DESIGN CONSIDERATIONS AND ALTERNATIVES FOR EARTH RETAINING STRUCTURES

WHERE TO CONSIDER AN EARTH RETAINING STRUCTURE

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
\[ H = 3 \text{ to } 10 \text{ ft} / 1 \text{ to } 3 \text{ m} \]
\[ R / W \text{ Required} \]
\[ 0.5 \text{ to } 0.7 \text{ of } H \]
Cost: $15 / ft² or $150 / m²
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 to 15 ft / 1.5 to 5 m

R / W Required
0.5 to 0.7 of H

Cost: $40 / ft² or $400 / m²

REINFORCED SOIL SLOPES

Height Range
H = 10 to 100 ft / 3 to 30 m

R / W Required
0.5 to 1.0 of H

Cost: $60 / ft² or $600 / m²

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 / ft² or $300 / m²
MECHANICALLY STABILIZED EARTH, PRECAST PANELS

Height Range
$H = 10$ to $65$ ft / $3$ to $20$ m

$R/W$ Required
$1.7$ to $2.0$ times $H$

Cost: $50/ft^2$ or $500/m^2$

Concrete Crib Wall
Typical Section

MSE Wall, Precast Panels --
Steps and Walkway

MSE Wall, Precast Panels --
Railroad Overpass and Wing

MSE Wall, Precast Panels --
Roadway Overpass Abutment

MSE Wall, Precast Panels
Typical Section
**MSE Wall, Precast Panels**

**Typical Section Showing Forces**

**MECHANICALLY STABILIZED EARTH, GEOGRID FACING**

**Height Range**

\[ H = 5 \text{ to } 50 \text{ ft} / 1.5 \text{ to } 15 \text{ m} \]

**R/W Required**

0.7 to 1.0 of \( H \)

**Cost:** $20 / ft² or $200 / m²

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**MSE Wall, Geogrid Facing**

**MODULAR BLOCK WALL WITH REINFORCEMENT**

**Height Range**

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

**R/W Required**

0.7 to 1.0 of \( H \)

**Cost:** $20 / ft² or $200 / m²

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**MSE Wall, Geogrid Facing**

**Typical Section**

**Modular Blockwalls**
**MODULAR BLOCK WALL WITHOUT REINFORCEMENT**

**Height Range**

$H = 2 \text{ to } 5 \text{ ft} / 0.5 \text{ to } 1.5 \text{ m}$

**R/W Required**

$0.5 \text{ to } 0.7 \text{ of } H$

**Cost:** $35 / \text{ ft}^2 \text{ or } $350 / \text{ m}^2$

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**BINWALL**

**Height Range**

$H = 5 \text{ to } 35 \text{ ft} / 1.5 \text{ to } 11 \text{ m}$

**R/W Required**

$0.5 \text{ to } 0.7 \text{ of } H$

**Cost:** $30 / \text{ ft}^2 \text{ or } $300 / \text{ m}^2$
EARTH RETAINING STRUCTURES IN CUT SECTIONS

Used in cut sections where extensive backslopes are impractical, or soil to be retained is of poor quality.
**SHEET PILING**

*Height Range*

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

*R/W Required*

None

*Cost: $100 / ft}^2 \text{ or } $1000 / m}^2*

May Also Be Used Temporarily

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**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 / ft}^2 \text{ or } $250 / 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.

**GEOTECHNICAL CONSIDERATIONS**

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.

**HEIGHT RANGE**

<table>
<thead>
<tr>
<th>WALL TYPE</th>
<th>R/W REQD.</th>
<th>FPERS FEET</th>
<th>COST PER</th>
<th>SPECS</th>
<th>COMMENTS</th>
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<td>FILL, GROUP 1</td>
<td>CONCRETE GRAVITY</td>
<td>0.5-1.5</td>
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<td>REINFORCED SOIL SLOPES</td>
<td>3-30</td>
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<td>FILL, GROUP 2</td>
<td>CONCRETE CRIBWALL</td>
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<td>MSE, PRECAST PANELS</td>
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<td>MSE, GEOGRID FACING</td>
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<td>2-35</td>
<td>0.5</td>
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<tr>
<td>CUT, GROUP 1</td>
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<td>0-15</td>
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<td>1000</td>
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<tr>
<td></td>
<td>SOLDIER PILES OR TIEBACK</td>
<td>0-5</td>
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<tr>
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<td>ANCHORED WALL</td>
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## SUMMARY OF WALL TYPES AND PROPERTIES

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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
SS  USED FOR SHORTEST CONCRETE WALL REQUIRED
SS  THE BASIC MOST COMMON GROUP 1 FILL WALL TYPE
SS  USED IF TALLER CANTILEVER WALL REQUIRED
RSP  BEST WHERE AESTHETICS NOT A CONCERN
U  RELATIVELY NEW

U  RARELY USED
RSP  THE MOST COMMON GROUP 2 WALL TYPE
U  RARELY USED
RSP  STILL LIMITED USE, MOSTLY LOCAL AGENCIES
RSP  GROUP 2 COMPLEMENT TO CONCRETE GRAVITY WALL
U  RARELY USED

SS  MOST COMMON CUT WALL TYPE; MOST OFTEN TEMP.
U  MAY BE TEMPORARY
U  RELATIVELY NEW; MAY BE TEMPORARY
U  RELATIVELY NEW; MAY BE TEMPORARY