CIV E 681 – SEEPAGE AND DRAINAGE
Fall 2014
Department of Civil & Environmental Engineering
University of Alberta

Instructor: Dr. L. Deng
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Lectures: TU TR 11:00 – 12:20
NREF 2-020

Office hour: By appointment or walk in
Laboratory: Refer to emails from lab coordinator
Textbook: There is no single recommended text

References: Cedergren (1989) Seepage, Drainage, and Flow Nets
Harr (1962) Groundwater and Seepage

Supplementary References
Lecture notes

Grading:
50% term work
5 Assignments. 25%
10 Reading assignments. 15%
4 Graduate laboratories (2 lab reports). 10%
50% Final exam

Course Outline (subject to changes)

1) Introduction
Importance of groundwater flow and seepage control in geotechnical engineering

2) Elements of Hydrogeology
Regional groundwater flow

3) Fundamentals of Groundwater Flow (GWF)
Darcy's law and validity of Darcy’s Law
Permeability and its determination: Lab and field methods
Piezometers: Types, response time, time lag

4) 2D GWF Equations and Solution methods to 2D GWF
Governing equations for saturated and unsaturated:
Equations for steady-state GWF
Equations for transient GWF
Solution methods to 2D Groundwater Flow:
Flow nets, Anisotropic soil and flow net transformation
Method of Fragments
Finite different method
Introduction to FEM procedures

5) Water Pressure and Seepage failure
Hydrostatic pressure
Seepage pressure (effect of flow on earth pressure)
Piping and bulk heave

6) Well Hydraulics
Steady state flow (Dupuit-Forchheimer) into slot and well w & w/o infiltration
Reach of wells (Sichardt, Theis) and optimum flow
Multiple well systems
Methods for dewatering excavations

7) Seepage Control in Dams:
3 main control methods: filters, drainage and seepage reduction
Dam cross-sections for seepage control
Filters: Filter criteria and dimensioning filters, graded filters
Geotextiles for drainage
Seepage reduction: cores, partial cutoffs, complete cutoffs, impervious blankets,
efficiency of cutoffs

8) Flow through Rock:
Permeability of rock and discontinuities
Flow through discontinuities and jointed rock
Special considerations for flow through rock (anisotropy, stress dependence)

9) Groundwater flow and contamination:
Groundwater quality
Sources of contamination
Mechanism for migration in GW
Soil chemical processes which alter contaminates
Equations for solute transport in GW

READING ASSIGNMENTS (RAS)
Read papers and hand in: (1) a summary of the reading assignment and (2) definitions of
selected geoengineering terms from the paper, before the due date.
A summary must be typed on letter-size paper with 1 in margin using 11 pt type; 1 or 2
pages. Papers and definition sheets are downloaded from eclass
https://eclass.srv.ualberta.ca/portal/.

RAS 1: SEPTEMBER 19, 2014
Canadian Geotechnical Journal, 14:466 476.
RAS 2: SEPTEMBER 22, 2014

RAS 3: OCTOBER 3, 2014 (REVIEW)
Lambe and Whitman - Soil Mechanics, Chapter 17: "One dimensional Fluid Flow".

RAS 4: OCTOBER 10, 2014 (REVIEW)
Lambe and Whitman - Soil Mechanics, Chapter 18: "Two dimensional Fluid Flow".

RAS 5: OCTOBER 17, 2014 (PERMEABILITY TEST)
Kalin, M. 1977 "Hydraulic Piping - Theoretical and Experimental Findings", (No need to concentrate on mathematics), Canadian Geotechnical Journal, 14:107 124.

RAS 6: OCTOBER 24, 2014 (REVIEW)
Lambe and Whitman - Soil Mechanics, Chapter 19: "Soil Permeability and Filter Requirements".

RAS 7: OCTOBER 31, 2014
Leonards, G.A. - Foundation Engineering, Chapter on Dewatering, particularly p. 310 347.

RAS 8: NOVEMBER 7, 2014 (MODEL DAM)
Casagrande, A. 1940 "Seepage through Dams", Boston Soc. of Civil Eng.,1940.

RAS 9: NOVEMBER 14, 2014

RAS 10: NOVEMBER 21, 2014