characteristics and Goods Described

There was one driver who was also the courier for this delivery. The courier did not make a delivery, but instead, was at this location to complete a pick-up of a large, flat parcel from a customer.

Courier Behavior in Response to Built (street, road, and land use characteristics) Environment

The courier driver did cut across the bike buffer lane, bike lanes, and onto to the sidewalk when he both temporarily left his vehicle and when he returned, instead of using the cross walk.

Cutting through the bike infrastructure was a shorter route to the sidewalk than if he had used the crosswalk.

It is interesting to note that he chose to wait for the traffic in the adjacent transit lane to subside so that he could safely access the back passenger sliding door instead of choosing to place the parcel in the cargo compartment located in the back-end of the vehicle. There must be a method of organizing his items inside the various cargo compartments.

C.4 1023 1st Ave. Seattle, WA 98104

Delivery Location, Date, and Time

Delivery Coordinates	47.605209, -122.336867
----------------------	------------------------

Delivery at Yellow Curb	Yes
Observation Date & Time	Friday, November 17, 2017 11:00 - 12 PM

Commercial Vehicle Characteristics

This was a vehicle making deliveries on behalf of Amazon. This vehicle resembled a van more than a truck. This is a Class 3 vehicle. Figure 22 shows the observed delivery vehicle.

The driver and front passenger doors are both swing out doors. There were two doors on the passenger side of the vehicle, the first one in front was swing out, and the second was with a sliding door. There was also a cargo compartment at the back end of the vehicle with two doors that open out.



Figure 22 Observed Amazon Commercial Vehicle (Sheth, 2017-2018)

Exiting/Entering Commercial Vehicle Behavior

The courier driver waited in the vehicle before carefully exiting the vehicle after vehicular traffic in the adjacent transit lane subsided. In this example, the parking lane also serves as a transit lane.

Accessory Used and Accessory Path

This commercial parked in a strategic location, because the courier made multiple deliveries to different customers in the area from this location. For some of the deliveries, a hand truck was used to facilitate the delivery.

The hand truck was taken out from the cargo compartment located on the back end of the truck and was observed operating directly on the sidewalk. The courier driver made a couple of his deliveries walking along the sidewalk. The courier driver placed the hand truck behind the back end of the cargo compartment, opened the cargo doors, folded the hand truck, and placed it in the back cargo compartment. For the smaller deliveries, the courier driver made hand deliveries.

Courier Path to Access Cargo – Movements Described Around Commercial Vehicle

During the observation period, the courier driver had walked from the back end of the cargo compartment to the sliding door to access the cargo from the back passenger side. He stood on the sidewalk with loading the hand truck next to him with parcels. For his last delivery, he returned to the sidewalk next to the delivery vehicle with a parcel and placed it on the floor of the front passenger area.

Delivery Characteristics and Goods Described

This delivery included one driver who was also the courier. All goods delivered were small or medium sized packages. This made it easy for the courier driver to organize and load his hand truck, or make some deliveries by hand.

Courier Behavior in Response to Built (street, road, and land use characteristics) Environment

This delivery took place in Downtown Seattle, which is mainly mixed-use, residential, and commercial. The courier was observed mainly keeping to the sidewalk, and it was a place of refuge for the courier to comfortably load his hand truck or take longer about decision making regarding his deliveries. The courier decided to cut through the curb instead of using the curb ramp very close to the truck. The parking lane was also a transit lane, so the courier driver waited for traffic to subside before entering or exiting the driver seat.

C.5 4201 University Way NE, Seattle, WA 98105

Delivery Location, Date, and Time

Delivery Coordinates	47.658428, -122.313321
----------------------	------------------------

Delivery at Yellow Curb	No
Observation Date & Time	Wednesday, December 13, 2017 12:14 – 12:29 PM

Commercial Vehicle Characteristics

A vehicle making Amazon deliveries was observed at this location. This is a Class 5 truck.

Figure 23 depicts the observed delivery vehicle. This vehicle has two side doors, one for the driver and passenger respectively. The door types are swing out doors. The cargo compartment is located in the back end of the truck, and has a manual roll up cargo door.



Figure 23 Observed Amazon Delivery Truck (Sheth, 2017-2018)

Exiting/Entering Commercial Vehicle Behavior

The courier driver was observed exiting from the driver side. Before exiting the vehicle, the courier driver was observed holding the door ajar and waiting from the driver seat for oncoming traffic to subside before exiting the vehicle. When oncoming traffic ceased for a moment, he stepped into the road and walk over to the back end of truck. At the end of the delivery, he placed the accessory back into the cargo compartment, walked on the road to access the driver side of the vehicle.

Accessory Used and Accessory Path

The accessory used for this delivery was a hamper. The hamper was stored in the cargo compartment, and was then placed behind the cargo compartment on the road. There was no

assembly or disassembly required. The hamper simply sprung into shape. The hamper stayed behind the vehicle while the courier driver stepped into the cargo compartment and organized parcels and placed them into the hamper from the inside of the cargo compartment.



Figure 24 Hamper (Accessory Used) Outlined in Yellow (Sheth, 2017-2018)

Courier Path to Access Cargo – Movements Described Around Commercial Vehicle

The courier driver exited the vehicle from the driver side and walked into the road and toward the cargo compartment. The courier driver stepped onto the ledge under the cargo compartment to roll up the cargo door. The courier driver retrieved the hamper from inside the cargo compartment and placed it onto the roadway, as seen in Figure 24. After organizing parcels from inside the cargo compartment and placing parcels in the hamper, the courier driver then stepped out next to the hamper to pull down and securely shut the cargo compartment. Then, the courier driver placed the hamper over his shoulder and walked across the street without using the crosswalk. After making the delivery, he returns to the cargo compartment, rolls it up, places the empty hamper back inside, and rolls down the cargo door to close it.

Delivery Characteristics and Goods Described

This delivery included one driver who was also the courier. All goods delivered were small or medium sized packages that fit inside the hamper.

Courier Behavior in Response to Built (street, road, and land use characteristics) Environment

For this delivery, the courier driver parked in a restricted parking area. It was restricted because of the presence of a fire hydrant on the curb adjacent to where he parked. The curb space behind the parked vehicle is available for other vehicles to legally park. A passenger vehicle is seen legally parked in Figure 24, while the observed truck is not legally parked.

Though there was a crosswalk next to the parked delivery vehicle, the driver/courier only used it when the pedestrian signal was on. Otherwise, he jaywalked across the street with the parcels, or ran through the street when he forgot his scanner. The courier shared that Amazon is using hampers to make deliveries and rarely uses hand trucks.

C.6 4311 University Way NE, Seattle, WA 98105 (Back Door - Alley Delivery)

Delivery Location, Date, and Time

Delivery Coordinates	47.660081, -122.313721
Delivery at Yellow Curb	No
Observation Date & Time	Wednesday, December 13, 2017 12:32 – 12:50 PM

Commercial Vehicle Characteristics

A Sysco refrigerated delivery vehicle was observed during this delivery. This is a Class 5 vehicle. Figure 25 depicts the observed commercial vehicle. The driver and passenger doors are swing out doors. The cargo compartment has a roll up door.



Figure 25 Observed Sysco Vehicle, Ramp Engaged (Sheth, 2017-2018)

Exiting/Entering Commercial Vehicle Behavior

The courier driver exited the vehicle from the driver side of the vehicle. After parking, he kept his door open, walking to the back of the vehicle to check his parking, and then returned to the driver side door to close it. He then walked from the driver door to the back end of the truck to the cargo compartment. After the delivery was completed, the courier driver returned the accessories, closed the cargo compartment, returned to the driver side, and departed.

Accessory Used and Accessory Path

The courier driver used a ramp and a hand truck for this delivery. To extend the ramp, the courier driver first lifted up the cargo compartment door slightly in order to access the ramp extension. He then stood on to one side of the ramp and pulled the ramp out of its compartment, while walking backwards next to it. The courier's stance in relation to the ramp is exemplified in Figure 26. After extending the ramp, he walked up the newly extended ramp, and completely rolled up the cargo compartment door. These movements can be seen in Figure 27.

A hand truck was also used for this delivery. The hand truck was stored in the cargo compartment, and was then rolled down the ramp and around to the customer. Please see Figure 28 for an image of the hand truck being rolled down the ramp.

Multiple deliveries were made to the same customer using the hand truck and ramp. At end of the deliveries, the hand truck was placed back inside the cargo compartment and the ramp was collapsed back into its compartment.



Figure 26 Courier Completes Extending Ramp and its Placement (Sheth, 2017-2018)



Figure 27 Courier Fully Rolling Up and Lifting Cargo Compartment (Sheth, 2017-2018)



Figure 28 Courier Using Ramp to Deliver Goods using the Ramp and Hand Truck (Sheth, 2017-2018)

Courier Path to Access Cargo – Movements Described Around Commercial Vehicle

The courier driver had accessed the cargo by exiting the driver side of the vehicle, walking to the back end of the cargo compartment, slightly lifting the cargo compartment door, pulling out the ramp, walking up the ramp, completely lifting the cargo compartment door, and then enters the cargo compartment to organize the goods. He used the cargo compartment to review his inventory list, organize goods, and load the hand truck.

After organizing the goods and loading the hand truck, he walks it down the ramp. When exiting the ramp with the hand truck, additional space required to turn the hand truck is noted. The additional space required after the ramp has been extended is depicted in Figure 29.



Figure 29 Additional Space Required to Maneuver Hand Truck (Sheth, 2017-2018)

Delivery Characteristics and Goods Described

This delivery included one driver who was also the courier. Goods delivered were all parcels containing items required by the customer.

Courier Behavior in Response to Built (street, road, and land use characteristics) Environment

Please note that this observation took place in an alley. Therefore, these activities occurred in a more controlled environment in which the courier driver felt comfortable extending his ramp without having full visibility of activities occurring in blind spots. He may have made different movement choices if this delivery occurred at a curb. However, the use of the ramp limited areas at which the ramp could be deployed, and an alley was one of the places at which the ramp could be extended.

C.7 4201 University Way NE, Seattle, WA 98105

Delivery Location, Date, and Time

Delivery Coordinates	47.658428, -122.313321
Delivery at Yellow Curb	No
Observation Date & Time	Wednesday, December 13, 2017 1:23 PM – 1:45 PM

Commercial Vehicle Characteristics

The observed commercial vehicle is a beverage vehicle for Coca-Cola. This is a Class 5 vehicle.

It has six cargo compartments on the driver and passenger side of the vehicle each. Figure 30 exemplifies the location of the cargo compartments, which have been outlined blue, and design of the vehicle. Each of the cargo compartments are roll up cargo doors.

The driver and passenger doors were swing out doors.



Figure 30 Coca Cola Delivery Vehicle (Sheth, 2017-2018)

Exiting/Entering Commercial Vehicle Behavior

The parking and exiting of the vehicle was not captured in this observation. Upon returning to the vehicle, the courier driver walked along the sidewalk lining the passenger side and walked in front of the vehicle to the driver side. The crosswalk was not used, even though it was adjacent to the parked vehicle.

Accessory Used and Accessory Path

The accessory used for this delivery is a hand truck. The item was removed from the open cargo compartment on the passenger side as seen in Figure 31. It was then placed on the sidewalk adjacent to the vehicle and loaded. The courier driver then walked along the sidewalk to the customer. The courier driver returned with the hand truck along the same sidewalk and was placed back into the open compartment seen in Figure 31.

Courier Path to Access Cargo – Movements Described Around Commercial Vehicle

The courier driver was not fully observed when he first accessed the cargo. To unload and load the hand truck and beverage crates, the courier driver stood on the sidewalk while comfortably accessing the cargo. His stance did not block pedestrians, and can be seen in Figure 31.



Figure 31 Courier Driver Accessing Cargo Compartments (Sheth, 2017-2018)

Delivery Characteristics and Goods Described

This delivery included one driver who was also the courier. The items delivered are Coca-Cola beverages in small crates.

Courier Behavior in Response to Built (street, road, and land use characteristics) Environment

This delivery took place in the University District of Seattle, which is mixed use and includes a mixture of restaurants, cafes, and specialty stores and residential units. This vehicle is parked illegally next to a fire hydrant.

Adjacent to the observed commercial vehicle is a vehicle lane without any clear pavement marking separating the function and space of the delivery from the adjacent vehicle lane. For this delivery, the courier driver is able to comfortably and safely access the cargo compartments from the sidewalk. The same sidewalk is used to make the delivery and return as well, which limits the driver/courier's exposure to more dynamic elements on the road. Though a crosswalk was present next to the driver and passenger doors, the courier driver was observed not using it to access the driver side.

C.8 1201 NE Campus Pkwy, Seattle, WA 98105

Delivery Location, Date, and Time

Delivery Coordinates	47.655937, -122.315042
Delivery at Yellow Curb	Yes
Observation Date & Time	Wednesday, December 13, 2017 1:57 PM – 2:18 PM

Commercial Vehicle Characteristics

The observed vehicle is an OnTrac delivery van. This is a Class 3 vehicle. This commercial vehicle has swing out driver, passenger, and cargo doors. It is unclear if the passenger door on the passenger is a sliding door or a swing out door, and could not be confirmed because it was not used during the delivery. The cargo compartment that was used was on the back end of the vehicle, and had two swing out cargo doors. Please see Figure 32 for a visual aid for this observed delivery.



Figure 32 OnTrac Observed Delivery Vehicle with Extended Cargo Doors (Sheth, 2017-2018)

Exiting/Entering Commercial Vehicle Behavior

The courier driver exited from the driver side of the vehicle, into the street, and around to the cargo compartment located at the back end of the vehicle. There were no vehicles on the transit lane adjacent to the courier driver's exit point. After the delivery was complete, he looked to see if there was any oncoming traffic, and went to the driver side using the transit lane when it was clear of traffic.

Accessory Used and Accessory Path

A large bin on wheels was used for this delivery. It is interesting to note that the bin was provided by the high density building that was receiving the parcels. In this case, this building is a dorm (Lander Hall) at the University of Washington. The bin was rolled onto the sidewalk from the building and stayed on the curb while it was loaded with parcels. The bin was then rolled back to the building on that same block. The building was adjacent to the parked delivery vehicle, and therefore, no crosswalks were utilized or roads crossed. Figure 33 exemplifies the bin used for this delivery.



Figure 33 Accessory for this Delivery - Bin on Wheels (Sheth, 2017-2018)

Courier Path to Access Cargo – Movements Described Around Commercial Vehicle

The courier driver exited the vehicle from the driver side and briefly walked into the adjacent transit lane in order to access the cargo compartment on the back end of the vehicle. He stood behind the vehicle and opened out the cargo doors at a 90° angle. He stood inside the cargo compartment and consolidated and scanned the parcels that needed to be delivered. During this time, he called the building and requested for someone to come meet him with the bin. Once the delivery items were consolidated, he stepped onto the road behind the vehicle and continued managing his deliveries and using his scanner.

When the bin arrived, he pushed the right cargo door all the way back and around so that he could easily load the bin with the consolidated parcels. The right side of the cargo door can be seen as such in Figure 33. The driver/courier stood on the road while loading the bin with parcels.

Delivery Characteristics and Goods Described

This delivery included one driver who was also the courier. The items delivered were parcels of all sizes. Figure 34 exemplifies the size of parcels the driver/courier was organizing and delivering.



Figure 34 Parcels Being Organized and Scanned Within the Cargo Compartment (Sheth, 2017-2018)

Courier Behavior in Response to Built (street, road, and land use characteristics) Environment

This delivery took place at the University of Washington, and the building unit it was delivered to was a dormitory. The recipient worked at the dorm and was aware that she must bring a bin to receive the large volume of deliveries to the dorm.

The commercial vehicle was parked at a CVLZ that was a part of a curb cutout. When the driver first arrived, he had to park at a “No Parking” zone because a passenger vehicle was dwelling in the CVLZ, however, once the passenger vehicle left, he moved his vehicle to the CVLZ. The courier driver was observed looking for traffic to clear before exiting/entering his vehicle because he had to swing his door open and walk into a transit lane.

C.9 415 Pine St, Seattle, WA 98101

Delivery Location, Date, and Time

Delivery Coordinates	47.611515, -122.336741
Delivery at Yellow Curb	No
Observation Date & Time	Wednesday, December 27, 2017 11 AM – not captured

Commercial Vehicle Characteristics

A UPS delivery truck was observed during this delivery. This is a Class 5 vehicle.

This vehicle type has sliding driver and passenger doors and a roll up cargo compartment at the back end of the vehicle. Figure 35 exemplifies the cargo compartment location and type.



Figure 35 Observed UPS Vehicle - Cargo Compartment at Back End (Sheth, 2017-2018)

Exiting/Entering Commercial Vehicle Behavior

The courier driver first slid the passenger door open, pulled in the rear view mirror on the passenger side, and then exited out of the vehicle from the passenger side to the back end of the vehicle. The vehicle was parked on a one-way road that is pedestrian and vehicle heavy. The driver was vigilant while exiting the vehicle from the passenger side into the transit lane adjacent to it. The courier driver was not observed returning to his vehicle.

Accessory Used and Accessory Path

Two 2-way convertible hand truck were used for this delivery, but only one was used at a time, as there were multiple rounds of deliveries from this location. These 2-way convertible hand trucks were stored inside the cargo compartment, and they were placed behind the vehicle on the bulb out portion of the sidewalk.

During the observed delivery, the hand trucks were kept on the sidewalk they were already on to complete the deliveries. Depending on the needs of that particular round of deliveries, the courier driver would pick one of them that best suited his needs, and placed the other one back.



Figure 36 2-Way Convertible Hand rucks Used in Delivery (Sheth, 2017-2018)

Courier Path to Access Cargo – Movements Described Around Commercial Vehicle

During the observed rounds of delivery, the courier driver was mainly operating inside the cargo compartment or on the bulb-out portion of the sidewalk. He organized and scanned parcels from inside the cargo compartment. He brought out the two 2-way convertible hand truck and placed them onto the sidewalk, so that he could make more room to organize the parcels inside the cargo compartment. Once he had organized and scanned the parcels, he stood on the bulb-out portion of the sidewalk and loaded a hand truck. He then placed the hand truck not in use back in the cargo compartment before walking along the sidewalk to the customer. During the observed portion of the delivery, the courier driver had followed the same route from cargo compartment, to bulb-out, and from sidewalk to customer three times.

Delivery Characteristics and Goods Described

This delivery included one driver who was also the courier. The items delivered and returned to the courier driver are parcels of all sizes and weight.

Courier Behavior in Response to Built (street, road, and land use characteristics) Environment

This delivery was observed next to the Westlake Link Light Rail Station, in a highly commercial area. This area experiences a lot of vehicular and pedestrian traffic. The courier driver parked at a 3-minute passenger load and unload zone, but was there for at least one hour. All deliveries were not completed, as he was expecting to operate from that spot for many hours.

The curb-cut design of the passenger load/unload zone also facilitates a type of bulb-out of the sidewalk. This bulb-out was observed to be very convenient for the driver/courier, because when he operated behind the vehicle, he was simply standing on the bulb-out portion of the sidewalk. There were newspaper stands on the sidewalk adjacent to the delivery vehicle. Though this was not significantly obstructive, it was noted to be quite close to the vehicle as seen in Figure 37.



Figure 37 Newspaper Stand Adjacent to Observed Delivery Vehicle (Sheth, 2017-2018)

C.10 415 Pine St, Seattle, WA 98101

Delivery Location, Date, and Time

Delivery Coordinates	47.611469, -122.336854
Delivery at Yellow Curb	No
Observation Date & Time	Wednesday, December 27, 2017 11:30 AM – 12 PM

Commercial Vehicle Characteristics

The observed vehicle was a LOOMIS vehicle. This is a Class 5 vehicle. The driver and passenger vehicle are swing out doors. The cargo compartment was located at the back end of the vehicle and was also a swing out cargo door. Figure 38 exemplifies the design of the observed delivery vehicle.



Figure 38 Observed LOOMIS Delivery Vehicle (Sheth, 2017-2018)

Exiting/Entering Commercial Vehicle Behavior

There was a driver and courier involved in this delivery. The courier sitting on the passenger side pulled in the rear view mirror on the passenger side, open the door, and exited out into the transit lane. He walked along the road, and then got on to the sidewalk. The driver did not exit the vehicle.

Accessory Used and Accessory Path

LOOMIS is a cash handling company. For the observed delivery, there were not delivery accessories used. The courier hand delivered the item.

Courier Path to Access Cargo – Movements Described Around Commercial Vehicle

The courier had the delivery item with him when he exited the passenger side of the vehicle. Therefore, he was not observed accessing any other compartments or equipment. The courier walked along the passenger side of his parked vehicle and the other vehicles behind him, even though a transit lane was present adjacent to him. He walked against the flow of traffic, and therefore had good visibility of activity in the transit lanes. He eventually joined the sidewalk visible in Figure 38. The courier was not observed re-entering his vehicle upon departure.

Delivery Characteristics and Goods Described

There were two people involved in this delivery, one driver and one courier. The goods being hand delivered was money in a bag.

Courier Behavior in Response to Built (street, road, and land use characteristics) Environment

This delivery was observed next to the Westlake Light Rail Station, in a highly commercial area.

This area experiences a lot of vehicular and pedestrian traffic. The driver parked at a 3-minute passenger load and unload zone. The courier exited the vehicle into the transit lane next to him and proceeded to walk along the transit lane instead of accessing the nearby sidewalk sooner.

C.11 600 Pine St, Seattle, WA 98101

Delivery Location, Date, and Time

Delivery Coordinates	47.612408, -122.334955
Delivery at Yellow Curb	No
Observation Date & Time	Wednesday, December 27, 2017 12:13 PM – 12:30 PM

Commercial Vehicle Characteristics

The observed vehicle is a FedEx delivery truck. This is a Class 5 vehicle. This vehicle has sliding driver and passenger doors. The cargo compartment is located at the back end of the vehicle and has a roll up cargo door. Figure 39 exemplifies the observed vehicle and its design features.



Figure 39 Observed FedEx Delivery Vehicle (Sheth, 2017-2018)

Exiting/Entering Commercial Vehicle Behavior

The courier driver slid open the passenger door, but did not exit through it. After that, he rolled up the cargo compartment door from the inside of the cargo compartment itself. He exited from

the cargo compartment, and closed the cargo compartment. He stepped over on to the sidewalk seen in Figure 39. When the courier driver completed picking up returns and making deliveries, he returned to his vehicle through the passenger side of the vehicle.

Accessory Used and Accessory Path

No accessories were used in this delivery. All items were hand carried.

Courier Path to Access Cargo – Movements Described Around Commercial Vehicle

The courier driver was observed exiting the vehicle from the cargo compartment. He had a parcel with him and hand delivered it. He returned to the back end of the cargo compartment with a return, placed it in the cargo compartment, picked-up another parcel to delivery and hand carried it. He did cross any roads or use any crosswalks. All of his deliveries and returned occurred at the buildings on the sidewalk adjacent to him.

Delivery Characteristics and Goods Described

This delivery included one driver who was also the courier. A couple of small parcels were hand carried to the customer or brought back as a return.

Courier Behavior in Response to Built (street, road, and land use characteristics) Environment

This delivery was observed on a commercial street off of the Westlake Light Rail Station. This area experiences a lot of vehicular and pedestrian traffic. The driver/courier parked at a 3-minute passenger load and unload zone. It was interesting to observe that he entered his vehicle through the passenger side, the side of the vehicle closest to the sidewalk and curb.

C.12 500 Olive Way, Seattle, WA

Delivery Location, Date, and Time

Delivery Coordinates	47.612922, -122.336969
Delivery at Yellow Curb	No
Observation Date & Time	Wednesday, December 27, 2017 1:36 PM – not captured

Commercial Vehicle Characteristics

This vehicle was deployed to make a delivery, but the company affiliation is not clear. This is a Class 3 vehicle. The driver and passenger doors are swing out. The cargo compartment is located at the back end of the vehicle and has two open out doors. The second door on the passenger side is a sliding door.



Figure 40 Observed Vehicle (Sheth, 2017-2018)

Exiting/Entering Commercial Vehicle Behavior

The courier driver is observed exiting from the driver side of the vehicle onto the sidewalk. His return to the vehicle was not observed or captured.

Accessory Used and Accessory Path

A hand truck and bins were used in this delivery. These accessories were stored in the second passenger compartment. These accessories were pulled out and placed onto the road space adjacent to the second passenger door. The placement of these accessories can be seen in Figure 41. The bins and goods were loaded on to the hand truck on the roadway and then pull around next to the back end of the vehicle and onto the sidewalk.



Figure 41 Accessories Used and Placement (Sheth, 2017-2018)

Courier Path to Access Cargo – Movements Described Around Commercial Vehicle

The courier driver had exited from the driver side of the vehicle onto the sidewalk. He then walked around the back end of the vehicle over to the second passenger door. He stood next to the second passenger cargo compartment, and at times, strayed into the adjacent transit lane. Figure 42 displays some of his movements next to the passenger cargo compartment. After loading the hand truck with a large parcel and two bins, he walks around the back end of the vehicle with the hand truck and onto the sidewalk. His return to the vehicle was not captured.



Figure 42 Driver/Courier Observed in Adjacent Transit Lane (Sheth, 2017-2018)

Delivery Characteristics and Goods Described

This delivery included one driver who was also the courier. Mainly smaller parcels were being delivered.

Courier Behavior in Response to Built (street, road, and land use characteristics) Environment

This delivery took place in Downtown Seattle next to the Westlake Station. This area is mix of commercial and office space. The courier driver chose to park at a 3-minute passenger load/unload zone. Though he was parked for at least 20 minutes. This is a one way, three lane street. One lane is mainly allocated to parking, the second is a transit lane, and the third is a bus only and bike lane. The courier driver was observed using a substantial amount of space in the adjacent transit lane while loading the hand truck. This is generally a highly congested area and the courier driver’s actions are high risk. Figure 43 exemplifies the extent to which the courier operated in the adjacent transit lane.



Figure 43 Courier Operating in Adjacent Transit Lane (Sheth, 2017-2018)

C.13 1601 5th Ave #100, Seattle, WA 98101

Delivery Location, Date, and Time

Delivery Coordinates	47.612450, -122.337761
Delivery at Yellow Curb	Yes
Observation Date & Time	Wednesday, December 27, 2017 1:45 PM – not captured

Commercial Vehicle Characteristics

The observed delivery vehicle was a FedEx Ground vehicle. This is a Class 5 vehicle.

The driver and passenger doors are open out doors. The cargo compartment is located at the back end of the vehicle, and has a roll up cargo compartment. Figure 44 exemplifies the design of the observed vehicle.



Figure 44 Observed FedEx Ground Vehicle (Sheth, 2017-2018)

Exiting/Entering Commercial Vehicle Behavior

The courier driver's movements exiting/entering the vehicle were not captured. However, it is presumed because of the design of the vehicle that the courier driver exited from the driver side of the vehicle and was exposed to the adjacent transit lane during the entering/exiting process.

Accessory Used and Accessory Path

The accessory used in this delivery is a 2-way convertible hand truck. During the observed delivery, the courier driver was managing returns. He had walked along the sidewalk and placed the hand truck next to the cargo compartment on the sidewalk. The courier driver would stand on the road behind the cargo compartment and kept the hand truck on the sidewalk. The placement of the hand truck in relation to the cargo compartment and courier driver can be seen in Figure 45.



Figure 45 2-Way Convertible Hand Truck Placed and Accessed on Sidewalk (Sheth, 2017-2018)

Courier Path to Access Cargo – Movements Described Around Commercial Vehicle

At the time of the observed delivery, the courier driver was observed transporting parcels to and from the cargo compartment using the hand truck. He stood behind the cargo compartment on the road in order to access and manage the parcels. The 2-way convertible hand truck stayed on the sidewalk next to the cargo compartment. The courier driver can be seen managing his parcels in Figure 46. During the time of observation, two delivery sessions were completed by the one courier driver.



Figure 46 Courier Driver Managing Parcels (Sheth, 2017-2018)

Delivery Characteristics and Goods Described

This delivery included one driver who was also the courier. Parcels of all sizes and dimensions were being returned or delivered to the cargo compartment.

Courier Behavior in Response to Built (street, road, and land use characteristics) Environment

The courier driver was parked at a CVLZ. He mainly use the sidewalk to place his deliveries and organize the hand truck. He was behind the cargo compartment for many minutes at a time, however, he seemed comfortable. This may be because there was no additional parking spaces behind the cargo compartment. Therefore, there was no possibility of another vehicle coming and parking close behind the cargo compartment.

C.14 1628 5th Ave, Seattle, WA 98101

Delivery Location, Date, and Time

Delivery Coordinates	47.612724, -122.337128
Delivery at Yellow Curb	No
Observation Date & Time	Wednesday, December 27, 2017 1:50 PM – 1:07 PM

Commercial Vehicle Characteristics

The observed vehicle is a Certified Folder Display Service, Inc. delivery van. This is a Class 3 vehicle. The driver and passenger doors are open out doors. The second passenger door is a slide open door. The trunk of the vehicle has a lift up door. The second passenger door and trunk both serve as the cargo compartment. Figure 47 exemplifies the vehicle type and design.



Figure 47 Observed Delivery Vehicle (Sheth, 2017-2018)

Exiting/Entering Commercial Vehicle Behavior

The courier driver was observed exiting the vehicle from the driver side and walking along on the road to the back end of the cargo compartment. When the delivery was complete, the courier driver closed the back end cargo compartment and walked along the road to the driver's seat.

Accessory Used and Accessory Path

A hand truck was used in this delivery. This hand truck was stored in the back end of the cargo compartment, taken out, assembled on the street, and loaded. During the observation, the hand truck was loaded on the street and then taken up the curb ramp seen in Figure 48. The courier driver loaded the hand truck, made a delivery, returned to the same location to reload the hand truck, and made another delivery following the same path.



Figure 48 Hand Truck Observed in Delivery and Cross Walk (Sheth, 2017-2018)

Courier Path to Access Cargo – Movements Described Around Commercial Vehicle

The courier driver walked along the driver side of the vehicle, which was adjacent to a transit lane and stood next to the back end of the cargo compartment. After loading the hand truck, he walked up the curb ramp. He returned using the same curb ramp and reloaded the hand truck behind the back end of the cargo compartment. Upon the final delivery, he closed the cargo compartment and walked along the driver's side of the vehicle to the driver's seat.

Delivery Characteristics and Goods Described

This delivery included one driver who was also the courier. Parcels were being delivered.

Courier Behavior in Response to Built (street, road, and land use characteristics) Environment

This delivery took place in Downtown Seattle, in an area with high density commercial and office space. The courier driver chose to park at an unmarked curb, behind a 3-minute passenger load/unload zone. The back wheels of the vehicle is very close to the crosswalk marking, and the back bumper is in fact hovering of a part of the crosswalk. This can be clearly seen in Figure 49. The delivery load/unload process occurred on the crosswalk, though it did not significantly impact pedestrian movement. Figure 49 captures a moment in which someone in a wheelchair utilized the crosswalk while the hand truck was being loaded.



Figure 49 Wheelchair and Loading Parcels on Crosswalk (Sheth, 2017-2018)

C.15 500 Olive Way, Seattle, WA
Delivery Location, Date, and Time

Delivery Coordinates	47.612820, -122.337201
Delivery at Yellow Curb	Yes
Observation Date & Time	Friday, December 29, 2017 12:20 PM – 12:57 PM

Commercial Vehicle Characteristics

The vehicle observed was a Frito-Lay company vehicle. This is a Class 5 vehicle. There is no driver side door. Only a passenger door which slides open. The cargo compartment is located at the back end of the vehicle and has two open out doors. Figure 50 exemplifies the truck type and design. Note that there are no doors on the driver’s side.



Figure 50 Observed Frito-Lay Vehicle Design (Sheth, 2017-2018)

Exiting/Entering Commercial Vehicle Behavior

The courier driver was observed exiting the vehicle from the cargo compartment. His return to the vehicle after making the delivery was not observed.

Accessory Used and Accessory Path

Two hand trucks were used to make this delivery. The hand trucks were loaded inside the cargo compartment, and then lifted and placed out onto the crosswalk. These hand trucks were carrying chips, so their total weight was not severe, despite the high volume being delivered. Figure 51 shows the hand trucks placed on the crosswalk. These hand trucks seem relatively light, even after being loaded because the courier driver made the delivery using two dollies at the same time. The courier driver then walks the items across the crosswalk to the other side.



Figure 51 Hand Trucks Loaded and Placed on Crosswalk (Sheth, 2017-2018)

Courier Path to Access Cargo – Movements Described Around Commercial Vehicle

The courier driver was observed exiting the vehicle from the cargo compartment, standing on the roadway to close the cargo compartment, and then walking with the goods across the crosswalk. During this part of the delivery, the courier driver was not observed walking along the driver or passenger side of the vehicle.

Delivery Characteristics and Goods Described

This delivery included one driver who was also the courier. Chip products were being delivered using stacked crates and hand trucks. These items appeared to be very light from the way the courier driver handled the items.

Courier Behavior in Response to Built (street, road, and land use characteristics) Environment

This delivery took place in Downtown Seattle, in an area with high density commercial and office space. Although the courier driver parked at a CVLZ, the truck was too long, and the front of the truck spilled over into the red curb space. The courier driver temporarily placed the hand trucks in the crosswalk, which was located right next to the cargo compartment and where the CVLZ yellow curb paint ended. The hand trucks on the crosswalk did not significantly impact the pedestrian flow of traffic or obstruct the roadway for vehicles.

C.16 1200 5th Ave, Seattle, WA 98101

Delivery Location, Date, and Time

Delivery Coordinates	47.608777, -122.333407
Delivery at Yellow Curb	Yes
Observation Date & Time	Friday, December 29, 2017 1:17 PM – 1:33 PM

Commercial Vehicle Characteristics

The observed vehicle for this delivery was a Coca-Cola delivery vehicle. This is a Class 5 vehicle. The driver and passenger doors are swing out doors. The cargo compartment is located

at the back end of the vehicle, and it has a roll up cargo door as well as a lift gate. Figure 52 exemplifies the observed vehicle and its design elements.



Figure 52 Observed Coca-Cola Vehicle Design Elements (Sheth, 2017-2018)

Exiting/Entering Commercial Vehicle Behavior

The courier driver was not observed while exiting the vehicle from the driver side of the vehicle.

The vehicle was larger than the CVLZ parking space, so the vehicle partially obstructed the adjacent transit lane. After the delivery was complete, the courier driver waited for traffic to clear before stepping into the road in order to access the driver seat.

Accessory Used and Accessory Path

A pallet jack was used for this delivery. At the time of the observation, the pallet jack was already loaded inside the cargo compartment and was coming down to the lift gate, as seen in Figure 53. After the nearest crosswalk gave the pedestrian signal, the courier driver walked with the pallet jack over to the crosswalk and onto the parallel curb. This action is exhibited in Figure 54. After the delivery is completed, the pallet jack is brought to the lift gate, and returned to the cargo compartment.



Figure 53 Courier Exiting Cargo Compartment with Loaded Forklift (Sheth, 2017-2018)



Figure 54 Courier Street Crossing with Forklift (Sheth, 2017-2018)

Courier Path to Access Cargo – Movements Described Around Commercial Vehicle

At the start of the observed aspects of this delivery, the courier driver was exiting the vehicle with the loaded pallet jack. It is clear that the pallet jack was loaded and organized in the cargo compartment before exiting the vehicle on the lift gate. After the delivery, the pallet jack was returned to the cargo compartment, and then the courier driver stood on the lift gate to come down.

He then stepped off of the lift gate, further behind it in order to fold one segment of the lift gate in. The folding of the silver part of the lift gate can be seen in Figure 55. In order to disengage the lift gate, the courier driver stood on the right side of the lift gate on the road, in between the lift gate and sidewalk. He pushed a button and guided the lift gate to disengage and collapse into

a solid structure that rests on the back end of the truck. An image of the courier driver guiding the lift gate shut can be seen in Figure 56.



Figure 55 Portion of Lift Gate Manually Folded (Sheth, 2017-2018)



Figure 56 Courier Guiding Lift Gate Shut (Sheth, 2017-2018)

Delivery Characteristics and Goods Described

This delivery included one driver who was also the courier. The items delivered were crates of beverages.

Courier Behavior in Response to Built (street, road, and land use characteristics) Environment

The courier driver had parked at a CVLZ, but the vehicle's dimensions were much larger than the load zone. The parked vehicle obstructed the adjacent transit lane. Vehicles were observed slowing down or moving over to the other transit lane for greater comfort. There is no pavement marking present around the vehicle to clearly define where the load zone begins and ends.

The vehicle is parked at a curb cut. Although this design did not interfere with this particular delivery, the courier driver shared that sometimes the lift gate extends and cannot sit flush against the pavement because the bulb-out portion of the curb cut becomes an obstruction.

C.17 721 2nd Ave, Seattle, WA 98104

Delivery Location, Date, and Time

Delivery Coordinates	47.603538, -122.333843
Delivery at Yellow Curb	Yes
Observation Date & Time	Friday, December 29, 2017 2:04 PM – 2:36 PM

Commercial Vehicle Characteristics

A UPS delivery truck was observed during this delivery. This is a Class 5 vehicle.

This vehicle type has sliding driver and passenger doors and a lift up and roll up cargo compartment at the back end of the vehicle. Figure 57 exemplifies the design elements of the observed vehicle.



Figure 57 Observed UPS Vehicle Design (Sheth, 2017-2018)

Exiting/Entering Commercial Vehicle Behavior

The courier driver or courier were not observed exiting the vehicle. However, upon entering the vehicle, the courier entered the passenger side through the passenger door.

Accessory Used and Accessory Path

At the time of the observation, a hand truck was used to manage returned parcels. The hand truck rested at an angle against the vehicle from the roadway, as seen in Figure 58. After the parcels are unloaded and placed in the cargo compartment, the hand truck is straightened up and placed behind the cargo compartment on the road during the next 30 minutes of the observation.



Figure 58 Hand truck Resting at Angle on UPS Vehicle (Sheth, 2017-2018)

Courier Path to Access Cargo – Movements Described Around Commercial Vehicle

At the time of the observation, the delivery had already started. The courier driver and courier were observed standing on the road next to the cargo compartment organizing parcels and preparing for the next hand delivery. They then dispersed either across the street using the crosswalk over to the other side, or the sidewalk adjacent to the parked vehicle to complete deliveries. Figure 59 shows the courier making a hand delivery using the crosswalk and the empty hand truck left on the street behind the vehicle's cargo compartment. The courier was observed finishing his delivery earlier than the courier driver, and he waited for his colleague in the passenger seat.



Figure 59 Courier Using Crosswalk & Stagnant Hand truck (Sheth, 2017-2018)

Delivery Characteristics and Goods Described

This delivery included two people, one courier driver and one courier. The items delivered or returned were parcels.

Courier Behavior in Response to Built (street, road, and land use characteristics) Environment

This delivery took place in Downtown Seattle where there were mainly offices present on this block. Although this vehicle is parked at a CVLZ, the CVLZ is not long enough to accommodate the length of the vehicle itself. There is a white solid line present to mark the width of the CVLZ. The courier driver and courier were both seen standing on the crosswalk behind the cargo compartment organizing parcels at leisure. Their stance did not conflict with the pedestrian flow on the crosswalk or the vehicle flow in the adjacent transit lane.

C.18 721 2nd Ave, Seattle, WA 98104

Delivery Location, Date, and Time

Delivery Coordinates	47.603468, -122.333701
Delivery at Yellow Curb	No
Observation Date & Time	Friday, December 29, 2017 2:21 PM – 2:42 PM

Commercial Vehicle Characteristics

The observed delivery van is for an unidentified company. This is a Class 3 vehicle.

This vehicle has a driver, passenger, back end cargo, and passenger side cargo doors, all of which are swing out doors. The van's design elements can be seen in Figure 60.



Figure 60 Observed Delivery Van Design (Sheth, 2017-2018)

Exiting/Entering Commercial Vehicle Behavior

The courier driver exited from the driver side of the vehicle, but is clearly inside the solid white paint. He walked along the vehicle around to the back end and onto the sidewalk in order to access the 2-way convertible hand truck. After the delivery, the courier driver went around the back end of the vehicle to the driver side.

Accessory Used and Accessory Path

The accessory used for this delivery was 2-way convertible hand truck. The hand truck was stored in the passenger cargo compartment, and was taken out onto the adjacent sidewalk and assembled. Then, the hand truck moved along the sidewalk, closer to the cargo compartment located on the back end of the vehicle. This was a failed delivery. The courier driver returned to the sidewalk and loaded the passenger cargo compartment with the parcels, folded the hand truck, and placed it inside the passenger cargo compartment as well. He then walked around the back of the vehicle to the driver side.

Courier Path to Access Cargo – Movements Described Around Commercial Vehicle

The courier driver exited the driver side of the vehicle and walked onto the sidewalk in order to access the passenger cargo compartment. During this time, he stood on the sidewalk. He then

moved to the cargo compartment on the back end of the vehicle. Here, he stood directly next to the cargo compartment on the road in order to unload the cargo compartment behind the vehicle and place items on the hand truck, which was perched on the sidewalk next to him. Figure 61 depicted this action. This was a failed delivery. When the courier driver returned with the failed delivery, he stayed on the sidewalk and loaded the passenger cargo compartment from the sidewalk. After the delivery was completed, he walked around the back end of the vehicle to the driver side.



Figure 61 Courier Observed Loading 2- way hand truck (Sheth, 2017-2018)

Delivery Characteristics and Goods Described

This delivery included one driver, who was also the courier. The items delivered or returned were parcels.

Courier Behavior in Response to Built (street, road, and land use characteristics) Environment

This delivery took place in Downtown Seattle where there were mainly offices present on this block. This vehicle parked in a 3-minute passenger load/unload zone. There is a solid white line present to mark the width of the load zone. The courier driver made good use of the sidewalk by keeping the hand truck here. He did not appear to be concerned about having a transit lane adjacent to him or having an active CVLZ behind him.

C.19 4140 Roosevelt Way NE, Seattle, WA 98105

Delivery Location, Date, and Time

Delivery Coordinates	47.658138, -122.317715
Delivery at Yellow Curb	Yes
Observation Date & Time	Friday, January 05, 2018 9 AM – 9:19 AM

Commercial Vehicle Characteristics

The observed vehicle is a Costco vehicle. This is a Class 5 vehicle. The driver and passenger doors are both swing out doors. The cargo compartment is located at the back end of the truck, and has a roll up cargo door as well as a lift gate. Figure 62 exemplifies the design of the truck with the lift gate extended.



Figure 62 Observed Costco Delivery Vehicle (Sheth, 2017-2018)

Exiting/Entering Commercial Vehicle Behavior

The courier driver exited the driver's side of the vehicle onto the sidewalk. Upon completing the delivery and returning to the vehicle, he walked around the back end of the vehicle, up onto the sidewalk, and to the driver's seat.

Accessory Used and Accessory Path

In the observed delivery, a pallet jack was used to transport the goods. The items were organized onto the pallet jack in the cargo compartment. Then was taken on the lift gate down to the road. The pallet jack stayed behind the vehicle on the road, until the courier driver was signaled to

cross. Figure 63 exemplifies the pallet jack on the road. This portion of the roadway is designated for passenger load/unload zone, and is demarcated by the white paint on the curb. After the delivery was completed, the pallet jack was brought back to the lift gate and returned to the cargo compartment.



Figure 63 Courier Waiting for Crosswalk Signal in Passenger Load/Unload Zone (Sheth, 2017-2018)

Courier Path to Access Cargo – Movements Described Around Commercial Vehicle

The courier driver had exited the vehicle from the driver's side and onto the sidewalk. He then stepped into the adjacent transit lane in order to manage the lift gate. After getting onto the extended lift gate and into the cargo compartment, he placed a cone on the extended edge of the lift gate. It is presumed that he has done this to emphasize the presence of the gate to road users around the parked vehicle, as the lift gate did occupy a part of the adjacent transit lane. He then stood on the lift with the loaded pallet jack and secured the cargo compartment door shut. He operated the lift gate down to the road while standing on the lift gate. Once the lift gate sits flush against the road, he steps into the roadway and stands in the passenger load zone, which is the area behind the back end of the vehicle next to the cargo compartment. He waits on the roadway until the crosswalk signals to pedestrians their right to cross. Upon returning to the vehicle after the delivery was completed, the courier driver uses the lift gate, opens up the cargo compartment door in order to return the pallet jack and the cone to the

cargo compartment. He then takes the lift down, and steps into the adjacent transit lane in order to access the button that collapses the lift gate. Figure 65 shows the courier driver standing in the roadway to operate the lift gate. Note the oncoming white vehicle next to him.



Figure 64 Extended Lift Gate with Cone (Sheth, 2017-2018)



Figure 65 Courier Operating Lift Gate - Standing in Transit Lane (Sheth, 2017-2018)

Delivery Characteristics and Goods Described

This delivery included one driver, who was also the courier. The items delivered were small crates of beverages and office supplies.

Courier Behavior in Response to Built (street, road, and land use characteristics) Environment

This vehicle is parked at a CVLZ on a one-way street with two transit lanes adjacent to the parking lane and a protected bike lane in the third lane over from the parked vehicle. The length

of the CVLZ is not long enough to accommodate this vehicle, and therefore, this vehicle is extended far into the passenger load/unload zone.

There is a solid white lane present to demarcate the width of the CVLZ, but it is too narrow for this vehicle type. This becomes apparent when the lift gate is extended and a portion of it is in adjacent transit lane. The courier driver placed a cone at the edge of the lift to communicate its presence with road users.

The courier driver was managing a heavy load. He stood on the roadway, next to the crosswalk until the pedestrian sign was signaled. The courier driver had to step into the adjacent transit lane to manage the lift gate, and did so when the traffic subsided.

C.20 4214 Roosevelt Way NE, Seattle, WA 98105

Delivery Location, Date, and Time

Delivery Coordinates	47.658558, -122.317701
Delivery at Yellow Curb	Yes
Observation Date & Time	Friday, January 05, 2018 9:16 AM – 9:22 AM

Commercial Vehicle Characteristics

The observed delivery involved is a Smith & Greene company vehicle. Smith & Greene is a food service equipment and supplies store. This vehicle is a Class 5 truck. The driver and passenger doors are both swing out doors. The cargo compartment is located at the back end of the truck, and has a lift up cargo door. Figure 66 exemplifies the vehicle type and design.



Figure 66 Observed Smith & Greene Vehicle (Sheth, 2017-2018)

Exiting/Entering Commercial Vehicle Behavior

The courier driver was observed exiting from the driver's side of the vehicle onto the sidewalk. Upon completing the delivery, the courier driver walked from the back end of the vehicle, onto the sidewalk, to the driver's door.

Accessory Used and Accessory Path

A hand truck is used in this delivery. It is removed from the cargo compartment, assembled, and placed behind the cargo compartment. Figure 67 depicts the hand truck resting on the road, waiting to be loaded. After the hand truck is loaded, the courier driver lifts it over the curb and makes the delivery. Upon completing the delivery, the courier driver returns, collapses the hand truck, and places it back in the cargo compartment.



Figure 67 Hand Truck Placed Behind Cargo Compartment (Sheth, 2017-2018)

Courier Path to Access Cargo – Movements Described Around Commercial Vehicle

The courier driver walked from the driver’s seat over to the back end of the vehicle to the cargo compartment, using the adjacent sidewalk. He then rolls the cargo door, steps inside and organizes his delivery. During this time, he has placed the hand truck on the road. He then steps onto the road next to the hand truck to load it.

Delivery Characteristics and Goods Described

This delivery included one driver, who was also the courier. The items delivered were brown boxes of food supply.

Courier Behavior in Response to Built (street, road, and land use characteristics) Environment

This vehicle is parked at a CVLZ on a one-way street with two transit lanes adjacent to the parking lane, and a protected bike lane in the third lane over from the parked vehicle. The length of the CVLZ accommodates this vehicle, and the extended use behind the cargo compartment. There is a solid white lane present to demarcate the width of the CVLZ, which also accommodated the width of this vehicle. The courier driver was observed comfortably loading his hand truck behind the cargo compartment.

C.21 4300 Roosevelt Way NE, Seattle, WA 98105

Delivery Location, Date, and Time

Delivery Coordinates	47.660199, -122.317665
Delivery at Yellow Curb	Yes
Observation Date & Time	Friday, January 05, 2018 9:35 AM – 9:50 AM

Commercial Vehicle Characteristics

The observed delivery involved is an Office Depot vehicle. This vehicle is a Class 5 truck. The driver and passenger doors are both swing out doors. The cargo compartment is located at the back end of the truck, and has a roll up cargo door. Figure 68 exemplifies the vehicle type and design.



Figure 68 Observed Office Depot Vehicle (Sheth, 2017-2018)

Exiting/Entering Commercial Vehicle Behavior

The courier driver was not observed exiting the vehicle. However, when entering the vehicle after completing the delivery, he entered the driver's side by walking from the back end of the vehicle, onto the sidewalk adjacent to the driver door, and into the driver's seat.

Accessory Used and Accessory Path

A hand truck was used in this delivery. The hand truck was stored in the cargo compartment, but taken out and placed on the road behind the cargo compartment. Here, the hand truck was tilted against the vehicle and loaded. After the hand truck was loaded, the courier driver lifted the hand truck over the curb. Upon the delivery being completed, the hand truck was rolled over to the road space behind the cargo compartment and placed in the cargo compartment.



Figure 69 Tilted Handtruck Loaded (Sheth, 2017-2018)

Courier Path to Access Cargo – Movements Described Around Commercial Vehicle

The courier driver exited the driver's side of the vehicle, lifted the cargo door, and stepped inside to organize parcels. Figure 69 exemplifies the courier driver organizing the parcels inside the cargo compartment. He then places the hand truck on the roadway and stepped into the road next to the hand truck to load parcels from the cargo compartment onto the hand truck. After the hand truck is loaded, he closes the cargo compartment, and walks the hand truck up and over the adjacent sidewalk. He completes his delivery and returns to the vehicle with returned parcels. He loads the cargo compartment with the returned parcels while standing on the road behind the cargo compartment. He places the hand truck inside and walks to the driver's seat using the sidewalk.



Figure 70 Driver/Courier Organizing Parcels in Cargo Compartment (Sheth, 2017-2018)

Delivery Characteristics and Goods Described

This delivery included one driver, who was also the courier. The items delivered were boxes for office supplies.

Courier Behavior in Response to Built (street, road, and land use characteristics) Environment

This vehicle is parked at a CVLZ on a one-way street with two transit lanes adjacent to the parking lane, and a protected bike lane in the third lane over from the parked vehicle. The length of the CVLZ accommodates this vehicle, and the extended use behind the cargo compartment.

There is a solid white lane present to demarcate the width of the CVLZ, which also

accommodated the width of this vehicle. The courier driver was observed comfortably loading his hand truck behind the cargo compartment.

C.22 4247 University Way NE, Seattle, WA 98105

Delivery Location, Date, and Time

Delivery Coordinates	47.659631, -122.313262
Delivery at Yellow Curb	No
Observation Date & Time	Friday, January 05, 2018 8:20 AM – 8:25 AM

Commercial Vehicle Characteristics

The observed delivery involved is a University of Washington commercial vehicle. This vehicle is a Class 3 vehicle. The driver and passenger doors are both swing out doors. The secondary driver and passenger doors are slide open doors. The cargo compartment is located at the back end of the truck, and has two swing out doors. Figure 71 exemplifies the vehicle type and design.



Figure 71 UW Van Delivery (Sheth, 2017-2018)

Exiting/Entering Commercial Vehicle Behavior

The courier driver was not observed exiting the vehicle. However, when entering the vehicle after completing the delivery, he entered the driver’s side by walking from the back end of the vehicle, onto the roadway adjacent to the driver door, and into the driver’s seat.

Accessory Used and Accessory Path

The returned parcel was hand delivered to the commercial vehicle. Therefore, there was no accessory used or accessory path.

Courier Path to Access Cargo – Movements Described Around Commercial Vehicle

The courier driver used the shortest path available to the back end cargo compartment by jaywalking across the road. The courier opened the cargo door to place the returned item inside. He then walks on the transit lane to access the driver’s seat.

Delivery Characteristics and Goods Described

This delivery included one driver, who was also the courier. A small parcel was delivered.

Courier Behavior in Response to Built (street, road, and land use characteristics) Environment

Although this commercial vehicle was parked at the end of a block adjacent to a crosswalk, the courier driver decided to jaywalk as this was still the shortest way to access his vehicle from his start point.

C.23 4232 University Way NE, Seattle, WA 98105

Delivery Location, Date, and Time

Delivery Coordinates	47.659323, -122.313111
Delivery at Yellow Curb	Yes
Observation Date & Time	Wednesday, December 13, 2017 1:10 PM – 1:15 PM

Commercial Vehicle Characteristics

A UPS delivery truck was observed during this delivery. This is a Class 5 vehicle. This vehicle type has sliding driver and passenger doors and a roll up cargo compartment at the back end of the vehicle. Figure 72 exemplifies the design elements of the observed vehicle. Note that this image is not of the actual location of observation.



Figure 72 UPS Delivery Vehicle Type Observed (Sheth, 2017-2018)

Exiting/Entering Commercial Vehicle Behavior

For this delivery, there were two UPS employees. One was the courier driver and the other was the courier. At the time of observation, the driver and courier exited the vehicle from the passenger side of the vehicle onto the sidewalk to make a delivery.

Accessory Used and Accessory Path

At the time of the observation, a parcel was being hand delivered by the courier. Therefore, there was no accessory used or accessory path.

Courier Path to Access Cargo – Movements Described Around Commercial Vehicle

After the vehicle was parked, the courier driver and courier entered the cargo compartment from the inside of the vehicle to retrieve the parcel. They both then exited the vehicle from the passenger side onto the sidewalk. They both returned after the delivery and accessed the driver and passenger seat from the passenger's door only. Therefore, they avoided walking on the roadway.

Delivery Characteristics and Goods Described

This delivery included one courier driver and one courier. One parcel was delivered.

Courier Behavior in Response to Built (street, road, and land use characteristics) Environment

This vehicle is parked at a CVLZ located on a curb cut. This CVLZ is located on a dense commercial street (University Avenue). After parking, the driver pulled in his door mirror.

C.24 Lander Hall, 1201 NE Campus Pkwy, Seattle, WA 98105

Delivery Location, Date, and Time

Delivery Coordinates	47.655956, -122.315076
Delivery at Yellow Curb	Yes
CVLZ Signage	30 Minute Truck Load and Unload Only 8 AM – 5 PM, Except Sun.-Holidays
Observation Date & Time	Wednesday, December 27, 2017 10:20 AM – 10:45 AM

Commercial Vehicle Characteristics

A UPS delivery truck was observed during this delivery. This is a Class 5 vehicle. This vehicle type has sliding driver and passenger doors and a lift up and roll up cargo compartment at the back end of the vehicle. Figure 73 exemplifies the design elements of the observed vehicle. Note that this image is not of the actual location of observation.



Figure 73 UPS Vehicle Type Observed (Sheth, 2017-2018)

Exiting/Entering Commercial Vehicle Behavior

For this delivery, one UPS employee was both the courier and driver. At the time of observation, the courier driver was in the middle of making deliveries. He was standing in the cargo compartment sorting parcels. How he exited /entered the vehicle was not observed.

Accessory Used and Accessory Path

This delivery was made with the assistance of the University of Washington Lander Hall staff. Lander Hall is a dormitory, and because of the high parcel volumes expected, Lander Hall staff met the UPS delivery person at the curb with two bins. The bins were brought to the UPS truck using a sidewalk and remained stationary on the sidewalk while it was loaded with parcels.

Courier Path to Access Cargo – Movements Described Around Commercial Vehicle

At the time of observation, the parcels were being sorted inside the cargo compartment. The courier driver stayed in the cargo compartment and passed parcels to the Lander Hall staff after scanning them, all while staying in the cargo compartment.

Delivery Characteristics and Goods Described

This delivery included one courier driver, and two Lander Hall staff. Many parcels were being delivered.

Courier Behavior in Response to Built (street, road, and land use characteristics) Environment

This vehicle is parked at a CVLZ located on a curb cut. This CVLZ is located adjacent to Lander Hall. Having Lander Hall staff assist with the delivery limited the driver/courier's movements mainly to the vehicle's cargo compartment. The courier driver was able to sort, scan, and pass parcels to Lander Staff, who then loaded the bins.