INDOT Research

TECHNICAL *Summary*

Technology Transfer and Project Implementation Information

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Guidelines for Use and Types of Retaining Devices

Introduction

A large number of types of retaining devices can be used for design, but their limitations, recommendations and guidelines are scattered in the technical literature. A synthesis study has been conducted in which different technologies have been investigated to develop guidelines for the use of the different types of retaining devices. For this purpose, an extensive literature review has been performed and a new classification has been proposed. Retaining devices are divided into fill and cut walls. Fill walls support a backfill while cut walls support the natural ground. Fill walls are subdivided in: (1) Rigid and Cantilever Gravity Walls (RCGW); (2) Flexible Gravity Walls (FGW); and (3) Mechanically Stabilized Earth (MSE) Walls. Cut walls are subdivided in: (1) Driven walls (DW); (2) Cast in-place Walls (CIPW); and (3) Soil Nailed Walls (SNW).

Databases that collect a large number of case histories can be used as decision-making tools. The information stored can be utilized for: (1) development of correlations and trends among the cases in the database; (2) comparison of a new wall design with the case histories in the database to determine similarities and differences between the projects.

An electronic database with 207 selected cases from the technical literature and INDOT archives has been created. The database stores the following information: (1) Type of Retaining Device, location; (2) Geometry: Dimensions (height, length, etc.); (3) Soil conditions: Foundation, backfill; (4) Experience and Performance (Service: Deformations during and after construction); (5) Construction: Material used, construction process, problems; (6) Durability: Maintenance records, type and cost; (7) Economy: Construction and maintenance costs; (8) Other issues: special considerations, noise levels, etc.

Findings

The information stored has been analyzed through a number of correlations. The following conclusions have been obtained:

(1) The most cost-effective type of wall for a given project depends on the height of the wall and on the soil conditions.

(2) For fill walls:

(a) Mechanically Stabilized Earth (MSE) Walls can tolerate large differential settlements; Flexible Gravity Walls (FGW) can tolerate differential settlements up to 1/50; and. Rigid and Cantilever Gravity Walls (RCGW) can only tolerate differential settlements up to 1/500.

(b) The use of a fine-grained backfill without pore pressure considerations typically leads to failure of the wall. Freezing and thawing also leads to long-term progressive failure in a cohesive backfill.

(c) Corrosion of galvanized metallic elements is usually not significant.
(d) Compaction of the backfill around the connection of the reinforcement of MSE walls is usually reported as a problem.
(e) Large differential settlements in MSE walls can cause damage to the facing elements.
(f) MSE walls are the most economic fill retaining devices. If MSE walls cannot be used, Concrete and Masonry walls are the most cost effective devices for heights smaller than three meters. For larger heights, FGW are typically used.
(g) A flowchart has been developed to identify the most cost-effective solution based on the height of the wall, cost, and soil conditions.

(3) For cut walls:
(a) Driven Walls (DW) and Cast in-place Walls (CIPW) above five meters require additional support systems.
(b) Additional settlements can occur in DW during construction if the time between excavation and placement of the lagging is too large.
(c) CIPW limit the ground settlements behind the wall.
(d) Soil nails have had a limited use because of lack of experience with their design and construction. They are not used in soils without sufficient frictional resistance, which is necessary to provide stability to the un-reinforced section of the wall immediately after excavation.

Implementation

The following is recommended for implementation:

(1) Use the flowcharts developed as a preliminary decision-making tool to decide the optimum type of wall for a given project.

(2) The flowcharts and additional notes provide general recommendations based on limited information. The flowcharts are not intended to cover all possible cases; they should be used for preliminary design and to facilitate engineering decision. Site-specific conditions or project constraints may require a different solution than that provided by the charts.

(3) The recommendations are based on up-to-date information. It is expected that with time design the trends and wall typologies identified in this study may become obsolete and new technologies may emerge. It is recommended that the database and flowcharts be updated every five years.

Contacts

For more information:

Prof. Antonio Bobet
Principal Investigator
School of Civil Engineering
Purdue University
West Lafayette IN 47907
Phone: (765) 4945033
Fax: (765) 496-1364

Indiana Department of Transportation
Division of Research
1205 Montgomery Street
P.O. Box 2279
West Lafayette, IN 47906
Phone: (765) 463-1521
Fax: (765) 497-1665

Purdue University
Joint Transportation Research Program
School of Civil Engineering
West Lafayette, IN 47907-1284