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# Concurrent vs. Exclusive

## The Traffic Engineer's Dilemma with Pedestrian Signal Phasing

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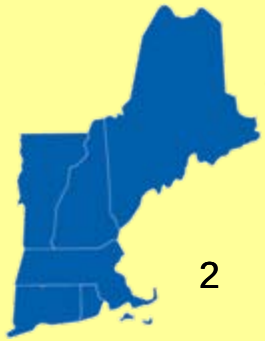
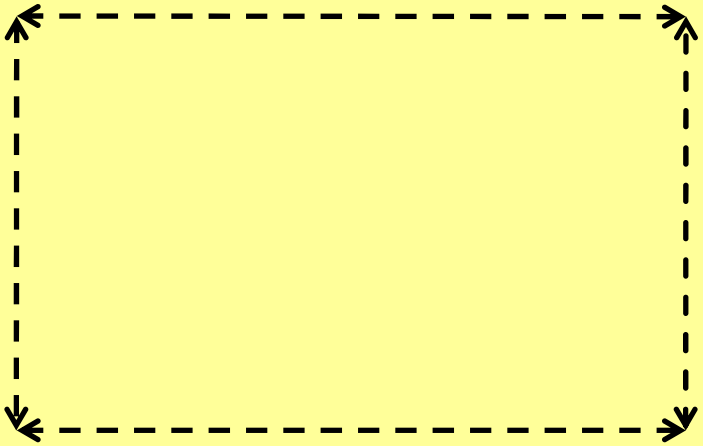


- An **exclusive** pedestrian phase occurs when traffic is stopped on all approaches to allow pedestrians to cross any leg of the intersection.



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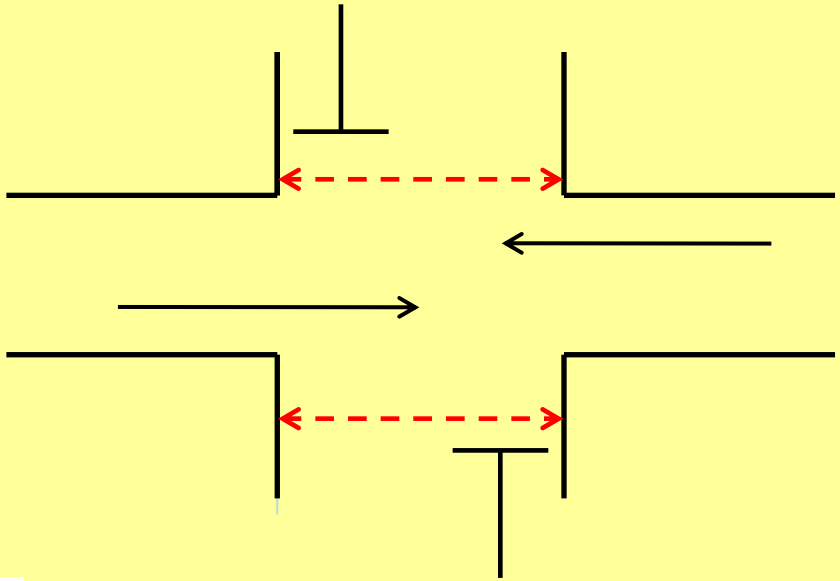
- A **concurrent** pedestrian phase allows the pedestrian to cross in the same direction at the same time as parallel motor vehicle traffic receives a green indication.



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- Early release – allows pedestrians to leave the curb before vehicles are permitted to turn.

- Late release – holds pedestrians (with respect to vehicles) until a certain portion of the phase has been given to turning vehicles.

# Comparison of Alternative Pedestrian Phasing[1]
# Exclusive vs. Concurrent Phasing

## Exclusive Phasing

- Feeling of security for all pedestrians when there are no vehicle conflicts.
- Will result in longer delays for motor vehicles and pedestrians.
- Meaning of Hand/Walking Man sometimes misunderstood by pedestrians.
- Pedestrians often cross against the traffic light concurrent with parallel traffic if no conflicts are apparent.
- May require NO RIGHT TURN ON RED Sign.

## Concurrent Phasing

- Conflict between turning vehicles and pedestrians.
- Results in less delay to motor vehicles and pedestrians.
- More widely used and recognized.
- Incorporation of early or late release pedestrian interval to lessen conflict with turning vehicles.
- Pedestrians must exercise more caution and judgment.

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1. VERMONT AGENCY OF TRANSPORTATION, PEDESTRIAN AND BICYCLE FACILITY PLANNING AND DESIGN MANUAL.

# PEDESTRIAN CROSSING POLICIES
# NEW ENGLAND STATES

Vermont - Assess each intersection on a case by case basis, no written policy.

New Hampshire - Primarily use exclusive, but will consider concurrent phase on coordinated signal systems.

Maine DOT – Typically use concurrent pedestrian phase.

Connecticut DOT – Assess each intersection on a case by case basis.

Rhode Island DOT – Default is to use concurrent phase, no written policies.

MassDOT - Primarily exclusive, no written policy.

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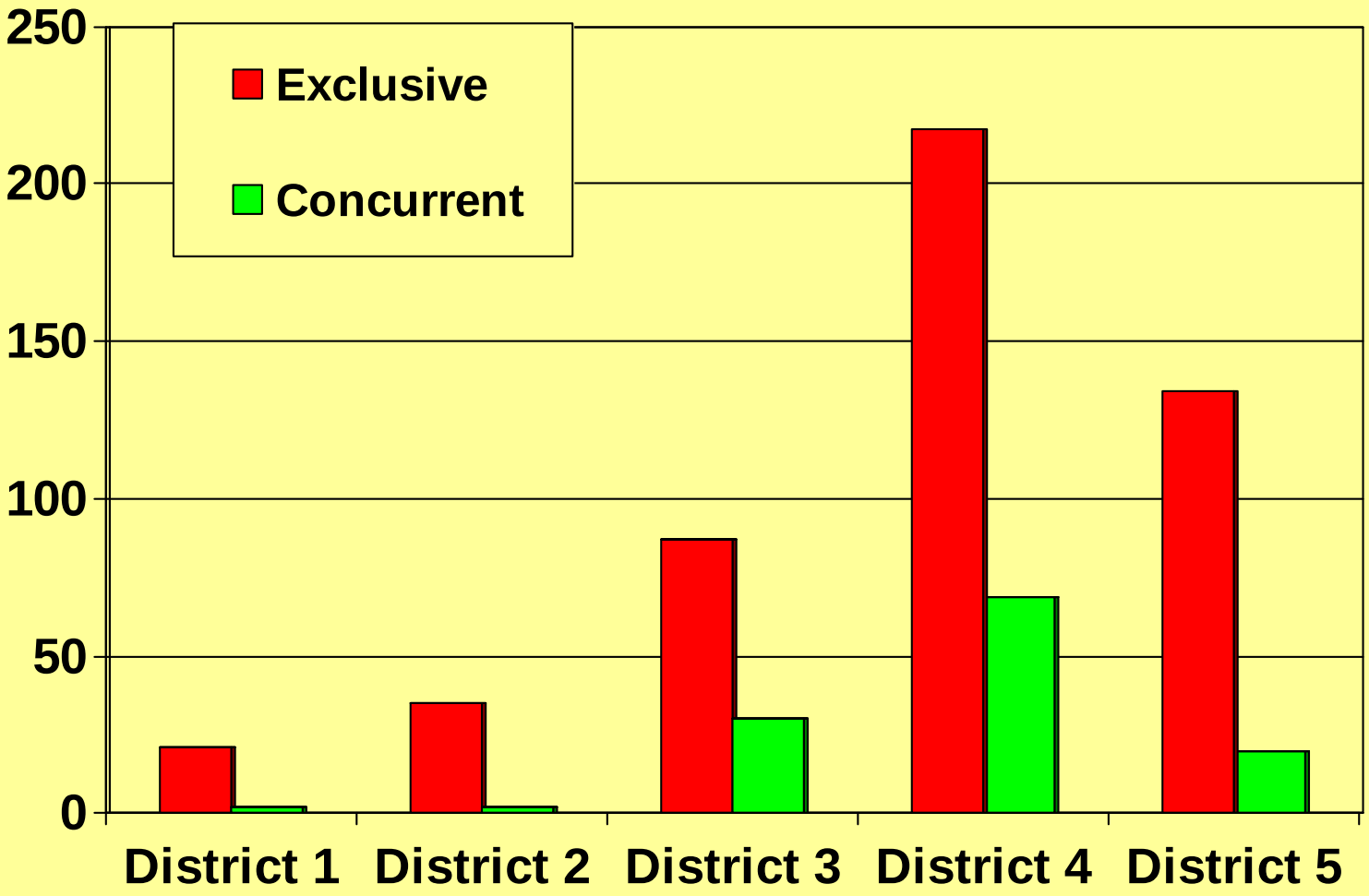
# MassDOT Traffic Pedestrian Signal Phases
## Exclusive vs. Concurrent

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HAND – MAN INDICATION

RED – YELLOW INDICATION[2]

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2. BOSTON.COM

# Transportation Research Record No. 1141
# Safety of Pedestrian Crossings at Signalized Intersections
# David M. Zaidel and Irit Hocherman

## Study Criteria

- Study was performed in Israel, to determine the relative risk for pedestrian crashes at intersections that have an exclusive pedestrian phase, concurrent pedestrian phase and an uncontrolled crossing. In this study the safety performance of the three crossing arrangements at urban signalized intersections is examined.

- Information regarding 320 intersections and 1310 pedestrian crashes was gathered and analyzed. Components known to affect crash levels, such as, vehicle volume, pedestrian activity and intersection geometry was gathered.

- To determine intersection complexity, the intersection geometry included the number of legs in the intersection and the number of turning and through lanes.

- Average Annual Daily Traffic (AADT) was separated into levels below and above 18,000 vehicles (AADT) and pedestrian activity was graded into three levels, Low (less than 200 pedestrians crossing at peak hour), medium (200 to 600 crossings at peak hour) and heavy (more than 600 crossings at peak hour).

# Transportation Research Record No. 1141
# Results of Study
# Concurrent vs. Exclusive

- Number of crashes increased as the traffic volume, level of pedestrian activity and the number of legs increased.
- Effect of vehicle volume is larger in conjunction with medium or high levels of pedestrian activity.

## DATA BY CROSSING TYPE

| | | Exclusive Pedestrian Phase | | Uncontrolled Crossing | | Concurrent Pedestrian Phase | |
|---|---|---|---|---|---|---|---|
| TRAFFIC VOLUME | PEDEST-RIAN ACTIVTY | Avg. # of Crashes | Number of Intersections[a] | Avg. # of Crashes | Number of Intersections[a] | Avg. # of Crashes | Number of Intersections |
| Low | Low | ---------- | ---------- | 1.9 | 8 | 1.6 | 27 |
| Low | High[b] | 2.6 | 12 | ---------- | ---------- | 2.4 | 28 |
| High | Low | 1.4 | 7 | 1.1 | 14 | 2.4 | 25 |
| High | High[b] | 3.4 | 13 | 4.0 | 8 | 4.0 | 43 |

a. Number of accidents is not shown for cells containing less than six intersections.
b. Medium and high pedestrian counts combined.

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# Transportation Research Record No. 1141
# Conclusions of Study
# Concurrent vs. Exclusive

- Traffic volume, amount of pedestrian activity and complexity of the intersection (as measured by the number of legs) are related to the increased likelihood of pedestrian crashes.

- An exclusive pedestrian phase may be warranted when an intersection has high vehicle volumes and high pedestrian activity.

- Compared with the other crossing types, the concurrent pedestrian phase appears to be more dangerous to pedestrians when vehicle volume is high but pedestrian activity is light. Exclusive pedestrian phase should be considered.

Transportation Research Record No. 847
Effect of Pedestrian Signals and Signal Timing on Pedestrian Accidents

Charles V. Zeeger, Kenneth S. Opiela and Michael J. Cynecki

## INTRODUCTION

- The purpose of this study was to determine whether pedestrian accidents are significantly affected by the presence of pedestrian signal indications and by different timing strategies for pedestrian signal timing.
- The authors hope that the result of this study will identify the types of intersections where pedestrian signals are most (or least desirable) from a safety standpoint and in order to improve their effectiveness, as an aid in determining whether changes are required in the design of pedestrian signals.

## METHODOLOGY

- To determine the effect on safety, pedestrian accident experience was used to determine the effect of pedestrian signals and timing on pedestrian safety.
- A comparative analysis of accidents at locations with and without pedestrian signals was selected for evaluation.

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## DATA NEEDS

- Traffic and pedestrian volumes were collected for each intersection by leg (if available) .
- The following additional variables used to describe the intersection characteristics were also identified:
  - Geometric design factors:
    - Number of lanes, Intersection alignment, use and type of pedestrian signal, and number of turn lanes and/or turn prohibitions
  - Environmental factors:
    - City, land use, area type, and functional classification.
  - Operational factors:
    - Signal timing and phasing, provision for right turn on red, bus operations, speed limits, one-way or two-way street operations and parking.
- Accident reports, all basic information about each accident, who was at fault, accident type, severity, contributing circumstances as well as 20 other accident details.

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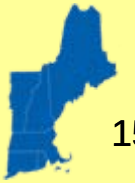
## SITE SELECTION

- Candidate cities need to satisfy the following criteria:
  - Must be willing to cooperate and provide necessary data
  - Pedestrian and traffic volume data from counts conducted within the past five years
  - Other required location data, such as signal timing charts, land use maps, etc., should be readily available.
  - Crash data must be available
  - Cities should have an adequate sample of signal timing types.
  - Candidate cities shall represent a variety of density, traffic laws and pedestrian attitudes.

- 1297 intersections in 15 cities were selected across US were selected for the study. All of the intersections had the following features:
  - All intersections had four approaches w/no unusual features.
  - All intersections had traffic signals, some intersections had pedestrian signal indications and some intersections did not.
  - All intersections were in urban or suburban areas.



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**SITE SELECTION, continued**

- Differences at the intersections were;
  - Varying pedestrian timing schemes. (Exclusive, pedestrian or no pedestrian signal).
  - Range of pedestrian volumes, (between 50 and 50,000 pedestrians per day) and traffic volumes (between 1600 and 78000 entering vehicles per day)
  - Land use of each intersection was split between commercial, residential or recreational.
  - Variety of roadway features, such as, number of lanes, turn prohibitions and the presence/absence of right turn on red.
  - Of the 1297 intersections, 507 did not have signal indications, 652 intersections had concurrent phasing, 109 intersections had an exclusive pedestrian phasing and 34 intersections had early or late release phasing.

**DATA COLLECTION**

- Data Collection effort usually involved one or more visits to the cities to obtain traffic, accident, and roadway data as well as field surveys to obtain pedestrian volume counts.

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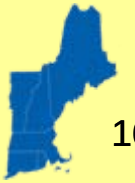

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## CHARACTERISTICS OF PEDESTRIAN ACCIDENTS

- Crash Data collected and analyzed consisted of 2081 accidents that occurred at the 1297 intersections.
- Crash period ranged from three to six years.
- Crash data in the study was from five large urban areas. (Chicago, Washington, D.C., Toledo, OH, Detroit and Seattle). The crashes in these five areas represent 88% of the accidents in the study.
- Summary of Pedestrian Crash Data
  - 40% of the crashes involved the young and older pedestrians.
  - Males are hit more often than females.
  - Approximately 60% of the pedestrian crashes involved vehicles proceeding straight, left turning vehicles accounted for 22.5% of the crashes and right turning vehicles accounted for almost 15% (actual is 14.8%) of the crashes.
  - Approximately one half of the pedestrians crashes are caused by pedestrians in violation of the traffic or pedestrian signal and the remaining half were caused by motorists that failed to observe or yield to pedestrians.

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- General Conclusions:
  - The presence or absence of a pedestrian signal indication had no significant affect on the pedestrian crash experience.
  - As the average annual daily traffic and the pedestrian average daily traffic increased the mean annual pedestrian crashes per location also increased (See Slides No. 19, 20, 21)

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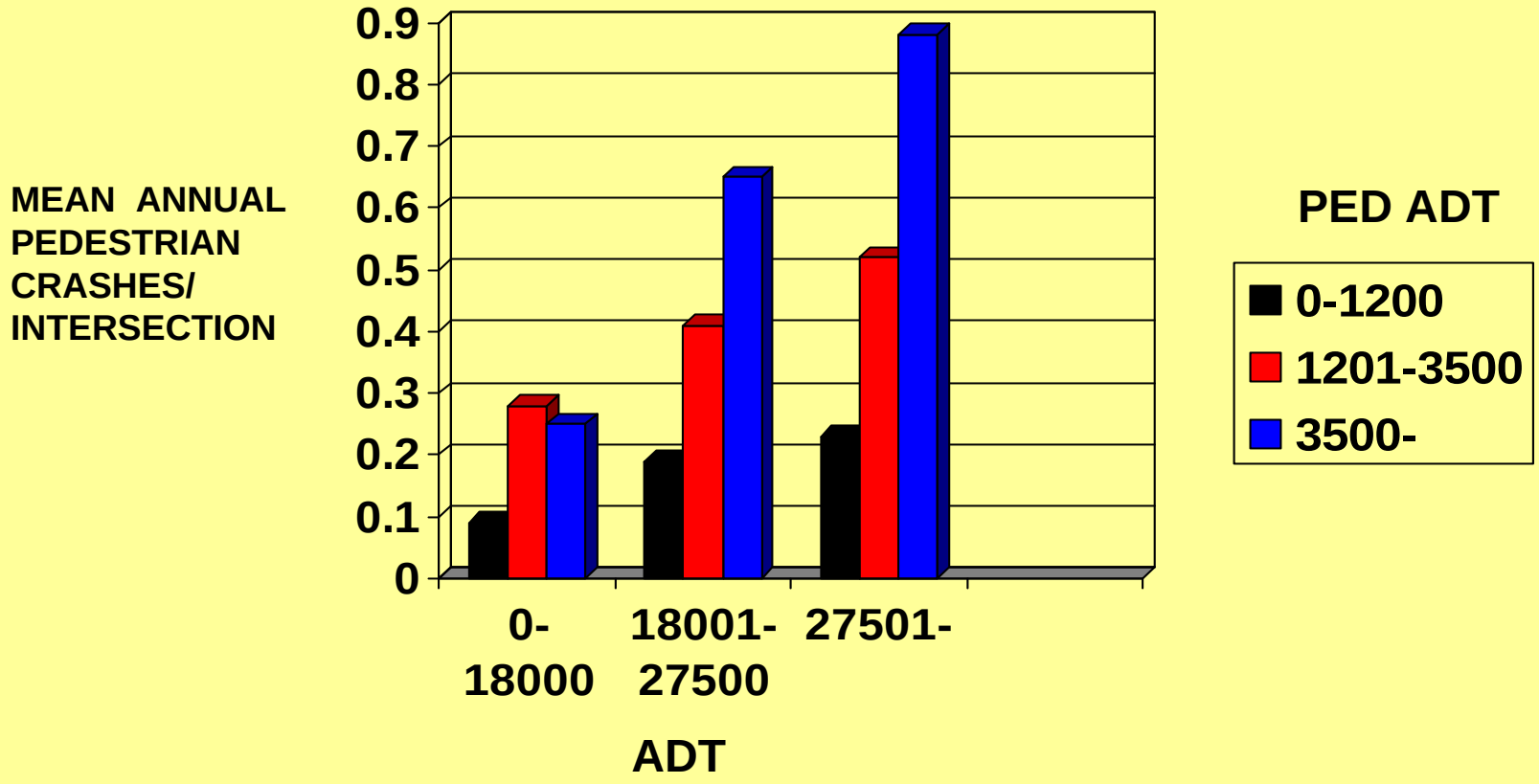
## NO PEDESTRIAN SIGNAL INDICATIONS



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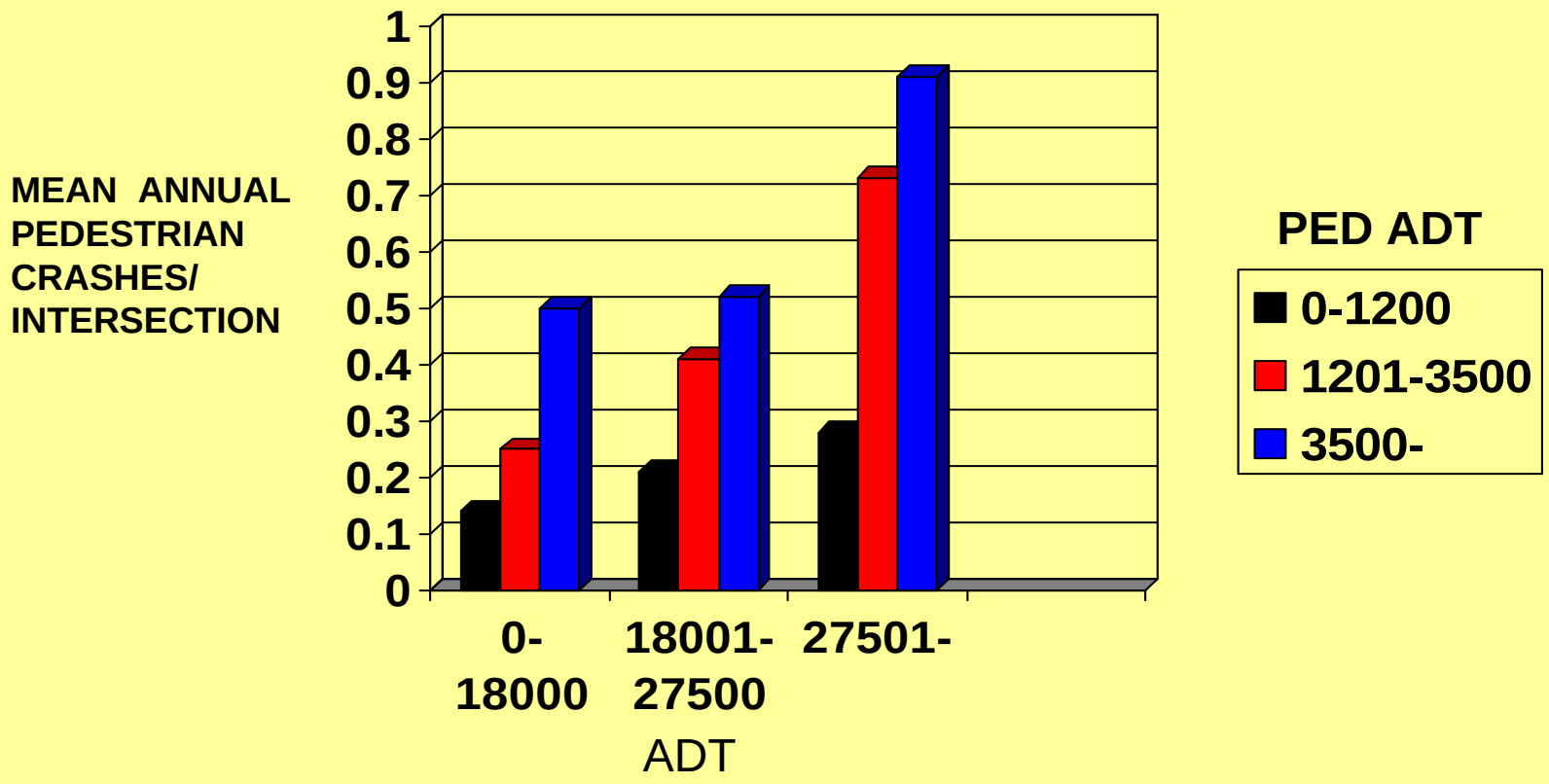
## CONCURRENT PEDESTRIAN SIGNAL TIMING



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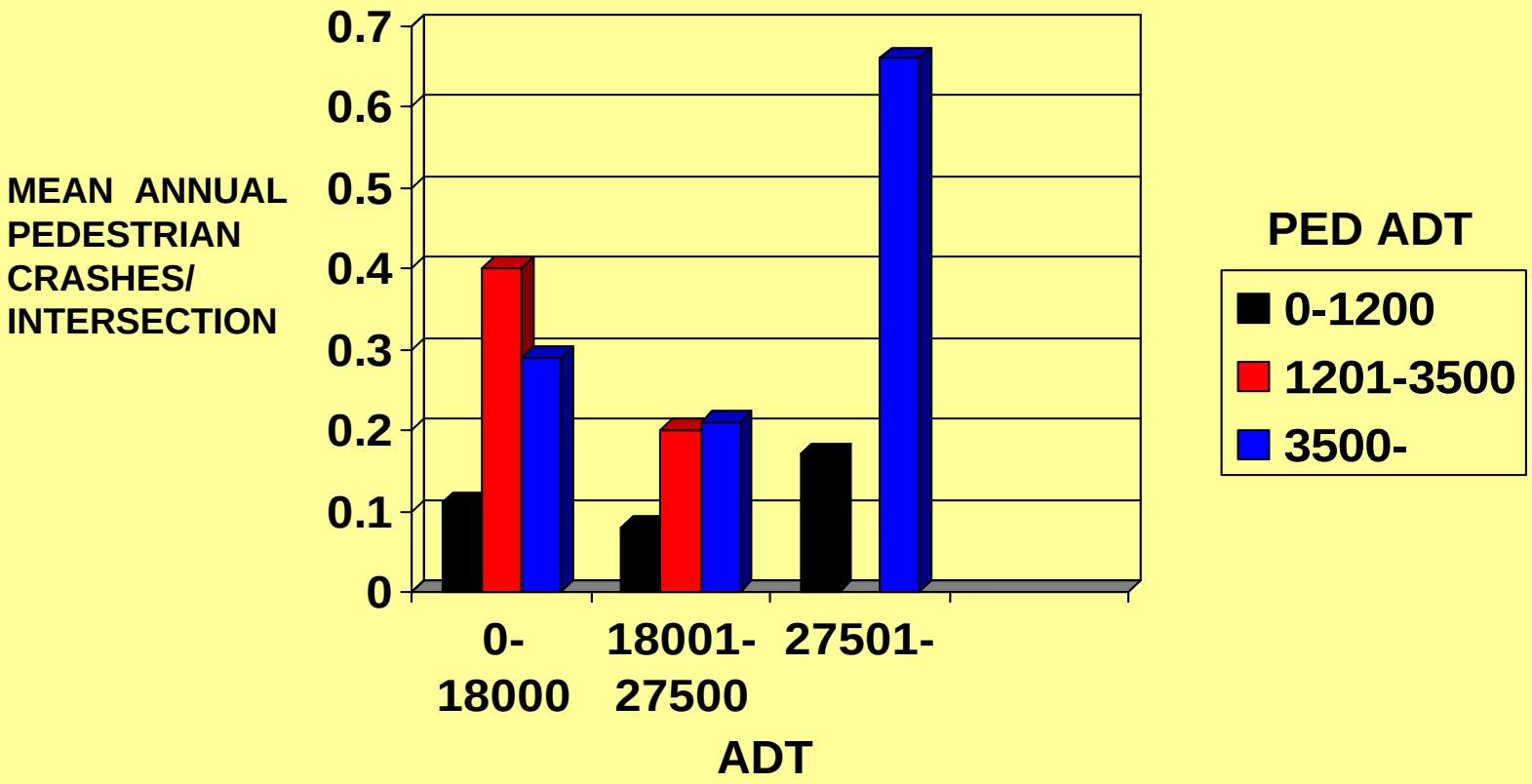
## EXCLUSIVE PEDESTRIAN SIGNAL TIMING



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- Other variables that were found to be of some importance:
  - Bus operation -- The presence of buses was found to be an important factor at in pedestrian crashes at locations that average greater than 1000 pedestrians per day and had concurrent pedestrian timings or no pedestrian signals.
  - Street operation -- for intersections whose pedestrian ADT was greater than 8000, pedestrian crashes were much lower at the intersection of two-one way streets than for the intersection of two-two way streets.
  - Area Type -- Higher pedestrian crash rate at intersections located in residential areas (as opposed to business and recreational areas) that had a bus route and pedestrian ADT greater than 1000.
  - Street approach width – Street widths with a width of greater than 50 ft and pedestrian ADT's greater than 1000 were associated with higher pedestrian crash rates.

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**SUMMARY AND CONCLUSIONS**

- Using statistical analysis the authors have made the following conclusions:
  - The use of concurrent timed pedestrian was found to have no significant effect on pedestrian accident distributions or pedestrian accident frequencies.
  - The presence of exclusive pedestrian timing was associated with significantly lower pedestrian accident distributions or frequencies when compared to intersections with concurrent timed pedestrian signals and no pedestrian signals.
  - The number of pedestrian crashes that involved turning vehicles was significantly higher for locations that had concurrent timed pedestrian signals when compared to intersections that had no pedestrian signal indications. This could be explained by the possibility that pedestrians are less cautious or fail to look for turning vehicles when they see a “WALK” signal indication.
  - Pedestrian volume is the is the single most important variable in explaining the variation pedestrian crashes. Traffic volume is the second most important variable in explaining pedestrian crashes.
  - Urban area types had significantly higher crashes than other area types.
  - Street operation – one way streets vs. two way streets
  - The presence of bus routes was associated with higher pedestrian crashes.

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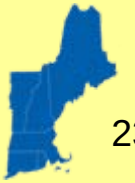

The summary and conclusions of the two reports reinforces MassDOT's use of the exclusive pedestrian phase. MassDOT will consider concurrent pedestrian phase's on a case by case basis. It is our opinion that the exclusive pedestrian phase will give the pedestrian the best opportunity to cross the street safely.


## ACKNOWLEDGEMENTS

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