HIGHWAY STANDARDS BRANCH

PROVINCIAL ENGINEERING MEMORANDUM

Material Engineering and Research Office (MERO) #2020-01, March 23, 2020

This memorandum provides guidance to foundation designers for the selection of geotechnical resistance factors for deep foundations and embankments.

Implementation

This memorandum is effective as of the date of issue.

Background

The selection of geotechnical resistance factors is a critical component in foundation engineering analysis. Optimization of these factors is required to achieve the desired performance of the foundation and geotechnical system and to produce cost effective designs for the service life of the structure or embankment (e.g. 75 years).

Limit states are classified as either ultimate limit states (ULS) or serviceability limit states (SLS). Foundations and geotechnical systems shall be designed to satisfy the ULS and SLS requirements as specified in Section 6.4 of the CHBDC.

At the ULS, the design shall be such that the factored ultimate geotechnical resistance is equal to or greater than the effect of factored loads for a given ULS.

At the SLS, the design shall be such that factored serviceability geotechnical resistance shall be equal to or greater than the effect of factored loads for a given SLS.

Factored ultimate and serviceability geotechnical resistances used in the design shall provide acceptable performance of the foundation and geotechnical system and the supported structure at all limit states.

The factored ultimate geotechnical resistance is determined by multiplying the ultimate geotechnical resistance by:

1. ψ = consequence factor given in Clause 6.5.2
2. φ_{gu} = ultimate geotechnical resistance factor given in Clause 6.9

The factored serviceability geotechnical resistance is determined by multiplying the serviceability geotechnical resistance by:

1. ψ = consequence factor given in Clause 6.5.2
2. φ_{gs} = serviceability geotechnical resistance factor given in Clause 6.9

The ULS and SLS consequence factor, ψ, are given in Table 6.1 in Clause 6.5.2. Consequence factors are given for high, typical and low consequence levels.

Table 6.2 in Clause 6.9 provides geotechnical resistance factors for various applications for both ULS and SLS for varying degrees of understanding. Factors with precision of two decimal places have been determined by rigorous reliability assessment. Factors with precision of one decimal place (the SLS factors) are applicable to the current code, but are under development and need further study to refine their accuracy.

Sound engineering judgement is relied upon in making recommendations in geotechnical engineering. This judgment is achieved as a result of experience allowing the gap to be bridged between theory and practice. The comprehensive system of consultant selection and review prevalent at the MTO reassures that this judgement and experience will be applied in the selection of specific and relevant resistance factors for MTO projects.

Policy

Geotechnical Resistance Factors shall be in accordance with Section 6.9 of the CHBDC and Table 6.2 in Section 6.9.1 of the CHBDC. When approved by MTO, the exceptions tabulated in Table 1 below can be used:

Table 1 – Geotechnical Resistance Factors

Application	Limit State	Test Method/Model	Degree of Understanding		
			Low	Typical	High
Deep Foundations	Compression(φ_{gu})	Static Test	0.50	0.65	0.75
	Tension	Static Test	0.40	0.55	0.65
	Lateral	Static Test	0.45	0.55	0.60
Embankment Fills	Global stability – temporary (φ_{gu})	Analysis	0.7	0.75-0.8	0.80-0.85
	Global Stability - permanent(φ_{gu})	Analysis	0.6	0.65-0.7	0.7-0.75
	Settlement	Analysis	1.0	1.0	1.0
		Test	N/A	N/A	N/A

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