Construction Quality Assurance for MSE Walls

By Alex Abraham, P.E.
Typical section & components of MSE structures
Supplier Design

- Formal Policy
- System Approval
- Design Manual, Details
- Specifications
- Bid Documents
- Supplier Design
- Review

Bid ➔ Design ➔ Build
Inspector’s Responsibility

To be thoroughly familiar with

- Plans and Specifications
- Site Conditions
- Construction Materials
- Construction Sequence
Inspector’s Tools

- Design Drawings
- Shop Drawings
- Specs
- Health and Safety Requirements
- Field testing equipment
- Trained Staff
- CQA Plan
- Inspector’s Handbook
Foundation Preparation
Leveling Pads
Facing Panels

Plant Certification
Liner Fabrication Drawings
Test Panels for Liner and Stain
Panel Storage

Protect Connection Device
Protect Panel Face
Protect Damage to Panels - Cracks, Chipped Corners
Precast Concrete Panels

Certifications
Inspect before the panel is placed on the wall.
Place the correct panel at the right location.
Facing Assembly

Plumb, vertical tolerance, and horizontal alignment tolerance = ¾” over 10’
Allowable offset in panel joint = ¾”
The overall plumb from top to bottom = 0.05 in./ft.
Provide Fall Protection as Required
Filter Fabric

Specifications for filter cloth
Placement
Specifications for filter cloth
Exposure to direct sunlight
Placement
Precast Concrete Panels
Strips Stockpiled on site
Reinforcing – Type, Length, Spacing
Connections
Offset Reinforcements Using Strongbacks at Large Obstructions

- Strongback bolted to adjacent panels
- Reinforcements bolted to strongback
Parallel Pipes

PIPE SIZE VARIES

150 mm (6") MIN.

150 mm (6") MIN.

15° MAX, BEND

140 mm (5 1/2")

TIE STRIP

REINFORCING STRIP

FRONT FACE OF WALL PANEL
Parallel Pipes
Reinforcement Strip Skew

SKEW REINFORCING STRIPS
TO AVOID OBSTRUCTION

15° MAX. (SEE NOTE 7, SHT. 10)

150 (6")
MIN. (TYP.)

OBSTRUCTION (SEE NOTE)
Accommodating Deep Foundations
Existing Drainage Structures
Drainage Penetrations
Select Granular Fill
Structure Backfill, Type 3 (excludes No. 30)

- Approved Source
- Approved Testing Lab
- Laboratory Testing:
  - Gradation
  - Unit Weight (Compaction Control)
  - Friction Angle
  - Organic Content
  - Permeability
  - Resistivity and pH
Compact Backfill (only walk-behind compactor close to wall)
Select Granular Fill
Structure Backfill, Type 3 (excludes No. 30)

- **Field Testing for No. 4 size:**
  - Criteria – 95%
  - Tests Defined - Section 203.24(b) - Nuclear Density, Sand Cone and One Point Proctor
  - Moisture Content
Select Granular Fill
Structure Backfill, Type 3 (excludes No. 30)

• Field Testing for all sizes other than No. 4 size:
  • No density tests
  • 4 passes with a vibratory roller and 1 pass with the same roller in the static mode.
B-Borrow
(Triangular Wedge of Fill Behind Select Fill)

- **Source approved by tests**
- **Testing:**
  - Gradation (no more than 10% passing No. 200 sieve)
  - Suitably graded
  - Frequency of testing (1 per 2,000 t or two per contract)
Fill in front of the wall

- Backfilled as soon as practically possible
- A strong rainstorm could cause heavy flow along the wall. This could cause soil erosion and undermining of the leveling pad and wall.
Drainage

Section 718.03 for underdrains
Location as per plans
Walls subject to Flooding

Select Backfill - limited to No. 8 stone
Ancillary Items

- **Barriers**
  - Cast-in-place barrier
  - Guard rail

- **Coping**
  - Precast coping
  - Cast-in-place coping

- **Abutments**
Precast Concrete Panels
Cast-in-Place Coping

13 mm x 13 mm
(1/2" x 1/2")
CHAMFER

240 mm
(9 1/2" MIN.)

#4 AT DOWEL LOCATION

2 - #4 FOLLOW SLOPE LINE

#4 PARALLEL W/ TOP OF PANEL

610 mm (2'-0")
(VARIES)

300 mm (12")

50 mm (2") CLR.

50 mm (2") Min.
330 mm (13") Max.

#4 FOLLOW SLOPE LINE

100 mm
(4"") MIN.

3 - #4 DOWELS
610 mm (2'-0") LONG
EMBEDDED 300 mm (1'-0")
IN PANEL (SEE PARTIAL ELEVATION)

FRONT FACE
OF WALL PANEL
AND HORIZ.
CONTROL LINE
Precast Coping

LEVEL-UP CONCRETE AS REQUIRED

CONTRACTOR TO FILL ANCHOR RECESS WITH NON-SHRINK GROUT AFTER PLACEMENT OF COPING

3-#4 610 mm (2'-0"") LONG DOWELS PER PANEL. CONTRACTOR TO TRIM DOWELS WHERE REQUIRED TO CLEAR TOP OF LEVEL-UP CONCRETE FILL

FRONT FACE OF WALL PANEL AND HORIZ. CONTROL LINE

400 mm (1'-4"")

200 mm 200 mm

(8") (8")

40 mm (1 1/2") CLR.

610 mm (2'-0")

380 mm (1'-3")

50 mm 2" MIN.

130 mm (5") MIN.
Skew Top Level of Reinforcements To Clear Guide Rail Post Locations
Guard rails
Interface at CIP

Geotextile fabric, class 2, type A 150 (6") min. ea. surface

Ø soil stabilizing element connections

Front face of prefabricated retaining wall

20 (3/4") joint

20 (3/4") exp. joint material

C.I.P. wall

16 (#5)

#16 @ 300 (#5 @ 12")

6 (1/4") exp. joint mat'l.

125 (5")

6 (1/4") joint

100 (4")

40 (11/2") CLR.
Interface at CIP
Slip Joint

GEOTEXTILE

REINFORCING STRIP

CL OF SLIP JOINT COVER

100 mm (4”) MIN.

50 mm (2”) MIN.

560 mm (1”-10”) MIN.

140 mm (5 1/2”) MIN.

FRONT FACE OF WALL
Construction Phasing
Acute Corners
Acute Corners
MSE WALL ASSETS
SUPPORT OTHER ASSETS

- Highways, ramps, embankments
- Bridge abutments
- Traffic barriers, noise barriers, lighting, signs, signals
- Drainage pipes, culverts (penetrations)
- Planters & plantings

We know how to manage these assets
When Should We Evaluate Retaining Wall Assets?

- During construction (QA/QC)
- Periodic (routine) performance inspections
- Extreme events (seismic, flood, impact)
- Before widening, load changes, rehabilitation
- As part of plan to extend useful life – as part of asset management
Core Questions About MSE Walls

What is the current state of my MSE walls?

- What do I own?
- Where is it?
- What condition is it in?
- What is its remaining useful life?
- What is its remaining economic value?
More Core Questions

- Which assets critical for sustained performance?
  - How do they fail?
  - How can they fail?
  - What is the likelihood of failure?
  - What will it cost to repair?
  - What are the consequences of failure?
Core Questions - Paraphrased

What are my best investment strategies for "Moving Indiana into a Prosperous New World"?