



Document Change Announcement

2007 Design Manual

DCA2010-DM-23

DATE December 8, 2010

Subject: Revision to Subsection 2.3.2 of the Design Manual

Description of Change

To identify and update considerations and requirements for design of alternate retaining walls, prefabricated modular walls and mechanically stabilized embankment walls for NJTA projects.

Instructions to Designers and Consultants

Effective immediately, the revisions contained in this announcement shall be applied to all projects in every phase of design. For advertised contracts awaiting the opening bids, this revision shall be incorporated via addendum, if applicable. Contact your NJTA Project Manager for instructions. Attached revision is noted in italics.

Designers may access these revisions in the NJTA Design Manual, which is available on the Authority's Web Page: <http://www.state.nj.us/turnpike/nj-buss.htm>.

Information for In-House Staff

The revisions have been incorporated into the Design Manual, which is available on the S drive @ S:\Project Files\Design-Procedure Manual. Please distribute the information to your respective Project Managers and have them direct their consultants appropriately.

Recommended By:

Handwritten signature of Robert J. Fischer in black ink.

Robert J. Fischer, P.E.
Assistant Chief Engineer, Design

Approved By:

Handwritten signature of Richard J. Raczynski in black ink, dated 12/9/10.

Richard J. Raczynski, P.E.
Chief Engineer

New Jersey Turnpike Authority

DOCUMENT UPDATE REQUEST

Forward to Assistant Chief Engineer, Design

Initiator	Richard Schaefer	Submittal Date	1 Dec 2010
Firm	HNTB Corporation	Telephone	973-237-1650

Document (check one)

- Procedures Manual
- Design Manual
- Sample Plans
- Standard Drawings
- Standard Specifications

Description of Change

SUBSECTION 2.3 RETAINING WALLS

Delete Paragraph 2.3.2, Alternate/Proprietary Retaining Walls, and replace with the following:

1. *Engineers shall consider the use of proprietary retaining wall systems at all retaining wall locations. Proprietary retaining wall systems, Mechanically Stabilized Earth (MSE) Walls and Prefabricated Modular (PM) Walls, are generally more cost effective and provide a shorter construction time than conventional cast-in-place reinforced concrete cantilever retaining wall systems. Allowing contractors to bid on and construct alternative proprietary retaining wall systems also encourages competitive bidding and should result in additional cost savings.*
2. *The Supplementary Specifications to the current New Jersey Turnpike Authority Standard Specifications provide a list of Prefabricated Modular and Mechanically Stabilized Embankment wall systems and design and construction criteria that shall be used as guidance when developing the project specific specifications.*
3. *The Engineer shall compare retaining wall types and listed systems to determine which wall configurations best meet project objectives, i.e., structure cost, functionality, construction time, aesthetics, durability, and other project specific parameters. Analysis and recommendations should be included in the Bridge Type Study and Structural Foundation Geotechnical Engineering Report.*
4. *Engineers shall consult with wall system manufacturers/suppliers/vendors during the design process to discuss project specific design requirements and details to ensure there will be no conflicts during the construction phase, and to verify the applicability of the wall system to specific sites and the project. The Engineer shall list the applicable wall systems in the contract specifications. Only those wall systems participating in the design consultation shall be listed in the contract specifications.*
5. *Alternate retaining walls will be generically presented in the contract documents using the Common Structure Volume (CSV) concept. The CSV is the volume into which all potential*

wall systems can be placed. All work items required to construct the wall and all appurtenances, ancillary items and all work to complete the project located within the CSV are not measured but are included in the pay item for the retaining wall. The CSV concept allows the quantification of pay items outside the CSV, such as excavations, embankments, etc., such that those quantities will not vary due to the proprietary wall system selection. Alternate walls are defined as walls, often proprietary, such as Mechanically Stabilized Earth Walls (MSE) and Prefabricated Modular Walls (PM), other than conventional walls (cantilever, gravity, piling and crib walls), deemed appropriate for construction at a given site and bid competitively.

6. MSE Wall Design Guidelines

- a. Except as modified by the Supplementary Specifications to the current New Jersey Turnpike Authority Standard Specifications and the 2007 New Jersey Turnpike Authority Design Manual, Section 2, through Current Updates designs of MSE and Prefabricated Modular Wall retaining wall systems shall conform to the following:

DESIGN SPECIFICATIONS

AASHTO LRFD Bridge Design Specifications, Current Edition with Interims through Current Editions

AASHTO LRFD Bridge Construction Specifications, Current Edition with Interims through Current Editions

2002 AASHTO Standard Specifications for Highway Bridges, 17th Edition and as Modified by the 2007 New Jersey Turnpike Authority Design Manual, Section 2, through Current Updates, for Modifications Appropriate to Load Factor Design (LFD).

DESIGN METHOD

Load and Resistance Factor Design (LRFD): Proprietary Wall

Load Factor Design (LFD): Internal Strength and Stability for Barrier Parapet and Moment Slab System

Allowable Stress Design (ASD): External Stability for Moment Slab

IMPACT LOAD

Load Factor Design (LFD) and Allowable Stress Design (ASD): Vehicular Impact Load applied to the Barrier Parapet and the Moment Slab System shall be as per AASHTO Standard Specification, Section 2.7.1.3.

Load and Resistance Factor Design (LRFD): Vehicular Impact Load applied to MSE walls shall be as per 2007 AASHTO LRFD Bridge Design Specifications, Section 11.10.10.1

The impact requirements of AASHTO LRFD Section 3.6.5. are waived for MSE or PM abutment walls which envelop pile supported abutment seat beams.

- b. Design Engineers will be responsible for developing preliminary design and contract documents for MSE Walls to include, but not limited to:

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- *Establish Project Requirements – including all geometry, loading conditions (permanent, transient, seismic, etc.), performance criteria, and construction constraints.*
 - *Establish Project Parameters – evaluate existing topography, site subsurface conditions, geotechnical report, reinforced wall fill properties, and retained backfill properties.*
 - *Estimate Wall Embedment Depth, Design Height(s), and Soil Reinforcement Length(s)*
 - *Define nominal loads*
 - *Summarize Load Combinations, Load Factors, and Resistance Factors*
 - *Evaluate External Stability for strength limit state and extreme events*
 - *Evaluate sliding*
 - *Evaluate eccentricity*
 - *Evaluate bearing on foundation soil*
 - *Settlement analysis (at service limit state)*
 - *Assess Overall Global Stability*
 - *Static loading conditions*
 - *Seismic loading conditions*
 - *Sudden drawdown conditions*
 - *Assess Compound Stability*
 - *Design Wall Drainage Systems. – Coordinate with vendor*
 - *Subsurface drainage*
 - *Surface drainage*
 - *Develop the Common Structure Volume for each wall in the Contract.*
 - *Provide design information in contract documents*
 - *Strength limit state factored and nominal bearing resistances*
 - *Seismic nominal resistance*
 - *Bottom of footing elevations*
 - *Design parameters: density, friction angle, cohesion*
 - *External loads: lateral loads from MSE abutments, impact loads*
- c. *Contractors, material suppliers and/or wall vendors will be responsible for developing the final design for MSE Walls to include but not limited to the following:*
- *Evaluate Internal Stability for Strength limit state and extreme event, and Confirm External Stability*
 - *Select type of soil reinforcement*
 - *Define critical failure surface (for selected soil reinforcement type)*
 - *Define unfactored loads*
 - *Establish vertical layout of soil reinforcements*
 - *Calculate factored horizontal stress and maximum tension at each reinforcement level*
 - *Calculate nominal and factored long-term tensile resistance of soil reinforcements*
 - *Select grade (strength) of soil reinforcement and/or number of soil reinforcement elements at each level*
 - *Calculate nominal and factored pullout resistance of soil reinforcements, and check established layout*
 - *Check connection resistance requirements at facing*
 - *Estimate lateral wall movements (at service limit state)*
 - *Check vertical movement and compression pads*
 - *Design of Facing Elements*

- *Confirm Overall Global Stability*
- *Confirm Compound Stability*
- *Confirm Wall Drainage Systems – working drawings*
 - *Subsurface drainage*
 - *Surface drainage*

- *Where design parameters are modified by the contractor, material supplier and/or vendor, they shall also evaluate the external stability for revised wall configurations.*

d. *The following guidance shall also be followed:*

See Sections 432 and 433 of the Supplementary Specifications for additional guidance.

The NJTA Sample Plans and Exhibits 2-500 Series of this Manual shall be referred to for guidance in providing for proprietary wall details and presentations.

Use of on-site materials for select backfill shall be considered. Geotechnical site investigation shall include sampling and testing of potential borrow sites for select backfill – see NJTA Procedures Manual.

Where foundation conditions indicate consideration of two stage wall construction, the Engineer shall evaluate, in consultation with wall vendors, one stage wall construction with ground improvement techniques versus a two stage wall regarding differential settlement, post construction settlement, construction duration, rideability, life cycle costs, etc.

Use of MSE wall systems that include geosynthetic reinforcements (polymeric reinforcement), also defined as extensible, is not permitted.

For MSE wall systems that are located adjacent to roadways that may be chemically deiced, a high density polyethylene geo-membrane shall be placed below the pavement and just above the first row of reinforcements to intercept any flows that may contain the deicing chemicals. The membrane shall be sloped to drain away from the wall facing. Reference is made to NJTA Supplementary Specifications for type of material to be used.

Where MSE walls are constructed “back to back”, such as on ramps and bridge approaches, the configuration of the drainage and impervious membrane systems shall be designed to prevent chemically aggressive runoff from penetrating select backfills, porous fills and any fill retained between the wall systems. Underdrain piping shall be provided to direct the runoff beyond the limits of the wall systems.

Where MSE walls will be constructed in or adjacent to open water that may be salt, tidal or potentially brackish, the water must be tested for pH, chlorides, sulfates and other aggressive chemicals. Where tests show aggressive materials, extraordinary provisions to provide 75 year service life may be required. Consultant shall provide the test results in the Supplemental Specifications for the Contractor's use in design of the soil reinforcement. In chemically aggressive environments the use of stainless steel soil reinforcements may be considered. The wall system supplier shall make appropriate recommendations and designs to include provisions for the required 75 or 100 year service life.

In the design of Prefabricated Modular Walls, when the wall is to be constructed in fills or cuts above the water table, one weep hole and a 2' x 2' stone pocket shall be provided behind the front face of each of the lowest exposed units. If necessary, the weep hole may be replaced with a 8 inch perforated corrugated metal pipe and a 2' x 2' stone pocket.

For MSE Walls and Prefabricated Modular Walls constructed in cuts below the water table, an 8-inch P.C.M.P. and 2' x 2' stone pocket shall be placed parallel to and behind the wall. The area above the stone pocket behind the wall shall be backfilled with porous fill.

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