Interim Revision to Bridge Standard Drawing(s)  |  Precast Concrete Substructure Standards, PennDOT Drawing 12-603-BDTD, March 18, 2013 (New Product No. 56), Sheets AS-1 thru AS-5, incorrect Bridge Approach Slab thicknesses in multiple details replaced with a note.

BACKGROUND: A designer has pointed out an inconsistency in the approach slab thicknesses shown on the “Approach Slab” drawing sheets. BDTD contacted the original developer of this standard to confirm what had been the intent regarding the thickness of the bridge approach slab.

Shts. AS-1 & AS-2 - SECTION D-D (OPTIONS 1 & 2), B-B, E-E & F-F: replaced approach slab thickness of 13” with “SEE NOTE 1” or “SEE NOTE 2” and added the statement shown below as a note on the right hand side of the sheets.

Shts. AS-3 & AS-4 – SECTIONS A-A: replaced approach slab thickness of 1’-3” with “SEE NOTE 5” and added the statement shown below as a note on the right hand side of the sheets.

Sht. AS-5 - SECTION A-A & TYPICAL TRANSVERSE SECTION: replaced approach slab thickness of 13” with “SEE NOTE 1” and added the statement shown below as a note on the right hand side of the sheet.

NOTE:

APPROACH SLAB THICKNESS IN ACCORDANCE WITH BD-628M OR A SMALLER THICKNESS MAY BE USED IF CONFIRMED BY DESIGN COMPUTATIONS WHICH TAKE INTO ACCOUNT THE HIGHER CONCRETE STRENGTH OF PRECAST CONCRETE.

Changes made to details are indicated with yellow highlighting on the five (5) attached pages and the following statement has been added to the bottom of each drawing sheet:
CORRECTIONS TO THE SLAB THICKNESS INDICATED WITH YELLOW HIGHLIGHTING MADE BY BRIDGE DESIGN AND TECHNOLOGY DIVISION ON 7-30-14 AFTER COMMUNICATION WITH STANDARD DEVELOPER.

Please note that implementation of these corrections is immediate.

Direct any questions concerning the above issue to:

Guozhou Li, P.E.
PennDOT, Bureau of Project Delivery
Bridge Design and Technology Division
Phone: (717) 214-8773 Fax: (717) 787-2882
guli@pa.gov

Archived copies of all previously distributed e-Notifications can be obtained from the PennDOT Bridge Standards website at http://www.penndot.gov/ProjectAndPrograms/Bridges/Pages/Plans-and-Specifications.aspx
12-603-BDTD, Sht. AS-1:

SECTION D-D:
LONGITUDINAL JOINT OPTION 1

SECTION D-D:
LONGITUDINAL JOINT OPTION 2
SECTION B-B: CANTILEVER ABUTMENT

NOTE: CONCRETE GIRDER SHOWN STEEL BEAM SIMILAR.

SECTION E-E
12-603-BDTD, Sht. AS-2 (cont.):

12-603-BDTD, Sht. AS-3:

DETAIL 2 & DETAIL 3 to have similar correction
12-603-BDTD, Sht. AS-4:

DETAIL 4 & DETAIL 5 to have similar correction

12-603-BDTD, Sht. AS-5:

SECTION A-A: TYPICAL LONGITUDINAL APPROACH SLAB DRAIN
Notes added to Sheets AS-1 thru AS-5:

**NOTE:**

APPROACH SLAB THICKNESS IN ACCORDANCE WITH BD-628M OR A SMALLER THICKNESS MAY BE USED IF CONFIRMED BY DESIGN COMPUTATIONS WHICH TAKE INTO ACCOUNT THE HIGHER CONCRETE STRENGTH OF PRECAST CONCRETE.

CORRECTIONS TO THE SLAB THICKNESS INDICATED WITH YELLOW HIGHLIGHTING MADE BY BRIDGE DESIGN AND TECHNOLOGY DIVISION ON 7-30-14 AFTER COMMUNICATION WITH STANDARD DEVELOPER.
PennDOT e-Notification No. 54

April 16, 2015

Interim Revision to Bridge Standard Drawing(s)

Acrylite Soundstop Structure Mounted Sound Barrier System, PennDOT Drawing 2012-050A PE, May 1, 2014 (New Product No. 68), Sheet 1. Specifying the tightening method for all bolts and post construction tolerance

BACKGROUND: A request for post construction tolerance and bolt tightening method in Acrylite Soundstop Structure Mounted Sound Barrier System from standard developer has been reviewed. The following items have been accepted by BDTD and added to Sheet 1 of the above drawings.

Sheet 1 has been revised as follows:

- REV. 1 added to Drawing Number and along with Approval Date of 4/10/15 entered into Revision Table.
- NOTE 10: Added “POSTS MUST BE SET WITH &plus;1/4″ OF PLAN. VARIANCES FROM POST CANNOT ADD UP TO MORE THAN &plus;1/4″ ”.
- NOTE 11 is replaced with: “ALL BOLTS ARE 5/8″ DIA. ASTM A325 OR A325T UNLESS INDICATED OTHERWISE. BOLTS SHALL BE PRETENSIONED WITH THE TURN OF NUT METHOD PER THE LASTEST VERSION OF THE SPECIFICATION FOR STRUCTURAL JOINTS USING ASTM A325 OR A490 BOLTS BY THE RESEARCH COUNCIL ON STRUCTURAL CONNECTIONS.”.

Changes made to drawing are indicated with yellow highlighting. Please note that implementation of these corrections is immediate. Direct any questions concerning the above issue to:

Guozhou Li, P.E.
PennDOT, Bureau of Project Delivery
Bridge Design and Technology Division
Phone: (717) 214-8773 Fax: (717) 787-2882
guli@pa.gov

Archived copies of all previously distributed e-Notifications can be obtained from the PennDOT Bridge Standards website at http://www.penndot.gov/ProjectAndPrograms/Bridges/Pages/Plans-and-Specifications.aspx
# PennDOT e-Notification No. 55

**May 22, 2015**

<table>
<thead>
<tr>
<th>Interim Revision to Bridge Standard Drawing(s)</th>
<th>Precast Concrete Substructure Standards, PennDOT Drawing 12-603-BDTD, March 18, 2013 (New Product No. 56), Sheets IA-2 and IA-5, Integral Abutment’s Pile to Pipe Cap Connection Detail revisions.</th>
</tr>
</thead>
</table>

**BACKGROUND:** Pile to pile cap connection showed 8 rebars inserted through the top of the pile’s web. The original developer of this standard was asked to add two details for the H-Pile and Pipe Pile connection to an integral abutment’s pile cap.

**Sht. IA-2 - NOTES:** Added Note 4: REFER TO SHEET IA-5 FOR DETAILS OF PILE CONNECTION IN PRECAST PILE CAP FOR INTEGRAL ABUTMENT. This addition has a Rev.1 triangle placed next to it.

**Sht. IA-2 – WINGWALL SECTION D-D:** removed indication of the 8 rebars or studs in the top of the pile which is located within the corrugated metal pipe. Also, removed 1’-0” MIN. pile insertion dimension.

**Sht. IA-5 – Pile Connection to Pile Cap Details:** added H-PILE CONNECTION TO PILE CAP and PIPE PILE CONNECTION TO PILE CAP details both indicate a 2’-0” MIN. insertion of pile into pile cap. (see attached sheets).

Changes made to details are indicated with revision 1 symbols and are highlighted in yellow on the three (3) attached 8.5”x11” pages. Revision 1, entitled “PILE CONNECTION”, was entered in the revision tables on these two drawing sheets.

Please note that implementation of these corrections is immediate. Direct any questions concerning the above issue to:

Guozhou Li, P.E.
PennDOT, Bureau of Project Delivery
Bridge Design and Technology Division
Phone: (717) 214-8773 Fax: (717) 787-2882
guli@pa.gov
Archived copies of all previously distributed e-Notifications can be obtained from the PennDOT Bridge Standards website at [http://www.penndot.gov/ProjectAndPrograms/Bridges/Pages/Plans-and-Specifications.aspx](http://www.penndot.gov/ProjectAndPrograms/Bridges/Pages/Plans-and-Specifications.aspx)
NOTES:
1. ALL REINFORCING NOT SHOWN FOR CLARITY.
2. PROVIDE TEMPORARY BRACING/SHORING UNTIL CONNECTION HAS ACHIEVED ADEQUATE STRENGTH.
3. INSTALL DEEP FOUNDATION PRIOR TO SETTING WINGWALL ELEMENTS.
4. REFER TO SHEET IA-5 FOR DETAILS OF PILE CONNECTION IN PRECAST PILE CAP FOR INTEGRAL ABUTMENT.

WINGWALL SECTION D-D
H-PILE CONNECTION TO PILE CAP

NOTES: 1. IN LIEU OF (6) STUDS, (3) $\frac{7}{8}'' \times 1' - 0''$ LONG, THREADED F1554 GRADE 36 ANCHOR RODS WITH (4) A563 GRADE A HEX NUTS MAY BE USED. HOLES SHALL BE DRILLED OR PUNCHED IN ACCORDANCE WITH 1105.03(c) OF PUB 408.
PIPE PILE CONNECTION TO PILE CAP
**PennDOT e-Notification No. 57**

**June 6, 2016**

| Interim Revision to Bridge Standard Drawing(s) | Folded Steel Plate Girder System, PennDOT Drawing No. 14-604-BDTD, Sept. 2, 2014 (New Product No. 71), Sheets 1 & 2 – Folded Steel Plate Girder System – Correction of Steel Hardware Galvanization Notes. |

**BACKGROUND:** It was recently pointed out to BDTD that the notes for galvanizing the steel hardware needed to be corrected since they were requiring hardware to be hot dipped galvanized instead of mechanically galvanized in both the Design and Construction Specifications.

**Sheets 1 – Design Specifications:** In third column, 4th paragraph; replace HOT DIP GALVANIZED with EITHER HOT DIP GALVANIZED OR MECHANICALLY GALVANIZED. Also added (MECHANICALLY GALVANIZED) or (HOT DIP GALVANIZED) after the four hardware items listed. The corrected text is indicated with clouding in the attached 8½”x11” sheet.

**Sheets 2 – Construction Specifications:** In first column, 5th paragraph; replace HOT DIP GALVANIZED with EITHER HOT DIP GALVANIZED OR MECHANICALLY GALVANIZED. Also added (MECHANICALLY GALVANIZED) or (HOT DIP GALVANIZED) after four hardware items listed. The corrected text is indicated with clouding in the attached 8½”x11” sheet.

Please note that implementation of these corrections is immediate.

Direct any questions concerning the above issue to:

Guozhou Li, P.E.
PennDOT, Bureau of Project Delivery
Bridge Design and Technology Division
Phone: (717) 214-8773 Fax: (717) 787-2882
guli@pa.gov

Archived copies of all previously distributed e-Notifications can be obtained from the PENNDOT Bridge Standards website at [http://www.penndot.gov/ProjectAndPrograms/Bridges/Pages/Plans-and-Specifications.aspx](http://www.penndot.gov/ProjectAndPrograms/Bridges/Pages/Plans-and-Specifications.aspx)
e-Notification No.57, 14-604-BDTD, Sht. 1 – Correction of Steel Hardware Galvanization Note:

DESIGN SPECIFICATIONS

HAUNCH AND BARRIER ARE EXCLUDED FROM THE COMPOSITE GIRDER SECTION PROPERTIES.

DECK SLAB THICKNESS INCLUDES A 1/2 IN. INTEGRAL WEARING SURFACE, EPOXY OVERLAY, OR LMC OVERLAY.

PROVIDE STRUCTURAL STEEL CONFORMING TO AASHTO M 270/M 270M, GRADE 50 (ASTM A 709/A 709M, GRADE 50) DESIGNATION, EXCEPT WHEN NOTED OTHERWISE. ALL STRUCTURAL STEEL SHALL BE HOT DIP GALVANIZED.

ALL STRUCTURAL STEEL HARDWARE SHALL BE HOT-DIP GALVANIZED OR MECHANICALLY GALVANIZED.

HIGH STRENGTH BOLTS: ASTM A325, TYPE 1 (MECHANICALLY GALVANIZED)

ANCHOR BOLTS: ASTM F1554, GRADE 55 (HOT DIP GALVANIZED)

NUTS: ASTM A563/A563M, GRADE DH (MECHANICALLY GALVANIZED)

WASHERS: ASTM F436/F436M, TYPE 1 (MECHANICALLY GALVANIZED)

SEPARATOR PLATES SHALL BE SPACED BY DESIGN.
CONSTRUCTION

1.0 GENERAL

PROVIDE MATERIALS AND PERFORM WORK IN ACCORDANCE WITH SPECIFICATIONS, PUBLICATION 408, CURRENT VERSION, AASHTO/AMS D1.5/D1.5: 2008 BRIDGE WELDING CODE, AND THE CONTRACT SPECIAL PROVISIONS.

STEEL AND CONCRETE FABRICATORS MUST BE BULLETIN 15 (PENNDOT PUB. 35) APPROVED.

PROVIDE STRUCTURAL STEEL CONFORMING TO AASHTO M 270/M 270W, GRADE 50 (ASTM A 709/A 709W, GRADE 50) DESIGNATION, EXCEPT WHEN NOTED OTHERWISE. ALL STRUCTURAL STEEL SHALL BE HOT DIP GALVANIZED.

PROVIDE FABRICATED STRUCTURAL STEEL IN ACCORDANCE WITH PUBLICATION 408 SECTION 1050 AND 1105, AS MODIFIED BY THE CONTRACT SPECIAL PROVISIONS.

ALL STRUCTURAL STEEL HARDWARE SHALL BE HOT DIP EITHER HOT DIP GALVANIZED OR MECHANICALLY GALVANIZED.

HIGH STRENGTH BOLTS: ASTM A325, TYPE 1 (MECHANICALLY GALVANIZED)

ANCHOR BOLTS: ASTM F1554, GRADE 55 (HOT DIP GALVANIZED)

NUTS: ASTM A563/A563M, GRADE DH (MECHANICALLY GALVANIZED)

WASHERS: ASTM F436/F436M, TYPE 1 (MECHANICALLY GALVANIZED)

PROVIDE 2" CONCRETE COVER ON REINFORCEMENT BARS, EXCEPT AS NOTED.

DECK SLAB THICKNESS INCLUDES A 1/2 IN. INTEGRAL WEARING SURFACE, EPOXY OVERLAY, OR LATEX MODIFIED CONCRETE (LMC) OVERLAY.

SUPERSTRUCTURE DIMENSIONS SHOWN ARE FOR A NORMAL TEMPERATURE OF 68°F.

PROVIDE MINIMUM EMBEDMENT AND SPLICE LENGTHS IN ACCORDANCE WITH STANDARD DRAWING BC-736M, UNLESS OTHERWISE INDICATED.

2.0 NOTES FOR STEEL GIRDER

SHOP OR FIELD SPLICES WILL NOT BE PERMITTED.

DO NOT USE FORM SUPPORT SYSTEMS THAT WILL CAUSE UNACCEPTABLE OVERSTRESS OR DEFORMATION TO PERMANENT BRIDGE MEMBERS.

ALL FASTENERS ARE 3/8 IN. DIAMETER HS BOLTS, EXCEPT AS NOTED.

PREPARE BEARING AREAS AS SPECIFIED IN PUBLICATION 408, SECTION 1001.3(k) 19.

DO NOT WELD PERMANENT METAL DECK FORMS OR OTHER ATTACHMENTS TO GIRDERS TOP FLANGES IN TENSION AREAS. (TENSION AREAS OF TOP FLANGES ARE DESIGNATED ON THE PLANS.) THREADED STUDS FOR THE SUPPORT OF THE OVERHANG DECK FORMING BRACKET ARE PERMITTED PROVIDED...
PennDOT e-Notification No. 70

Aug. 23, 2017

| Interim Revision to Bridge Standard Drawing(s) | PREFABRICATED T-WALL RETAINING WALL SYSTEM, PennDOT Drawing No. 87-402 PE, April 13, 2017 (New Product No. 76), Sheet 1 – Correction of Note regarding LRFD Specifications. |

BACKGROUND: The general note which lists the AASHTO LRFD Specifications was listing a specific Edition and Interim revisions which might cause an inconsistency with other documents.

Sheet 1, T-WALL Design Specifications:
Revise 3.0 Design section note 3.0.d(4) as indicated below:

Current appearance:

(4) AASHTO LRFD Bridge Design Specifications, fifth edition with 2010 revisions

New appearance:

(4) AASHTO LRFD Bridge Design Specifications

A text box describing this correction with yellow highlighting is being added next to the drawing border.

The above referenced modification is provided on the attached 8½”x11” sheet.

Please note to implement this change immediately. Direct any questions concerning the above issue to:

Guozhou Li, P.E.
PennDOT, Bureau of Project Delivery / Bridge Design and Technology Division
Phone: (717) 214-8773 Fax: (717) 787-2882
guli@pa.gov

Archived copies of all previously distributed e-Notifications can be obtained from the PennDOT Bridge Standards website at http://www.penndot.gov/ProjectAndPrograms/Bridges/Pages/Plans-and-Specifications.aspx
d. In the event that certain design Parameters, Stresses or Specifications are in conflict, the following order of precedence governs:

(1) Design requirements listed in "Special Drawings and Special Design Requirements" of the special provisions.
(2) Pennsylvania Department of Transportation current Design Manual Part 4
(3) Pennsylvania Department of Transportation standard drawings.
(4) AASHTO LRFD Bridge Design Specifications

I CERTIFY THAT ALL ASSUMPTIONS MADE IN DESIGNING THIS WALL HAVE BEEN VALIDATED THROUGH CONSTRUCTION DETAILS, SPECIAL NOTES AND INSTRUCTIONS TO THE FABRICATOR, INSTRUCTOR AND CONTRACTOR.

LRFD SPECIFICATIONS NOTE MODIFIED TO PERMIT CONSISTENCY WITH OTHER DOCUMENTS BY BRIDGE DESIGN & TECHNOLOGY DIVISION ON 8-23-17.

DESIGNER
THE NEEL COMPANY
4/13/2017

SCALE: NO SCALE
DESIGNED: GAA
DRAWN: CAA
CHECKED: CUD
TNC JOB #: 78604
TNC SHT #: 1 OF 67
PennDOT e-Notification No. 74

September 19, 2019

Interim Revision to Bridge Standard Drawing(s)  

BACKGROUND: Unintended changes and errors were found in the recently released Change #2 of the April 2016 Edition of the Bridge Design (BD) Standards (Publication 218M) and need to be corrected.

BD-601M, Sheet 1 – NOTES: Several inadvertent changes need to be undone. In Note 4, correct the barrier concrete cover from 2½" to 2", correct the sidewalk top cover from 2" to 2½", and correct the minimum transverse reinforcement bar spacing from 5" to 5½". Also, return the sentence "SEE DESIGN MANUAL PART 4, SECTION D5.4.3.1." from the end of Note 5 to the end of Note 6.

BD-620M, Sheet 4 – TOP FLANGE LATERAL BRACING CONNECTIONS: The note under the detail title was incorrectly replaced to be consistent with the 2014 Edition of the Design Manual, Part (DM-4). This change should not have occurred because the DM-4 was already being revised in the forthcoming edition to be consistent with BD-620M. The preferred arrangement remains to attach lateral bracing to the bottom flange as shown on BC-754M because oversized holes are specified for the installation of the bracing to prevent pseudo-box girder behavior. Revert back to the previous note that stated this preference.

BD-624M, Sheet 2 – SECTION C-C and ALTERNATE SECTION C-C: In the call-Out of the class of concrete to be used in the lower portion of the flared safety wings, correct "VERTICAL CONSTRUCTION JOINT" to "HORIZONTAL CONSTRUCTION JOINT".

BD-627M, Sheet 3 – REINFORCEMENT FOR BARRIER WITH ASPHALT-PAVED CONCRETE SHOULDER: In the detail title, delete "CONCRETE" which was intended to be deleted when the terminology was changed from "BITUMINOUS CONCRETE" to "ASPHALT-PAVED".

BD-628M, Sheet 24 – TYPE 3 APPROACH SLAB - DETAIL 19: The #6 transverse bar passing through the adjacent box beams and placed inside the hook of the approach slab anchor bar was incorrectly deleted and shall be provided.

deleted by Change 3 (2/19/2021) to the BD Standards, April 2016 Edition
BD-660M, Sheet 1—NOTES: In Note 1, after “WORK QUALITY” delete “MANSHIP” which was intended to be deleted when the terminology was changed from “WORKMANSHIP” to “WORK QUALITY”.

These corrections are indicated with red markups on the six attached 8½”x11” sheets.

Please note that implement of these corrections is immediate. Direct any questions concerning the above issue to:

Guozhou Li, P.E.
PennDOT, Bureau of Project Delivery / Bridge Design and Technology Division
Phone: (717) 214-8773 Fax: (717) 787-2882
guli@pa.gov

Archived copies of all previously distributed e-Notifications can be obtained from the PennDOT Bridge Standards website at
http://www.penndot.gov/ProjectAndPrograms/Bridges/Pages/Plans-and-Specifications.aspx
e-Notification No. 74, BD-601M, Sheet 1 – Correction of Notes:

4. DESIGN CONTROLS:
   **CONCRETE COVER**
   - DECK TOTAL TOP COVER = 2½"
   - DECK BOTTOM COVER = 1"
   - BARRIER = 2½"
   - SIDEWALK TOP COVER = 2½"
   - ALTERNATE SIDEWALK DETAIL BARRIER = 2"

   **MIN. VERTICAL CLEAR DISTANCE BETWEEN LONGITUDINAL REINFORCMENTS IN TOP MAT AND LONGITUDINAL REINFORCMENTS IN THE BOTTOM MAT = 2"**
   **MIN. VERTICAL CLEAR DISTANCE BETWEEN TRANSVERSE REINFORCMENTS IN TOP MAT AND TRANSVERSE REINFORCMENTS IN THE BOTTOM MAT = 2"**

   **BAR SIZE:**
   - MAXIMUM BAR SIZE: 1 1/4, 1 1/2, AND 2 1/4 IN.
   - MINIMUM BAR SIZE: 1, 1 1/4, 1 1/2, AND 2 1/4 IN.
   - S4, S6, S8, AND ST BAR SIZE: 3/4 IN.

   **BAR SPACINGS:**
   - MAXIMUM SPACING IN SLAB AND BARRIERS = 5½"
   - MINIMUM TRANSVERSE REINFORCEMENT SPACING = 5½"
   - SPACING INCR = 5½"
   - THE TOP 1½" OF THE SLAB IS CONSIDERED TO BE AN INTEGRAL WEARING SURFACE.
   - STAGGER LONGITUDINAL REBARS SUCH THAT NO REBAR IN THE TOP MAT IS DIRECTLY ABOVE A REBAR IN THE BOTTOM MAT.
   - DECK THRONE: MINIMUM THICKNESS INCLUDING 1½" INTEGRAL WEARING SURFACE = 1/8" DISTANCE BETWEEN DESIGN SECTIONS FOR NEGATIVE MOMENT = 120mil / 30 = 4mil ≥ 8mil, THICKNESS INCR = 1/4mil.

   **F Cur Factor for Crack Control = 130 kips/in.**

5. USE ONLY BONDED EPOXY COATED REINFORCEMENT IN ACCORDANCE WITH PUBLICATION 406, SECTION 705. SEE DESIGN MANUAL PART 1, SECTION 3 A.2.2.3.

6. FOR ALL BARRIER REINFORCEMENT AND FOR HOOKED OR BENT BARS IN THE DECK SLAB, DO NOT USE RAIL STEEL (A 990). SEE DESIGN MANUAL PART 4, SECTION D5.4.3.1.
TOP FLANGE LATERAL BRACING CONNECTIONS

NOTE:

PREFERRED ARRANGEMENT IS TO ATTACH LATERAL BRACING TO THE TOP FLANGE. ATTACHING THE LATERAL BRACING TO THE BOTTOM FLANGE OR STRAIGHT GINER BRIDGES WITH NARROW TOP FLANGE WIDING IS PERMITTED PER BC-745M.

PREFERRED ARRANGEMENT IS TO ATTACH LATERAL BRACING TO BOTTOM FLANGE PER BC-754M. THE TOP FLANGE ATTACHMENT DETAILS ARE SHOWN FOR THE INFREQUENT SITUATIONS THAT NECESSITATE ATTACHMENT TO THE TOP FLANGE.
Notification No. 74, BD-624M, Sheet 2 – Correction of construction joint referenced in concrete call-outs:
e-Notification No. 74, BD-627M, Sheet 3 – Correction of Detail Title:

REINFORCEMENT FOR BARRIER WITH ASPHALT-PAVED CONCRETE SHOULDER
e-Notification No. 74, BD-628M, Sheet 24 – Correction of incorrectly deleted bar:

TYPE 3 APPROACH SLAB - DETAIL 19

APPROACH SLAB CONNECTED TO PRESTRESSED CONCRETE ADJACENT BOX BEAMS WITH BACKWALL, FOR BEAM DEPTHS 33" AND GREATER
e-Notification No. 74, BD-660M, Sheet 1 – Correction of Note 1:

**NOTES:**

1. PROVIDE MATERIAL AND WORK QUALITY W vitamin IN ACCORDANCE WITH THE APPROPRIATE SPECIFICATIONS AS OUTLINED IN THE PENNSYLVANIA DEPARTMENT OF TRANSPORTATION PUBLICATION 408.
Interim Revision to Bridge Standard Drawing(s): BD-632M, R.C. BOX CULVERT, August 30, 2019, Sheet 14 – SEGMENT JOINT DETAILS: Correction of the applicability of the Precast R.C. Box Culvert configuration with squared segment joints.

BACKGROUND: Precast R.C. Box Culvert Segment Joint Details were added to BD-632M in Change No. 2 to the April 2016 Edition of the Standards. The configuration with squared segment joints was labeled as being a second option for culverts with skew angles less than 75°. However, squared joints may be considered for all culverts, limited only by the minimum skew angle for which the end segments can be fabricated. In fact, due to post-tensioning effects, squared joints are preferred though not required.

Additionally, clarification is added to indicate that the fabricator may submit shop drawings for any of the options on this standard that meet the design.

SKEW ANGLE < 75° - OPTION 2 detail: Renamed detail “SQUARED JOINT OPTION (ALL SKEW ANGLES)”.
SKEW ANGLE ≥ 75° detail: Added “SKEWED JOINT OPTION” to detail name.
SKEW ANGLE < 75° - OPTION 1 detail: Added “SKEWED JOINT OPTION” to beginning of detail name and removed “- OPTION 1”.

DESIGN INSTRUCTIONS table: Revised the column headings to correct the applicability of the three options; corrected the segment descriptions for the Squared Joint Option; and expanded the note to clarify the fabricator’s options.

These updates are indicated with red markups on the attached 8½”x11” sheets.

Please note that implementation of these updates is immediate. Direct any questions concerning the above issue to:

Guozhou Li, P.E.
PennDOT, Bureau of Project Delivery / Bridge Design and Technology Division
Phone: (717) 214-8773 | Fax: (717) 787-2882
guli@pa.gov

Archived copies of all previously distributed e-Notifications can be obtained from the Bridge “Plans, Standards and Specifications” page on the Department’s website: https://www.penndot.gov/ProjectAndPrograms/Bridges/Pages/Plans,-Standards-and-Specifications.aspx
e-Notification No. 75, BD-632M, Sheet 14 – Revisions to the detail names of the culvert configuration options:

**SKEW ANGLE < 75 DEGREES OPTION 2**

**SQUARED JOINT OPTION (ALL SKEW ANGLES)**

**SKEWED JOINT OPTION**

**SKEW ANGLE ≥ 75 DEGREES**

**SKewed JOINT OPTION**

**SKew ANGLE < 75 DEGREES**
### DESIGN INSTRUCTIONS:

<table>
<thead>
<tr>
<th></th>
<th>SKewed Joint Option **</th>
<th>Squared Joint Option **</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CULVERT SKEW ≥ 75°</strong></td>
<td>WALL FACES, TOP SLAB FACES AND BOTTOM FACES ALONG THE JOINT ARE SKEWED WITH CULVERT SKEW ANGLE.</td>
<td>WALL FACES, TOP SLAB FACES AND BOTTOM FACES ALONG THE JOINT ARE SKEWED WITH CULVERT SKEW ANGLE.</td>
</tr>
<tr>
<td><strong>CULVERT SKEW &lt; 75°</strong></td>
<td>WALL FACES ARE SQUARED OFF ALONG JOINT. TOP SLAB FACES AND BOTTOM FACES ALONG THE JOINT ARE SKEWED WITH CULVERT SKEW ANGLE.</td>
<td>WALL FACES ARE SQUARED OFF ALONG JOINT. WALL FACES, TOP SLAB FACES AND BOTTOM FACES ALONG THE JOINT ARE SQUARED OFF ALONG JOINT.</td>
</tr>
<tr>
<td><strong>ALL CULVERT SKews</strong></td>
<td>WALL FACES, TOP SLAB FACES AND BOTTOM FACES ALONG THE JOINT ARE SQUARED OFF ALONG JOINT.</td>
<td>WALL FACES, TOP SLAB FACES AND BOTTOM FACES AT END SECTION SIDE ARE SKEWED WITH CULVERT SKEW ANGLE.</td>
</tr>
</tbody>
</table>

**INTERMEDIATE SEGMENTS**

**END SEGMENTS**

---

**BRIDGE**

**TO BE DETERMINED BY DISTRICT ENGINEER. AT SHOP DRAWING STAGE, FABRICATOR MAY SUBMIT ANY OPTION ON THIS STANDARD. IF THE OPTION SUBMITTED MEETS THE DESIGN, THE OPTION SHOULD BE ACCEPTED.**

**ARE SQUARED OFF ALONG JOINT.**
Bureau of Project Delivery  
Bridge Design and Technology Division

**PennDOT e-Notification No. 76**  
**June 26, 2020**

<table>
<thead>
<tr>
<th>Interim Revision to Bridge Standard Drawing(s)</th>
<th>New e-Notification Server and Email Addresses; Subscription Renewal Required</th>
</tr>
</thead>
</table>

**BACKGROUND:** On June 26, 2020 the PennDOT Bridge Publications e-Notification system will be switched to a new server. This is the last e-Notification you will receive from the old server penndot-bqad-pubs@listserver.bakerprojects.com.

The new e-Notification server will use the following email addresses:

Send questions to the list:  
penndot-BdtdPubs@listserv.bakerprojects.com

Send blank email to subscribe:  
penndot-BdtdPubs-subscribe-request@listserv.bakerprojects.com

Send blank email to unsubscribe:  
penndot-BdtdPubs-unsubscribe-request@listserv.bakerprojects.com

In the new email addresses, “bqad-pubs” now becomes “BdtdPubs” and “listserver” becomes “listserv”.

**ACTION ITEMS:** Starting on June 26, 2020, if you want to continue to receive e-Notifications you will need to renew your subscription by sending a blank email to penndot-BdtdPubs-subscribe-request@listserv.bakerprojects.com to subscribe to the new server. You must then reply to the confirmation email with "OK" in the body of the message to complete your subscription.

If you do not see the confirmation email in your inbox, please look for it in your spam or junk folder. If you locate the confirmation email in your spam or junk folder, then it is recommended that you add a rule to your email software to allow all emails from “@listserv.bakerprojects.com” to be delivered to your inbox.

Direct any questions concerning the above issue to:

Nikki Krise  
PennDOT, Bureau of Project Delivery / Bridge Design and Technology Division  
Phone: (717) 783-6416 | Fax: (717) 787-2882  
nkrise@pa.gov

Archived copies of all previously distributed e-Notifications can be obtained from the Bridge “Plans, Standards and Specifications” page on the Department’s website:  
https://www.penndot.gov/ProjectAndPrograms/Bridges/Pages/Plans,-Standards-and-Specifications.aspx
PennDOT e-Notification No. 77
December 21, 2020

BACKGROUND: GRS-IBS bridge abutment technology has been utilized in Pennsylvania since 2011. GRS-IBS bridges are constructed differently than conventional bridges and the construction and utility communities are just beginning to experience and encounter the technology in real world situations. Recently, a utility project, unknowingly adjacent to a GRS-IBS bridge, performed excavation that intercepted and damaged the integrated approach and back of the GRS structure of the bridge. This incident prompted investigation into a method of marking the limits of GRS-IBS abutments. Treating the bridge abutment similar to an underground utility and properly marking its location was developed for inclusion in the BD-697M standard.

NEW SHEET / DETAILS: The new details shown on the attached 11” x 17” sheet require the use of customized detectable underground warning tape. This tape is similar to underground utility marking tape but can be customized in color and wording. Wording on the tape directs any contractor uncovering the tape to notify the bridge owner so care can be taken to either avoid the reinforcement of the GRS-IBS or to investigate how work can be done without causing damage to the structure. There are various manufacturers of this material eliminating sole sourcing concerns.

Please note that implementation of this update is immediate.

ACTION ITEMS: Starting immediately, the following items should be incorporated on any new GRS-IBS structures or when any rehabilitation work involving the unearthing of top layers of geotextiles is anticipated or performed:

- Include Customized Detectable Underground Warning Tape in the Special Provisions as part of the Component Items Schedule. The Special Provision should include the wording to be called out on the tape. The suggested wording is: **STOP DIGGING-GRS ABUTMENT-CALL <BRIDGE OWNER>**. Insert the name of the township or PennDOT District for Bridge Owner. See sample below.

- On contract drawings, delineate where the caution tape should be located as shown in the new details in BD-697M.
As part of the preliminary design discussion, designers should discuss with owners the potential for future utilities in the project site. Owners of GRS-IBS bridges should be very aware of utility work in the vicinity of the bridge and advise the excavation company accordingly in order to protect the structure.

Direct any questions concerning the above issue to:

Kristin Langer, P.E.
PennDOT, Bureau of Project Delivery / Bridge Design and Technology Division
Phone: (717) 787-7506
klanger@pa.gov

Archived copies of all previously distributed e-Notifications can be obtained from the Bridge “Plans, Standards and Specifications” page on the Department’s website:
https://www.penndot.gov/ProjectAndPrograms/Bridges/Pages/Plans,-Standards-and-Specifications.aspx
GRS CAUTION TAPE (SIDE VIEW)

GRS CAUTION TAPE (ISOMETRIC VIEW)

NOTES
1. GRS CAUTION TAPE IS PLACED ON THE TOP LAYER OF SAND TO INDICATE THE END OF THE GRS STRUCTURE.
2. FOR GRS CAUTION TAPE OUTSIDE OF THE GRS BRIDGE STRUCTURE, PLACE THE CAUTION TAPE 2 FEET IN FRONT OF THE STRUCTURE IN THE LOCATION SHOWN.
3. GRS CAUTION TAPE IS TO BE CUSTOMIZED DETECTABLE UNDERGROUND MARKING TAPE AS SHOWN BELOW.

STOP DIGGING-GRS ADJMENT-CALL OWNER
Interim Revision to Bridge Standard Drawing(s)

Revisions to the BD Standards (Pub. 218M) and BC Standards (Pub. 219M) for MASH 2016 compliance

The Bureau of Project Delivery has released Change 3 to the April 2016 Edition of the Bridge Design Standards, BD-600M Series (Pub. 218M) and Change 3 to the September 2016 Edition of the Bridge Construction Standards, BC-700M Series (Pub. 219M), both dated February 19, 2021. (Note: Change 7 to June 2010 Edition of Roadway Construction Standards (Pub. 72M) was also part of this release.)

These changes contain revisions related to compliance with the AASHTO Manual for Assessing Safety Hardware (MASH 2016).

The revised standards have been incorporated into the updated publications that are available from the PennDOT website on either the Forms, Publications, and Maps webpage or the Bridge Plans, Standards and Specifications webpage. The index sheets in these Publications indicate which standards have been revised as part of Change 3. The transmittal letters for these Publications include a description of the changes and Change 3 revisions are indicated by light blue highlighting.

These standards may be used immediately and can be adopted as soon as practical on new and existing designs without affecting letting schedules. However, projects with T.S.&L. submissions after July 1, 2021 and projects let after April 1, 2022 shall incorporate these standards.

NOTE: Revisions to Bridge Structure Mounted Guiderail (SMGR) will be issued in a later change package. Therefore, continue to use the current standards for projects that use SMGR.

Direct any questions concerning the above issue to:

Guozhou Li, P.E.
PennDOT, Bureau of Project Delivery / Bridge Design and Technology Division
Phone: (717) 214-8773 | guli@pa.gov

Archived copies of all previously distributed e-Notifications can be obtained from the Bridge “Plans, Standards and Specifications” page on the Department’s website: https://www.penndot.gov/ProjectAndPrograms/Bridges/Pages/Plans,-Standards-and-Specifications.aspx
Interim Revision to Bridge Standard Drawing(s) | BD-601M, CONCRETE DECK SLAB, February 19, 2021: Revision of Deck Slab Lap Splice Length Legend Note 11, Sheet 1

In the 8th Edition of the AASHTO LRFD Bridge Design Specifications (adopted by DM-4, 2019 Edition), the calculation of the development length of reinforcement bars in tension was revised. Change No. 3 to the 2016 Editions of the BD and the BC Standards updated the development and lap splice lengths throughout the standards for compliance with the AASHTO changes.

The calculations and assumptions used to update the deck slab lap splice lengths on BD-601M have been revisited and the lap splice lengths specified in Legend Note 11 on Sheet 1 are being adjusted. They now match Table B on BC-736M, Sheet 3.

<table>
<thead>
<tr>
<th>Bar Size</th>
<th>Deck Slab Lap Splice Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal Weight Concrete</td>
<td></td>
</tr>
<tr>
<td>#5</td>
<td>2’ - 10”</td>
</tr>
<tr>
<td>#6</td>
<td>3’ - 10”</td>
</tr>
<tr>
<td>Lightweight Concrete</td>
<td></td>
</tr>
<tr>
<td>#5</td>
<td>3’ - 5”</td>
</tr>
<tr>
<td>#6</td>
<td>4’ - 6”</td>
</tr>
</tbody>
</table>

These revisions are indicated with red markups on the attached 8½”x11” sheet.

Please note that implementation of these revisions to BD-601M is immediate. For current bridge projects, implementation is at the discretion of the District Bridge Engineer.

Direct any questions concerning the above issue to:

Guozhou Li, P.E.
PennDOT, Bureau of Project Delivery / Bridge Design and Technology Division
Phone: (717) 214-8773  |  guli@pa.gov

Archived copies of all previously distributed e-Notifications can be obtained from the Bridge “Plans, Standards and Specifications” page on the Department’s website:
https://www.penndot.gov/ProjectAndPrograms/Bridges/Pages/Plans,-Standards-and-Specifications.aspx
**LEGEND:**

1. **Within 10**' on both sides of an expansion joint in the barrier and at the end of the bridge barrier, reduce spacing of reinforcement bars to half the shown spacing. For barrier end transition to guide rail follow details shown on BD-622M and BD-624M.

2. Extend one half of the S1, bottom transverse bars, across the full width of the overhang. The alternate bars which do not extend into the overhang shall extend 6" minimum beyond the interior edge of the flange of the fascia beam.

3. Bundle the bars listed as S7 in the reinforcement tables to each S2 bar.

4. **Begin S3 and S3' bars at location of design section for negative moment, see sheet 9. S3 and S3' bars do not need to be placed over the beam for spread box beam bridge.**

5. **For embedment into the concrete barrier, see sheet 7.**

6. **For drip notch details, see BC-775M.**

7. **Underside of deck slab may be constructed level.**

8. **For deck top reinforcement mat: transverse bars shown on top, similar when longitudinal bars on top. (See Note 24)**

9. **For deck slab reinforcement, see typical slab panel details, sheet 2.**

10. **If the barrier is positioned directly above a girder the S7 bar, if required, must extend the distance "L" beyond the adjacent beams on each side.**

11. **Deck slab lap splice length: Normal weight concrete:**

   - 2'-10" #5 bars 3'-0"
   - 3'-10" #6 bars 3'-7"
   - 4'-6" #6 bars 4'-2"

12. **Light weight concrete:**

   - 3'-5" #5 bars 3'-6"
   - 4'-6" #6 bars 4'-2"

13. **Drain runoff with curb drains through concrete barrier or with type 2 scuppers in sidewalk slab. Where curb drains are used, set sidewalk elevation at rear face of barrier 1" above gutter line elevation. This may result in increased cover for S2 & S7 bars. Bevel drains as per BC-751M.**

14. **When a traffic barrier is mounted on the deck between two girders, provide top and bottom reinforcement area in the deck in the bay where the barrier exists, at least equal to the overhang top reinforcement area as shown on sheets 10 and 11. If S7 bars are required they should match the spacing of the S2 bars on the top mat and S1 bars on the bottom mat.**

15. **To be used when matching detail is specified in approach roadway.**

16. **To be used only for bridges without longitudinal joints.**

17. **Space bars S3, S3', S4, S5, and S6 symmetrically about the panel centerline.**

18. **Provide haunch to compensate for irregularities in camber. See Table 9 for minimum haunch requirements.**

19. **For prestressed concrete bridges made continuous, design S5 and S6 bars in accordance with DM-4 Article D5.12.3.3.**

20. **Use beam haunch details shown with removable deck forms. Face of haunch is vertical when permanent metal deck forms are used in placing the deck. Beam haunch detail shall conform to BC-752M.**

21. **Splices should be outside of negative moment area if possible, if not, center bar length on center of negative moment area. Stagger splices as per BD-660M.**
PennDOT e-Notification No. 80
June 28, 2022

Interim Revision to Design Manual, Part 4 (Pub. 15M)

INTERIM HOLLOW BAR POLICY:
Revisions to Design Manual, Part 4, Appendix O

This e-Notification serves to establish interim policy for hollow bar use in soil nailing and other hollow bar applications until pertinent bridge and geotechnical publications are updated.

The use of hollow bars can be beneficial for constructability, bond strength and cost. However, the potential for corrosion of the bars is a concern due to the installation process. Furthermore, the long-term performance of the bars is unknown.

The attached revisions to Design Manual, Part 4 (DM-4), Appendix O provide criteria for hollow bar use. The following serves as a summary of the interim policy:

1.) Hollow bars may be approved for use on a case-by-case basis. Submit project specific requests with rationale for hollow bar use on specific projects to the Bureau of Construction and Materials, Geotechnical Section for approval. Involve the Geotechnical Section early in the review process for projects with proposed hollow bars.

2.) The design of hollow bars shall include corrosion considerations. Estimating the ultimate bond stress for hollow bars in soil and determining the amount of sacrificial steel shall be based on FHWA-NHI-14-007 Soil Nail Wall Reference Manual.

3.) The structure and/or geotechnical plans shall include a note indicating the use of hollow bars.

4.) Grouting specifications for hollow bars shall include the requirements of Chapter 10 of FHWA-NHI-14-007 and shall address the return of cuttings from the drill hole so that only grout remains in the bonded zone.

5.) A monitoring plan based on FHWA-NHI-14-007, Article 10.5, shall be developed and followed for soil nail walls constructed using hollow bars.

Archived copies of all previously distributed e-Notifications can be obtained from the Bridge “Plans, Standards and Specifications” page on the Department’s website: https://www.penndot.pa.gov/ProjectAndPrograms/Bridges/Pages/Plans,-Standards-and-Specifications.aspx
When hollow bars are used, the District Geotechnical Engineer or the District Bridge Engineer shall add the project to the Department’s Hollow Bar Inventory Spreadsheets.

Additional specification updates and publication changes are forthcoming which will provide for a more coherent process for hollow bars applications. This e-Notification is an initial step to ensure consistent practice for hollow bar applications including corrosion considerations in design and to ensure longevity of projects incorporating hollow bars in various applications.

In addition to the hollow bar requirements summarized above, the corrosion protection required for solid bar soil nails has been updated. The epoxy coating thickness has been revised from a minimum of 12 mils to a range from 7 to 12 mils.

Please note that implementation of these revisions to Appendix O of DM-4 is immediate. For current bridge or geotechnical projects, please contact the Bridge Office or the Bureau of Construction and Materials, Geotechnical Section.

Direct any questions concerning the above issue to:
Guozhou Li, P.E.
PennDOT, Bridge Office
Phone: (717) 214-8773 | guli@pa.gov

Beverly Miller, P.E.
PennDOT, Bureau of Construction and Materials / Geotechnical Section
Phone: (717) 787-1496 | bevemiller@pa.gov

Archived copies of all previously distributed e-Notifications can be obtained from the Bridge “Plans, Standards and Specifications” page on the Department’s website:
https://www.penndot.pa.gov/ProjectAndPrograms/Bridges/Pages/Plans,-Standards-and-Specifications.aspx
1.1 GENERAL

Soil-nailed walls may be used to stabilize and retain permanent or temporary cut slopes of weathered rock, granular soils, and clayey soils whose liquidity index is less than 0.2 and undrained shear strength greater than 1.04 ksf. The finished slope may be vertical or at a batter. At present, the permanent facing may be constructed as cast-in-place concrete, shotcrete, or with precast concrete panels.

Hollow bar soil nails may be approved for use on a case-by-case basis. Submit project specific requests with rational to the Bureau of Construction and Materials, Geotechnical Section for approval. Involve the Geotechnical Section early in the review process for projects with proposed hollow bar soil nails.

Soil-nailed retaining walls may be constructed for fill situations with bottom-up construction. For bottom-up construction, District Bridge Engineer approval shall be obtained prior to the design.

Soil-nailed retaining walls shall not be used in conjunction with a mechanically stabilized earth retaining walls or abutments to retrofit/repair or stabilize. The restriction on the use of soil-nailed walls with mechanically stabilized earth retaining systems applies to temporary and permanent applications.

Because of limited experience with these types of systems, they shall not be used under the following conditions:

(a) For structures greater than 50 ft. in height

(b) For retention of granular slopes composed of uniform fine sands or where 5-ft. cuts would not stay vertically open for the amount of time required for the installation of the nails and the application and subsequent curing of the shotcrete

(c) For retention of cohesive clay slopes exhibiting liquidity indexes greater than 0.2 and undrained shear strengths less than 1.04 ksf

(d) Where the nails would extend beyond the right-of-way limits

(e) For retention, where high groundwater table would generate excessive flows

(f) For retention of frost-susceptible and expansive soils

(g) For retention of weathered rock with weak structural discontinuities that are inclined steeply toward and daylight into the excavation face

C1.1

Soil nailing systems are designed to reinforce in situ soil, using passive reinforcements to retain excavations or stabilize or construct vertical or nearly vertical slopes. In soil-nailed retaining structures, the inclusions (nails) are generally steel bars or other metal elements, which can resist tensile stresses and bending moments. They are either placed in drilled boreholes and grouted along their total length or driven in the ground. The nails are not prestressed, and their center-to-center spacing (density) is relatively tight, thus providing an anisotropic cohesion. The outside facing of the structure, which ensures local stability between the reinforcement layers, can consist of a thin layer of shotcrete 4 in. to 6 in. thick reinforced with a steel mesh, prefabricated panels, or a cast-in-place concrete veneer. Certain methods of nail installation may be proprietary, as well as certain types of prefabricated facings.
SPECIFICATIONS

The design of Soil Nail Walls shall follow design methodology established in the FHWA and NHI Soil Nail Wall Reference Manual (FHWA-NHI-14-007). The references to Allowable Stress Design (ASD) shall utilize the service load design (SLD) approach as defined in the AASHTO Standard Specifications for Highway Bridges, seventeenth edition, (2002). The references to LRFD approach shall utilize the current AASHTO LRFD Bridge Design Specification as supplemented by Design Manual Part 4 and as defined in Soil Nail Wall Reference Manual (FHWA-NHI-14-007). The most conservative design for the soil nail shall be used, i.e., the longest nail length. The design of the other wall elements, concrete facing, reinforcement, etc., shall follow an LRFD approach as defined in the 2017 AASHTO LRFD Bridge Design Specifications.

Contractors specializing in the design and construction of soil-nailed structures shall be responsible for final wall design using the guidelines herein.

COMMENTARY

Appendix O provides a design guideline for Soil-nailed Retaining Wall as there is limited design criteria in AASHTO.

The proposed LRFD Design Specifications for Soil Nail Walls contained in NCHRP Report 701, Appendix A, have been supplemented by the FHWA and NHI Soil Nail Wall Reference Manual (FHWA-NHI-14-007).

The design of soil-nailed walls is a complex problem of soil-structure interaction, strongly influenced by methods of construction. To provide guidance in the design and construction of soil-nailed structures, the Federal Highway Administration (FHWA) and National Highway Institute (NHI) have developed a Reference Manual for the design and construction of soil-nailed walls (FHWA-NHI-14-007). Preliminary design guidelines, restrictions, and technical considerations developed in earlier editions of this manual have been incorporated herein.
1.4.6 Nail Pullout Capacity

The ultimate pullout resistance per unit length used for preliminary design shall be taken as:

\[ Q_u = 12\sigma_b\pi D \] (1.4.6-1)

where:

- \( Q_u \) = ultimate pullout resistance per unit length (kip/ft)
- \( \sigma_b \) = ultimate grout-ground bond stress estimated from Table 1.4.6-1, 1.4.6-2, or 1.4.6-3 (ksi)
- \( D \) = nail drill hole diameter (in.)

The design pullout resistance in accordance with LRFD used for preliminary design shall be taken as:

\[ Q = \phi_q Q_u r \] (1.4.6-2)

where:

- \( \phi_q \) = ground pullout resistance factor
  \( = 0.65, \) Strength Limit State
  \( = 0.65, \) Extreme Limit State
- \( Q \) = design pullout resistance (kip/ft)
- \( r \) = soil weight factor, see Fig. 1.5.1-3

In calculating the allowable pullout resistance, factors of safety shall be as specified in Article 5.7.6.2 of the AASHTO Standard Specifications for Highway Bridges, 2002.

The indicated resistance factor of 0.65 for both the Strength and Extreme Limit State are from Table 6.3 in the Reference Manual for Soil Nail Walls (FHWA-NHI-14-007).

Table 1.4.6-1 – Ultimate Bond Stress for Cohesionless Soils

<table>
<thead>
<tr>
<th>Soil Type</th>
<th>Ultimate Bond Stress (ksi)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-plastic silt</td>
<td>0.0030 - 0.0045</td>
</tr>
<tr>
<td>Loess</td>
<td>0.0035 - 0.0110</td>
</tr>
<tr>
<td>Medium dense sand and silty sand/sandy silt</td>
<td>0.0070 - 0.0110</td>
</tr>
<tr>
<td>Dense silty sand and gravel</td>
<td>0.0115 - 0.0145</td>
</tr>
<tr>
<td>Very dense silty sand and gravel</td>
<td>0.0175 - 0.0345</td>
</tr>
</tbody>
</table>
Table 1.4.6-2 – Ultimate Bond Stress for Cohesive Soils

<table>
<thead>
<tr>
<th>Soil Type</th>
<th>Ultimate Bond Stress (ksi)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stiff Clay</td>
<td>0.0060 - 0.0085</td>
</tr>
<tr>
<td>Stiff Clayey Silt</td>
<td>0.0060 - 0.0145</td>
</tr>
<tr>
<td>Stiff Sandy Clay</td>
<td>0.0165 - 0.0290</td>
</tr>
</tbody>
</table>

Table 1.4.6-3 – Ultimate Bond Stress for Rock

<table>
<thead>
<tr>
<th>Rock Type</th>
<th>Ultimate Bond Stress (ksi)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marl/Limestone</td>
<td>0.0435 - 0.0580</td>
</tr>
<tr>
<td>Phyllite</td>
<td>0.0145 - 0.0435</td>
</tr>
<tr>
<td>Chalk</td>
<td>0.0720 - 0.0865</td>
</tr>
<tr>
<td>Soft Dolomite</td>
<td>0.0580 - 0.0865</td>
</tr>
<tr>
<td>Fissured Dolomite</td>
<td>0.0865 - 0.1445</td>
</tr>
<tr>
<td>Weathered Sandstone</td>
<td>0.0290 - 0.0435</td>
</tr>
<tr>
<td>Weathered Shale</td>
<td>0.0145 - 0.0215</td>
</tr>
<tr>
<td>Weathered Schist</td>
<td>0.0145 - 0.0255</td>
</tr>
<tr>
<td>Basalt</td>
<td>0.0720 - 0.0865</td>
</tr>
</tbody>
</table>

Tables 1.4.6-1 through 1.4.6-3 are based on straight shaft nail drill holes formed by rotary drilling in rock and open hole construction in soils and subsequently grouting by gravity or low pressures.

Hollow bar soil nails have been shown to develop higher bond strengths than solid bar soil nails. Table 10.1 in FHWA-NHI-14-007 provides ranges of nominal bond strengths in different granular soils. These values may be used to estimate the ultimate bond stress of hollow bar soil nails.

Field pullout tests shall be conducted to verify the values of the ultimate bond stress used for preliminary design using procedures outlined in the specifications. Final design shall be based on field data obtained.

The tables of ultimate bond stress values are consistent with data available in the literature and shall not be used for final design without verification pullout tests as provided in the Special Provisions.
specifications commentary

1.7 CORROSION PROTECTION

Nail head assemblies and nails shall be protected against corrosion consistent with site conditions. The level and extent of corrosion protection shall be a function of the ground environment and of whether the nail is intended for temporary or permanent applications. For permanent applications in non-aggressive ground, a minimum of double corrosion protection shall be provided. Double corrosion protection can be achieved by resin bond epoxying of the nail and head assembly to a minimum thickness of 12 mils in accordance with AASHTO M 284/M 284M thickness ranging from 7 to 12 mils and providing minimum grout cover of 1.5 in. along the entire length of the nail. For permanent applications in aggressive ground or for critical structures, nails shall be fully encapsulated. Full encapsulation consists of a nail grouted full-length inside a plastic corrugated tube, placed in an oversized drill hole, and then grouted again against the side of the drill hole. Aggressive site conditions exist whenever one or more of the limiting values specified in Table D11.9.7-1 is exceeded. For all temporary applications, grout cover over the entire nail length shall be adequate. Other potentially corrosive conditions shall be identified and evaluated by the wall designer, and appropriate means of corrosion protection shall be designed by the soil nail wall specialty contractor.

The nail tendon protection, whether epoxy coating or encapsulation, shall extend at least 3 in. into the shotcrete construction facing.

Hollow bar soil nails shall not be used in aggressively corrosive soils. Table 7.2 in FHWA-NHI-14-007 determines the threshold for non-aggressive soils. If the soil does not meet the requirements of Table 7.2, the soil is considered aggressively corrosive.

Due to the nature of the installation of hollow bar soil nails, provide sacrificial steel to account for potential corrosion. Corrosion loss and remaining bar diameter shall be taken as:

\[ X = 80 t_r^{0.8} \]  \hspace{1cm} (1.7-1)
\[ d_{loss} = d_{bar} - 2 \times \left( \frac{X}{25400} \right) \]  \hspace{1cm} (1.7-2)

where:

- \( X \) = loss of steel (μm)
- \( t_r \) = service life (years)
- \( d_{loss} \) = bar diameter after sacrificial steel is considered (in.)
- \( d_{bar} \) = nominal bar diameter (in.)

Equations 1.7-1 and 1.7-2 were adopted from FHWA-NHI-14-007. See NCHRP Report 675 for additional information.
1.10 SUBMITTALS

As a minimum for preliminary design, the information outlined for final design shall be provided with the following changes:

(a) Special Provisions for Soil-Nailed Retaining Walls shall be amended as necessary and included.

   Include a grout specification in the special provision for hollow bar soil nails. Specify grout requirements according to Chapter 10 of NHI-FHWA-14-007. The special provision shall address the return of cuttings from the drill hole so that only grout remains in the final bonded area.

(b) Nails shall have no free stressing length.

(c) Type of facing, or shotcrete or cast-in-place concrete (or both) shall be indicated.

(d) If designing with hollow bars, note them on the Structure or Geotechnical plans and in the special provision (as designed and as built).

As a minimum for final design, the following information shall be provided when applicable.

(a) Subsurface exploration information. As a minimum, the following information shall be obtained through the subsurface exploration and testing program for use in design:

   (1) Location and thickness of soil and rock units

   (2) Engineering properties of in situ soil and rock and granular soil backfill including unit weight, shear strength, and compressibility

   (3) Groundwater conditions

   (4) Ground surface topography

   (5) Geochemistry of soil and groundwater for corrosion potential

   (6) Presence of stray electrical currents

(b) Design earth pressures, water pressures, and surcharge loadings (to be included in final plan submission)

(c) Allowable foundation pressures/factored foundation resistance (to be included in final plan submission)
SPECIFICATIONS

(d) Design depth of scour if the wall is located adjacent to a stream channel (to be included with foundation stage submission)

(e) Geometric considerations including beginning and ending wall stations, wall profile and alignment, right-of-way limits, utility locations, construction considerations such as traffic restrictions or required construction sequences, and location of wall appurtenances such as drainage outlets, overhead signs and lights, and traffic barriers (to be included in the plans)

(f) References and methods used for analysis including all calculations, computer analyses, assumptions, input, and explanation of all symbols, notations, and formulas (to be included in final plan submission)

(g) Vertical wall element types, sizes, and spacing; hardware details; and erection sequence (to be included in the plans)

(h) Details, dimensions, connections, and schedules of all reinforcing steel for vertical wall elements and facing (to be included in the plans)

(i) Drainage requirements (to be included in the plans)

(j) Corrosion protection and/or accommodation details for the wall elements and hardware (to be included in the plans)

(k) Nail type and estimated capacity, nail inclination, and nail locations and spacings

(l) Description of nail installation procedures including drilling and grouting

(m) Corrosion protection details for the nails and nail head assemblies

(n) Detailed plans for proof, performance/verification, creep (if applicable), and pullout testing of nails including specified load measuring devices, test locations, and testing procedures

(o) Analyses of the stability of the wall at critical stages of construction

(p) Corrosion monitoring plan for soil nails walls built with hollow bars. NHI-FHWA-14-007 describes several corrosion monitoring options.
1.12.3 Materials

(a) Soil nails – Section 709.1 of Publication 408 (Pub 408)
   – Thread as necessary. Provide epoxy-coated bars with a
   minimum thickness of 12 mils where required and shown
   on the plans, thickness ranging from 7 to 12 mils as
   indicated. Epoxy coating to be in accordance with
   AASHTO M 284/M 284M.

(b) Steel welded wire fabric – Section 709.3 of Pub 408.

(c) Cast-in-place concrete – Provide Class AA concrete for
   structural concrete facing where required and shown on
   the plans, conforming to the requirements of Section 704
   of Pub 408.

(d) Precast concrete – Provide precast concrete facing where
   required and shown on the plans, conforming to the
   requirements for panels for mechanically stabilized earth
   walls.

(e) Permanent structural shotcrete facing, provide shotcrete
   conforming to the requirements in Section 1043 of
   Publication 408.

(f) Temporary shotcrete facing - Provide for approval,
   materials, methods, and control procedures in
   accordance with Section 1043 of Publication 408.

(g) Grout - Provide a neat cement grout to be used in soil
   nail anchorage consisting of a pumpable mixture capable
   of reaching a cube strength of 3 ksi in accordance with
   AASHTO T 106. Chemical additives that can control,
   bleed, or retard set in the grout are to
   be used only when
   approved in writing.

(h) Fasteners and attachment devices - Provide high-strength
   nuts conforming to Section 1105.02(c)2.a of Pub 408.
   Provide plates and shims conforming to Section
   1105.02(a)2 of Pub 408. Provide plastic centralizers of
   a minimum diameter 1/2 in. smaller than the nominal
   diameter of the drill hole. Provide a minimum of two
   centralizers per soil nail.

(i) Horizontal drains - Provide as required and shown on the
   plans slotted and unslotted PVC pipe conforming to
   AASHTO M 278. Install to the depths directed by the
   engineer, which will not exceed the maximum depths
   shown on the plans. Insure that the hole does not collapse
   prior to the insertion of the slotted drain. Only the front
   12 in. of drain pipe shall be unslotted.

(j) Wall drains - Provide as required and shown on the plans,
   prefabricated, fully wrapped, preformed drains. The
   core, not less than 1/4 in. thick or more than 1/2 in. thick,
shall be either a preformed grid of embossed plastic or a system of plastic pillars and interconnections forming a semirigid mat. When covered with filter fabric, the core material shall be capable of maintaining a drainage void for the entire height of permeable liner. Provide a polypropylene geotextile having a minimum weight of 6 oz/yd² as the filter fabric.

### 1.12.4 Construction

(a) Submittals - Provide two sets of design drawings, calculations, material certificates, construction procedures, and detailed construction sequencing plans, including excavation sequence for approval. Provide sufficient details in the design drawings to eliminate a need for shop drawings. Assume all risks for work performed without approved plans.

(b) Qualifications - Submit proof of two projects on which contractor has designed and/or installed soil nails or ground anchors in the past two years. The contractor's staff on this project is to include a supervising engineer with at least three years of experience in the design and construction of anchored walls.

Drilling operators and foreman are to have a minimum of two-year experience installing soil nails or permanent ground anchors with the contractor's organization. Submit documentation that project personnel have appropriate qualifications. Inadequate proof of personnel qualifications shall be cause for withholding wall design approval. Changes to previously approved personnel must be approved in writing.

The shotcrete crew foreman and nozzlemen must meet the requirements specified in Section 1043.3(a) of Pub. 408.

(c) Excavation – In conformance with Section 203 of Pub 408, and to the limits and construction stages indicated.

(d) Shotcreting – After each stage cut, and in anticipation of shotcreting, prepare surfaces in accordance with Section 1043.3(b) of Pub. 408. Use weep holes, drain pipes, or other methods to control seepage. Where used, provide a weep hole, a 2-ft.-long, 2-in.-diameter, slotted drain pipe (Schedule 40 PVC) placed in pre-drilled holes sloped 5 percent to drain. Apply shotcrete conforming to the requirements in Section 1043 of Publication 408.

(e) **Solid bar soil nail** installation – Drill holes for soil nails at the location shown. Provide the soil nail length necessary to develop adequate load capacity to satisfy
testing acceptance criteria for the design load required, but not less than the length shown on approved plans. Casing may be necessary to maintain a clean open hole drilled to the size and inclination shown. Drilling methods and grouting pressure are at the option of the contractor. At the point of entry, the nail angle shall be within plus or minus 3 degrees of that shown on the approved plans. Subsidence or physical damage by such operations shall be cause for immediate cessation of operations and repair at the contractor's expense.

Inject grout at the lowest point of the drill hole. Pump grout through grout tubes, casing, hollow-stem augers, and drill rods until the hole is filled to prevent air voids. Fill with grout progressively from the bottom to top. Provide grouting equipment capable of continuous mixing and producing a grout free of lumps. Place a nail in each drilled hole within 15 minutes of the grout injection.

Place centralizers at 10-ft. intervals in total length, and ensure that no less than 1.5 in. of grout cover is achieved at all locations along the tendon.

Lightly stress installed nails to take up any slack after the grout has reached a compressive strength of at least 1.5 ksi.

(f) Construction sequencing – Follow the construction sequence on the approved plans closely.

(g) Nail testing:

(1) Equipment – Provide a dial gauge capable of measuring to 0.001 in. to measure movement. A hydraulic jack and gauge calibrated as a unit shall be used to apply the test load. Provide pressure gauge graduated in 100 psi increments or less and use to measure the applied load. Apply test load incrementally.

(2) Pullout testing – Install one nail per horizontal row, but no more than 3 percent of the total number of nails as non-service nails, and load test to pullout failure (maintained movement without increased load). Install and test at each level at a rate consistent with construction operations. Choose test length of nail to cause pullout failure prior to steel yield, but not at less than 8 ft. Provide a minimum ungrouted zone 3 ft. long to the face. The method of installation and size of the drill hole shall be the same as for the production nails.
Grout in place each test nail as part of a regular production grouting process. After grouting, do not load for a minimum of three days.

Perform pullout test by incrementally loading the nail in accordance with the following schedule. Measure nail movement and record to the nearest 0.001 in. with respect to an independent fixed reference point at each increment of load. Monitor the test with a pressure gauge. The load hold period shall start as soon as the test load is applied. Movement shall be recorded at 1 minute, 2, 3, 4, 5, 6 and 10 minutes. Each increment of load shall be no greater than 15 percent of the steel yield strength of the nail. Terminate loading at failure or earlier, at the option of the contractor, if the design friction limit is demonstrated.

(3) Acceptance criteria – The nail is acceptable if the developed friction limit at failure is greater than the design friction limit. Unacceptable test results shall result in modification to design and/or construction procedures. Any modification of design or construction procedures shall be at no change in the contract prices. Graphs shall be plotted during the test of deflection against load.

(h) Cast-in-place concrete facing – At the completion of the sequenced construction and where required, construct cast-in-place structural facing in accordance with the provisions of Section 1001, Pub. 408.

(i) Precast concrete facing – At the completion of the sequenced construction and where required, construct precast concrete structural facing in accordance with the provisions for precast concrete panels for mechanically stabilized embankments. Attachment devices are to be shown on the plans as to size and material composition.