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Please contact Tony Allen at 360-705-5450 or allent@wsdot.wa.gov with comments, questions, or suggestions for improvement to the manual.

For printed manuals, page numbers indicating portions of the manual that are to be removed and inserted are shown below.

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Washington State Department of Transportation
Geotechnical Services
1655 S 2nd Avenue
Tumwater, WA 98512-6951
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Preapproved Wall Appendix: Specific Requirements and Details for Tensar ARES Walls

Preapproved Wall Appendix: Specific Requirements and Details for Nelson Walls

Preapproved Wall Appendix: Specific Requirements and Details for Tensar Welded Wire Form Walls
In addition to the general design requirements provided in Appendix 15-A, the following specific requirements apply:

The detailed design methodology, design properties, and assumptions used by Tensar Earth Technologies for the ARES wall are summarized in the HITEC evaluation report for this wall system (HITEC, 1997, Evaluation of the Tensar ARES Retaining Wall System, ASCE, CERF Report No. 40301). The design methodology, which is based on the Standard Specifications for Highway Bridges (2002) is consistent with the general design requirements in Appendix 15-A, except as noted below. Interim approval is given for the continued use of the AASHTO Standard Specifications as the basis for design.

Reinforcement pullout shall be calculated based on the default values for geogrid reinforcement provided in the AASHTO Specifications. For LRFD based design, while it is recognized that product and soil type specific pullout interaction coefficients obtained in accordance with the AASHTO LRFD Specifications for the Tensar products used with this wall system are provided in the HITEC report for the ARES Wall system, pullout resistance design using these product and soil specific interaction coefficients has not been calibrated using the available product specific data statistics and reliability theory. Therefore, the specified resistance factors in the GDM and AASHTO LRFD Specifications should not be considered applicable to the product specific pullout interaction coefficients provided in the HITEC report.

The reinforcement long-term tensile strengths (T_{al}) provided in the WSDOT Qualified Products List (QPL) for the Tensar Geogrid product series, which are based on the 2003 version of the product series, shall be used for wall design, until such time that they are updated, and the updated strengths approved for WSDOT use in accordance with WSDOT Standard Practice T925. Until such time that the long-term reinforcement strengths are updated, it shall be verified that any material sent to the project site for this wall system is the 2003 version of the product. Furthermore, the short-term ultimate tensile strengths (ASTM D6637) listed in the QPL shall be used as the basis for quality assurance testing and acceptance of the product as shipped to the project site per the WSDOT Standard Specifications for Construction.

The HITEC report provided details and design criteria for a panel slot connector to attach the geogrid reinforcement to the facing panel. Due to problems with cracking of the facing panel at the location of the slot, that connection system has been discontinued and replaced with a full thickness panel in which geogrid tabs have been embedded into the panel. For this new connection system, the geogrid reinforcement is connected to the geogrid tab through the use of a Bodkin joint. Construction and fabrication inspectors should verify that the panels to be used for WSDOT projects do not contain the discontinued slot connector.
The Bodkin connection test results provided by letter to WSDOT dated September 28, 2004, were performed on the 2003 version of the Tensar geogrid product line. In that letter, it was stated that UMESA6 (UX1700HS) will typically be used for the connector tabs, regardless of the product selected for the reinforcement. If a lighter weight product is used for the connector tabs, the connection strength will need to be reduced accordingly. Table 15-(Tensar ARES)-1 provides a summary of the connection strengths that are approved for use with the ARES wall system.

<table>
<thead>
<tr>
<th>Tensar Soil Reinforcement Geogrid Product</th>
<th>Tensar Panel Connector Tab Geogrid Product</th>
<th>$T_{ult}$ (MARV) for Geogrid Reinforcement per ASTM D6637 in WSDOT QPL (lbs/ft)</th>
<th>$CR_u$</th>
<th>RF</th>
<th>$T_{ac}$ (lbs/ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>UMESA3/UX1400HS</td>
<td>UMESA6/UX1700HS</td>
<td>4,820</td>
<td>1.0</td>
<td>3.6</td>
<td>1,340</td>
</tr>
<tr>
<td>UMESA4/UX1500HS</td>
<td>UMESA6/UX1700HS</td>
<td>7,880</td>
<td>1.0</td>
<td>3.5</td>
<td>2,250</td>
</tr>
<tr>
<td>UMESA5/UX1600HS</td>
<td>UMESA6/UX1700HS</td>
<td>9,870</td>
<td>1.0</td>
<td>3.4</td>
<td>2,900</td>
</tr>
<tr>
<td>UMESA6/UX1700HS</td>
<td>UMESA6/UX1700HS</td>
<td>12,200</td>
<td>0.91</td>
<td>3.3</td>
<td>3,360</td>
</tr>
<tr>
<td>UMESA3/UX1400HS</td>
<td>UMESA3/UX1400HS</td>
<td>4,820</td>
<td>0.85</td>
<td>3.6</td>
<td>1,140</td>
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<tr>
<td>UMESA4/UX1500HS</td>
<td>UMESA4/UX1500HS</td>
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<td>3.5</td>
<td>1,780</td>
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<td>UMESA5/UX1600HS</td>
<td>UMESA5/UX1600HS</td>
<td>9,870</td>
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<td>3.4</td>
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<td>UMESA6/UX1700HS</td>
<td>UMESA6/UX1700HS</td>
<td>12,200</td>
<td>0.91</td>
<td>3.3</td>
<td>3,360</td>
</tr>
</tbody>
</table>

**Approved Connection Strength Design Values for Tensar Ares Walls**

Table 15-(Tensar ARES)-1

$T_{ac}$, the long-term connection strength, shall be calculated as follows for the Tensar ARES wall:

$$T_{ac} = \frac{T_{MARV} \cdot CR_u}{RF}$$  \hspace{1cm} (15-(Tensar ARES)-1)

where,

$$RF = RF_{ID} \times RF_{CR} \times RF_D$$

and,

$T_{MARV}$ = The minimum average roll value for the ultimate geosynthetic strength $T_{ult}$

$CR_u$ = The ultimate connection strength $T_{ultconn}$ divided by the lot specific ultimate tensile strength, $T_{lot}$ (i.e., the lot of material specific to the connection testing)

$RF_{ID}$ = Reduction factor for installation damage

$RF_{CR}$ = Creep reduction factor for the geosynthetic

$RF_D$ = The durability reduction factor for the geosynthetic
Approved details for the Tensar ARES wall system are provided in the following plan sheets. Exceptions and additional requirements regarding these approved details are as follows:

- For all plan sheets, the full height panel details are not preapproved. Full height panels may be used by special design, with the approval of the State Bridge Design Engineer and the State Geotechnical Engineer, provided a complete wall design with detailed plans are developed and included in the construction contract (i.e., full height panel walls shall not be submitted as shop drawings in design-bid-build projects).

- In plan sheet 3 of 19, there should be a minimum cover of 4 inches of soil between the geogrid and the traffic barrier reaction slab.

- In plan sheet 8 of 19, the strength of the geogrid and connection available shall be reduced by 10% to account for the skew of the geogrid reinforcement. The skew angle relative to the perpendicular from the wall face shall be no more than 10°.

- In plan sheets 10 and 14 of 19, regarding the filter fabric shown, WSDOT reserves the right to require the use WSDOT Standard Specification materials as specified in Standard Specification Section 9-33 that are similar to those specified in this plan sheet.

- In plan sheet 15 of 19, the guard rail detail, the guard rail post shall either be installed through precut holes in the geogrid layers that must penetrated, or the geogrid layers shall be cut in a manner that prevents ripping or tearing of the geogrid.

- The culvert penetration and obstruction avoidance details are preapproved up to a diameter of 2 ft for culvert penetration through the face and up to 4 ft for obstruction avoidance. Larger diameter culverts or obstructions are not considered preapproved. This wall is also preapproved for use with traffic barriers.
# Chapter 15: Preapproved Wall Appendix: Specific Requirements and Details for Tensar ARES Walls

## STANDARD ARES PRECAST PANEL RETAINING WALL DETAILS

<table>
<thead>
<tr>
<th>SHEET</th>
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<th>SHEET</th>
<th>DESCRIPTION</th>
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<td>ARES Retaining Wall Construction Requirements</td>
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<td>ARES Articulated Panel Leveling Pad</td>
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<td>3</td>
<td>ARES Articulated Panel Cross-Section</td>
<td>11</td>
<td>ARES Full Height Panel Leveling Pad</td>
</tr>
<tr>
<td>4</td>
<td>ARES Full Height Panel Cross-Section</td>
<td>12</td>
<td>Panel Coping</td>
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<tr>
<td>5</td>
<td>ARES Articulated Panels</td>
<td>13</td>
<td>Obstructions</td>
</tr>
<tr>
<td>6</td>
<td>ARES Full Height Panels</td>
<td>14</td>
<td>Typical Details</td>
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<tr>
<td>7</td>
<td>Corner/Slip Joint Elements</td>
<td>15</td>
<td>32 Inch Type ‘F’ Traffic Barrier Standard</td>
</tr>
<tr>
<td>8</td>
<td>Geogrid Panel Connection</td>
<td>16</td>
<td>42 Inch Type ‘F’ Traffic Barrier Standard</td>
</tr>
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## CONSTRUCTION DRAWINGS

Prepared For

STATE OF WASHINGTON
DEPARTMENT OF TRANSPORTATION

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**Note:** This page contains technical details and specifications for Tensar ARES precast panel retaining walls, including construction drawings and requirements. The content is specific to the state of Washington's Department of Transportation and is intended for use in geotechnical design and engineering projects. The details provided include sheet numbers, descriptions, and specific components of the ARES system, such as geogrid panels, leveling pads, and traffic barriers. These specifications are crucial for ensuring the structural integrity and safety of retaining wall projects.
ARTICULATED PANEL CONNECTION DETAIL - PLAN VIEW
NOT TO SCALE

FULL HEIGHT PANEL CONNECTION DETAIL - PLAN VIEW
NOT TO SCALE

Panel Connection Detail Section (A-A)

To form a panel, bond connection for connections to facing panel:
1. Bend the last aperture of reinforcing mesh as shown.
2. Pass the side of the side attached through the side of the facing panel at the level of the wall at the point where reinforcing mesh intersects the wall.
3. Pull reinforcing mesh to tension connection.

Panel Connection - Bonding Detail

WSDOT Geotechnical Design Manual
M 46-03.07
April 2012

Revisions

Standard ARES Precast Panel Retaining Wall Details

Geogrid Panel Connection
In addition to the general design requirements provided in Appendix 15-A, the following specific requirements apply to the design of the Nelson Wall:

No HITEC evaluation report is currently available for this wall system. However, in general, this wall system is used as a precast concrete substitute for the WSDOT Standard Plan Reinforced Concrete Cantilever Wall. The design procedures used for Nelson Walls are based on the AASHTO Standard Specifications for Highway Bridges (2002). Interim approval is given for the continued use of the AASHTO Standard Specifications as the basis for design.

The preapproved height for this wall system (28 ft) is less than the standard preapproved height of 33 ft for proprietary wall systems. Use of this wall system for heights greater than 28 ft requires approval by the State Bridge Design Engineer and the State Geotechnical Engineer.

Approved details for the Nelson Wall system are provided in the following plan sheets. Note that no approved details for penetration of culverts or other objects through the wall face were provided. Therefore, this wall system is not preapproved for such situations. This wall system is preapproved for placement of traffic barriers on top of the wall.
In addition to the general design requirements provided in Appendix 15-A, the following specific design requirements shall be met:

No HITEC evaluation report is currently available for this wall system. Design procedures for specific elements of the wall system have been provided to WSDOT in a submittal dated May 20, 2005, and final Wall Details submitted May 26, 2005. The design procedures used by Tensar Earth Technologies (TET) are in full conformance with the AASHTO LRFD Bridge Design Specifications (2004).

This wall system consists of Tensar geogrid reinforcement that is connected to a welded wire facing panel. Regarding the welded wire facing panel, the minimum wire size acceptable for permanent walls is W4.5, and the welded wire shall be galvanized in accordance with the AASHTO LRFD specifications. The actual wire size submitted is W4.0. The exception regarding the wire size is allowed. Due to the smaller wire size, there is some risk that the welded wire form will not provide the full 75 year life required for the wall. Therefore, to insure internal stability of the wall, the geogrid reinforcement shall be wrapped fully behind the face to add the redundancy needed to insure the wall face system is stable for the required design life. The galvanization requirement for the welded wire form still applies, however, as failure of the welded wire form at some point during the wall design life could allow some local sagging of the wall face to occur. The minimum clear opening dimension of the facing panel, or backing mat if present, shall not exceed the minimum particle size of the wall facing backfill. The maximum particle size for the wall facing backfill shall be 4 inches. The maximum vertical spacing of soil reinforcement shall be 18 inches for vertical and battered wall facings.

The geogrid tensile strengths used for design for this wall system shall be as listed in the WSDOT Qualified Products List (QPL).

The Bodkin connection shown in the typical cross-section (page 15-(Tensar WW)-1) may be used subject to the following conditions:

- No more than one Bodkin connection may be used within any given layer, and on no more than 50% of the layers in a given section of wall.

- If the Bodkin connection is located outside of the active zone for the wall as defined in the AASHTO LRFD Bridge Design Specifications plus 3 ft and is located at least 4 ft from the face, no reduction in design tensile strength due to the presence of the Bodkin connection is required.
• If the Bodkin connection is located closer to the wall face than as described immediately above, the design tensile strength of the reinforcement shall be reduced to account for the Bodkin connection. Table 15-(Tensar WW)-1 provides a summary of the reduction factors to be applied to account for the presence of the Bodkin connection.

<table>
<thead>
<tr>
<th>Tensar Primary Soil Reinforcement Geogrid Product</th>
<th>Tensar Product to Which Soil Reinforcement is Connected</th>
<th>Connection Strength Reduction Factor, CRu</th>
</tr>
</thead>
<tbody>
<tr>
<td>UMESA3/UX1400HS</td>
<td>UMESA6/UX1700HS</td>
<td>1.0</td>
</tr>
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<td>UMESA4/UX1500HS</td>
<td>UMESA6/UX1700HS</td>
<td>1.0</td>
</tr>
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</tr>
<tr>
<td>UMESA6/UX1700HS</td>
<td>UMESA6/UX1700HS</td>
<td>0.91</td>
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<td>UMESA3/UX1400HS</td>
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<td>0.85</td>
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<tr>
<td>UMESA6/UX1700HS</td>
<td>UMESA6/UX1700HS</td>
<td>0.91</td>
</tr>
</tbody>
</table>

**Approved Bodkin Connection Strength Reduction Factors for Tensar Welded Wire Form Walls**

Table 15-(Tensar WW)-1

Approved details for the Tensar Welded Wire Form Wall system are provided in the following plan sheets. Exceptions and additional requirements regarding these approved details are as follows:

• Though not shown in the approved plan sheets, if guard rail is to be placed at the top of the wall, the guard rail post shall either be installed through precut holes in the geogrid layers that must penetrated, or the geogrid layers shall be cut in a manner that prevents ripping or tearing of the geogrid.

• In plan sheets on pages 3, 4, 5, and 13, regarding the geotextiles shown, WSDOT reserves the right to require the use WSDOT Standard Specification materials as specified in Standard Specification Section 9-33 that are similar to those specified in this plan sheet.

• Regarding the plantable face alternate plan details on page 6, this alternative shall only be considered approved if specifically called out in the contract specifications.

• Regarding the welded wire form and support strut details on page 7, galvanization is required per the contract specifications for all permanent walls.
• Regarding the geogrid penetration plan sheet detail on page 15, alternative 1 from Article 11.10.10.4 of AASHTO LRFD Bridge Design Specifications shall be followed to account for the portion of the geogrid layer cut through by the penetration. For penetration diameters larger than 30 inches or closer than 3 ft from the wall face, Alternative 2 in AASHTO LRFD Article 11.10.10.4 shall apply to accommodate the load transfer and to provide a stable wall face.

• The culvert penetration and obstruction avoidance details are preapproved up to a diameter of 4 ft for culvert penetration through the face and up to 2.5 ft for obstruction avoidance. Larger diameter culverts or obstructions are not considered preapproved. This wall is also preapproved for use with traffic barriers.

• This wall system is preapproved for both a welded wire/gravel fill face for vertical to near vertical facing batter, and welded wire vegetated face, provided a minimum horizontal step of 6 inches between each facing lift is used, effectively battering the wall face at 3V:1H or flatter. The horizontal step is necessary to reduce vertical stress on the relatively compressible topsoil placed immediately behind the facing so that settlement of the facing does not occur.
TYPICAL CROSS-SECTION

DESCRIPTION: TYPICAL CROSS-SECTION
FILE NAME: WWFSS5.DWG
NOTES:
1. SEE WELDED WIRE FACING UNIT DETAIL FOR MATERIAL AND DIMENSIONS.
2. ALL FACING UNITS SHALL BE GALVANIZED AS PER ASTM A123 AFTER FABRICATION.
3. OPTIONAL THIN LAYER OF FINER STONE MAY BE PLACED AT THE TOP OF EACH UNIT TO PROVIDE A LEVEL SURFACE FOR THE UNIT ABOVE.

ALTERNATE WELDED WIRE FACING DETAIL
NOT TO SCALE

DESCRIPTION: ALTERNATE WELDED WIRE FACING DETAIL
FILE NAME: WWF1w204305.DWG

Tensar Earth Technologies Inc.
ALTERNATE WELDED WIRE FACING DETAIL (1" - 2" FACE FILL)

NOT TO SCALE

NOTES:
1. SEE WELDED WIRE FACING UNIT DETAIL FOR MATERIAL AND DIMENSIONS.
2. ALL FACING UNITS SHALL BE GALVANIZED AS PER ASTM A123 AFTER FABRICATION.

AASHTO M288 CLASS 3 GEOTEXTILE

DESCRIPTION
ALTERNATE WERRASCAPE FACING DETAIL (1" - 2" FACE FILL)

FILE NAME: WWFSS26020305.DWG

Tensar Earth Technologies Inc.

TYPICAL DETAIL
Chapter 15 Preapproved Wall Appendix: Specific Requirements and Details for Tensar Welded Wire Form Walls

**ALTERNATE WELDED WIRE FORM FACING DETAIL (PLANTABLE FACE FILL)**

NOT TO SCALE

**NOTES:**
1. SEE WELDED WIRE FORM FACING UNIT DETAIL FOR FACING MATERIAL AND DIMENSIONS.
2. FACING UNITS SHALL BE CONSTRUCTED FROM BLACK STEEL.
3. PLANTABLE FILL OR TOP SOIL MAY BE PLACED AT THE FACE TO SUPPORT VEGETATION GROWTH.

**WSDOT Geotechnical Design Manual M 46-03.07 Page 149**

April 2012
SUPPORT STRUT LENGTH
(MEASURE INSIDE HOOK-INSIDE HOOK)

1.5" (TYP.)

ELECTROPLATED

SUPPORT STRUT

WIRE STRUTS
2'-0" C/C TYP.
(FIELD ADJUST AS REQUIRED)

1.5'

VIEW A

2.0' C/C MAX.
(AS REQUIRED)

1.5'

10'-0"

4x4-W4.0xW4.0
WELDED WIRE FABRIC

NOTES:
1. FACING TO CONSIST OF PREFABRICATED WWF 4x4-W4.0xW4.0 FORMS.
2. ALL FORMS SHALL BE GALVANIZED PER ASTM A123 AFTER BENDING WHEN REQUIRED.
3. OVERALL LENGTH OF WIRE FORMS IS 10'-0", EFFECTIVE CONSTRUCTED WIDTH IS 9'-8" WITH 4" OVER LAPPING AT ENDS.
4. STRUT LENGTH AND CROSS-SECTIONAL FORM DIMENSIONS TO BE PROVIDED IN FABRICATORS SHOP DRAWINGS.

WELDED WIRE FORM DETAIL

DESCRIPTION: WELDED WIRE FORM DETAIL

FILE NAME: WWF_0200

Tensar Earth Technologies Inc.

TYPICAL DETAIL
NOTES:
BEND OR CUT BASKETS TO FIT FIELD CONDITIONS
ENSURE THAT GEOTEXTILE AND BIAXIAL GEORIGID OVERLAP 1" MINIMUM

90° OUTSIDE CORNER DETAIL
NOT TO SCALE

Tensar Earth Technologies Inc.
90° INSIDE CORNER DETAIL

NOTE:
BEND, BUTT OR CUT BASKETS TO FIT FIELD CONDITIONS

TIE BASKETS

NOT TO SCALE
MINIMUM 3" OF SOIL BETWEEN OVERLAPPING LAYERS OF GEOGRID

FRONT FACE

TRIM GEOGRID AT FACE WHERE NECESSARY

GEOGRID PLACEMENT ON CURVES
NOT TO SCALE

DESCRIPTION: GEOGRID PLACEMENT ON CURVES
FILE NAME: GPCF2.DWG

Tensar Earth Technologies Inc.

TYPICAL DETAIL
3" soil fill required between overlapping geogrids for proper anchorage

WALL CORNER DETAIL

NOT TO SCALE

Tensar Earth Technologies Inc.
GEOGRID 90° CORNER DETAIL
NOT TO SCALE

TYPICAL DETAIL
**PIPE PENETRATION DETAIL AT WELDED WIRE FACE SYSTEM**

**NOT TO SCALE**

**ELEVATION VIEW**

**PLAN VIEW**

**NOTES:**

1. **ELEVATION VIEW**
   - Cut wire facing as close as possible to pipe penetration.
2. **ELEVATION VIEW**
   - Cut or terminate geogrids 3 inches or less from pipe.
3. **ELEVATION VIEW**
   - Wrap entire pipe with AASHTO M288 Class 3 non-woven drainage geotextile. Ensure that wrap extends at least 12 inches behind wire facing at penetration to ensure no loss of fill.
4. **ELEVATION VIEW**
   - For geogrid layout refer to elevation view for length, type and location.

---

**SELECT FILL (TYP.), (AS REQUIRED BY OTHERS)**

**REINFORCED FILL (TYP.)**

**FIELD CUT WWF BASKETS TO FIT AROUND PIPE (48” MAX. PIPE DIAMETER)**

**EXTENT OF GEOTEXTILE WRAP AT PENETRATION**

---

**TYPICAL DETAIL**

Tensar Earth Technologies Inc.
GEOGRID PLACEMENT AT PIPE

NOT TO SCALE

SPACE EQUAL DISTANCE APART 3" (MIN.)
SOIL COVER BETWEEN GEOGRIDS

2x PIPE DIAMETER (MIN.)

GEOGRID (TYP.)

3" (MIN.) SOIL COVER
BETWEEN PIPE & GEOGRID

DESCRIPTION: GEOGRID PLACEMENT AT PIPE
FILE NAME: DPP1.DWG

Tensar Earth Technologies Inc.
CUT OPENING IN GEOGRID A MAX. OF 2" LARGER THAN VERTICAL STRUCTURES

30.0" (MAX.)

3.0' (MIN.)

FRONT FACE OF WIRE FORM WALL

NOTE: FOR OTHER CONDITIONS APPLY THE PROVISIONS OF ARTICLE 11.10.10.4 OF AASHTO LRFD SPECIFICATIONS.

GEOGRID PENETrATION
NOT TO SCALE

Tensar Earth Technologies Inc.

TYPICAL DETAIL
TO FORM A BODKIN CONNECTION:
1. BEND THE LAST APERTURE OF ONE PIECE OF GEOGRID IN HALF.


3. PULL BOTH PIECES OF GEOGRID IN OPPOSITE DIRECTIONS TO COMPLETE CONNECTION.

NOTE:
THE SPliced GEOGRID PIECE ON EITHER SIDE OF THE BODKIN CONNECTION BE AT LEAST 5 FEET LONG UNLESS THE GEOGRID TERMINATES IN A FIXED CONNECTION.

BODKIN CONNECTION
NOT TO SCALE

Tensar Earth Technologies Inc.
Appendix 15-D  Preapproved Proprietary Wall Systems

The following wall systems are preapproved for use in WSDOT projects:

<table>
<thead>
<tr>
<th>Wall Supplier</th>
<th>System Name</th>
<th>System Description</th>
<th>ASD/LFD or LRFD?</th>
<th>Height, or Other Limitations</th>
<th>Year Initially Approved</th>
<th>Last Approved Update</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Reinforced Earth Co. 8614 Westwood Center Dr. Suite 1100 Vienna, VA 22182 703-821-1175</td>
<td>Reinforced Earth Wall</td>
<td>Precast concrete 5’x5’ facing panels and steel strip soil reinforcement</td>
<td>ASD/LFD</td>
<td>33 ft</td>
<td>1987</td>
<td>Approved 11/9/04 (submitted 3/29/04)</td>
</tr>
<tr>
<td>L.B. Foster Company Foster Geotechnical 1660 Hotel Circle North, Suite 304 San Diego, CA 92108-2803 619-688-2400</td>
<td>Retained Earth Wall</td>
<td>Precast concrete 5’x5’ facing panels and steel bar mat soil reinforcement</td>
<td>ASD/LFD</td>
<td>33 ft</td>
<td>Unknown</td>
<td>Approved 11/9/04 (submitted 12/11/03)</td>
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<tr>
<td>Tensar Earth Technologies, Inc. 5883 Glenridge Drive, Suite 200 Atlanta, GA 30328 404-250-1290</td>
<td>ARES Wall</td>
<td>Precast concrete 5’x5’ facing panels and Tensar geogrid soil reinforcement</td>
<td>ASD/LFD</td>
<td>33 ft</td>
<td>1998</td>
<td>Approved 11/9/04 (submitted 8/6/04)</td>
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<tr>
<td>Hilfiker Retaining Walls 3900 Broadway PO Box 2012 Eureka, CA 95503-5707 707-443-5093</td>
<td>Eureka Reinforced Soil Wall</td>
<td>Precast concrete 5’x5’ facing panels and welded wire mat soil reinforcement</td>
<td>ASD/LFD</td>
<td>33 ft</td>
<td>Unknown</td>
<td>Approved 11/9/04 (submitted 10/5/04)</td>
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<tr>
<td>Hilfiker Retaining Walls 3900 Broadway P.O. Box 2012 Eureka, CA 95503-5707 707-443-5093</td>
<td>Welded Wire Retaining Wall</td>
<td>Welded wire facing that is continuous with welded wire soil reinforcement</td>
<td>ASD/LFD</td>
<td>33 ft*</td>
<td>Unknown</td>
<td>Approved 11/9/04 (submitted 9/15/03)</td>
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<tr>
<td>Keystone Retaining Wall Systems, Inc. 4444 West 78th Street Minneapolis, MN 55435 952-897-1040</td>
<td>Key System I Wall</td>
<td>Modular dry cast concrete block facing with steel welded wire ladder strip soil reinforcement</td>
<td>ASD/LFD</td>
<td>33 ft</td>
<td>2001</td>
<td>Approved 11/9/04 (submitted 3/31/04)</td>
</tr>
<tr>
<td>Tensar Earth Technologies, Inc. 5883 Glenridge Drive, Suite 200 Atlanta, GA 30328 404-250-1290</td>
<td>MESA Wall</td>
<td>Modular dry cast concrete block facing with Tensar geogrid soil reinforcement</td>
<td>ASD/LFD</td>
<td>33 ft</td>
<td>2000</td>
<td>Approved 11/9/04 (submitted 4/19/04 and 9/22/04)</td>
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<tr>
<td>Wall Supplier</td>
<td>System Name</td>
<td>System Description</td>
<td>ASD/LFD or LRFD?</td>
<td>Height, or Other Limitations</td>
<td>Year Initially Approved</td>
<td>Last Approved Update</td>
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<tr>
<td>Nelson Wall 12356 Northup Way,</td>
<td>Nelson Wall</td>
<td>Precast concrete gravity wall (similar to Standard Plan Concrete cantilever wall)</td>
<td>ASD/LFD</td>
<td>28 ft</td>
<td>1995</td>
<td>Approved 11/9/04 (submitted 9/12/03)</td>
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<tr>
<td>Suite 109 Bellevue, WA 98005 425-861-8292</td>
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<tr>
<td>The Neel Company</td>
<td>T-WALL</td>
<td>Precast concrete modular wall</td>
<td>ASD/LFD</td>
<td>25 ft</td>
<td>1994</td>
<td>Approved 11/9/04 (submitted 11/05/04)</td>
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<tr>
<td>Tensar Earth Technologies, Inc.</td>
<td>Welded Wire Form</td>
<td>Tensar geogrid wrapped face wall with welded wire facing form</td>
<td>ASD/LFD</td>
<td>33 ft*</td>
<td>2006</td>
<td>Approved 3/3/06 (submitted 11/26/05)</td>
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<tr>
<td>Atlanta, GA 30328 404-250-1290</td>
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*If the vegetated face option is used for the Hilfiker Welded Wire Retaining Wall or the Tensar Welded Wire Form Wall, the maximum wall height shall be limited to 20 ft. Greater wall heights for the vegetated face option for these walls may be used on a case by case basis as a special design if approved by the State Geotechnical Engineer and the State Bridge Engineer.