TRANSIT

RAPID TRANSIT SYSTEM EXTENSIONS
COMPENDIUM OF DESIGN CRITERIA

VOLUME II
STATION DESIGN CRITERIA

CHAPTER 3
STRUCTURAL DESIGN CRITERIA

INTERIM RELEASE
REV 1

OCTOBER 30, 2008

PROGRAM MANAGEMENT CONSULTANT

– Intentionally Left Blank –

MIAMI-DADE COUNTY TRANSIT

VOLUME II – STATION

CHAPTER 3 – STRUCTURAL DESIGN CRITERIA

REVISION 1

Program Management Consultant

Submitted _____ Date 4/16/2009
Project Manager, Soji Tinubu

Miami-Dade Transit
Engineering Review Board Members

Approval _____ Date 4-16-09
Chief of Design & Engineering, Isabel Padrón

_____ Date 4/16/09
FOR Chief of Construction, Ron Steiner

_____ Date 4.16.09
Chief of Safety, Eric Muntan

_____ Date 4/16/09
Manager of Systems Engineering, Daniel Mondesir

Director Approval

Approval _____ Date 4/20/09
Deputy Director, Albert A. Hernandez

Approval _____ Date 06/01/09
MDT Director, Harpal Kapoor

– Intentionally Left Blank –

DOCUMENT REVISION RECORD

ISSUE NO.	DATE	REVISION DESCRIPTIONS
0	4-19-07	Interim Release
1	10-30-08	Revisions to incorporate MIC-EH design specifications that have been adopted by MDT.

ISSUE NO.	SECTIONS CHANGED
1	No changes were made to this chapter in this revision.

– Intentionally Left Blank –

VOLUME II - STATION

CHAPTER 3 - STRUCTURAL DESIGN CRITERIA

REVISION 1

TABLE OF CONTENTS PAGE NO.

3.1 GENERAL

3.1.1 PURPOSE OF THE STRUCTURAL DESIGN CRITERIA

Station structures, vehicular bridges, pedestrian bridges, all other structures (except guideways) and their components shall be designed to meet the geometric, functional, aesthetic and structural requirements of these criteria. The criteria presented herein are minimum requirements not intended to supplant the exercise of engineering judgment by the Engineer of Record.

3.1.2 SCOPE OF THE STRUCTURAL DESIGN CRITERIA

These criteria are intended for the design of station structures, vehicular bridges, pedestrian bridges and all other structures (except guideways) not directly subjected to transit vehicular loading. Refer to Volume 3, Chapter 3, Structural Design Criteria for Aerial Guideway for criteria of aerial station structures subjected to train loading.

These criteria apply to all new construction occurring in 2006 and beyond.

3.1.3 APPLICABLE CODES AND REGULATIONS

The current version of codes, standards and regulations shall apply, and unless otherwise directed, all addenda, interim supplements, revisions and ordinances by the respective code body shall also apply. Where conflicts exist between these requirements, and unless otherwise directed by MDT, the more stringent requirement shall take precedence.

3.1.3.1 Station/Building Structures:

- Florida Building Code
- ASCE (American Society of Civil Engineers) Standard 7, Minimum Design Loads for Buildings and Other Structures

- ACI (American Concrete Institute), Building Code Requirements for Structural Concrete
- AISC (American Institute of Steel Construction), Steel Construction Manual
- AISC Code of Standard Practice for Steel Buildings and Bridges
- AISI (American Iron and Steel Institute), Cold-Formed Steel Design Manual
- Aluminum Association, Aluminum Design Manual

3.1.3.2 Pedestrian Bridges

- Publications, manuals, specifications and other documents listed for Station/Building Structures in Section 3.1.3.1
- AASHTO (American Association of State Highway and Transportation Officials) Guide Specifications for Design of Pedestrian Bridges

3.1.3.3 Highway Bridges

- AASHTO (American Association of State Highway and Transportation Officials) LRFD Bridge Design Specifications for Customary U.S. Units
- FDOT (Florida Department of Transportation) Structures Design Guidelines
- FDOT Plans Preparation Manual

3.1.4 FOUNDATION CRITERIA

Foundation criteria will be established at each site by the Engineer of Record's Geotechnical Specialty Engineer. Soil Boring and testing program shall be submitted to MDT for acceptance.

3.2 LOADS AND FORCES

Sustained, transient and construction loads shall be considered in the design of the structural components and connections. The loads and combinations of forces shall be in accordance with the referenced codes and regulations provided in Section 3.1.3, except as modified herein.

3.2.1 DEAD LOADS

The dead loads consist of the actual weight of the structure, including the weight of the material and equipment permanently fastened thereto or supported thereby including walls, floors, partitions, roofs, electrification, utilities and all other permanent construction fixtures. In the absence of definite information, presumptive values and the method for their determination shall be submitted to MDT for acceptance. A specific check should be made as to the actual weight where a variation might affect the adequacy of the design.

In the absence of more precise information, the unit weights specified for plain South Florida Oolitic Concrete shall be taken as 0.138 kips per cubic foot.

3.2.2 LIVE LOADS

Live load shall consist of any nonpermanent loads including the weight of machinery, equipment, stored materials, persons, elevators, escalators or other moving objects, construction loads, and loads due to maintenance operations. Live loads and combinations of forces shall be in accordance with the referenced codes and regulations provided in Section 3.1.3, except as modified herein.

3.2.2.1 Roof Live Load

Roof areas of canopies, ancillary facilities and other buildings shall be designed for a minimum uniform load of 30 pounds per square foot (psf).

3.2.2.2 Garage Live Load

All parking garage levels shall be designed for a minimum uniform load of 50 psf.

3.2.2.3 Station Platform Live Load

The station platforms shall be designed for a minimum uniform passenger live load of 100 psf, and a concentrated maintenance load of 3000 pounds applied to the platform on a 2'-8" by 6'-1" wheelbase located so as to produce a maximum stress condition. The 100psf live load shall not be applied within the wheelbase area when considering the maintenance load.

3.2.2.4 Stairways

Stairways shall be designed for a minimum uniform load of 100 psf.

3.2.2.5 Aerial Walkways and Pedestrian Bridges

Aerial walkways and pedestrian bridges shall be designed for a minimum uniform load of 100 psf. Where aerial walkways and pedestrian bridges are accessible to MDT maintenance vehicles, design shall incorporate the vehicle loading provisions of the AASHTO Guide Specifications for Design of Pedestrian Bridges.

3.2.2.6 Slabs on Grade

Slabs on grade, shall be designed for a minimum uniform load of 150 psf unless otherwise designated herein.

3.2.2.7 Other Floor Loads

A minimum uniform load of 300 psf shall be used in the design of the floor slab in the Electrical Equipment Room of the stations and in the transformer and circuit breaker areas of the Traction Power Substation and Gap Tie Buildings.

3.2.2.8 Railings

Railings, when used in station platforms and mezzanines shall be designed to resist a load of 100 pounds per lineal foot applied in any direction at the top of such barriers. Railings in other places of public assembly shall be designed in accordance with the Florida Building Code.

3.2.2.9 Gratings

Gratings in streets, sidewalks and in areas accessible to out-of-control vehicles shall be designed to carry vehicular live load in accordance with the AASHTO LRFD Bridge Design Specifications. Gratings protected from vehicular traffic shall be designed for a uniform load of 250 psf.

3.2.2.10 Curbs

A horizontal force of 500 plf shall be applied at the top of curbs of permanent structures.

3.2.3 REDUCTION IN LIVE LOAD

No reduction in the design live load shall be made for station platforms, elevated concourses and their supporting columns.

3.2.4 WIND LOAD ON STRUCTURE

For all wind loading on stations and other building structures, the requirements of the Florida Building Code and the referenced ASCE 7 shall

apply. In addition to the above requirements, the following parameters shall be incorporated into the design:

- The Basic Wind Speed (V) shall be taken as the 100-year recurrence wind speed of 150 miles per hour.
- Wind Importance Factor (I) shall be taken as 1.15.

3.2.5 SELF STRAINING FORCES

Provisions shall be made for self straining forces resulting from movements, such as differential settlements, temperature variations, concrete shrinkage/expansion and creep. Estimation of these movements shall be based on realistic assessments of these effects occurring in service.

The following minimum temperature ranges shall be considered in the design:

- Concrete

  Temperature Rise 35°F.

  Temperature Fall 35°F.
- Steel

  Temperature Rise 40°F.

  Temperature Fall 40°F.

3.2.6 EARTH PRESSURE

Structures which retain earth shall be designed for side pressure due to earth abutting the structure and load surcharges resting on top of the abutting earth. Soil properties and earth pressures for design shall be developed by the Engineer of Record's Geotechnical Specialty Engineer.

The effects of buoyancy and hydrostatic pressures shall be considered where applicable.

3.2.7 LOAD COMBINATIONS

Combinations of loading shall be according to the referenced codes and regulations provided in Section 3.1.3, except as modified herein.

Passenger loading at the platform level shall not be considered when wind velocity exceeds 60 mph. The following load combinations shall be added to include behavior under operational wind, using an operational wind velocity (W_{op}) of 60 mph:

- Combining Factored Loads Under Strength Design
  $1.2(D + F + T) + 1.2L + 1.6(H + W_{op}) + 0.5(L_r \text{ or } R)$

- Combining Nominal Loads Using Allowable Stress Design
  $D + H + F + 0.75(L + T) + W_{op} + 0.75(L_r \text{ or } R)$
  In which:
  D = Dead Load
  F = Load due to Fluids with Well-Defined Pressures and Maximum Heights
  H = Load due to Lateral Earth Pressure, Ground Water Pressure, or Pressure of Bulk Materials
  L = Live Load
  L_r = Roof Live Load
  R = Rain Load
  T = Self-Straining Force
  W_{op} = Operational Wind Load

– Intentionally Left Blank –

3.3 CONCRETE DESIGN

Concrete Members shall be designed in accordance with the requirements of ACI Building Code Requirements for Structural Concrete, as modified herein.

3.3.1 MODULUS OF ELASTICITY

The modulus of elasticity, E_c, for concrete shall be computed in accordance with Equation 3.3.1-1.

$$E_c = K_1\ 33\ w_c^{1.5}\sqrt{f'_c} \qquad psi \qquad \text{(Eq. 3.3.1-1)}$$

in which:

K_1 = correction factor taken as 1.00 for normal weight concrete and 0.90 for concrete using Oolitic limestone aggregates.

w_c = unit weight of plain concrete (psf)

$f'c$ = specified concrete compressive strength (psi)

3.3.2 CONCRETE PROTECTION FOR REINFORCEMENT

Concrete cover shall comply with Section 7.7 of the ACI Code except as provided hereinafter. The specified concrete cover shall be adhered to unless anti-corrosion protection is provided by galvanizing or other treatment approved by MDT. Use of epoxy coated reinforcement is not acceptable, unless specifically approved by MDT on a case-by-case basis.

The specified concrete cover shall be increased by one inch for columns and footings in direct contact with soil or water with chloride content equal to or greater than 2000 ppm.

3.3.3 ALLOWABLE STRESSES FOR PRESTRESSED MEMBERS

Prestressed concrete members shall be designed under the stress limits for Class U members as defined by ACI 318 Section 18.3.3.

3.4 STEEL DESIGN

The latest provisions of the AISC Specification shall apply.

– Intentionally Left Blank –

3.5 FOUNDATIONS

3.5.1 SPREAD FOUNDATIONS

The design of spread foundations shall keep the maximum edge and average soil pressures within the allowable bearing values specified by the Engineer of Record's Geotechnical Specialty Engineer.

There shall be no increase in the allowable bearing pressure for any load combination.

3.5.2 DEEP FOUNDATIONS

Driven Pile, Drilled Shaft and Augercast Pile foundations shall be designed so that the load on any pile does not exceed its allowable load specified by the Engineer of Record's Geotechnical Specialty Engineer.

There shall be no increase in the allowable pile load for any load combination.

3.5.3 PROTECTION OF EXISTING STRUCTURES

Designs shall consider when foundation construction operations will be in close proximity to any existing structure (both MDT and others), so that all reasonable precautions will be taken in order to prevent damage to such structures.

– Intentionally Left Blank –

3.6 CORROSION

Refer to Volume III Guideway Design Criteria Chapter 4 Electrical, for additional requirements for Corrosion Control.

3.6.1 METAL STRUCTURES

All exposed metal structures shall be protected from corrosion. Protection will be achieved by proper material selection or suitable coatings.

3.6.2 CONCRETE STRUCTURES

Concrete mix designs shall be proportioned to maximize the durability of the structure. The following guidelines are provided for proportioning concrete mix designs when chloride content of soil or water in direct contact with concrete surfaces is equal to or greater than 500 ppm:

- 500 ppm $\leq$ Chloride Content < 2000 ppm:
  Consider use of fly ash, slag, silica fume, and/or special cement type to reduce permeability
- Chloride Content $\geq$ 2000 ppm:
  Consider use of calcium nitrite and silica fume admixtures

3.6.3 DEEP FOUNDATIONS

Consider cathodic protection or bonding only when the pile or shaft is in the vicinity of existing utilities cathodic protection. Concrete piles in these areas may require bonding if tests indicate the potential for detrimental stray current effects.

– Intentionally Left Blank –

3.7 STRUCTURAL PERFORMANCE

The maximum live load deflection (in space) at the edge of the station platform shall be limited to ¼ inch under 100 psf live load.

– Intentionally Left Blank –