

# Slope and Abutment Construction using Geosynthetic Reinforced Soil

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# GRS-IBS (Geosynthetic Reinforced Soil-Integrated Bridge System)

- ▶ Developed in conjunction with US Department of Transportation (US DOT) and Federal Highway Administration (FHWA)
- ▶ Championed by FHWA in 2010
- ▶ Synthesis Report Issued by FHWA in 2011
- ▶ Over 200 Bridges Constructed in over 44 States
- ▶ Part of the FHWA Every-Day Counts program
- ▶ <http://www.fhwa.dot.gov/innovation/everydaycounts/edc-3/grs-ibs.cfm>

# Traditional Concrete Abutment





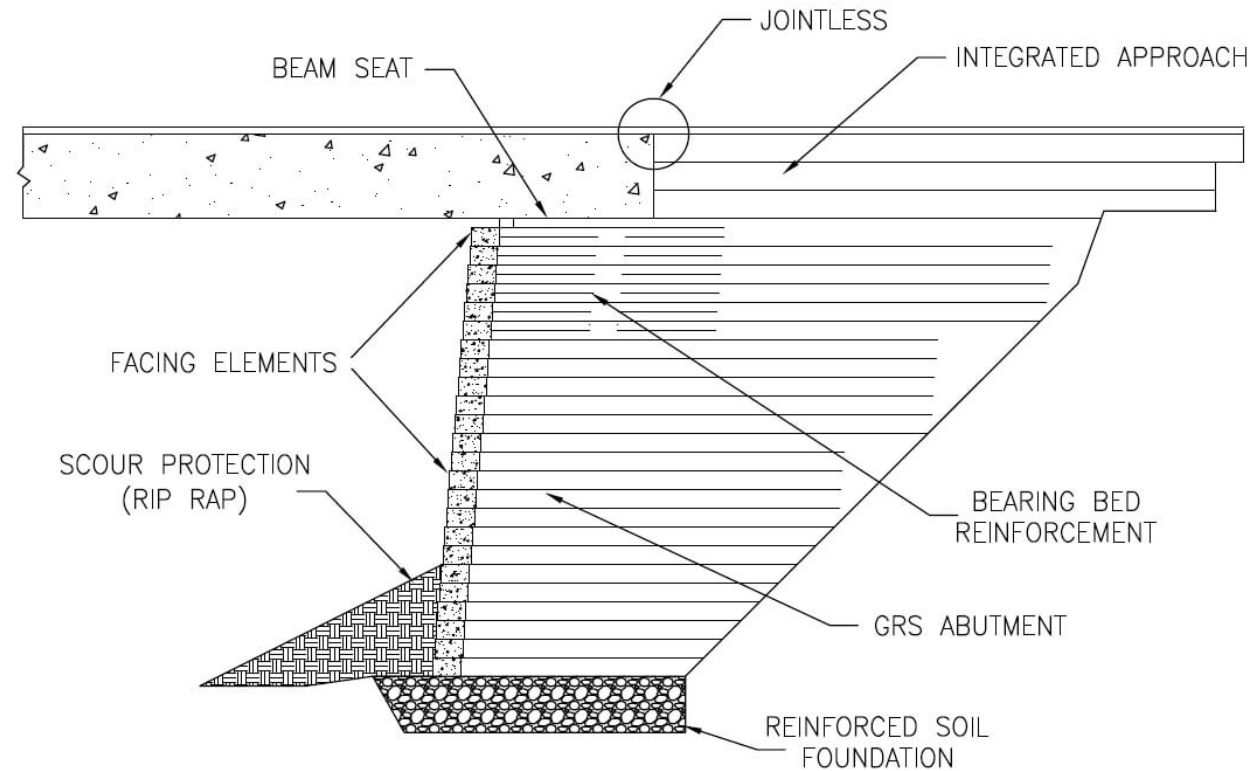
# GRS-IBS Abutment



Photo Courtesy of FHWA

# Benefits of GRS Structure

- ▶ Accelerated Construction
- ▶ Reduced Cost - up to 60%
- ▶ Flexible Design
- ▶ Eliminate the bump at the bridge
- ▶ Environmental Advantages
- ▶ Can Construct in less-than ideal weather conditions
- ▶ Heights up to 30 feet
- ▶ Spans in excess of 150 feet
- ▶ Easy to Install



Typical GRS-IBS Cross-Section

# Basic Design Steps

- ▶ Establish Project Requirements
- ▶ Perform a Site Evaluation
- ▶ Evaluate Project Feasibility
- ▶ Determine layout of GRS-IBS
- ▶ Calculate Loads
- ▶ Conduct External Stability Analysis
- ▶ Conduct Internal Stability Analysis
- ▶ Implement Design Details
- ▶ Finalize GRS-IBS



# Fish Passage Culverts - Corrugated Metal



Fish Passage using Corrugated  
Metal Pipe

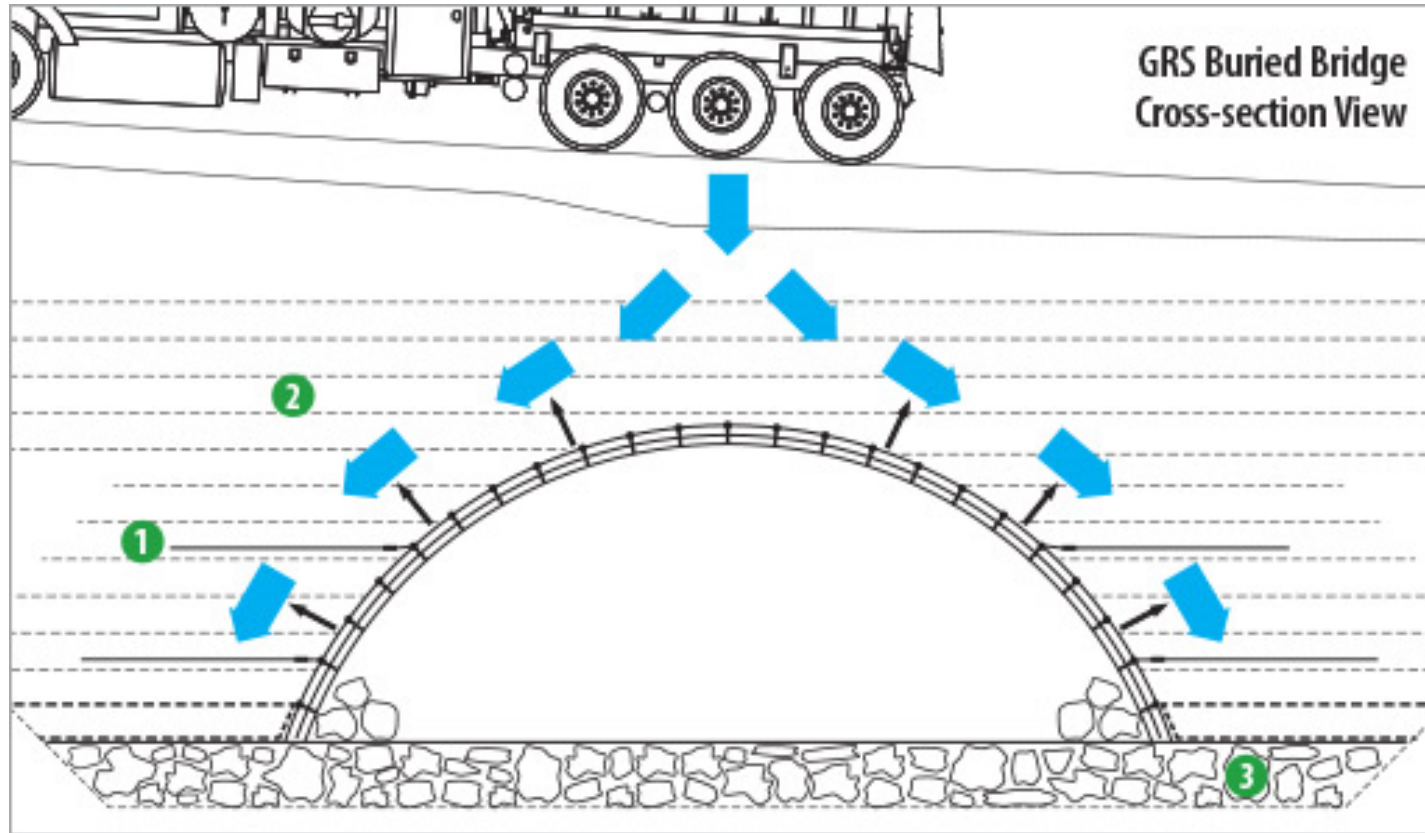
Photo Courtesy of Washington Department of Natural Resources



Fish Passage using Corrugate Metal Pipe and GRS

Photo Courtesy of AIL Canada

# Culvert using GRS



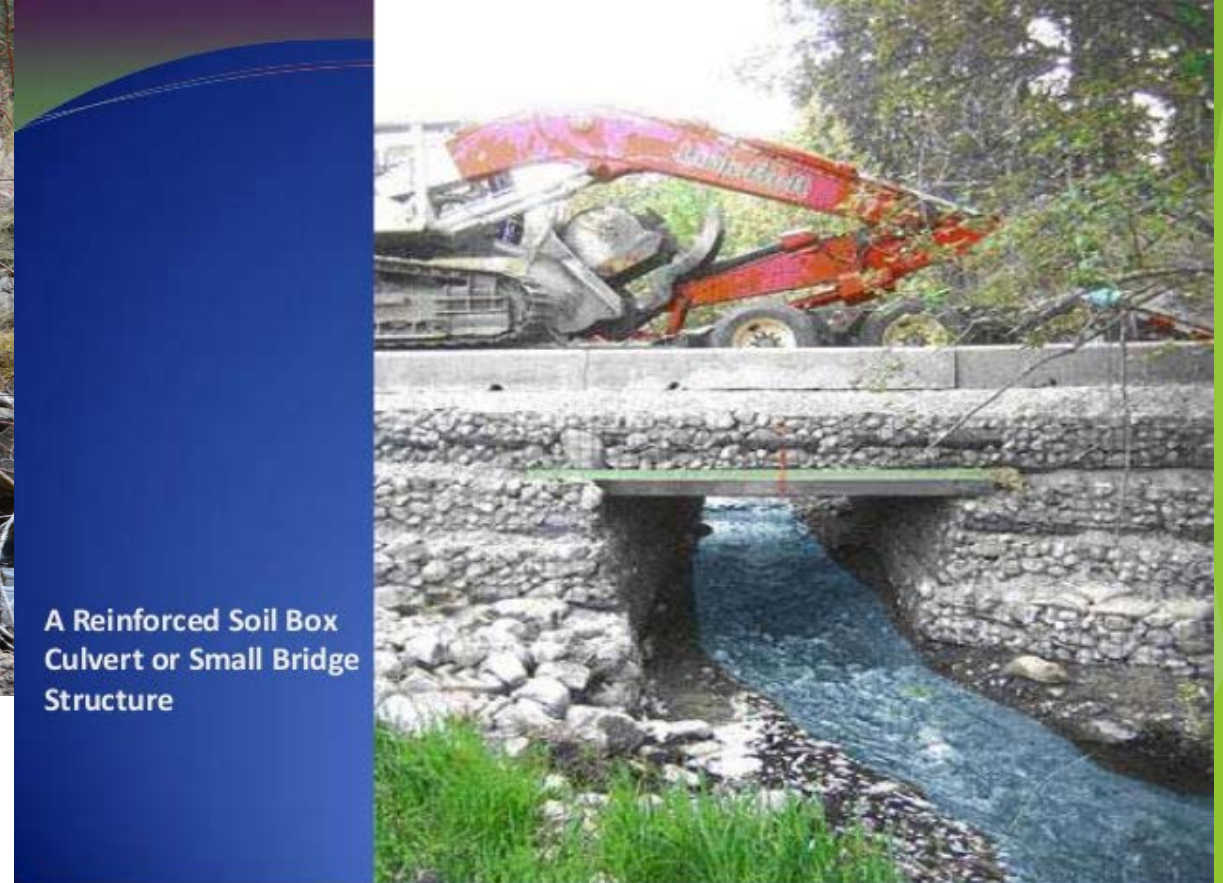


# Box Culvert



**Traditional Concrete Construction**

Photo Courtesy of US Forest Service



**A Reinforced Soil Box  
Culvert or Small Bridge  
Structure**

**GRS-IBS Structure**

Photo Courtesy of FHWA



# GRS-IBS for Fish Passage



GRS-IBS Bridge Abutments

Photo Courtesy of FHWA

# Longer Span Crossing using GRS Abutments



Photo Courtesy of FHWA

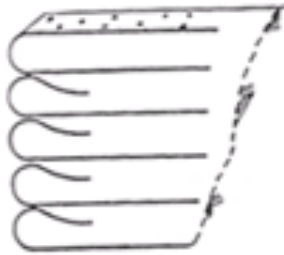


# Construction

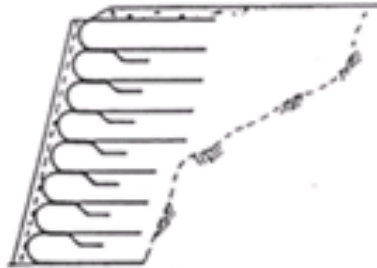


Photo Courtesy of Allen Block Corporation

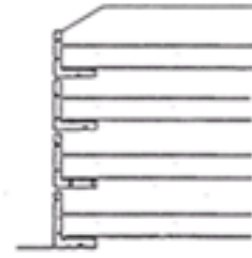
# Facing Element Ideas



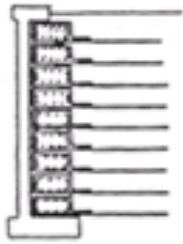
*Wrapped-faced wall*



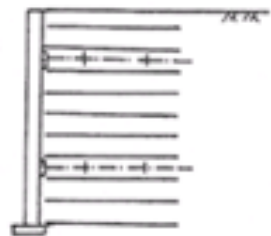
*Wrapped-faced wall  
With shotcrete cover*



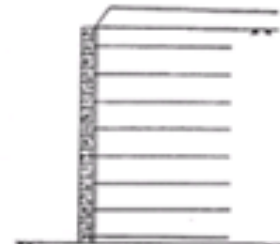
*GRS wall with articulated  
concrete facing*



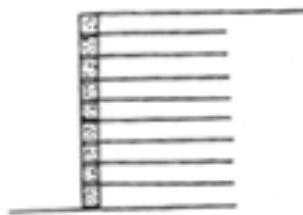
*GRS wall with full-height  
concrete facing*



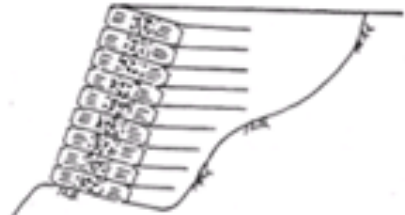
*Full-height concrete  
MSB wall*



*Timber-faced wall*



*Modular block wall*



*Tire-faced wall*



*Gabion-faced wall*

# Negative Batter



Photo Courtesy of Japan Negative Batter Research Center



# Slides and Road Failures



Road Slide near Scottsburg,  
Oregon.



Road Slide near Blue River Reservoir



# Traditional Slide Repair Methods



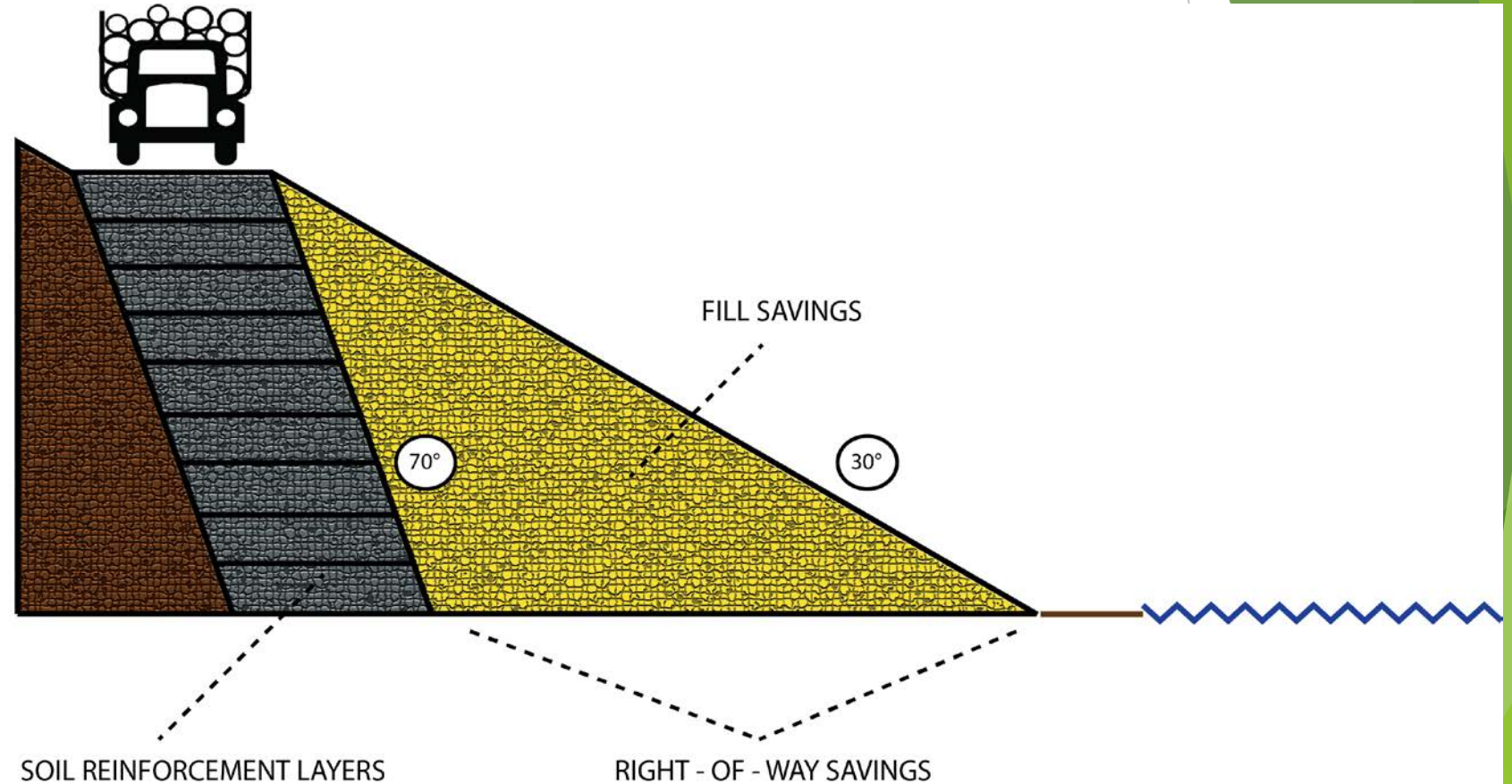
Slide Repair using H-Piles and Timber



Slide Repair using Boulders and Large Rock

# Reinforced Soil Slope Benefits

- ▶ Environmental Advantages
- ▶ Can Construct in less-than ideal weather conditions
- ▶ Slope Heights in excess of 150 feet
- ▶ No Limit on Length of Structure
- ▶ Steeper Slope Angles
- ▶ Less Fill
- ▶ Accelerated Construction
- ▶ Flexible Design





# Reinforced Soil Slopes (RSS)

- ▶ Used by most State DOTs
- ▶ US Forest Service
  - ▶ Deep Patch Road Repair
- ▶ FHWA
- ▶ Concept Developed Thousands of Years ago in Chinese Construction
- ▶ More recently in the 17<sup>th</sup> and 18<sup>th</sup> Century by French Settlers along the Bay of Fundy in Canada
- ▶ Recent History of Reinforced Earth developed by French Architect Henri Vidal in early 1960s

# Design and Construction

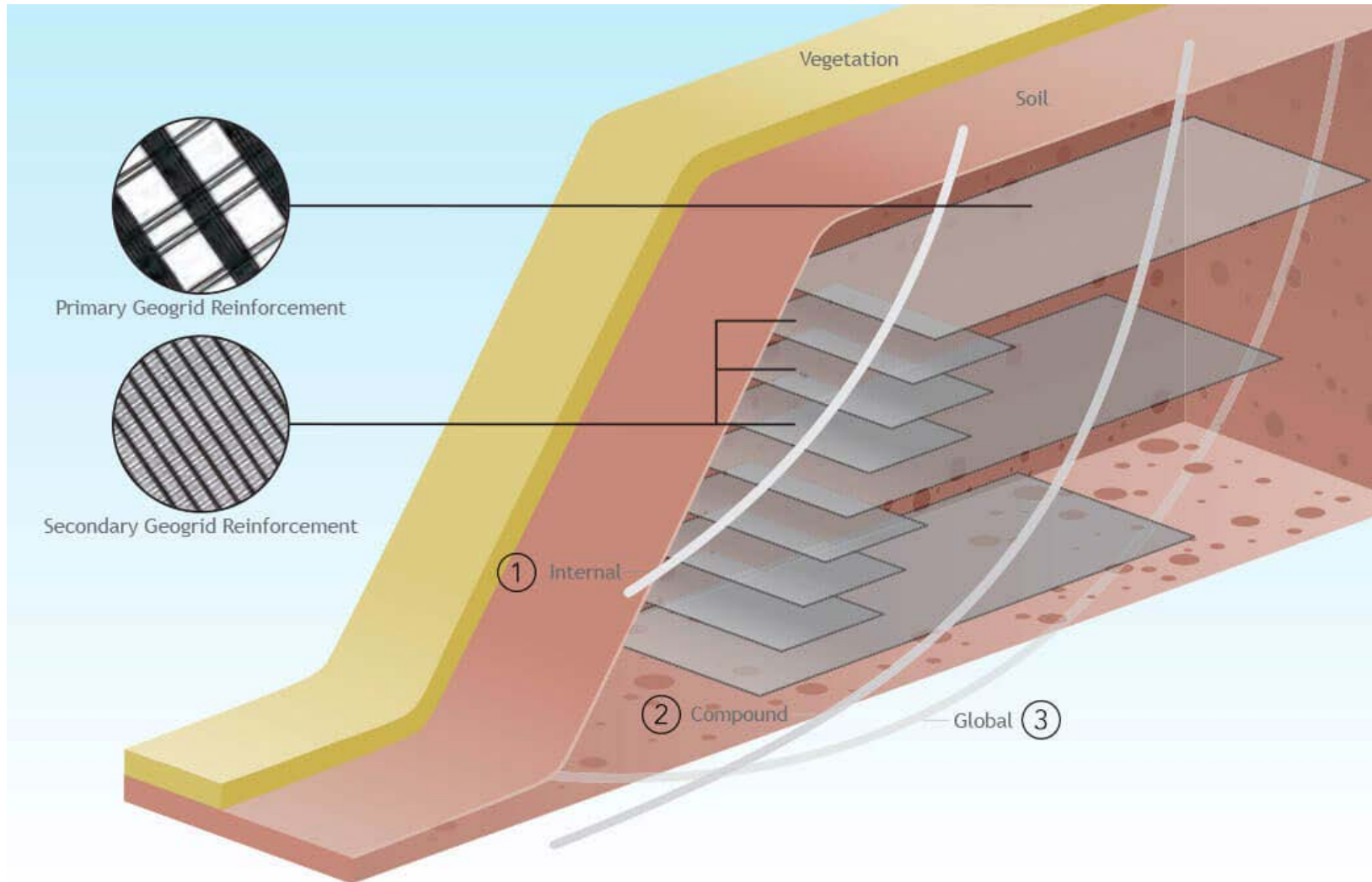


Photo Courtesy of Strata Corp.



# Construction



Reinforced Soil Slope near Agness, Oregon

Photo Courtesy of FHWA



# Construction - Continued



Reinforced Soil Slope near Agness, Oregon

Photo Courtesy of FHWA



# Questions?

More Information can be found at the following locations

- Call or Visit your local Alliance Geo Representative or office in Drain, Oregon
- GRS-IBS YouTube Video:  
[https://www.youtube.com/watch?v=w\\_5WFoAdoUw](https://www.youtube.com/watch?v=w_5WFoAdoUw)
- <http://www.fhwa.dot.gov/innovation/everydaycounts/edc-3/grs-ibs.cfm>
- [www.alliancegeo.com](http://www.alliancegeo.com)

Thank you for your time and attention!