An Informational Report on Pedestrian Countdown Signals (PCS)
Transportation Association of Canada (TAC)
Traffic Operation & Management Standing Committee

Pedestrian Countdown Signal Project Steering Committee Members:

Chi Y. Lee, Traffic Engineer, City of Red Deer, Alberta (Chair)
Chris Brinkmann, Traffic Operations Division, City of Ottawa, Ontario
Mavis Johnson*, The Canadian Traffic Safety Institute, Burnaby, British Columbia
Robert Kahle, Chef de la division circulation direction voirie, Ingénieur de section, Ville de Montréal, Québec
Dave Keenan, Manager of Signals Division, City of Calgary, Alberta
Steven Kodama, Manager of Traffic Data Centre & Safety Bureau, City of Toronto, Ontario
Michel Masse, Ingénieur, Ministre des Transports, Québec, Québec
Don McDonald, Director of Signals & Street Lighting, City of Edmonton, Alberta
Ron Stewart, Senior Associate, IBI Group, Toronto, Ontario
Simon Tam, Supervisor of Signals & Systems, City of Hamilton, Ontario
Rob Wanless, Vice President of Transportation Planning, Marshall Macklin Monaghan, Thornhill, Ontario
Alison Wong, Road Safety Engineer, North Vancouver, British Columbia
Katarina Cvetkovic, TAC Secretariat

Other Agency Staff Participating in the Project:

Alex Mawanay, Traffic Signals Engineer, Traffic Operations Branch, City of Edmonton, Alberta
Rebecca Clark, Traffic Signal Technician, City of Red Deer, Alberta
Heather Calvert, Traffic Analysis Technician, City of Red Deer, Alberta

* Resigned from Committee in February 2004.
CONTENTS

1 SUMMARY

5 CHAPTER 1 INTRODUCTION
1.1. Background, 5
1.2. Study Approach & Report Organization, 5

6 CHAPTER 2 STATE OF PRACTICE
2.1. Survey Method, 6
2.2. Profile of Persons Surveyed, 6
2.3. Survey Results, 6
  2.3.1. Three Configurations and Six Countdown Timing Strategies, 7
  2.3.2. Geographical Distribution of PCS Installations, 8
  2.3.3. PCS Configurations by Region, 9
  2.3.4. PCS Countdown Strategies by Regions, 10
  2.3.5. The Quebec PCS Standard, 10
  2.3.6. Opinions on PCS Installation Criteria & Concerns, 10

11 CHAPTER 3 SUMMARY FINDINGS OF NINE PCS ISSUES
3.1. Do Pedestrians Understand Conventional Pedestrian Signal Displays? 11
3.2. Do Pedestrians Understand Pedestrian Countdown Signal Displays? 11
3.3. Do Pedestrians Prefer Pedestrian Countdown Signals or Conventional
  Pedestrian Signals? 12
3.4. Do Pedestrian Countdown Signals Reduce Pedestrian Related
  Crashes? 12
3.5. Do Pedestrian Countdown Signals Lead to Increases in Vehicle Speeds
  and Acceleration to "Beat the Light"? 13
3.6. Do Pedestrian Countdown Signals Result in Pedestrians Running,
  Hesitating, or Turning Around? 13
3.7. Do Pedestrian Countdown Signals Result in the Abuse of the
  Pedestrian Signal Crossing Intervals? 13
3.8. Are Pedestrian Countdown Signals Beneficial for Seniors and Teens? 15
3.9. How do Pedestrian Countdown Timing Strategies Affect Pedestrian
  Signal Performance? 16
**CHAPTER 4  PCS LITERATURE & STUDY REPORTS**

4.1. Survey Measures Knowledge of Pedestrian Laws and Traffic Control Devices, 18
4.2. Evaluation of Pedestrian Understanding of Pedestrian Countdown Signals, Orlando, Florida, 18
4.3. Pedestrian Signals Countdown Device, Hampton, Virginia, 19
4.4. A Comparison of Pedestrian Signal Heads, 19
4.6. Pedestrian Signal Head Survey Report, Boulder, Colorado, 21
4.7. Behavioural Evaluation of Pedestrians and Motorists towards Pedestrian Countdown Signals, Monterey, California, 22
4.8. Countdown Pedestrian Signal Survey, Sacramento, California, 23
4.9. Pedestrian Countdown Indication – Market Research and Evaluation, Minneapolis, Minnesota, 24
4.10. The Effects of Pedestrian Countdown Signals in Lake Buena Vista, California, 25
4.11. San Francisco Pedestrian Countdown Signals: Preliminary Evaluation Summary, 26
4.12. Pedestrian Countdown Signals: An Experimental Evaluation, San Jose, California, 27
4.13. Pedestrian Countdown Devices: Edmonton’s Pilot Project, 28
4.15. Countdown Timer Survey, Salt Lake City, Utah, 30
4.16. City of Fountain Valley Countdown Pedestrian Signal Evaluation, 30
4.17. Evaluation of Pedestrian Countdown Signals in Montgomery County, Maryland, 31
4.18. Pedestrian Countdown Signal Study, Clackamas County, Oregon, 32
4.19. Canadian Research on Pedestrian Safety, 32

**CHAPTER 5  COMPARISON OF PCS STANDARDS**

5.1. Technical Specifications Comparison (for 7 Manufacturers), 33
5.2. Signal Head Specification Comparison (for 3 Jurisdictions), 33
5.3. Installation Specification Comparison (for 3 Jurisdictions), 33
5.4. Operation Strategies Comparison (for 3 Jurisdictions), 33
5.5. Usage Warrants Comparison (for 6 Jurisdictions), 33
5.6. Quebec PCS Head Configurations, 33
SUMMARY

In April 2003, the Traffic Operations & Management Standing Committee (TOMSC) of the Transportation Association of Canada struck a volunteer project steering committee to investigate the feasibility of adopting guidelines for the "Optional Use of Pedestrian Countdown Timers" into the Manual of Uniform Traffic Control Devices of Canada (MUTCDC).

The Project Committee surveyed 194 North American jurisdictions to identify the quantity, location, configuration, operation strategy, and operation experiences of existing Pedestrian Countdown Signals (PCS) installed. The survey showed that 1756 PCS were installed in 71 jurisdictions in Year 2003. More than 360 additional PCS are planned for installation in 48 jurisdictions in 2004. The existing and proposed PCS comprise of about 10% of all traffic signals in the jurisdictions responding with existing PCS. Three PCS configurations and six countdown timing strategies are being used. The most widely used PCS configuration is the "Separate Countdown Housing" configuration, as shown in Figure 1-B and 1-B1. The most widely used countdown strategy is counting down the flashing HAND (or flashing DON'T WALK) interval only. The New York State Department of Transportation with about 500 PCS and the City of Montreal with 260 PCS are the two largest PCS users. Combined, these two jurisdictions accounted for about half of all PCS installed among North American respondents to the survey.

The North American wide survey provided an overview of existing PCS practices; and a list of 85 conditions (Table 1) in which traffic signal operating agencies feel PCS may be beneficial or harmful. These are grouped into major issues for investigation. A fact-finding exercise followed. Reported experiences, empirical field surveys and laboratory simulation studies were reviewed. A total of 41 literatures were reviewed. The review showed that:

1. 26% - 80% of all pedestrians did not understand the meaning of the conventional flashing HAND display.

2. 50% - 97% of pedestrians understood the meaning of the Pedestrian Countdown Timer display; and 78% - 94% of pedestrians found the PCS easier to understand than conventional pedestrian signals. However, more pedestrians incorrectly believe they are permitted to enter on the flashing HAND display at PCS installations. Pedestrians were using the PCS to decide when to start crossing.

3. 80% - 92% of pedestrians felt the PCS was an improvement over the conventional pedestrian signals because the PCS provides the additional information on "how much time is remaining to cross".
4. PCS does not appear to increase crashes or conflicts. Two of the studies provide indications that PCS would reduce pedestrian-vehicle conflicts.

5. There were no noticeable changes in vehicle speed, acceleration, signal violation or other vehicle behaviour after PCS were installed.

6. No change was observed for pedestrians stopping, hesitating or turning-around.

7. Pedestrians exiting during steady HAND periods predominately decreased with PCS installation.

8. Under PCS control, the proportion of teenagers crossing properly and being successfully serviced increased by 20%. However, there are incidences of teens trying to "beat the light".

9. Under PCS control, seniors crossing properly and being successfully serviced increased by 11%. However, more seniors entered during the WALKING PEDESTRIAN and exited during the steady HAND intervals, showing a need for longer clearance time for seniors.

10. If the PCS countdowns were to start from the WALKING PEDESTRIAN interval, blank or erroneous countdown numbers would be displayed. This can occur when the durations of consecutive WALK intervals vary during timing plan changes, actuated operations, emergency vehicle pre-emptions, transit pre-emptions, or manual control of the signal through the police panel. In 2003, the US MUTCD adopted a standard that the countdown display is to countdown the flashing HAND period only. Countdown displays during the WALKING PEDESTRIAN interval shall not be used.

As PCS are relatively new, many practitioners are required to form opinions and make decisions on the installations (or non-installations) of Pedestrian Countdown Timers without the benefit of factual performance evidences. There is a need to synthesize available information to assist practitioners in forming judgments on Pedestrian Countdown Timer installations. Therefore, this Report provides:

1. Summary findings of nine most commonly raised PCS installation issues.
2. Summaries of 19 PCS studies.
3. Comparisons of the PCS technical specifications, signal head specifications, installation specifications, countdown timing strategies and usage warrants for seven manufacturers and six jurisdictions.
4. 15 graphical comparisons of existing PCS installations in 61 jurisdictions and five regions of North America.
Based on this information, the Project Steering Committee and the Traffic Operations & Management Standing Committee (TOMSC) of the Transportation Association of Canada recommend (details outlined in Chapter Six of this Report):

1. PCS be adopted as an optional device for installation at locations where pedestrian signal heads are installed.
2. The "Separate Countdown Housing" configuration, as shown in Figure 1-B, be used as the standard configuration. The "Overlap/Countdown Side by Side" configuration (Figure 1-A) and the "Separate Countdown Housing with no Overlap" configuration (Figure 1-B1) may also be used under retrofit situations.
3. The PCS is to count down during the flashing HAND pedestrian clearance period only (Figure 2-4).
4. The PCS Information Sign shown in Figure 19 may be installed adjacent to the pedestrian pushbuttons to inform pedestrians of the usage of the PCS.
5. Signal controller manufacturers and pedestrian countdown display manufacturers are encouraged to jointly develop technology to consistently show the correct information, enabling count down from the start of the WALKING PEDESTRIAN period.

Several information gaps and innovative pedestrian signalization alternatives warrant further research. More effective usage of PCS in the future would benefit from this research:

1. Although existing research shows PCS provides improvements to various pedestrian safety surrogates, the real measure of pedestrian safety is the "number of pedestrian crashes reduced". Before and after studies should be conducted to document the change in pedestrian crashes and other traffic crashes, after the installation of PCS.

2. Conduct empirical evaluation of alternative PCS configurations and timing strategies on pedestrian crash reductions. This Report identifies the configurations and timing strategies associated with existing PCS study results at different jurisdictions. Critical review of pedestrian crash records at these jurisdictions could give a better indication of the comparative safety effect of different PCS configurations and timing strategies.

3. Develop accident prediction models for the installation of PCS. Disciplined criteria for the installation of PCS and pedestrian signals require confident prediction of the effect of these devices on pedestrian crashes.
4. The Quebec PCS and the UK Puffins (Section 7.1) eliminated the use of the flashing HAND pedestrian clearance interval and its associated confusion to the public. Empirical field surveys and comparative analysis of pedestrian crash records should be conducted to confirm the relative effectiveness of the Quebec PCS and the UK Puffins on pedestrian crash reductions and other pedestrian safety surrogates.
Chapter 1
INTRODUCTION

1.1. Background

Pedestrian Countdown Signals have been installed in some cities. The countdown device shows a descending numerical countdown to indicate to pedestrians the number of remaining seconds available for their crossing. Without a national standard, the installations will continue to increase but will vary in application, configuration and operation. There is a need for a standard before the variations become more widespread and cause public confusion.

In April 2003, the Traffic Operations & Management Standing Committee (TOMSC) of the Transportation Association of Canada struck a project steering committee to investigate the feasibility of adopting guidelines that will provide “An Informational Report on PCS”, which can be placed into the Manual on Uniform Traffic Control Devices of Canada. The objectives of the investigations are:

1. Identify conditions under which PCS are effective.
2. Recommend the preferred PCS configurations and layout.
3. Recommend a PCS operation guideline.

1.2. Study Approach & Report Organization

The investigation consists of:
1. A survey of North American jurisdictions to identify the quantity, location, configuration, operation strategy and operation experiences of existing PCS installed. Descriptions of the survey methods and survey results are in Chapter 2 of this Report.
2. Analysis of nine commonly raised PCS issues in Chapter 3.
3. Summaries of 19 PCS literature in Chapter 4. The literature was reviewed to assess available research results for the effectiveness, benefits, disadvantages and other potential issues related to PCS installations.
4. Identifying the PCS specifications of selected suppliers and government jurisdictions for comparison in Chapter 5.
5. Recommending PCS usage guidelines, configurations, and countdown timing strategies in Chapter 6.
6. Identifying further research for enhancing PCS usage effectiveness in Chapter 7.
Chapter 2
STATE OF PRACTICE

2.1. Survey Method

To provide a low cost and quick response survey:
1. An eight-question survey form (Appendix A) was prepared.
2. A list of 2,658 email addresses of all ITE (Institute of Transportation Engineers) members that work in governments were compiled based on information listed in the ITE Membership Directory. The email addresses were organized by regions and by federal, provincial, state and local governments.
3. Survey questionnaires were emailed to all persons on this list and they were asked to pass the survey to the appropriate persons for response.
4. A follow-up reminder was sent to all those who had not replied to the survey after approximately 21 days.
5. Some survey forms were also sent out to jurisdictions that were reported to have PCS installations based on literature reports, personal observations, and referrals by the U.S. Federal Highway Administration and others.
6. Follow up telephone and email interviews were conducted with some respondents to clarify the information provided in their replies.

2.2. Profile Of Persons Surveyed

Over 263 survey forms were sent out to ITE members who work for governments in Canada; of which 213 work for county or local governments, 47 work for provincial governments and three work for the Canadian Federal Government.

In the United States, 2396 survey forms were sent out to 1694 county and local government members, 558 state government members and 144 U.S. Federal Government ITE members.

A profile of the persons surveyed broken down by countries and government level is shown in Appendix B.

2.3. Survey Results

The survey was intended for persons working in government jurisdictions that operate traffic signals. Responses to the email survey were received from 193 jurisdictions. Jurisdictions with several ITE members received multiple survey forms but usually replied with one response. Few responses were received from persons
working at the Canadian Federal Government, the U.S. Federal Government, government planning offices, transit departments etc. since these agencies do not operate traffic signals.

2.3.1. Three Configurations and Six Countdown Timing Strategies

The survey shows that three PCS configurations and six countdown timing strategies are presently being used. The three PCS configurations are shown in Figure 1:

A. Overlap/Countdown Side by Side Configuration: "WALKING PEDESTRIAN & HAND Overlay" placed side by side with "Countdown Numbers" in one signal head housing.

B. Separate Countdown Housing Configuration: "WALKING PEDESTRIAN & HAND Overlay" in one housing or separated in two housings with "Countdown Numbers" in a separate signal head housing.

C. All in One Overlap Configuration: "WALKING PEDESTRIAN, HAND & Countdown Numbers Overlay" in one signal head housing.

The six countdown timing strategies are shown in Figure 2:

1. **WALK\textsuperscript{a} to FDW\textsuperscript{b} Strategy**: The countdown starts at the beginning of the WALKING PEDESTRIAN symbol (WALK) period and ends at the end of the flashing HAND symbol (flashing DON’T WALK) period.

2. **WALK\textsuperscript{a} to Amber Strategy**: The countdown starts at the beginning of the WALKING PEDESTRIAN symbol (WALK) period and ends at the end of the Amber period.

3. **WALK\textsuperscript{a} to All Red Strategy**: The countdown starts at the beginning of the WALKING PEDESTRIAN symbol (WALK) period and ends at the end of the All Red period.

4. **FDW\textsuperscript{b} Only Strategy**: The countdown starts at the beginning of the flashing HAND symbol (flashing DON’T WALK) period and ends at the end of the flashing HAND symbol (flashing DON’T WALK) period.

5. **FDW\textsuperscript{b} to Amber Strategy**: The countdown starts at the beginning of the flashing HAND symbol (flashing DON’T WALK) period and ends at the end of the Amber period.

6. **FDW\textsuperscript{b} to All Red Strategy**: The countdown starts at the beginning of the flashing HAND symbol (flashing DON’T WALK) period and ends at the end of the All Red period.

\textsuperscript{a} WALKING PEDESTRIAN
\textsuperscript{b} flashing HAND (flashing DON’T WALK)
2.3.2. Geographical Distribution Of PCS Installations

The geographical distributions of PCS installations are shown on three maps of North America in Figures 3, 4 and 5. The maps are divided into five regions – Canada, U.S. Northwest, U.S. Northeast, U.S. Southwest and U.S. Southeast:

- Figure 3 shows the location of jurisdictions that responded with existing, proposed, or no PCS installations.
- Figure 4 shows the configuration used by each of the jurisdictions with PCS.
- Figure 5 shows the countdown timing strategy used by each of the jurisdictions with PCS.

Figures 6 to 13 provide more detailed analysis of PCS usage in each jurisdiction and geographical region. As only partial data are available in some of the survey responses, only jurisdictions with sufficient data are included in each analysis.

Proportion of PCS installation by jurisdictions:
Out of the 194 jurisdictions that responded to the survey, PCS were in operation in 71 (37%) jurisdictions in 2003, and being planned for 14 (7%) more jurisdictions in 2004. No PCS are being planned or in operation in the remaining 109 (56%) jurisdictions. About half of the jurisdictions with existing PCS plan to install more in 2004. This is shown in Figure 6. The existing and proposed PCS installations are evenly spread among the five regions in North America. Figure 7 shows the proportion of jurisdictions with PCS in each region as a percentage of all jurisdictions with PCS in that region, and as a percentage of all jurisdictions with PCS in North America.

Of the Canadian respondents with PCS installations in 2003, PCS as a proportion of total existing traffic signals in their jurisdiction range from 2% to 100%. All but two jurisdictions that responded have PCS at less than 10% of their pedestrian signals. Burnaby, B.C. is the only Canadian city with PCS installed at all their signals. Minor PCS additions are proposed in 2004 by the other jurisdictions. This is shown in Figure 9.

For the United States respondents, PCS as a proportion of total existing traffic signals in their jurisdiction range from 1% to 100%. City of Fountain Valley, California is the only U.S. city with PCS installed at all their signals. Four other cities (Thornton, Colorado; Broomfield, Colorado; Salt Lake City, Utah; and Myrtle Beach, South Carolina) planned to install PCS at all their signals in 2004. The highest proportion of signals with PCS is in the US Northwest (12%), followed by Canada (6%) and the US Southwest (6%) respondents. The highest proportion (4%) of signals proposed for PCS installation in 2004 is in the US Northwest. This is shown
in Figure 8. Figures 10 to 13 provide a more detailed review of PCS installations in each of the four U.S. regions.

Number of PCS installation by jurisdictions:
Among those jurisdictions that responded to the survey, about 1756 PCS were in operation in 2003. More than 360 additional PCS are planned for installation in 2004. The existing and proposed PCS comprise about 10% of all traffic signals in the jurisdictions that responded with existing PCS. The New York State Department of Transportation has the largest number (500) of PCS in operation. This is followed by the City of Montreal with about 260 PCS; Burnaby, B.C. with 198 PCS; and Salt Lake City, Utah with 111 PCS in 2003. Montreal accounted for about 50% of all existing PCS among Canadian respondents. The New York State Department of Transportation accounted for 40% of all PCS installed among U.S. respondents. Combined, these two jurisdictions accounted for about half (43%) of all PCS installed among North American respondents.

2.3.3. PCS Configurations By Region

Figures 14 and 15 provide more detailed analysis of PCS configurations in each geographical region. Again, only jurisdictions with sufficient data provided are included in each analysis.

As shown in Figure 14, the "Separate Countdown Housing" configurations (Figures 1-B and 1-B1) are used in the largest number (about 65% of existing PCS installations), in North America. Montreal, New York and Burnaby (the three jurisdictions with the largest number of PCS) used this configuration. It is also the most used configuration in the regions that New York (US Northeast) and Montreal and Burnaby (Canada) belong to. Nearly all PCS in the remaining three regions of the U.S. is of the "Overlap / Countdown Side by Side" configuration (Figure 1-A). The US MUTCD adopted the "Separate Countdown Housing" configuration (Figure 1-B and 1-B1) as standard in Year 2003.

Figure 15 shows that the "Overlap / Countdown Side by Side" configuration (Figure 1-A) is used in the largest number (about 67%) of jurisdictions with existing PCS installations in North America. It is used by most jurisdictions in all regions, except the US Northeast. The "Separate Countdown Housing" configurations (Figures 1-B and 1-B1) are used by most jurisdictions in the US Northeast.

None of the survey respondents indicated they use the "All in One Overlay" configuration (Figure 1-C).
2.3.4. PCS Countdown Strategies By Region

Figures 16 and 17 provide more detailed analysis of PCS countdown timing strategies in each geographical region. Only jurisdictions with sufficient data provided are included in each analysis.

As shown in Figure 16, the "FDW Only" (Figure 2-4) countdown strategy and the "WALK to FDW" (Figure 2-1) countdown strategy are the two most commonly used strategies. The "FDW Only" (Figure 2-4) countdown strategy is used at 79% of all PCS installations in the U.S (or 57% of all existing PCS installations in North America). The "FDW Only" (Figure 2-4) countdown strategy is used in more PCS installations, in three of the five regions (US Northeast, US Southeast, US Southwest).

The "WALK to FDW" (Figure 2-1) countdown strategy is used in nearly all PCS in Canada. Both "WALK to FDW" (Figure 2-1) and "FDW Only" (Figure 2-4) countdown strategies are used in about the same number of PCS installations in the US Northwest.

As shown in Figure 17, the "FDW Only" (Figure 2-4) countdown strategy is used at 51% of all jurisdictions with PCS surveyed in North America. The "FDW Only" (Figure 2-4) countdown strategy is the most widely used by jurisdictions in all regions except Canada. The "WALK to FDW" (Figure 2-1) countdown strategy is the most widely used by different Canadian jurisdictions that responded to the survey.

2.3.5. The Quebec PCS Standard

In Canada, the Province of Quebec uses the PCS configuration shown in Figure 1-B1. Detailed layout and dimensions are shown in Figure 18. The WALKING PEDESTRIAN, HAND and "Countdown Numbers" are displayed in three separate housings. The countdown "WALK to FDW" strategy is stipulated with the exception that the flashing HAND display is eliminated. Pedestrians are shown the WALKING PEDESTRIAN symbol with the countdown numbers descending from the beginning of the WALKING PEDESTRIAN interval and continue descending till the end of the "pedestrian clearance" interval. This is followed by the steady HAND symbol with the number "0" being displayed.

2.3.6. Opinions On PCS Installation Criteria & Concerns

The survey asked respondents’ opinions on the benefits and concerns about PCS installation and suggest conditions under which PCS should or should not be installed. These comments are taken directly from the survey responses and summarized. See Table 1 in Appendix C.
This Chapter provides the summary findings on nine most commonly raised PCS issues based on reports of empirical field performance surveys, pedestrian interviews, before/after studies, and laboratory simulations. The nine issues are:

1. Do pedestrians understand conventional pedestrian signal displays?
2. Do pedestrians understand pedestrian countdown signal displays?
3. Do pedestrians prefer pedestrian countdown signals or conventional pedestrian signals?
4. Do pedestrian countdown signals reduce pedestrian related crashes?
5. Do pedestrian countdown signals lead to increases in vehicle speeds and acceleration to "Beat the Light"?
6. Do pedestrian countdown signals result in pedestrians running, hesitating, or turning around?
7. Do pedestrian countdown signals result in abuse of the pedestrian signal crossing intervals?
8. Are pedestrian countdown signals beneficial for seniors and teens?
9. How do pedestrian countdown timing strategies affect pedestrian signal performance?

3.1. Do Pedestrians Understand Conventional Pedestrian Signal Displays?

*Studies conducted:* Five studies reviewed this issue. The studies were conducted between 1984 and 1999, in one Canadian city, two U.S. cities and 48 U.S. states.

*Results:* The studies showed that 26% - 80% of all pedestrians did not understand the meaning of the conventional flashing HAND display.

Individual findings of the studies are summarized in Table 2, in Appendix C.

3.2. Do Pedestrians Understand Pedestrian Countdown Signal Displays?

*Studies conducted:* Fifteen studies reviewed this issue. The studies were conducted between 1995 and 2003, in nine U.S. cities and in the US Federal Highway Administration’s simulation laboratory.

*Results:* The studies showed that 50% - 97% of pedestrians understood the meaning of the Pedestrian Countdown Timer display; and 78% - 94% of pedestrians found the PCS easier to understand when compared to conventional pedestrian signals. The
FHWA simulation laboratory studies also found that 15% - 21% more people understood the appropriate action for a PCS than for a conventional flashing HAND display. The studies also found that more pedestrians incorrectly believe they are permitted to enter on the flashing HAND display at PCS installations. Pedestrians were using the PCS to decide when to start crossing.

Individual findings of the studies are summarized in Table 3 in Appendix C.

3.3. **Do Pedestrians Prefer Pedestrian Countdown Signals or Conventional Pedestrian Signals?**

*Studies conducted:* Thirteen studies reviewed this issue. The studies were conducted between 1994 and 2003, in two Canadian cities, nine U.S. cities and in the FHWA simulation laboratory.

*Results:* The studies showed that 80% - 92% of pedestrians felt the PCS was an improvement over the conventional pedestrian signals. This finding is consistent at all 11 cities studied and is also reported to be consistent at all nine intersections observed in San Francisco. The most cited reason for preferring PCS is "knowing how much time remaining to cross".

Individual findings of the studies are summarized in Table 4, in Appendix C.

3.4. **Do Pedestrian Countdown Signals Reduce Pedestrian Related Crashes?**

*Studies conducted:* Five studies reviewed this issue. The studies were conducted between 1994 and 2003, in one Canadian city and four U.S. cities.

*Results:* The five studies are consistent in finding that PCS does not appear to increase crashes or conflicts. Two of the studies provide indications that PCS would reduce pedestrian-vehicle conflicts. This needs to be confirmed by more studies in different cities.

Determining if PCS reduces pedestrian-related crashes would require data to be collected over several years. Most North American PCS were installed in recent years. It is unlikely that such study results would be available in the short term.

Individual findings of the studies are summarized in Table 5, in Appendix C.
3.5. Do Pedestrian Countdown Signals Lead to Increases in Vehicle Speeds and Acceleration to "Beat the Light"?

*Studies conducted:* Five studies reviewed this issue. The studies were conducted between 1999 and 2003, in one Canadian city and four U.S. cities.

*Results:* The five studies showed that there were no noticeable changes in vehicle speed, acceleration, signal violation or other vehicle behaviour, after PCS were installed. This finding is consistent at all five cities studied.

Individual findings of the studies are summarized in Table 6, in Appendix C.

3.6. Do Pedestrian Countdown Signals Result in Pedestrians Running, Hesitating, or Turning Around?

*Studies conducted:* Five studies reviewed this issue. The studies were conducted between 2000 and 2003, in one Canadian city and four U.S. cities.

*Results:* The study results were not consistent. Three studies showed fewer pedestrians were running after PCS installation. One study showed no change and one study showed an increase in pedestrian running. No change was observed for pedestrians stopping, hesitating or turning-around.

Individual findings of the studies are summarized in Table 7, in Appendix C.

3.7. Do Pedestrian Countdown Signals Result in the Abuse of the Pedestrian Signal Crossing Intervals?

*Results:* The effect of pedestrian countdown signals on the pedestrian crossing intervals are consolidated in the following table. The bases of these consolidated findings are outlined in subsequent sections.
<table>
<thead>
<tr>
<th>Undesirable Pedestrian Signal Usages</th>
<th>Effect of PCS Installation</th>
</tr>
</thead>
<tbody>
<tr>
<td>A) Entered during WALK &amp; Exited during steady HAND</td>
<td>No significant change</td>
</tr>
<tr>
<td>B) Entered during steady HAND</td>
<td>No significant change</td>
</tr>
<tr>
<td>C) Entered during flashing HAND</td>
<td>Increased at some intersections. No change or decreased at other intersections</td>
</tr>
<tr>
<td>D) Exited during steady HAND</td>
<td>Predominately decreased</td>
</tr>
</tbody>
</table>

*Studies conducted on Issues A and B (above):* Three studies reviewed issues A and B in the above consolidated table findings. The studies were conducted between 1999 and 2002, in one Canadian city and two U.S. cities.

*Results:* The studies showed that there is no significant change in the proportion of pedestrians that:
A) Entered during WALK & exited during steady HAND displays.
B) Entered during the steady HAND display.

Individual findings of the studies are summarized in Table 8, in Appendix C.

*Studies conducted on Issue C:* Nine studies reviewed issue C in the above consolidated table findings. The studies were conducted between 1995 and 2003, in one Canadian city and eight U.S. cities.

*Results:* The studies showed:
C1) The proportion of pedestrians who entered during the flashing HAND clearance period increased at some and had no change or decreased at other intersections.
C2) There are indications that pedestrians who entered during the beginning of the flashing HAND period (when the countdown number is high) increased while those who entered during the last five seconds of the flashing HAND period decreased.

*Studies conducted on Issue D:* Ten studies reviewed Issue D in the above consolidated table findings. The studies were conducted between 1995 and 2003, in one Canadian city and nine U.S. cities.

*Results:* The studies showed:
D) The proportion of pedestrians who exited during the steady HAND period predominately decreased. Decreases were observed at six cities. Both increases
and decreases were observed at two cities. No change was observed at two other cities.

Individual findings of the studies are summarized in Table 9, in Appendix C.

3.8. Are Pedestrian Countdown Signals Beneficial for Seniors and Teens?

Studies conducted: Nine studies reviewed this issue. Quantified survey results are provided by the 2003 FHWA pedestrian simulation study and by pedestrian surveys conducted between 1995 and 1999, in Sacramento, Monterey and Minneapolis. Opinions on this issue are also expressed in five other studies.

Results: The study results are as follows:

Teens
1. An overwhelming majority of seniors and teens respectively felt PCS are clearer, easier to understand, and make them feel safer. This finding is consistent at all three cities (Sacramento, Monterey and Minneapolis).
2. Minneapolis’ field survey showed that under PCS control, the proportion of teens entering and exiting during the steady HAND interval decreased by 18%. Teens crossing properly and being successfully serviced increased by 20%.
3. The author’s opinion in the study at one city (Region of York) is that PCS should be installed near schools. The author’s opinion in the studies at another city (Lake Buena Vista) is that teens may try to "beat the light" at a PCS. The City of Fountain Valley also cited one complaint of children trying to "beat the light".

Seniors
4. While the majority of seniors felt a PCS is an improvement, many felt that it provided insufficient crossing times for pedestrians.
5. Under PCS control, seniors crossing properly and being successfully serviced increased by 11%. However, more seniors entered at WALK and exited during the steady HAND period. This appears to be consistent with the findings in point (4) above. This could indicate that when given the feeling of security and safety by the PCS, seniors would take the longer time they required to cross an intersection when not being hurried.
6. All four quantified survey studies showed that seniors have a lower level of understanding of the pedestrian clearance period (PCS or conventional) than the other age groups. FHWA laboratory simulation study identified that almost all older adults correctly understand the pedestrian clearance period of PCS if the countdown starts at the beginning of the flashing HAND and goes blank 5 seconds before the end of the flashing HAND.
7. Opinions in the Lake Buena Vista, Edmonton, and York studies suggested PCS should be installed for seniors.
Individual findings of the studies are summarized in Table 10, in Appendix C.

3.9. **How do Pedestrian Countdown Timing Strategies Affect Pedestrian Signal Performance?**

Discussion on this issue is found in several publications.

A U.S. Federal Highway Administration study\(^{36}\) compares six PCS countdown-timing strategies with the standard MUTCD pedestrian crossing signal, to determine which strategies are better understood by pedestrians. The study report has not been finalized. The Draft Report indication is that:

a. "the countdown signal does not necessarily lead to higher comprehension than the standard signal"

b. "no countdown display timing strategy resulted in significantly better comprehension than the others"

c. Among different age groups, "the older adults experienced the greatest difficulties explaining the clearance interval". However, almost all older adults correctly understand the clearance period of PCS if the countdown starts at the beginning of the flashing HAND and goes blank 5 seconds before the end of the flashing HAND (Study Table 7)

The 1999 Minneapolis Study Report\(^{10}\), the 2002 Edmonton Study Report\(^{17}\), a 2003 written commentary from the City of Vancouver and a 2004 City of Montreal Report\(^{5}\) have all indicated technical difficulties if countdowns were to start from the WALK period.

1. The 1999 Minneapolis Study\(^{10}\) indicated that "the PCS was set to count down during the flashing HAND clearance interval only despite the equipment can allow countdown to start during the WALK person interval. The reason is emergency vehicle pre-emption can shorten the WALK interval."

2. The 2002 Edmonton Study\(^{17}\) indicated "PCS can be programmed to countdown during both the WALK and flashing HAND clearance phase or just during the FDW phase only. Edmonton chose to countdown during the flashing HAND phase only because if countdowns are to include the WALK phase, erroneous countdown numbers will be displayed during timing plan changes and fire pre-emption. Countdown devices count down based on what was displayed during the previous signal cycle."

3. The 2003 City of Vancouver commentary indicated, "These would work at most of our signals, provided that they begin timing at the start of the flashing HAND interval, which has a fixed duration at all times. We could not time them from the start of the WALK interval, because its duration varies. They would work at all signals where the flashing HAND changes to steady HAND at the start of the
amber, and this is how most of our signals work. The timer would reach zero simultaneously with the amber, and the conflicting green would start five seconds later. There would be no problem with permissive period operation or audible tones."

4. The 2004 City of Montreal Report\(^5\) recommended "limiting the display of the countdown to the pedestrian clearance period." The Report outlined several problems with countdown starting from the display of the white silhouette WALKING PEDESTRIAN and ending with the fixed orange HAND. The problems included missing or erroneous countdown displays during signal pre- emptions, signal timing plan changes, semi-actuated operation and manual control through the police panel; and difficulties in operating with conflict monitors or two-tone audible signals.

In 2003, the US MUTCD\(^29\) stipulated the following countdown strategy as standard: "If used, the display of the number of remaining seconds shall begin only at the beginning of the pedestrian change interval. After the countdown has terminated, the display shall remain dark until the beginning of the next countdown.

If used, the countdown pedestrian signal shall display the number of seconds remaining until the termination of the pedestrian change interval or until the termination of the concurrent vehicular phase’s green interval, whichever occurs first. Countdown displays during the walk interval shall not be used."
Chapter 4
PCS LITERATURE & STUDY REPORTS

This Chapter provides the summaries of 19 study reports on Pedestrian Countdown Signals. Whenever they can be identified, the PCS configuration and countdown timing strategies used in each study report are described at the beginning of each summary.

4.1. Survey Measures Knowledge of Pedestrian Laws and Traffic Control Devices

Road Injury Prevention & Litigation Journal 1997

This article summarized surveys in Transportation Research Record (TRR) 1502 "Driver and Pedestrian Comprehension of Pedestrian Law and Traffic Control Devices". The objective of the TRR survey was to identify specific traffic control devices that may be misunderstood. A two-page survey questionnaire was distributed at driver’s license examination stations in 48 states. Some of the results relevant to pedestrian signals are as follows:

1. Nearly half of the respondents incorrectly believed flashing HAND or upraised HAND signals mean pedestrians should return to the curb if they have just begun to cross at an intersection.
2. Just under half of respondents incorrectly assumed a steady WALK symbol or message meant they could cross safely without consideration for conflicts with traffic that also had the right-of-way; such as, right-turn-on-red or left-turn-on-green vehicles.
3. A majority of respondents incorrectly identified Pedestrian Crossing Signs to mean that a pedestrian crosswalk was 200 feet ahead instead of at the actual location of the crosswalk.

4.2. Evaluation of Pedestrian Understanding of Pedestrian Countdown Signals, Orlando, Florida

Dana Chester and Mark Hammond, 1998

A PCS was installed in a tourist area in Orlando, Florida. Survey shows that the vast majority of both U.S. and non-U.S. pedestrians understood the meaning of the PCS and found it to be an effective aid in crossing the intersection.
4.3. Pedestrian Signals Countdown Device, Hampton, Virginia
Lynn Edward Allsbrook, 1999

PCS were installed for a high-volume, pedestrian signalized intersection in downtown Hampton. Pedestrians using this intersection were interviewed. The results are as follows:

1. 26% did not understand the conventional pedestrian displays.
2. 92% felt the PCS were clearer.
3. 85% felt the PCS was an improvement.

PCS do not appear to be contributing to increased vehicle crashes due to drivers attempting to beat the light.

4.4. A Comparison of Pedestrian Signal Heads
Configuration B "Separate Countdown Housing"

In a laboratory simulation, 48 subjects were tested on their understanding of the conventional standard pedestrian signal versus PCS, and five other alternative pedestrian signal displays. The results are as follows:

1. PCS and an experimental 3-lens signal are more easily understood than the standard pedestrian signal and the other alternatives compared. (Study’s Table 1).
2. The WALK interval displays are very well understood, both in the PCS and in the standard pedestrian signal.
3. The flashing HAND with a Pedestrian Countdown Timer display is the best-understood clearance interval displays among all alternatives compared. (Study’s Figure 4)
4. If standing at the curb, 89% of all subjects correctly determined the appropriate action when presented with the clearance interval displays of a standard flashing HAND or a standard flashing HAND with Pedestrian Countdown Timer.
5. If walking across the street, 30% - 38% of pedestrians correctly determined the appropriate action when presented with the PCS clearance interval display of a flashing HAND with Pedestrian Countdown Timer. Only 15% - 17% of pedestrians correctly determined the appropriate action when presented with the standard flashing HAND display. (Study’s Table 3)
6. Among seven alternative pedestrian signals compared, only PCS had an acceptable level of comprehension when the subject was crossing the street.
7. Among seven alternative pedestrian signals compared, 59% of the subjects picked PCS as their favourite pedestrian signal followed by 27% for an experimental 3-lens signal.
Gabriel Rousseau and Greg Davis, Human Centered Systems Team, FHWA, 2003
Configuration B "Separate Countdown Housing"
Countdown Timing Strategy 1 "WALK to FDW", 4 "FDW Only" & Others

This study compares six PCS display-timing strategies with the standard MUTCD pedestrian crossing signal, to determine which strategies are better understood by pedestrians. 134 participants of three age groups (18-29, 30-59, >59) were tested under laboratory conditions. The six PCS display countdown strategies tested are:

<table>
<thead>
<tr>
<th>Countdown Versions</th>
<th>Don’t Walk</th>
<th>Walk</th>
<th>Flashing Don’t Walk</th>
<th>Don’t Walk</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>--</td>
<td>19, 18…16, 15</td>
<td>14, 13……...</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1, 0</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>--</td>
<td>19, 18…16, 15</td>
<td>14, 13…6,5</td>
<td>--</td>
</tr>
<tr>
<td>3</td>
<td>9,8 ...... 1,0</td>
<td>--</td>
<td>--</td>
<td>23, 22 ... 11, 10</td>
</tr>
<tr>
<td>4</td>
<td>--</td>
<td>--</td>
<td>14, 13……...</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1, 0</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>--</td>
<td>--</td>
<td>14, 13…6,5</td>
<td>--</td>
</tr>
<tr>
<td>6</td>
<td>--</td>
<td>--</td>
<td>5, 4 ... 1, 0</td>
<td>--</td>
</tr>
</tbody>
</table>

The results are as follows:
1. Pedestrians’ understanding of the PCS displays and the standard signal displays are about the same. Table 4 of the Study shows the percentage of pedestrians correctly understanding PCS signals are marginally but insignificantly higher than that of conventional signals.
2. Pedestrians’ understanding of the six different PCS display-timing strategies is about the same. Table 5 of the Study shows the percentage of pedestrians correctly understanding the PCS displays vary from 81% to 89% for five of the six PCS countdown strategies tested.
3. Compared to other age groups, a much higher percentage of older adults have difficulty understanding the clearance interval for conventional pedestrian signal displays and for PCS countdown display versions 2 and 4. (Study Tables 6 and 7)
4. Older adults’ understanding of the PCS clearance displays improves substantially with PCS countdown display versions 5 and 1, as shown in Table 7 of the Study. Almost all older adults correctly understand the clearance interval of PCS display version 5.
Version 5: countdown starts at the beginning of flashing DON’T WALK. The countdown goes blank 5 seconds before the end of the flashing DON’T WALK.

5. 85% and 81% of pedestrians preferred PCS version 5 and version 1 over conventional pedestrian signal displays respectively. Pedestrians appear to value the added information provided.

6. Given the confusion created by the flashing DON’T WALK, one potential solution that merits future research is a signal that eliminates the flashing DON’T WALK and instead uses only a countdown during the clearance interval.

4.6. Pedestrian Signal Head Survey Report, Boulder, Colorado³
Diane Baron, City of Boulder, Colorado, 1998

830 pedestrians at a Pedestrian Countdown Timer installation in downtown Boulder, Colorado were interviewed during a one-week period. The results are as follows:

1. 97% of all pedestrians who noticed the PCS understood that it meant the seconds left to cross the street and 88% felt the countdown information was useful. The most cited reasons were:
   a. It’s good for pedestrians to know how much time they have left (74%).
   b. Lets pedestrians who arrive just as the signal changed, know they can still cross (43%).
   c. Lets pedestrians who are late know they don’t have enough time to cross (43%).
   d. Lets older people know they still have time to get across (14%).
   e. Lets handicapped people know they still have time to get across (16%).

2. About 8% felt the PCS was harmful. About 22% of the 18-22 age group felt the PCS is harmful while less than 10% of the remaining age groups felt it is harmful. The most cited reasons are:
   a. People will try to get across too close to the signal change (57%).
   b. Waste of money / not necessary / silly (43%).
   c. Confusing to people (18%).

3. When told: "the traditional pedestrian signals cost $150, but the PCS cost $700":
   a. 63% think PCS should replace only a limited number of pedestrian signals where they might do the most good, as they are too expensive to use everywhere.
b. 33% think no existing pedestrian signals should be replaced by PCS. The advantages aren’t enough to offset the extra cost.
c. 4% think PCS should eventually replace all pedestrian signals as they are worth the cost.

While more people entered during the beginning of the "Don’t Start" period, 25% less people started crossing during the last five seconds of the "Don’t Start" period after PCS was installed.

4.7. Behavioural Evaluation of Pedestrians and Motorists towards Pedestrian Countdown Signals, Monterey, California

Jacques Leonard, Matthew Juckes and Bernard Clement, 1999

Configuration B "Separate Countdown Housing"
Countdown Timing Strategy 4 "FDW Only"

In Monterey, California, PCS were installed at two intersections with pedestrian refuge medians. Pedestrian and motorist behaviours were evaluated. The pedestrian signal displays were activated for every cycle. 760 pedestrians were observed during a 3-day survey. 282 pedestrians were interviewed after they crossed the PCS intersection. The results are as follow:

1. 83% of pedestrians started at the beginning of the pedestrian phase and made the crossing safely.
2. Among the pedestrians who stopped on the median, many did not wait for the next pedestrian phase to cross.
3. The countdown displays did not prevent pedestrians from initiating the crossing movement at the beginning of the flashing HAND indication.
4. Pedestrians did not attempt to cross when the PCS showed there were less than 6 – 10 seconds remaining. People walked faster when they realized time was running out. As a result, only 2% of pedestrians were left stranded in the crosswalk when time ran out.
5. 87% found the PCS easier to understand and 77% felt safer with the PCS.

<table>
<thead>
<tr>
<th>Age</th>
<th>&lt;12</th>
<th>12-20</th>
<th>21-60</th>
<th>&gt;60</th>
<th>Over-all</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pedestrians correctly understood the meaning of the PCS</td>
<td>100%</td>
<td>97%</td>
<td>96%</td>
<td>95%</td>
<td>96%</td>
</tr>
<tr>
<td>Pedestrians felt the PCS were easier to understand</td>
<td>100%</td>
<td>86%</td>
<td>88%</td>
<td>86%</td>
<td>87%</td>
</tr>
<tr>
<td>Pedestrians felt safer with the PCS</td>
<td>100%</td>
<td>75%</td>
<td>79%</td>
<td>70%</td>
<td>77%</td>
</tr>
<tr>
<td>Pedestrians felt positive about the PCS</td>
<td>100%</td>
<td>100%</td>
<td>97%</td>
<td>100%</td>
<td>98%</td>
</tr>
</tbody>
</table>
6. The most common pedestrian comments about the PCS are "not enough time" (30%), "very helpful, good idea" (21%), "want/should have more of them in their home town" (14%).

7. A driver approaching at 30 mph is found to be able to read the countdown signal at 107 – 238 feet from the stop line. This is well within the distance (353 feet) given by a 4.5 second clearance interval. There is very limited probability for drivers to use the displayed countdown information to race through the intersection.

8. No accelerating vehicles were observed after many hours of observations. Two technicians standing, within the maximum readability distance to the two PCS intersections, looked for vehicles suddenly accelerating while the PCS display was less than six seconds.

9. PCS usage guidelines are proposed on page 17 of the Study.

10. Recommend the display of the countdown numbers be in Portland Orange LED instead of red LED.

4.8. **Countdown Pedestrian Signal Survey, Sacramento, California**

Sacramento County Transportation Division
Configuration A "Overlap/ Countdown Side by Side"
Countdown Timing Strategy 4 "FDW Only" and 5 "FDW to Amber"

In 1995, Sacramento installed PCS at one intersection. A before and after survey indicated one out of three pedestrians did not understand the standard flashing HAND pedestrian signal head display; and 94% of all pedestrians felt the PCS were clearer. The detailed results are as follow:

<table>
<thead>
<tr>
<th>Age</th>
<th>Under 13</th>
<th>13-60</th>
<th>Over 60*</th>
<th>Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Before PCS installation</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pedestrians did not understand the flashing HAND display</td>
<td>20%</td>
<td>30%</td>
<td>33%</td>
<td>No Report</td>
</tr>
<tr>
<td><strong>After PCS installation</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pedestrians felt PCS were clearer than the conventional pedestrian signal display</td>
<td>100%</td>
<td>100%</td>
<td>82%</td>
<td>94%</td>
</tr>
<tr>
<td>Pedestrians felt the PCS signal heads are an improvement</td>
<td>100%</td>
<td>84%</td>
<td>55%*</td>
<td>80%</td>
</tr>
</tbody>
</table>

*Most of the Over 60 age group felt the new signals were clearer, but the time allotted to pedestrians was insufficient.
In 1997, Sacramento installed PCS at five other intersections. A 6-hour before and 6-hour after survey was conducted at each intersection. 633 pedestrians were surveyed. The results are as follow:

1. The proportion of pedestrians that arrived at the intersections and entered during flashing HAND instead of waiting for the next WALK display increased significantly at four of the five intersections (19%, 9%, 0%, 7%, 9%) after PCS were installed.
2. The proportion of pedestrians exiting during the steady HAND decreased significantly at three of the five intersections (-8%, -2%, -6%, 3%, 0%) after PCS were installed.
3. The number of false pedestrian calls decreased from 11 to two after PCS were installed.

4.9. **Pedestrian Countdown Indication – Market Research and Evaluation, Minneapolis, Minnesota**

Beverly Ann B. Farraher, 1999

Configuration A "Overlap / Countdown Side by Side" and B "Separate Countdown Housing"

Countdown Timing Strategy 4 "FDW Only"

In Minneapolis-St. Paul, PCS were installed for pedestrians crossing the main highway at five highway – city road intersections. Pedestrians of three age groups (<16, 16-64, >65) were observed. 372 pedestrian crossings before and 535 pedestrian crossings after the installation of PCS were observed. 211 interviews were conducted of the "over 15" age group after they crossed on a PCS. The results are as follow:

1. 60% of all pedestrians correctly responded that they should continue crossing (not begin crossing) when the flashing HAND is displayed with a PCS. 78% found the PCS easier to understand and preferred PCS to the conventional pedestrian signal display.

<table>
<thead>
<tr>
<th>Answers to “What are you expected to do when HAND is flashing with numeric countdown?”</th>
<th>16-25</th>
<th>26-64</th>
<th>Over 65</th>
<th>Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td>Begin crossing</td>
<td>2%</td>
<td>7%</td>
<td>7%</td>
<td>6%</td>
</tr>
<tr>
<td>Continue crossing</td>
<td>76%</td>
<td>56%</td>
<td>41%</td>
<td>60%</td>
</tr>
<tr>
<td>Wait to cross</td>
<td>15%</td>
<td>29%</td>
<td>41%</td>
<td>26%</td>
</tr>
<tr>
<td>Don’t know / not sure</td>
<td>7%</td>
<td>8%</td>
<td>10%</td>
<td>8%</td>
</tr>
<tr>
<td>Pedestrians felt the PCS were easier to understand</td>
<td>90%</td>
<td>74%</td>
<td>72%</td>
<td>78%</td>
</tr>
<tr>
<td>Pedestrians preferred PCS over the conventional pedestrian signals</td>
<td>91%</td>
<td>77%</td>
<td>59%</td>
<td>79%</td>
</tr>
</tbody>
</table>
2. The most cited reasons for preferring PCS are:
a. Like the numbers/show exactly how much time until light turns red / good for wheelchairs (36%)
b. Can judge how fast to move/how much time to cross (33%)
c. Big improvement/safer/will make people more cautious (30%)

3. Overall, pedestrians properly crossing the intersection increased by 8%. For the "Under 16" age group, those properly crossing the intersection increased by 20%. Those entered during steady HAND and exited during steady HAND decreased by 18%.
For the "Over 65" age group, those properly crossing the intersection increased by 11%. However, individuals that entered during WALK and exited during steady HAND also increased by 11%.

<table>
<thead>
<tr>
<th>Changes in Pedestrian crossing behaviour after PCS installation</th>
<th>Teens &lt;16</th>
<th>Other adults 16-65</th>
<th>Seniors &gt;65</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Entered During</td>
<td>Exited During</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WALK</td>
<td>flashing HAND</td>
<td>38%</td>
<td>14%</td>
<td>15%</td>
</tr>
<tr>
<td>WALK</td>
<td>steady HAND</td>
<td>-0.5%</td>
<td>-7%</td>
<td>11%</td>
</tr>
<tr>
<td>flashing HAND</td>
<td>flashing HAND</td>
<td>-1%</td>
<td>-5%</td>
<td>1.5%</td>
</tr>
<tr>
<td>flashing HAND</td>
<td>steady HAND</td>
<td>0.5%</td>
<td>0%</td>
<td>-1%</td>
</tr>
<tr>
<td>steady HAND</td>
<td>steady HAND</td>
<td>-18%</td>
<td>2%</td>
<td>-1%</td>
</tr>
<tr>
<td>Increased proportion of successful crossing after PCS is installed</td>
<td>20%</td>
<td>6%</td>
<td>11%</td>
<td>8%</td>
</tr>
</tbody>
</table>

4. The PCS was set to countdown during the flashing HAND clearance interval only, even though the equipment can allow countdown to start during the WALK person interval. The reason is emergency vehicle pre-emption can shorten the WALK interval.

5. No complaints were received regarding the operation of any of the PCS intersections. Depending upon the location, either no positive comments have been received or numerous positive comments have been received.

6. New pedestrian instruction stickers were installed with each PCS installation. The stickers include a graphic of the PCS and the flashing HAND and describe in English text the correct interpretation of the international crossing symbol.
4.10. **The Effects of Pedestrian Countdown Signals in Lake Buena Vista, California**
Herman Huang and Charles Zegeer, 2000
Configuration B "Separate Countdown Housing"
Countdown Timing Strategy 4 "FDW Only"

In Lake Buena Vista, two PCS intersections were evaluated using a treatment-and-control study design. The WALK signals at the intersections were displayed only when the pedestrian actuated buttons were pushed. The results of the Study are as follows:

1. Pedestrians were less likely to comply with the pedestrian WALK signals at the PCS sites than at conventional pedestrian signal sites.
2. About the same proportion of pedestrians would run out of time to cross at PCS sites as at conventional pedestrian signal sites. This may be the result of late entry pedestrians walking faster to complete their crossing.
3. About 3% of pedestrians at PCS sites and 10% of pedestrians at conventional pedestrian signal sites started running when the flashing HAND signal appeared.
4. The authors suggested PCS may result in more pedestrian signal violations near high schools and universities as teenagers and young adult males may try to "beat the light"; but may be more promising at intersections frequented by older adults, by virtue of the added information about the time available for crossing.

4.11. **San Francisco Pedestrian Countdown Signals: Preliminary Evaluation Summary**
San Francisco Dept of Parking & Traffic and DKS Associates, 2001

In San Francisco, California, before and after studies for the installation of PCS were conducted for a 3-month before and a 6-month after periods. The results are as follow:

1. The proportion of pedestrians incorrectly believing they are permitted to enter on flashing HAND increased from 60% before PCS installation to 83% after PCS installation. This shows pedestrians are using the PCS to decide when to start crossing.
2. The proportion of pedestrians exiting during steady HAND decreased from 14% to 9% at eight intersections observed after PCS were installed. This is due mostly to walkers hurrying across.
3. There was little change in when pedestrians started crossing.
4. The proportion of pedestrians running or aborting their crossing decreased from 13% to 8% after PCS were installed.
5. The reported incidence of red light running decreased from 2% to 1% after PCS were installed.
6. About 92% of pedestrians explicitly said the PCS were more helpful than conventional pedestrian signals, primarily because they showed the time remaining to cross. This finding is very consistent at all nine intersections observed, with at least 87% of pedestrians stating that the PCS were more helpful than conventional pedestrian signals.

7. DKS Associates suggested the highest priority locations for PCS installations to be at intersections that are:
   - wide, with over four traffic lanes
   - provide relatively short crossing times relative to street width
   - high pedestrian volume
   - ranked high in pedestrian collisions over the last five years

8. San Francisco seeks permission to expand the PCS to all locations with pedestrian signals with the exception of narrow streets (less than 40 feet curb to curb).

4.12. Pedestrian Countdown Signals: An Experimental Evaluation, San Jose, California
Jan Botha, Aleksandr Zabyshny, Jennifer Day, Ron Northouse, Jaime Rodriguez, Tamara Nix, 2002
Configuration A "Overlap / Countdown Side by Side"
Countdown Timing Strategy 4 "FDW Only"

In San Jose, California, before and after studies for the installation of PCS were conducted at four intersections for a 3-month before and a 6-month after period. Pedestrian compliance, pedestrian walking speed and motorist behaviour were observed. The results are as follows:

1. PCS may result in more pedestrians believing that they may enter the intersection during the flashing HAND.
   The proportion of pedestrians incorrectly believing they are permitted to enter on flashing HAND increased from 24% before PCS installation to 41% after PCS installation.
   80% of pedestrians believed they could begin the crossing during the flashing HAND if they thought they could finish before the PCS counted down to zero.

2. PCS may be causing people to enter the intersection on the flashing HAND, particularly when the countdown still displays a high number.
   The proportion of pedestrians arriving during flashing HAND and entering during flashing HAND instead of waiting for the next WALK display increased significantly at three of the four intersections (6.3%, 16.0%, -0.3%, 32.7%) after PCS were installed.

3. The proportion of pedestrians entering during flashing HAND increased slightly at all four intersections (2.7%, 0.5%, 1.1%, 1.2%) after PCS were installed.
The proportion of pedestrians entering during steady HAND decreased insignificantly at three of the four intersections (-0.3%, -1.3%, -1.3%, 1.7%) after PCS were installed. The proportion of pedestrians exiting during flashing HAND increased significantly at all four intersections (2.0%, 7.6%, 7.1%, 7.9%) after PCS were installed. The proportion of pedestrians exiting during steady HAND decreased significantly at all four intersections (-2.2%, -3.9%, -4.4%, -3.0%) after PCS were installed.

4. The above may be an indication that pedestrians used the countdown information to adjust their walking speeds to clear the intersection before the steady HAND phase. However, survey shows that PCS does not significantly affect walking speeds.

5. There was little difference in the before-and-after proportions of unusual pedestrian activities (running, stopping/hesitating, turning-around and pedestrian-vehicle conflicts).

6. Pedestrians do not have a reasonably good sense of the required clearance time.

7. Motorist signal violations (entering in yellow or red) showed no discernable negative effect with PCS installation.

8. Analysis of crash reports for a period of three years before and four to seven months after PCS installations, showed no evidence that misinterpretation of the flashing HAND or the PCS device played a role in any of the crashes. Differences between the before and after conflict rates are relatively small. There are a few movements that the conflict rates are reduced significantly in the after period.

9. A potential solution could involve the modification of the PCS to display the initial WALK interval (counting down) in green, followed by the pedestrian clearance interval (counting down) in red, without the conventional pedestrian symbols.

4.13. Pedestrian Countdown Devices: Edmonton’s Pilot Project

Deanna Green, 2002

Configuration A "Overlap / Countdown Side by Side"

Countdown Timing Strategy 4 "FDW Only"

In Edmonton, Alberta, before and after studies for the installation of PCS were conducted at two intersections during the am, noon and pm peak hours of a Tuesday, Wednesday and Thursday. 19,969 pedestrian crossings before and 23,481 pedestrian crossings after the installation of PCS were observed. 240 phone comments from the public about the PCS were received. The results are as follow:

1. The proportion of pedestrians entering during flashing HAND increased slightly after PCS were installed.
The proportion of pedestrians entering during steady HAND decreased slightly after PCS were installed. Among those who entered during WALK, the proportion exiting during steady HAND decreased slightly after PCS were installed. Among those who entered during flashing HAND, the proportion exiting during steady HAND decreased slightly at the Downtown intersection, but increased slightly at the University intersection after PCS were installed.

<table>
<thead>
<tr>
<th>Entered during WALK</th>
<th>Entered during flashing HAND</th>
<th>Entered during steady HAND</th>
<th>% of those Entered during WALK Exited during steady HAND</th>
<th>% of those Entered during flashing HAND Exited during steady HAND</th>
</tr>
</thead>
<tbody>
<tr>
<td>Downtown</td>
<td>-1.9%</td>
<td>2.3%</td>
<td>-0.4%</td>
<td>-0.7%</td>
</tr>
<tr>
<td>Shopping area near University</td>
<td>-3.7%</td>
<td>3.8%</td>
<td>-0.1%</td>
<td>-0.3%</td>
</tr>
</tbody>
</table>

2. There was no noticeable change in vehicle behaviour after PCS were installed.

<table>
<thead>
<tr>
<th>No apparent change in vehicle speed as motorist approached amber/red</th>
<th>Vehicle sped up and entered intersection on Amber</th>
<th>Vehicle sped up and entered intersection on Red</th>
</tr>
</thead>
<tbody>
<tr>
<td>Downtown</td>
<td>-3.2%</td>
<td>0%</td>
</tr>
<tr>
<td>Shopping area near University</td>
<td>1.9%</td>
<td>-0.4%</td>
</tr>
</tbody>
</table>

3. 90% of the phone comments received from the public were extremely positive about the PCS.

4. Recommended a guideline to install PCS at locations with
   a. high pedestrian volumes - to benefit more pedestrians.
   b. short walk phases - as more people are still in the crosswalk at the end of short walk phases.
   c. wide crossing distances - to ease pedestrian’s uncertainty of when a long flashing HAND clearance period will end.
   d. high vehicle volumes - to ease concern about pedestrian-vehicle conflict.
   e. many senior and handicaped individuals - to ease anxiety of slow moving pedestrians.
5. PCS can be programmed to countdown during both the WALK and flashing HAND clearance phase or just during the flashing HAND phase only. Edmonton chose to countdown during the flashing HAND phase only, because if countdowns are to include the WALK phase, erroneous countdown numbers will be displayed during timing plan changes and fire pre-emption. Countdown devices count down based on what was displayed during the previous signal cycle.

Lizuarte Simas, 2002

In the Region of York, three PCS intersections were evaluated using a treatment-and-control study design. 830 pedestrians were observed. The results are as follow:
1. 5% more pedestrians complied with the WALK signal at the PCS intersection (97%) than at conventional pedestrian signal intersections (92%).
2. 3% fewer pedestrians ran out of time at the PCS intersection (1%) than at conventional pedestrian signal intersections (4%).
3. 2% fewer pedestrians started running at the PCS intersection (2%) than at conventional pedestrian signal intersections (4%) when the steady HAND appeared.
4. No pedestrian related collisions at either PCS or conventional pedestrian signal intersections were reported during the observation period.
5. Recommended PCS be considered at intersections with long pedestrian crossing distances, in close proximity to schools or near senior centers having a high percentage of pedestrian usage.

4.15. Countdown Timer Survey, Salt Lake City, Utah
Salt Lake City Department of Transportation, 2002

A one hour survey of pedestrians at a Pedestrian Countdown Timer installation at a mid-block crosswalk was conducted by the Salt Lake City Department of Transportation. The results are as follow:
1. The majority of pedestrians understood what the timer represented.
2. The majority of pedestrians liked the idea very much, because PCS shows them how much time there is to cross the street.
3. Some pedestrians stopped in the island when they noted there were only a few seconds remaining on the timer and proceeded to cross on the next walk light.
4.16. **City of Fountain Valley Countdown Pedestrian Signal Evaluation**¹⁶
Mark Lewis, City of Fountain Valley, 2003
Configuration A "Overlap / Countdown Side by Side"
Countdown Timing Strategy 4 "FDW Only"

In Fountain Valley, California, PCS were installed for pedestrians crossing the main street at five intersections with semi-actuated signals. Pedestrian crossing side streets remained controlled by standard pedestrian signal heads. A before and after study, with a minimum of 100 observations, was collected at each experimental intersection.

The results are as follow:

1. About 50% of pedestrians understood that they should not start crossing during the countdown phase.
2. The proportion of pedestrians exiting during the steady HAND decreased significantly (-12.4%) from 28.2% to 15.8% after PCS were installed.
3. The proportion of pedestrians running across the crosswalk increased significantly (10.0%) from 4.6% to 14.6% after PCS were installed.
4. No observations were made of pedestrians noticing the time remaining and hesitating or aborting their cross.
5. The proportion of pedestrian-vehicle conflicts decreased significantly (-7.2%) from 11.2% to 4.0%. Most conflicts involved vehicles passing through the crosswalk on a red and interrupting the pedestrians from completing the crossing.
6. 70% of pedestrians found the PCS made them feel safer.
7. Over 90% of pedestrians preferred the PCS over the conventional pedestrian signals, because it showed the time remaining to cross.
8. One complaint was that kids are running ahead of crossing guards or parents in attempts to beat the countdown and coming in conflict with vehicles.
9. Due to positive response, Fountain Valley would like to request that PCS be installed citywide.

4.17. **Evaluation of Pedestrian Countdown Signals in Montgomery County, Maryland**¹³
Kimberly Eccles, Ruihua Tao & Bruce Mangum, 2003

In Montgomery County, Maryland, before and after studies for the installation of PCS were conducted at five intersections. 107 pedestrians were interviewed after they crossed the PCS intersection. The results are as follow:

1. 63% of all pedestrians responded that the PCS shows the seconds left to cross the street. An additional 32% said it shows the seconds remaining until the light turns red.
2. Of the 20 approaches surveyed after PCS installation, the proportion of pedestrians entering during flashing HAND or steady HAND decreased at 13
approaches and increased at seven approaches. The decreases were significant at six approaches (-4%, -5%, -6%, -9%, -17%, -24%) and the increases were significant at two approaches (9%, 12%).

3. Of the five intersections surveyed after PCS installation, the number of pedestrians exiting during steady HAND (remaining in the intersection at the release of conflicting traffic) decreased significantly at three intersections and there were no significant changes at the remaining two intersections.

4. The PCS had no effect on vehicle approach speeds during the pedestrian clearance interval. Out of seven approaches observed at four intersections, changes in mean speed after PCS installation varied from -2 mph to +1.2 mph and changes in 85th percentile speeds varied from -3.7 mph to +3.0 mph. The difference in mean speed is significant at only one of the seven approaches.

5. The number and circumstances of each pedestrian - motor vehicle conflict were recorded for each leg of four intersections for about two hours of peak pedestrian activity before and after PCS were installed. The results show that pedestrian-vehicle conflicts decreased at all four intersections. These decreases were significant at the 95% confidence level.

4.18. Pedestrian Countdown Signal Study, Clackamas County, Oregon
Chris Christofferson, Clackamas County, Oregon, 2003

In Clackamas County, Oregon, before and after studies for the installation of PCS was conducted at two intersections. 80% (12 of 15) of pedestrians interviewed after they crossed the PCS intersection indicated they liked the PCS signal because it improved the comfort level of crossing the long crosswalks.

Ron Van Houten and J. E. Louis Malenfant, 1994
Configuration B "Separate Countdown Housing"
Countdown Timing Strategy 1 "WALK to FDW"

This is a synthesis of Canadian studies on pedestrian safety. It quoted a 1994 PCS evaluation study at two intersections in Saint-Laurent, Quebec. 1918 pedestrians were surveyed before and after the PCS were installed. The results are as follows:
1. About 80% of pedestrians did not understand the flashing HAND display.
2. PCS did not increase the pedestrian’s understanding of the WALK, steady HAND and pedestrian clearance phases.
3. PCS increases pedestrians’ feeling of security.
4. Vehicle-pedestrian conflicts were measured, but the data was not reported in this study. On the basis of reported data, the Study concluded that PCS was not associated with any increase in pedestrian safety.
5. The Study also quoted a 1990 study in Toulouse, France, which found "no significant change in pedestrian behaviour after PCS was installed."
Chapter 5

COMPARISON OF PCS SPECIFICATIONS, OPERATION STRATEGIES, & USAGE WARRANTS

5.1. Technical Specifications Comparison (for seven Manufacturers)
    Table 11 (see Appendix C)

5.2. Signal Head Specification Comparison (for three Jurisdictions)
    Table 12 (see Appendix C)

5.3. Installation Specification Comparison (for three Jurisdictions)
    Table 13 (see Appendix C)

5.4. Operation Strategies Comparison (for three Jurisdictions)
    Table 14 (see Appendix C)

5.5. Usage Warrants Comparison (for six Jurisdictions)
    Table 15 (see Appendix C)

5.6. Quebec PCS Head Configuration
    Figure 18 (see Appendix C)
Chapter 6
RECOMMENDATIONS FOR ADOPTION

The North American wide survey provided an overview of existing PCS practices and a list of 85 conditions in which traffic signal operating agencies felt that PCS may be beneficial or harmful. These were grouped into nine major issues for investigation. A fact-finding exercise was carried out. Reported experiences, empirical field surveys and laboratory simulation studies were reviewed. Similar studies were grouped together and their findings are compared for consistencies. Based on this, recommended standards were developed and debated. Determining if PCS reduces pedestrian-related crashes would require data to be collected over several years. Since most North American PCS were installed in recent years, it is unlikely that such study results would be available in the short term. However, existing studies are consistent in finding that PCS does not appear to increase crashes or conflicts. More people understood the appropriate action for a PCS when compared to a conventional flashing HAND (flashing DON'T WALK) display and under PCS control, more pedestrians were successfully serviced. Section 6.1 "PCS Effectiveness Information" is provided to assist those considering the optional use of this device. This Chapter outlines the proposed PCS standards.

6.1. PCS Effectiveness Information

Below is a proposed section to be incorporated into the MUTCDC:

Section B2.3 PCS Effectiveness Information

Pedestrian Countdown Timers may be used as an optional device at locations where pedestrian signal heads are installed. For each location or intersection, PCS could be installed at one or more crossings. Studies have found that with PCS installation:

- The additional information provided by the countdown timer enhances pedestrian crossing experiences and leads to greater understanding of the flashing HAND (flashing DON'T WALK) display.
- There were no noticeable changes in vehicle speed, acceleration, signal violation or other undesirable vehicle behaviour.
- No change was observed for pedestrians stopping, hesitating or turning-around.

a) Locations that have a high percentage use by seniors, children, and other mobility challenged pedestrians

- Areas near hospitals, seniors’ housings and complexes
  Based on the length of time they require when crossing, mobility challenged individuals such as seniors are the most vulnerable and are most concerned about
safety. The presence of the countdown devices would enhance their crossing experience and may increase their sense of security.

- **Areas near schools**
  At pedestrian signals with Pedestrian Countdown Timers, more teenagers are found to cross properly and are successfully serviced by the pedestrian signal. There may be incidences when teenagers and young adults near high schools and universities, try to "beat the light" after seeing how much time is left in the clearance interval. If this occurs, a public information program in explaining the use of the PCS would be beneficial.

b) **Locations with a history of high pedestrian and vehicle conflicts**

- **Pedestrian/vehicle conflict/collision**
  The presence of the countdown will have a positive effect on the behaviour of pedestrians. Studies show that although more pedestrians are starting their crossing during the flashing HAND (flashing DON’T WALK) interval, a higher percentage of pedestrians often clear the crosswalk before the flashing HAND (flashing DON’T WALK) turns solid. This behaviour, which can be attributed to pedestrians quickening their pace in response to the display, results in the reduced number of potential conflicts between pedestrians and the conflicting traffic. At the same time, the countdown may deter some pedestrians from beginning their crossing during the latter part of the clearance interval, which can also reduce the conflict. The presence of the PCS will warn the pedestrians of the impending signal change and enables them to make better decisions about when to start crossing.

c) **Locations that generate high pedestrian and/or vehicle traffic**

- **Proximity to pedestrian traffic generator (within 250 meters)**
  Locations that attract pedestrian traffic include shopping malls, tourist attractions, recreation facilities, medical facilities, etc. PCS are of most benefit at these locations, where pedestrian activity is high. In comparison, locations in an industrial district may draw little pedestrian activity.

- **Vehicle volume**
  The level of pedestrian comfort while crossing is commonly related to the level of vehicle activity at the intersection. Busy intersections with high vehicle volumes pose a higher level of anxiety for pedestrians.

d) **Intersection characteristics**

- **Width of crossing (greater than four lanes)**
  A short WALK (WALKING PEDESTRIAN) interval at a wide intersection intimidates many pedestrians for fear of not being able to complete the crossing before cross street traffic begins. With a short WALK (WALKING PEDESTRIAN) interval,
most pedestrians feel anxious as they may only get across one or two lanes before the onset of the flashing HAND indication. The additional information will be beneficial in assuring the pedestrians of sufficient crossing times.

The devices are suggested at intersections where the ratio of the minimum WALK (WALKING PEDESTRIAN) interval to flashing HAND (flashing DON’T WALK) interval is 0.4 or less. This ratio assumes that a pedestrian who started crossing at the onset of the WALK (WALKING PEDESTRIAN) interval, still has more than 60% of the length of the crosswalk when the clearance phase begins. The WALK (WALKING PEDESTRIAN) interval duration used for this part of the evaluation should be the minimum WALK (WALKING PEDESTRIAN) interval duration of the daytime period; as the WALK (WALKING PEDESTRIAN) interval durations of night-time period could be exceptionally short when there are few pedestrians.

6.2. Recommended PCS Standard Layout and Configuration

- Pedestrian Countdown Timer shall consist of Portland Orange numbers that are at least 135 mm in height (220 mm lens height) on a black opaque background. The countdown numbers should preferably be "double stroke" to improve visibility, and provide a certain amount of "fail-safe".
- Where the pedestrian enters the crosswalk more than 30 m from the countdown pedestrian signal display, the numbers should be at least 175 mm in height (305 mm lens height).
- Pedestrian Countdown Timer shall be of the "Separate Countdown Housing" configuration (Figure 1-B). The "Overlap/Countdown Side by Side" configuration (Figure 1-A) and the "Separate Countdown Housing with no Overlap" configuration (Figure 1-B) may be used under retrofit situation although the use of the "Separate Countdown Housing" configuration (Figure 1-B) is strongly encouraged in order to avoid future standardization cost. The countdown pedestrian signal shall be located immediately adjacent to the associated HAND pedestrian signal head indication.
- The WALK and the HAND indications shall be the same as that of the conventional pedestrian signal and must comply with Section B1.5.4, Section B3.4, and Figure B3-9 of the Manual of Uniform Traffic Control Devices of Canada.

6.3. Recommended PCS Countdown Timing Strategy

- The display of the number of remaining seconds in a Pedestrian Countdown Timer shall begin only at the beginning of the flashing HAND (flashing DON’T WALK) interval. After the countdown has terminated, the display shall remain dark until the beginning of the next countdown.
• The Pedestrian Countdown Timer shall display the number of seconds remaining until the termination of the flashing HAND (flashing DON'T WALK) interval. Countdown displays during the WALK (WALKING PEDESTRIAN) interval shall not be used.

• Under vehicle actuated control, if the vehicle GREEN is extended longer than the WALK (WALKING PEDESTRIAN) and flashing HAND (flashing DON'T WALK) durations, the countdown display will remain dark with the steady HAND (steady DON'T WALK) display for a certain duration until the onset of the next flashing HAND (flashing DON'T WALK) display (see Figure 2-4).

• If used with a pedestrian signal head that does not have a concurrent vehicular phase, the Pedestrian Countdown Timer should display the number of seconds in the Pedestrian Clearance period (see MUTCD Section B4.2.2) minus a duration equivalent to the intergreen period (see MUTCD Section B4.2.1), such that the countdown's zero point is reached some seconds prior to the green light being displayed to conflicting vehicular traffic.

It is recognized that PCS is an advancing technology with continuous improvement. However, the recommended countdown standard should be easy to adopt by traffic engineering practitioners and should be easy to implement on existing ordinary traffic signal controllers. The above Countdown "FDW Only Strategy" (Strategy 4) was recommended after considering the six alternative strategies shown in Figure 2. The Countdown "Walk to FDW", "Walk to Amber" and "Walk to All Red" Strategies (Strategies 1, 2 and 3) were not chosen because these strategies cannot consistently display valid countdown numbers through standard NEMA controllers. The pedestrian countdown device needs at least two consecutive countdown periods of identical durations to be able to display a value. Otherwise, blank or erroneous values will be displayed. This can occur when the durations of consecutive WALK intervals vary during timing plan changes, actuated operations, emergency vehicle pre-emptions, transit pre-emptions, or manual control of the signal through the police panel. The Countdown "FDW Only Strategy" (Strategy 4) and the Countdown "FDW to All Red Strategy" (Strategy 6) were most favoured. The Countdown "FDW Only Strategy" (Strategy 4) was selected as the recommended standard for the following reasons:

a. Pedestrians intuitively believe the Countdown Timer shows the number of remaining seconds available for their crossing. MUTCD Section B4.2.2 defines the "number of seconds available for crossing" (pedestrian clearance period) to consist of a flashing HAND (flashing DON’T WALK) indication plus the associated vehicle intergreen interval. This corresponds to the Countdown "FDW to All Red Strategy" (Strategy 6). However, present Pedestrian Countdown Timers are only capable of monitoring the duration of the flashing HAND (flashing DON’T WALK) display; implementation of Countdown "FDW to All Red Strategy" (Strategy 6) is not feasible at this time.
b. Under vehicle actuated control, a variable vehicle extension interval exists between the minimum green interval and the intergreen interval (see Figure 2). The "FDW to All Red Strategy" (Strategy 6) would result in an erroneous value being displayed when the green interval is extended by vehicle actuation.

c. The Countdown "FDW Only Strategy" (Strategy 4) provides an extra margin of safety by displaying the count down to "0" a few seconds (equivalent to the intergreen interval) before the expiration of the pedestrian clearance interval.

d. Public confusion would be minimized by a consistent interpretation of the meaning of the Pedestrian Countdown Timer display in Canada and the U.S. The Countdown "FDW Only Strategy" (Strategy 4) is consistent with the interpretation adopted by the latest version of the U.S. MUTCD.

6.4. **Recommended PCS Information Sign & Public Education Program**

A public education program explaining the usage and benefits of pedestrian countdown timers is a fundamental component for the implementation of this device. The education program should clarify the meaning of each pedestrian countdown signal display, explain to seniors the crossing times available, and discourage teens from using this device for "beating the light".

The Pedestrian Countdown Signal Information Sign shown in Figure 19 may be installed adjacent to the pedestrian pushbuttons to inform pedestrians of the usage of the Pedestrian Countdown Signal. The detailed design of this sign, as shown in Figure 19, is the same as that adopted in the US Manual on Uniform Traffic Control Devices.
Chapter 7

FUTURE PCS IMPROVEMENTS

7.1. Eliminating the Flashing HAND (Flashing DON’T WALK) Display

Studies have shown that large portions of the public, especially seniors, do not understand the conventional pedestrian signal display or the countdown signal display, although PCS was reported to be a significant improvement. The most confusing portion of the pedestrian signal display appears to be the flashing HAND (flashing DON’T WALK) display. Two pedestrian signalization alternatives completely eliminated the flashing HAND (flashing DON’T WALK) displays. These two alternatives are being used in Quebec, Canada and the United Kingdom. These have the potential of enhancing the public’s understanding of the pedestrian signals and improve safety. Subject to further studies described in Section 7.3 of this Chapter, these two pedestrian signalization alternatives can potentially provide further improvement to the PCS. The two alternatives are briefly described below:

1. The Quebec PCS: The Quebec Ministry of Transportation’s PCS standard39 completely eliminated the flashing HAND symbol (flashing DON’T WALK) display. Pedestrians were shown the WALKING PEDESTRIAN symbol (WALK) display with the countdown numbers. This is followed by the steady HAND symbol (steady DON’T WALK) display with no countdown numbers being displayed. The flashing HAND symbol (flashing DON’T WALK) display means different things to different pedestrians:
   • For pedestrians approaching the curb, it means don’t walk, stop at the curb.
   • For pedestrians that have left the curb, it means keep walking, don’t stop.
   This pedestrian signalization alternative eliminates the ambiguity.

   The Quebec PCS standard provides pedestrians with the information on how many seconds are left before the steady HAND (steady DON’T WALK) interval is displayed. The pedestrians need to judge if the number of seconds displayed is sufficient for them to cross the road. Some of the studies17 reviewed in this Report have shown that pedestrians do not have a reasonably good sense of the required walking clearance time.

2. The UK Puffin: Another concept that would completely eliminate the need for a flashing HAND (flashing DON’T WALK) display is the Puffin. One of the features of this new UK Department of Transport’s pedestrian crossing signal is that the pedestrian signal displays are positioned on the near (departure) side of the crossing. The pedestrian signal display on the far (arrival) side of the crossing is eliminated. The near side display is only visible to pedestrians approaching the crossing and gives them clear direction to walk or not to walk from the curb. The
near side display is not visible to pedestrians that have already left the curb. After the near side display directs pedestrians not to walk from the curb, a period equivalent to the flashing HAND (flashing DON'T WALK) pedestrian clearance interval can be provided before a green light is displayed to conflicting traffic. A more detailed description of the UK Puffin can be found at the UK Department of Transport web site (http://www.dft.gov.uk/stellent/groups/dft_roads/documents/page/dft_roads_504816-02.hcsp).

7.2. Are Pedestrian Crashes Reduced?

Existing literature have identified the effect of PCS installations on various pedestrian safety surrogates, such as pedestrian understanding of the countdown devices, pedestrian-vehicle conflicts, proportion of pedestrians exiting during the steady HAND (steady DON'T WALK) period, changes in motorists and pedestrian behaviours, etc. However, the real measure of safety is the "number of pedestrian crashes reduced" and the "number of vehicle crashes reduced". This requires data to be collected over several years, before and after PCS were installed. This information is unavailable because most North American PCS were installed in recent years. However, such information should become available for analysis in future.

7.3. Optional Use Of PCS

As the North American wide survey showed, several jurisdictions have adopted Pedestrian Countdown Timers as part of their standard pedestrian signal installations. These include the State of New York Department of Transportation; Province of Quebec Ministry of Transportation; City of Burnaby, British Columbia; Salt Lake City, Utah; City of Thornton, Colorado; City of Bloomfield, Colorado; Fountain Valley, California and City of Myrtle Beach, South Carolina. While over 70 jurisdictions have installed PCS, others have expressed concerns about their use. It is evident that PCS usage will become more widespread and experiences with PCS usage will grow in the next few years. New studies would provide answers to some of the information gaps identified above and help different jurisdictions in determining the prudence of PCS usage. Adoption of PCS as an optional use at present helps to foster this increase in experience. A more widespread usage can be considered by individual jurisdictions or by the MUTCD if future studies show definite reductions of pedestrian crashes and/or vehicle crashes as a result of PCS installations.
7.4. Future Research For Improvements

More effective usage of PCS would benefit from further research on the above identified information gaps and innovative pedestrian signalization alternatives. Some of the required research is listed below:

1. Conduct a before and after study to document the increase or decrease in pedestrian crashes and other traffic crashes after the installation of PCS. As Table 5 of this Report indicated, some studies showed little or no differences in pedestrian related crashes or conflict rates after PCS were installed. The Montgomery County Study\textsuperscript{13} indicated a decrease in pedestrian–vehicle conflicts at the 95\% confidence level. The San Jose Study\textsuperscript{7} indicated the conflict rate was reduced for a few movements. The variability of these results may indicate that PCS could be more effective under certain environmental, geometric, traffic or pedestrian flow conditions. A better understanding of these conditions would improve the effectiveness of PCS and help prioritize future PCS installations.

2. Conduct empirical evaluations of alternative PCS configurations and timing strategies on pedestrian crash reductions. This Report identifies the configurations and timing strategies associated with existing PCS study results at different jurisdictions. Critical review of pedestrian crash records at these jurisdictions could give a better indication of the comparative safety effect of different PCS configurations and timing strategies.

3. Develop accident prediction models for the installation of PCS. Disciplined criteria for the installation of PCS and pedestrian signals require confident prediction of the effect of these devices on pedestrian crashes.

4. Conduct empirical field surveys and comparative analysis of pedestrian crash records to confirm the relative effectiveness of the Quebec PCS and the UK Puffin on pedestrian crash reductions and other pedestrian safety surrogates.
REFERENCES & BIBLIOGRAPHY


9. Christofferson, C. *Pedestrian Countdown Signal Survey*. Clackamas County, OR: Clackamas County Department of Transportation and Development.


Appendix A

Survey Questionnaire
Pedestrian Countdown Signal (PCS) Questionnaire

Dear Transportation Professionals:

We would appreciate you taking a few minutes to complete the attached questionnaire and return it by September 15, 2003 to

Email                  HeatherC@city.red-deer.ab.ca or
Fax 1-403-342-8211

A Study is being conducted on the feasibility of adopting guidelines for the use of Pedestrian Countdown Signals (PCS) in the Manual on Uniform Traffic Control Devices of Canada. The Transportation Association of Canada’s Traffic Operations & Management Standing Committee (TOMSC) has struck a project committee to undertake this investigation. As a first step, this questionnaire would identify the type of existing PCS installations and available research reports.

If someone else in your organization is more suitable for answering this survey, please assist us by forwarding this form to the appropriate person. If you need further information, please contact the undersigned or any of the Committee members.

It is important that we hear from you! Thank you for your participation in this questionnaire.

Yours truly,

Chi Y. Lee
Chair, Pedestrian Countdown Signal Project Committee
c/o City of Red Deer - Engineering Services
Box 5008, Red Deer, Alberta, Canada T4N 3T4
Tel: 403-342-8172
Fax: 403-342-8211
## Pedestrian Countdown Signal (PCS) – Usage Questionnaire

1. Name of Your Organization:
   Your Name: 
   Address: 
   Phone Number: 
   Fax Number: 
   E-mail Address: 

2. Some jurisdictions may not install Pedestrian Signals and/or Pedestrian Countdown Signals on all 4 approaches of an intersection. As of September 1, 2003, how many intersections and how many intersection approaches are controlled by the following type of signals in your jurisdiction?

<table>
<thead>
<tr>
<th>Signal Types</th>
<th>Number of Intersections</th>
<th>Number of Intersection Approaches</th>
<th>Number of Collisions per year per Intersection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traffic Signals</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Traffic Signals with Conventional Pedestrian Signal Displays (non-PCS)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Traffic Signals with Pedestrian Countdown Signals (PCS)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Proposed - Pedestrian Countdown Signals (PCS) to be installed before December 2004</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3. Please indicate below (or attach) your jurisdiction's warrants/criteria for selecting locations for PCS installation.

4. Are there locations you would avoid installing PCS? Why? (i.e. due to crosswalk width, certain pedestrian ages, walk interval duration, nearby land uses, adjacent to schools etc?)
5. Has your jurisdiction conducted studies or surveys regarding PCS?
☐ Yes ☐ No
Please attach a copy of the study report OR advise where a copy can be obtained.

6. Please check all boxes that correctly describe the PCS displays & sequence in your jurisdiction:

a. The Countdown Time Display remains dark except appears during the following periods:

☐ WALK display or “Walking Pedestrian” symbol display
☐ Flashing DON’T WALK or “Flashing Hand” symbol display
☐ DON’T WALK or “Steady Hand” symbol display
☐ Yellow traffic signal interval display
☐ All red traffic signal interval display

b. The Countdown Time Display begins the counting down at the start of the:

☐ WALK display or “Walking Pedestrian” symbol display
☐ Flashing DON’T WALK or “Flashing Hand” symbol display

c. The Countdown Time Display reaches zero and ends the counting down at the end of the:

☐ Flashing DON’T WALK or “Flashing Hand” symbol display
☐ Yellow traffic signal interval display
☐ All red traffic signal interval display

7. There are variations in the configuration, layout and design of PCS on the market. Please provide the following information for your PCS:

   Brand Name:
   Model:
   Manufacturer:

8. Please provide the Manufacturer or Supplier's:

   Contact Name:
   Phone Number:
   Email Address:
Appendix B

Profiles of Persons Surveyed
<table>
<thead>
<tr>
<th>Region</th>
<th>Federal</th>
<th>Provincial/State</th>
<th>County</th>
<th>Local</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canada</td>
<td>3</td>
<td>47</td>
<td>31</td>
<td>0</td>
<td>81</td>
</tr>
<tr>
<td>Alberta</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>52</td>
<td>52</td>
</tr>
<tr>
<td>British Columbia</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>27</td>
<td>27</td>
</tr>
<tr>
<td>Manitoba</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>New Brunswick</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Nova Scotia</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Toronto</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>57</td>
<td>57</td>
</tr>
<tr>
<td>Hamilton</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>21</td>
<td>21</td>
</tr>
<tr>
<td>Southwestern Ontario</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Quebec</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Saskatchewan</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td><strong>Total Canada</strong></td>
<td><strong>3</strong></td>
<td><strong>47</strong></td>
<td><strong>31</strong></td>
<td><strong>182</strong></td>
<td><strong>263</strong></td>
</tr>
<tr>
<td><strong>% Canada</strong></td>
<td><strong>1%</strong></td>
<td><strong>18%</strong></td>
<td><strong>12%</strong></td>
<td><strong>69%</strong></td>
<td><strong>100%</strong></td>
</tr>
<tr>
<td></td>
<td>Federal</td>
<td>Provincial / State</td>
<td>County</td>
<td>Local</td>
<td>Total</td>
</tr>
<tr>
<td>------------------------</td>
<td>---------</td>
<td>-------------------</td>
<td>--------</td>
<td>-------</td>
<td>-------</td>
</tr>
<tr>
<td>USA</td>
<td>144</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>144</td>
</tr>
<tr>
<td>Alabama</td>
<td>16</td>
<td>4</td>
<td>15</td>
<td></td>
<td>35</td>
</tr>
<tr>
<td>Alaska</td>
<td>5</td>
<td>0</td>
<td>0</td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>Arizona</td>
<td>8</td>
<td>29</td>
<td>68</td>
<td></td>
<td>105</td>
</tr>
<tr>
<td>Brazos Valley</td>
<td>0</td>
<td>0</td>
<td>7</td>
<td></td>
<td>7</td>
</tr>
<tr>
<td>California Border</td>
<td>5</td>
<td>10</td>
<td>38</td>
<td></td>
<td>53</td>
</tr>
<tr>
<td>Capital Area</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Central California</td>
<td>3</td>
<td>6</td>
<td>8</td>
<td></td>
<td>17</td>
</tr>
<tr>
<td>Central Coast</td>
<td>5</td>
<td>11</td>
<td>24</td>
<td></td>
<td>40</td>
</tr>
<tr>
<td>Colorado-Wyoming</td>
<td>17</td>
<td>10</td>
<td>56</td>
<td></td>
<td>83</td>
</tr>
<tr>
<td>Dallas</td>
<td>1</td>
<td>2</td>
<td>28</td>
<td></td>
<td>31</td>
</tr>
<tr>
<td>Deep South</td>
<td>18</td>
<td>0</td>
<td>8</td>
<td></td>
<td>26</td>
</tr>
<tr>
<td>Florida</td>
<td>26</td>
<td>96</td>
<td>50</td>
<td></td>
<td>172</td>
</tr>
<tr>
<td>Georgia</td>
<td>27</td>
<td>0</td>
<td>14</td>
<td></td>
<td>41</td>
</tr>
<tr>
<td>Greater Fort Worth</td>
<td>0</td>
<td>0</td>
<td>10</td>
<td></td>
<td>10</td>
</tr>
<tr>
<td>Hawaii</td>
<td>5</td>
<td>1</td>
<td>0</td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>Houston</td>
<td>1</td>
<td>5</td>
<td>8</td>
<td></td>
<td>14</td>
</tr>
<tr>
<td>Illinois</td>
<td>3</td>
<td>8</td>
<td>27</td>
<td></td>
<td>38</td>
</tr>
<tr>
<td>Indiana</td>
<td>12</td>
<td>2</td>
<td>3</td>
<td></td>
<td>17</td>
</tr>
<tr>
<td>Intermountain</td>
<td>33</td>
<td>31</td>
<td>35</td>
<td></td>
<td>99</td>
</tr>
<tr>
<td>Kentucky</td>
<td>8</td>
<td>6</td>
<td>1</td>
<td></td>
<td>15</td>
</tr>
<tr>
<td>Metro NY/NJ</td>
<td>23</td>
<td>8</td>
<td>20</td>
<td></td>
<td>51</td>
</tr>
<tr>
<td>Michigan</td>
<td>16</td>
<td>29</td>
<td>15</td>
<td></td>
<td>60</td>
</tr>
<tr>
<td>Mid Atlantic</td>
<td>0</td>
<td>5</td>
<td>15</td>
<td></td>
<td>20</td>
</tr>
<tr>
<td>Missouri</td>
<td>39</td>
<td>7</td>
<td>60</td>
<td></td>
<td>106</td>
</tr>
<tr>
<td>New England</td>
<td>31</td>
<td>0</td>
<td>35</td>
<td></td>
<td>66</td>
</tr>
<tr>
<td>New Mexico</td>
<td>0</td>
<td>4</td>
<td>10</td>
<td></td>
<td>14</td>
</tr>
<tr>
<td>New York Upstate</td>
<td>13</td>
<td>3</td>
<td>5</td>
<td></td>
<td>21</td>
</tr>
<tr>
<td>North Carolina</td>
<td>20</td>
<td>2</td>
<td>57</td>
<td></td>
<td>79</td>
</tr>
<tr>
<td>North Central</td>
<td>71</td>
<td>0</td>
<td>21</td>
<td></td>
<td>92</td>
</tr>
<tr>
<td>Northern California</td>
<td>18</td>
<td>19</td>
<td>26</td>
<td></td>
<td>63</td>
</tr>
<tr>
<td>Ohio</td>
<td>11</td>
<td>10</td>
<td>20</td>
<td></td>
<td>41</td>
</tr>
<tr>
<td>Oregon</td>
<td>10</td>
<td>14</td>
<td>37</td>
<td></td>
<td>61</td>
</tr>
<tr>
<td>Riverside/San Bernardino</td>
<td>0</td>
<td>8</td>
<td>17</td>
<td></td>
<td>25</td>
</tr>
<tr>
<td>San Francisco Bay Area</td>
<td>10</td>
<td>14</td>
<td>183</td>
<td></td>
<td>207</td>
</tr>
<tr>
<td>South Carolina</td>
<td>4</td>
<td>2</td>
<td>4</td>
<td></td>
<td>10</td>
</tr>
<tr>
<td>South Texas</td>
<td>0</td>
<td>1</td>
<td>11</td>
<td></td>
<td>12</td>
</tr>
<tr>
<td>Southern California</td>
<td>8</td>
<td>17</td>
<td>133</td>
<td></td>
<td>158</td>
</tr>
<tr>
<td>Tennessee</td>
<td>17</td>
<td>6</td>
<td>21</td>
<td></td>
<td>44</td>
</tr>
<tr>
<td>Texas No</td>
<td>0</td>
<td>0</td>
<td>17</td>
<td></td>
<td>17</td>
</tr>
<tr>
<td>Virginia</td>
<td>16</td>
<td>8</td>
<td>23</td>
<td></td>
<td>47</td>
</tr>
<tr>
<td>Washington D.C.</td>
<td>27</td>
<td>48</td>
<td>9</td>
<td></td>
<td>84</td>
</tr>
<tr>
<td>Washington State</td>
<td>11</td>
<td>41</td>
<td>58</td>
<td></td>
<td>110</td>
</tr>
<tr>
<td>Wisconsin</td>
<td>17</td>
<td>5</td>
<td>25</td>
<td></td>
<td>47</td>
</tr>
<tr>
<td><strong>Total US</strong></td>
<td>144</td>
<td>558</td>
<td>472</td>
<td>1222</td>
<td>2396</td>
</tr>
<tr>
<td><strong>% US</strong></td>
<td>6%</td>
<td>23%</td>
<td>20%</td>
<td>51%</td>
<td>100%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>147</td>
<td>605</td>
<td>503</td>
<td>1403</td>
<td>2658</td>
</tr>
<tr>
<td><strong>% North America</strong></td>
<td>6%</td>
<td>23%</td>
<td>19%</td>
<td>53%</td>
<td>100%</td>
</tr>
</tbody>
</table>
Appendix C

Figures and Tables
<table>
<thead>
<tr>
<th>A.</th>
<th>&quot;Overlap/Countdown Side by Side&quot; Configuration</th>
</tr>
</thead>
<tbody>
<tr>
<td>B.</td>
<td>&quot;Separate Countdown Housing&quot; Configuration</td>
</tr>
<tr>
<td>B1.</td>
<td>&quot;Separate Countdown Housing with no Overlap&quot; Configuration</td>
</tr>
<tr>
<td>C.</td>
<td>&quot;All in One Overlap&quot; Configuration</td>
</tr>
</tbody>
</table>
FIGURE 2  Types of PCS Countdown Timing Strategies

1. WALK$^1$ to FDW$^2$ Strategy

<table>
<thead>
<tr>
<th>Green</th>
<th>Variable</th>
<th>Amber</th>
<th>All Red</th>
<th>Red</th>
</tr>
</thead>
<tbody>
<tr>
<td>...14, 13, 12, ..., 06, 05, 04, 03, 02, 01, 00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Walk</td>
<td>Flashing</td>
<td>Don’t Walk</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Don’t Walk</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2. WALK$^1$ to Amber Strategy

<table>
<thead>
<tr>
<th>Green</th>
<th>Variable</th>
<th>Amber</th>
<th>All Red</th>
<th>Red</th>
</tr>
</thead>
<tbody>
<tr>
<td>...20, 19, 18, 17, 16, 15, 14, 13, 12, 11, 10, 09, 08, 05, 04, 03, 02, 01, 00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Walk</td>
<td>Flashing</td>
<td>Don’t Walk</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Don’t Walk</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3. WALK$^1$ to All Red Strategy

<table>
<thead>
<tr>
<th>Green</th>
<th>Variable</th>
<th>Amber</th>
<th>All Red</th>
<th>Red</th>
</tr>
</thead>
<tbody>
<tr>
<td>...22, 21, 20, 19, 18, 17, 16, 15, 14, 13, 12, 11, 10, 09, 08, 07, 06, 05, 04, 03, 02, 01, 00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Walk</td>
<td>Flashing</td>
<td>Don’t Walk</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Don’t Walk</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4. FDW$^2$ Only Strategy

<table>
<thead>
<tr>
<th>Green</th>
<th>Variable</th>
<th>Amber</th>
<th>All Red</th>
<th>Red</th>
</tr>
</thead>
<tbody>
<tr>
<td>...07, 06, 05, ..., 02, 01, 00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Walk</td>
<td>Flashing</td>
<td>Don’t Walk</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Don’t Walk</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

5. FDW$^2$ to Amber Strategy

<table>
<thead>
<tr>
<th>Green</th>
<th>Variable</th>
<th>Amber</th>
<th>All Red</th>
<th>Red</th>
</tr>
</thead>
<tbody>
<tr>
<td>...13, 12, 11, 10, 09, 08, 07, 06, 05, 04, 03, 02, 01, 00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Walk</td>
<td>Flashing</td>
<td>Don’t Walk</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Don’t Walk</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

6. FDW$^2$ to All Red Strategy

<table>
<thead>
<tr>
<th>Green</th>
<th>Variable</th>
<th>Amber</th>
<th>All Red</th>
<th>Red</th>
</tr>
</thead>
<tbody>
<tr>
<td>...15, 14, 13, 12, 11, 10, 09, 08, 07, 06, 05, 04, 03, 02, 01, 00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Walk</td>
<td>Flashing</td>
<td>Don’t Walk</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Don’t Walk</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1 WALKING PEDESTRIAN
2 flashing DON’T WALK (flashing HAND)
FIGURE 3  Distribution of PCS Installations in North America
FIGURE 4  Distribution of PCS Configurations in North America
FIGURE 5   Distribution of PCS Countdown Timing Strategies in North America
FIGURE 6  Existing and Planned PCS Usages in North America

- None exist. None proposed. 109 Jurisdictions 56%
- Some exist. Some proposed. 36 Jurisdictions 19%
- Some exist. None proposed. 35 Jurisdictions 18%
- None exist. Some proposed. 14 Jurisdictions 7%
The existing and proposed PSC are fairly evenly spread among the five regions in North America.

a. About 20% of total existing PCS and 20% of total proposed PCS in North America are located in each region.

b. About 40% of jurisdictions surveyed in each region have existing PCS in 2003.

c. About 30% of jurisdictions surveyed in each region proposed more PCS for 2004.
Existing and proposed PCS comprised of about 10% of all pedestrian signals among respondents with existing PCS. The highest proportion (12%) of signals presently under PCS control is in the US Northwest. The highest proportion (4%) of signals proposed for PCS control in 2004 is also in the US Northwest.
For Canadian jurisdictions with PCS existing in 2003, all but two jurisdictions that responded have less than 10% of their pedestrian signals under PCS control. Minor PCS additions were proposed in 2004 by these jurisdictions. All pedestrian signals in Burnaby are PCS controlled.
For the US Northwest jurisdictions that responded with existing PCS, about 12% of their 2003 combined total pedestrian signals are PCS controlled. Half of the 14 jurisdictions surveyed have less than 12% of their pedestrian signals under PCS control and minor additions are proposed. Three jurisdictions will be equipping all their pedestrian signals with PCS. The US Northwest has a higher proportion of their signals under PCS control than any other regions surveyed.
For the US Northeast jurisdictions that responded with the PCS existing, most have less than 10% of their pedestrian signals under PCS control. Other than the City of White Plains and New York State DOT in Rochester, no significant addition is proposed in 2004.
For the US Southwest jurisdictions with PCS existing, the proportion of signals under PCS control varied widely in 2003. Ten jurisdictions have less than 10%, two have one-quarter, and two have nearly all their pedestrian signals in PCS. Significant additions are proposed for 2 cities in 2004.
FIGURE 13  PCS as a Percentage of All Pedestrian Signals in U.S. Southeast

The US Southeast respondents have the lowest proportion of existing signals under PCS control in North America. All jurisdictions that responded have less than 10% of their pedestrian signals in PCS. Myrtle Beach, SC plan to equip all their signals with PCS in 2004. No significant additions are proposed by other jurisdictions.
The "Separate Countdown Housing" configuration (Figure 1-B & B1) is used in the largest number of existing PCS installations in North America. Montreal, New York and Burnaby, the three jurisdictions with the largest number of PCS, use this configuration. It is also the most used configuration in the regions that New York (US NE) and Montreal & Burnaby (Canada) belong to. Nearly all PCS in the remaining three regions of the U.S. are of the "Overlap / Countdown Side by Side" configuration (Figure 1-A).
The "Overlap / Countdown Side by Side" configuration (Figure 1-A) is installed at 67% of all jurisdictions with PCS surveyed in North America. It is used by the most jurisdictions in all regions except the US Northeast. The "Separate Countdown Housing" configuration (Figure 1-B) is used by most jurisdictions in the US Northeast.
The "FDW Only" (Figure 2, section 4) Countdown Strategy and the "WALK to FDW" (Figure 2, section 1) Countdown Strategy are the two most commonly used strategies. The "FDW Only" (4) Countdown Strategy is predominately used in all regions except Canada and the US Northwest. The "WALK to FDW" (Figure 2, section 1) Countdown Strategy is used in nearly all PCS in Canada. Both "WALK to FDW" (Figure 2, section 1) and "FDW Only" (Figure 2, section 4) Countdown Strategies are equally used in the US northwest.
The "FDW Only" (Figure 2, section 4) Countdown Strategy is used at 51% of all jurisdictions with PCS surveyed in North America. The "FDW Only" Countdown Strategy is the most widely used in all regions except Canada. The "WALK to FDW" (Figure 2, section 1) Countdown Strategy is the most widely used by different Canadian jurisdictions surveyed.
FIGURE 18 Quebec PCS Head Configurations
Minimum Dimensions for Numerical Countdown Pedestrian Signals
(Vertical Signal Heads)


Minimum Dimensions for Numerical Countdown Pedestrian Signals
(Horizontal Signal Heads and Combined Signal Heads)

FIGURE 19  PCS Information Sign

COLORS:  LEGEND  —  BLACK
          BACKGROUND  —  WHITE  (RETROREFLECTIVE)
          OB, HAND SYMBOL  —  ORANGE  (RETROREFLECTIVE)
FIGURE 19  PCS Information Sign (continued)
START CROSSING
Watch For Vehicles

DON'T START
Finish Crossing If Started

FLASHER

STEADY

DON'T CROSS

TO CROSS

PUSH BUTTON
FIGURE 19  PCS Information Sign (continued)

TRAVESEZ
Soyez prudent

NE PAS S’ENGAGER
Terminez la traverse si déjà engagé

NE PAS TRAVERSER

POUR TRAVERSER
APPUYEZ SUR LE BOUTON
TABLE 1  Summary of Survey Responses

Positive opinions about PCS installations

1. PCS performed very well in all situations. Public support overwhelming
2. Trial to see if acceptance or 'WOW' factor
3. Positive response
4. Useful at all signalized intersections

Negative opinions about PCS installations

1. The devices are dumb devices and there is no data exchange from the controller. Therefore, if they display the wrong number of seconds, accidents could occur. With any monitoring of the behaviour like conflict monitors, they could be a source of liability
2. Like PCS but not comfortable as to how they interact at railroad pre-empted intersections
3. Not convinced of benefit. Purpose not justified
4. Pedestrian crossings are confusing enough. If you start on the walk, proceed at a reasonable pace and the traffic engineer has timed it right, you will make it. The pedestrian has no concept of time or distance
5. Waiting for approval from MUTCD, TAC, FHWA, State
6. Fail to see a real need for them as it does nothing to improve safety or compliance with pedestrian signal indications
7. Installation and maintenance costs and funding
8. All studies seem to be based on "feeling safer"
9. Conflicting studies
10. Concerns related to motorist behaviour, i.e. concerns that drivers might use the devices to speed up to beat the light
11. Do not believe the additional data provided by PCS enhances pedestrian safety. It may encourage pedestrians to cross contrary to the signal displays
12. Teach pedestrians the meaning of pedestrian symbols rather than relying on countdown
13. No further installations as no study has proven that PCS increases pedestrian safety
14. PCS not intended for general use
15. PCS give pedestrians false indication of time remaining until the signal changes and encourages abuse of FDW
16. PCS would encourage pedestrians to cross if they felt that there is enough time even at FDW display
17. PCS do not provide a clear message. Pedestrians don’t have the ability to accurately judge the width of an intersection and the time it takes to cross an unfamiliar roadway
<table>
<thead>
<tr>
<th>Survey respondents’ suggested conditions for PCS installations</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. High pedestrian volume</td>
</tr>
<tr>
<td>2. High vehicle volume</td>
</tr>
<tr>
<td>3. High vehicular speeds</td>
</tr>
<tr>
<td>4. Low vehicular speeds</td>
</tr>
<tr>
<td>5. Proximity to pedestrian traffic generator - senior &amp; medical facilities, public institutions, schools, shopping centers, recreation</td>
</tr>
<tr>
<td>6. High non-local pedestrian traffic areas (hotels, casinos, truck stops)</td>
</tr>
<tr>
<td>7. Pedestrian &amp; vehicle conflicts/collisions (severe crossing conflict area)</td>
</tr>
<tr>
<td>8. Substantial pedestrian walking violations</td>
</tr>
<tr>
<td>9. Age &amp; disabilities of pedestrians (school children or seniors)</td>
</tr>
<tr>
<td>10. Academic institutions because the age group poses more possible signal violations than any other</td>
</tr>
<tr>
<td>11. Crosswalk serves multi-use (bike/pedestrians)</td>
</tr>
<tr>
<td>12. Length of crosswalk (long)</td>
</tr>
<tr>
<td>13. Within downtown core</td>
</tr>
<tr>
<td>14. Intersections with long cycle lengths that may reduce likelihood of pedestrians running the reds</td>
</tr>
<tr>
<td>15. Challenging intersection</td>
</tr>
<tr>
<td>16. Locations with a median. Crossing pedestrians to a median rather than across the entire roadway</td>
</tr>
<tr>
<td>17. Type of highway (i.e. wide arterial road, strategic regional arterials)</td>
</tr>
<tr>
<td>18. 4 lane or 5 lane roadways</td>
</tr>
<tr>
<td>19. Mid block intersection</td>
</tr>
<tr>
<td>20. Crossing main street only</td>
</tr>
<tr>
<td>21. Side street service only</td>
</tr>
<tr>
<td>22. Engineering judgment</td>
</tr>
<tr>
<td>23. Pedestrian signal locations</td>
</tr>
<tr>
<td>24. Public relations program</td>
</tr>
<tr>
<td>25. New or modified signal installations with pedestrian indicators</td>
</tr>
<tr>
<td>26. Requested or demanded from organization, citizen, council directive</td>
</tr>
<tr>
<td>27. Pedestrian complaints of insufficient crossing times</td>
</tr>
<tr>
<td>28. Critical Walk to FDW ratio (wide crossings with minimum walk time)</td>
</tr>
<tr>
<td>29. Locations with an exclusive pedestrian phase</td>
</tr>
<tr>
<td>30. Low turning volumes (or high turning volumes but intersection is with left turn phase)</td>
</tr>
<tr>
<td>31. Conflicting turning vehicle traffic</td>
</tr>
<tr>
<td>32. Other remedies exhausted</td>
</tr>
</tbody>
</table>
## Survey respondents’ suggested conditions for which PCS should not be installed

1. Low pedestrian volume
2. Short crossings
3. Smaller intersections
4. Rural isolated intersection
5. Locations where pedestrians are banned
6. Across signalized driveway entrances
7. Unmarked intersections (needs other devices first)
8. Wide locations as pedestrians may underestimate the time required to make the crossing
9. Two lanes of travel
10. Four or three legged intersections as drivers see countdown and drive accordingly
11. High-speed arterials. Concerns that drivers might use the devices to speed up to beat the light
12. Not be installed in median islands or other roadway locations where pedestrians would be stored
13. Main streets as pedestrian crossing changes cycle by cycle
14. Low priority should be at schools or academic institutions
15. Intersections with variable cycle length
16. Roadways that have a history of drivers trying to beat the light or red light running
17. On main street green (coordinated phases) along arterials where there is already a long WALK phase
18. Semi-actuated phases
19. Fully actuated signal intersections
20. Crossings that operate during a coordinated phase - usually crossing side streets, so that variable time of the coordinated phase (often known at the beginning of the phase) doesn't force us to give inaccurate information.
21. Intersections with very complex phasing. Had difficulty at one location with overlapping pedestrian phases combined with an exclusive pedestrian phase
22. Signal intersections with right angle collision pattern
23. Signal with high red light violation rates
24. Where walk is re-serviced
25. Where at the end of the safe pedestrian crossing interval can not be accurately predicted. (i.e., where the parallel vehicular movement remains with a green display long after the walk and FDW interval end
26. Split pedestrian operation
27. Does not work with leading left turn signal. Loses its accuracy when no demand is required for it and then demanded again. Appears that it works for fixed time signal. Initially had PCS on all four legs but had to remove the two sides with left turn signals
28. Intersections with concurrent pedestrian phasing
Survey respondents’ suggested conditions for which PCS should not be installed

(continued)

29. Where pedestrian phase is on recall along major arterial, and/or minor street is resting on red

30. Locations with pre-empt (time displayed does not always match actual pedestrian time). Non actuated pedestrian phase at actuated locations (pedestrian time will change cycle by cycle depending on cross street demand)

31. Across approaches (or departures) where it is not appropriate for a pedestrian to cross

32. Locations that are interconnected to a railroad crossing (preemption issue)
### TABLE 2  Literature Summary for Section 3.1
Do pedestrians Understand Conventional Pedestrian Signal Displays?

<table>
<thead>
<tr>
<th>Year of Report or Survey</th>
<th>Survey Location</th>
<th>Survey Method</th>
<th>Survey Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>1984³⁵</td>
<td></td>
<td>TRR 959  &quot;The Safety, Operational, and Cost Impacts of Pedestrian Indications at Signalized Intersections&quot; pp1-7</td>
<td>About 50% of pedestrians did not understand the standard flashing DON’T WALK display.</td>
</tr>
<tr>
<td>1994⁴⁰</td>
<td>Saint-Laurent, Quebec</td>
<td>1918 pedestrians were surveyed before and after PCS was installed at 2 intersections.</td>
<td>About 80% of pedestrians did not understand the standard flashing hand display.</td>
</tr>
<tr>
<td>1995³⁷</td>
<td>Sacramento, CA</td>
<td>Pedestrians were surveyed before and after PCS was installed at 1 intersection.</td>
<td>1 out of 3 pedestrians did not understand the standard flashing DON’T WALK display.</td>
</tr>
<tr>
<td>1995³⁸</td>
<td>48 U.S. states</td>
<td>TRR Survey questionnaire was distributed at Drivers’ Examination Stations</td>
<td>Nearly 50% of the respondents incorrectly believed flashing DON’T WALK or upraised hand signals mean pedestrians should return to the curb if they have just begun to cross at an intersection.</td>
</tr>
<tr>
<td>1999¹</td>
<td>Hampton, Virginia</td>
<td>Pedestrians were surveyed before PCS was installed at 1 intersection.</td>
<td>26% of pedestrians did not understand the conventional pedestrian display.</td>
</tr>
<tr>
<td>Configuration</td>
<td>Sequence</td>
<td>Report/ Survey Year &amp; Location</td>
<td>Survey Results</td>
</tr>
<tr>
<td>---------------</td>
<td>----------</td>
<td>--------------------------------</td>
<td>----------------</td>
</tr>
<tr>
<td>A 4 &amp; 5</td>
<td>1995</td>
<td>Sacramento, California</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1998</td>
<td>Orlando, Florida</td>
<td>Vast majority</td>
</tr>
<tr>
<td></td>
<td>1998</td>
<td>Boulder, Colorado</td>
<td>97%</td>
</tr>
<tr>
<td></td>
<td>1999</td>
<td>Hampton, Virginia</td>
<td></td>
</tr>
<tr>
<td>B 4</td>
<td>1999</td>
<td>Monterey, California</td>
<td>96%</td>
</tr>
<tr>
<td>A &amp; B 4</td>
<td>1999</td>
<td>Minneapolis -St. Paul, Minnesota</td>
<td>60%</td>
</tr>
<tr>
<td></td>
<td>2002</td>
<td>Salt Lake City, Utah</td>
<td>&gt;50%</td>
</tr>
<tr>
<td>B N A 4</td>
<td>2002</td>
<td>FHWA simulation lab</td>
<td>When crossing a street, 15% - 21% more people understood the appropriate action for a PCS (30% - 38%) than for a conventional flashing hand display (15% - 17%).</td>
</tr>
<tr>
<td>B 1 &amp; 4</td>
<td>2003</td>
<td>FHWA simulation lab</td>
<td>Almost all older adults correctly understand the clearance interval of PCS countdown display Version 5(see note). The second best understood is Version 1(see note).</td>
</tr>
</tbody>
</table>
Do Pedestrians Understand Pedestrian Countdown Signal Displays?

<table>
<thead>
<tr>
<th>Report/ Survey Year &amp; Location</th>
<th>Survey Results</th>
<th>% of Pedestrians found the PCS easier to understand than conventional pedestrian signal</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A 4</strong> 2003 Fountain Valley, California</td>
<td>50%</td>
<td></td>
</tr>
</tbody>
</table>
| **B 1** 1994 Saint-Laurent, Quebec, 1990 Toulouse, France | 1. PCS did not increase the pedestrian’s understanding of the WALK, DON’T WALK and pedestrian clearance phases.  
2. The Report also quoted a 1990 study in Toulouse, France, which found "no significant change in pedestrian behaviour after PCS was installed". |  
| 2001 San Francisco, California | The proportion of pedestrians that incorrectly believed they were permitted to enter on flashing DON’T WALK increased from 60% to 83% after PCS installation. This shows pedestrians are using the PCS to decide when to start crossing. |  
| **A 4** 2002 San Jose, California | The proportion of pedestrians that incorrectly believed they were permitted to enter on the flashing DON’T WALK display increased from 24% to 41% after PCS installation.  
80% of pedestrians believed they could begin the crossing during the FDW if they thought they could finish before the PCS counted down to zero. |  

NOTE:  
Version 1: Countdown starts at the beginning of WALK and goes blank at the end of the flashing DON’T WALK.  
Version 5: Countdown starts at the beginning of flashing DON’T WALK and goes blank 5 seconds before the end of the flashing DON’T WALK.
<table>
<thead>
<tr>
<th>Configuration</th>
<th>Sequence</th>
<th>Report / Survey Year &amp; Location</th>
<th>Survey Method</th>
<th>Survey Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>1</td>
<td>1994 Saint-Laurent, Quebec&lt;sup&gt;40&lt;/sup&gt;</td>
<td>1918 pedestrians were surveyed before and after PCS was installed at 2 intersections.</td>
<td>PCS increases pedestrians’ feeling of security.</td>
</tr>
</tbody>
</table>
|               |          | 1998 Boulder, Colorado<sup>3</sup> | 830 pedestrians were surveyed after PCS was installed at 1 downtown intersection. | 1. 88% felt the countdown information was useful and 8% felt it was harmful.  
2. About 22% of the 18-22 age group and less than 10% of the remaining age groups felt the PCS was harmful.  
3. 74% of those found PCS useful said, "it’s good to know how much time is left."  
4. 57% of those found PCS harmful said, "People will try to get across too close to the signal change". |
|               |          | 1999 Hampton, Virginia<sup>1</sup> | Pedestrians using a downtown PCS intersection were interviewed. | 1. 92% felt the PCS were clearer.  
2. 85% felt the PCS was an improvement. |
<table>
<thead>
<tr>
<th>Configuration</th>
<th>Sequence</th>
<th>Report / Survey Year &amp; Location</th>
<th>Survey Method</th>
<th>Survey Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>B 4</td>
<td>1999 Monterey, California&lt;sup&gt;25&lt;/sup&gt;</td>
<td>282 pedestrians at 2 PCS intersections with pedestrian refuge medians were interviewed after crossing the intersection.</td>
<td>1. 77% felt safer with the PCS. 2. 98% felt positive about the PCS. 3. The most common pedestrian comments were: &quot;Not enough time&quot; (30%), &quot;Very Helpful, good idea&quot; (21%), &quot;Want/should have more of them in their home town&quot; (14%).</td>
<td></td>
</tr>
<tr>
<td>A 4 &amp; 5</td>
<td>1995 Sacramento, California&lt;sup&gt;37&lt;/sup&gt;</td>
<td>Pedestrians were surveyed before and after PCS was installed at 1 intersection.</td>
<td>80% felt the PCS was an improvement.</td>
<td></td>
</tr>
<tr>
<td>A &amp; B 4</td>
<td>1999 Minneapolis-St. Paul, Minnesota&lt;sup&gt;10&lt;/sup&gt;</td>
<td>211 pedestrians of the &quot;over 15&quot; age group at 5 PCS equipped highway – city road intersections were interviewed after crossing the intersection.</td>
<td>1. 79% preferred PCS over the conventional pedestrian signals 2. No complaints were received regarding the operation of any of the PCS intersections. 3. Depending upon the location, either no positive comments have been received or numerous positive comments have been received. 4. 69% of those who preferred PCS cited &quot;knowing how much time to cross until the light turns red&quot; as the reason.</td>
<td></td>
</tr>
<tr>
<td>Configuration</td>
<td>Sequence</td>
<td>Report / Survey Year &amp; Location</td>
<td>Survey Method</td>
<td>Survey Result</td>
</tr>
<tr>
<td>---------------</td>
<td>----------</td>
<td>---------------------------------</td>
<td>---------------</td>
<td>---------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2001 San Francisco, California¹²</td>
<td>Before and after studies for the installation of PCS was conducted for a 3-month before and a 6-month after periods.</td>
<td>About 92% explicitly said the PCS were more helpful than conventional pedestrian signals, primarily because they showed the time remaining to cross. This finding is very consistent at all nine intersections observed, with at least 87% of pedestrians stated that the PCS were more helpful than conventional pedestrian signals.</td>
</tr>
<tr>
<td>A 4</td>
<td></td>
<td>2002 Edmonton¹⁷</td>
<td>Before and after studies for the installation of PCS was conducted at 2 intersections. Signs were posted with a phone number so citizens could phone in their questions or comments.</td>
<td>240 phone comments were received. 90% were extremely positive about the PCS.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2002 Salt Lake City, Utah⁴</td>
<td>A 1-hour survey of pedestrians at a Countdown Timer installation at a mid-block crosswalk was conducted.</td>
<td>The majority liked PCS very much because it shows them how much time there is to cross the street.</td>
</tr>
<tr>
<td>Configuration</td>
<td>Sequence</td>
<td>Report / Survey Year &amp; Location</td>
<td>Survey Method</td>
<td>Survey Result</td>
</tr>
<tr>
<td>---------------</td>
<td>----------</td>
<td>---------------------------------</td>
<td>---------------</td>
<td>---------------</td>
</tr>
<tr>
<td>B</td>
<td>NA</td>
<td>2002 FHWA simulation lab(^{27})</td>
<td>In a laboratory simulation, 48 subjects were tested of their understanding of the conventional standard pedestrian signal vs. PCS and 5 other alternative pedestrian signal displays.</td>
<td>59% picked PCS as their favourite pedestrian signal among 7 alternative pedestrian signals compared.</td>
</tr>
<tr>
<td>B</td>
<td>1 &amp; 4</td>
<td>2003 FHWA simulation lab(^{36})</td>
<td>In a laboratory simulation, 134 subjects of 3 age groups were tested of their understanding of 6 PCS display timing strategies.</td>
<td>85% and 81% preferred PCS version 5(^{\text{see note}}) and version 1(^{\text{see note}}) over conventional pedestrian signal displays respectively. Pedestrians appear to value the added information provided.</td>
</tr>
</tbody>
</table>
| A             | 4        | 2003 Fountain Valley, California\(^{16}\) | A before/after study was conducted for PCS installed for pedestrians crossing the main street at 5 intersections with semi-actuated signals. Pedestrian crossing main streets remain to be controlled by standard pedestrian signal heads. | 1. 70% felt safer with the PCS.  
2. Over 90% preferred PCS over the conventional pedestrian signals because it showed the time remaining to cross.  
3. One complaint was that kids are running ahead of crossing guards or parents in attempts to beat the countdown and coming in conflict with vehicles. |
| N             | NA       | 2003 Clackamas County, Oregon\(^{9}\) | 15 pedestrians were interviewed after they crossed 1 of 2 PCS intersections. | 80% liked the PCS because it improved the comfort level of crossing the long crosswalks. |
TABLE 4  Literature Summary for Section 3.3 (continued)
Do Pedestrians Prefer Pedestrian Countdown Signals or Conventional Pedestrian Signals?

NOTE: Version 1: Countdown starts at the beginning of WALK and goes blank at the end of the flashing DON’T WALK.
Version 5: Countdown starts at the beginning of flashing DON’T WALK and goes blank 5 seconds before the end of the flashing DON’T WALK.

TABLE 5  Literature Summary for Section 3.4
Do Pedestrian Countdown Signals Reduce Pedestrian Related Crashes?

<table>
<thead>
<tr>
<th>Configuration</th>
<th>Sequence</th>
<th>Report / Study Year &amp; Location</th>
<th>Study Method</th>
<th>Study Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>1</td>
<td>1994 Saint-Laurent, Quebec⁴⁰</td>
<td>Vehicle-pedestrian conflicts were measured, but the data was not reported in this study.</td>
<td>On this basis of data reported, the Study concluded that PCS was not associated with any increase in pedestrian safety.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1999 Hampton, Virginia¹</td>
<td>Unknown</td>
<td>The first 2 years of the study have indicated that PCS does not appear to be contributing to increased vehicle crashes due to drivers attempting to beat the light.</td>
</tr>
</tbody>
</table>
| A             | 4        | 2002 San Jose⁷               | Crash reports for 3 years before and 4 to 7 months after PCS installation were analyzed. | 1. There was no evidence that misinterpretation of the FDW or the PCS device played a role in any of the crashes.
2. The differences between the before and after conflict rates are relatively small. For a few movements, the conflict rate was reduced after PCS was installed. |
<table>
<thead>
<tr>
<th>Configuration</th>
<th>Report / Study Year &amp; Location</th>
<th>Study Method</th>
<th>Study Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>2002</td>
<td>Region of York, Ontario⁴¹</td>
<td>Using a &quot;treatment&quot; and &quot;control&quot; study design, each of the 3 PCS locations were compared to other similar pedestrian activity intersections, which do not use the PCS.</td>
<td>There were no pedestrian related collisions at both PCS and conventional pedestrian signal intersections during the observation period.</td>
</tr>
<tr>
<td>2003</td>
<td>Montgomery County, Maryland¹³</td>
<td>The number and circumstances of each pedestrian - motor vehicle conflict were recorded for each leg of 4 intersections for about 2 hours of peak pedestrian activity before and after PCS were installed.</td>
<td>Pedestrian-vehicle conflicts decreased at all 4 intersections. These decreases were significant at the 95% confidence level.</td>
</tr>
</tbody>
</table>
TABLE 6  Literature Summary for Section 3.5
Do Pedestrian Countdown Signals Lead to Increases in
Vehicle Speeds and Acceleration to "Beat the Light"?

<table>
<thead>
<tr>
<th>Configuration</th>
<th>Sequence</th>
<th>Report / Survey Year &amp; Location</th>
<th>Field Survey Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>4</td>
<td>1999 Monterey, California²⁵</td>
<td>No accelerating vehicles were observed while the PCS display is less than 6 seconds.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2001 San Francisco, California¹²</td>
<td>The reported incidence of red light running decreased from 2% to 1% after PCS were installed.</td>
</tr>
<tr>
<td>A</td>
<td>4</td>
<td>2002 San Jose, California⁷</td>
<td>Motorist signal violations (entering in yellow or red) showed no discernable negative effect with PCS installation.</td>
</tr>
<tr>
<td>A</td>
<td>4</td>
<td>2002 Edmonton, Alberta¹⁷</td>
<td>Survey shows no noticeable change in vehicle behaviour after PCS were installed.</td>
</tr>
<tr>
<td>N</td>
<td>N</td>
<td>2003 Montgomery County, Maryland¹³</td>
<td>The PCS had no effect on vehicle approach speeds during the pedestrian clearance interval.</td>
</tr>
<tr>
<td>Configuration</td>
<td>Sequence Number</td>
<td>Report / Survey Year &amp; Location</td>
<td>Field Survey Results</td>
</tr>
<tr>
<td>---------------</td>
<td>----------------</td>
<td>---------------------------------</td>
<td>----------------------</td>
</tr>
<tr>
<td>B 4</td>
<td>2000</td>
<td>Lake Buena Vista&lt;sup&gt;19&lt;/sup&gt;</td>
<td>No. The proportion of pedestrians running during the pedestrian clearance interval decreased from 10% at conventional signal sites to 3% at PCS sites.</td>
</tr>
<tr>
<td></td>
<td>2001</td>
<td>San Francisco, California&lt;sup&gt;12&lt;/sup&gt;</td>
<td>No. The proportion of pedestrians running or aborting their crossing decreased from 13% to 8% after PCS were installed.</td>
</tr>
<tr>
<td>A 4</td>
<td>2002</td>
<td>San Jose, California&lt;sup&gt;7&lt;/sup&gt;</td>
<td>No. Survey shows that PCS does not significantly affect walking speeds. The proportions of unusual pedestrian activities (running, stopping/hesitating, turning-around and pedestrian-vehicle conflicts) did not change.</td>
</tr>
<tr>
<td>A 4</td>
<td>2002</td>
<td>Edmonton, Alberta&lt;sup&gt;17&lt;/sup&gt;</td>
<td>No. The proportion of pedestrians running during the pedestrian clearance interval decreased from 4% to 2% after PCS was installed.</td>
</tr>
<tr>
<td>A 4</td>
<td>2003</td>
<td>Fountain Valley, California&lt;sup&gt;16&lt;/sup&gt;</td>
<td>Yes. The proportion of pedestrians running increased from 5% to 15% after PCS were installed. No observations were made of pedestrians hesitating or aborting their crossing.</td>
</tr>
</tbody>
</table>
TABLE 8  Literature Summary for Section 3.7  
Do Pedestrian Countdown Signals Result in the Abuse of the Pedestrian Signal Crossing Intervals?  
[See Issues A & B from Section 3.7]

<table>
<thead>
<tr>
<th>Configuration</th>
<th>Sequence</th>
<th>Report / Survey Year &amp; Location</th>
<th>Entered during WALK</th>
<th>Entered during DW</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Teens &lt;16</td>
<td>Other adults 16-65</td>
</tr>
<tr>
<td>A &amp; B</td>
<td>4</td>
<td>1999 Minneapolis - St. Paul, Minnesota</td>
<td>-0.5%</td>
<td>-7%</td>
</tr>
<tr>
<td>A</td>
<td>4</td>
<td>2002 Edmonton</td>
<td>-0.7%</td>
<td>-0.3%</td>
</tr>
<tr>
<td>A</td>
<td>4</td>
<td>2002 San Jose, California</td>
<td>The proportion of pedestrians entering during DW decreased insignificantly at 3 of the 4 intersections (-0.3%, -1.3%, -1.3%, 1.7%).</td>
<td></td>
</tr>
</tbody>
</table>
TABLE 9  Literature Summary for Section 3.7
Do Pedestrian Countdown Signals Result in the Abuse of the Pedestrian Signal Crossing Intervals?
[See Issue D from Section 3.7]

<table>
<thead>
<tr>
<th>Configuration</th>
<th>Sequence</th>
<th>Report / Survey Year &amp; Location</th>
<th>Entered during FDW</th>
<th>Exited during FDW</th>
<th>Entered during FDW</th>
<th>Exited during DW</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Teens &lt;16 Other 16-65 Seniors &gt;65 Total</td>
<td>Teens &lt;16 Other 16-65 Seniors &gt;65 Total</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>4 &amp; 5</td>
<td>1995 Sacramento, California³⁷</td>
<td>Pedestrians arrived at the intersections and entered during FDW instead of waiting for the next WALK display increased significantly at 4 of the 5 intersections (19%, 9%, 0%, 7%, 9%).</td>
<td>Pedestrians exiting during the DW decreased significantly at 3 of the 5 intersections (-8%, -2%, -6%, 3%, 0%).</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>1998 Boulder, Colorado³</td>
<td>More people entered during the beginning of the &quot;Don’t Start&quot; period; 25% less people started crossing during the last 5 seconds of the &quot;Don’t Start&quot; period.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A &amp; B</td>
<td>4</td>
<td>2002 Edmonton, Alberta¹⁷</td>
<td>-1% -5% 1.5% -3% 0.5% 0%</td>
<td>-2.5% 0.8%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>4 &amp; 5</td>
<td>1999 Minneapolis-St. Paul, Minnesota¹⁰</td>
<td>The countdown displays did not prevent pedestrians from initiating the crossing movement at the beginning of the FDW indication.</td>
<td>Pedestrians did not attempt to cross when the PCS showed there were less than 6 – 10 seconds remaining. People walked faster when they realized time was running out. As a result, only 2% of pedestrians were left stranded in the crosswalk when time ran out.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
TABLE 9  Literature Summary for Section 3.7 (continued)
Do Pedestrian Countdown Signals Result in the Abuse of the Pedestrian Signal Crossing Intervals?
[See Issue D from Section 3.7]

<table>
<thead>
<tr>
<th>Configuration</th>
<th>Sequence</th>
<th>Report / Survey Year &amp; Location</th>
<th>Entered during FDW Exited during FDW</th>
<th>Entered during FDW Exited during DW</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>4</td>
<td>2000 Lake Buena Vista¹⁹</td>
<td>About the same proportion of pedestrians would run out of time to cross at PCS sites as at conventional pedestrian signal sites. This may be the result of late entry pedestrians walking faster to complete their crossing.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2001 San Francisco, California¹²</td>
<td>There was little change in when pedestrians started crossing.</td>
<td>Pedestrians exiting during DW decreased from 14% to 9% at 8 intersections observed. This is due mostly to walkers hurrying across.</td>
</tr>
</tbody>
</table>
**TABLE 9**  Literature Summary for Section 3.7 (continued)
Do Pedestrian Countdown Signals Result in the Abuse of the Pedestrian Signal Crossing Intervals?
[See Issue D from Section 3.7]

<table>
<thead>
<tr>
<th>Configuration</th>
<th>Sequence</th>
<th>Report / Survey Year &amp; Location</th>
<th>Entered during FDW</th>
<th>Entered during FDW</th>
<th>Entered during FDW</th>
<th>Entered during FDW</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Entered during FDW</td>
<td>Exited during FDW</td>
<td>Entered during DW</td>
<td>Exited during DW</td>
</tr>
<tr>
<td>A</td>
<td>4</td>
<td>2002 San Jose, California⁷</td>
<td>1. PCS may be causing people to enter the intersection on the FDW, particularly when the countdown still displays a high number. 2. The proportion of pedestrians arriving during FDW and entering during FDW instead of waiting for the next WALK display increased significantly at 3 of the 4 intersections (6.3%, 16.0%, -0.3%, 32.7%) after PCS were installed. 3. The proportion of pedestrians entering during FDW increased slightly at all 4 intersections (2.7%, 0.5%, 1.1%, 1.2%). 4. The proportion of pedestrians exiting during FDW increased significantly at all 4 intersections (2.0%, 7.6%, 7.1%, 7.9%).</td>
<td>The proportion of pedestrians exiting during DW decreased significantly at all 4 intersections (-2.2%, -3.9%, -4.4%, -3.0%) after PCS were installed.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
TABLE 9  Literature Summary for Section 3.7 (continued)

Do Pedestrian Countdown Signals Result in the Abuse of the Pedestrian Signal Crossing Intervals?
[See Issue D from Section 3.7]

<table>
<thead>
<tr>
<th>Configuration</th>
<th>Sequence</th>
<th>Report / Survey Year &amp; Location</th>
<th>Entered during FDW</th>
<th>Exited during FDW</th>
<th>Entered during FDW</th>
<th>Exited during DW</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2002 Region of York, Ontario⁴¹</td>
<td></td>
<td></td>
<td>3% less pedestrians ran out of time at the PCS intersection (1%) than at conventional pedestrian signal intersections (4%).</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2002 Salt Lake City, Utah⁴</td>
<td>Some pedestrians stopped in the island when they noted there were only a few seconds remaining on the timer. They then would wait for the next red light to cross.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>4</td>
<td>2003 Fountain Valley, California¹⁶</td>
<td></td>
<td></td>
<td>The proportion of pedestrians exiting during DW decreased significantly (-12.4%) from 28.2% to 15.8%</td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>A</td>
<td>2003 Montgomery County, Maryland¹³</td>
<td>Of the 20 approaches surveyed after PCS installation, the proportion of pedestrians entering during FDW or DW decreased at 13 approaches and increased at 7 approaches. The decreases were significant at 6 approaches (-4%, -5%, -6%, -9%, -17%, -24%) and the increases were significant at 2 approaches (9%, 12%).</td>
<td>Of the 5 intersections surveyed after PCS installation, the number of pedestrians exiting during DW (remaining in the intersection at the release of conflicting traffic) decreased significantly at 3 intersections and there were no significant changes at the remaining 2 intersections.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### TABLE 10  
**Literature Summary for Section 3.8**  
**Are Pedestrian Countdown Signals Beneficial for Seniors and Teens?**

<table>
<thead>
<tr>
<th>Configuration</th>
<th>Sequence</th>
<th>Report / Survey Year &amp; Location</th>
<th>Effects of PCS on Seniors &amp; Teens</th>
<th>Senior Citizens</th>
<th>Teens</th>
</tr>
</thead>
<tbody>
<tr>
<td>A 4 &amp; 5</td>
<td>1995</td>
<td>Sacramento, California³⁷</td>
<td>A before and after survey of pedestrians of &quot;&gt;60&quot; and &quot;&lt;13&quot; age groups showed the following: Before PCS installation, % pedestrians did not understand the FDW display (Adult 30%)</td>
<td>33%</td>
<td>20%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>After PCS installation, % pedestrians felt PCS were clearer than the conventional pedestrian signal displays (Adult 100%)</td>
<td>82%</td>
<td>100%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>% pedestrians felt the PCS signal heads are an improvement (Most of the &quot;Over 60&quot; age group felt the new signals were clearer, but the time allotted to pedestrians was insufficient) (Adult 84%)</td>
<td>55%*</td>
<td>100%</td>
</tr>
</tbody>
</table>
### TABLE 10  Literature Summary for Section 3.8 (continued)

**Are Pedestrian Countdown Signals Beneficial for Seniors and Teens?**

<table>
<thead>
<tr>
<th>Configuration</th>
<th>Sequence</th>
<th>Report / Survey Year &amp; Location</th>
<th>Effects of PCS on Seniors &amp; Teens</th>
<th>Senior Citizens</th>
<th>Teens</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1998</td>
<td>Boulder, Colorado&lt;sup&gt;3&lt;/sup&gt;</td>
<td>1. One of the most cited reasons that pedestrians felt countdown information was useful is that PCS lets seniors and handicaps know they still have time to get across. 2. 22% of the &quot;18-22 age group&quot; felt PCS is harmful while less than 10% of the remaining age groups felt it is harmful. The most cited reasons that some pedestrians felt PCS is harmful are: a. People will try to get across too close to the signal change b. Waste of money / not necessary / silly c. Confusing to people</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>4</td>
<td>1999 Monterey, California&lt;sup&gt;25&lt;/sup&gt;</td>
<td>Interviews of pedestrians of the &quot;&gt;60&quot; and &quot;12-20&quot; age groups showed the following % of pedestrians: a. Correctly understood the meaning of the PCS b. Felt the PCS were easier to understand c. Felt safer with the PCS d. Felt positive about the PCS</td>
<td>95 % 97 %</td>
<td>86 % 86 %</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>One person under 12 years of age was interviewed and replied positively for all the above 4 items.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### TABLE 10  Literature Summary for Section 3.8 (continued)
Are Pedestrian Countdown Signals Beneficial for Seniors and Teens?

<table>
<thead>
<tr>
<th>Configuration</th>
<th>Sequence</th>
<th>Report / Survey Year &amp; Location</th>
<th>Effects of PCS on Seniors &amp; Teens</th>
<th>Senior Citizens</th>
<th>Teens</th>
</tr>
</thead>
<tbody>
<tr>
<td>A &amp; B</td>
<td>4</td>
<td>1999 Minneapolis -St. Paul, Minnesota(^{10})</td>
<td>Pedestrians of the &quot;&gt;65&quot; and &quot;16 – 25&quot; age groups were asked &quot;What are you expected to do when hand is flashing with numeric countdown?&quot; The percent of pedestrians with the following answers are:</td>
<td>Begin crossing</td>
<td>Continue crossing (56% for adult group)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>7%</td>
<td>41%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2%</td>
<td>76%</td>
</tr>
<tr>
<td>Configuration</td>
<td>Sequence</td>
<td>Report / Survey Year &amp; Location</td>
<td>Effects of PCS on Seniors &amp; Teens</td>
<td>Senior Citizens</td>
<td>Teens</td>
</tr>
<tr>
<td>---------------</td>
<td>----------</td>
<td>---------------------------------</td>
<td>---------------------------------</td>
<td>----------------</td>
<td>-------</td>
</tr>
<tr>
<td>B</td>
<td>4</td>
<td>2000 Lake Buena Vista¹⁹</td>
<td>1. The authors suggested PCS may result in more pedestrian signal violations near high schools and universities as teenager and young adult males may try to &quot;beat the light&quot;; but may be more promising at intersections frequented by older adults, by virtue of the added information about the time available for crossing. 2. Pedestrians do not have a reasonably good sense of the required clearance time.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>4</td>
<td>2002 Edmonton, Alberta¹⁷</td>
<td>The author suggested a guideline to install PCS at locations with many seniors and handicapped users to ease anxiety of slow moving pedestrians.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2002 Region of York, Ontario⁴¹</td>
<td>The author suggested PCS be considered at intersections with wide pedestrian crossing distances and proximity to schools or senior centers having a high percentage of pedestrian usage.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### TABLE 10

**Literature Summary for Section 3.8 (continued)**

*Are Pedestrian Countdown Signals Beneficial for Seniors and Teens?*

<table>
<thead>
<tr>
<th>Configuration</th>
<th>Sequence</th>
<th>Report / Survey Year &amp; Location</th>
<th>Effects of PCS on Seniors &amp; Teens</th>
<th>Senior Citizens</th>
<th>Teens</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>1 &amp; 2003</td>
<td>FHWA simulation lab(^{36})</td>
<td>A much higher percentage of older adults (&gt;59 age group) have difficulties understanding the clearance interval for conventional pedestrian signal displays and for PCS countdown display versions 2 and 4. (Study Tables 6 and 7). Older adults’ understanding of the PCS clearance displays improves substantially with PCS countdown display versions 5 and 1 as shown in Study Table 7. <strong>Almost all older adults correctly understand the clearance interval of PCS countdown display Version 5(^{\text{see note}}). The second best understood is Version 1(^{\text{see note}}).</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>4</td>
<td>2003 Fountain Valley, California(^{16})</td>
<td>One complaint was that kids are running ahead of crossing guards or parents in attempts to beat the countdown and coming in conflict with vehicles.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**NOTE:**

Version 1: Countdown starts at the beginning of WALK and goes blank at the end of the flashing DON’T WALK.

Version 5: Countdown starts at the beginning of flashing DON’T WALK and goes blank 5 seconds before the end of the flashing DON’T WALK.
**TABLE 11  Technical Specifications Comparison (for 7 Manufacturers)**

(1) Refer to FIGURE 1 for Types of PCS Configurations
(2) Single Stroke refers to countdown numbers composed of one line of LEDs; double stroke refers to countdown numbers composed of two lines of LEDs.
### TABLE 12  Signal Head Specification Comparison (for 3 Jurisdictions)

<table>
<thead>
<tr>
<th>Jurisdiction</th>
<th>Specifications</th>
</tr>
</thead>
</table>
| Quebec\(^{39}\) (Figure 18) | - Lanterns can be 9" or 12".  
- UPRAISED HAND can be outline figure only.  
- WALKING PERSON can be either solid or outline figure.  
- Minimum dimensions provided for lanterns, figures and numerals, including stroke width. |
| Pennsylvania\(^{22}\) | - The UPRAISED HAND and WALKING PERSON symbols can be either solid or outline figures.  
- The pedestrian countdown signal timer can be either integral to, or separate from, the pedestrian countdown signal. If the pedestrian countdown signal timer is a separate component, the message display unit and the countdown timer unit must be approved as one system.  
- The pedestrian countdown signal shall display colors in conformance with ITE chromaticity specifications. Portland orange/pedestrian orange shall be used for the UPRAISED HAND symbol and the LED countdown timer. White/lunar white shall be used for the WALKING PERSON symbol.  
- The pedestrian countdown signal timer digits shall be a minimum of 8" high. |
| US MUTCD\(^{29}\) | - If used, countdown pedestrian signals shall consist of Portland orange numbers that are at least 150 mm (6 in) in height on a black opaque background. The countdown pedestrian signal shall be located immediately adjacent to the associated UPRAISED HAND (symbolizing DON’T WALK) pedestrian signal head indication.  
- For crosswalks where the pedestrian enters the crosswalk more than 30 m (100 ft) from the countdown pedestrian signal display, the numbers should be at least 225 mm (9 in) in height. |
# TABLE 13 Installation Specification Comparison (for 3 Jurisdictions)

<table>
<thead>
<tr>
<th>Installation Specifications</th>
<th>Quebec</th>
<th>MUTCD®</th>
<th>Pennsylvania</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Lenses must have a black background</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>2 Lenses must be square or rectangular in shape</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>3 Specific arrangements and dimensions of lenses, symbols and countdown timer</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>4 Pedestrian head at each end of crosswalk</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>5 Installed within pedestrians' field of vision.</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>6 Allowable range of heights for pedestrian signal heads</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>7 Distance from curb to pedestrian head outlined</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>8 Shall meet the requirements set forth in the March 1985 Institute of Transportation Engineers (ITE) Standard for &quot;Pedestrian Traffic Control Signal Indications&quot;</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>9 LED Specifications</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>10 Portland orange and lunar white figures</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>11 Retrofit into standard 12&quot; or 16&quot; fixtures</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>12 The pedestrian countdown signal shall be completely sealed to resist moisture and dust intrusion.</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>13 The pedestrian countdown signal shall be able to withstand mechanical shock, vibration from high winds and other sources, and vandalism.</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>14 All pedestrian countdown signal components shall be corrosion-resistant.</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>15 Acceptable working temperatures.</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>16 Screens, visors required.</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>17 Warranty period</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Jurisdiction</td>
<td>Operation Strategies Comparison (for 3 Jurisdictions)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>--------------</td>
<td>-----------------------------------------------------</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| Quebec       | - Both **ENTRANCE** and **CLEARANCE** intervals are merged into one and indicated simultaneously with the outline and numerical countdown.  
- The **WAIT** interval is displayed with the steady hand and "0" numerical-countdown number. |
| Pennsyl-vania | - The numeric display of the pedestrian countdown signal timer shall start at the beginning of the flashing UPRAISED HAND indication. When the flashing UPRAISED HAND becomes steady, the numeric display shall exhibit zero (0) for one second, and then completely blank-out so that no phantom message is visible under any lighting condition.  
- The pedestrian countdown signal timer shall monitor the pedestrian change intervals and automatically adjust for any changes made at the controller.  
- The countdown timer module shall have an internal conflict monitor to prevent any possible conflicts between the UPRAISED HAND / WALKING PERSON signal indications and the time display. When the UPRAISED HAND is solid, it shall be impossible to display any time, other than zero (0).  
- A catastrophic failure of a single LED shall not result in a total loss of more than three (3) LEDs. |
| US MUTCD      | - If used, the display of the number of remaining seconds shall begin only at the beginning of the pedestrian change interval. After the countdown has terminated, the display shall remain dark until the beginning of the next countdown.  
- If used, the countdown pedestrian signal shall display the number of seconds remaining until the termination of the pedestrian change interval or until the termination of the concurrent vehicular phase’s green interval, whichever occurs first. Countdown displays during the walk interval shall not be used.  
- If used with a pedestrian signal head that does not have a concurrent vehicular phase, the countdown pedestrian signal should display the number of seconds minus four remaining in the pedestrian change interval such that the countdown’s zero point is reached approximately 4 seconds prior to the termination of the pedestrian change interval.  
- At intersections equipped with the pedestrian signal heads, the pedestrian signal indications shall be displayed except when the vehicular traffic control signal is being operated in flashing mode. At those times, the pedestrian signal lenses shall not be illuminated. |
TABLE 15  Usage Warrants Comparison (for 6 Jurisdictions)

<table>
<thead>
<tr>
<th>Summary of warrants from 6 jurisdictions:</th>
<th>Quebec</th>
<th>Edmonton</th>
<th>Hamilton</th>
<th>Burlington</th>
<th>Pennsylvania</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 High pedestrian volume</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>2 Proximity to pedestrian traffic generator - senior &amp; medical facilities, public institutions, schools, shopping centers, recreation</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>3 Pedestrian &amp; vehicle conflicts/collisions (severe x-ing conflict area.)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>4 Age &amp; disabilities of pedestrians (school children or seniors)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>5 Intersections with long cycle lengths that may reduce likelihood of peds running the reds</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>6 Challenging intersection</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>7 4 lane or 5 lane roadways</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>8 Crossing main street only</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>9 Engineering Judgment</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>10 Pedestrian Signal Locations</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>11 Requested or demanded from organization, citizen, council directive</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>12 Critical Walk to FDW ratio (wide crossings with min walk time)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>13 Low turning volumes (or high turning volumes but intersection is with LT phase)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>14 Conflicting turning vehicle traffic</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>15 Other remedies exhausted</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>16 Traffic signals not visible to pedestrians</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>17 Pedestrians need assistance to cross roadway</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
</tbody>
</table>