EARTH RETAINING STRUCTURES ARE CLASSIFIED INTO TWO GROUPS

GROUP 1:
Designer Must Provide Complete Design And Plan Details
GROUP 2:

Designer Makes Only A Conceptual Application, And Reviews A Contractor-Chosen Proprietary Design After The Letting, Through Shop Plans And Computations

EARTH RETAINING STRUCTURES

IN FILL SECTIONS

Used With Embankment Where Allowance For Side Slopes Is Limited

FILL-SECTION SYSTEM

TYPES OF EARTH RETAINING STRUCTURES IN FILL SECTIONS

GROUP 1

SYSTEMS

CONCRETE GRAVITY WALL

Height Range
\[ H = 3 \text{ to } 10 \text{ ft} / 1 \text{ to } 3 \text{ m} \]

\[ R / W \text{ Required} \]
\[ 0.5 \text{ to } 0.7 \text{ of } H \]

\[ \text{Cost: } \$15 / \text{ft}^2 \text{ or } \$150 / \text{m}^2 \]
Concrete Gravity Wall

Typical Section

CONCRETE CANTILEVER WALL

Height Range
H = 5 to 30 ft / 1.5 to 9 m

R/W Required
0.4 to 0.7 of H

Cost: $50 / ft² or $500 / m²

Reinforced Concrete Cantilever Wall Typical Section

CONCRETE COUNTERFORT WALL

Height Range
H = 30 to 60 ft / 9 to 18 m

R/W Required
0.4 to 0.7 of H

Cost: $50 / ft² or $500 / m²

Reinforced Concrete Counterfort Wall Typical Section
GABIONS

Height Range
  $H = 5 \text{ to } 15 \text{ ft} / 1.5 \text{ to } 5 \text{ m}$

R / W Required
  0.5 to 0.7 of $H$

Cost: $40 / \text{ft}^2 \ or \ $400 / \text{m}^2$

Gabion Wall Baskets

Gabion Wall

Typical Section

REINFORCED SOIL SLOPES

Height Range
  $H = 10 \text{ to } 100 \text{ ft} / 3 \text{ to } 30 \text{ m}$

R / W Required
  0.5 to 1.0 of $H$

Cost: $60 / \text{ft}^2 \ or \ $600 / \text{m}^2$

May Also Be Used Temporarily.
GROUP 2 SYSTEMS

CONCRETE CRIB WALL

Height Range
\[ H = 5 \text{ to } 35 \text{ ft} / 1.5 \text{ to } 11 \text{ m} \]

\[ R/W \text{ Required} \]
\[ 0.5 \text{ to } 0.7 \text{ of } H \]

Cost: $30 / ft^2 \text{ or } $300 / m^2
MECHANICALLY STABILIZED EARTH, PRECAST PANELS

Height Range
\[ H = 10 \text{ to } 65 \text{ ft} / 3 \text{ to } 20 \text{ m} \]

R / W Required
1.7 to 2.0 times \( H \)

Cost: $50 / ft\(^2\) or $500 / m\(^2\)
MSE Wall, Precast Panels
Typical Section Showing Forces

MECHANICALLY STABILIZED EARTH, GEOGRID FACING

Height Range
H = 5 to 50 ft / 1.5 to 15 m

R / W Required
0.7 to 1.0 of H

Cost: $20 / ft² or $200 / m²

MSE Wall, Geogrid Facing

Modular Block Walls

MODULAR BLOCK WALL WITH REINFORCEMENT

Height Range
H = 3 to 10 ft / 1 to 3 m

R/W Required
0.7 to 1.0 of H

Cost: $20 / ft² or $200 / m²
Modular Block Wall With Reinforcement -- Typical Section

MODULAR BLOCK WALL
WITHOUT REINFORCEMENT

Height Range
H = 2 to 5 ft / 0.5 to 1.5 m

R/W Required
0.5 to 0.7 of H

Cost: $35 / ft² or $350 / m²

Modular Block Wall Without Reinforcement -- Typical Section

BINWALL

Height Range
H = 5 to 35 ft / 1.5 to 11 m

R/W Required
0.5 to 0.7 of H

Cost: $30 / ft² or $300 / m²
EARTH RETAINING STRUCTURES

IN CUT SECTIONS

Used In Cut Sections
Where Extensive
Backslopes Are Impractical,
Or Soil To Be Retained
Is Of Poor Quality

TYPES OF EARTH RETAINING STRUCTURES
IN CUT SECTIONS

GROUP 1 SYSTEMS
ONLY
**SHEET PILING**

*Height Range*

\[ H = 0 \text{ to } 15 \text{ ft} / 0 \text{ to } 5 \text{ m} \]

*R/W Required*

None

*Cost:*

\[ \$100 / \text{ft}^2 \text{ or } \$1000 / \text{m}^2 \]

May Also Be Used Temporarily

---

**SOLDIER PILING OR TIEBACK WALL**

*Height Range*

\[ H = 0 \text{ to } 15 \text{ ft} / 0 \text{ to } 5 \text{ m} \]

*R/W Required*

None

*Cost:*

\[ \$25 / \text{ft}^2 \text{ or } \$250 / \text{m}^2 \]

May Also Be Used Temporarily.
ANCHORED WALL

Height Range
\[ H = 15 \text{ to } 65 \text{ ft} / 5 \text{ to } 20 \text{ m} \]

R / W Required
0.5 of \( H \), plus anchor bond length

Cost: $60 / ft^2 or $600 / m^2

May Also Be Used Temporarily.

SOIL NAILING

Height Range
\[ H = 10 \text{ to } 65 \text{ ft} / 3 \text{ to } 20 \text{ m} \]

R / W Required
0.6 to 1.0 of \( H \)

Cost: $45 / ft^2 or $450 / m^2

May Also Be Used Temporarily.
GEOTECHNICAL CONSIDERATIONS

Most Foundations Are Shallow, Without Piles, On Dense Sand Or Silty Clay, And Not On Soft Soils Such As Peat, Marl, Or Silt.

Reinforced Concrete Cast-In-Place Group 1 Walls In Fill Sections May Be Founded On Piles, So As To Get Through Soft Soils.
SYSTEM SELECTION
CONSIDERATIONS

Future Uses Of The Site

Differential Deflection Or Settlement Of Wall Sections

Project-Specific Special Features

SYSTEM SELECTION
CONSIDERATIONS

Long- And Short-Term System Stability

Comparable Degree Of Safety

Accessibility To Construction Site

SYSTEM SELECTION
CONSIDERATIONS

Staged-Construction Limitations

Right-Of-Way Limits

Site-Imposed Physical Limitations

SYSTEM SELECTION
CONSIDERATIONS

Seismic Activity

Wall Inundation

Aesthetics

SYSTEM SELECTION
CONSIDERATIONS

Environment Sensitivity

Construction Time Restraints

Economics

ECONOMIC CONSIDERATIONS
WHEN SELECTING A GROUP 2 SYSTEM

Fill Section Or Cut Section?

Wall Area

Average Wall Height
ECONOMIC CONSIDERATIONS
WHEN SELECTING A
GROUP 2 SYSTEM

Foundation Conditions
Availability And Cost Of
Select Backfill
Availability And Cost Of
Right Of Way

GEOTECHNICAL INFORMATION
REQUEST
Field Check Plans Stage:
  System's Beginning And
Ending Stations
  Top And Bottom Elevations
  Locations Of Steps

DESIGN GUIDELINES
Chapter 68 of The Indiana
Design Manual's New
Part VI, Structures,
Is Forthcoming This Year, And
Will Include Everything We've
Discussed Today In More Detail.

<table>
<thead>
<tr>
<th>WALL TYPE</th>
<th>HEIGHT</th>
<th>CMR</th>
<th>R/W REQD.</th>
<th>SPECS</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>FILL, GROUP 1</td>
<td>0.5-1.5</td>
<td>0.5</td>
<td>0.5</td>
<td>0.5</td>
<td>SS</td>
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<tr>
<td>CONCRETE GRAVITY</td>
<td>0.5-1.5</td>
<td>0.5</td>
<td>0.5</td>
<td>0.5</td>
<td>SS</td>
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<tr>
<td>REINF. CONC. CANTILEVER</td>
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<td>0.5</td>
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<td>SS</td>
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<td>0.5</td>
<td>0.5</td>
<td>0.5</td>
<td>SS</td>
</tr>
<tr>
<td>GABIONS</td>
<td>0.5-1.5</td>
<td>0.5</td>
<td>0.5</td>
<td>0.5</td>
<td>SS</td>
</tr>
<tr>
<td>REINFORCED SOIL SLOPES</td>
<td>0.5-1.5</td>
<td>0.5</td>
<td>0.5</td>
<td>0.5</td>
<td>SS</td>
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<tr>
<td>CONCRETE CRIBWALL</td>
<td>0.5-1.5</td>
<td>0.5</td>
<td>0.5</td>
<td>0.5</td>
<td>SS</td>
</tr>
<tr>
<td>MSE, PRECAST PANELS</td>
<td>0.5-1.5</td>
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<td>0.5</td>
<td>0.5</td>
<td>SS</td>
</tr>
<tr>
<td>MSE, GEOGRID FACED</td>
<td>0.5-1.5</td>
<td>0.5</td>
<td>0.5</td>
<td>0.5</td>
<td>SS</td>
</tr>
<tr>
<td>MODULAR BLOCK, WITH REINF.</td>
<td>0.5-1.5</td>
<td>0.5</td>
<td>0.5</td>
<td>0.5</td>
<td>SS</td>
</tr>
<tr>
<td>MODULAR BLOCK, W/O REINF.</td>
<td>0.5-1.5</td>
<td>0.5</td>
<td>0.5</td>
<td>0.5</td>
<td>SS</td>
</tr>
<tr>
<td>BINWALL</td>
<td>0.5-1.5</td>
<td>0.5</td>
<td>0.5</td>
<td>0.5</td>
<td>SS</td>
</tr>
<tr>
<td>SHEET PILING</td>
<td>0.5-1.5</td>
<td>0.5</td>
<td>0.5</td>
<td>0.5</td>
<td>SS</td>
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<tr>
<td>SOLID PILE</td>
<td>0.5-1.5</td>
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<td>0.5</td>
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<td>SS</td>
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<tr>
<td>HOLLOW PILE</td>
<td>0.5-1.5</td>
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<td>SS</td>
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<tr>
<td>NARROW</td>
<td>0.5-1.5</td>
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<td>0.5</td>
<td>0.5</td>
<td>SS</td>
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<tr>
<td>WIDE</td>
<td>0.5-1.5</td>
<td>0.5</td>
<td>0.5</td>
<td>0.5</td>
<td>SS</td>
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</tbody>
</table>

DESIGN GUIDELINES
Earth Retaining Systems Are To
Be Designed In Accordance With
AASHTO Standard Specifications
For Highway Bridges.

In The Current Edition,
This Information Is Mostly In
Part I, Section 5.
### SUMMARY OF WALL TYPES AND PROPERTIES

<table>
<thead>
<tr>
<th>WALL TYPE</th>
<th>HEIGHT RANGE</th>
<th>R/W REQD.</th>
<th>COST PER</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Meters</td>
<td>Feet</td>
<td>m²</td>
</tr>
<tr>
<td>FILL, GROUP 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CONCRETE GRAVITY</td>
<td>0.5-1.5</td>
<td>1-5</td>
<td>0.5-0.7</td>
</tr>
<tr>
<td>REINF. CONC. CANTILEVER</td>
<td>1.5-9</td>
<td>5-30</td>
<td>0.4-0.7</td>
</tr>
<tr>
<td>REINF. CONC. COUNTERFORT</td>
<td>9-18</td>
<td>30-60</td>
<td>0.4-0.7</td>
</tr>
<tr>
<td>GABIONS</td>
<td>1.5-5</td>
<td>5-15</td>
<td>0.5-0.7</td>
</tr>
<tr>
<td>REINFORCED SOIL SLOPES</td>
<td>3-30</td>
<td>10-100</td>
<td>0.5-1.0</td>
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<tr>
<td></td>
<td></td>
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<tr>
<td>FILL, GROUP 2</td>
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<td></td>
</tr>
<tr>
<td>CONCRETE CRIBWALL</td>
<td>1.5-11</td>
<td>5-35</td>
<td>0.5-0.7</td>
</tr>
<tr>
<td>MSE, PRECAST PANELS</td>
<td>3-20</td>
<td>10-65</td>
<td>1.7-2.0</td>
</tr>
<tr>
<td>MSE, GEOGRID FACING</td>
<td>1.5-15</td>
<td>5-50</td>
<td>0.7-1.0</td>
</tr>
<tr>
<td>MODULAR BLOCK, WITH REINF.</td>
<td>1-3</td>
<td>3-10</td>
<td>0.7-1.0</td>
</tr>
<tr>
<td>MODULAR BLOCK, W/O REINF.</td>
<td>0.5-1.5</td>
<td>2-5</td>
<td>0.5-0.7</td>
</tr>
<tr>
<td>BINWALL</td>
<td>1.5-11</td>
<td>2-35</td>
<td>0.5-0.7</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CUT, GROUP 1</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>SHEET PILING</td>
<td>0-5</td>
<td>0-15</td>
<td>0</td>
</tr>
<tr>
<td>SOLDIER PILES OR TIEBACK</td>
<td>0-5</td>
<td>0-15</td>
<td>0</td>
</tr>
<tr>
<td>ANCHORED WALL</td>
<td>5-20</td>
<td>15-65</td>
<td>0.5</td>
</tr>
<tr>
<td>SOIL NAILING</td>
<td>3-20</td>
<td>10-65</td>
<td>0.6-1.0</td>
</tr>
</tbody>
</table>

R/W REQD. – Required Portion of Wall Height Shown

SPECS – SS: In Standard Specifications
RSP: Among Recurring Special Provisions
U: Unique Special Provision Currently Required
<table>
<thead>
<tr>
<th>SS</th>
<th>Used for shortest concrete wall required.</th>
</tr>
</thead>
<tbody>
<tr>
<td>SS</td>
<td>The basic, most common Group 1 fill wall type.</td>
</tr>
<tr>
<td>SS</td>
<td>Used if taller cantilever wall required.</td>
</tr>
<tr>
<td>RSP</td>
<td>Best where aesthetics not a concern.</td>
</tr>
<tr>
<td>U</td>
<td>Relatively new.</td>
</tr>
<tr>
<td>U</td>
<td>Rarely used.</td>
</tr>
<tr>
<td>RSP</td>
<td>The most common Group 2 wall type.</td>
</tr>
<tr>
<td>U</td>
<td>Rarely used.</td>
</tr>
<tr>
<td>RSP</td>
<td>Still limited use, mostly local agencies.</td>
</tr>
<tr>
<td>RSP</td>
<td>Group 2 complement to concrete gravity wall.</td>
</tr>
<tr>
<td>U</td>
<td>Rarely used.</td>
</tr>
<tr>
<td>SS</td>
<td>Most common cut wall type; most often temp.</td>
</tr>
<tr>
<td>U</td>
<td>May be temporary.</td>
</tr>
<tr>
<td>U</td>
<td>Relatively new; may be temporary.</td>
</tr>
<tr>
<td>U</td>
<td>Relatively new; may be temporary.</td>
</tr>
</tbody>
</table>