The Ultimate Civil PE Review Course

Geotechnical – Depth

CEA

Geotechnical - Depth

"The knowledge areas here are not exclusive or exhaustive…" NCEES

Subsurface Exploration and Sampling 7.5%
Drilling and sampling procedures, Soil classification, General rock characterization (e.g., RQD, description, joints and fractures), Boring log interpretation (e.g., soil profile), In situ testing

II Engineering Properties of Soils and Materials 12.5%
Index properties, Phase relationships, Permeability, Geosynthetics, Pavement design criteria, Shear strength properties, Frost susceptibility

III. Soil Mechanics Analysis 12.5%
Pressure distribution, Lateral earth pressure, Consolidation, Compaction, Expansive soils, Effective and total stresses

IV. Earthquake Engineering 5%
Liquefaction, Pseudo-static analysis and earthquake loadings, Seismic site characterization

IV Earth Structures 10%
Slope stability, Slabs-on-grade, Earth dams, Techniques and suitability of ground modification

VI. Shallow Foundations 15%
Bearing capacity, Settlement, Mat and raft foundations

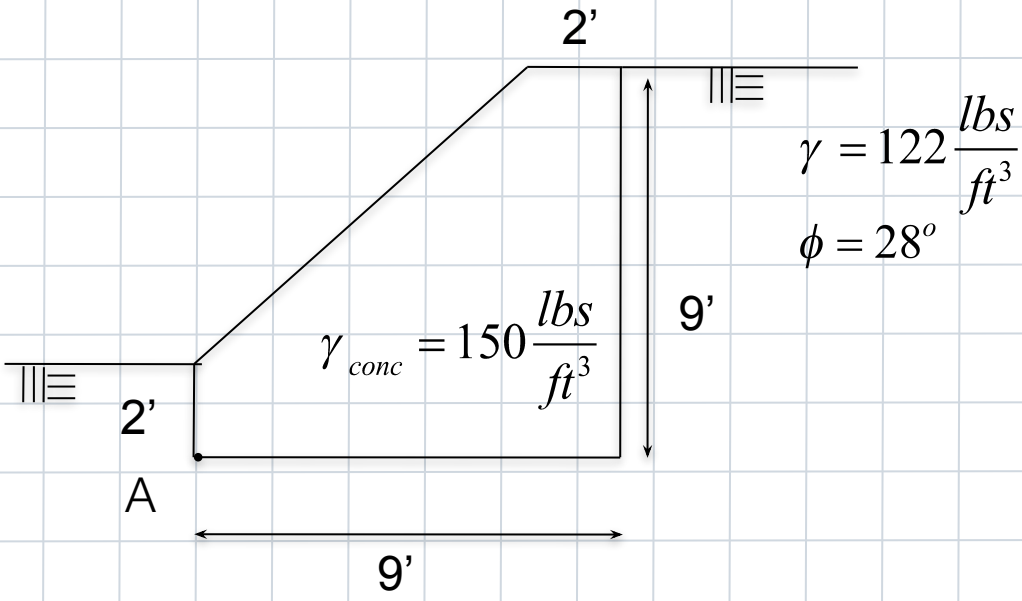
VII Earth Retaining Structures, & Temp. Structures 17.5%
Gravity walls and cofferdams, Cantilever walls, Stability analysis, Mechanically stabilized earth walls E. Braced and anchored excavations, Soil and rock anchors, Temporary structures, including shoring and re-shoring

VIII Deep Foundations 10%
Axial capacity (single pile/drilled shaft), Lateral capacity and deflections (single pile/drilled shaft), Settlement, Behavior of pile and/or drilled shaft group, Pile load test, Pile installation, Pile dynamics (e.g., wave equation, high-strain dynamic testing)

IX. Other Topics 10%
Groundwater and well fields & Seepage, Quality control process (QA/QC) (e.g., when digging, confirming quality; writing QA processes), Concrete maturity and early strength evaluation Worker health, safety, and environment, including OSHA regulations

Problem 251

What is the factor of safety against overturning for the wall shown? Disregard passive pressure.



Problem 252

Problem 253

Problem 254

Problem 255

Problem 256

Problem 257

Shoring and reshoring

- shores are direct shoring
- Re-shores support shores
- e.g. multistory slab system
- ACI 347.2R-05 Guide for Shoring/Reshoring of Concrete Multistory Buildings
- ACI 347 Formwork for concrete

<u>Considerations:</u>

- Number of levels to be shored
- Shoring to the ground versus slabs below
- Logistics of removing reshores
- Stiffness of concrete increases
- Lower floor carry more than upper floors
- design live load capacity is important in the design
- add 20% to dead load (formwork, etc). DL' = 1.2D

Problem 258

Which of the following is false for a multi-story concrete slab apartment building?

A) Shoring struts below a slab may be removed after 75% of the design strength is achieved.
B) The total load of the system is distributed based on stiffness
C) Re-shoring and shoring provide different purposes.
D) The live load capacity of the slabs below the currently poured slab is a factor to the re-shoring design.

Cofferdams

A cofferdam is a temporary enclosure built within, or in pairs across, a body of water and constructed to allow the enclosed area to be pumped out, creating a dry work environment for the major work to proceed. (ref 6)

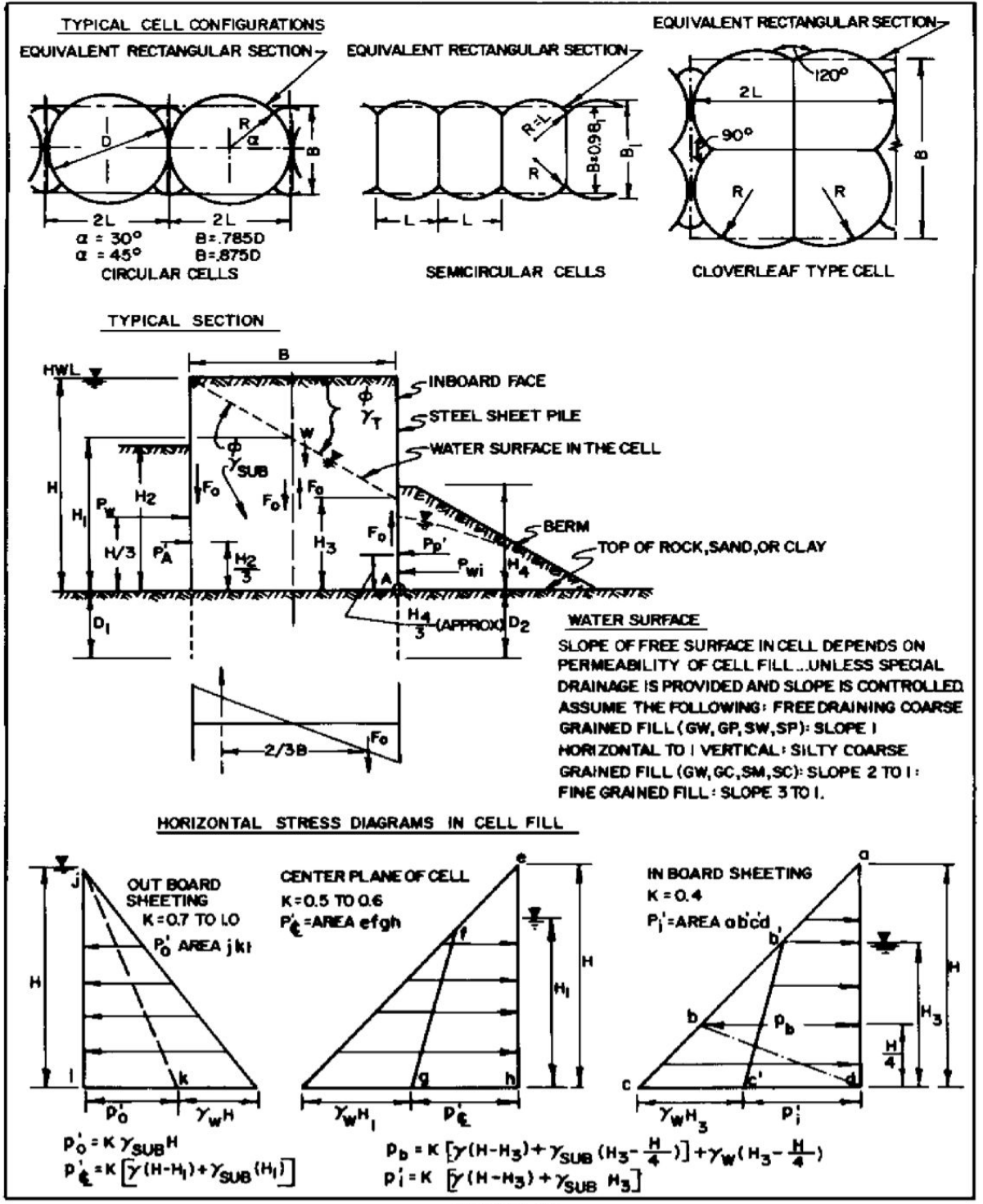


FIGURE 37
Design Criteria for Cellular Cofferdams

PARAMETERS FOR ANALYSIS

1.	Equivalent width of cofferdam.	Assume B = 0.85H for first trial.
2.	Effective weight of cell fill.	$W = [B(H-H_1)\gamma_T + B(H_1)\ \gamma_{sub}]$
3.	Average distance between cross walls.	L
4.	Horizontal active force on outboard side - compute using $K_A = \tan^2(45 - \phi/2)$.	$P_A' = K_A \frac{\gamma_{SUB}(H_2)^2}{2}$
5.	Coefficient of horizontal earth pressure.	K (varies - see horizontal pressure - diagram)
6.	Water force on outboard side.	$P_w = \gamma_w \frac{(H)^2}{2}$
7.	Horizontal passive force due to berm plus water force.	$P_p = P_p' + P_{wi}$ (include wall friction between sheet pile and soil
8.	Net overturning moment due to total horizontal force.	$M_O = (P_w \times \frac{H}{3}) + (P_A' \times \frac{H_2}{3}) - (P_p \times \frac{H_4}{3})$ (point of application of P_p is approximated as H4/3, see References in text for further guidance)

9.	Resisting moment due to cell fill.	$M_R = W(B/2)$
10.	Radius of cell wall.	R
11.	Interlock tension.	$T = P_b L$ where P_b = total horizontal stress at point b Zone at maximum interlock tension located at H/4 above base. See stress diagram, Inboard Sheeting and references cited in text
12.	Ultimate interlock strength.	T_u = 16 kip/in for ordinary U.S. steel sheet piles and 28 kips/in for high interlock U.S. sheet piles
13.	Effective unit weight.	γ_E = weighted average of cell fill γ_T and γ_{SUB} (above and below water in the cell)

FIGURE 37 (continued)
Design Criteria for Cellular Cofferdams

14.	Friction angle of soil and steel.	$\delta = 2/3\ \phi'$
15.	Coefficient of friction between cell fill and rock.	λ = use 0.5 for smooth rock, for all other use $\tan\phi$
16.	Drained angle of shearing resistance of soil.	ϕ'
17.	Coefficient of interlock friction.	$r = 0.3$
18.	Horizontal effect stress on a vertial plane.	p' = (see pressure diagram for subscript)
19.	Horizontal effect force on a vertical plane.	P' = (see pressure diagram for subscript)

FIGURE 37 (continued)
Design Criteria for Cellular Coffordams

MSE Walls

"Mechanically Stabilized Earth Wall (MSE wall or MSEW) is a generic term that includes reinforced soil (a term used when multiple layers of inclusions act as reinforcement in soils placed as fill). Reinforced Earth® is a trademark for a specific reinforced soil system." (PER US DOT)

- Also example appended to end

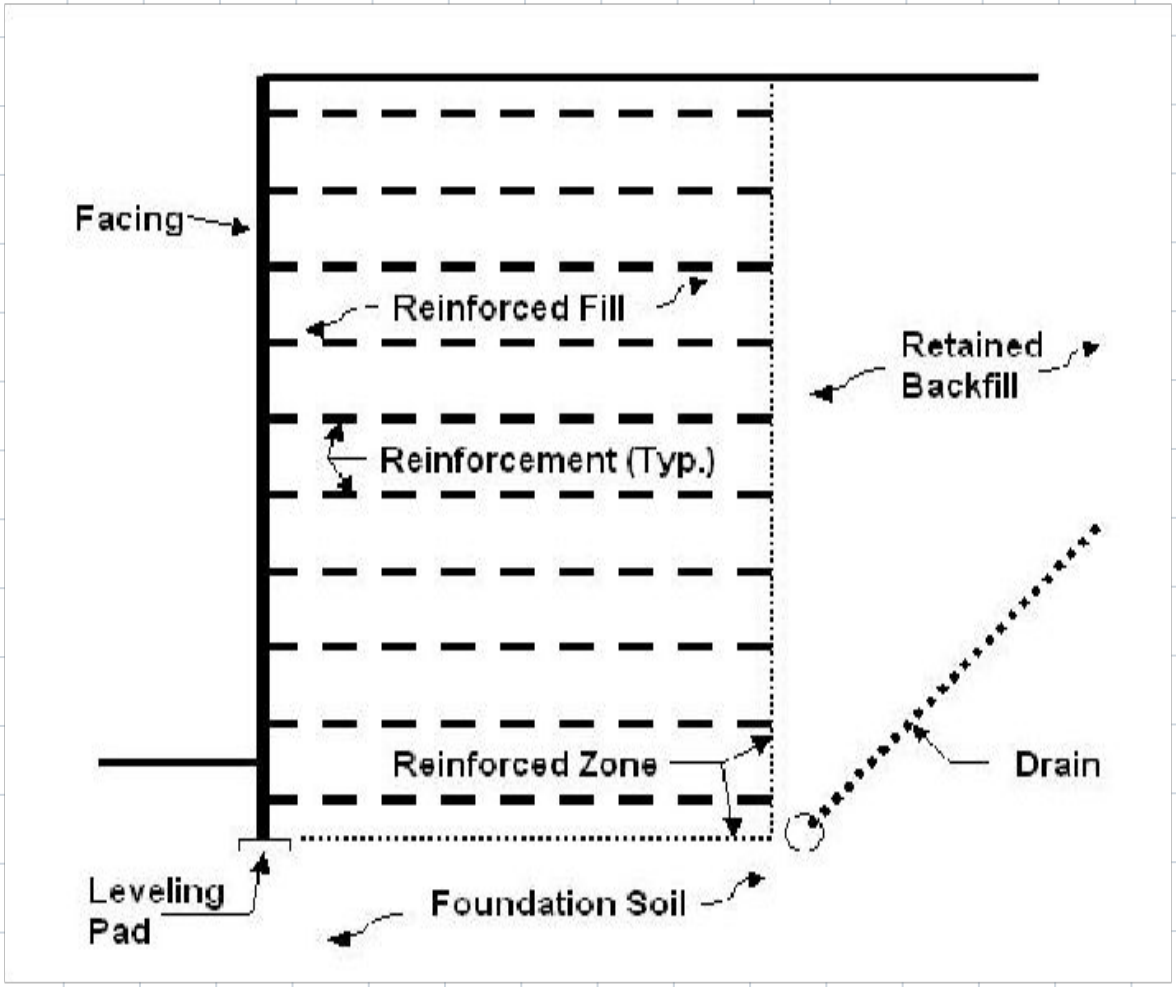


Figure 1-1. Generic cross section of an MSE structure.

Ref 7

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Q&A Number 3

GEOTECHNICAL – REFERENCES

Thanks to:

Cover Image:

http://www.flickr.com/photos/savannahcorps/8476083793/

14th Edition of the Civil Engineering Reference Manual

NAVFAC 7.02

Braja M Das Principles of Geotechnical Engineering

Structural Engineeering Reference Manual (PPI)

Reference: http://en.wikipedia.org/wiki/Cofferdam

MSE Walls: Publication No. FHWA-NHI-10-024