

## **RAILROAD OPERATIONS**

COMMUTER RAIL DESIGN STANDARDS MANUAL

> VOLUME I SECTION II

# **STATIONS AND PARKING**

Revision No. 1 April 19, 1996

## TABLE OF CONTENTS

### SECTION II - STATIONS AND PARKING

<u>Chapt</u>	hapter				Rev	Page	
1.	CIRCU	ILATIO	n and	PARKING	Rev.1	4-19-96	
I.	INTRO	DUCTIO	ON				1.1
II.	DESIG	IN OBJE	ECTIVE	S			1.1
III.	DESIG	N GUI	DELINE	S			1.1
	A. B. C.	Separ Arriv Pedes	ration val/De strian	of Circulation Mo parture Modes Circulation	des		$1.1 \\ 1.1 \\ 1.2$
		1. 2. 3. 5. 6. 7.	Gene Walk Cros Ramp Stai Pede Trac	ral Principles ways swalks s rs strian Guard Rails k Crossings			1.2 1.3 1.6 1.9 1.12 1.12
			a. b. c.	Location Grade level cros Grade separated	sings crossings		1.12 1.13 1.15
	D.	Vehi	cular	Circulation			1.16
		1. 2. 3. 4. 5.	Gene Vehi Stan Vehi Drop	ral Principles cle Turning Radii dard Road Dimensio cle Entrances and -off/Pick-up Area	ns and Gradients Exits s (Passenger Loac	ling Zones)	1.16 1.16 1.21 1.21 1.23
	Ε.	Park	ing Lo	t Layout			1.25
		1. 2.	Gene Park	ral Principles ing Layout			1.25 1.25
			a. b. c.	Bay Orientation Parking Stall Or Perimeter Parkin	ientation g		1.25 1.25 1.25

Massachusetts Bay Transportation	Commuter Bail	Stations and Parking Section		
Authority RAILROAD OPERATIONS	Design Standards	Table Of Contents		
Revision No. 1 Date: 4/19/96	Manual		Page i	

<u>Chapt</u>	er				<u>Revi</u>	<u>sion</u>	Page
		3.	Dimen	sional Guidelines			1.26
			a.	General notes Standards for 90 dogr	oo narking &	physically	1.26
			D.	disabled Standards for parallo	l parking on	supface late	1.26
		л	U. Accos	sible Parking	ι ραικτιίς υπ	surface fors	1.20
		5. 5.	Gradi	ents			1.30
		0. 7.	Pedes	trian and Traffic Isla	nds		1.32
	F. G.	Use o Use o	f Land f Barr	scape Buffers iers			1.32 1.32
		1. 2.	Gener Types	al statement of Barriers			1.32 1.32
			a. b.	Curbing Vehicular Guard Rail			1.32 1.33
			c. d.	Bollards Pipe Rail			1.33 1.33
			e. f.	Fencing Inter-track Fencing			1.33 1.34
	H. I.	Parki Parki	ng Are ng Fee	a Drainage Requirement Collection	S		1.34 1.34
IV.	REFER	ENCE S	TANDAR	DS			1.37
۷.	PREFE	RRED M	IATERIA	LS			1.37
	A. B	Pavin	ng Mate	erials			1.37
	С. р	Barri	ers	atorials			1.37
	υ.	Strip	nig na				1.50
2.	CANOP	IES AN	ID PLAT	FORMS	Rev.1	4-19-96	
Ι.	INTRO	DUCTIC	)N				2.1
II.	DESIG	N OBJE	CTIVES	5			2.1
III.	DESIG	N GUID	DELINES	5			2.1
	Α.	Platf	forms				2.1
		1. 2.	Locat Safet	cion Cy			2.1 2.2

Massachusetts Bay Transportation	Commuter	Stations and Parking	Section II
RAILROAD OPERATIONS	Design Standards	Table Of Contents	
Revision No. 1 Date: 4/19/96	Manual		Page ii

<u>Chapter</u>				<u>Revision</u>	Page
		3. 4.	Efficiency Use of Barriers		2.2 2.4
	Β.	Shelt	cers		2.5
		1. 2. 3. 4.	General Location Conveniences Lighting		2.5 2.5 2.5 2.5
	С.	Acces	ssibility for Shelters and Platform	IS	2.5
IV	DIMEN	ISIONAL	GUIDELINES		2.6
	Α.	Platf	forms		2.6
		1. 2. 3. 4. 5.	Elevation Length Width Gradient Warning Stripe		2.6 2.6 2.7 2.8 2.8
	Β.	Shelt	cers		2.8
		1. 2.	Size Minimum Clearances		2.8 2.8
۷.	DESIG	IN CRIT	TERIA AND DETAILS		2.10
	Α.	Plati	form		2.10
		1. 2. 3.	Paving Materials Platform Curving with Tactile War Barriers	ning	2.10 2.10 2.12
	Β.	Shelt	ters		2.12
3.	LIGHT	ING	Rev	v.l 4-19-96	
Ι.	INTRO	DUCTIO		3.1	
II.	DESIG	GN OBJI	ECTIVES		3.1
	A. B. C. D. E. F.		3.1 3.1 3.2 3.2 3.2 3.2		

Massachusetts Bay Transportation		Commuter Bail	Stations and Parking	Section II
Authority RAILROAD O	PERATIONS	Design Standards	Table Of Contents	
Revision No. 1	Date: 4/19/96	Manual		Page iii

. \_\_\_\_\_\_

Charlenger and the second			·			
<u>Chapt</u>	<u>er</u>		Revision	Page		
III.	DESIG	GN GUIDELINES		3.2		
	A. B.	Illumination Levels Optical Considerations		3.2 3.3		
		<ol> <li>Contrast Levels</li> <li>Glare</li> <li>Reflected Glare</li> <li>Methods of Control</li> </ol>		3.3 3.3 3.3 3.3 3.3		
	C.	Emphasis of Hazardous and Transiti	on Areas	3.3		
	D.	Emergency Lighting		3.5		
IV.	DESIG	GN CRITERIA AND DETAILS		3.5		
	A. B. C. D. E.	<ul> <li>A. General Luminaries Selection Criteria</li> <li>B. General Lamp Selection Criteria</li> <li>C. Wiring</li> <li>D. Control Components</li> <li>E. Fixture Mounting and Location</li> </ul>				
4.	GRAPH	HICS	Rev. 1 4-19-9	6		
I.	INTRO	DDUCTION		4.1		
II.	DESIG	GN OBJECTIVES		4.1		
	A. B. C.	User Convenience Consistency Durability		4.1 4.1 4.1		
III.	DESIG	GN GUIDELINES		4.1		
	Α.	Terminology		4.1		
		<ol> <li>General</li> <li>Authority Name</li> <li>Authority Symbol</li> </ol>		4.1 4.1 4.2		

	4.	Platform Information	4.2
	5.	Other Standard Terminology	4.2
	6.	Grammatical Guidelines	4.3
	7.	Punctuation Guidelines	4.3
	8	Abbreviation Guidelines	4.3
B.	Pict	cographs	4.4
C.	Cart	cography	4.4

	Massachusetts Bay Transportation		Commuter Bail	Stations and Parking Section	
Authority RAILROAD OPERATIONS		Design Standards	Table Of Contents	1	
Revisi	on No. 1	Date: 4/19/96	Manual		Page iv

<u>Chapte</u>	er			Revision	Page
	D.	Sign 1. 2.	Types General Identification Signs		4.5 4.5 4.5
			a. General b. System Identification Sign c. Station Identification Sign d. Track Number/Destination Sigr e. On-Site Identification Signs	I	4.5 4.5 4.6 4.6
		3.	Directional Signs		4.6
			a. General b. Trailblazers c. On-Site Directional Signs		4.6 4.7 4.7
		4.	Regulatory/Warning Signs		4.7
			a. General b. "Look Before Crossing" Sign c. "No Parking" Sign d. "No Smoking" Sign		4.7 4.7 4.8 4.8
		5.	System Use Signs		4.8
			a. General b. System Panel Map c. Schedule Panel		4.8 4.8 4.9
IV.	DESIG	AN CRIT	FERIA AND DETAILS		4.10
	A. B. C.	Gener Typog Acces	ral graphy ssible Features		4.10 4.10 4.12
		1.	General Requirements		4.12
			a. Character Proportion b. Character Height c. Finish and Contrast		4.12 4.12 4.12
		2.	ADA Sign Types		4.12
			<ul> <li>a. Tactile/Braille signs</li> <li>b. Station Identification Signs</li> <li>c. Directional Signs</li> <li>d. Variable Message Signs</li> <li>e. Miscellaneous Signs</li> </ul>		4.12 4.12 4.12 4.12 4.12 4.12

Massachusetts Bay Transportation		Commuter Rail Design Standards	Stations and Parking	Section II
Authority RAILROA	D OPERATIONS		Table Of Contents	
Revision No. 1	Date: 4/19/96	Manual		Page v

<u>Chapter</u>			Revision	Page
D.	Symbo	1, Arrow and Pictographs		4.12
	1. 2. 3.	Authority "T" Symbol Directional Arrow Symbol Pictographs		4.12 4.13 4.13
Ε.	Use o	f Color		4.13
	1. 2. 3. 4. 5. 6. 7.	Reference to <u>Authority's Manual o</u> <u>Standards.</u> Maximum of five colors to be used Use black letters and symbols on for most directional and informat Purple Red Yellow Blue	<u>f Guidelines and</u> white background ion signs	4.13 4.13 4.13 4.13 4.21 4.21 4.21
F.	Sign	Layout		4.22
	1. 2.	General Identification Signs		4.22 4.22
		a. "T" Symbol b. Station Identification Sign c. Other Identification Signs		4.22 4.22 4.28
	3.	Directional Signs a. Trailblazer b. Other Directional Signs c. Left justify all copy on si	gns away from platform	4.28 4.28 4.28 4.28
	4. 5.	Regulatory/Warning Signs System Use		4.28 4.28
G.	Sign	Materials and Methods of Construct	ion	4.35
	1. 2. 3.	Fiberglass Sheet Aluminum Galvanized Steel		4.35 4.35 4.35

Massachusetts Bay Transportation		Commuter Bail	Stations and Parking	Section I
Authority RAILROAD	OPERATIONS	Design Standards	Table Of Contents	
Revision No. 1	Date: 4/19/96	Manual		Page v

<u>Chap</u>	ter		<u>Revi</u>	<u>sion</u>	Page
5.	COMFO	ORT AND CONVENIENCE FACILITIES	Rev.1	4–19–96	
I.	INTRO	DDUCTION			5.1
II.	DESIG	GN OBJECTIVES			5.1
	A. B.	Comfort Convenience			5.1 5.1
III.	DESIC	GN GUIDELINES			5.1
	A. B.	General Seating			5.1 5.1
		<ol> <li>General</li> <li>Capacity Guidelines</li> <li>Location Guidelines</li> </ol>			5.1 5.1 5.2
	C. D. E. F. G.	Telephones Trash Receptacles Vending Machines and Concessions Clocks Toilet Facilities			5.2 5.3 5.3 5.4 5.4
IV.	DESIC	GN CRITERIA AND DETAILS			5.5
	A. B. C. D.	Seating Telephones Trash Receptacles Toilet Facilities			5.5 5.5 5.7 5.7
6.	LANDS	SCAPING	Rev. 1	4–19–96	
I.	INTRO	DDUCTION			6.1
II.	DESIG	GN OBJECTIVES			6.1
	A. B. C. D. E.	Attractiveness Safety and Security Preservation Durability/Maintainability Soil Conservation			6.1 6.1 6.1 6.1 6.1
III.	DESIG	GN GUIDELINES			6.2
	A. B.	General Buffers			6.2 6.2
		<ol> <li>General</li> <li>Types of Buffers</li> </ol>			6.2 6.2

Massachusetts Bay Transportation	Commuter	Stations and Parking	Section II
RAILROAD OPERATIONS	Design Standards	Table Of Contents	
Revision No. 1 Date: 4/19/96	Manual		Page vii

A second s

			a. Site Topography b. Earth Berms c. Planting d. Fencing	6.2 6.2 6.2 6.2
		3. 4. 5.	EPA noise guidelines Two approaches to alleviating noise impacts a. Berms and walls b. Visual screening Location Guidelines	6.4 6.4 6.4 6.4 6.4
	C.	Site [	Drainage	6.5
		1. 2. 3. 4.	General Station Improvements create need for drainage Grade Modification Guidelines Drainage of Paved Areas	6.5 6.5 6.5 6.5
			<ul> <li>a. General</li> <li>b. Minimum and Maximum Slopes</li> <li>c. Design Flows</li> <li>d. Storm Frequency Determination</li> <li>e. Hydraulics</li> <li>f. Gravity Flow</li> <li>g. Water Collection</li> </ul>	6.5 6.6 6.6 6.6 6.6 6.6 6.6
		5.	Drainage of Unpaved Areas	6.7
	D.	Plant	ing	6.8
		1. 2. 3. 4.	General Preserve Existing Natural Features Types of Planting Location of Planting	6.8 6.8 6.9 6.9
IV.	DESIG	N CRITI	ERIA AND DETAILS	6.12
	A. B.	Genera Site I	al Drainage	6.12 6.12
		1. 2. 3.	Materials Storm Drainage Pipe Manholes, Basins and Inlets	6.12 6.12 6.12
	С.	Plant	ing	6.13
		1. 2.	General Plant Types	6.13 6.13
			a. Large trees b. Small trees	6.13 6.13

Massachusetts Bay Transportation		Commuter Rail	Stations and Parking	Section I
RAILROAD OP	ERATIONS	Design Standards	Table Of Contents	l
Revision No. 1	Date: 4/19/96	Manual		Page vi

<u>Chapter</u>		Revision	<u>Page</u>
		c. Evergreen trees d. Shrubs e. Ground cover	6.13 6.13 6.13
	3. 4. 5. 6.	Station Areas for Planting Matrix of Preferred Size and Location of Plantings Planting Requirements Tree Grates	6.15 6.15 6.15 6.16

Massachusetts Bay Transportation		Commuter Bail	Stations and Parking	Section II
Authority RAILROAD	OPERATIONS	Design Standards	Table Of Contents	
Revision No. 1	Date: 4/19/96	Manual	L	Page ix

## CHAPTER 1 CIRCULATION AND PARKING

#### I. INTRODUCTION

Design standards for vehicular and pedestrian circulation and parking facilities at commuter rail stations are addressed in this section. The guidelines contained herein are intended to direct design consultants in the development of plans and details that will conform to the Authority's current goals for commuter rail station design. These guidelines include design criteria for roadways, walkways, stairs, ramps, and parking lots. Current State and Federal rules, regulations and standards for accessibility are applicable to commuter rail station facilities. (Refer also to the MBTA Guide to Access).

It should be emphasized that these standards are not exhaustive and will leave many site specific issues unaddressed. It is the design consultant's responsibility to seek direction from the Authority where situations arise not covered by these guidelines. Further, it is the responsibility of the design consultant to review the latest applicable Federal, State, and local regulations. Where conflict may exist between such regulations, these guidelines, and/or the MBTA Guide to Access, the most stringent shall apply.

#### **II. DESIGN OBJECTIVES**

Safety, efficiency, and accessibility are the principal objectives to consider in the design of circulation and parking facilities at commuter stations. The organization and detail of the station design must also address specific issues of security, maintenance, and snow removal.

#### III. DESIGN GUIDELINES

#### A. Separation of Circulation Modes

For the maximization of safety station site circulation modes of pedestrian, vehicular, and rail movements should be separately delineated. Locations where circulation modes cross or interface must be well identified and sight lines maximized.

#### B. Arrival/Departure Modes

Station design must address the variety of arrival/departure modes:

- Pedestrian walk-in and bicycles
- Public transportation, including taxis
- Drop-off/pick-up
- Park and ride

Pedestrian, public transportation, and drop-off/pick-up modes should be encouraged by minimizing walking distances from site entry points, and curbside stops to the platform.

Mass Bay Tran	sachusetts sportation	Commuter Bail	Stations and Parking	Section II
Auth R	OFITY	Design Standards	<b>Circulation and Parking</b>	Chapter 1
Revision N	5. 1 Date: 4/19/96	Manual		Page 1.1

#### C. Pedestrian Circulation

- 1. General Principles
  - a. Pedestrian pathways should be direct, well defined, and provide a clear indication of where they lead.
  - b. Pedestrian access from the surrounding community should be encouraged by providing a direct, paved walkway to the platforms.
  - c. An accessible route of travel, free from steps, must link the accessible station entrance with public sidewalks, bus stops, parking and passenger loading zones. The platform may be considered to be a part of this accessible entrance route. With exceptions allowing for specific site conditions, this accessible route of travel should be the primary route for all station users.
- 2. Walkways

Note:

The following section represents a partial summary of the design constraints for walkways. Consult the MBTA <u>Guide to Access</u> and relevant codes for additional information.

a. Width: 5'-0" preferred minimum 4'-0" absolute minimum

Notes:

- 1. For widths less than 5'-0", provide 5'-0" by 5'-0" passing spaces at intervals not to exceed 200'-0".
- 2. Subject to Authority approval and code compliance, the clear width of an accessible route may be a minimum of 36" excluding curb stones and 32" at columns or other obstructions having a depth less than 24".
- b. Slope in the 5% (approx. 5/8" per foot) direction of travel: absolute maximum

Note:

If the slope is greater than 5%, it must be treated as a ramp with a maximum slope of 8%.

Cross-slope:

2% maximum

- c. No level change greater than 1/2" is permitted unless a ramp is provided. Level changes between 1/4" and 1/2" must be beveled with a maximum slope of 1:2.
- d. Walkway surfaces must be slip-resistant (minimum static coefficient of friction of 0.6) with all joints finished flush.

Massachusetts Bay Transportation	Commuter Bail	Stations and Parking	Section II
Authority RAILROAD OPERATIONS	Design Standards	<b>Circulation and Parking</b>	Chapter 1
Revision No. 1 Date: 4/19/96	Manual		Page 1.2

e. Walkways adjacent to roadways should be physically separated by curbing, guardrail, or bollards for safety and to prevent encroachment by vehicles.

Note:

The use of bollards should be minimized as they may interfere with snow removal.

- f. Where sidewalks are located immediately adjacent to parking areas, vehicle overhang from 90° or angle parking should be accounted for in the layout of walkways to ensure that required sidewalk width is maintained.
- g. Snow removal and storage must be considered in the location and design of sidewalks.
- h. Sidewalk shall not be utilized simply as a design element, such as an edge treatment along a roadway. Minimize the amount of sidewalk to that which is truly required.
- 3. Crosswalks
  - a. Locate crosswalks to maximize visibility between pedestrians and vehicles.
  - b. Width: Equal to or wider than walkway width. (6'-0" minimum)

Curb cuts at marked crossings must be wholly within the crossing markings (excluding flared sides).

- c. Pedestrian roadway crossings should be defined by white warning stripes painted on the surface of the roadway (See diagram following).
- d. Curb cuts must be provided wherever an accessible route crosses a curb. The preferred minimum width of curb cuts shall be 40" (absolute minimum no less than 36"), not including sloped sides. The maximum slope of the curb ramp shall be 1:12.
- e. Curb cut ramps must be installed perpendicular to the curbs. Diagonal curb cuts are not allowed.

Note: Consult the MBTA Guide to Access for additional information on the location and design of curb cuts.

Massachusetts Bay Transportation	Commuter Bail	Stations and Parking	Section II
Authority RAILROAD OPERATIONS	Design Standards	Circulation and Parking	Chapter 1
Revision No. 1 Date: 4/19/96	Manual		Page 1.3





	ssachusetts y insportation	Commuter Bail	Stations and Parking	Section II
F	THORITY	Design Standards	<b>Circulation and Parking</b>	Chapter 1
Revision N	lo. 1 Date: 4/19/96	Manual		Page 1.4

### Typical Curb Cut



Curb Cut in Narrow Sidewalk



Massachusetts Bay Transportation		Commuter Bail	Stations and Parking	Section II
		Design Standards	Circulation and Parking	Chapter 1
Revision No. 1	Date: 4/19/96	Manual		Page 1.5

4. Ramps

Note: The f requir appli	following se rements for cable Federa	ction represents a partial summary of the design ramps. Consult the MBTA Guide to Access and 1 and State codes for additional information.
a.	Width:	4'-0" absolute minimum (measured from inside to inside of railing)
b.	Slope: Note: Ramps shall	8% maximum (1" rise in 12.5" run) have a cross slope that is 1:50 (2%) or less.
c.	Distance be	tween landings: 30'-0" maximum
d.	Length of L	andings: Equal to width of ramp (5'-0" minimum length)
	Note: Where a ram 5'-O" by 5' ponding of	p changes direction the landing should be at least -O". Adequate drainage must be provided to prevent water at landings.
e.	Provide a 1 width of th top and bot	evel area that is 5'-O" in length and equal to the e ramp (2% maximum slope in either direction) at the tom of each ramp.
f.	Ramps shall friction of	have a slip-resistant (minimum static coefficient of 0.8) and a glare-free surface.
g.	Run-off is the nearest	the clear area between the end of a stair or ramp and obstruction conflicting with pedestrian movement.
	(1) The r pier	un-off to an obstruction such as a wall, kiosk, or should be equal to 1.7 times the width of the ramp.
	(2) The r front	un-off to the edge of a queuing space, such as the edge of a platform, should be at least 10'-0".
h.	Ramps and railings or chairs from 2" high. P gap above t minimum of	landings with drop-offs shall have curbs, walls, projecting surfaces that prevent people and wheel slipping off the ramp. Curbs shall be a minimum of rotective railings shall allow a maximum 2" vertical he ramp surface. Projecting surfaces must extend a 12" beyond the outside of the guard/hand rail.
i.	Handrails a	t ramps:
	(1) Provi	de continuous handrails on both sides of all ramps.

Massachusetts Bay Transportation	Commuter Bail	Stations and Parking	Section II
C Authority RAILROAD OPERATIONS	Design Standards	Circulation and Parking	Chapter 1
Revision No. 1 Date: 4/19/96	Manual		Page 1.6

(2) Heights: 2'-10" and 1'-7"
 (measured vertically from
 the ramp surface)

(3) Extension: 1'-0" minimum

Note: Handrail should extend beyond top and bottom of ramp, return to a wall or post and must be parallel to ground surface.

(4) Handgrip: Not less than 1 1/4" Not more than 1 1/2" (outside diameter)

> Note: Handgrip should be round or oval in cross-section, should have a smooth surface with no sharp corners, and should be uninterrupted for its entire length to provide a continuous gripping surface.

- k. Where there is a vertical drop at the side of a ramp, provide pedestrian guardrail. (Refer to paragraph 6. Pedestrian Guardrails.)

Massachusetts Bay Transportation	Commuter Bail	Stations and Parking	Section II
Authority RAILROAD OPERATIONS	Design Standards	<b>Circulation and Parking</b>	Chapter 1
Revision No. 1 Date: 4/19/96	Manual		Page 1.7

Ramp Landings



## Ramp Handrails with Extensions



Massachusetts Bay Transportation	Commuter Bail	Stations and Parking	Section II
Authority RAILROAD OPERATIONS	Design Standards	<b>Circulation and Parking</b>	Chapter 1
Revision No. 1 Date: 4/19/96	Manual		Page 1.8

#### 5. Stairs

#### Note:

The following section represents a partial summary of the design constraints for stairs. Consult the MBTA <u>Guide to Access</u> and relevant codes for additional information.)

- a. Width: 6'-0" preferred minimum 4'-0" absolute minimum
- b. Landings: Every 12'-0" of vertical rise

Length: Equal to width of stair (4'-6" absolute minimum)

Tread Size: 11"< T <13"

Note:

These standards represent extremes; riser-tread ratios should be calculated using the following formula:

2R + T = 25"

The treads and risers of any stair must be of a uniform dimension. The minimum number of risers for any stair is three, and the risers themselves should be closed. Stair treads shall not have an abrupt projection of nosing.

- d. Slope of riser: 1 1/4" maximum (measured from the horizontal projection of the tread below) Riser to tread angle: Greater than 70 degrees (See diagram)
- e. Stair treads should pitch to avoid ponding of water (a maximum of 1/8" per foot).
- f. Stair treads shall have a slip-resistant (minimum static coefficient of friction of 0.6), glare-free surface.
- g. Handrails at stairs:
  - (1) Provide continuous (not interrupted by newel posts or other obstructions) handrails on both sides of all stairs. When stairs are greater than 7'-4" in width, intermediate rails are required.
  - (2) Heights: 2'-10" and 1'-7"

(measured vertically from nosing)

	Massachusetts Bay Transportation		Commuter Rail Design Standards	Stations and Parking	Section II
	Authority RAILROAD OPERATIONS	<b>Circulation and Parking</b>		Chapter 1	
Revisi	on No. 1	Date: 4/19/96	Manual		Page 1.9

(3) Extension: 1'-0" minimum (top) 1'-0" minimum + length of one tread (bottom)

Note:

At the top, the extension shall be parallel to the walking surface; at the bottom, the handrail shall continue to slope for the distance of the width of one tread, then shall be parallel to the walking surface. Both handrail extensions should return to a wall or post.

Handrail extensions are not require if they would impede travel or create a hazard on the landing.

(4) Handgrip: Not less than 1 1/4"
Not more than 1 1/2"
(outside diameter)

Note:

Handgrip should be round or oval in cross-section, should have a smooth surface with no sharp corners, and should be uninterrupted for its entire length to provide a continuous gripping surface.

(5) Handgrip Clearance: 1 1/2"
 (measured between wall and the wall-side
 face of the handgrip)

Massachusetts Bay Transportation Authority RAILROAD OPERATIONS	Commuter Rail Design Standards Manual	Stations and Parking	Section II
		<b>Circulation and Parking</b>	Chapter 1
Revision No. 1 Date: 4/19/96			Page 1.10

Stair Nosing







Massachus Bay Transporta	etts tion		Stations and Parking	Section II
Authority RAILROAD OPERATIONS	Design Standards	<b>Circulation and Parking</b>	Chapter 1	
Revision No. 1	Date: 4/19/96	Manual		Page 1.11

6. Pedestrian Guardrails:

Note:

The following section represents a partial summary of the design constraints for guardrails. Consult the MBTA Guide to Access and relevant codes for additional information.

- a. A pedestrian guardrail is a system of building components located on the open side of walking surfaces for the purpose of minimizing the possibility of an accidental fall from the walking surface to a lower level.
- b. Use pedestrian guardrails where required by applicable code and in the following situations:
  - (1) Where there is a direct vertical drop in excess of 4'-0" closer than 2'-0" to a walkway, parking area, or roadway.
  - (2) Along all open-sided walkways, mezzanines, and landings.
  - (3) Where there is a vertical drop at the side of a ramp or stair.
- c. Height: 3'-6" minimum (measured vertically the leading edge of the tread or from the top of the walking surface)
- d. Openings: 6" maximum opening
- e. Loading Requirements:

All required pedestrian guardrails shall be designed and constructed to meet the structural loading conditions set forth in the most recent edition of the Massachusetts State Building Code.

- f. Do not use unnecessary horizontal elements that may provide an easy surface for climbing.
- 7. Track Crossings
  - a The location and number of grade level pedestrian track crossings shall be determined on a site specific basis by the Authority.
    - Note:

Grade level crossings are not permitted at stations on high speed lines (speeds greater than 80 miles per hour).

Massachusetts Bay Transportation	Commuter Rail Design Standards	Stations and Parking	Section II
Authority RAILROAD OPERATIONS		<b>Circulation and Parking</b>	Chapter 1
Revision No. 1 Date: 4/19/96	Manual		Page 1.12

- b. Grade level crossings:
  - (1) Pedestrian crossings should be located where pedestrian traffic is greatest. Grade level crossings should be offset from areas on the platform where the train doors are likely to align when trains are stopped for loading or disembarking passengers. Crossings should be located to be blocked when a train is stopped within the station to prevent pedestrian track crossings.
  - (2) Grade level track crossings should be offset from access points to the platform. Design layout should seek to reduce the probability of pedestrians stepping out into the crossing without looking for on-coming trains.
  - (3) Width: 8'-0" minimum

(4)	Slope in the direction of travel:	5% (approx. 5/8" per foot) absolute maximum
	Cross Slope:	2% (approx. l/4" per foot) absolute maximum

Note:

The above slopes apply to walking surfaces within the crossing. The platform should slope down at a maximum slope of one in twelve (1:12) to the level of the crossing to permit access for wheelchairs and maintenance vehicles.

No level change greater than 1/2" is permitted unless a ramp is provided. Level changes between 1/4" and 1/2" must be beveled with a maximum slope of 1:2.

- (6) The crossing surface should be slip-resistant (maximum static coefficient of friction should be 0.6 for walking surface and 0.8 for ramped surfaces). Material should be impervious to oil and grease.
- (7) The construction of pedestrian crossing construction should be 'panelized' for ease of removal for track maintenance.
- (8) The gap between rail and adjacent track crossing surfaces shall be governed by American Rail Engineer's Association standards and shall comply with State and Federal accessibility rules, regulations and standards. The maximum permissible gap at the inner edge of each rail is 2-1/2".
- (9) Detectable warning surfaces for persons with visual disabilities shall be provided at the edge of all track crossings.

1	Bay Transportation		Commuter Bail	Stations and Parking	Section II	
	Authority Design RAILROAD OPERATIONS Standards	<b>Circulation and Parking</b>	Chapter 1			
	Revisio	on No. 1	Date: 4/19/96	Manual		Page 1.13

(10) Provide fully automated crossing warning systems at each pedestrian crossing on main line tracks. Secondary and other low speed tracks may be exempted from this requirement on a site specific basis. Locate warning signs on all crossings to be visible from each entry to the crossing. These signs should have the phrase "Look Before Crossing" on both sides. (See Chapter on "Graphics" for design criteria for the standard sign.)

#### Pedestrian Track Crossing



Massachusetts Bay Transportation	Commuter Bail	Stations and Parking	Section II
Authority RAILROAD OPERATIONS	Design Standards Manual	<b>Circulation and Parking</b>	Chapter 1
Revision No. 1 Date: 4/19/96		L	Page 1.14

- c. Grade separated crossings:
  - (1) All new pedestrian crossings on the Providence line shall be grade separated.
  - (2) Locate new grade separated crossings where pedestrian traffic is greatest--e.g. at the midpoint of platforms or at the point of access to/from parking. Reuse existing grade separated crossings where possible.
  - (3) Width: 6'-O" minimum (open, elevated crossings) 12'-O" minimum (enclosed passageways, tunnels)
  - (4) Slope in the direction of travel:
     Cross Slope:
     5% (approx. 5/8" per foot) absolute maximum
     2% (approx. 1/4" per foot) absolute maximum
  - (5) Grade separated structures must comply with rules and regulations governing accessibility. Access shall be provided by ramp or elevator.
  - (6) All grade separated crossings shall be illuminated in accordance with the guidelines presented in Chapter "Lighting".
  - (7) Elevated grade separated structures shall be enclosed with metal grating or fencing with a maximum openings of 1" between members as a means of preventing dropping or throwing debris at trains. Limit such protective enclosures to directly over the track area to facilitate snow removal.
  - (8) Pedestrian bridges and associated ramps must be covered to protect against rain and the accumulation of snow on the walkway surfaces.

Massachusetts Bay Transportation	Massachusetts Bay Transportation Authority RAILROAD OPERATIONS	Commuter Rail Design Standards Manual	Stations and Parking	Section II
Authority RAILROA			Circulation and Parking	Chapter 1
Revision No. 1	Date: 4/19/96			Page 1.15

#### D. Vehicular Circulation

- 1. General Principles
  - a. Provide the most direct roadway access possible between the entrance to the site and the drop-off/pick-up area.
  - b. Where site conditions permit, vehicle access to the site should favor the inbound side.
  - c. Provide convenient loop turn-arounds for drop-off/pick-up vehicles (buses, taxis, private automobiles).
  - d. Roadways in public rights-of-way that are to be relocated or improved shall be designed to current standards set forth by the Massachusetts Department of Public Works and as required by local codes.
- 2. Vehicle Turning Radii

Note:

The following table is taken from the 1990 edition of <u>A Policy on the</u> <u>Geometric Design of Highways and Streets.</u>

Design Vehicle	Minimum Turning Radius	Minimum Inside Radius	Minimum Turning Path	
Passenger Car (P)	24	13.8	25.5	
Single Unit Trànsit Bus (BUS)	42	24.4	46.5	
Šingle Unit Truck (SU)	42	27.8	44.1	
Semitrailer (WB 50)	45	19.2	46.3	

Massachusetts Bay Transportation Authority RAILROAD OPERATIONS	Commuter Bail	Stations and Parking	Section II
	Design Standards	<b>Circulation and Parking</b>	Chapter 1
Revision No. 1 Date: 4/19/96	Manual		Page 1.16

## Minimum Turning Paths of Typical Vehicles

The following diagrams are take from <u>A Policy on the Geometric Design of Highways and Streets,</u> 1990 ed.



Minimum turning path for P design vehicle.

Massachusetts Bay Transportation		Commuter Bail	Stations and Parking	Section II
Authority RAILROA	D OPERATIONS	Design Standards	<b>Circulation and Parking</b>	Chapter 1
Revision No. 1	Date: 4/19/96	Manual		Page 1.17

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Minimum Turning Paths of Typical Vehicles
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## Minimum turning path for SU design vehicle.

Massachusetts Bay Transportation Authority RAILROAD OPERATIONS	Commuter Rail Design Standards Manual	Stations and Parking	Section II
		<b>Circulation and Parking</b>	Chapter 1
Revision No. 1 Date: 4/19/96			Page 1.18





Minimum turning path for BUS design vehicle.

Massachusetts Bay Transportation	Commuter Bail	Stations and Parking	Section II
Authority RAILROAD OPERATIONS	Design Standards Manual	<b>Circulation and Parking</b>	Chapter 1
Revision No. 1 Date: 4/19/96			Page 1.19



Minimum turning path for WB-50 design vehicle.

Massachusetts Bay Transportation Authority RAILROAD OPERATIONS	Commuter Rail Design Standards Manual	Stations and Parking	Section II
		<b>Circulation and Parking</b>	Chapter 1
Revision No. 1 Date: 4/19/96			Page 1.20

#### 3. Standard Roadway Dimensions and Gradients

- a. The preferred minimum roadway lane width is 12'-0". The absolute minimum lane width is 10'-0". The absolute minimum lane width for a one-way single lane is 16'-0".
- b. Roadways shall be cross pitched to provide positive drainage. The preferred cross pitch is 2% (approx. 1/4" per foot). The absolute minimum cross pitch is 1% (approximately 1/8" per foot). The maximum cross pitch is 3% (approx. 3/8" per foot). Where possible, roadways should be crowned in the middle and drain to the edges.
- c. Roadway gradients:

Vehicle	Roadway Gradients (Slope)	
Automobile	10% maximum (approx. 1 3/16" per foot) for ramps, access roadways, and driveways; 6% maximum (approx. 3/4" per foot) sustained grade for safe operation; 5% maximum (approx. 5/8" per foot) on roadways subject frequent ice, snow, sleet, and fog.	
Bus	10% maximum (approx. 1 3/16" per foot) operating grade; 6.5% maximum (approx. 13/16" per foot) design gradecontrolled by safety considerations and desirable operating conditions in the winter months.	

- d. Where an accessible route crosses a roadway, the maximum allowable slope in the direction of travel is 5% with a maximum cross slope of 2%.
- 4. Vehicle Entrances and Exits
  - a. The number and location of vehicle entrances and exits at a station is determined by many factors, including parking lot size, drop-off/pick-up volume, site topography, traffic volumes on adjacent streets, and adjacent land uses.

Massachusetts Bay Transportation Authority RAILROAD OPERATIONS	Commuter Rail Design Standards Manual	Stations and Parking	Section II
		<b>Circulation and Parking</b>	Chapter 1
Revision No. 1 Date: 4/19/96			Page 1.21

b. The recommended distance between site entrances/exits and adjacent street intersections along various types of roadways is presented below:

 Type of Roadway	Minimum Distance (ft)	Preferred Distance(ft)
 Major Arterial	200	400
Minor Arterial	150	300
Collector/Local Street	100	200

- c. Entrance and Exit Design
  - (1) At exits where a moderate number of left hand turns is anticipated, a second auxiliary exit lane should be considered to separate left and right hand turns. The preferred width of auxiliary lanes is 12'-0"; the minimum width is 10'-0". (See Diagram following.)
  - (2) Vehicle storage length is the area required to accommodate vehicles exiting the site. This area should be separate from and not interfere with the operation of vehicles in the remainder of the parking lot.
- d. For further information on the design of intersections, auxiliary lanes and deceleration lanes, see <u>A Policy on the Geometric</u> <u>Design of Highways and Streets</u>, published by the American Association of State Highway and Transportation Officials.

Massachusetts Bay Transportation Authority RAILROAD OPERATIONS	Commuter Rail Design Standards	Stations and Parking	Section II
		<b>Circulation and Parking</b>	Chapter 1
Revision No. 1 Date: 4/19/96	Manual		Page 1.22

#### Layout of Auxiliary and Deceleration Lanes



- 5. Drop-off/Pick-up Areas (Passenger Loading Zones)
  - a. Provide drop-off/pick-up areas at all stations, even those sites where no long term parking is provided. Locate the dropoff/pick-up area within a maximum 100 feet of the station platform and ensure compliance with the Rules and Regulations of the Architectural Access Board (AAB) of the Commonwealth of Massachusetts. Accessible drop-off/pick-up areas shall be identified with international symbol of accessibility signs.

$\widehat{\mathbf{T}}$	Hassachusetts Bay Transportation	Commuter Bail	Stations and Parking	Section II	
Authority RAILROAD OPERATIONS		Design Standards	Circulation and Parking	Chapter 1	
Revisi	on No. 1	Date: 4/19/96	Manual		Page 1.23

Note: As of the date of this writing, the requirement of the Americans with Disabilities Act Accessibility Guidelines (ADAAG) for tactile warning material at curb-side locations has been suspended.

- b. Limit the size of drop-off/pick-up areas. Without strict enforcement of parking restrictions, all-day parkers will utilize drop-off/pick-up areas. Parking lot aisles can be used for queuing of vehicles waiting to pick up passengers.
- c. Drop-off/Pick-up Area Layout:
  - (1) The drop-off area must be designed for accessibility, providing a 5'-0" wide aisle space between the vehicle and the curb over its full length. Provide curb cuts within the drop-off area.

Drop-off areas should be designed for right-hand curbside drop. (See Diagram)

- (2) Where passengers transfer from local bus lines to commuter rail, a bus drop-off/pick-up area with a berth size of 80'-0" by 11'-0" should be provided.
  - At bus stops where a lift will be deployed:
  - Provide firm, stable surface a minimum clear length of 96" measured from the curb or vehicle roadway.
  - Provide minimum 60" clear width, measured parallel to vehicle and roadway.

Passenger Loading Zone



#### Passenger Loading Zone Without Curb

Passenger Loading Zone With Curb

$\widehat{\mathbf{T}}$	Massachusetts Bay Transportation		Commuter Bail	Stations and Parking	Section II
	Authority RAILROAD OPERATIONS		Design Standards	<b>Circulation and Parking</b>	Chapter 1
Revisio	on No. 1	Date: 4/19/96	Manual		Page 1.24

#### E. Parking Lot Layout

#### 1. General Principles

Factors such as site topography, location of access roads, land availability, adjacent land use, and community requirements will determine in large part the layout of parking facilities. However, other factors to consider in the initial planning for parking lots are:

- a. Where possible, parking layout should be designed to maximize use of the accessible route to the platform. At low platforms, this is typically toward the outbound end, where the access platform is located.
- b. Avoid dead end aisles unless a turnaround is provided.

Where turnarounds are not possible in dead-end aisles, provide one striped space and sign it as a "turning-space-only" to eliminate the need to back out the length of the parking lot.

Provide for snow removal at the end of dead end aisles.

- 2. Parking Layout
  - a. Bay Orientation

Site conditions permitting, parking bays should be laid out perpendicular to the track and platform to allow people to walk down the aisles to the platform.

(As a rule of thumb, if a site has a curb to curb dimension measured at right angles to the track which is greater than 200 feet, the parking bays should be perpendicular to the track and platform. However, there may be specific site conditions or circulation requirements which dictate an orientation parallel to the track and platform.)

b. Parking Stall Orientation

90 degree parking is preferred. Use diagonal parking only when 90 degree parking is not feasible. Diagonal parking should not be used in structures. Follow accepted standards for diagonal parking such as the Handbook of Landscape Architectural Construction, published by the Landscape Architecture Foundation.

c. Perimeter Parking

Use 90 degree parking around the entire perimeter of the site where possible to maximize the capacity of the lot.

$\widehat{\mathbf{T}}$	Massachusetts Bay Transportation Authority RAILROAD OPERATIONS		Commuter Rail Design Standards	Stations and Parking	Section II
				<b>Circulation and Parking</b>	Chapter 1
Revisi	on No. 1	Date: 4/19/96	Manual		Page 1.25
- 3. Dimensional Guidelines
  - a. General Notes:

Deviations from the dimensional guidelines shown in the accompanying diagram may be permitted in site-specific situations, however it is the responsibility of the design consultant to bring such deviations to the attention of the Authority for review and approval.

90 degree parking spaces may be shortened by up to 2'-O" where vehicles can overhang the curb. Vehicle overhangs must not interfere with the required clear width of an accessible pathway.

Avoid single row parking in parking structures.

# b. <u>Standards for 90 degree Parking for Use by the Physically</u> <u>Disabled</u>

Provide minimum 8'-0" wide spaces with an adjacent 5'-0" wide striped access way. Depth, aisle, and bay dimensions should comply with those requirements for parking lots and structures of the Rules and Regulations of the AAB and the ADAAG.

Two spaces may share the same 5'-0" access way. Provide sidewalk ramps as necessary at the end of access ways to connect with the accessible route to the platform. Where accessible spaces are grouped together, it may be advantageous to lower the sidewalk to the level of the parking spaces. Accessible parking spaces and access aisles shall have surface slopes not exceeding 1:50 (2%) in all directions.

# c. <u>Standards for Parallel Parking on Surface Lots</u>

Use parallel parking only where other layouts are impractical. Do not use parallel parking in any location where it might interfere with heavily traveled vehicular access routes.

Parallel parking spaces should be 8'0" wide by 22'0" long.

Massachusetts Bay Transportation		Commuter Bail	Stations and Parking	Section II
Authority RAILROAD OPERATIONS		Design Standards	<b>Circulation and Parking</b>	Chapter 1
Revision No. 1	Date: 4/19/96	Manual		Page 1.26

# Standard Parking Stall Layout





		TWO RO	TWO ROWS OF CARS			ONE ROW OF CARS		RS
		STAND	ARD	COMP.		STAND	ARD	COMP.
90° I SURI	PARKING IN FACE LOTS	PREF.	<b>ALT.</b> BAY < 60 FT.			PREF.	<b>ALT.</b> BAY < 43 FT.	
(a)	STALL WIDTH	8'-3"	8'-6"	8'-0"		8'-3"	8'-6"	8'-0"
B	STALL DEPTH	17'-0"	17'-0"	15'-0"		17'-0"	17'-0"	15'-0"
O	AISLE	26'-0"	24'-0"	24'-0"		26'-0"	24'-0"	24'-0"
0	BAY WIDTH	60'-0"	58'-0"	54'-0"		43'-0"	41'-0"	39'-0"
90° PARKING IN PARKING STRUCTURE								
${}^{\otimes}$	STALL WIDTH	8'-6"	N.A.	N.A.		8'-6"	N.A.	N.A.
B	STALL DEPTH	17'-0"	N.A.	N.A.		17'-0"	N.A.	N.A.
O	AISLE	26'-0"	N.A.	N.A.		26'-0"	N.A.	N.A.
O	BAY WIDTH	60'-0"	N.A.	N.A.		43'-0"	N.A.	N.A.
CO	L. SPACING	58'-0"	N.A.	N.A.		41'-0"	N.A.	N.A.

\* CONSULT HANDBOOKS FOR DIAGONAL PARKING LAYOUTS. (E. G.: <u>ARCHITECTURAL</u> <u>GRAPHIC STANDARDS</u> OR <u>HANDBOOK OF LANDSCAPE ARCHITECTURAL CONSTRUCTION</u>)

Massachusetts Bay Transportation	Commuter Bail	Stations and Parking	Section II
Authority RAILROAD OPERATIONS	Design Standards Manual	<b>Circulation and Parking</b>	Chapter 1
Revision No. 1 Date: 4/19/96			Page 1.27

Accessible Spaces Without Curb



Access Through Parking Area



Massachusetts Bay Transportation Authority RAILROAD OPERATIONS	Commuter Rail Design Standards Manual	Stations and Parking	Section II
		<b>Circulation and Parking</b>	Chapter 1
Revision No. 1 Date: 4/19/96			Page 1.28

- 4. Accessible Parking
  - a. The rules and regulations of the Architectural Access Board (AAB) of the Commonwealth of Massachusetts apply to the modernization or expansion of commuter rail parking facilities, including surface lots and garage structures. Federal regulations also require accessible parking be provided at these facilities.
  - b. The MBTA <u>Guide to Access</u> addresses accessible parking at commuter rail stations. Accessible parking spaces must comply with Section 23 of the Rules and Regulations of the Architectural Access Board of the Commonwealth of Massachusetts and Section 4 of the Americans with Disabilities Act Accessibility Guidelines.
  - c. Provide accessible parking spaces as follows:

Total No.Parking Spaces	Required No. Accessible
	<u>Parking Spaces</u>
1–25	1
26–50	2
51-75	3
76-100	4
101-150	5
151–200	6
201-300	7
301-400	8
401-500	9
501-1000	2% of total
1001 & over	20 + 1 for each 100 over 1,000

Note: One in every eight accessible spaces, but not less than one, shall be served by a minimum 96 in. access aisle and be designated "van accessible" as required by ADAAG 4.6.4.

Where there is more than one parking lot provided on the same side of the track, it is acceptable to place all accessible parking spaces in the parking lot closest to the platform. However, in such case, the total number of accessible spaces must be computed on a lot by lot basis and added together. They may not be computed from the total number of spaces in the lots. Provide signage at the auxiliary lots to indicate where the accessible parking spaces are located.

Where multiple lots are provided on both sides of the track, a proportionate number of accessible parking spaces must be placed on both sides of the track. If this is not possible, a variance must be obtained from the Massachusetts Architectural Access Board. Where there is more than one lot, the number of accessible parking spaces is calculated on a per lot basis.

Massachusetts Bay Transportation	Commuter Bail	Stations and Parking	Section II
Authority RAILROAD OPERATIONS	Design Standards	<b>Circulation and Parking</b>	Chapter 1
Revision No. 1 Date: 4/19/96	Manual		Page 1.29

- 5. Gradients
  - a. The absolute maximum parking lot gradient is 5% (approx. 5/8" per foot). The absolute minimum acceptable gradient is 0.5% (approx. 1/16" per foot); the preferred minimum is 1% (approx. 1/8" per foot).

Where an accessible route occurs within the parking area, the maximum slope is 5% with a maximum cross slope of 2% except at aisles between accessible spaces.

- b. Crown the pavement in each parking bay at the center and pitch to the outside edges to avoid water ponding within aisles where pedestrians will walk.
- 6. Clearances
  - a. To allow for vehicle overhang, the minimum clearance between the inside face of curbing in a parking lot and any object (such as signs, light poles, trees, fences and barrier walls) is 2'-0".
  - b. Where parking is adjacent to track without a platform, provide vehicular guard rail mounted with chain link fence at a minimum of 8'-6" from the center line of track. Where vehicular guard rail is located less than 12'-6" from track centerline, provide a 15" clear space under the guard rail to facilitate cross tie replacement.

# Typical Minimum Clearances, Low Platform



Massachusetts Bay Transportation	Commuter Bail	Stations and Parking	Section II
Authority RAILROAD OPERATIONS	Design Standards	<b>Circulation and Parking</b>	Chapter 1
Revision No. 1 Date: 4/19/96	Manual		Page 1.30

Minimum Clearance at Track, No Platform



Typical Minimum Clearances (Platform More Than 8" Above Adjacent Surface)



NOTE:

FOR HIGH LEVEL PLATFORMS WITH SIDE PANELS WHICH ARE EASILY DAMAGED, PROVIDE A RAISED CURB 2'-0' AWAY FROM THE SIDE OF THE PLATFORM.

$\bigcirc$	Massachusetts Bay Transportation	Commuter Rail Design Standards	Stations and Parking	Section II	
	Authority RAILROAD OPERATIONS		<b>Circulation and Parking</b>	Chapter 1	
Revisi	on No. 1	Date: 4/19/96	Manual		Page 1.31

- 7. Pedestrian and Traffic Islands
  - a. Avoid islands since they make snow removal more difficult, increase cost, and complicate drainage. Provide painted islands at the end of bays; raised islands impede snow removal.
  - b. General Guidelines (if needed)
    - (1) Islands should be a minimum of 4'-0" wide.
    - (2) Use long islands perpendicular to parking stalls only when necessary for grading or circulation. Provide 8' to 10' wide breaks at every other parking bay (approx. 120' intervals) to allow for plowing and pedestrian access.
    - (3) Avoid curbed inside corners since they make plowing difficult, trap debris and increase the number of drainage structures needed.

# F. Use of Landscape Buffers

- 1. See Chapter 6 for specific design criteria governing the appropriate use of landscape buffers. In general, the Authority prefers to minimize unnecessary landscaping at commuter rail stations.
- 2. Where appropriate, lay out parking lots to preserve significant natural features--specimen trees, natural berms, outcroppings, etc--which may enhance the visual characteristics of the site. Such features should not detract from the operation, security, and capacity of the lot.
- 3. Lay out parking areas to leave sufficient space at the perimeter of the site to provide a buffer from surrounding neighborhoods or other sensitive receptors.

# G. Use of Barriers

- 1. Use barriers in station parking areas to channel vehicular and pedestrian traffic, contain water run-off, and, in certain instances, limit pedestrian access to the site. Barriers should be used to maintain a safe separation between platform and vehicular circulation and parking. Typical barriers include curbing, guard rail, bollards, and fencing. (Conditions which govern the use of barriers are described below.)
- 2. Types of Barriers:
  - a. Curbing

Curbing is the preferred method of defining the limits of a parking lot. Use curbing to control water run-off, to separate

Massachusetts Bay Transportation	Commuter Bail	Stations and Parking	Section II	
	Authority RAILROAD OPERATIONS	Design Standards	<b>Circulation and Parking</b>	Chapter 1
Revisio	on No. 1 Date: 4/19/96	Manual		Page 1.32

pedestrian and vehicular traffic, and to confine vehicle movements.

Granite is preferred as a curb material (7" maximum vertical reveal). Consider sloped granite as an alternative to vertical granite, but do not use sloped granite in areas of pedestrian circulation. Existing on-site granite curbing may be reused where possible.

If the lot can be easily drained to nearby ditches curbing may not be desirable. Guard rail or bollards should be used to confine vehicles to the paved lot where no curbing is provided.

Do not use the railroad right of way ditch for drainage of the parking area.

b. Vehicular Guard Rail

Vehicular guard rail is used to confine vehicle parking to specific areas. Under certain conditions, it is advisable to provide both curbing and guard rail (or bollards) as a secondary safety barrier (e.g. at the edge of an embankment).

c. Bollards

Use bollards for the same purposes as guard rail. However, bollards allow the free flow of pedestrians between them. Bollards interfere with snow plowing operations requiring either hand shoveling or the use of small machines. Therefor, their use should be minimized to short segments only where necessary.

d. Pipe Rail

Pipe rail may be used for pedestrian guardrails and as a means of channeling pedestrian movements. Typical applications occur along the back face of platforms with vertical drops in excess of 8", along the top side of retaining walls, and at stairs and ramps. Consult the pedestrian guardrail section of this chapter for design criteria.

e. Fencing

Use fencing to limit pedestrian access to the site for safety and security reasons. Fences adjacent to roadways and/or parking lots should be set back and protected by curbing or vehicular guardrail to allow for vehicle overhangs and the storage of plowed snow. Provide curbing or vehicular guardrail.

	RAILROAD OPERATIONS	Commuter Rail Design Standards	Stations and Parking	Section II		
			<b>Circulation and Parking</b>	Chapter 1		
	Revisio	on No. 1	Date: 4/19/96	Manual		Page 1.33

f. Inter-track Fencing

Inter-track fencing is chain link fence installed between tracks to prevent pedestrians from crossing the tracks except at designated locations.

Inter-track fencing should 4'-0" high and extend a minimum distance of 200'-0" beyond the ends of the platforms. Consult Standard Plan No. 3204 for design criteria.

# H. Parking Area Drainage Requirements

1. Authority policy is to install a storm drainage system in all new parking lots as well as those being upgraded.

Only small parking lots (generally those with under a twenty-five vehicle capacity) surrounded by porous soil capable of absorbing water run-off form the parking area may be designed without a storm drainage system. Do not drain toward the track right of way under any circumstances.

2. Storm drainage systems should conform with the Massachusetts Department of Public Works standards. See the Landscaping subsection for a description of drainage system design guidelines.

# I. Parking Fee Collection

- 1. At stations where a parking fee is to be collected, the Authority uses a central coin-slot system to collect parking fees.
  - a. The central coin-slot system consists of a centralized parking fee depository with numbered coin slots which are keyed to numbered spaces in the parking lot. The user deposits the fee as he or she walks to the platform. (See diagram following)

Location of the central collection box shall be determined by the Authority . Where possible, the central collection box should be highly visible and should be located under a canopy and on the same side of the track as the parking in a central area adjacent to the inbound platform. In larger parking lots, divide the lot into numbering zones of not more than 200 spaces. (See diagram following)

See <u>MBTA Guide to Access</u> for guidelines on how to make collection boxes accessible to the physically disabled. Collection boxes must be located on an accessible route.

b. Parking spaces should be clearly marked and numbered consecutively.

$\bigcirc$	Massachusetts Bay Transportation Authority RAILROAD OPERATIONS		Commuter Rail Design Standards	Stations and Parking	Section II
				<b>Circulation and Parking</b>	Chapter 1
Revisi	on No. 1	Date: 4/19/96	Manual		Page 1.34



Parking Space Numbering For Fee Collection

Up dated 9/2/01 P. 2 APR- 3-02 WED 10:48 AM MBTA REVENUE DEPT Group A Signage File COPY MBTA Standard LVETICA MEDIUM LETTERING. Yellow LINE (TYP.) 12. W 2 赵 d TYPICAL SPACE NUMBER

Elevation of Cash Box Panel



$\widehat{\mathbf{T}}$	Massachusetts Bay Transportation		Commuter Bail	Stations and Parking	Section II
Authority RAILROAD OPERATIONS	Design Standards	<b>Circulation and Parking</b>	Chapter 1		
Revisio	on No. 1	Date: 4/19/96	Manual		Page 1.36

# **IV. REFERENCE STANDARDS**

Consult the following reference standards for more information:

- <u>Architectural Graphic Standards</u>, by Ramsey and Sleeper, Edited by the American Institute of Architects, Published by John Wiley and Sons.
- <u>Handbook of Landscape Architectural Construction</u>
- Mass D.P.W. Standard Specifications for Highways and Bridges (1988 Ed.)
- MBTA <u>Guide to Access</u>
- MBTA <u>Standard Specifications</u>
  - A Policy on the Geometric Design of Highways and Streets, Published by the American Association of State Highway and Transportation Officials.

# V. PREFERRED MATERIALS

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A. Paving Materials

<u>its</u>
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Bituminous

The Authority prefers to use bituminous Concrete to pave parking lots because it is durable, inexpensive, and easily repaired. See details Mass DPW Standard Specifications for Highways and Bridges.

B. Curbing Materials

Granite

<u>Material</u>	<u>Comments</u>
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The Authority prefers to use granite curbing in parking lots because it resists damage from salt and snowplows.

Bit. Conc. Swales Used to channel runoff to a catch basin when a more substantial curb is not required; formed integrally with paving. Often used in combination with guard rail.

C. Barriers

# <u>Material</u>

# <u>Comments</u>

Vehicular Guard Rail Used to confine vehicular traffic to designated areas. May be either galvanized steel highway guardrail or heavy duty steel

Massachusetts Bay Transportation	Commuter Rail Design Standards	Stations and Parking	Section II
Authority RAILROAD OPERATIONS		<b>Circulation and Parking</b>	Chapter 1
Revision No. 1 Date: 4/19/96	Manual		Page 1.37

	pipe rail. See Mass DPW Standard Specifications for Highways and Bridges.
Bollards	Used to confine vehicular traffic while allowing pedestrians to pass through. Use concrete-filled galvanized steel pipe. Height varies:
	2'-0" when used with a curb 2'-6" when used to define the edge of a parking area 4'-0" when used as a barrier (e.g. to close off a road)
Fencing	Used to limit access to a restricted area for security reasons, or to channel pedestrian traffic. Typically galvanized steel wire mesh. MBTA Standard Specifications.
Pipe Rail/Guardrail	Used to channel pedestrian flows and to minimize the possibility of an accidental fall from an elevated walking surface. Consult section on pedestrian guardrail for design criteria.
Striping Materials	
<u>Material</u>	Comments

Roadway Marking Paint

D.

Use roadway marking paint within the station to delineate traffic lanes, parking spaces, parking space numbers, crosswalks, etc. See Mass DPW <u>Standard Specifications for Highways</u> <u>and Bridges</u>.

$\widehat{\mathbf{T}}$	Massachusetts Bay Transportation		Commuter Rail	Stations and Parking	Section II
	Authority RAILROAD OPERATIONS	Design Standards	<b>Circulation and Parking</b>	Chapter 1	
Revisi	on No. 1	Date: 4/19/96	Manual		Page 1.38

# CHAPTER 2 CANOPIES AND PLATFORMS

# I. INTRODUCTION

This section establishes design objectives, guidelines, and design criteria for the construction of new shelters and platforms at commuter rail stations. Both high and low level platforms are discussed.

The objectives and guidelines presented below are a response to user needs and to the practical operating and maintenance requirements of the Authority. Surveys have indicated that shelter is the most important feature of a station to the commuter rail user.

# II. DESIGN OBJECTIVES

Comfort, safety, efficiency, and durability are the principal objectives to be considered in the design of platforms and shelters at commuter rail stations. The station shelters function primarily as a protection from the elements. However, they should be designed to include good lighting, visibility from both the inside and out, as well as multiple means of egress to enhance the users sense of safety. These objectives should also address specific issues of maintenance and snow removal.

# **III. DESIGN GUIDELINES**

#### A. PLATFORMS

- 1. LOCATION
  - a. All commuter rail stations should have a paved platform(s).
  - b. A major consideration in determining platform location is achieving maximum visibility of the platform from the surrounding area for security reasons. Access should be as direct as possible from the surrounding area and parking lot.
  - c. Platforms should be located to avoid conditions where a stopped train or a grade crossing gate will back-up local traffic on the crossing street (see illustration). The preferred platform arrangement at stations adjacent to grade crossings is a split configuration in which trains pull beyond the grade crossing far enough to clear the crossing signal circuit. Where this arrangement is not feasible, the preferred alternative is a configuration locating both platforms on the outbound side of the crossing. This arrangement clears the crossing during the evening period when traffic is typically heaviest.
  - d. Locate platforms so that trains held at interlocking signals can load/unload.
  - e. An important consideration in the location of platforms is the topography and access for maintenance and snow removal equipment.

Hassachusetts Bay Transportation	Commuter Bail	Stations and Parking	Section II
Authority RAILROAD OPERATIONS	Design Standards	<b>Canopies and Platforms</b>	Chapter 2
Revision No. 1 Date: 4/19/96	Manual		Page 2.1

It is not desirable to locate platforms where the right-of-way topography is severe, since this will require the construction of retaining walls that will increase the cost per linear foot of the platform.

- 2. SAFETY
  - a. Platforms should have adequate space for passengers gathering on the platform and waiting in line to board the train during peak times.
  - b. Platform areas should be well lighted and drained and should have a slip-resistant surface.
  - c. The track side edge of the platform must have a tactile warning strip.
  - d. Minimize the number of obstructions on the platform to insure maximum visibility of the platform by the train crew, as well as to insure good pedestrian flow and access of maintenance vehicles.
- 3. EFFICIENCY
  - a. Access to platforms should be highly visible and direct from drop-off/pick-up points and pedestrian walkways.
  - b. Platforms should be free of columns, utility poles, and other objects impeding free pedestrian flow.

Massachusetts Bay Transportation	Commuter Bail	Stations and Parking	Section II
Authority RAILROAD OPERATIONS	Design Standards	<b>Canopies and Platforms</b>	Chapter 2
Revision No. 1 Date: 4/19/96	Manual		Page 2.2

# Platform Location Diagram



<u>Note</u>: Coordination of track alignment and profile with the precast concrete station platform is critical! Track alignment and profile must be surveyed and verified by Massachusetts licensed surveyor.

Preferred Arrangement of Platforms at Grade Crossing







Hassachusetts Bay Transportation	Commuter Bail	Stations and Parking	Section II
Authority RAILROAD OPERATIONS	Design Standards	<b>Canopies and Platforms</b>	Chapter 2
Revision No. 1 Date: 4/19/96	Manual		Page 2.3

#### 4. USE OF BARRIERS

- a. Provide barriers along the back face of a platform under the following conditions:
  - Where there is a sharp drop in elevation exceeding 2'-0".
  - Where active freight tracks are located behind the platform. Random pedestrian crossing of these tracks is a potential safety hazard that can be minimized trough the use of a barrier that channels pedestrian movements to specific points.
  - Where a parking lot abuts the platform. Under this condition the barrier serves as a primary or secondary deterrent to vehicle access to the platform. When a barrier system such as a guard rail is used in this situation it may also double as a sitting area for waiting passengers, as the accompanying detail illustrates.
- b. Typical barrier systems that might be used along the back face of a platform include pipe rail, guard rail, and wire mesh fencing. The choice of system will depend on factors such as the magnitude of the safety problem (i.e. protecting a person from a ten foot fall or it may simply be a reminder to cross tracks at a specified location) and specific project funding limitations.

Detail of Barrier System Limiting Vehicle Access to Platform Area



 T	Massachusetts Bay Transportation		Commuter Bail	Stations and Parking	Section II
	Authority RAILROAD	OPERATIONS	Design Standards Manual	<b>Canopies and Platforms</b>	Chapter 2
Revisio	on No. 1	Date: 4/19/96			Page 2.4

# B. SHELTERS

# 1. GENERAL

- a. Canopy structures should provide overhead and wind protection along portions of the platform(s). When combined with a vertical windscreen panel, the canopy provides the user a moderate amount of protection from rain, snow, and wind. At the same time, it is a relatively economical and low-maintenance form of shelter.
- b. It is not economically feasible to provide heat in this type of open-air shelter.
- 2. LOCATION
  - a. New shelters should be located on or adjacent to the platform in areas that are the most visible from adjacent streets and neighborhoods. For low level platforms, canopies must be provided for the protection of access paltforms and ramps. Generally a second canopy should be provided at a central location on the low platform. High level platforms may only require a single shelter, however the location(s) must provide for the protection of any access ramp(s) serving the platform(s).
  - b. New shelters should also be located on the most directly accessible route from the site entrance(s) to the platform when this location does not conflict with the high visibility guidelines described above.
  - c. New shelters should be designed and located in a manner that does not obstruct the visibility of the conductors in the approaching trains.

# 3. CONVENIENCES

A detailed description of the types of conveniences that should be provided appears in the Comforts and Conveniences chapter.

4. LIGHTING

Lighting design guidelines for buildings and canopies are presented in the Lighting chapter of this manual.

# C. ACCESSIBILITY FOR SHELTERS AND PLATFORMS

- 1. All shelters and platforms should be readily accessible via primary site entrance/exit.
- 2. Persons with disabilities must have full access to all shelters and platforms, as specified in the Rules and Regulations of the

Mac Bay Tra	ssachusetts / nsportation	Commuter Rail Design Standards Manual	Stations and Parking	Section II
Aut R	HOUTE CONTRACTIONS		<b>Canopies and Platforms</b>	Chapter 2
Revision N	lo. 1 Date: 4/19/96			Page 2.5

Massachusetts Architectural Access Board, Americans with Disabilities Act Access Guidelines, and the MBTA Guide to Access. For 'key' station sites, refer to ADAAG Section 6, the MBTA Guide to Access and consult with the Authority for specific requirements. Some of the requirements pertaining to shelters are summarized below.

- a. The approach to the primary entrance/exit of all shelters shall be uninterrupted by steps. If there is a change of elevation, a ramp will be provided in conformance with the ramp design requirements described in the Circulation subsection of this manual.
- b. Access should be as direct as possible from the surrounding area and parking lot to platform.
- c. New stations shall have full length high level platforms.

# IV. DIMENSIONAL GUIDELINES

- A. PLATFORMS
  - 1. ELEVATION
    - a. The standard height of <u>low level platforms</u> is 8" above top of rail on non-super-elevated tracks; the horizontal clearance between the centerline of track and the track-side face of a low-level platform curb shall be 5'-1" on tangent track. Minihigh level platforms are required on the outbound end of low level platforms.
    - b. The standard height of <u>high level platforms</u> is 4'-0" above top of rail on non-super-elevated tracks; the horizontal clearance between the centerline of track and the track side of a high level platform shall be 5'-7" on tangent track. This horizontal dimension applies only to locations where freight clearance is not a problem.
    - c. Mini-High level platforms requiring additional freight clearance shall be equipped with a "flip-up" platform edge (Consult the Authority for details of this special edge detail).
  - 2. LENGTH
    - a. Unless otherwise directed, platforms must accommodate a 9 car train. On low platforms, the access platform (mini-high) is included in the length of the platform.
    - b. The length of outbound platforms should be equal to the length of the longest train serving the station plus a 20'-0" allowance for a train overshooting or undershooting the platform. The intention is to provide disembarking passengers the opportunity

G	Massachusetts Bay Transportation		Commuter Bail	Stations and Parking	Section II
		OPERATIONS	Design Standards	<b>Canopies and Platforms</b>	Chapter 2
Rev	ision No. 1	Date: 4/19/96	Manual		Page 2.6

to exit the train directly from any coach. Typically, trains are 2 to 12 coaches in length. The following formula can be used to calculate outbound platform length:

- Number of coaches on longest train x 85'-0" + 20'-0"=length of platform. (In general, design for 9 cars unless directed otherwise).
- c. The length of the inbound platform may be shorter than the longest train. It is standard MBTA practice to run the locomotive always on the "country" or outbound end of the train set. As a result, the engineer on an inbound train in the control cab of the front car of the train set is always blocking passenger access to the front door of the first car. However, the rear door of the first car remains accessible. The inbound platform may therefore be 55'- 0" shorter than the length calculated by the above formula for the outbound platform.
- d. The absolute minimum platform length is 2 coach modules + 20'-0" or 190'-0".
- 3. WIDTH
  - a. Platforms should be sufficiently wide to comfortably accommodate peak loading requirements. The width is also affected by line, available space, and ridership only at short platforms. Adequate comfort levels for waiting and boarding movements can be achieved at a maximum density of 5 sq. ft. per person. As the following example illustrates, the maximum density level will rarely be approached at commuter rail stations.
    - Assume a peak train boarding level of 200 people (about 1/3 system stations average this number or more). At a density of 7 sq. ft. per person, the space requirement is 1,400 sq. ft. Assume an absolute minimum length platform that is 190'-0" long and 10'-0" wide. The effective width of the platform (allowing for 2'-0" safety clearance at the track side face of the platform) will be 8'-0"and the effective area of the platform will be 1,520 sq. ft. or in excess of the 1400 sq. ft. minimum. With platforms generally in the range of 700-800 feet in length, standing/boarding capacity is normally of no concern.
  - b. The preferred platform width is 12'-0"; 10'-0" is acceptable and 8'-0" is the absolute minimum width.
  - c. For reasons of economy, long platforms may be tapered at the ends to a minimum width of 8'-0".
  - d. The preferred island platform width is 22'-0" for a minimum of

Massachusetts Bay Transportation	Commuter Bail	Stations and Parking	Section II
Authority RAILROAD OPERATIONS	Design Standards	<b>Canopies and Platforms</b>	Chapter 2
Revision No. 1 Date: 4/19/96	Manual		Page 2.7

1/2 the platform length. Ends of island platforms may taper to a minimum width of 12'-0".

4. GRADIENT

Platforms should comply with accessibility regulations which state that the cross slope (the slope perpendicular to the direction of the tracks) can be a maximum of 2%; or not exceeding 1 ft. of rise for every 50 ft. of run.

5. WARNING STRIPE

All platforms must have a 24" yellow tactile warning strip running the length of the platform to comply with ADA access guidelines. Tactile warning strip should not be installed at low level platform ends.

#### B. SHELTERS

- 1. Size
  - a. The sheltered area at each station should accommodate approximately sixty percent of the passengers boarding at times of peak volume. This figure reflects two considerations: first, that about twenty percent of the passengers either wait in their automobiles or arrive at the last minute and do not use the shelter. Secondly, economic considerations do not allow the Authority to fully accommodate peak period needs.
  - b. The optimal size of the platform canopy should be determined as follows:
    - Assume no shelter is currently at the station.
    - Number of passengers using peak volume train = 100.
    - Design capacity of shelter = 60 % of 100 = 60
    - Net area required = 60x7 sq. ft. = 420 sq. ft.
    - Gross area required = 420x1.05 = 447 sq. ft. or approximately 400-450 sq. ft. of shelter.
- 2. MINIMUM CLEARANCES
  - a. The preferred minimum horizontal clearance between vertical support for a canopy and the track-side edge of platform is 10'-0". The absolute minimum is 8'-0".
  - b. The minimum horizontal clearance between a canopy roof overhang and the centerline of any track is 7'-6" (8'- 6" on the Framingham/Worcester Line) except where the canopy is at a height that overhangs operating equipment. The minimum clearance from the track centerline to face of canopy columns, wall, or other obstruction is 15'-1".

Massachusetts Bay Transportation		Commuter Bail	Stations and Parking	Section II	
9	Authority RAILROAD OF	PERATIONS	Design Standards	<b>Canopies and Platforms</b>	Chapter 2
Revisio	on No. 1	Date: 4/19/96	Manual		Page 2.8

- c. The minimum clearance between the floor and the vertical panel in a canopy is 6". This clearance prevents the accumulation of leaves and debris in corners of the canopy.
- d. The vertical clearance from the top of rail to the bottom face of the canopy adjacent to track is 12'-1".
- e. Refer to <u>MBTA Railroad Operations Book of Standard Plans</u>, Roadway and Track for further clearance information, drawing No. 1013 in particular for station requirements.

Detail of Minimum Shelter Clearances



# V. DESIGN CRITERIA AND DETAILS

#### A. PLATFORM

# 1. PAVING MATERIALS

High level platforms shall be architectural precast concrete. Please refer to structural drawings provided by the Authority for reinforcing, connections, and bearing. Low level platforms are constructed of bituminous concrete with timber or pre-cast concrete curbing. Design and construction of all work shall conform to the following:

- MBTA Standard specifications including special provisions
- Massachusetts Building Code, 5th edition
- Americans with Disabilities Act Accessibility Guidelines (ADAAG)
- Rules and Regulations of the Architectural Access Board (AAB) of the Commonwealth of Massachusetts

In case of conflict between the codes, standards, regulations, specifications, general notes and/or manufacturer's requirements use the most stringent provisions.

2. PLATFORM CURBING WITH TACTILE WARNING

Platform curbing is essential to the creation of a safe and durable transition between the train and the platform. All platforms must be curbed with a 24" tactile warning strip. See accompanying details for precast and timber curbing

Precast Concrete Edge for Commuter Rail High Platforms



$\widehat{\mathbf{T}}$	Massachusetts Bay Transportation		Commuter Bail	Stations and Parking	Section II
C	Authority	OPERATIONS	Design Standards	<b>Canopies and Platforms</b>	Chapter 2
Revisio	on No. 1	Date: 4/19/96	Manual		Page 2.10

Precast Concrete Edge Unit for Commuter Rail Low Platforms



$\widehat{\mathbf{T}}$	Massachusetts Bay Transportation		Commuter Bail	Stations and Parking	Section II
		PERATIONS	Design Standards	<b>Canopies and Platforms</b>	Chapter 2
Revisio	on No. 1	Date: 4/19/96	Manual		Page 2.11

# 3. BARRIERS

- a. Pipe Rail: should be used to channel pedestrian movements, not as a safety barrier. Typical details are presented in the Circulation chapter.
- B. Guard rail: should be either galvanized steel, heavy timber, or either type of rail used in conjunction with concrete posts. Steel guard rail should conform with the MDPW <u>Standard</u> <u>Specifications for Highways and Bridges</u>, Division III, Section M8. Heavy timber guard rail is typically less expensive than galvanized steel and should be of a type similar to that described in the Circulation chapter.
- c. Fencing: A wire mesh type of fencing may be used in certain platform locations. Standard Authority details for wire mesh fencing are shown in the Circulation chapter.

## B. SHELTERS

The MBTA has established design standards that specify the appropriate materials and types of construction that must be used for shelters. This documentation may be obtained directly from the Authority.

Massachusetts Bay Transportation	Commuter Rail Design Standards	Stations and Parking	Section II
RAILROAD OPERATIONS		<b>Canopies and Platforms</b>	Chapter 2
Revision No. 1 Date: 4/19/96	Manual		Page 2.12

# CHAPTER 3 LIGHTING

## I. INTRODUCTION

This section describes commuter rail station illumination requirements. Station area illumination is a critical factor in the enhancement of the rider's comfort and perception of safety. Therefore, careful consideration to both the quality and quantity of light is necessary.

#### II. DESIGN OBJECTIVES

Security, visual comfort, compatibility with surrounding uses, efficiency, and attractiveness should be addressed in the design of commuter rail station site lighting.

## A. SECURITY

The primary function of lighting is to make the commuter rail station and site safe and secure, as well as visible from surrounding areas.

#### B. EMPHASIS

Highlighting should be used to emphasize potential hazards, informational signage, and major focal and access points which include:

- Stairs
- Ramps
- Vehicular and pedestrian track crossings
- Platforms
- Pedestrian crosswalks
- Tracks
- Shelters
- Drop-off/pick-up areas
- Building entrances and exits
- Vehicular entrances and exits
- Signage

#### C. VISUAL COMFORT

To insure visual comfort, station and site lighting should:

- Provide the appropriate level of lighting.
- Provide the appropriate contrast between lighting levels.
- Minimize glare. Light sources should not be located within the normal visual angle of pedestrians or drivers.
- Minimize reflected glare from smooth surfaces, such as signs.

Bay Transportation	Commuter Rail Design Standards	Stations and Parking	Section II
Authority RAILROAD OPERATIONS		Lighting	Chapter 3
Revision No. 1 Date: 4/19/96	Manual		Page 3.1

# D. COMPATIBILITY WITH SURROUNDING USES

Station and site lighting should not interfere with:

- Adjacent residential neighborhoods
- Train operation and signals
- Operation of vehicles off-site

# E. EFFICIENCY

One consideration in the selection of lighting type should be its lifetime cost. This includes the cost of purchase, installation, operation, maintenance, and replacement of lamps and standards.

# F. ATTRACTIVENESS

Commuter rail station and site lighting hardware should be:

- Compatible in appearance with the surrounding environment.
- Durable under the following conditions: extreme weather conditions, vandalism, dirt accumulation, and limited maintenance.

#### III. DESIGN GUIDELINES

#### A. ILLUMINATION LEVELS

The following illumination levels satisfy the objectives discussed above. However, the designer may deviate from the standards listed below to compensate for specific operating or site conditions.

#### LOCATION

#### AVERAGE MAINTAINED FOOTCANDLES

1-2
2-5
5-10
5-10
10
5-10
5-10
5
5-10

Massachusetts Bay Transportation	Commuter Rail Design Standards	Stations and Parking	Section II
Authority RAILROAD OPERATIONS		Lighting	Chapter 3
Revision No. 1 Date: 4/19/96	Manual		Page 3.2

## **B. OPTICAL CONSIDERATIONS**

In the design of station building and site lighting, the contrast between various surfaces within eye contact should be maintained at ratios that will not reduce visual acuity, result in visual discomfort, or cause direct or reflected glare.

1. Contrast Ratios

The ideal contrast ratio between illuminated areas and adjacent or surrounding areas should be limited to 20:1. In no case should it exceed 80:1. The contrast between emphasis lighting and surrounding surfaces should not exceed a ratio of 3:1. The relative levels of luminance of signs and information panels to adjacent and background surfaces should not exceed a ratio of 5:1.

2. Glare

Luminaires should be designed and located to prevent the source's full brightness from being visible to the eye within normal viewing angle as shown in the accompanying illustration.

3. Reflected Glare

The angle of view of a vertical surface should exceed the angle at which light strikes the surface to avoid direct reflections from the source, as the accompanying diagram illustrates.

4. Methods of Control

Contrast ratios, glare, and reflected glare can be controlled through use of the following:

- Diffusers to moderate source brightness whenever possible.
- Indirect lighting, such as "wall washing" with light, to control glare and reduce the contrast ratio between a light source and the surrounding environment.
- Parabolic reflectors within light fixtures to control a light source without sacrificing light intensity on the lighted surface. They are especially useful with High Intensity Discharge (HID) lighting near residential neighborhoods.
- Contrast ratios and glare can also be controlled by adjusting the location and intensity of the source.

# C. EMPHASIS OF HAZARDOUS AND TRANSITION AREAS

Higher levels of light should occur at potential danger or decision areas (stairs, track crossings, street crossings, platform edges, hidden corners, railings, and signage). This illumination should be at least 5-10 average maintained footcandles at the surface being lighted.

Massachusetts Bay Transportation Authority		Commuter Bail	Stations and Parking	Section II
Authority RAIL	, ROAD OPERATIONS	Design Standards	Lighting	Chapter 3
Revision No. 1	Date: 4/19/96	Manual		Page 3.3





Minimize Reflected Glare by Insuring That Angle of View Exceeds Angle of Reflection



Massachusetts Bay Transportation	Commuter Bail	Stations and Parking	Section II	
Authority RAILROAD	O OPERATIONS	Design Standards	Lighting	Chapter 3
Revision No. 1	Date: 4/19/96	Manual		Page 3.4

#### D. EMERGENCY LIGHTING

Emergency lighting should be limited to the interior of enclosed station buildings and enclosed stairs. The system should have a selfcontained battery pack and should be mounted at a height sufficient to prevent vandalism and to provide adequate emergency lighting with a minimum of fixtures.

## IV. DESIGN CRITERIA AND DETAILS

## A. GENERAL LUMINAIRES SELECTION CRITERIA

Luminaires used at commuter stations should meet the following criteria:

- Function effectively for a minimum of 20 years.
- Resist vandalism, with polycarbonate or high impact acrylic diffusers and vandal-proof access devices such as latches, screws, and locks.
- Minimize maintenance time and costs. Replacement of lamps and ballasts shall be easily accomplished. Lamps and ballasts shall be readily available and standardized to the greatest extent possible. All lenses, diffusers, access devices, and fasteners shall be of the captured type; hinged and removable to provide easy access and prevent loss or damage of parts.
- Contain only non-corrosive materials.
- Function effectively within a -20 to +110 F ambient temperature range (-28 C to +43 C).
- Provide fixture enclosure that keeps moisture and dust out, but allows heat to dissipate.

#### B. GENERAL LAMP SELECTION CRITERIA

- 1. A variety of lamp types is available today. Three factors should be considered in selecting the lamp type.
  - Lumen/watt efficiency of the lamp.
  - Effect of the light source color on the surface color appearance of the surrounding areas and objects.
  - Mounting flexibility.
- 2. Due to the effect of light source color on surface color appearance, the result of lamp choice on user perception should be considered. A given lamp's lumen/watt efficiency and mounting flexibility should also be considered.
- 3. The lamp types available are:
  - a. High Intensity Discharge

High Intensity Discharge (HID) is the preferred light source for

Massachusetts Bay Transportation Authority RAILROAD OPERATIONS		Commuter Rail Design Standards	Stations and Parking	Section II	
			Lighting	Chapter 3	
Revisio	n No. 1	Date: 4/19/96	Manual		Page 3.5

commuter rail stations because it is highly energy efficient. HID lamps are point light source, electric discharge lamps requiring ballasts. Starting requires several minutes. The preferred HID lamps are:

- Mercury vapor lamps, which emit a greenish-blue light and cause a perceptible shift in color rendition. They are highly efficient (30-65 lumens/watt) with long rated lives (16,000-24,000 hrs.) and excellent lumen maintenance. Mercury vapor lamps are primarily suited to high bay (over 13'-0" mounting height) applications.
- Metal halide lamps, which produce a white light. Color rendition is as least equal to mercury vapor. Metal halide lamps are smaller in size than mercury vapor lamps, yet produce a substantially greater output of lumens/watt.
- High pressure sodium lamps, which emit a distinctly yelloworange light and have a very perceptible effect on color rendition. High pressure sodium is the preferred HID lamp because it is the most efficient lamp currently available (approximately 100 lumens/watt). It should be used for lighting large exterior areas such as parking lots and walkways. A typical fixture that might be used in these applications is described in accompanying illustrations.
- b. Fluorescent
  - Available in several colors. Warm white fluorescent lamps produce good color rendition and mix well with incandescent. Cool white lamps tend to dull warm colors and intensify cool colors, but are the most efficient (lumens/watt) fluorescent color. Fluorescent is a linear light source characterized by higher light efficiencies, cooler operating temperatures, and longer life expectancies than incandescent.
  - Fluorescent lamps are effective in low and medium level lighting applications due to their efficiency and low source brightness. Fluorescent lamps are appropriate under most interior conditions and preferred over incandescent. They are recommended for lighting under canopies and shelters.
- c. Incandescent
  - Incandescent lamps are the least efficient light source (lumens/watt) and should not be used.

Massachusetts Bay Transportation	Commuter Rail Design Standards Manual	Stations and Parking	Section II
Authority RAILROAD OPERATIONS		Lighting	Chapter 3
Revision No. 1 Date: 4/19/96			Page 3.6

# Fixture Example



# C. WIRING

- At all sites where regrading or resurfacing is planned, underground wiring shall be used. Underground wiring installed in Fiberglass Reinforced Epoxy (FRE) conduit sized in accordance with then Massachusetts Electrical Code (MEC) is preferred to overhead wiring for reasons of safety, reliability, lower long-term operating cost, and site appearance.
- 2. Wiring within canopies should be concealed whenever possible.
- 3. Any exposed wiring must be enclosed in conduit. The conduit should be installed in a manner consistent with the following criteria:
  - Follow architectural structural members, moldings, or ornamental details in as unobtrusive a manner as possible.
  - Match the color of the background on which it is mounted.
  - Resist vandalism with supports at intervals per the MEC within 9'-0" of ground level.

# D. CONTROL COMPONENTS

- 1. Lighting control components at commuter rail stations include outdoor control centers and switches.
- 2. Outdoor control centers shall be provided at all stations. They shall be weatherproof and contain panelboards, lighting contactors, time clocks, and selector switches.
- 3. Recommended manufacturers of the control center enclosure are Hoffman Engineering Company, Lee Products Co., Russell L. Stroll, the Harry Richmond Company, or equal.
- 4. Control equipment utilized in commuter rail station lighting systems include:
  - a. Selector Switches

Selector switches provide control operation in three positions: Hands-Off- Automatic.

b. Photoelectric Sensors

Photoelectric sensors are fully automatic and provide illumination from dusk to dawn. Photoelectric switches are particularly applicable at locations where security and safety is a concern, such as shelters, station buildings, and track crossings.

T	Massachusetts Bay Transportation	Commuter Bail	Stations and Parking	Section II
	Authority RAILROAD OPERATIONS	Design Standards	Lighting	Chapter 3
Revis	Revision No. 1 Date: 4/19/96	6 Manual		Page 3.8
c. Time Clocks

Time clocks shall be 24 hour and fully automatic and provide light at pre-set hours. Time clock components include such features as a seven day or astronomical dial, manual bypass lever, and sixteen-hour power reserve units. Time clocks are the most appropriate for parking area and platform lights that need not operate during the entire night. Time clocks shall be equipped with mechanically held contacts.

Typical Detail of a Pole Mounted Lighting Fixture Mounted on a 2'-O" High Concrete Pedestal for Protection from Vehicles



Massachusetts Bay Transportation	Commuter	Stations and Parking	Section II
Authority RAILROAD OPERATIONS	Design Standards	Lighting	Chapter 3
Revision No. 1 Date: 4/19/96	Manual		Page 3.9

#### E. FIXTURE MOUNTING AND LOCATION

- 1. The following general fixture mounting criteria apply to commuter rail stations:
  - Minimum clearance between the bottom face of the luminaire and ground level is 9'-0"; the preferred minimum clearance is 11'-0".
  - Placement should be beyond the reach of persons standing on benches, trash receptacles, retaining walls, or other site furniture.
- 2. Criteria listed below apply to pole-mounted fixtures:
  - Fixture height: minimum of 9'-0" in pedestrian areas (platforms, walkways, etc.), 20'-0" minimum in vehicular areas such as parking lots and roadways; maximum of 30'-0".
  - Number of fixtures per pole : capable of receiving 1,2,3, or 4.
     Location must be accessible for servicing by a bucket truck.
  - Poles shall be fixed, rather than hinged type base.
  - Do not use aluminum poles. Experience indicates that they break more readily than the steel pole.
  - Poles shall have handholes.
  - Fixture shall have individual cut-off optics.
  - Poles shall be mounted on a base extending a minimum of 2'-0" above finished grade at locations where poles are susceptible to damage by snowplows or other vehicles.
  - Shorter poles (20'-0" long) shall be able to resist damage from "whipping" and other acts of vandalism.
- 3. Typical pole-mounted fixtures which meet the above criteria include the Crouse Hinds ASL series, Sterner Lighting Systems (Model Type "Executive 25"), Gardco Lighting (Model Type "Form Ten EH"), or equal.
- 4. Fluorescent fixtures should meet the following criteria:
  - Be available in standard 4'-0" and 8'-0" lengths.
  - Provide single or double lamp capacity.
  - Have a 430 or 800 MA lamp capability.
  - Have a capability for use as a strip or individual fixture.

Massachusetts Bay Transportation	Commuter Bail	Stations and Parking	Section II
Authority RAILROAD OPERATIONS	Design Standards	Lighting	Chapter 3
Revision No. 1 Date: 4/19/96	Manual		Page 3.10

# CHAPTER 4 GRAPHICS

#### I. INTRODUCTION

This section deals with the graphics requirements at commuter rail stations. As used in this manual, the term graphics refers to the full range of signs required to direct people to and within a commuter rail station site, warn of hazardous areas such as track crossings, and inform on matters of system use and operation. The format and appearance of the graphics described in this section are largely derived from the Authority's earlier graphics standards work; the <u>MBTA Manual of Standards and Guidelines</u>, Part V (1990 and subsequent revisions). These rapid transit system standards have been modified to meet the needs of more open and isolated commuter rail station environments.

#### **II. DESIGN OBJECTIVES**

User convenience, consistency, and durability are the principal design objectives of a commuter rail station graphics system.

#### A. USER CONVENIENCE

Graphics should be readily legible and should seek to minimize any uncertainty about train operation, present location, and destination.

#### B. CONSISTENCY

Graphics used at commuter rail stations should be consistent in appearance with those used on other lines operated by the Authority. This consistency contributes to the creation of a unified graphics system throughout the Authority.

#### C. DURABILITY

The various components of the graphics system- signs, sign frames, etc. should be fabricated from durable materials. They should be resistant to the effects of harsh weather conditions and vandalism and should require minimal long term maintenance.

#### III. DESIGN GUIDELINES

#### A. TERMINOLOGY

- 1. This subsection deals with the standard terminology that shall be used at all commuter rail stations, as well as guidelines for the use of non-standard terminology, punctuation, and abbreviations.
- 2. Authority Name

In general, the full Authority name, Massachusetts Bay Transportation Authority, is not used at commuter rail stations. When used, however, it shall conform to formats presented later in this section.

Massachusetts Bay Transportation	Commuter Bail	Stations and Parking	Section II
RAILROAD OPERATIO	Design DNS Standards	Graphics	Chapter 4
Revision No. 1 Date: 4	Manual Manual		Page 4.1

3. Authority Symbol

The Authority's "T" symbol shall be used at all commuter rail stations to identify all entrances to the station site. At stations outside the Authority district, the "T" symbol shall be used in conjunction with the standard Trailblazer sign consisting of the "T", the words "Commuter Rail Station", and the standard directional arrow. The "T" shall also be located on the commuter rail system map panel and printed maps and schedules.

- 4. Platform Information
  - a: All stations with double or multiple track operations shall have the following destination information on the information band of the station identification signs:

Inbound: "Inbound to Boston" Outbound: "Outbound"

b. All stations with single track operations shall have the following destination information on station identification signs:

Two lines using 1-1/2" text in the white band with a special arrow and text "Direction to Boston" and below it "Direction to xxxx" (outer terminal).

- c. Exceptions to the preceding guidelines are North Station and South Station where the terms "Inbound to Boston" and "Outbound" are deleted.
- d. Space permitting, additional local destination information may be placed in the information band of the station identification sign. Terminology should conform to the grammatical, punctuation, and abbreviation guidelines discussed below.
- e. At multi-track stations (island platform or 2 side platforms) provide track number/destination signs above the platform, at right angles to the track.
- 5. Other Standard Terminology
  - a. At stations where "live" parking, or a drop-off/pick-up area is provided, information directing the user to that area shall include the following terminology:

"Drop Off/Pick Up" and the international symbol of accessibility.

$\widehat{\mathbf{T}}$	Massachusetts Bay Transportation		Commuter Bail	Stations and Parking	Section II
	Authority RAILROAD 0	PERATIONS	Design Standards	Graphics	Chapter 4
Revisi	on No. 1	Date: 4/19/96	Manual		Page 4.2

- b. A warning sign with the phrase "Look Before Crossing" shall be located in front of all vehicular and pedestrian track crossings.
- c. A warning sign with the phrase "Danger Will Not Clear Man on Side of Car" shall be located at each end of high level platforms.
- 6. Grammatical Guidelines
  - a. Terminology should be consistent in style and format with that used by the Authority outside the commuter rail system. Messages should be brief, avoiding unnecessary words and punctuation. Some examples follow.
    - "To" is normally not used with an arrow-circle unit, as in "To Exit", "To Platform", and "To Town Center". Exceptions to this rule are phrases such as "Exit to Mass. Ave." and "To Trains", which are used with the arrow-circle unit.
    - Avoid phrases such as "Left to Town Center". Use the arrow-circle unit in combination with the words "Town Center".
- 7. Punctuation Guidelines
  - a. Minimize use of punctuation to be consistent with good grammatical form and clarity of meaning.
  - b. Use the comma between items in a series and to separate two pieces of information. Example: "Town Center, Norwood Hospital".
  - c. The period is used after an abbreviation and for the abbreviated versions of morning and evening. Example: "a.m.", and "p.m.".
  - d. The hyphen is used to denote all joint names. Example: "Central Square-Lynn". While the hyphen is normally used between the words "Drop Off/Pick Up" sign presented later in this section.
  - e. The ampersand is used in place of the word "and" when connecting two words which naturally belong together because of similarity of function or geographical proximity. Example: "Hamilton & Wenham".

In the case of unusual space constraints the ampersand may be substituted for the word "and".

Hassachusetts Bay Transportation	Commuter Bail	Stations and Parking	Section II
RAILROAD OPERATIONS	Design Standards	Graphics	Chapter 4
Revision No. 1 Date: 4/19/96	Manual		Page 4.3

8. Abbreviation Guidelines

a.	Limit use	of abbreviations	to	the	most	common	and	widely
	understood.	Among those that	may	be u	sed ar	re:		
	"St."	street						
	"Ave."	avenue						
	"P]."	place						
	"Blvd."	boulevard						
	"Pkwy."	parkway						
	"Rte."	route						
	"N."	north						
	"S."	south						
	"E."	east						
	"W."	west						
	"Ctr."	center						
	"Sq."	square						

#### B. PICTOGRAPHS

- 1. Pictographs are graphic symbols that are used to convey a message in a more direct and readily recognizable manner than word signage. In the case of warning or prohibition signs (such as "No Smoking and "No Parking") the pictograph is often a more empathetic method of conveying the message than the words alone. Pictographs identifying accessible elements are to be accompanied by verbal description placed directly below the pictograph.
- 2. The standard pictographs to be used at commuter rail stations are based on the recommendations for a uniform pictographic vocabulary proposed by the American Institute of Graphic Arts to the U.S. Department of Transportation. The pictographs are described in more detail in the publication, Symbol Signs, DOTOS-40192, which may be ordered from: the National Technical Information Service, Springfield, VA 22151.

#### C. CARTOGRAPHY

- 1. The cartographic or map requirements at commuter rail stations are quite limited by comparison with those of rapid transit stations. Commuter rail station environments are generally quite open, thereby reducing the need for directions around the station and to destinations away from the stations. Two types of maps are potentially appropriate at commuter rail stations: the system map and the rapid transit line map.
- 2. System Map

The commuter rail system map is a diagrammatic representation of the entire commuter rail system that is consistent in format with the Authority's diagrammatic map of the rapid transit system. This map typically has three colors (purple, black, and white) and identifies connections with the Authority's rapid transit system. The purpose of

$\widehat{\mathbf{T}}$	Massachusetts Bay Transportation		Commuter Bail	Stations and Parking	Section II
	Authority RAILROAD O	PERATIONS	Design Standards	Graphics	Chapter 4
Revisi	on No. 1	Date: 4/19/96	Manual		Page 4.4

this map is to provide users with general knowledge of the commuter rail service available and the system's connections to other Authority services.

3. Rapid Transit Line Map

This map is provided at stations where there is a direct or nearby connection to the rapid transit system.

#### D. SIGN TYPES

- 1. Four types of signs are generally found at commuter rail stations: identification, directional, regulatory/warning, and system use. A large share of the signs are in the identification and directional categories. A general description of each sign type, as well as location guidelines, is presented below. Sign layouts and methods of construction are described in Design Criteria.
- 2. Identification Signs

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- a. The two most common signs in this category are the System Identification Sign and the Station Identification Sign.
- b. System Identification Sign
  - Purpose: to identify the location of stations on the Authority's system.
  - Description: consists of the Authority's "T" symbol mounted in a circular metal frame on a free-standing pole. It is similar in design to the "T" lollipop -shaped sign used at rapid transit stations, except the commuter rail version is not back-lighted. Illumination of this sign should be from adjacent, pole-mounted fixtures.
  - Location: at all major vehicular and pedestrian entrances to the station. Experience indicates that two system identification signs per station are normally sufficient.
- c. Station Identification Sign
  - Purpose: to assist those disembarking from the train in identifying the station. Also to identify the platform necessary to direct passengers to local destinations.
    - Description: consists of a 9" high station name band and a 6" high information band typically mounted in a freestanding frame. The information band identifies the platform ("Inbound to Boston" or "Outbound"), and in some instances contains local destination information.
    - Location: along the back face of the platform parallel to the track(s). Preferred spacing of the signs is at 85'-O" intervals on each platform (one coach length). The minimum number of station identification signs at a station shall

ſ	Massachusetts Bay Transportation		Commuter Bail	Stations and Parking	Section II
		D OPERATIONS	Design Standards	Graphics	Chapter 4
	Revision No. 1	Date: 4/19/96	Manual		Page 4.5

be one per platform. The signs should also be located adjacent to a platform light fixture for maximum visibility during evening hours. Avoid locating these signs directly across the tracks from a seating area to discourage vandals from sitting on the benches and throwing objects at the signs.

- d. Track Number /Destination Sign
  - Purpose: to identify the destination of the train located on the designated track.
  - Description: The track number and destination may be used in combination with the commuter rail combination sign panel. Refer to the <u>MBTA Manual of Standards and</u> <u>Guidelines</u>, Chapter 5 for more information.
- e. On-Site Identification Signs
  - A variety of on-site identification signs will typically be required in limited numbers. Among these are signs identifying accessible parking spaces, bus and drop-off zones, compact car spaces, space numbering and signage and taxi stands. With the exception of the required accessible parking signs, the number of these signs should be kept to an absolute minimum.
  - The locations of these signs are site specific. Signs identifying accessible parking spaces should be provided for each designated parking stall. These signs are normally pole-mounted, and care should be taken in locating the poles a minimum distance of 1'-0" from the outside face of a curb in areas where vehicles may be parked parallel to the curb; in areas of perpendicular parking, the minimum distance is 2'-6". "Compact Car Only" sign should be located at either end of the row of parking spaces with arrows pointing towards the center of the row. "Compact Car Only" signs without arrows should be located every 100 feet between these two signs.
- 3. Directional Signs
  - a. Included in this category of signs are off-site trailblazers, as well as signs providing directions around the station site. Directional signage should include signage to identify accessible routes between access platforms and parking areas and/or entrances and exits. Where the accessible route diverges from that used by the general public, an access symbol with directional arrow is required.

Massachusetts Bay Transportation	Commuter Bail	Stations and Parking	Section II
Authority RAILROAD OPERATIONS	Design Standards	Graphics	Chapter 4
Revision No. 1 Date: 4/19/96	Manual		Page 4.6

- b. Trailblazers
  - Purpose: to direct potential users of the commuter rail system to stations and to improve access for drop-off/pickup vehicle drivers who are unsure of the station location.
     Description: consists of the "T" symbol the words
    - Description: consists of the "T" symbol, the words "Commuter Rail Station", and the Authority's standard directional arrow. It is pole-mounted.
  - Location: typically along several major corridors to a station. Usually, all signs are within a several mile radius of the station and are placed at all key decision points. At stations outside the Authority district boundary, trailblazers are also mounted on the system identification sign at the station entrance since the "T" symbol alone may not be recognized in these areas.
- c. On-Site Directional Signs
  - In addition to the directions that may be provided on the station identification signs, directional signs may also be required to direct motorists to drop-off/pick-up areas, bus drop-off/pick-up zones, remote accessible parking areas, the direction of major highway routes from the parking lot exit drive and the accessible route to the platform entrance, if it diverges from the general route to the platform entrance. Use of these signs should normally be limited to the larger, more complicated sites.
  - These signs combine the standard pictographs with the directional arrow.
  - Locations of the signs will vary with site conditions.
     Minimum curb clearances discussed earlier in this subsection should also be maintained with these signs.
- 4. Regulatory/Warning Signs
  - Three types of signs in this category are generally used at commuter rail stations-"Look Before Crossing", "No Smoking", and "No Parking".
  - b. "Look Before Crossing" Sign
    - Purpose: to alert motorists and pedestrians of any on-site railroad track crossing.
    - Description: a pole-mounted sign containing the phrase, "Look Before Crossing".
    - Location: at all vehicular and pedestrian approaches to a track crossing, including all main line tracks as well as freight sidings. Signs should be located a minimum of 8'-6" from the centerline of a single track; in double or multiple track locations, signs may be placed between

	Aassachusetts ay ransportation	Commuter Bail	Stations and Parking	Section II
	RAILROAD OPERATIONS	Design Standards	Graphics	Chapter 4
Revision	No. 1 Date: 4/19/96	Manual		Page 4.7

tracks if a minimum clearance of 6'-9" to both track centerlines is maintained.

- c. "No Parking "Signs
  - Purpose: to identify areas on the station property where parking is not allowed.
  - Description: consists of the standard pictograph mounted on a pole.
  - Location: based on the needs of each station, but due to potential vandalism, the number of signs should be minimized. The l'-0" and 2'-6" curb clearance criteria discussed previously in this subsection also apply to this sign.
- d. "No Smoking" Sign
  - Purpose: to inform users of the Commonwealth of Massachusetts law prohibiting smoking in Authority stations and vehicles.
  - Description: a standard combination pictograph/written message sign provided by the Authority.
  - Location: sign must be displayed in all enclosed waiting areas.
- 5. System Use Signs
  - a. Current Authority policy is to provide two types of system use information at commuter rail stations. One is a diagrammatic map of the system, and the other is train schedule information.
  - b. System Map Panel
    - Purpose: to inform commuters of all stations/locations served by the commuter rail system, as well as stations at which connections can be made to other service provided by the Authority.
    - Description: a diagrammatic line map similar in format and design to the Authority "spider map" of the rapid transit system. It is typically presented on a 4'x 4' metal panel that is mounted on the station identification sign frame.
       Location: integrated into a station identification sign
      - Location: integrated into a station identification sign frame that is located at a central point on the inbound platform. Every station should have at least one system map, and some stations with higher ridership may warrant two maps, depending on the station layout. At least one system map panel must be located on the accessible route.

Massachusetts Bay Transportation	Commuter Bail	Stations and Parking	Section II
RAILROAD OPERATIONS	Design Standards	Graphics	Chapter 4
Revision No. 1 Date: 4/19/96	Manual		Page 4.8

- c. Schedule Panel
  - Purpose: to provide commuters routine information such as train schedules, notice of changes in service, fares, etc.
  - Description: this type of information is subject to relatively frequent change. The approach used by the MBTA is to provide a combination sign panel that provides visual and tactile station identification, route maps, and schedules.
  - Location: Provide at least one route map/schedule case combination along the accessible path to the platform. Refer to Part V, Graphics chapter of the <u>MBTA Manual of</u> <u>Standards and Guidelines</u> for more information.

Massechusetts Bay Transportation	Commuter Bail	Stations and Parking	Section II
Authority RAILROAD OPERATIONS	Design Standards	Graphics	Chapter 4
Revision No. 1 Date: 4/19/96	Manual		Page 4.9

#### IV. DESIGN CRITERIA AND DETAILS

#### A. GENERAL

- 1. The typography, symbols, arrows, pictographs, colors, and sign layouts described below are standards to be applied in the design of all signs for commuter rail stations. These standards are based on the Authority's <u>Manual of Standards and Guidelines</u>, Part V, Graphics.
- 2. The sign materials and methods of construction presented below are not standards, but are the product of the cumulative experience of the Authority with many previous sign design and fabrication contracts for both rapid transit and commuter rail stations.

#### B. TYPOGRAPHY

- 1. The standard Authority font is Helvetica and is illustrated on graphic pages following in this chapter. It is highly legible and available in all media: metal composition, photo-composition, wax transfer lettering, and vinyl adhesive-backed pre-cut letters. The standard weight used by the Authority is medium, and only capital letters shall be used on signs described in this manual.
- 2. Letter Size for Station Platform and Related Directional Signs:
  - a. Four letter sizes most generally used on the signs described in this manual 6", 4", 3" and 1-1/2".
  - b. 6" letters are used on station identification signs for:
     Station name in the 9" color band.
  - c. 4" letters are used for:
    - Station name in the 6" color band.
  - d. 3" letters are used for:
    All information in the 6" white band except as noted below.
  - e. 1-1/2" letters are used for:
    Information in the 6" wide band where space is limited.
- 3. Letter size for site signing:

Size varies to suit available space and intended use. See sketches of typical standard signs.

4. Letter and Word Spacing

Letter and word spacing shall be in accordance with the rules established in Part V of the Authority's <u>Manual of Standards and Guidelines</u> and reproduced on the following pages. However, exceptions to this spacing are permitted in the case of space limitations. All exceptions must be approved by the Authority's Design Development Department.

Massachusetts Bay Transportation	Commuter Bail	Stations and Parking	Section II
Authority RAILROAD OPERATIONS	Design Standards	Graphics	Chapter 4
Revision No. 1 Date: 4/19/96	Manual		Page 4.10

Commuter Rail Combination Sign Panel



Commuter rail combination sign panels provide required information for visual and tactile station identification, route maps and schedules. Sign bands may also contain information concerning track number, accessible route, etc. Provide at least one route map/schedule case combination along the accessible path to the platform. Where a raised access platform is located at a remote location from the main platform, provide this sign combination in both areas. Provide Tactile/Braille ID. sign in at least one central location along each platform.

Source: MBTA Manual of Standards and Guidelines, Chapter V.

Massachusetts Bay Transportation Authority RAILROAD OPERATIONS		Commuter Bail	Stations and Parking	Section II	
		Design Standards	Graphics	Chapter 4	
Revisio	on No. 1 Da	te: 4/19/96	Manual		Page 4.11

#### C. ACCESSIBLE FEATURES

#### 1. General Requirements

Please refer to the Graphics chapter of the <u>MBTA Manual of Standards</u> and <u>Guidelines</u>, <u>Part V</u>, <u>Section Q</u> for detailed information about ADA regulations for MBTA signage.

- a. <u>Character Proportion:</u> The standard Helvetica Medium typeface used in MBTA signage should be used to comply with ADA specified width-to-height ratios.
- b. <u>Character Height:</u> Where signs are mounted suspended overhead, letter height must be a minimum of 3".
- c. <u>Finish and Contrast:</u> Characters should provide the maximum contrast with their background. White characters against a black background are the most legible. ADA requires that the characters and background should be of a non-glare finish, such as matte or eggshell. It is also helpful to have contrast between the sign and the wall in which it is posted on, and post the signs as frequently as possible.
- 2. ADA Sign Types
  - a. <u>Tactile/Braille signs:</u> Required to identify permanent rooms, stations at entrances and platforms. The centerline of the sign must be 5'-0" A.F.F.
  - b. <u>Station Identification Signs:</u> Consist of the typical MBTA sign bands system. ADA imposes certain requirements as to their location and frequency.
  - c. <u>Directional Signs</u>: Provide information that riders need to use the system. Additional signs are required when 1) the accessible route diverges from the path of travel for the general public, or 2) when not all of a particular element are accessible.
  - d. <u>Variable Message Signs:</u> If a public address system is used, ADA requires that a visual message system be provided for hearing impaired persons.
  - e. <u>Miscellaneous Signs:</u> Other signs such as clocks, and accessible parking signs are regulated by ADA guidelines. Please refer to the Graphics chapter of the <u>MBTA Manual of Standards and</u> <u>Guidelines</u>, Revision 1995 for more detailed information.

#### D. SYMBOL, ARROW, AND PICTOGRAPHS

1. Authority "T" Symbol

The "T" symbol is typically 3'-3" in diameter when used on the system identification sign.

Massachusetts Bay Transportation	Commuter Bail	Stations and Parking	Section II
Authority RAILROAD OPERATIONS	Design Standards	Graphics	Chapter 4
Revision No. 1 Date: 4/19/96	Manual		Page 4.12

# Arrow/Circle



down

Massachusetts Bay Transportation	Commuter Bail	Stations and Parking	Section II
Authority RAILROAD OPERATIONS	Design Standards	Graphics	Chapter 4
Revision No. 1 Date: 4/19/96	Manual		Page 4.14

Train Direction Arrow

This arrow is to be used without a circle for indicating the direction of Inbound and Outbound trains for island platforms and single track stations.



Massachusetts Bay Transportation	Commuter Bail	Stations and Parking	Section II
Authority RAILROAD OPERATIONS	Design Standards	Graphics	Chapter 4
Revision No. 1 Date: 4/19/96	Manual		Page 4.15





Down left only



Go right



Go straight



Go down You have arrived



Up right, or half-right



Down right only

These are the proper attitude positions for the Arrow/Circle decal. Use the Arrow/Circle either left or right. Do not use on both sides of a sign unless one end or the other is obscured by a column, wall, etc. from some viewing positions. See following page for relationships to the edge of the sign and Section D of this chapter for use.

Massachusetts Bay Transportation	Commuter Bail	Stations and Parking	Section II
Authority RAILROAD OPERATIONS	Design Standards	Graphics	Chapter 4
Revision No. 1 Date: 4/19/96	Manual		Page 4.16



Use of Arrow /Circle- Opaque Sign Bands

On a 6" signband, letters are 3" high and the arrow/Circle diameter is 5". The outside edge of the Arrow/Circle is 2 1/2" from left edge of signband and 2 1/2" from lettering margin. Spacing remains the same with the Arrow/Circle and lettering on the right side of signs.

Massachusetts Bay Transportation	Commuter Bail	Stations and Parking Section	
Authority RAILROAD OPERATIONS	Design Standards	Graphics	Chapter 4
Revision No. 1 Date: 4/19/96	Manual		Page 4.17



Use of Arrow /Circle- Continuous Opaque Sign Band

Single floating directional sign



Two adjacent directional signs

Massachusetts Bay Transportation		Commuter Bail	Stations and Parking	Section II
RAI	V LROAD OPERATIONS	Design Standards	Graphics	Chapter 4
Revision No.	1 Date: 4/19/96	Manual		Page 4.18





On signbands that provide information together, as a pair, the arrow must appear once, on the white band.

Messachusetts Bay Transportation	Commuter Bail	Stations and Parking	Section II
Authority RAILROAD OPERATIONS	Design Standards	Graphics	Chapter 4
Revision No. 1 Date: 4/19/96	Manual		Page 4.19

Sign for Designated Parking for Railroad Passengers



Massachusetts Bay Transportation		Commuter Rail	Stations and Parking	Section II
Authority RAILROAD	OPERATIONS	Design Standards	Graphics	Chapter 4
Revision No. 1	Date: 4/19/96	Manual		Page 4.20

#### Graphics

- b. Commuter rail purple is specified using the Pantone Matching System (PMS) of offset printing inks developed by Pantone, Inc. Pantone Color Selector is available through art supply stores. The color number for commuter rail purple is PMS 241 (uncoated) and PMS 249 (coated). While experience indicates that this color may be difficult to match in certain applications, the designer should attempt to achieve the closest possible match in all uses of purple on the commuter rail system. See the accompanying chart for the Authority's standard color specification for purple in brush and spray paints.
- 5. Red
  - a. The color red is used on regulatory/warning signs, especially the "No Parking" and "No Smoking" signs.
  - b. Red should be as specified in the accompanying chart.
- 6. Yellow
  - a. The color yellow is used on the vehicular/pedestrian track crossing warning sign, "Look Before Crossing".
  - b. Yellow should be as specified in the complying chart.
- 7. Blue
  - a. The color blue is used for accessibility. The blue used for accessible parking space signs should match Pantone 300 (coated) and Pantone 293 (uncoated).

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Pantone (printing <u>Color</u>	ink) <u>Uncoated</u>	<u>Coated</u>	Dupont (paints) <u>Imron (spray)</u>	<u>Dulux (brush)</u>
Red	485	485	58209UM	93-58209H
Blue	293	300	772570	93-77257
Orange	144	152	60659UH	93-60659
Green	348	348	5316UH	93-5316
Purple	241	249	1976UM	
Yellow	123	123	6808U	93–6808
Silver	877	429	44400UH	
Dark Gray	a431	431	55322U	93-55322
Light Gray	422	422	55137U	93-55322
White			817U	93-21667
Beige	454	454	4480U	93-221667
Aqua	340	569	72218U	93-72218
Black	Black	Black	99U	93-005

Massachusetts Bay Transportation	Commuter Bail	Stations and Parking	Section II
Authority RAILROAD OPERATIONS	Design Standards	Graphics	Chapter 4
Revision No. 1 Date: 4/19/96	Manual		Page 4.21

#### F. SIGN LAYOUT

- 1. Sign Layout criteria generally are based on standards prescribed in the Authority's <u>Manual of Guidelines and Standards</u>, Part V. They are discussed below in terms of the four categories of signs.
- 2. Identification Signs
  - a. The system identification sign, the "T" symbol, is laid out in accordance with the accompanying symbol art work except that the circle surrounding the "T" is omitted. This circle is replaced by the circular metal frame surrounding the "T".
  - b. Station Identification Sign
    - The station name is on the purple colored band, which is typically 9"x 8'-0". The height of the letters (6") may be reduced if necessary to fit the station name within the 8'-0" panel.
    - The platform identification "Inbound to Boston" and "Outbound To (Terminal Station or Stations)" is centered on the white portion of the band (6"x 8'-0") with 3" text in double or multiple platform conditions. See the accompanying illustrations for examples of this layout.
    - For single track and island platform conditions, the 6" information band contains "Direction to Boston" in 1-1/2" text over the text "Direction To (name of terminal station or stations)" in 1-1/2" text. Both lines of directional text are either preceded or followed by a special train direction arrow detailed in the preceding pages. The information is left or right-justified in accordance with the following illustration.
    - The margins between the arrow-circle unit, the borders of the panel, and adjacent words are standards to be maintained with other information presented on the panel.
    - Local destination information may be incorporated into the 6" information panel along with the platform identification. Where space is limited, 2 lines of 1-1/2" text may be used.
    - Messages (platform identification and local destinations) must be separated.
    - Letter size must be the same for each message.
    - Letter size may be reduced below the standard 4" height when additional space is required. The circle-arrow unit must also be reduced in size proportionally to maintain the same 5:4 ratio of outside circle diameter to letter height.
    - Provide an arrow-circle unit for messages in a single platform condition.

$\widehat{\mathbf{T}}$	Massachusetts Bay Transportation		Commuter Bail	Stations and Parking	Section II
	Authority RAILROAD	OPERATIONS	Design Standards	Graphics	Chapter 4
Revisi	on No. 1	Date: 4/19/96	Manual		Page 4.22







• Logo Proportions example: for 20" diameter;  $20 \ge 54.7\% = 10.94$ " high T

Massachusetts Bay Transportation		Commuter Bail	Stations and Parking	Section II
Authority RAILRO	AD OPERATIONS	Design Standards	Graphics	Chapter 4
Revision No. 1	Date: 4/19/96	Manual		Page 4.23

Standard Trailblazer Sign



Massachusetts Bay Transportation	Commuter Bail	Stations and Parking	Section II
Authority RAILROAD OPERATIONS	Design Standards	Graphics	Chapter 4
Revision No. 1 Date: 4/19/96	Manual		Page 4.24

Destination Information, Double or Multiple Track Station with Side Platforms. (Assume right hand direction of trains)



Massachusetts Bay Transportation	Commuter Bail	Stations and Parking	Section II
Authority RAILROAD OPERATIONS	Design Standards	Graphics	Chapter 4
Revision No. 1 Date: 4/19/96	Manual		Page 4.25

#### Island Platform and Single Track Destination Information

These designs should be used for island platforms with multiple tracks or for single track stations where trains heading inbound and outbound make use of the same track.



# 12 Ft. Station Identification Sign



$\widehat{\mathbf{T}}$	Massachusetts Bay Transportation		Commuter Bail	Stations and Parking	Section II
	Authority RAILROA	OPERATIONS	Design Standards	Graphics	Chapter 4
Revisio	on No. 1	Date: 4/19/96	Manual		Page 4.26

Example of Standard Method for Inserting Local Destination Information on Station Identification Sign



Massachusetts Bay Transportation	Commuter Bail	Stations and Parking	Section II
RAILROAD OPERATIONS	Design Standards	Graphics	Chapter 4
Revision No. 1 Date: 4/19/96	Manual		Page 4.27

c. Other Identification Signs

The other most commonly used identification sign is the pictograph used to identify parking spaces for the handicapped. The standardization of pictograph sign sizes is not appropriate, but a convenient size used in the past consists of a maximum image area dimension of  $10 \ 3/4"$  on a  $1'-2"x \ 1'-2"$  sheet metal field (see accompanying illustration).

- 3. Directional Signs
  - a. The trailblazer sign is a commonly available size of sheet aluminum: 1'-6"x 3'-0" and is Authority standard in terms of letter and symbol size, color, and layout. The standard sign is described in the accompanying illustration.
  - b. Other directional signs, such as those directing the motorist to drop-off/pick- up areas and additional parking, will vary in size with site conditions. The relationship of the arrowcircle unit to the message unit (e.g., the "P" symbol or "Drop Off/Pick Up") should be in accordance with the examples presented in the accompanying illustration.
  - c. All copy on directional signs located away from the platform should be left-justified.
- 4. Regulatory/Warning Signs
  - a. The "No Parking" pictograph sign should be designed in accordance with the pictograph layout criteria presented above.
  - b. The vehicular/pedestrian track crossing sign must conform to the standard illustration on the following page. For this sign only, the words are stacked and centered rather than leftjustified.
- 5. System Use
  - a. The system map is a standard size. Camera ready art work for these maps is provided by the Authority for a fee of \$1,000.00.
  - b. The information panel is typically a white panel of the same size as the system map panel-4'x 4'.

Massachusetts Bay Transportation	Commuter Bail	Stations and Parking	Section II
Authority RAILROAD OPERATIONS	Design Standards	Graphics	Chapter 4
Revision No. 1 Date: 4/19/96	Manual		Page 4.28

### Standard On-Site Identifications Signs (Pictographs)



Massachusetts Bay Transportation	Commuter Bail	Stations and Parking	Section II
Authority RAILROAD OPERATIONS	Design Standards	Graphics	Chapter 4
Revision No. 1 Date: 4/19/96	Manual		Page 4.29

## Standard On-Site Identifications Signs (Pictographs)



$\widehat{\mathbf{T}}$	Massachusetts Bay Transportation	Commuter Bail	Stations and Parking	Section II
	Authority RAILROAD OPERATIONS	Design Standards	Graphics	Chapter 4
Revisio	n No. 1 Date: 4/19/9	6 Manual		Page 4.30

# Standard On-Site Identifications Signs (Pictographs)





These signs should be located at either end of the bus and drop off/ pick up zones.

Massachusetts Bay Transportation	Commuter	Stations and Parking	Section II
Authority RAILROAD OPERATIONS	Design Standards	Graphics	Chapter 4
Revision No. 1 Date: 4/19/96	Manual		Page 4.31



\* MBTA to supply art.

Massachusetts Bay Transportation	Commuter Bail	Stations and Parking	Section II
Authority RAILROAD OPERATIONS	Design Standards	Graphics	Chapter 4
Revision No. 1 Date: 4/19/9	6 Manual		Page 4.32

Examples of On-Site Directional Signs





These signs are to be used en-route to the various facilities, and up to the platform entrance locations. These signs are not to be used within platform areas.





Commuter Rail Design Standards Manual	Stations and Parking	Section II
	Graphics	Chapter 4
		Page 4.33
	Commuter Rail Design Standards Manual	Commuter Rail Design Standards Manual Standards
Standard Vehicular/Pedestrian Track Crossing Sign



Massachusetts Bay Transportation	Massachusetts Bay Transportation AuthorityCommuter Rail Design Standards 	Stations and Parking	Section II
Authority RAILROAD OPERATIONS		Graphics	Chapter 4
Revision No. 1 Date: 4/19/96			Page 4.34

#### G. SIGN MATERIALS AND METHODS OF CONSTRUCTION

#### 1. Fiberglass

- a. All platform and related directional signs, plus the station name sign at the entry to parking lots are 1/4" fiberglass, bonded to 3/4" aluminum channel stiffeners. Refer to "Manual of Guidelines and Standards, Part V" for more detailed information on fiberglass sign material specifications.
- b. The "T" symbol uses 1/4" flat sheet fiberglass over a plywood backing. Trailblazers are 1/8" fiberglass.
- c. All other site miscellaneous small signs are to highway standards- plastic film laminated on 1/8" aluminum.
- d. At locations where the fiberglass sign frame is susceptible to vehicle or snowplow damage, mount the frame on reinforced concrete pedestals, as illustrated in the accompanying detail.
- 2. Sheet Aluminum
  - a. Sheet aluminum of a 0.125" thickness is typically used for all other commuter rail station signs. Typical fabrication and installation details for system identification sign are illustrated on following pages.
  - b. The standard mounting detail for all other sheet aluminum sizes is the Massachusetts Department of Public Works P-5 break-away post assembly, specified as galvanized. (See the accompanying detail).
  - c. Minimum clearance between the lower face of the circular frame of the system identification sign and grade is 12'-0".
  - d. Minimum clearance between all other sheet aluminum signs and grade is 7'-0", a Massachusetts Department of Public Works standard.
- 3. Galvanized Steel
  - a. Galvanized steel used in sign frames may be finished with shop applied paint within 12 hours of galvanizing.

Massachusetts Bay Transportation	Commuter Bail	Stations and Parking	Section II		
	Authority RAILROAD OPERATIONS	Design Standards	Graphics	Chapter 4	
	Revision No. 1	Date: 4/19/96	Manual		Page 4.35





Massachusetts Bay Transportation		Commuter Bail	Stations and Parking	Section II
RAILROAD OPERATIONS	Design Standards	Graphics	Chapter 4	
Revision No. 1	Date: 4/19/96	Manual		Page 4.36



Typical Construction Details for the Station Identification Sign

• Typical Commuter Rail Sign section with Name & Information Band - Fiberglass Sign Panels scale: 3/4" = 1"



Vertical Joint at Edge of Sign

$\widehat{\mathbf{T}}$	Massachusetts Bay Transportation	Commuter Bail	Stations and Parking	Section II	
Authority RAILROAD OPERATIONS		Design Standards	Graphics	Chapter 4	
Revisi	on No. 1	Date: 4/19/96	Manual		Page 4.37





Viewing Angles for Single Height Rail Car at Low Platform



Viewing Angles for Single Height Rail Car at High Platform

Massachusetts Bay Transportation	Commuter Bail	Stations and Parking	Section II
Authority RAILROAD OPERATIONS	Design Standards	Graphics	Chapter 4
Revision No. 1 Date: 4/19/96	Manual		Page 4.38

Typical Construction Details for Concrete Pedestals Used with Pedestal- Mounted Station Identification Sign



Messachusetts Bay Transportation Authority RAILROAD OPERATIONS		Commuter Bail	Stations and Parking	Section II
		Design Standards	Graphics	Chapter 4
Revision No. 1	Date: 4/19/96	Manual		Page 4.39



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Massachusetts Bay Transportation	Commuter Rail Design Standards	Stations and Parking Section	
C Authority RAILROAD OPERATIONS		Graphics	Chapter 4
Revision No. 1 Date: 4/19/96	Manual	· · ·	Page 4.40





Massachusetts Bay Transportation		Commuter Bail	Stations and Parking	Section II
Authority RAILROAD	OPERATIONS	Design Standards	Graphics	Chapter 4
Revision No. 1	Date: 4/19/96	Manual		Page 4.41

Standard Mounting Details for Sheet Aluminum Signs



Massachusetts Bay Transportation	Commuter Bail	Stations and Parking	Section II
Authority RAILROAD OPERATIONS	Design Standards Manual	Graphics	Chapter 4
Revision No. 1 Date: 4/19/96			Page 4.42

# CHAPTER 5 COMFORT AND CONVENIENCE FACILITIES

#### I. INTRODUCTION

This section deals with the types of user comforts and conveniences that should be incorporated into commuter rail stations, such as seating, telephones, and concessions. These facilities, when integrated into the design, make the station more comfortable and convenient.

#### II. DESIGN OBJECTIVES

#### A. COMFORT

Provide facilities that increase the user's comfort while waiting for the train, consistent with the objectives of minimizing targets of vandalism and achieving economy of design.

#### **B. CONVENIENCE**

Provide facilities that make the station more convenient to use by consolidating activities that might otherwise require several trips (buying a newspaper, making a phone call, etc.) in one location.

#### III. DESIGN GUIDELINES

#### A. GENERAL

Six types of facilities are discussed in this section: seating, telephones, trash receptacles, vending machines and concessions, clocks, and toilet facilities. Some of these facilities should only be included at the most heavily used stations.

At low platform stations with an access platform, platform amenities (seating, etc.) must also be provided on the access platform.

#### B. SEATING

- 1. Seating should be provided at all stations and designed to provide maximum:
  - Physical comfort
  - Capacity
  - Freedom of choice
  - Durability under exposure to extreme weather conditions and severe vandalism.

#### 2. Capacity Guidelines

a. The amount of seating required at a station will vary with the shape and size of the site and surrounding facilities. Seating requirements are best established through observation of how other stations are currently used rather than basing the need on

$\widehat{\mathbf{T}}$	Massachusetts Bay Trensportation Authority RAILROAD OPERATIONS		Commuter Bail	muter Stations and Parking	
			Design Standards	Comfort and	Chapter 5
Revisi	on No. 1	Date: 4/19/96	Manual		Page 5.1

overall or peak period ridership. The designer should seek to identify the extent to which people use adjacent facilities, such as restaurants, taxi stands, and their cars when waiting for the train.

- b. The quantity of seating should also be based on observations of sitting patterns, including the spacing people maintain for psychological comfort. Studies indicate that typically 28 people are seated per 100 linear feet of sitting space.
- 3. Location Guidelines
  - a. Seating should be located where the user will have easy and direct access to the platform. The user should also have a direct view of approaching trains from the seating.
  - b. Avoid locating seating across the tracks from sign units to discourage vandals from throwing objects at the signs while sitting at the station.
  - c. Seating should be highly visible from surrounding activities and in a well lighted area for night time use.
  - d. Avoid locating seating in areas that will impede pedestrian traffic flow.
  - e. Seating should be in a covered location if possible.
  - f. Do not locate seating where it may prevent direct approach to signs by users with limited vision.
  - g. Seating must conform to AAB requirements to be located at intervals along platforms to not exceed 200 feet.

#### C. TELEPHONES

- 1. A public telephone should be readily accessible at all commuter rail stations, either on site or immediately adjacent to the site.
- 2. Telephones should be located:
  - Under shelter or cover where possible
  - In highly visible (from the station and surrounding area) and heavily traveled areas
  - Where users can view an approaching train
  - Where they do not impede or obstruct pedestrian traffic
  - In areas and at mounting heights accessible to the handicapped
- 3. Where interior public or banks of (two or more in a single location) telephones are provided, at least one should be TTY equipped. It must be identified with the TTY symbol.

Hossochusetts Bey Transportation		Commuter Bail	nuter Stations and Parking		
	Authority RAILROAD OI	PERATIONS	Design Standards	Comfort and	Chapter 5
Revisi	on No. 1	Date: 4/19/96	Manual	Convenience Facilities	Page 5.2

#### D. TRASH RECEPTACLES

- 1. Trash receptacles should be installed at all commuter rail stations, but only if the Authority has negotiated an agreement for the periodic pick-up of trash and maintenance of the receptacles.
- 2. The receptacles should be located:
  - In heavily used areas
  - Where they do not impede pedestrian traffic
  - At points that are accessible to pick-up crews

#### E. VENDING MACHINES AND CONCESSIONS

- 1. Currently, the Authority does not install or maintain vending machines or concessions at commuter rail stations. In certain instances, the Authority encourages businesses to lease unused space and provide concessions oriented to users of the system. The following guidelines identify some of the more appropriate types of vending machine services and concessions that might be provided at commuter rail stations, as well as the appropriate locations for these facilities.
- 2. The types of vending machine services that are most appropriate at a station include:

Newspapers	Snacks-candy,	pastries,	etc.
Soda	Coffee		
Stamps			

With the exception of newspapers, these vending services are generally provided in an enclosed building and are under continuous surveillance by the operator or user of the services. Some of the services also require electricity, plumbing, and heat. Accordingly, vending services other than newspapers should be provided only at those stations with enclosed buildings and that are manned by a ticket agent or a concessionaire.

3. Among the concessions appropriate to a commuter rail station are:

Florist shops
Real estate offices
Travel agencies
Laundry/dry cleaners

Concessions such as these will require an enclosed building. They are generally feasible only when the station has high ridership or is located in an area that has high visibility and traffic volumes.

T	Massachusetts Bay Transportation		Commuter Bail	Stations and Parking	Section II
		Design Standards	Comfort and	Chapter 5	
Revis	ion No. 1	Date: 4/19/96	Manual	Convenience raciiities	Page 5.3

- 4. The need for vending machines and concessions should be evaluated on the basis of the availability of these facilities in the vicinity of the station.
- 5. Vending machines and concessions should be located in areas that are:
  - Readily accessible to waiting areas and pedestrian walkways along an accessible route.
  - Easily observed by the station agent (in the case of most vending machine services) or from the surrounding community (in the case of newspaper vending machines.)
- 6. The facilities should also be located where they do not obstruct views of the platform and approaching trains or impede pedestrian flow.

#### F. CLOCKS

Clocks should be provided at all stations with enclosed waiting areas. They should be located where they are readily visible from all parts of the waiting area and conform to ADA standards.

#### G. TOILET FACILITIES

- 1. All manned stations shall have toilet facilities, and at the discretion of the station agent, may be made available to commuter rail passengers. All toilet facilities must comply with the <u>Americans with</u> <u>Disabilities Act Accessibility Guidelines</u>. Toilet facilities open to the public must also comply with the <u>Rules and Regulations of the</u> <u>Architectural Access Board</u> of the Commonwealth of Massachusetts.
- 2. Toilet facilities shall conform to all building code requirements. Fixtures and accessories required include:

1	sink	1 tissue dispenser
1	toilet	1 trash receptacle
1	mirror with shelf	grab bars as required
1	electrical outlet	partitions as required
1	soap dispenser	

3. The preferred location for toilet rooms in station buildings is adjacent to the main waiting room with access doors directly observable from the agent's office.

Massachusetts Bay Transportation Authority RAILROAD OPERATIONS		Commuter Rail Design Standards	Stations and Parking	Section II
			Comfort and	Chapter 5
Revision No. 1	Date: 4/19/96	Manual	Convenience Facilities	Page 5.4

#### IV. DESIGN CRITERIA AND DETAILS

#### A. SEATING

- 1. Seating at a station can take many forms, but should meet the following dimensional criteria:
  - A continuous bench style, at least 7'-6" long, to allow for maximum freedom of choice.
  - A minimum of 16" and maximum of 20" high
  - A minimum of 15" in depth
  - A minimum 3" heel space for ease of rising from a seated position.
  - To facilitate sitting and rising for people with limited strength and flexibility it is recommended that at least half of the fixed benches at each site have a high back and armrests.
- 2. The seating should be designed to require a minimum number of vertical supports, thereby reducing the potential for litter collection beneath the seating.
- 3. Seats should be slatted and sloped from front to back for rain and snow drainage.
- 4. Seating materials must be highly durable and vandal-resistant, but non abrasive to human contact.
- 5. Avoid the use of materials such as the extruded aluminum benches found in prefabricated bus shelters and wood of 2" nominal thickness or smaller since they are highly susceptible to vandal damage.

#### B. TELEPHONES

- 1. Public telephone installations must include at least one telephone per bank (two or more in a single location) that is accessible to people who use wheelchairs, as required by the <u>Rules and Regulations of the</u> <u>AAB</u> and <u>ADAAG</u>. In addition, 25% of the telephones per bank, but never less than one, must have a volume control.
- 2. Among the other features which each telephone installation should contain are:
  - Posted numbers listing emergency numbers (police, fire, etc.) and convenience numbers (Authority number for information on service, delays, etc., and local taxis).
  - A telephone directory, attached to the installation and protected from the weather.
  - Lighting to read the dial and directory.
  - A shelf for personal articles such as gloves, purse, change, etc.
  - TTY

Massachusetts Bay Transportation	Commuter Rail Design Standards	Stations and Parking	Section II
Authority RAILROAD OPERATIONS		Comfort and	Chapter 5
Revision No. 1 Date: 4/19/96	Manual	Convenience Facilities	Page 5.5

Typical Bench Construction Details



Massachusetts Bey Transportation		Commuter Bail	Stations and Parking	Section II	
	Authority RAILROAD OPERATIONS		Design Standards	Comfort and	Chapter 5
Revisio	on No. 1	Date: 4/19/96	Manual	Convenience Facilities	Page 5.6

#### C. TRASH RECEPTACLES

- 1. Trash receptacles should follow the MBTA Commuter Rail standard with locking tops. Refer to previous construction jobs for specifications. They should also have the following features:
  - Large opening for easy trash disposal
  - Minimal exposure of opening to rain and wind
  - High (55 gallon) capacity, self-draining container
  - Durable material, resistant to the abuse of weather and vandalism
    Capability for being affixed to an object such as a utility pole or located within a heavy, immovable container (precast concrete,

#### D. TOILET FACILITIES

etc.)

- 1. Fixtures: all urinals, and sinks shall be wall-hung vitreous china. Fittings should be either stainless steel or chrome-plated brass with concealed or vandal-proof anchors.
- 2. Accessories: compartment partitions and fittings should be stainless steel. Mirrors should be plate glass with stainless steel frames. All other accessories should be of stainless steel construction with concealed and tamper-proof mounting devices.
- 3. Room finishes: should be rugged, chemical- resistant, and easily cleaned.
- 4. Lighting: provide lighting to achieve an average level of 30 footcandles. Switch should be provided so that the lights are in operation only when the facilities are in use.
- 5. Ventilation: provide mechanical ventilation to the outdoors with makeup air supply from either louvers or undercuts at the toilet room access doors.
- 6. Floor drains and wash down facilities should be included where possible.

Massachusetts Bay Transportation	Commuter Bail	Stations and Parking	Section II
Authority RAILROAD OPERATIONS	Design Standards	Comfort and	Chapter 5
Revision No. 1 Date: 4/19/96	Manual	Convenience Facilities	Page 5.7

# CHAPTER 6

#### I. INTRODUCTION

This section deals with landscaping of the station site. As used in this manual, the term landscaping refers to the existing natural features of a station, as well as additional natural (trees, shrubs, ground cover, etc.) and man-made (fencing, special paving materials, etc.) elements that can be used to enhance the overall visual quality of a station. Proper use of existing station landscaping, when combined with the selective use of new landscape elements, can also help make the site compatible with the surrounding area.

#### II. DESIGN OBJECTIVES

The principal objectives of the site landscaping are increased attractiveness, user safety and security, preservation of significant existing features, durability/maintainability of the landscape elements, and soil conservation.

#### A. ATTRACTIVENESS

Provide an attractive station environment by using landscaping to 'soften' the effect of large paved areas, integrate the station into compatible surrounding areas, and buffer the station from incompatible surroundings.

#### **B.** SAFETY AND SECURITY

Use landscaping elements to improve the safety of pedestrian and vehicular movements and to maximize surveillance of the station (and enhance user security) from the surrounding area. Note that enhancing security through increased station visibility from the surrounding area may conflict with requirements to buffer the site from incompatible surroundings.

#### C. PRESERVATION

Preserve and capitalize on existing site assets such as trees, water, views, or historic buildings.

#### D. DURABILITY/ MAINTAINABILITY

Use landscaping suited to the climate, resistant to vandalism, and low in maintenance requirements.

#### E. SOIL CONSERVATION

Provide adequate storm water drainage facilities that minimize uncontrolled water run-off and minimize soil erosion on and off site.

	Massachusetts Bay Transportation		Commuter Bail	Stations and Parking	Section II
	Authority RAILROAD	OPERATIONS	Design Standards	Landscaping	Chapter 6
I	Revision No. 1	Date: 4/19/96	Manual		Page 6.1

#### III. DESIGN GUIDELINES

#### A. GENERAL

Three areas of concern addressed in this section are: buffers, site drainage and planting. Site improvements in each of these categories may contribute to the achievement of the attractiveness, safety, security, preservation, and soil conservation objectives. All of the design guidelines pertaining to each of the categories are aimed at satisfying the fifth objectivedurability and maintainability of the site improvements.

#### B. BUFFERS

- 1. Buffers include various types of natural and man-made devices that can be used to visually screen incompatible land uses (such as a station parking lot from adjacent residences) or to attenuate the noise emanating from trains.
- 2. Among the visual screening devices that may be used are:
  - a. Site topography: at some stations it may be possible to use substantial grade changes on the site to visually screen parking from the surrounding area. However, it is necessary to maintain the visibility of the parking lot at all times, in order to increase the feeling of security and discourage vandalism and crime.
  - b. Earth berms: where a relatively level site does not permit the use of site topography, earth berms, as illustrated on the following page, may be used as a screening device. They are generally a minimum of 3'-O" high and require a minimum of 20'-O" horizontal distance to achieve proper slope ratios for the minimum height berm. They are typically planted with a low maintenance ground cover, described later in this section.
  - c. Planting: sticker-bushes, hedgerows, and trees may be used as a partial visual screen. The general effect of planting will be to lessen the visual impact of the station on the adjacent area, rather than to create a complete blockage of sight lines between the station and the surrounding area. Maintaining at least partial station visibility from the surrounding area is important to enhancing personal security at the station. Appropriate plant materials are described later in this section.
  - d. Fencing: another means of visual screening is accomplished through the use of fencing. Opaque fencing material solid wood fencing and masonry walls are examples is typically very expensive and difficult to maintain. Consequently, the use of fencing as a screening device is not recommended at commuter rail stations and should be used only when the other three approaches are found to be unsuitable to a site.

6	Massachusetts Bay Transportation		Commuter Bail	Stations and Parking	Section II
	Authority RAILROAI	D OPERATIONS	Design Standards	Landscaping	Chapter 6
R	evision No. 1	Date: 4/19/96	Manual		Page 6.2

# Site Topography as a Screening Device



Berms as a Screening Device



$\overline{\mathbf{r}}$	Massachusetts Bay Transportation		Commuter Bail	Stations and Parking	Section II
Authority RAILROAD OPERATIO	OPERATIONS	Design Standards	Landscaping	Chapter 6	
Revisio	on No. 1	Date: 4/19/96	Manual		Page 6.3

- 3. The Federal Environmental Protection Agency has formulated standards for the noise levels of railroad rolling stock. The proposed standards are 88dBA for rolling stock operating at up to a 72 kph (45 mph) and 93 dBA for speeds greater than 72 mph, as measured at a distance of 30 meters (100'-0").
- 4. Two approaches to alleviating noise impacts are described below:
  - a. Berms and walls: a high percentage of rail right-of -way noise is generated at track level. Earth berms or walls located immediately adjacent to the tracks will partially deflect or absorb this noise and reduce noise levels on abutting properties.
  - b. Visual screening: in some instances it has been noted that a major component of the noise problem is the result of a psychological rather than a physiological reaction to the noisesource of the i.e., viewing the noise becomes а disproportionately large part of the problem. In these cases, it may be possible to mitigate the impact through the use of densely planted shrubs and trees, especially evergreens. Note, however, that these materials do little to alleviate the noise.
- 5. Location Guidelines
  - a. The location of visual screening devices will, of course, vary with the site. In general, however, they should be located at the perimeter of the site.
  - b. Maintain a 10'-0" distance between walkways, platforms, and parking areas and new or existing dense vegetation.
  - c. Locate buffers in a manner that insures undisturbed visibility at all pedestrian and vehicular intersections.
  - d. Select tree species whose lowest branch height is 7'-0" or greater.
  - e. Insure that the landscaping does not reduce the effectiveness of the site lighting.
  - f. Avoid screening the platform waiting areas from the surrounding neighborhood and streets.

Massachusetts Bay Transportation		Commuter Bail	Stations and Parking	Section II
Authority RAILROA	D OPERATIONS	Design Standards	Landscaping	Chapter 6
Revision No. 1	Date: 4/19/96	Manual		Page 6.4

#### C. SITE DRAINAGE

- 1. As used in this chapter of the manual, the term site drainage refers to actions required to manage storm water in both paved and unpaved areas of a station site. Stations should have storm drainage systems that connect to municipal systems. Much of the storm water flows to existing street catch basins or is simply absorbed by the soil on-site. All plans for upgrading a station drainage system must be coordinated with local public works departments and conservation commissions.
- 2. Station improvements, especially parking, create a substantial increase in paved area and may also disrupt natural drainage patterns. The following guidelines establish a preferred approach to dealing with the issues of grade modifications, drainage of paved areas and unpaved areas, and slope control.
- 3. Grade Modification Guidelines
  - a. The grading design should balance the aesthetic, drainage, maintenance, and operational needs of the station site.
  - b. Coordinate proposed grades with plant material to remain (such as larger trees) and with other existing site elements.
  - c. The grading design should attempt to balance cut and fill.
  - d. Design slopes within minimum and maximum tolerances to insure positive drainage, ease of maintenance, and prevention of erosion.
  - e. Grading Around Trees to be Preserved
    - The maximum fill allowed within the drip line of any tree (the area encompassed by the tree's longest branches) shall be 6". No cut shall be permitted within the drip line area.
    - When more than 6" of fill is required, the tree should be removed. In the case of significant specimens, protect with a terrace or drywell.
    - Provide positive drainage away from the base of all trees.
- 4. Drainage of Paved Areas
  - a. In general, all new or rehabilitated parking lots at commuter rail stations should have a storm drainage system connecting with an existing municipal system.
  - b. Minimum and maximum slopes in paved areas will vary with the material and location, but should be as prescribed in the Circulation and Parking sections of this manual.

	ssachusetts / ansportation	Commuter	Stations and Parking	Section II
F	CHORING COPERATIONS	Design Standards	Landscaping	Chapter 6
Revision	lo. 1 Date: 4/19/96	Manual		Page 6.5

- c. Design flows for the system should be determined by using the Rational Method (or an accepted alternative) and as detailed in Manual No. 37, <u>Design and Construction of Sanitary and Storm</u> <u>Sewers</u>, American Society of Civil Engineers.
- d. The selection of a particular storm frequency and discharge capacity should be based upon the need for maximum reliability of operation, consistent with economy and local experience. The following chart can be used as a guide in determining the storm frequency.

Storm Frequency in Years	Drainage System Element
5	Secondary ditches
10	Median ditches, gutters, ditch inlets, curb and paved area inlets, and inlet ponding
25	All pipes and culverts except under major roads and culvert outlets
50	Relocated stream channels, major stream structures, transverse pipes, culverts, etc. under major roads
100	Use only when required by the local agency

- e. Hydraulics: in the design of a storm drain system, the following factors should be considered:
  - Topography: avoid designs that require pumping
  - Economy of construction: avoid excessively deep cuts
  - Peak flows
  - Slopes: determine slopes required for proper self-cleaning at minimum flows
  - Minimum pipe size: 12 inches
  - Maximum velocity: up to 10 feet per second
  - Hydraulic design should be in accordance with manual No.
    37, <u>Design and Construction of Sanitary and Storm Sewers</u>, American society of Civil Engineers. Coefficients of roughness should be as recommended in that manual.
- f. Gravity Flow: provide a self-cleaning velocity of 2 feet per second. Where this minimum is impractical to obtain, the design should consider the effects of sedimentation, odors, and operational difficulties at lower velocities.
- g. Water Collection
  - As illustrated in the diagram, continuous sheet flow of water into a swale located along an edge of flat areas,

	Massachusetts Bay Transportation		Commuter Bail	Stations and Parking	Section II
	Authority RAILROAD OPER	ATIONS	Design Standards	Landscaping	Chapter 6
Revisio	n No. 1 Da	nte: 4/19/96	Manual		Page 6.6

followed by the collection of this water in several area drains, is desirable. Area drains connected by ridges and valleys break up the continuity of paved surfaces and should be avoided.

- If area drains must be used, avoid strong linear paving patterns and reduce the pitch of the paving to the minimum.
- Trench drains are very expensive and should only be used where the collection of water in a small number of area drams is not practical, such as at the foot of some stairs and ramps.
- Coordinate the site drainage pattern with the design of barriers and curbs. For example, at some locations water from paved areas may flow to adjacent unpaved areas and be absorbed by the soil. In this situation, guard rail or bollards should be used instead of curbing as a barrier system at the edge of paved areas to prevent vehicles from destroying vegetation in the unpaved area.
- Coordinate drainage of the site with drainage of the track and roadbed to insure that water from one does not cause problems with the other.
- Where the presence of salt is likely, do not pitch the pavement to flush or recess planting areas.
- Avoid sheet flow across walks, ramps, and stairs.
- 5. Drainage of Unpaved Areas
  - a. Unpaved or planted areas should be designed to absorb normal rainfall without draining onto paved areas. In areas with steep, planted slopes, horizontal run outs should be incorporated into the design to absorb the water run-off before it reaches a paved area.
  - b. The range of acceptable natural slopes in unpaved areas is presented in the following chart.

Massachusetts Bay Transportation	Commuter Bail	Stations and Parking	Section II
RAILROAD OPERATIONS	Design Standards	Landscaping	Chapter 6
Revision No. 1 Date: 4/19/96	Manual		Page 6.7

	Landscaping					
Type of Ground Cover	Maximum Slope	Desirable Maximum Slope	Minimum Slope	Desirable Slope		
Mowed Lawn	3:1	4:1	1%	2%		
Unmowed Lawn and Ground Cover Areas	3:1 (if jute mat used)	3:1 (Fill slope) 2:1 (cut slope)	2%	3%		

#### D. PLANTING

- 1. The use of plant materials at commuter rail stations is one of the most effective means of enhancing the visual quality of a station, while at the same time performing an essential soil conservation function.
- 2. An important consideration in a station improvement program is the preservation of significant existing natural features- trees, shrubs, etc. By capitalizing on these features, new planting costs can often be kept to a minimum and concerned abutters may be reassured that the physical character of the site will not change dramatically. Among the actions that should be taken to preserve existing natural features are:
  - a. Wherever grading requires a cut of more than 6" or a fill of more than 4" at sites with good topsoil, the topsoil should be stripped and stored for later use.
  - b. Care should be taken in the scheduling and techniques of earth moving operations to insure that erosion of soil does not take place. Slopes that must remain unplanted or unfinished for substantial periods should have their soils stabilized with mulches, fast-growing temporary ground covers (rye, grass, or buckwheat) or man-made soil stabilizers (such as jute mats).
  - c. In areas that are to be cleared and grubbed, an analysis of all trees 2" and larger in diameter should be performed. Where possible, sound specimens of either soft or hardwood trees should be identified. They should be thinned to a minimum of 10'-0" on center and tagged for preservation. Exceptions to the thinning may be natural clumps of trees such as birches.

Massachusetts Bay Transportation		Commuter Bail	Stations and Parking	Section II
Authority RAILROAD	OPERATIONS	Design Standards	Landscaping	Chapter 6
Revision No. 1	Date: 4/19/96	Manual		Page 6.8

- 3. Types of Planting
  - a. Public areas in general and transit stations in particular can be difficult environments for the growth of plant material. Abuse by vandals, intense exposure to both vehicular and pedestrian traffic, and minimal maintenance all contribute to the condition.
  - b. The list of recommended plant materials (on the following page), developed by the American Horticultural Society in the report <u>Transit Planting: A Manual</u>, accounts for these problems. The report's criteria for selection are:
    - Climatic zone suitability
    - Durability (including pollution resistance)
    - All year performance
    - Long life span
    - Low-cost maintenance
    - Artistic utilization and availability
  - c. This list is not necessarily a definitive list for all planting that may be used at stations. Most of the materials were chosen for durability in urban locations or proximity to parking or roads. Many of the Authority's commuter rail stations are in suburban or rural areas without the major impact of vehicular and city pollution. Many of these stations have fine specimens of indigenous plant material. Consequently, the designer should also consider plantings that have already proven their suitability for a particular site.
  - d. Plant materials should require little care other than initial planting and cultivation. Grass should not be used except in those cases where the Authority enters into agreements with municipal or commercial establishments to provide maintenance, or where the appearance of uncut grass is not objectionable. Bushes and shrubs should not require trimming or pruning. Fruit bearing trees should also be avoided.
- 4. Location of Planting
  - a. Planting materials can reinforce the pedestrian circulation, but for the most part, cannot control it. Careful planning of access points to the site and platform area will help insure that planting areas do not become "short cut" paths.

Massachusetts Bay Transportation	Commuter Bail	Stations and Parking	Section II
Authority RAILROAD OPERATIONS	Design Standards	Landscaping	Chapter 6
Revision No. 1 Date: 4/19/96	Manual		Page 6.9

#### **Recommended Plant Materials**

#### **TREES**

Acer platanoides Acer rubrum Amelanchier candensis Carpinus betulus Cornus mas Fraxinus pennsylvanica Ginko biloba Halesia carolina <u>llex opaca</u> Koelreuteria paniculata Liquidambar styraciflua Phellodendron amurense Pyrus calleryana 'Bradford' Quercus phellos Sophora japonica Tilia cordata

#### <u>SHRUBS</u>

Abelia grandiflora Acanthopanax sieboldianus Berberis thunbergil Buxus microphylla var. japonica Chioanthus virginicus Deutzia gracilis Elaeagnus angustifolia Forsythia x intermedia Ilex crenata Juniperus chinensis "Pfitzerianas" Kolkwitzia amabilis Rhus copallina Spiraea x vanhouttei Taxus cuspidata Xanthorhiza simplicissima

#### GROUND COVERS

Ajuga reptans Arctostaphylas uva-ursi Cotoneaster horizontalis Epimedium sp. Hedera helix Hemerocallis sp. Ilex crenata Juniper chinensis 'Pfitzerianas' Lonicera japonica Rosa wichuraiana Sedum acre Vinca minor (Norway Maple) (Red Maple (Serviceberry) (European Hornbean) (Cornelian Cherry) (Green Ash) (Ginkgo) (Carolina Silverbell (American Holly) (Goldenrain-tree) (Sweet-Gum) (Amur Cork-tree) (Bradford Pear) (Willow Oak) (Japanese Pagoda-tree) (Littleleaf-Linden)

(Glossy Abelia) (Aralia) (Japanese Barberry) (Japanese Boxwood) (Fringe-tree) (Slender Deutzia) (Russian Olive) (Forsythia) (Japanese Holly) (Pfitzer Juniper) (Beautybush) (Shining Sumac) (Vanhouette Spirea) (Japanese Yew) (Yellowroot)

(Bugleweed) (Bearberry) (Rockspray Cotoneaster) (Forsythia) (English Ivy) (Daylily) (Japanese Holly) (Pfitzer Juniper) (Japanese Honeysuckle) (Memorial Rose) (Goldmoss Stonecrop) (Periwinkle)

Massachusetts Bay Transportation	Commuter	Stations and Parking	Section II
Authority RAILROAD OPERATIONS	Design Standards	Landscaping	Chapter 6
Revision No. 1 Date: 4/19/96	Manual		Page 6.10

- b. Shrubs should be planted so that when mature, they will not overhang walkways or platform areas.
- c. Trees that overhang walkways and waiting areas should be of a species whose lower limbs are of sufficient height to allow comfortable pedestrian circulation.
- d. In general, trees should be clustered in designated areas of a parking lot rather than scattered throughout the lot. In all cases, trees planted adjacent to parking areas should be carefully protected with bollards or curbs.
- e. Where traffic islands or planted strips are located within parking areas, plant materials should be selected with snow removal in mind. Plants should also not grow high enough to obstruct motorist's view. The planting must be able to bear the weight of accumulated snow, and trees should be planted a minimum of 8'-0" from the curb edge where snow would be deposited by plows, and small bushes should be avoided. In general, only low, hardy ground covers, grass, or non-plant ground covers should be used. Do not locate trees or other plant materials at random throughout a parking area because of these snow problems and the loss of space that can be used for parking. Concentrate planting in a few areas with a high visual impact.
- f. Non-Plant Ground Covers
  - Fabric weed barriers: Used before ground covers are applied. It is also used to keep mulch on sloped areas from sliding down.
  - Small stones or gravel: Also used as a ground cover.
  - Mulch: There are two general categories of mulch. Grass mulch consists of salt marsh hay or straw and is applied using an asphaltic binder, which holds the soil together until the seed is established. This mulch may also be used as a temporary soil erosion measure during construction. Bedding mulch is used to keep down weeds and to retain surface moisture around trees and shrubs. It also provides an attractive uniform ground plane surface. Three types of bedding mulch may be used:
  - <u>Wood chips</u> from local sources are usually the cheapest form of mulch and provide a coarse, light-gray appearance. Wood chips vary greatly in quality.
  - <u>Pine bark mulch</u> provides a darker, more uniform color and has a fine texture. It tends not to stay in place on sloping surfaces.
  - <u>Fir chunk bark mulch</u> is the most expensive mulch, but it provides excellent uniform color and texture. Larger dimension and weight gives it a longer life span than the other mulches.

Massachusetts Bay Transportation	Commuter Bail	Stations and Parking	Section II
Authority RAILROAD OPERATIONS	Design Standards	Landscaping	Chapter 6
Revision No. 1 Date: 4/19/9	Manual	L	Page 6.11

#### IV. DESIGN CRITERIA AND DETAILS

#### A. GENERAL

Design criteria are described in this section for site drainage and planting. Since the design of these items tends to be site specific, only general criteria are presented below.

#### B. SITE DRAINAGE

- 1. Materials
  - a. General Guidelines: the selection of the type of pipe to be utilized should be governed by the following factors:
    - Permanency of the facility
    - Static and impact loads which the pipe must sustain
    - Physical and chemical characteristics of soil
    - Physical and chemical characteristics of fluids
    - Availability of materials and the relative economics of construction of the installation
    - Initial cost versus maintenance cost of the system
  - b. All materials and installation methods shall conform with the Commonwealth of Massachusetts Department of Public Works <u>Standard</u> <u>Specifications for Highways and Bridges</u>.
- 2. Storm Drainage Pipe
  - Materials and structural requirements shall be detailed in Manual No. 37, <u>Design and Construction of Sanitary and Storm Sewers</u>, American Society of Civil Engineers.
  - b. Class shall be as required for strength.
  - c. Acceptable types of pipe are cast iron, reinforced concrete (both circular and elliptical), asbestos-coated corrugated metal. Where the base metal of the corrugated pipe is steel, it shall be galvanized.
- 3. Manholes, Basins, and Inlets
  - a. Provide manholes at maximum intervals of 300'-0" for drains 48" or smaller, and 600'-0" for drains 54" and larger. Minimum inside diameter shall be 4'-0". Minimum wall thickness shall be as required for depth of structure, but in no case less than 5".
  - b. Provide manholes at every junction, change in alignment, or change in grade of all drains.
  - c. All collection structures shall be self-cleaning and draining. Do not use cushions because of insect and odor problems.

Massachusetts Bay Transportation	Commuter	Stations and Parking	Section II
Authority RAILROAD OPERATIONS	Design Standards	Landscaping	Chapter 6
Revision No. 1 Date: 4/19/96	Manual		Page 6.12

- d. Each culvert or drain 15" or more in diameter shall be provided with a secured, but removable bar screen at the inlet and outlet structure to prevent children from crawling into the pipe. To reduce clogging of the inlet screen, use sloped vertical bars so that debris will ride up the bars during flow.
- e. All structures other than inlets shall be provided with steps meeting OSHA requirements. Minimum access opening shall be 22".
- f. Drainage inlets in curbed roadways shall be curb type inlets.
- g. Provide wing walls at inlets and outlets to improve flow. Energy dissipaters, flared ends, and erosion protection such as rip rap, gabion walls, or paved aprons should be utilized where flows can be expected to scour down-stream channels.
- h. All grates, covers, and lids shall be cast iron with no primer or coatings. All inlet grates located in roadways and walkways should be designed to avoid trapping bicycles.

#### C. PLANTING

- 1. The American Horticultural Society, in the report referenced earlier in this subsection, identifies five types of plant material and three areas of a station in which plantings might be used.
- 2. Plant Types
  - a. Large trees: deciduous trees which reach the most monumental proportions, are long lived, and are suitable for planting as space definers and shade producers.
  - b. Small trees: deciduous flowering trees which, at mature height and branching structure, are most likely to conflict with space required for pedestrians unless they are sited properly.
  - c. Evergreen trees: coniferous evergreen forest species with a large mature height.
  - d. Shrubs: deciduous or evergreen, broadleaf or coniferous, which are adaptable to local conditions and retain their form without pruning.
  - e. Ground cover: typical are the evergreen perennials with a dwarfed or prostrate condition and which are adaptable to local conditions.

Massachusetts Bay Transportation	Commuter Bail	Stations and Parking	Section II
Authority RAILROAD OPERATIONS	Design Standards	Landscaping	Chapter 6
Revision No. 1 Date: 4/19/96	Manual		Page 6.13

## Plant Material Usage

Description/Usage Mature height <sup>1</sup>		Large Trees	Small Trees	Evergreen Trees	Shrubs	Ground Covers
		75'- 0" or greater	25'- 35'	50'- 0"	20'- 0" <sup>2</sup>	24"
Mature spread <sup>1</sup>		50'- 0" or greater	20'- 35'	35'- 0"	15'- 0"	Up to 6'- 0"
Station Entry Zone	Minimum size at planting	4"- 5" caliper	3"- 3 1/12" caliper	NA	3'- 5' height 3'- 5' spread	2-year plants or 24" spread
	Minimum branch height	7'- 0"	4'- 6"	NA	NA	NA
General Circulation	Minimum size at planting	3"- 3 1/2" caliper	NA	NA	3'- 0" height 3'- 0" spread	2-year plants or 20" spread
	Minimum branch height	6 - 0"	NA	NA	NA	NA
Peripheral Areas	Minimum size at planting	3"- 3 1/2" caliper	2"- 2 1/2" caliper	3"- 3 1/2" caliper	3'- 0" height 3'- 0" spread	2-year plants or 20" spread
	Minimum branch height	5'- 0"	3'- 0"	NA	NA	NA
Minimum spac (massing and s	ing creening)	20'- 0" o.c. <sup>3</sup>	10'- 0" o.c.	10'- 0" o.c.	2 1/2'- 3' o.c.	12" o.c. or 24" o.c.
Minimum spacing (in circulation spaces)		25'- 0" o.c.	NA	NA	2 1/2'- 3' o.c.	12" o.c.
Maximum space (in circulation	cing spaces)	45'- 0" o.c.	NA	NA	5'- 0" o.c.	24" o.c.

1 Mature height and spread as listed in <u>Trees for American Gardens</u> and <u>Shrubs for American Gardens</u> by Donald Wyman. While it is understood that in urban conditions plants do not reach their normal mature heights and spread, the dimensions listed in this table shall be used in conjunction with the height and spread dimensions listed in Wyman's books for the purpose of specie selection.

2 5'- 0" in station entry zone.

3 On center.

Hassachusetts Bay Transportation	Commuter Bail	Stations and Parking	Section II
Authority RAILROAD OPERATIONS	Design Standards	Landscaping	Chapter 6
Revision No. 1 Date: 4/19/96	Manual		Page 6.14

- 3. Station Areas for Planting
  - a. Station entry zone: the area adjacent to primary access street, including the main vehicular and pedestrian access and drop-off area(s).
  - b. General circulation: all secondary pedestrian access routes, including plantings within parking areas and adjacent to platforms.
  - c. Peripheral Areas: areas not used by pedestrians or vehicles that either need general ground covers or that provide the opportunity to screen the station from the surrounding community.
- 4. The matrix on the preceding page identifies the preferred size and location of each type of planting in each station area.
- 5. Planting Requirements
  - a. Existing topsoil at each location should be examined to determine suitability for use in planting areas. Acceptable topsoil is defined as a friable loam, neither heavy in clay nor light in sand, containing a minimum of 3% organic matter and having an acidity range of (pH) 5.5 to 7.5. If the soil is found unsuitable, it shall either be improved to an acceptable state or removed from the planting area and replaced with a new soil meeting these criteria.
  - b. Soil of good fertility and friability shall be provided for the top 6" of lawn areas, the top 12" in shrub and perennial beds, and in a zone of 12" around the root balls of all trees, as illustrated on following pages.
  - c. Planting should be designed to survive without any supplemental irrigation after the first year.
  - d. Grasses may be either mowed or un-mowed. Mowed grasses used near circulation areas should be of a high quality perennial seed mix suitable to the locality and site conditions. Un-mowed grasses should be coarser grasses and may have non-grass flower species mixed in.
  - e. Sod may be used to establish grass areas where economics dictate or when it is desirable to use seed mixes not available as sod. When sod is applied on slopes greater than 4:1, use jute matting. All seeded areas should be mulched.

Massachusetts Bay Transportation Authority RAILROAD OPERATIONS	Commuter	Stations and Parking	Section II
	Design Standards	Landscaping	Chapter 6
Revision No. 1 Date: 4	Manual Manual		Page 6.15

- f. Broadleaf ground cover and bedding plants should be planted using 2" peat pots and spaced 12" to 18" apart in each direction. Coniferous ground covers should be containerized plants with a minimum of an 18" to 24" spread and planted between 2'-0" and 3'-0" apart. All beds for ground cover and bedding plants should be covered with 3" of bark mulch.
- g. Do not use plant material of a type, or in a location, where it will spread into the track area and foul the ballast and drainage. Chemicals that kill vegetation are often used along the track right-of-way to eliminate unwanted plant material.
- 6. Tree Grates

All tree grates shall be cast iron with no primers or coatings. They should be round or square, such as those illustrated on the following pages.

Massachusetts Bay Transportation	Commuter Bail	Stations and Parking	Section II
Authority RAILROAD OPERATIONS	Design Standards	Landscaping	Chapter 6
Revision No. 1 Date: 4/19/96	Manual		Page 6.16





Massachusetts Bay Transportation Authority RAILROAD OPERATIONS	Commuter Rail Design Standards	Stations and Parking	Section II	
		Landscaping	Chapter 6	
Revision No. 1	Date: 4/19/96	Manual		Page 6.17

### Typical Planting Detail Using Tree Grate



Massachusetts Bay Transportation	Commuter	Stations and Parking	Section II	
	OPERATIONS	Design Standards	Landscaping	Chapter 6
Revision No. 1	Date: 4/19/96	Manual		Page 6.18
Typical Tree Planting Detail in Area of Modular Paving, Such as Granite Block



	Massachusetts Bay Transportation		Commuter Bail	Stations and Parking	Section II
	Authority RAILROAD C	PERATIONS	Design Standards	Landscaping	Chapter 6
Revisi	on No. 1	Date: 4/19/96	Manual		Page 6.19

# Typical Tree Grates and Installation Detail



180° ROUND PREFERRED FOR CONCRETE, ASPHALT OR MODULAR PAVING WITHOUT A STRONG PATTERN



180° SQUARE PREFERRED FOR MODULAR PAVING WITH A STRONG RECTILINEAR PATTERN



Massachusette Bay Transportation	s	Commuter Bail	Stations and Parking	Section II
Authority RAILRO	AD OPERATIONS	Design Standards	Landscaping	Chapter 6
Revision No. 1	Date: 4/19/96	Manual		Page 6.21

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January 1, 1990

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illa l			- <b>.</b>		Eleva	tion in Inche	s (1-1/2 Und	rbalance) - C	Continued		·····			
7 I, 19	Dcgrce Of Curve	0	1/2	1	1-1/2	2	2-1/2	3	3-1/2	4	4-1/2	5	5-1/2	6
8		Speed in Miles per hour												
	4º-00'	23	27	30	33	35	38	40	42	44	46	48	50	52
	5°-00'	21	24	27	29	32	34	36	38	40	41	43	45	45
	6º-00'	19	23	25 24	28	29	31	33	35	36	39	39	43	44 42
	<u> </u>	18	21 20	<u>23</u> 23	26	28	<u> </u>	31 30	33	35 34	3635	3836	<u>39</u> 38	<u>41</u> 39
	7º-30' 8º-00'	17	20	22 21	24	26 25	28	29 28	31	32	34	35	37	38 37
	<u>8º-30'</u>	16	18	20	22	24	26	27	29	30	32	33	34	35
	9°-00' 9°-30'	15	18	20 19	22	24 23	25	27	28	30	31	32	33 32	35 34
1	10°-00'	15	17	19	21	22	24	25	27	28	29	30	31	33
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11

January 1, 1990

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			Class of	Track	5	6
Track Surface	3 10"	3"	2"	1-1/2"	1"	1/2"
The runoff in any 31 feet of track at the end of a raise may not be more than The deviation from uniform profile on either rail at the mid-ordinate of a 62-foot chord may not be more than Deviation from designated elevation on spirals may not be more than Variation in cross level on spirals in any 31 feet may not be more than Uniform deviation from zero cross level at any point on tangent or from designated elevation on curves between spirals may not be more than	3" 1-3/4" 2" 3" 3"	2-3/4" 1-1/2" 1-3/4" 2" 2"	2-1/4" 1-1/4" 1-1/4" 1-3/4" 1-3/4"	2" 1" 1" 1-1/4" 1-1/4"	1-1/4" 3/4" 3/4" 1" 1"	1/2" 1/2" 1/2" 1/2" 5/8"

§213.63 TRACK SURFACE The surface of track shall be maintained within the limits prescribed in the following table:

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### §213.11 RESTORATION OR RENEWAL OF TRACK UNDER TRAFFIC CONDITIONS.

If, during a period of restoration or renewal, track is under traffic conditions and does not meet all of the requirements prescribed in this part, the work on the track must be under the continuous supervision of a person designated under §213.7(a) who has at least one year of supervisory experience in railroad track maintenance. The term "continuous supervision" as used in this section means the physical presence of that person at a job site. However, since the work may be performed over a large area, it is not necessary that each phase of the work be done under the visual supervision of that person.

# §213.13 MEASURING TRACK NOT UNDER LOAD.

When track, not under load, is measured to determine compliance with the requirements of this part and rail movement under load is apparent, that apparent amount of rail movement must be added to the measurements taken.

# SUBPART B - ROADBED

### §213.31 SCOPE

This subpart prescribes minimum requirements for roadbed and areas immediately adjacent to roadbed.

### §213.33 DRAINAGE

Each drainage facility under or immediately adjacent to the roadbed must be kept sufficiently free of obstructions to accommodate expected water flow for the area concerned.

### §213.34 ROADBED ENCROACHMENTS

Any construction, or excavations or other activity on or about the roadbed which creates a condition not in conformance with the standard roadway section as shown on the standard plan must be protected by appropriate measures.

### §213.37 VEGETATION.

Vegetation on railroad property which is on or immediately adjacent to roadbed must be controlled so that it does not:

- Become a fire hazard to track-carrying structures;
- (b) Obstruct visibility of railroad signs and signals;
- Interfere with railroad employees performing normal trackside duties;
- (d) Prevent proper functioning of signal and communications lines;
- (e) Prevent railroad employees from visually inspecting moving equipment from their normal duty stations.

January 1, 1990

### SUBPART C-TRACK GEOMETRY

### §213.51 SCOPE.

This subpart prescribes requirements for the gage, alignment, and surface of track, and the elevation of outer rails and speed limits for curved track.

#### §213.53 GAGE.

- (a) Gage is measured between the heads of rails at right angles to the rails in a plane five-eighths of an inch (5/8") below the top of the rail head.
- (b) The gage of track must not be less than 4-ft 8in., on either tangents or curves, regardless of the class of track.
- (c) The gage of track must not be *more* than that prescribed in the following table:

Class of Track	Maximum Speed (mph) F-P	Tangent Track	Curved Track
1	10-15	4' 9-3/4"	4' 9-3/4"
2	25-30	4' 9-1/2"	4' 9-3/4"
3	40-60	4' 9-1/2"	4' 9-3/4"
4	60-80	4' 9-1/4"	4' 9-1/2"
5	70-100	4' 9"	4' 9-1/4"
6	70-100	4' 9"	4' 9"

#### §213.55 ALINEMENT.

Alinement may not deviate from uniformity more than the amount prescribed in the following table:

Class of Track	Maximum speed (mph) F-P	Tangent track: The deviation of the mid- offset from 62-ft. line <sup>1</sup> may not be more than	Curved track: The deviation of the mid- ordinate from 62-fL chord <sup>2</sup> may not be more than
1	10-15	5"	5"
2	25-30	3"	3"
3	40-60	1-3/4"	1-3/4"
4	60-80	1-1/2"	1-1/2"
5	70-90	3/4"	5/8"
6	70-100	1/2"	3/8"

<sup>1</sup> The ends of the line must be at points on the gage side of the line rail five-eighths of an inch (5/8") below the top of the rail head. Either rail may be used as the line rail, however, the same rail must be used for the full length of that tangential segment of track.

 $^2$  The ends of the chord must be at points on, the gage side of the outer rail, five-eighths of an inch (5/8") below the top of the rail head.

6

January 1, 1990

### §213.11 RESTORATION OR RENEWAL OF TRACK UNDER TRAFFIC CONDITIONS.

If, during a period of restoration or renewal, track is under traffic conditions and does not meet all of the requirements prescribed in this part, the work on the track must be under the continuous supervision of a person designated under §213.7(a) who has at least one year of supervisory experience in railroad track maintenance. The term "continuous supervision" as used in this section means the physical presence of that person at a job site. However, since the work may be performed over a large area, it is not necessary that each phase of the work be done under the visual supervision of that person.

# §213.13 MEASURING TRACK NOT UNDER LOAD.

When track, not under load, is measured to determine compliance with the requirements of this part and rail movement under load is apparent, that apparent amount of rail movement must be added to the measurements taken.

### **SUBPART B - ROADBED**

### §213.31 SCOPE

This subpart prescribes minimum requirements for roadbed and areas immediately adjacent to roadbed.

### §213.33 DRAINAGE

Each drainage facility under or immediately adjacent to the roadbed must be kept sufficiently free of obstructions to accommodate expected water flow for the area concerned.

### §213.34 ROADBED ENCROACHMENTS

Any construction, or excavations or other activity on or about the roadbed which creates a condition not in conformance with the standard roadway section as shown on the standard plan must be protected by appropriate measures.

### §213.37 VEGETATION.

Vegetation on railroad property which is on or immediately adjacent to roadbed must be controlled so that it does not:

- (a) Become a fire hazard to track-carrying structures;
- (b) Obstruct visibility of railroad signs and signals;
- (c) Interfere with railroad employees performing normal trackside duties;
- (d) Prevent proper functioning of signal and communications lines;
- (e) Prevent railroad employees from visually inspecting moving equipment from their normal duty stations.

January 1, 1990

## SUBPART C-TRACK GEOMETRY

### §213.51 SCOPE.

This subpart prescribes requirements for the gage, alignment, and surface of track, and the elevation of outer rails and speed limits for curved track.

### §213.53 GAGE.

- (a) Gage is measured between the heads of rails at right angles to the rails in a plane five-eighths of an inch (5/8") below the top of the rail head.
- (b) The gage of track must not be less than 4-ft. 8in., on either tangents or curves, regardless of the class of track.
- (c) The gage of track must not be *more* than that prescribed in the following table:

Class of Track	Maximum Speed (mph) F-P	Tangent Track	Curved Track
1	10-15	4' 9-3/4"	4' 9-3/4"
2	25-30	4' 9-1/2"	4' 9-3/4"
3	40-60	4' 9-1/2"	4' 9-3/4"
4	60-80	4' 9-1/4"	4' 9-1/2"
5	70-100	4' 9"	4' 9-1/4"
6	70-100	4' 9"	4' 9"

### §213.55 ALINEMENT.

Alinement may not deviate from uniformity more than the amount prescribed in the following table:

Class of Track	Maximum speed (mph) F-P	Tangent track: The deviation of the mid- offset from 62-ft. line <sup>1</sup> may not be more than	Curved track: The deviation of the mid- ordinate from 62-ft. chord <sup>2</sup> may not be more than
1	10-15	5"	5"
2	25-30	3"	3"
3	40-60	1-3/4"	1-3/4"
4	60-80	1-1/2"	1-1/2"
5	70-90	3/4"	5/8"
6	70-100	1/2"	3/8"

<sup>1</sup> The ends of the line must be at points on the gage side of the line rail five-eighths of an inch (5/8") below the top of the rail head. Either rail may be used as the line rail, however, the same rail must be used for the full length of that tangential segment of track.

 $^2$  The ends of the chord must be at points on, the gage side of the outer rail, five-eighths of an inch (5/8") below the top of the rail head.

6

January 1, 1990



# §213.57 CURVES; ELFVATION AND SPEED LIMITS.

- (a) The outer rail of a curve may not be lower than the inner rail, except as provided in §213.63 and through turnouts, crossovers and track crossings in elevated curved tracks when authorized by the Chief Engineering Officer.
- (b) Curves shall be surfaced to not more than six inches (6") elevation unless authorized by the Chief Engineering Officer.
- (c) The maximum allowable operating speed for each curve must not produce an underbalance in excess of one and one-half inches (1-1/2"), unless authorized by the Chief Engineering Officer.
- (d) Curves within station limits shall not have more than one inch elevation.
- (e) The following table gives maximum allowable speeds for passenger and freight trains for various degrees of curvature and various amounts of elevation. The speeds shown in this table are based on the operation of trains at one and one-half inches (1-1/2") of underbalance and must not be exceeded unless authorized by the Chief Engineering Officer.

### §213.59 ELEVATION OF CURVED TRACK; RUNOFF.

- (a) If a curve or segment of a compound curve is elevated, the full elevation must be provided between points of full curvature, throughout the curve unless physical conditions do not permit. If the elevation does not extend throughout the curve or segment of a compound curve, the minimum elevation must be used in determining the maximum allowable operating speed.
- (b) Elevation runoff must be at a uniform rate, within the limits of track surface deviation prescribed in §213.63, and it must extend at least the full length of the spiral. If physical conditions do not permit a spiral long enough to accommodate the minimum length of runoff, a maximum of one (1) inch elevation may be run off on tangent track.

### §213.61 CURVE DATA FOR CLASS 2 THROUGH 6 TRACK

A record shall be maintained at each curve in classes 2 through 6 track. The record must contain the following information:

- (a) Location; TS, SC, CS, ST
- (b) Degree of curvature;
- (c) Designated elevation;
- (d) Designated length of elevation runoff; and

(e) Maximum allowable operating speed. January 1, 1990

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		9	Τ	T				110	103	93	85	78	73	69	65	59	57	55	53
		5-1/2						109	100	89	82	76.	11	67	63	58	55	53	52
		S						105	96	86	79	73	68	64	61	56	53	51	50
		4-1/2					110	101	93	83	76	70	65	62	59	53	51	49	48
		4					108	97	89	79	72	67	63	59	56	51	49	47	46
on Curves	·	3-1/2					103	93	85	76	69	64	60	56	53	49	47	45	44
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Ule Operati Inches (1-1/2		2-1/2	ed in Miles p			106	93	83	76	68	62	57	53	50	48	44	42	40	39
Im Allowal Elevation in		7	Spe			100	87	77	11	63	58	53	50	47	45	41	39	38	37
Maximu		1-1/2			110	93	80	72	65	59	53	49	46	44	42	38	36	35	34
		-			103	85	73	65	60	33	49	45	42	40	38	35	33	32	31
		1/2			93	76	65	59	53	48	44	40	38	36	34	31	30	29	28
		0		110	80	65	57	51	46	41	38	35	33	31	29	27	56	ร	24
	Decree	jo	Curve	0°-10'	0°-20'	0°-30'	0°-40'	0°-50'	1ª-00'	1º-15'	1°-30'	1º-45'	2 <sup>°-00'</sup>	2°-15'	2°-30'	3ª-00'	3°-15'	3°-30'	3ª-45'

8

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January 1, 1990