Signal Infrastructure Findings & Recommendations

WALK SAFE SAN JOSÉ
Pedestrian Safety Plan

VISION ZERO SAN JOSÉ

Task Recap

Areas of Research

- How to use **signal design and signal phasing** to improve pedestrian safety
- Opportunities to **shorten pedestrian wait times**
- Strategies to **reduce the cost of signal construction**
- Ways to upgrade signal design to support **safe routes for seniors**

Approach

Initial research and benchmarking of other cities

Interview up to 4 peer agencies that have implemented innovative signal design supporting pedestrian safety and mobility

Determine SJDOT priorities and recommended solutions through **Signals Working Group**

Deliverables

- 2-3 working group meetings:
  - Mtg 1: Overview of task, brainstorm strategies of interest, and confirm list of peer agencies to research/engage
  - Mtg 2: Presentation of findings and discussion of recommended strategies
  - Mtg 3 (if needed): Finalize recommended strategies
- Best practice findings and working group recommendations to be piloted in the Plan area and for future use citywide

Interview Findings

Peer Agencies Interviewed

New York City Department of Transportation (NYC DOT)

June 5, 2023

Seattle Department of Transportation (SDOT)

June 7, 2023

Los Angeles Department of Transportation (LADOT)

June 7, 2023

Portland Bureau of Transportation (PBOT)

June 9, 2023

Vision Zero History

NYC DOT

New York City Department of Transportation

- Vision Zero adopted and launched in 2014
  - Efforts to install LPI was originally 300 per year and has reached up to an average of 600 per year
  - Emphasis on pedestrian priority

SDOT

Seattle Department of Transportation

- Vision Zero adopted and launched in 2015
  - In February 2020, Phase 2 of Bike and Pedestrian Safety Analysis was released to understand bicycle and pedestrian incident trends

LADOT

Los Angeles Department of Transportation

- Vision Zero adopted and launched in 2015
  - Vision Zero Signal Timing Staff vs General City
  - *Phase 1 (2017):* Reduce cycle length, *Phase 2: LPI* (Priority List of Intersections)

PBOT

Portland Bureau of Transportation

- Vision Zero adopted and launched in 2015
  - Efforts to install LPI has increased from 5 per year to 10 per year with about 150 implemented total
  - An ongoing budget item to be funded by Portland City Council

Peer Agency Findings Summary

Signal Design and Phasing

1. Leading Pedestrian Intervals (LPI)
2. Median Refuge Islands
3. Signal Timing

Reduce pedestrian wait times

1. Signal Timing
2. Pedestrian Detection Technology

Reduce signal construction costs

1. Construction Approach
2. Construction Costs

Peer Agency Signal Infrastructure

Agency	Number of Signalized Intersections	Fixed Time Signal	Actuated Signal	Protected Turn Phase	LPI (#)	LPI (%)
NYC DOT	14,000	Most	N/A	400	6,000+	43%
LADOT	4,854	~1,600	Most	1,000	1,500	31%
SDOT	1,100 – 1,200	200 - 300	N/A	N/A	N/A	N/A
PBOT	1,100	200	1/3	N/A	150	14%
SJ DOT	967	58	909	377	585	60%

Leading Pedestrian Intervals (LPIs)*

LPIs allow pedestrians to cross at intersections before vehicles are given a green signal and gives pedestrians priority over turning vehicles.

- NYC DOT
  - 7 seconds min, can be up to 20 seconds if high pedestrian volume
  - Implemented universally and at low cost
- PBOT
  - 3 seconds min and 15 seconds max
  - LPI is increased when there are concerns about cut-through traffic
  - A challenge when there is transit priority/delay
- SDOT
  - 3-7 seconds typically, but shorter time on the main streets
  - Implement LPI wherever feasible unless no turning ped conflicts
  - Limit LPI to 3-4 sec if there is no Accessible Pedestrian Signal (APS), which lack cues for visually impaired users

*** = applicable to Safe Routes for Seniors**

Median Refuge Islands*

Median refuge islands reduce pedestrian exposure to vehicle traffic and reduce the crossing length at large intersections.

- PBOT
  - Full crossing vs two-stage is context dependent
    - If it is unlikely peds will expect or want to across the entire street, then cross peds to median
    - Phase skips/rotations for light rail
  - Pedestrian detection in islands

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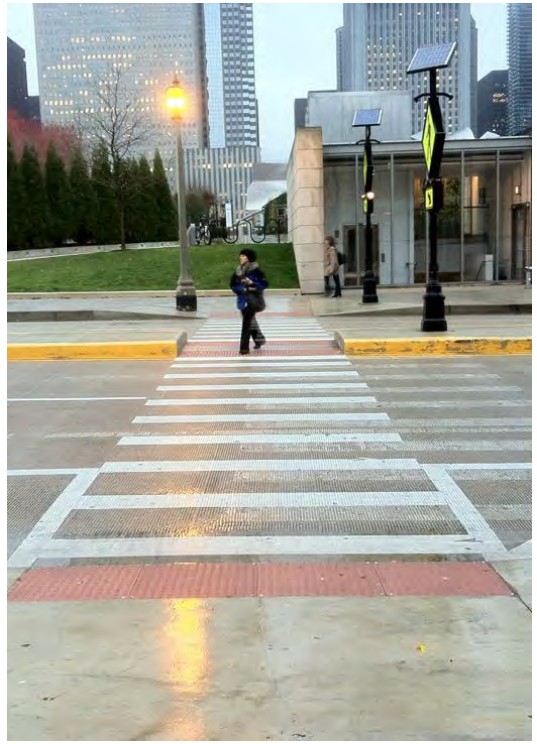
Median Refuge Islands*

Median refuge islands reduce pedestrian exposure to vehicle traffic and reduce the crossing length at large intersections.

- SDOT
  - Installation depends on context and location
  - Appropriate dimensions for a ped refuge is 8-ft (tactile strips included) and 4-ft of refuge area with crosswalk painted up to tactile
    - Considered a median island instead of a refuge if it does not meet this criteria
    - If not a refuge, then no push-button is provided
  - Crossings are typically timed for crossing from curb ramp to curb ramp even with refuge island
  - Push buttons required if there are ADA users
  - Median Refuge without push buttons used at both fixed and actuated signals



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Signal Timing Adjustments*

Timing adjustments can be made depending on the context of an intersection to reduce pedestrian wait times during off-peak hours.

Agency	Downtown	Outside of Downtown
NYC DOT	• Fixed timing at most signalized blocks; actuated if there is low pedestrian demand • "Green wave" coordinated progressions • Converted to protected turn phase based on: 1) Number of lanes (more than 3) 2) roadway width, turning volumes, and crash history	
SDOT	• All Downtown signals (200-300) are fixed time and have no detection	• Recently changed majority of streets to 25 mph—when they retime signals, they are timed to 25 mph
LADOT	• LPI as default for new signal installations • Most locations have pedestrian recall at least along a major corridor • Large intersections or intersections with similar volumes in all directions are mostly fixed time, but provide APS • Split-phasing not used for pedestrians, but the pedestrian scramble is used	
PBOT	• All Downtown signals (200) are fixed time • 60 second cycle lengths with 56 seconds during off-peak and 70 seconds on one-way couplets	• General approach is to coordinate and reduce the cycle length • Moving towards fully actuated for running pedestrian actuation during off-peak time

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Signal Timing Adjustments*

Timing Adjustments can be made depending on the context of an intersection to reduce pedestrian wait times during off-peak hours.

SDOT

- Limit the cycle length by setting a maximum cycle length based on street type
- Increase pedestrian crossing times by balancing with given cycle length
- Pedestrian actuation for urban villages or urban activity centers

PBOT

- General Approach:
  - Run signals as un-coordinated where possible
  - Maintain low cycle length if possible
- During off-peak hours where volumes are low:
  - Fully actuated
  - Permissive window in controller to minimize ped wait time

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Pedestrian Detection Technology*

reduces pedestrian delay to cross.

- Pedestrian detection, including APS detectors, can allow signals to run free and be more responsive to pedestrians in locations with lower demand
  - Most peer agencies noted that they use this approach
- Signals running free, rather than in full or partial recall mode due to lack of pedestrian detection, can allow shorter cycle lengths
  - Shorter cycle lengths also typically allow increased responsiveness and reduced pedestrian delay

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Pedestrian Detection Technology*

can provide extended crossing time for pedestrians.

- Extended push button press can provide extended crossing time on request
  - PBOT has investigated extended push button press and other technologies to make signals more responsive to different crossing timings
- In-crosswalk detection can allow extension of parallel vehicles phases to avoid conflicts for pedestrians finishing crossing

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Reduce Signal Construction Costs

Construction Approach

Agency	In-House	Contract Out
NYC DOT	• Signal design completed in-house • Signal studies done through 6 shop crews • Signal poles follow NYC Standard	• Signal knock-down repairs are completed through maintenance contractor • Contractors are used for subsurface construction
SDOT	• New signal and RRFB can be built in-house • Span wire can be applicable to in-house projects if there are existing constraints • A set amount of maintenance work can be done in-house	• Contractors are used for most signal construction; typically not allowed to construct new span wire • Bid-items are per project rather than lump sum for signal • Packaging multiple locations into one bid to reduce costs
LADOT	• Signal design completed in-house • Several yards are available for storing/replacing/repairing damaged signal equipment • Rectangular Rapid Flashing Beacon (RRFB) salvaged equipment become replacements for units in other areas when they break • Signal standards are based on 2006 Caltrans standard	• Civil design is completed through a consultant • 90% of construction is through a contractor • Contracts require contractor to procure the equipment, can delay project time • In order to fast-track, city will provide city-owned poles to contractor and have contractor procure replacements to be stored at a yard
PBOT	• In-house work restricted due to budgets/staffing • Signal standards are based on PBOT City standard • Engineering judgment used to decide whether the MUTCD “should” condition needs to be followed	• Signal construction is contracted out due to lack of inventory space and restricted budgets • Bids are typically bundled, no reduction in cost

Reduce Signal Construction Costs

Construction Cost

Agency	Full Signalized Intersection		RRFB	PHB
	Installation Cost	Design Cost	Installation Cost	
NYC DOT	• $150k - $180k per intersection • *Civil improvements not reflected*	• Signal design in-house (no consultant fee)	• N/A	• N/A
SDOT	• $500k for intersection and $300k for midblock if built in-house • $1.0M for intersection and $800k for midblock if through contractor • *$500k additional for civil improvements, typically only done with contractor*	• Signal design in-house for most in-house construction (no consultant fee) • Consultant fees not included in installation cost	• $60k in-house • $120k through contractor	• N/A
LADOT	• $250k - $300k • *Civil improvements not reflected*	• Signal design in-house (no consultant fee) • $10k fee for civil design (assuming minor civil/ curb ramp improvements)	• $50k	• $250k - $300k

PBOT	• $1.0M+ for a full signalized intersection
	  • Includes construction and design; typically would expect most of this cost to be materials/installation
	  • Does not include major civil work
		• All work is contracted out
		• Price not broken out separately in discussion, but would typically expect up to 10% of construction
			• $200k (with overhead indications)	• $400k - $450k (with overhead indications)

Recommendations

Recommendations

Topic Area	Summary of Recommendations
Signal Design and Phasing	1. Identify considerations for when to have leading left turn versus lagging left turn* 2. Prioritize LPI implementation in study area and set standards for LPI duration* 3. Adopt and/or develop a standard for when to provide protected left turns* 4. Develop guidelines for application of fixed signal timing* 5. Pilot signal timing strategies to reduce vehicle speeds and evaluate effectiveness* 6. Develop a standard around appropriate context for use of median refuge islands as an opportunity to time two-stage crossings*
Pedestrian Wait Times	7. Minimize cycle lengths where feasible* 8. Install pedestrian detection at all locations where feasible*
Construction Costs	9. Explore adoption of a signal standard that is not frequently updated

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Signal Design and Phasing To Improve Pedestrian Safety

Signal Phasing Recommendations

1. Identify considerations for when to have leading left turn versus lagging left turn*
    - Evaluate intersection capacity needs to determine lagging left-turn phase, which only benefits drivers
        - Lagging left turns cannot be truncated, potentially increasing pedestrian delay
    - Right-turn overlap with lagging left-turn phases may affect driver yielding behavior crossing parallel pedestrian paths
2. Prioritize LPI implementation in study area and set standards for LPI duration *
    - Minimum LPI for most agencies is 3 seconds
    - Could consider establishing guidance for LPI duration based on pedestrian demand

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Signal Design and Phasing To Improve Pedestrian Safety

Signal Timing Recommendations

3. Adopt and/or develop a standard for when to provide protected left turns*
    - Judicious application of left-turn phases can help reduce cycle lengths and potentially allow fixed signal timing
    - Resource: LA DOT's Left-Turn Calming Pilots
4. Develop guidelines for application of fixed signal timing*
    - Currently, few signals operate on fixed timing
    - Fixed timing operations can enhance service of pedestrian phases and bring down constructions costs by reducing need for detection equipment
5. Pilot signal timing strategies to reduce vehicle speeds and evaluate effectiveness*
    - Strategic use of coordination or free signal timing could lead to reduced vehicle speeds

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Signal Design and Phasing To Improve Pedestrian Safety

Median Refuge Islands Recommendations

6. Develop a standard around appropriate context for use of median refuge islands as an opportunity to time two-stage crossings*
    - Where a median refuge island is provided, always include a push-button
    - Ideal locations for two-stage timing:
        - Intersections with medians
        - Light-rail crossings

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Reduce Pedestrian Wait Times

Pedestrian Wait Time Recommendations

7. Minimize cycle lengths where feasible*
    - Reducing cycle lengths will reduce pedestrian wait times during peak time periods
8. Install pedestrian detection at all locations where feasible*
    - In addition to meeting PROWAG requirements for APS, pedestrian detection can allow signals to be responsive to pedestrian demands
    - Install in-crosswalk detection for long crossings to allow phase extension

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Reduce Construction Costs

Construction Cost Recommendations

9. Explore adoption of a signal standard that is not frequently updated
    - Allows for greater equipment inventory to be used (replacements and installation at new intersections)
    - Allows for more opportunities to do in-house or on-call labor


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