Memorandum

MIAMI-DADE COUNTY

Date: February 10, 2017

Agenda Item No. 2B3
March 7, 2017

To: Honorable Chairman Esteban L. Bovo, Jr.
and Members, Board of County Commissioners

From: Carlos A. Gimenez
Mayor

Subject: Miami-Dade Transit Safety Barriers Feasibility Study – Directive 142800

At the Board of County Commissioners (Board) meeting on January 21, 2015, Resolution R-65-15 was adopted requesting a feasibility study regarding the installation of safety barriers at bus benches and bus shelters in order to protect transit patrons. As a result, the Department of Transportation and Public Works (DTPW) staff revisited a 2013 study, which was generated pursuant to a similar directive adopted a Resolution R-1077-12 (Attachment A), which in turn was a review of a 2007 feasibility study (Attachment B).

In June 2007, following Board Resolution R-282-07, DTPW, then known as Miami-Dade Transit, researched the feasibility of installing cylinder posts (commonly known as bollards) between bus benches, shelters or the road edge at DTPW bus stops in unincorporated Miami-Dade County. While the findings from this study determined bollards to be the least intrusive and safest barrier device (in comparison to steel guardrails or concrete barrier walls), the study ultimately concluded that the benefits of bollards are limited since they are specifically designed for low-speed impacts. Therefore, a vehicle traveling at a high speed could be significantly damaged, and occupants/pedestrians could be severely or even fatally injured if the vehicle collided with a fixed object like a bollard. For these reasons and others, DTPW did not recommend the installation of bollards at bus benches or bus shelters.

In response to Resolution R-1077-12 in 2013, DTPW staff revisited the 2007 feasibility study and determined that the initial conclusions remained valid. The 2007 study found that most of the 1,600 benches and 1,032 shelters in unincorporated Miami-Dade County did not have the allowable space required for bollards to be installed to meet the Federal, State, or County design standards. Moreover, research showed that in nearly all cases, it was not possible to install bollards without violating the Americans with Disabilities Act and standards for clear zone and sight distance, as set forth in the Florida Manual of Uniform Minimum Standards for Design, Construction and Maintenance of Streets and Highways (commonly referred to as the Florida Green Book).

The Florida Green Book requires that structures along roads in the public right-of-way be set back a minimum of four (4) feet where there is curb and gutter, and a minimum of 14 feet where there is no curb and gutter. These distances can increase depending on the design speed of the road. The purpose of this requirement is to provide a clear recovery zone to provide motorists that have temporarily lost control of their vehicle with a clear area to allow them to regain control of their vehicle and return to the roadway without injuring themselves, passengers, or pedestrians. If bollards are placed in front of the shelters or benches, they would most likely be in violation of the roadside clear recovery zone and present a life-threatening hazard.

The 2007 study also identified 121 bus shelters that would be potential candidates for bollards based on shelter layouts with sufficient distance from the roadway; however, their installation is still not recommended for use as a safety barrier for transit patrons for the reasons stated above. Additionally, the average retro-fit cost for each of the 121 locations is estimated at $28,600.00 or a total of approximately $3,460,600.00 (based on 2015 construction costs).

In conclusion, the findings of the 2007 and 2013 studies, and this most recent review by DTPW, determine that the installation of safety barriers at bus stops (with benches or shelters) is not financially or operationally feasible. The Florida Department of Transportation concurs with DTPW's findings.

Pursuant to Ordinance 14-65, this memorandum will be placed on the next available Board meeting. If you have any questions, please contact Alice N. Bravo, Director of the Department of Transportation and Public Works, at 786-469-5406.

Attachments

c: Alina T. Hudak, Deputy Mayor, Office of the Mayor
Alice N. Bravo, P.E., Director, Department of Transportation and Public Works
Eugene Love, Agenda Coordinator

MEMORANDUM

Agenda Item No. 11(A)(4)

TO:	Honorable Vice Chairwoman Audrey M. Edmonson and Members, Board of County Commissioners	**DATE:**	December 18, 2012
FROM:	R. A. Cuevas, Jr. County Attorney	**SUBJECT:**	Resolution directing the County Mayor to study the feasibility of installing safety barriers at bus shelters and/or bus benches in order to protect transit patrons and report the findings of said study to the board within ninety days Resolution No. R-1077-12

The accompanying resolution was prepared and placed on the agenda at the request of Prime Sponsor Senator Javier D. Souto and Co-Sponsors Vice Chairwoman Audrey M. Edmonson, Commissioner Sally A. Heyman, Commissioner Dennis C. Moss, Commissioner Rebeca Sosa and Commissioner Xavier L. Suarez.

R. A. Cuevas, Jr.
County Attorney

RAC/cp

MEMORANDUM

(Revised)

TO: Honorable Vice Chairwoman Audrey M. Edmonson and Members, Board of County Commissioners

DATE: December 18, 2012

FROM: R. A. Cuevas, Jr. County Attorney

SUBJECT: Agenda Item No. 11(A)(4)

Please note any items checked.

_____ "3-Day Rule" for committees applicable if raised

_____ 6 weeks required between first reading and public hearing

_____ 4 weeks notification to municipal officials required prior to public hearing

_____ Decreases revenues or increases expenditures without balancing budget

_____ Budget required

_____ Statement of fiscal impact required

_____ Ordinance creating a new board requires detailed County Mayor's report for public hearing

_____ No committee review

_____ Applicable legislation requires more than a majority vote (i.e., 2/3's ____, 3/5's ____, unanimous _____) to approve

_____ Current information regarding funding source, index code and available balance, and available capacity (if debt is contemplated) required

Approved _____ Mayor
Veto _____
Override _____

Agenda Item No. 11(A)(4)
12-18-12

RESOLUTION NO. R-1077-12

RESOLUTION DIRECTING THE COUNTY MAYOR OR MAYOR'S DESIGNEE TO STUDY THE FEASIBILITY OF INSTALLING SAFETY BARRIERS AT BUS SHELTERS AND/OR BUS BENCHES IN ORDER TO PROTECT TRANSIT PATRONS AND REPORT THE FINDINGS OF SAID STUDY TO THE BOARD WITHIN NINETY DAYS

WHEREAS, the safety of transit patrons is of paramount importance; and

WHEREAS, the installation of safety barriers at bus shelters and/or bus benches may protect transit patrons from vehicles running off the road; and

WHEREAS, a feasibility study would assist in determining the potential costs, likely locations, and safety benefits of such an installation,

NOW, THEREFORE, BE IT RESOLVED BY THE BOARD OF COUNTY COMMISSIONERS OF MIAMI-DADE COUNTY, FLORIDA, that this Board directs the County Mayor or Mayor's designee to study the feasibility of installing safety barriers at bus shelters and/or bus benches in order to protect transit patrons and report the findings of said study to the Board within ninety days of the effective date of this Resolution. The County Mayor or Mayor's designee is further directed to identify the 100 most utilized bus stops for the potential installation of safety barriers and review the feasibility of amending existing bus bench and bus shelter contracts to facilitate said installation.

The Prime Sponsor of the foregoing resolution is Senator Javier D. Souto and the Co-Sponsors are Vice Chairwoman Audrey M. Edmonson, Commissioner Sally A. Heyman, Commissioner Dennis C. Moss, Commissioner Rebeca Sosa and Commissioner Xavier L. Suarez. It was offered by Commissioner Sally A. Heyman, who moved its adoption. The motion was seconded by Commissioner Rebeca Sosa and upon being put to a vote, the vote was as follows:

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Audrey M. Edmonson, Vice Chairwoman			aye
Bruno A. Barreiro	aye	Lynda Bell	aye
Esteban L. Bovo, Jr.	aye	Jose "Pepe" Diaz	aye
Sally A. Heyman	aye	Barbara J. Jordan	aye
Jean Monestime	aye	Dennis C. Moss	aye
Rebeca Sosa	aye	Sen. Javier D. Souto	absent
Xavier L. Suarez	aye	Juan C. Zapata	aye

The Chairperson thereupon declared the resolution duly passed and adopted this 18th day of December, 2012. This resolution shall become effective ten (10) days after the date of its adoption unless vetoed by the Mayor, and if vetoed, shall become effective only upon an override by this Board.

MIAMI-DADE COUNTY, FLORIDA
BY ITS BOARD OF
COUNTY COMMISSIONERS

HARVEY RUVIN, CLERK

By: Christopher Agrippa
Deputy Clerk

Approved by County Attorney as to form and legal sufficiency.

Bruce Libhaber

ATTACHMENT B

Memorandum

MIAMI-DADE COUNTY

Date:	September 12, 2007
To:	Honorable Chairman Dorrin D. Rolle and Members, Transit Committee
From:	George M. Burgess County Manager
Subject:	Findings of Feasibility Study for the Installation of Cylindrical Posts Between Bus Passenger Benches or Shelters and the Edge of the Road at Bus Stops in Unincorporated Miami-Dade County

TC
Agenda Item No. 8(F)

BACKGROUND

This report is presented in response to Resolution No. R-282-07 adopted by the Board on March 6, 2007 and sponsored by Commissioners Rolle and Edmonson requesting that a study be conducted to examine the feasibility of installing cylindrical posts between bus passenger benches or shelters and the edge of the road at Miami-Dade Transit (MDT) bus stops in Unincorporated Miami-Dade County. MDT solicited the services of a traffic consultant, F.R. Aleman & Associates, to study the feasibility of installing cylindrical posts, commonly known as bollards, between bus passenger benches or shelters and the edge of the road. The purpose of these bollards would be to act as a barrier and protect the patrons from errant vehicles that leave the roadway.

OBJECTIVE

Investigate and document the potential benefits, risks, regulatory issues, time and cost of installing cylindrical posts for passenger safety at over 2,300 bus stops throughout Miami-Dade County. The 2,300 bus stops consist of 1,100 bus shelters and 1,200 bus benches.

The study includes the investigation of 300 bus stop locations representing the various typical conditions that exist at bus stop with benches or shelters, and discusses the benefits, risks, costs, time frame for implementation, and compliance requirements for the installation of these bollards.

EXECUTIVE SUMMARY

Findings from the study indicate most of the benches and shelters do not have the allowable space required for bollards to be installed and meet Federal, State and County design standards. Bus routes generally travel along the County's busiest roadways. In most cases these streets have been widened to accommodate the increase in traffic over the years. As a result, our busiest streets generally have very limited right-of-way left. In nearly all cases it would not be possible to install bollards in front of bus benches and shelters without violating the standards set in the Florida Manual of Uniform Minimum Standards for Design, Construction and Maintenance of Streets and Highways, more commonly referred to as the Florida Green Book.

The Florida Green Book requires that structures in the public right-of-way along roads be set back a minimum of four (4) feet where there is curb and gutter and a minimum of fourteen (14) feet where there is no curb and gutter. The distance increases with the design speed of

the road. The purpose of this requirement is to provide a "clear recovery zone". The clear recovery zone provides motorists that have temporarily lost control of their vehicle a clear area without impediments allowing them to regain control of their vehicle and return to the roadway without danger of injury to themselves and their passengers. Shelters and bus benches are generally located at the limit of the clear zone. If bollards are place in front of the shelters or bus benches, they would most likely be in violation of the roadside clear zone and present a life threatening hazard to motorists.

Additionally, the Florida Green book requires that roadway intersections have an unobstructed view of the traffic in the intersection. This is called the site distance triangle. Most bus stops with shelters or benches have been placed just beyond the limits of the site distance triangle to accommodate the shelter or bus bench. Bollards placed in front of the shelters or benches would fall within the site distance triangle and would be in violation of State and County regulations and present a life threatening hazard to motorist.

Additional significant findings from this report are provided for your information below as follows:

- Bollards are designed for low speed impacts. A high speed collision at bus stop benches or shelters with bollards could result in pedestrians being hit or trapped by a bollard driven out of the ground.
- Designs for most locations would require bollards to be installed within four (4) feet of the curb and gutter, or fourteen (14) feet from flush roadways, violating Clear Zone guidelines.
- Objects installed within the Clear Zone are designed to bend or break upon impact. The Bollard would not bend or break.
- Maintaining 36 inches of clear width for disabled persons restricts bollards from being installed on most sidewalks.
- Bollards can obstruct the driver's view of traffic at an intersection.
- Large foundations and conflicts with subsurface utilities make designs impractical to implement and most locations.
- Shelter layouts with sufficient distance from the roadway are possible locations where bollards can be installed without violating State or County regulations. Based on the inventory, 11% of bus shelters (121 bus shelters) throughout the county are possible candidates for bollard retrofits. Benches are not recommended.
- The average cost for installation is $22,000. The cost of installation at 121 locations is approximately $2,662,000. Design costs are an average of 5% of construction, for a cost of $133,100. Total cost for installation is approximately $2,795,100.
- Design, Permitting and Construction would take approximately 12 months. The County's solicitation of a design consultant and contractor would take approximately 20 months for a total of thirty two (32) months.

The benefits of typical bollards for protection are limited. A typical bollard, like those found in parking lots or adjacent to fire hydrants, cannot withstand the impact associated with errant vehicles leaving the roadway. In fact, a bollard specifically designed to withstanding high speed collisions may actually increase the risk of a deadly incident as the driver or passenger of the errant vehicle are most likely to suffer serious injury.

While the concept of using bollards to protect the patrons of our bus system would at first blush appear to increase public safety, research indicates that it would in all likelihood result in the opposite effect. Therefore, cylindrical posts are not recommended for protection of pedestrians at bus stops against errant vehicles that leave the roadway. However, MDT will continue to explore other cost-effective measures achieving this purpose that may be in use by other transit systems.

Assistant County Manager

MEMORANDUM

Agenda Item No. 11(A)(21)

TO:	Honorable Chairman Bruno A. Barreiro and Members, Board of County Commissioners	DATE:	March 6, 2007
FROM:	Murray A. Greenberg County Attorney	SUBJECT:	Resolution directing County Manager to examine feasibility of installing cylindrical posts between bus benches or shelters and edge of the road

The accompanying resolution was prepared and placed on the agenda at the request of Commissioner Dorrin D. Rolle and Commissioner Audrey M. Edmonson.

for Murray A. Greenberg
County Attorney

MAG/jls

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MEMORANDUM
(Revised)

TO: Honorable Chairman Bruno A. Barreiro and Members, Board of County Commissioners

DATE: March 6, 2007

FROM: Murray A. Greenberg
County Attorney

SUBJECT: Agenda Item No. 11(A)(21)

Please note any items checked.

_____ "4-Day Rule" ("3-Day Rule" for committees) applicable if raised

_____ 6 weeks required between first reading and public hearing

_____ 4 weeks notification to municipal officials required prior to public hearing

_____ Decreases revenues or increases expenditures without balancing budget

_____ Budget required

_____ Statement of fiscal impact required

_____ Bid waiver requiring County Manager's written recommendation

_____ Ordinance creating a new board requires detailed County Manager's report for public hearing

_____ Housekeeping item (no policy decision required)

_____ No committee review

5

Approved _____ Mayor
Veto _____
Override _____

Agenda Item No. 11(A)(21)
3-6-07

RESOLUTION NO. _____

RESOLUTION DIRECTING THE COUNTY MANAGER TO EXAMINE THE FEASIBILITY OF INSTALLING CYLINDRICAL POSTS BETWEEN BUS PASSENGER BENCHES OR SHELTERS AND THE EDGE OF THE ROAD AT MIAMI-DADE TRANSIT BUS STOPS IN UNINCORPORATED MIAMI-DADE COUNTY

WHEREAS, there have been numerous accidents involving transit patrons waiting at Miami-Dade County bus stops; and

WHEREAS, the placement of cylindrical posts between bus passenger benches or shelters and the edge of the road may serve to prevent accidents and thus save lives,

NOW, THEREFORE, BE IT RESOLVED BY THE BOARD OF COUNTY COMMISSIONERS OF MIAMI-DADE COUNTY, FLORIDA, that this Board hereby directs the County Manager to prepare a report to determine the feasibility of installing cylindrical posts between bus passenger benches or shelters and the edge of the road. This report shall be presented to the Transit Committee within 60 days of the effective date of this Resolution and will include: total estimated cost, a time schedule for possible implementation, engineering or planning concerns, implications with the ADA, and potential safety benefits and risks.

The foregoing resolution was sponsored by Commissioner Rolle and Commissioner Audrey M. Edmonson and offered by Commissioner , who moved its adoption. The motion was seconded by Commissioner and upon being put to a vote, the vote was as follows:

3

60

Bruno A. Barreiro, Chairman
Barbara J. Jordan, Vice-Chairwoman

Jose "Pepe" Diaz	Audrey M. Edmonson
Carlos A. Gimenez	Sally A. Heyman
Joe A. Martinez	Dennis C. Moss
Dorrin D. Rolle	Natacha Seijas
Katy Sorenson	Rebeca Sosa
Sen. Javier D. Souto	

The Chairperson thereupon declared the resolution duly passed and adopted this 6th day of March, 2007. This resolution shall become effective ten (10) days after the date of its adoption unless vetoed by the Mayor, and if vetoed, shall become effective only upon an override by this Board.

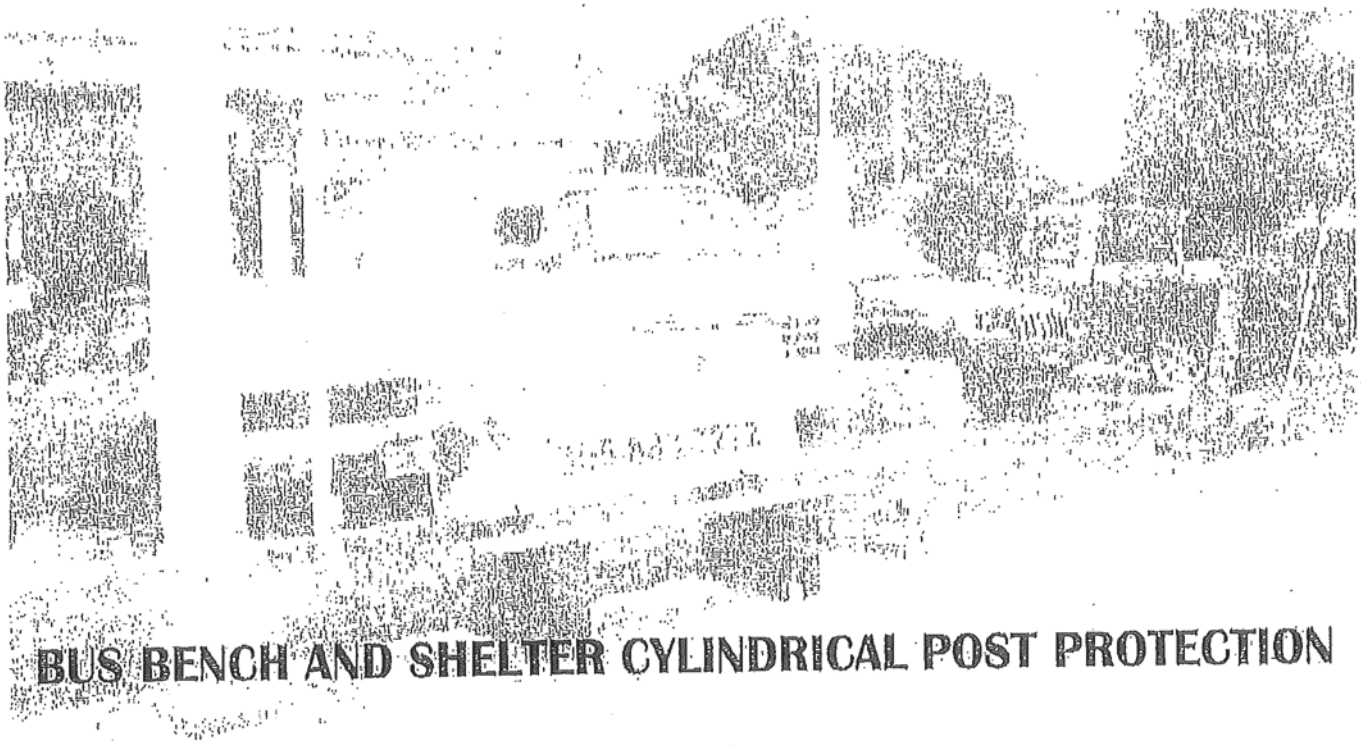
MIAMI-DADE COUNTY, FLORIDA
BY ITS BOARD OF
COUNTY COMMISSIONERS

HARVEY RUVIN, CLERK

By:_____
Deputy Clerk

Approved by County Attorney as
to form and legal sufficiency.

Bruce Libhaber



BUS BENCH AND SHELTER CYLINDRICAL POST PROTECTION

FEASIBILITY STUDY

Prepared for:

MIAMI-DADE COUNTY

Delivering Excellence Every Day

Prepared by:

R. ALEMAN & Associates, Inc.
CONSULTING ENGINEERS & SURVEYORS

August 31, 2007

EXECUTIVE SUMMARY

This report investigates the feasibility of installing cylindrical posts between bus passenger benches and shelters and the edge of the road at Miami-Dade Transit (MDT) bus stops throughout Miami-Dade County. Findings from the study indicate most of the benches and shelters do not have the allowable space required for bollards to be installed and meet Federal, State and County design standards. The benefits of typical bollards for protection are limited. A typical bollard, like those found in parking lots or adjacent to fire hydrants, cannot withstand the impact associated with errant vehicles leaving the roadway. A bollard specifically designed to withstanding high speed collisions actually increase the risk of a deadly incident as the driver or passenger of the errant vehicle are most likely to suffer serious injury. Therefore, cylindrical posts are not recommended for protection of pedestrians at bus stops against errant vehicles that leave the roadway.

Significant findings from this report are as follows:

- Bollards are designed for low speed impacts or for security applications.
- A high speed collision at bus stop benches or shelters with bollards could result in pedestrians being hit or trapped by one driven out of the ground. The installation of Bollards could create a more dangerous situation for both pedestrians and drivers
- At the majority of locations installation of bollards would violate design standards and codes for Clear Zone, Sight Distance and the Americans with Disabilities Act.
- Objects installed within the Clear Zone are designed to bend or break upon impact.
- Maintaining 36 inches of clear width for disabled persons restricts bollards from being installed on most sidewalks.
- Bollards can obstruct the driver's view of traffic at an intersection.
- Large foundations and conflicts with subsurface utilities make designs impractical to implement at most locations.
- Shelter layouts with sufficient distance from the roadway are possible locations where bollards can be installed without violating State or County regulations. The safety benefits of installing bollards at these locations would most likely be limited.
- Based on the inventory, 11% of bus shelters throughout the county are possible candidates for bollard retrofits, and at benches they are not recommended.
- There are approximately 1100 bus shelter locations, construction costs for 121 shelter sites are estimated at $2,662,000.

- Design, Permitting and Construction will take approximately twelve (12) months.

LIST OF FIGURES AND TABLES

1. INTRODUCTION

F.R. Aleman and Associates, Inc. was retained by Miami Dade Transit to investigate the feasibility of installing cylindrical posts between bus passenger benches and shelters and the edge of roadways throughout locations in Miami-Dade County. The study was sanctioned by the Commissioners of Miami-Dade County to improve safety at these locations and provide protection from vehicle impacts. The purpose of this report is to investigate and document the potential benefits and risks of installing cylindrical posts for passenger safety at over 2,300 bus stop benches and shelters throughout Miami-Dade County.

2. STUDY METHODOLOGY

The study was undertaken in accordance with the Letter of Authorization issued by Miami Dade Transit (MDT) dated June 2007. The study methodology was developed to address questions and concerns in the scope of services set forth by the Commissioners of Miami-Dade County to conduct a feasibility study for proposed safety improvements at bus stop locations countywide. The study includes an inventory of 300 locations representing the various conditions that exist at bus stops with benches or shelters, and discusses the benefits, risks, cost, timeline of implementation, and compliance requirements for the installation of cylindrical posts.

3. PROPOSED SAFETY IMPROVEMENTS

Upon direction of the Commissioners of Miami-Dade County, F.R. Aleman & Associates was selected by Miami-Dade Transit to study the feasibility of installing cylindrical posts, commonly known as bollards, between bus passenger benches or shelters and the edge of the road. The purpose of these bollards would be act as a barrier or protect the patron from errant vehicles that leave the roadway. Ideally, the bollard would absorb the impact from the collision and stop, or deflect, the vehicle from pedestrians waiting at the bus stop.

The bollards must be designed to improve safety without endangering drivers and pedestrians. They would have to be placed in front, and on the sides, to protect against vehicles approaching in both directions parallel to the bus stop. A typical design would have bollards spaced just a few feet from each other, and capable of stopping errant vehicles moving at the roadway's design speed. They must also comply with American with Disabilities Act (ADA) Standards for Accessible Design, Florida Department of Transportation (FDOT) Design Standards and be approved by Miami-Dade Public Works Department.

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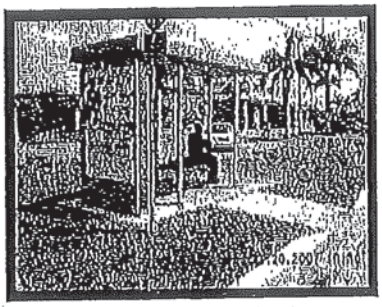

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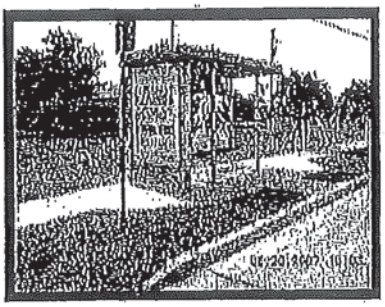

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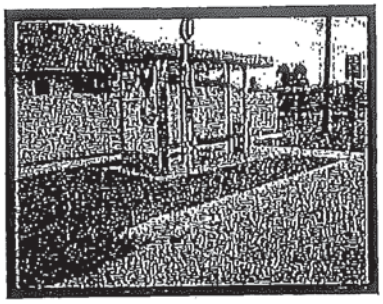

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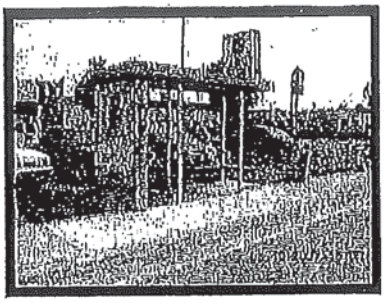

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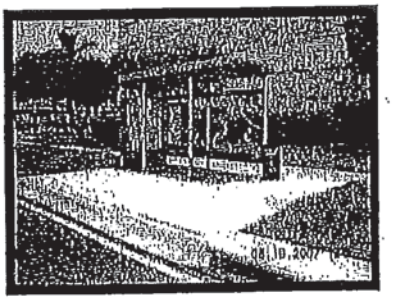

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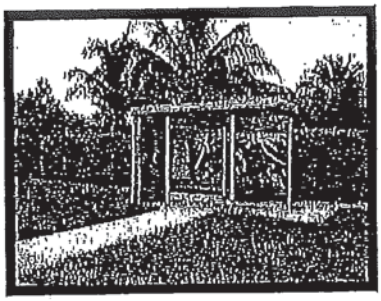

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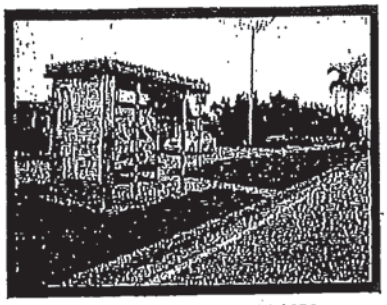

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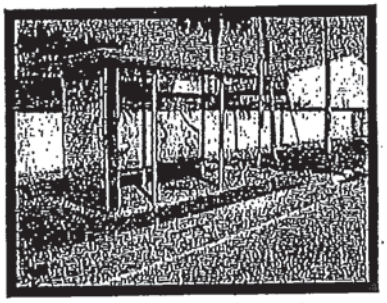

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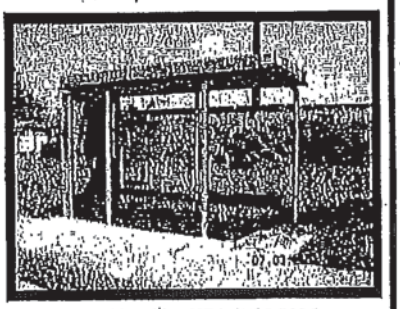

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R. ALEMAN & Associates, Inc. CONSULTING ENGINEERS

Bus Shelter Photos
Miami-Dade County

FIGURE 1

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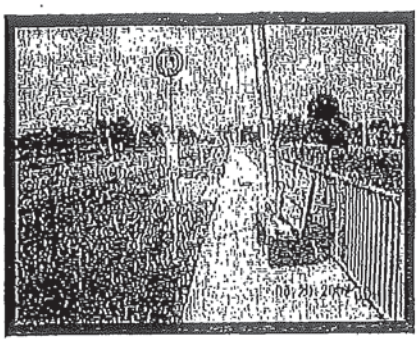

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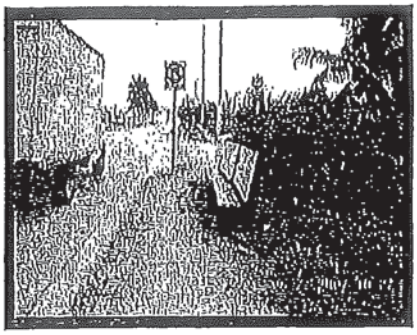

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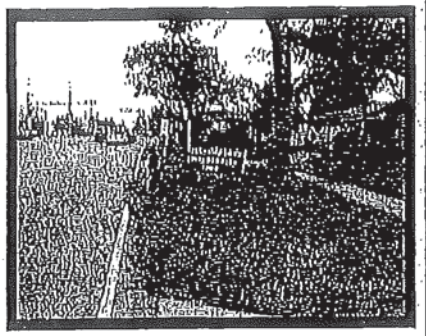

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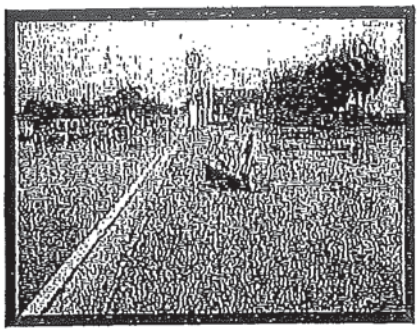

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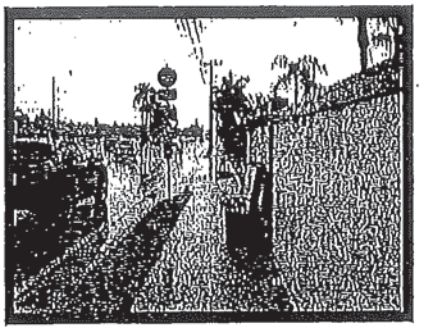

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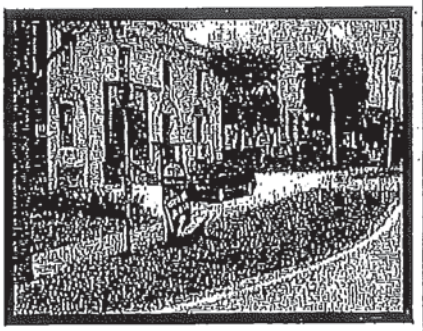

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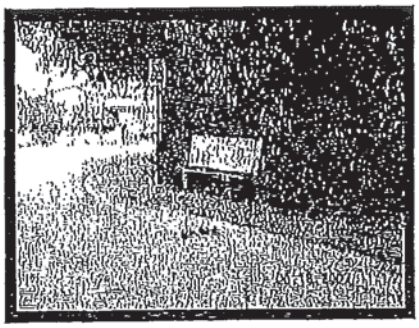

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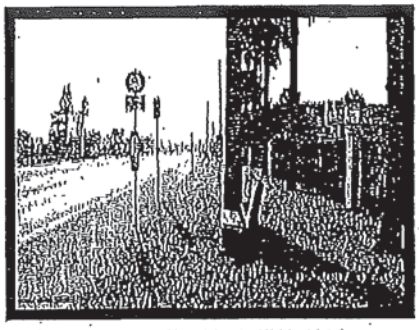

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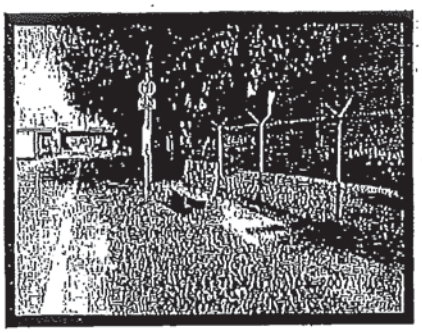

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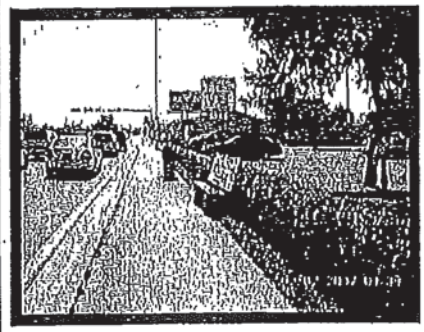

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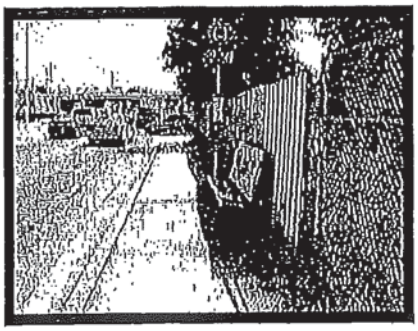

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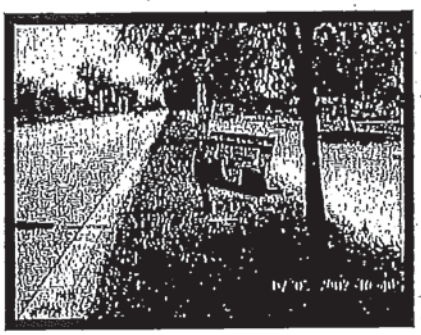


Bus Stop No: MD6-0726.0000

R. ALEMAN & Associates, Inc., CONSULTING ENGINEERS	**Bus Bench Photos Miami-Dade County**	**FIGURE 2**

4. EXISTING BUS BENCH & SHELTER LAYOUTS

The placement of benches and shelters can vary depending on the location and available Right-of-Way, but typically they are set on the back of sidewalk or behind it if space is available. The Right-of-Way is an easement, or strip of land, that is designated for transportation facilities such as rail lines, highways and roads. As the roadway expands, less space is available for installing curbside features such as benches, shelters, signs and utility poles. Figure 1 and Figure 2 show photos of various benches and shelters in Miami-Dade County.

The shelters are typically fourteen (14) feet by six (6) feet and sit on a reinforced concrete slab that is accessible to a sidewalk if present. Figures 3, 4 and 5 shows various shelter layouts along roadways and Transit Facilities Guidelines for Curbside Bus Shelters can be found in the Appendix. They provide protection from the elements and promote the use of public transportation. The bus shelters are designed to accommodate disabled persons and meet the American with Disabilities Act requirements. The shelters provide adequate mobility for wheelchair or mobility aid users by providing clear floor space within the shelter, maintaining clear width and access to sidewalks.

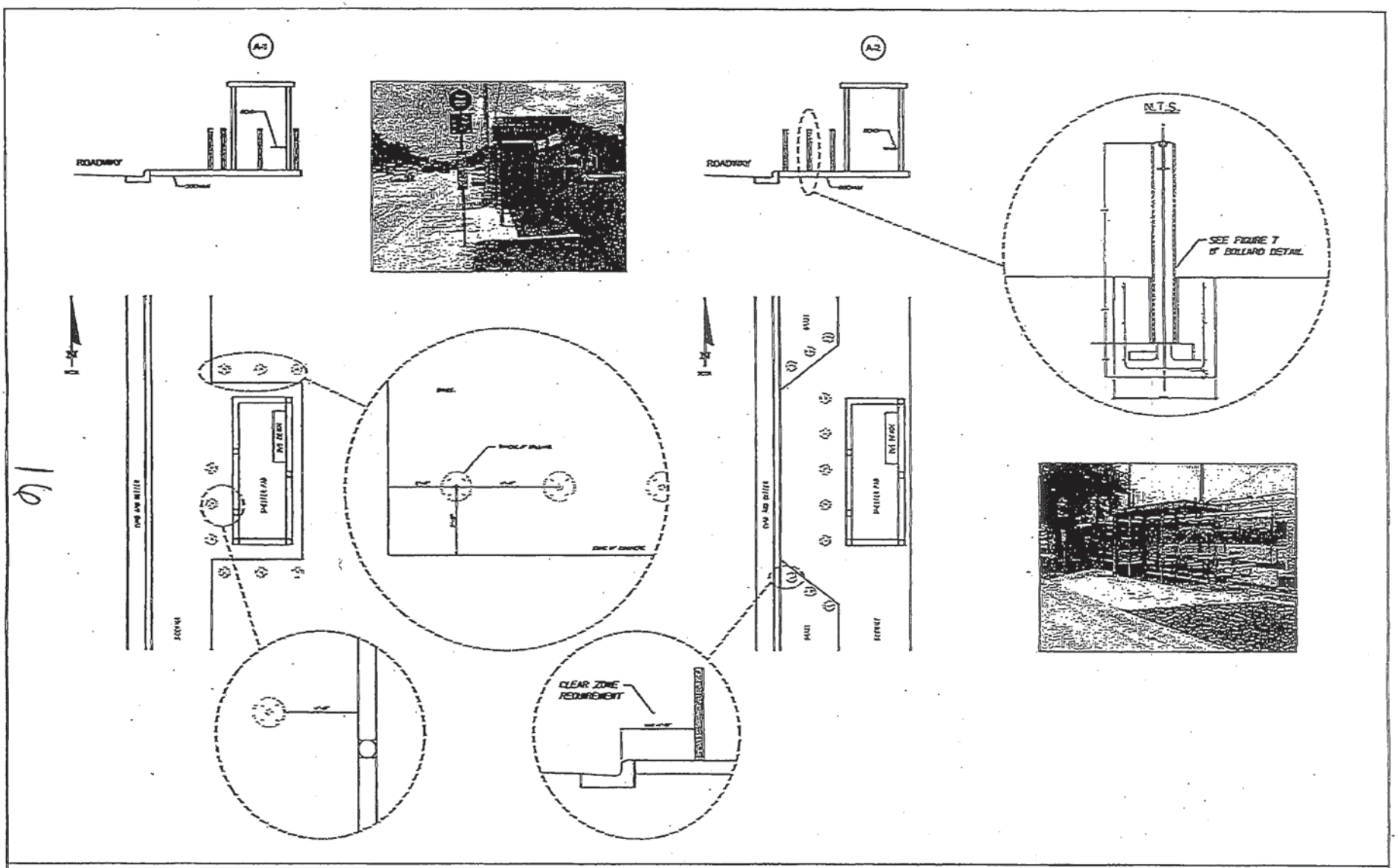
Benches are a low cost option for provide a waiting area for commuters. Often these are placed where Right-of-Way is limited and shelters are not a viable option. They are also seen at bus stops that experience a low volume of commuters throughout the day. Typically they are six (6) feet by two (2) feet, and constructed of concrete and/or wood. Figure 6 shows various placements of benches at roadways with different cross sections. Placement can vary, but typically they set on the back of sidewalk or behind it if space if available. Some of the benches found on major arterials are currently in violation of clear zone requirements. The table below summarizes the inventory layout types that were analyzed.

Bus Bench and Shelter Layouts

TYPE A	TYPE B	TYPE C	TYPE D
94	85	12	109

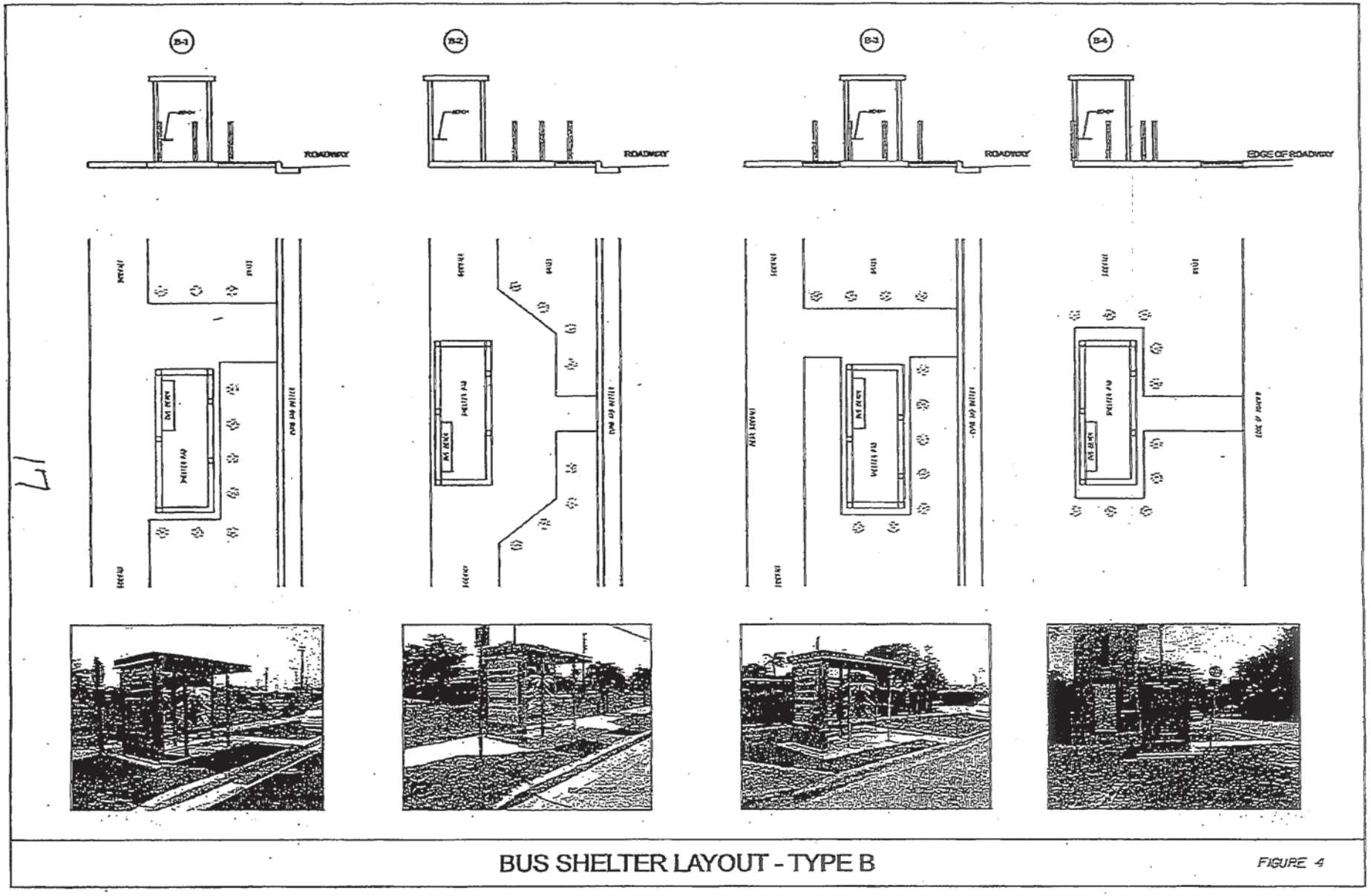
5. SAFETY BENEFITS

The safety benefits of typical bollards are quite limited. The typical bollard is designed to protect against low speed impacts such as vehicles slowing to make turns and navigation at parking stalls. The errant vehicle could be deflected or stopped by one of the bollards if a collision occurs. Bus stops which are located in parking lots would be the likely candidate for a bollard retrofit.



BUS SHELTER LAYOUT - TYPE A

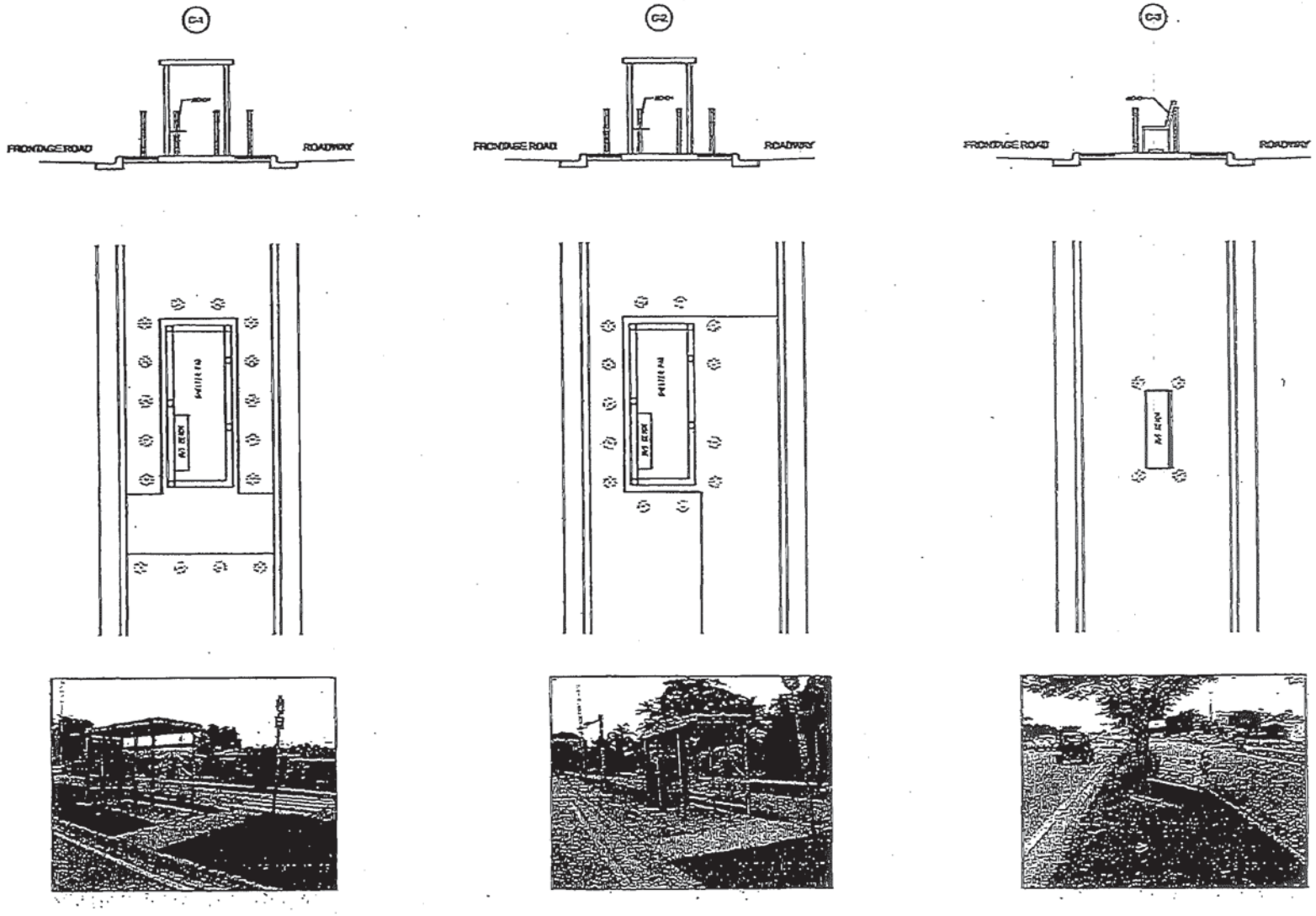
FIGURE 3



BUS SHELTER LAYOUT - TYPE B

FIGURE 4

18



BUS SHELTER LAYOUT - TYPE C

FIGURE 5

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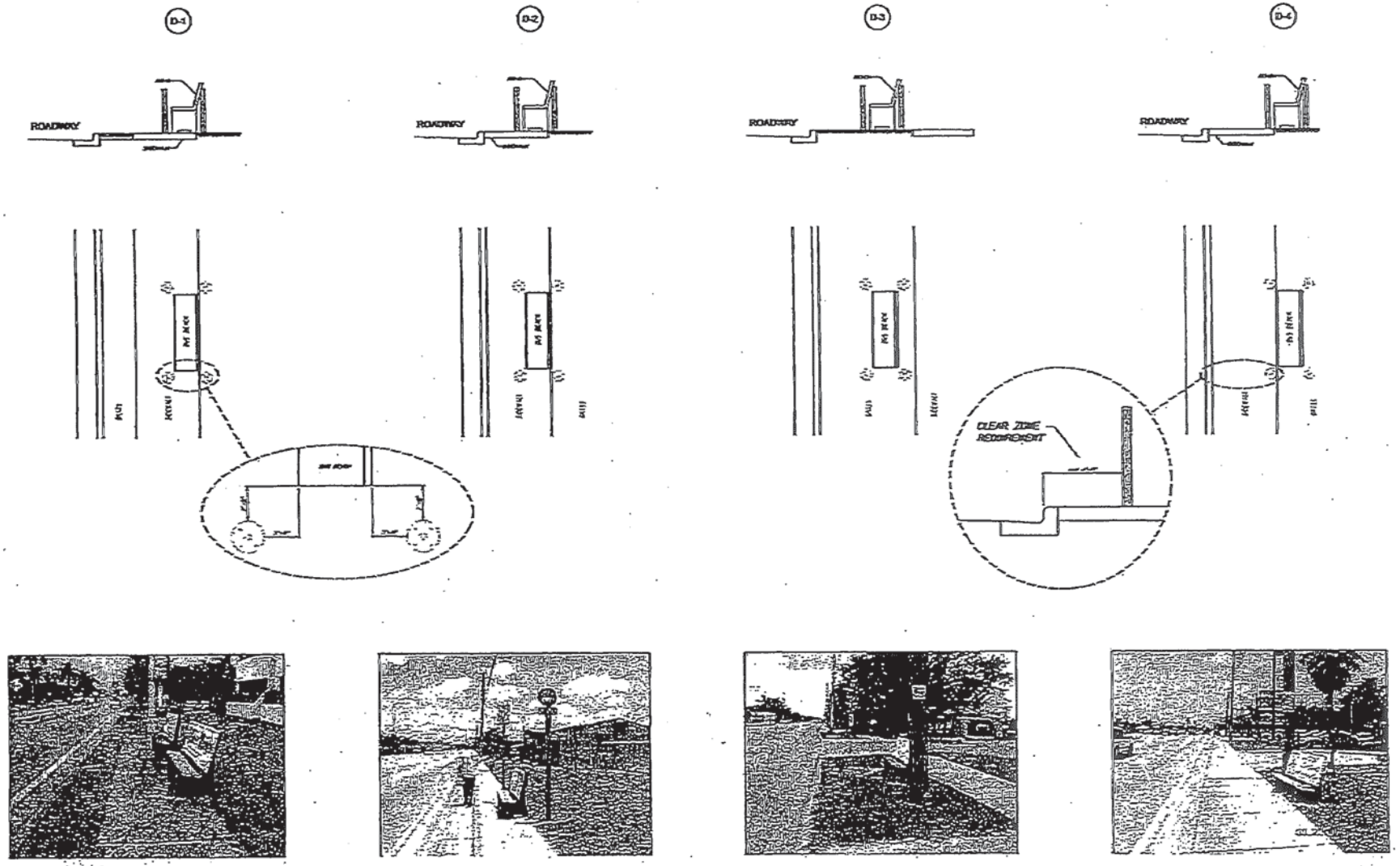


BUS BENCH LAYOUT - TYPE D

FIGURE 6

6. SAFETY RISKS

Typically bollards are used as a low speed deterrent, and not high impact collisions. Security bollards are designed for high speed collisions, but are larger and create more of a hazard for drivers and pedestrians. The low speed bollards are placed to alert drivers of objects in close proximity to the roadway and provided minimal deflection. They also aid in channeling traffic and alerting truck drivers of possible turn radius conflicts. Bollards that have experienced collisions at high impacts are known to be bent, or at worst, driven out of the ground. They pose an added threat to pedestrians if they are close to one being struck. A collision at bus stop benches or shelters with bollards could result in a pedestrian being hit or trapped by one driven out of the ground.

The installation of bollards at bus shelters presents safety hazards for drivers and pedestrians. Protection at bus stops with limited Right-of-Way would require installation within the Clear Zone and increase collisions with vehicles. This notion would contradict the concept of providing a safe roadway for drivers by introducing hundreds of potentially dangerous road hazards throughout the county.

A typical design for protection of a bus stop would require multiple bollards spaced a few feet apart, and would have to be placed four (4) feet from the curb and gutter to satisfy Clear Zone requirements. The Clear Zone provides motorists that have temporarily lost control of their vehicle a clear area without obstructions allowing them to regain control of their vehicle and return to the roadway. Most objects that are within the clear zone are designed to bend or break when impacted by a vehicle limiting the danger to an errant vehicle. Sections where the roadway curb and gutter is not present require a minimum of fourteen (14) feet to satisfy this requirement.

The Florida Green book requires that roadway intersections have an unobstructed view of the traffic in the intersection. This is called the site distance triangle. The bollards would have to be located so they would not compromise the visibility of motorists entering the roadway from other roads or driveways. Most bus stops with shelters or benches have been placed just beyond the limits of the site distance triangle. Bollards placed in front of the shelter or benches would fall within the site distance triangle and would be in violation of State and County regulations, creating a conflict for drivers at specific approaches. See Appendix for departure sight triangles for vehicle approaches. Drivers approaching northbound at an intersection may have difficulty seeing incoming traffic on the eastbound and westbound approaches. Bollards viewed at an angle could appear to the driver as a wall and obstruct the view of drivers.

Benches are typically installed at bus stops where, due to limited Right-of-Way, a shelter cannot be accommodated. The bus bench is placed at the back of sidewalk which generally is the limit of the Right-of-Way typically less than eight (8) feet from the edge or roadway. Under this scenario if bollards are placed in front of the bench, the bollards would violate both the Clear Zone and the American with Disability Act (ADA) requirements

Installing bollards at these locations would violate the clear width requirements for persons using wheelchair or mobility aids. The minimum clear width of an accessible route is 36 inches according to the Department of Justice ADA Standards of Accessible Design. Installing bollards that create minimal maneuvering capabilities increases the potential danger for disabled persons. Some may be forced to conduct dangerous maneuvers to clear the bollards at high volume roadways.

7. BOLLARD TYPES

Bollards can be used to protect roadside objects such as parking meters or fire hydrants, channel vehicles, and limit vehicle access. They are designed for low speed impacts. A typical bollard is shown in Figure 7. This 8" bollard has been designed for an impact force of 9,000 pounds applied at the top of the bollard. It requires a foundation which is three (3) feet in diameter and depth. Roadways with higher speed limits would require bollards with larger foundations making it difficult to install. Conflicts with subsurface utilities will create feasibility concerns during design and construction. Relocating multiple utilities lines at any given site will increase the costs and timeline of installation.

Security bollards are designed for intentional high speed impacts. They can stop a truck at high speeds, and are used at power plants, embassies, courthouses, and other government buildings. The Department of State (DOS) Bureau Diplomatic Security has developed certifications based on their crash-testing procedures, the details of which can be found in the Appendix. The highest classification (K12) specifies that the barrier can withstand the impact of a 15,000 lb vehicle running at 50 mph. This type of protection is costly and requires large foundations which are not practical.

8. INSTALLATION FEASIBILITY

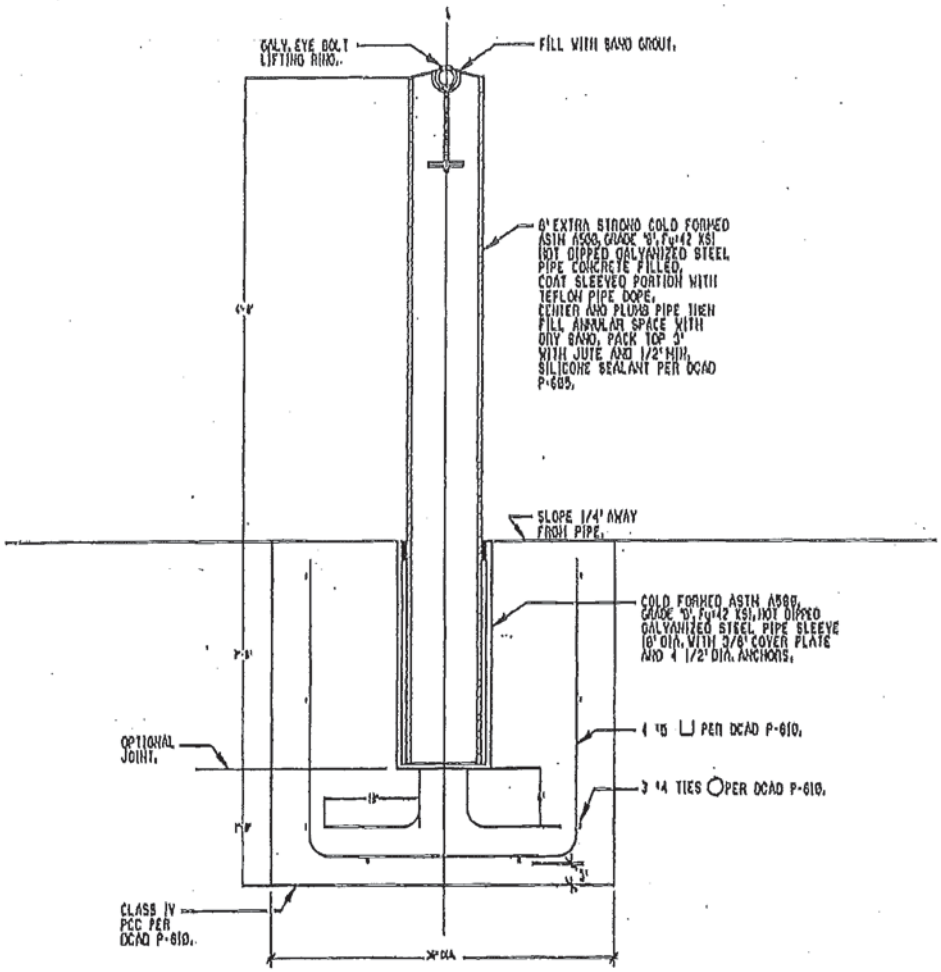
The bollards must be designed to improve safety without endangering drivers and pedestrians. They would have to be placed in front, and on the sides, to protect against vehicles approaching from both directions parallel to the bus stop. Locations where a frontage road for driveway access is behind the shelter or bench, bollards must be considered. A typical design would have bollards spaced just a few feet from each other, and capable of stopping errant vehicles moving at the roadway's design speed. They must also comply with the American with Disabilities Act (ADA) Standards for Accessible Design, as well as, Florida Department of Transportation (FDOT) Design Standards.

Based on the inventory, the majority of bus stops with benches are poor candidates for the installation of bollards as a safety measure. They are typically used at locations with limited space and, at a minimum, a five (5) foot sidewalk separating the curb from the Right-of-Way. Violations of the ADA requirements and Clear Zone widths set forth by the Florida Department of Transportation Design Standards restrict the feasibility of installing bollards at these locations.

Shelters must meet the same space requirements as benches and would require more bollards, which are impractical due to the size of the foundations. Shelter layouts such as Type B-4 in Figure 4 are a candidate for bollard retrofits. Provided the shelter is offset far enough from the roadway and sidewalks are not present, these locations can be protected with bollards without violating City or State regulations. This is not the majority of shelter layouts, most are built with limited space between the shelter and roadway. Locations of these shelters are sufficiently removed from the roadway that the safety benefits of installing bollards would most likely be limited.

There are approximately 1100 bus shelters throughout Miami-Dade County, and based on the inventory, 11% of bus shelter locations are possible candidates for bollards to be installed for protection. An estimate of 121 locations is a reasonable based on allowable space, however this number will decrease based on the complexity of subsurface utilities at each site.

N.T.S.



8" BOLLARD DETAIL - DCAD STANDARD

FOR PAVED AREAS

NOTES:

1. THIS BOLLARD HAS BEEN DESIGNED FOR AN IMPACT FORCE OF 9000 POUND APPLIED AT TOP OF BOLLARD.
2. STRENGTH OF CONCRETE 3400 PSI, 5" MAX SLUMP.
3. MINIMUM CONCRETE COVER SHALL BE 3 INCHES.
4. REINFORCING STEEL SHALL BE DEFORMED BAR CONFORMING TO ASTM A-615 GRADE 60.

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FIGURE 7

9. PLANNING AND PERMITTING CONCERNS

According to Miami-Dade Public Works Department, cylindrical posts on a sidewalk present a hazard to motor vehicles and pedestrians. Installing bollards outside of the Clear Zone will most likely be in the middle of the sidewalk which will violate ADA requirements. Ultimately, Miami-Dade Public Works Department has jurisdiction and must approve the designs.

The typical bollard is approximately four (4) feet high and would obstruct advertisements on the shelters. Advertising firms compensate for the cost of the shelters and reducing the visibility of the ads can be compared to a loss in revenue.

Conflicts with underground utilities are a concern that must be dealt with on a site by site basis. This could increase the cost and timeline of installation. Each location can have different elements below the surface that restrict placement of the bollards. Coordination with utility owners is crucial during planning and construction phases to prevent possible conflicts and interruption of service.

The Department of Justice American with Disabilities Act (ADA) Standards for Accessible Design set guidelines for accessibility to places of public accommodation and commercial facilities of disabled persons. Section 10.2 describes the requirements of transportation facilities to accommodate users of wheelchair and mobility aids. This section states:

> *"...that bus stops, bays or other areas where a lift is to be deployed shall have a firm, stable surface; a minimum clear length of 96 inches (measured from the curb or vehicle roadway edge) and a minimum clear width of 60 inches (measured parallel to the vehicle roadway) to the maximum extent allowed by legal or site constrains; and shall be connected to streets, sidewalks or pedestrian paths by an accessible route complying with 4.3 and 4.4".*

A minimum clear width for an accessible route according to section 4.3.3 is 36 inches. Sidewalks are required to maintain a clear continuous width of 36 inches to allow for accessibility. For stations where bus routes are equipped with wheelchair lifts the guidelines require larger clear floor space. These guidelines will considerably limit the number of locations where bollards could be installed. A major concern to the implementation of a bus stop bollard protection scheme would be to maintain compliance with ADA requirements.

CONSTRUCTION COST ESTIMATE FOR INSTALLING CYLINDRICAL POST BETWEEN BUS PASSENGER BENCHES OR SHELTERS AND THE EDGE OF THE ROAD AT MIAMI-DADE TRANSIT (MDT) BUS STOPS

BOLLARDS CONSTRUCTION COST ESTIMATE PER BUS STOP LOCATION

ITEM NO.	DESCRIPTION	UNIT	Qty	UNIT PRICES	Price for Loc. With 4 bollards	Price for Loc. With 6 bollards	Price for Loc. With 8 bollards	Price for Loc. With 10 bollards	Price for Loc. With 12 bollards	Price for Loc. With 16 bollards
1	Mobilization	LS	1	$1,500.00	$1,500.00	$1,500.00	$1,500.00	$1,500.00	$1,500.00	$1,500.00
2	Maintenance of Traffic	LS	1	$2,000.00	$2,000.00	$2,000.00	$2,000.00	$2,000.00	$2,000.00	$2,000.00
3	Removal of Existing Pavement	SY	1	$8.00	$32.00	$48.00	$64.00	$80.00	$96.00	$128.00
4	Concrete Sidewalk (6" thick)	SY	1	$54.42	$435.36	$653.04	$870.72	$1,088.40	$1,306.08	$1,741.44
ITEM NO.	Installation of Bollards									
5	8 Inches Diameter Bollards	EA	1	$300.00	$1,200.00	$1,800.00	$2,400.00	$3,000.00	$3,600.00	$4,800.00
6	Misclellaneous Concrete for Bollards Foundation	CY	0.5	$590.00	$1,180.00	$1,770.00	$2,360.00	$2,950.00	$3,540.00	$4,720.00
7	Misclellaneous Steel for Bollards Foundation	LB	100	$1.70	$680.00	$1,020.00	$1,360.00	$1,700.00	$2,040.00	$2,720.00
8	Miscellaneous Pavement Restoration	SY	1	$650.00	$2,600.00	$3,900.00	$5,200.00	$6,500.00	$7,800.00	$10,400.00
ITEM NO.	Underground Utility Clearance									
9	Subsurface Utility Locates	EA	1	$280.00	$1,120.00	$1,680.00	$2,240.00	$2,800.00	$3,360.00	$4,480.00
TOTAL PRICE					$10,747.36	$14,371.04	$17,994.72	$21,618.40	$25,242.08	$32,489.44

FIGURE 8

10. TIMELINE FOR INSTALLATION

Design of bollard protection for 110 locations will require approximately four (4) months. After plans are developed they must be approved by Miami-Dade County Public Works before construction can begin. Depending on the capabilities of the contractor, it would take approximately six (6) months for construction to be completed. Overall a timeline of twelve (12) months is a reasonable estimate for project completion.

11. DEVELOPMENT OF PRELIMINARY COST ESTIMATES

The construction costs of a single design will vary depending on the site conditions. A preliminary construction cost estimate is shown in Figure 8. Depending on the number of bollards, installing four (4) to sixteen (16) bollards can cost from $10,000 to $30,000 per location. This estimate does not include additional contingencies for designers and contractors which may be up to 5% of the construction costs. Subsurface utility relocation, if required, will also dramatically add to the cost of this project. At an average cost of $22,000 and only 11% of the bus shelters with allowable space to install bollards, construction costs for 121 shelters will be $2,662,000.

12. CONCLUSIONS

Findings from this feasibility analysis suggest that installation of bollards to protect bus shelters throughout Miami-Dade County creates a hazard to drivers and pedestrians. Based on Federal, State and County regulations, approximately 11% of bus shelter locations are possible candidates for a bollard retrofit, and at benches they are not recommended. Safety benefits of typical bollards are limited. They are designed as a low speed deterrent and not for high speed impacts.

A typical bollard, like those found in parking lots or adjacent to fire hydrants, cannot withstand the impact associated with errant vehicles leaving the roadway. A bollard specifically designed to withstanding high speed collisions actually increase the risk of a deadly incident as the driver or passenger of the errant vehicle are most likely to suffer serious injury.

Results from the inventory collected for this study shows that most of the benches and shelters do not have the allowable space for bollards to be installed and meet Federal, State and County design standards. Large foundations, conflicts with subsurface utilities, and approval make designs impractical to implement at most locations. It is not recommended to use cylindrical posts to provide protection at bus stops against errant vehicles that leave the roadway.

APPENDIX

Miami-Dade Transit (MDT)

EDP No. EDP-MT-MTX578119208

Scope of Services for the feasibility of installing cylindrical post between bus passenger benches or shelters and the edge of the road at about 2300 Miami-Dade Transit bus stops.

Purpose:

The Commissioners of Miami-Dade County have implemented a resolution directing the County Manager to examine the feasibility of installing cylindrical post between bus passenger benches or shelters and the edge of the road at Miami-Dade Transit (MDT) bus stops in Unincorporated Miami-Dade County. MDT requires the services of a consultant with an expertise's in traffic engineering to determine the feasibility of installing cylindrical post between bus passenger benches or shelters and the edge of the road at about 2300 Miami-Dade Transit bus stops. Study must be completed and submitted to MDT by August 31, 2007.

This report will include:

1. Meetings and Coordination.
2. Conduct Bus stop inventory for at least 300 locations county wide. Sample to be determined randomly.
3. Evaluate collected inventory data for possible installation of cylindrical post between bus passenger benches or shelters and edge of roadway. Also, this task will involve coordination with FDOT and Miami Dade Public works.
4. Performing total cost for installation of the cylindrical post including but not limited to, design, engineering, site plans.
5. Analysis of Time Schedule for implementation.
6. Evaluate Engineering, planning and permitting concerns.
7. Evaluate collected data for American with Disability Act (ADA) compliance requirements.
8. Conduct analysis of Potential safety benefits and risk for the installation of cylindrical post.
9. Development of the feasibility Study Report Draft.
10. Final Report Development and Submittal by implementing County comments from the Draft report.

C.7.f Roadside Clear Zone

The roadside clear zone is that area outside the traveled way available for use by errant vehicles. Vehicles frequently leave the traveled way during avoidance maneuvers, due to loss of control by the driver (e.g., falling asleep) or due to collisions with other vehicles. The primary function of the clear zone is to allow space and time for the driver to retain control of his vehicle and avoid or reduce the consequences of collision with roadside objects. This area also serves as an emergency refuge location for disabled vehicles.

The design of the roadway must also provide for adequate drainage of the roadway. Drainage swales within the clear zone should be gently rounded and free of discontinuities. Where large volumes of water must be carried, the approach should be to provide wide, rather than deep drainage channels. Side slopes and drainage swales that lie within the clear zone should be free of protruding drainage structures (CHAPTER 4 - ROADSIDE DESIGN, D.6.c. Culverts).

In the design of the roadside, the designer should consider the consequences of a vehicle leaving the traveled way at any location. It should always be the policy that protection of vehicles and occupants shall take priority over the protection of roadside objects. Further criteria and requirements for safe roadside design are given in CHAPTER 4 - ROADSIDE DESIGN.

C.7.f.1 Roadside Clear Zone Width

The clear zone width is defined as follows:

- Rural sections - measured from the edge of the outside motor vehicular travel way
- Urban sections - measured from the face of the curb

The minimum permitted widths are provided in Table 3 - 12. These are minimum values only and should be increased wherever practical.

In rural areas, it is desirable, and frequently economically feasible, to