Chapter 05

RETAINING WALLS (RW)
GENERAL NOTES

Specifications:

- SHA Specifications dated July, 2008
- Revisions thereof and additions thereto and Special Provisions for Materials and Construction


Concrete Design; LRFD, f'c = 3.0 ksi.

Reinforcing Steel Design; fy = 60.0 ksi.

Concrete:

All structure concrete shall be Mix. No. 3 (3500 psi) except as noted below under reinforcing steel.

Reinforcing Steel:

Reinforcing steel shall conform to A 615, Grade 60. All splices, not shown, shall be lapped as per Bar Lap Charts. Minimum cover for any bar shall be 2" unless otherwise noted, with the exception of bars at the bottom and sides of all footings which shall have 3" minimum cover.

If the front face of a retaining wall less than 10 feet from the edge of paved surfaces, epoxy coated reinforcement shall be used in the front face of the stem and Mix. No. 6 (4500 psi) concrete shall be used for the stem.

ONLY GRADE 60 CAN BE USED.

Design Parameters:

Earth pressure calculated based on Coulomb Theory.

Angle of Internal Friction:
33 degrees for excellent soil
30 degrees for good and poor soils and all walls on pile footings

For Wall Types E and F, passive earth pressure from top of footing to bottom of shear key was utilized in the design. In these cases, the top of footing shall have a minimum of 30" cover.

Safe bearing pressures are factored resistances,
Notes:

1. An "Excellent Soil Condition" is foundation material that can support a safe bearing pressure of 5 ksf and has an angle of friction of 33°.

2. If in the length of a wall the type of wall changes and provides for a different thickness of stem, then "Detail A" shall be used for all walls of greater than the least wall thickness.

3. Contractor has option of lapping main stem reinforcement with rear dowel reinforcement as shown or by extending the rear dowel reinforcement with no splicing. However, no additional compensation to Contractor will be allowed for whichever alternative is selected.

4. These walls are valid if traffic is present on the level area adjacent to the wall.

<table>
<thead>
<tr>
<th>Wall Type</th>
<th>H</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>Rear Dowel Bar</th>
<th>Main Stem Bar</th>
<th>Top Foot, Bar</th>
</tr>
</thead>
<tbody>
<tr>
<td>A-I</td>
<td>6'-0&quot;</td>
<td>1'-0&quot;</td>
<td>9&quot;</td>
<td>2'-0&quot;</td>
<td>3'-0&quot;</td>
<td>1'-0&quot;</td>
<td>2'-2&quot;</td>
<td>#5 @ 1'-0&quot;/6&quot;</td>
<td>#5 @ 1'-0&quot;/6&quot;</td>
<td>#5 @ 1'-0&quot;/6&quot;</td>
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<tr>
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<td>9&quot;</td>
<td>3'-3&quot;</td>
<td>5'-0&quot;</td>
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<td>2'-2&quot;</td>
<td>#5 @ 1'-0&quot;/6&quot;</td>
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<td>5'-6&quot;</td>
<td>7'-3&quot;</td>
<td>1'-3&quot;</td>
<td>2'-7&quot;</td>
<td>#6 @ 1'-0&quot;/6&quot;</td>
<td>#6 @ 1'-0&quot;/6&quot;</td>
<td>#6 @ 1'-0&quot;/6&quot;</td>
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<td>#7 @ 1'-0&quot;/6&quot;</td>
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<td>#7 @ 1'-0&quot;/6&quot;</td>
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</table>

State of Maryland
Department of Transportation
State Highway Administration
Office of Structures

Type A Retaining Wall Section
(For Excellent Soil Condition and Two Foot Surcharge)

Version 1.0

Detail No. RW-102

Sheets 1 of 1
DETAIL A
Scale: None
(See note 2 below)

*Where specific footing concrete and stem concrete items are included in the Proposal for a particular wall, these shall be the pay limits. Where no specific items have been set up in the Proposal, the cost of wall shall be included in the main structure Contract price, i.e.; box culvert, where wings are included in box culvert item; retaining wall, where no separate pay items are established, etc.

**Where in the length of a wall the type of wall changes and provides for a different thickness of stem, greater than the least wall thickness, an alternative is selected.

**Notes:
1. A "Good Soil Condition" is that foundation material that can support a safe bearing pressure of 4 ksf and has an angle of friction of 30°.
2. If in the length of a wall the type of wall changes and provides for a different thickness of stem, then "Detail A" shall be used for all walls of greater than the least wall thickness.
3. Contractor has option of lapping main stem reinforcement with rear dowel reinforcement as shown or by extending the rear dowel reinforcement with no splicing. However, no additional compensation to Contractor will be allowed for whichever alternative is selected.

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<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>Rear Dowel Bar</th>
<th>Main Stem Bar</th>
<th>Top Foot Bar</th>
</tr>
</thead>
<tbody>
<tr>
<td>B-I</td>
<td>6'-0''</td>
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<td>9''</td>
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<td>2'-7''</td>
<td>#5 @ 1'-0''%</td>
<td>#5 @ 1'-0''%</td>
<td>#5 @ 1'-0''%</td>
</tr>
<tr>
<td>B-II</td>
<td>8'-0''</td>
<td>1'-0''</td>
<td>9''</td>
<td>3'-6''</td>
<td>5'-3''</td>
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<td>#5 @ 1'-0''%</td>
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<td>2'-1''</td>
<td>#6 @ 6''%</td>
<td>#6 @ 6''%</td>
<td>#6 @ 6''%</td>
</tr>
<tr>
<td>B-IV</td>
<td>12'-0''</td>
<td>1'-0''</td>
<td>1'-0''</td>
<td>5'-6''</td>
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<td>#6 @ 6''%</td>
<td>#6 @ 6''%</td>
<td>#6 @ 6''%</td>
</tr>
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<td>14'-0''</td>
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<td>16'-0''</td>
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<td>18'-0''</td>
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<tr>
<td>B-VIII</td>
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<td>4'-6''</td>
<td>#8 @ 6''%</td>
<td>#8 @ 1'-0''%</td>
<td>#8 @ 6''%</td>
</tr>
</tbody>
</table>

**Notes:
4. These walls are valid if traffic is present on the level area adjacent to the wall.
Notes:
If in the length of a wall the type of wall changes and provides for a different thickness of stem, greater than the least wall thickness, an alternative is selected.

1. Where specific footing concrete and stem concrete items are included in the Proposal for a particular wall, these shall be the pay limits. Where no specific items have been set up in the Proposal, the cost of wall shall be included in the main structure Contract price, i.e.; box culvert, where wings are included in box culvert item; retaining wall, where no separate pay items are established, etc.

2. These walls are valid if traffic is present on the level area adjacent to the wall.

3. Contractor has option of lapping main stem reinforcement with rear dowel reinforcement as shown or by extending the rear dowel reinforcement with no splicing. However, no additional compensation to Contractor will be allowed for whichever alternative is selected.

4. "Poor Soil Condition" is foundation material that can support a safe bearing pressure of 3 ksf and has an angle of friction of 30°.

5. ** Where specific footing concrete and stem concrete items are included in the Proposal for a particular wall, these shall be the pay limits. Where no specific items have been set up in the Proposal, the cost of wall shall be included in the main structure Contract price, i.e.; box culvert, where wings are included in box culvert item; retaining wall, where no separate pay items are established, etc.

6. ** #4 @ 1'-6" c/c for wall types C-I thru C-IV
   ** #4 @ 1'-0" c/c for wall types C-V and C-VI
   ** #5 @ 1'-0" c/c for wall types C-VII and C-VIII

** For Drainage System, see RW-301 or SUB-DR-203

** This wall is used for all walls of a particular total length of wall.
**Where specific footing concrete and stem concrete items are included in the Proposal for a particular wall, these shall be the pay limits. Where no specific items have been set up in the Proposal, the cost of wall shall be included in the main structure contract price, i.e.; box culvert, where wings are included in box culvert item; retaining wall, where no separate pay items are established, etc.**

**Notes:**
1. An "Excellent Soil Condition" is foundation material that can support a safe bearing pressure of 5 ksf and has an angle of friction of 33°.
2. If in the length of a wall the type of wall changes and provides for a different thickness of stem, then "Detail A" shall be used for all walls of greater than the least wall thickness.
3. Contractor has option of lapping main stem reinforcement with rear dowel reinforcement as shown or by extending the rear dowel reinforcement with no splicing. However, no additional compensation to Contractor will be allowed for whichever alternative is selected.
4. These walls are valid if the sloping backfill levels off and traffic is present on the level area.

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### TYPICAL SECTION

<table>
<thead>
<tr>
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<th>H</th>
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<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>Main Stem Bar</th>
<th>Top Footing Bar</th>
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<td>#5 @ 1'-0&quot;</td>
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<td>#6 @ 1'-0&quot;</td>
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<td>#7 @ 1'-0&quot;</td>
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<td>D-V</td>
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<td>5'-9&quot;</td>
<td>#11 @ 1'-0&quot;</td>
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</table>

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**For Drainage System, See RW-301 or SUB-0R-203**

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**STATE OF MARYLAND**

**DEPARTMENT OF TRANSPORTATION**

**STATE HIGHWAY ADMINISTRATION**

**OFFICE OF STRUCTURES**

**TYPE D RETAINING WALL SECTION**

(For Excellent Soil Condition and Sloping Groundline)
Where specific footing concrete and stem concrete items are included in the Proposal for a particular wall, these shall be the pay limits. Where no specific items have been set up in the Proposal, the cost of wall shall be included in the main structure contract price, i.e.: box culvert, where wings are included in box culvert items; retaining wall, where no separate pay items are established, etc.

Pour against undisturbed material

<table>
<thead>
<tr>
<th>Wall Type</th>
<th>H</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>Straight Rear Dowel Bar</th>
<th>Hooked Rear Dowel Bar</th>
<th>Main Stem Bar</th>
<th>Top Foot, Bar</th>
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<tr>
<td>E-I</td>
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<td>9 @ 1'-0%&quot;</td>
<td>9 @ 1'-0%&quot;</td>
<td>9 @ 6&quot;%</td>
</tr>
</tbody>
</table>

Notes:
1. A "Good Soil Condition" is that foundation material that can support a safe bearing pressure of 4 ksf and has an angle of friction of 30°.
2. If in the length of a wall the type of wall changes and provides for a different thickness of stem, then "Detail A" shall be used for all walls of greater than the least wall thickness.
3. Contractor has option of lapping main stem reinforcement with rear dowel reinforcement as shown or by extending the rear dowel reinforcement with no splicing. However, no additional compensation to Contractor will be allowed for whichever alternative is selected.

These walls are valid if the sloping backfill levels off and traffic is present on the level area.
**NOTES:**

1. "Poor Soil Condition" is that foundation material that can support a safe bearing pressure of 3 ksf and has an angle of friction of 30°.
2. If in the length of a wall the type of wall changes and provides for a different thickness of stem, then "Detail A" shall be used for all walls of greater than the least wall thickness.
3. Contractor has option of lapping main stem reinforcement with rear dowel reinforcement (as shown) or by extending the rear dowel reinforcement with no splicing. However, no additional compensation will be allowed for whichever alternative is selected.

### TYPICAL SECTION

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<thead>
<tr>
<th>Wall Type</th>
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<th>Main Stem Bar</th>
<th>Top Foot,Bar</th>
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<tbody>
<tr>
<td>F-I</td>
<td>6'-0&quot;</td>
<td>1'-0&quot;</td>
<td>1'-9&quot;</td>
<td>4'-6&quot;</td>
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<td>2'-2&quot;</td>
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<td>*4 @ 1'-6&quot; c/c</td>
<td>*5 @ 1'-0&quot; c/c</td>
<td>*5 @ 1'-0&quot; c/c</td>
<td>*5 @ 6&quot;</td>
</tr>
<tr>
<td>F-II</td>
<td>8'-0&quot;</td>
<td>1'-0&quot;</td>
<td>1'-9&quot;</td>
<td>4'-9&quot;</td>
<td>1'-6&quot;</td>
<td>1'-0&quot;</td>
<td>2'-2&quot;</td>
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</tr>
<tr>
<td>F-III</td>
<td>10'-0&quot;</td>
<td>1'-0&quot;</td>
<td>1'-9&quot;</td>
<td>5'-6&quot;</td>
<td>1'-3&quot;</td>
<td>1'-0&quot;</td>
<td>2'-2&quot;</td>
<td>1'-0&quot;</td>
<td>*5 @ 1'-0&quot; c/c</td>
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<td>*5 @ 1'-0&quot; c/c</td>
<td>*5 @ 6&quot;</td>
</tr>
<tr>
<td>F-IV</td>
<td>12'-0&quot;</td>
<td>1'-3&quot;</td>
<td>2'-0&quot;</td>
<td>7'-3&quot;</td>
<td>10'-6&quot;</td>
<td>1'-6&quot;</td>
<td>3'-6&quot;</td>
<td>2'-0&quot;</td>
<td>*7 @ 1'-0&quot; c/c</td>
<td>*7 @ 1'-0&quot; c/c</td>
<td>*7 @ 1'-0&quot; c/c</td>
<td>*7 @ 6&quot;</td>
</tr>
<tr>
<td>F-V</td>
<td>14'-0&quot;</td>
<td>1'-6&quot;</td>
<td>3'-0&quot;</td>
<td>7'-6&quot;</td>
<td>12'-0&quot;</td>
<td>1'-9&quot;</td>
<td>3'-6&quot;</td>
<td>3'-0&quot;</td>
<td>*7 @ 1'-0&quot; c/c</td>
<td>*7 @ 1'-0&quot; c/c</td>
<td>*7 @ 1'-0&quot; c/c</td>
<td>*7 @ 6&quot;</td>
</tr>
<tr>
<td>F-VI</td>
<td>16'-0&quot;</td>
<td>1'-9&quot;</td>
<td>4'-0&quot;</td>
<td>8'-6&quot;</td>
<td>14'-3&quot;</td>
<td>2'-0&quot;</td>
<td>4'-7&quot;</td>
<td>3'-0&quot;</td>
<td>*8 @ 1'-0&quot; c/c</td>
<td>*8 @ 1'-0&quot; c/c</td>
<td>*8 @ 1'-0&quot; c/c</td>
<td>*8 @ 6&quot;</td>
</tr>
<tr>
<td>F-VII</td>
<td>18'-0&quot;</td>
<td>2'-3&quot;</td>
<td>5'-0&quot;</td>
<td>10'-3&quot;</td>
<td>17'-6&quot;</td>
<td>2'-3&quot;</td>
<td>5'-9&quot;</td>
<td>3'-0&quot;</td>
<td>*9 @ 1'-0&quot; c/c</td>
<td>*9 @ 1'-0&quot; c/c</td>
<td>*9 @ 1'-0&quot; c/c</td>
<td>*9 @ 6&quot;</td>
</tr>
<tr>
<td>F-VIII</td>
<td>20'-0&quot;</td>
<td>2'-9&quot;</td>
<td>6'-3&quot;</td>
<td>12'-0&quot;</td>
<td>21'-0&quot;</td>
<td>2'-6&quot;</td>
<td>5'-9&quot;</td>
<td>3'-0&quot;</td>
<td>*9 @ 1'-0&quot; c/c</td>
<td>*9 @ 1'-0&quot; c/c</td>
<td>*9 @ 1'-0&quot; c/c</td>
<td>*9 @ 6&quot;</td>
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*These walls are valid if the sloping backfill levels off and traffic is present on the level area.
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*4 @ 1'-6" c/c for wall types G-I thru G-IV
*4 @ 1'-0" c/c for wall types G-V and G-VI
*5 @ 1'-0" c/c for wall types G-VII and G-VIII

* **Typ.**

For Drainage System, See RW-301 or SUB-DR-203
Notes:
1. If in the length of a wall, the type of wall changes and provides for a different thickness of stem, then "Detail A" shall be used for all walls of greater than the least wall thickness.
2. Contractor has option of lapping stem reinforcement with toe reinforcement and/or dowels as shown; or by extending the toe and/or dowel reinforcement with no splicing. However, no additional compensation to Contractor will be allowed for whichever alternative is selected.
3. H piles shown for illustrative purpose only. For pile type, see Pile Layout on pertinent Contract Drawing.
4. Pile spacings are maximum. For actual pile spacing, see Pile Layout on pertinent contract drawing.
5. These walls are valid if traffic is present on the level area adjacent to the wall.
6. Capacities include resistance factors (LRFD only).

### Typical Pile Plan

#### Scale: 1/2" = 1'-0"

<table>
<thead>
<tr>
<th>Wall Type</th>
<th>H</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>Main Stem Bar</th>
<th>Top Footing Bar</th>
<th>Bottom Footing Bar</th>
</tr>
</thead>
<tbody>
<tr>
<td>G-I</td>
<td>6'-0&quot;</td>
<td>1'-0&quot;</td>
<td>0'-9&quot;</td>
<td>4'-3&quot;</td>
<td>6'-0&quot;</td>
<td>2'-3&quot;</td>
<td>#5 @ 1'-0&quot;</td>
<td>#5 @ 1'-0&quot;</td>
<td>#5 @ 1'-0&quot;</td>
</tr>
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</tr>
<tr>
<td>G-III</td>
<td>10'-0&quot;</td>
<td>1'-0&quot;</td>
<td>0'-9&quot;</td>
<td>4'-3&quot;</td>
<td>6'-0&quot;</td>
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<td>#5 @ 6&quot;</td>
<td>#7 @ 1'-0&quot;</td>
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</tr>
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<td>12'-0&quot;</td>
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<td>4'-3&quot;</td>
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<tr>
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<td>4'-3&quot;</td>
<td>7'-0&quot;</td>
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<td>20'-0&quot;</td>
<td>2'-0&quot;</td>
<td>2'-6&quot;</td>
<td>4'-3&quot;</td>
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<td>#8 @ 6&quot;</td>
<td>#8 @ 1'-0&quot;</td>
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</tbody>
</table>

### Pile Capacity - Design Load

<table>
<thead>
<tr>
<th>Pile Capacity</th>
<th>25 TONS</th>
<th>40 TONS</th>
<th>55 TONS</th>
<th>70 TONS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>J</td>
<td>K</td>
<td>J</td>
<td>K</td>
</tr>
<tr>
<td>25 TONS</td>
<td>5'-0&quot;</td>
<td>10'-0&quot;</td>
<td>5'-0&quot;</td>
<td>10'-0&quot;</td>
</tr>
<tr>
<td>40 TONS</td>
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<td>10'-0&quot;</td>
</tr>
<tr>
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<td>10'-0&quot;</td>
</tr>
<tr>
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### TYPICAL PILE PLAN

Scale: 1/2" = 1'-0"

### PILE CAPACITY - DESIGN LOAD

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### Notes:

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6. Capabilities include resistance factors (LRFD only).
GUIDE FOR ABUTMENT AND WING WALL FOOTING INTERSECTION

90° ABUTMENT
Scale: \( \frac{1}{4''} = 1'-0'' \)

SKewed AButMENT
Scale: \( \frac{1}{4''} = 1'-0'' \)

Note:
For additional details of expansion joint refer to SUB-WW-101

* GUIDE SHEET FOR PLAN DEVELOPMENT ONLY - DO NOT INCLUDE THIS SHEET IN CONTRACT PLANS *

* FOR OFFICE USE ONLY *

STATE OF MARYLAND
DEPARTMENT OF TRANSPORTATION
STATE HIGHWAY ADMINISTRATION
OFFICE OF STRUCTURES

STANDARD RETAINING WALL
STANDARD DETAILS

DETAIL NO. RW-201

APPROVAL
DIRECTOR
OFFICE OF STRUCTURES
DATE: 09/16/2019
VERSION
1.01

SHEET 1 OF
4" PVC pipe, Slope pipe 2% to outlet. Invert at outlet to be 2" above gutter line. (15' Maximum Spacing)

Top of proposed sidewalk. Provide joint in sidewalk over PVC pipe.

If front face of wall is visible to vehicular or pedestrian traffic, drain pipe shall extend 3' from face of wall for sidewalks adjacent to wall see above for all other conditions make flush.

This system shall be used for all box culvert wing walls and other wing walls that are both less than 30' long and less than 15' high height of wall from bottom of footing to top of highest section. One drain shall be placed at C of wall for all walls less than 15' long. For walls between 15' and 30' long, two drains shall be placed, one at each third point.

SYSTEM I

This system shall be used for all retaining walls, all wing walls (not in System II).

SYSTEM II

Note:
1. Exact elevation of drain to be determined by Engineer in field.
2. Porous backfill refer to Section 469.
3. Use this standard for bridges with wing walls that are not parallel to the highway. For bridges with wing walls parallel to the highway see Std. No. SUB-DR-203 sheet 5 of 5 for details.
Joint locations shall be as shown on contract drawing. If no locations are given concrete retaining walls shall have contraction joints a maximum of every 30'-0"; and expansion joints, with 1" sponge type material (see 911.02), a maximum of every 90'-0".

2. Stop key 9" below top of wall.

3. Reinforcing steel shall not pass through contraction or expansion joint.

4. For battered walls, with stems greater than 12 feet height, key dimensions noted thus *, shall be based on wall thickness at mid height.

5. All keys are nominal size.

6. Only place contraction and expansion joints in stems (no joint in footer).

Notes:

1. Exposed face to have 3/4" x 3/4" chamfer.

2. Be sure last vertical bar is placed at this location for segment with recessed key.

3. 2" cl. typ.*

4. Dampproof one side full height of key.

5. No chamfer required on non-exposed face.

6. This dimension will vary on battered walls.

1/2" 1/2"

2" cl. typ.*

\[ W = \text{Width at top of wall}, \]

\[ \frac{W}{3} \quad \frac{W}{3} \quad \frac{W}{3} \]

\[ 1" \text{ Sponge type joint material full height of wall. Fasten to one face with copper nails. (See note 1, below).} \]

\[ \frac{W}{6} \quad \frac{W}{6} \]

\[ 1" \text{ Sponge type joint material full height of wall. Fasten to one face with copper nails. (See note 1, below).} \]

\[ 1/2" \]

\[ 1/2" \]

\[ 1/2" \]

\[ 1" \text{ Sponge type joint material full height of wall. Fasten to one face with copper nails. (See note 1, below).} \]
Bend these bars and extend to bottom of lower footer.

Normal reinforcing steel Top and bottom (Typ.).

Maximum vertical spacing is 1'-0'' for additional bars.

Additional #5 bars.

If bottom mat is called for, bend upper layer of bottom mat and extend upward as shown.

If no bottom layer is called for, then additional #5 bars bent thus shall be provided @ 1'-0'', #5 bars @ 1'-0'' shall also be provided perpendicular to these bars for the 5'-0'' length.

Slope as steep as ground will allow.

1'-6'' For footings 2'-0'' thick and over.

1'-0'' For footings under 2'-0'' thick.

Notes:
1. All keys are nominal size.

**KEY SIZES**

<table>
<thead>
<tr>
<th>T</th>
<th>Key</th>
</tr>
</thead>
<tbody>
<tr>
<td>1'-0'' to 1'-5''</td>
<td>2'' x 4''</td>
</tr>
<tr>
<td>1'-6'' to 1'-11''</td>
<td>3'' x 6''</td>
</tr>
<tr>
<td>2'-0'' to 2'-5''</td>
<td>4'' x 8''</td>
</tr>
<tr>
<td>2'-6'' to 3'-0''</td>
<td>5'' x 10''</td>
</tr>
</tbody>
</table>

**TYPICAL SECTION**

Scale: 3/8''=1'-0''

### VERSION

1.0

**STATE OF MARYLAND**

**DEPARTMENT OF TRANSPORTATION**

**STATE HIGHWAY ADMINISTRATION**

**OCCUPY OF STRUCTURES**

**ASSISTANT DIRECTOR**

**STATEMENT OF COMPLIANCE**

**DATE: 08/28/2002**

**STEPPE FOOTING DETAIL**

**DETAIL NO. RW-402**
**Stepped Footing Detail with Piles**

**Notes:**
1. Steel H piles shown. Other pile types similar.
2. See Plan of Footing for orientation of piles.

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**Key Sizes**

<table>
<thead>
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</tr>
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</table>

**Typical Section**

Scale: $\frac{3}{8}'' = 1'-'0''$

---

*To center line of pile and to end of lower footer.*
Note:

1. Increase the size of each of the first three normal main vertical reinforcing steel bars, on each side of the wall opening. New bar size shall be such that each increase in bar area shall at least equal \( \frac{1}{6} \) the total area of the main reinforcing steel that has been cut.

2. When pipe size is over 3'-0'', sufficient horizontal bars shall be added over and below opening to transfer load to adjacent full sections of wall.

3. In no case shall concrete cover be less than 2''.

Adjust adjacent vertical & horizontal steel pattern so that nearest bars to opening are placed at minimum distances. (This also applies to front face of wall.)