Chapter

7

Slope Stability Analysis

7.1 General

Slope stability analysis is used for typical geotechnical design tasks, including but not limited to the following:

- Design maximum inclinations of permanent cut and fill slopes;
- Design of temporary excavations and shoring systems;
- Design stability and bearing capacity of embankments supported on weak, soft foundation soils for staged-construction;
- Design global and compound stability of retaining walls; and
- Assess forces and deformations of bridge deep foundations from effects of seismic liquefaction/lateral spread and potentially unstable slopes.

Stability analysis techniques specific to rock slopes, are described in Chapter 12. Detailed stability assessment of landslides is described in Chapter 13.

7.2 Geotechnical Design Parameters for Slope Stability Analysis

Geotechnical soil and rock design parameters are required for slope stability analysis with strength parameters developed using methodologies presented in Chapter 5, *Sabatini, et al. (FHWA, 2002*), and the referenced publications in Section 7.5. Slope stability analysis should consider the cases of short-term (undrained) and long-term (drained) stability using appropriate soil strength parameters, groundwater, and piezometric levels.

Detailed assessment of the groundwater regime within and beneath the slope is also critical. Detailed piezometric data at multiple locations and depths within and below the slope will likely be needed, depending on the geologic complexity of the stratigraphy and groundwater conditions. Potential seepage at the face of the slope must be assessed and addressed

7.3 Design Requirements

Slope stability design should be consistent with state-of-the-practice design guidelines, including but not limited to the referenced publications in Section 7.5. Slope stability design shall be evaluated using conventional limit equilibrium methods, and analyses should be performed using a state-of-the-practice slope stability computer program such as the most current versions of Slope/W® (Geo-Slope International), Slide® (Rocscience, Inc.), and/or ReSSA® (ADAMA Engineering, Inc.).

7.4 Resistance and Safety Factors for Slope Stability Analysis

For overall stability analysis of walls and structure foundations, design shall be consistent with Chapter 6, Chapter 8 and Chapter 15 and the *AASHTO LRFD Bridge Design Specifications*. For slopes adjacent to but not directly supporting structures, a maximum resistance factor of 0.75 should be used. For foundations on slopes that support structures such as bridges and retaining walls, a maximum resistance factor of 0.65 should be used. These resistance factors of 0.75 and 0.65 are generally equivalent to a safety factor of 1.3 and 1.5, respectively.

For general slope stability analysis of cuts, fills, and landslide repairs, a minimum safety factor of 1.25 should be used. Larger safety factors should be used if there is significant uncertainty in the slope analysis input parameters.

7.5 References

- *Turner, A.K. and Schuster, R.L., 1996, Transportation Research Board, National Research Council, Landslides investigation and Mitigation, Special Report 247,*
- *Cornforth, D.H., 2005, John Wiley & Sons, Inc., Landslides in Practice, Investigation, Analysis, and Remediation/Prevention Options in Soils."*
- *Collin, J.G., et al, 2005, U.S. Department of Transportation, Federal Highway Administration, Soil Slope and Embankment Design Reference Manual, FHWA-NHI-05-123.*
- *Samtani, N.C. and Nowatzki, E. A., 2006, U.S. Department of Transportation, Federal Highway Administration, Soils and Foundations Reference Manual, FHWA-NHI-06-088.*