



INDIANA DEPARTMENT OF TRANSPORTATION

Driving Indiana's Economic Growth

Office of Geotechnical Engineering
120 South Shortridge Road
Indianapolis, IN, 46219

PHONE: (317) 610-7251
FAX: (317) 356-9351

Mitchell E. Daniels, Jr., Governor
Michael B. Cline, Commissioner

Geotechnical Design Memorandum No. 2010-03

July 28, 2010

GEOTECHNICAL DESIGN MEMORANDUM 2010-03 (REVISED)

TO: All Geotechnical Engineers, Structure, Design, Operations and District Personnel and Consultants

FROM: Athar Khan, P.E.
Manager, Office of Geotechnical Services

SUBJECT: **Geotechnical Seismic Uplift Design Criteria**

EFFECTIVE: July 28, 2010

When evaluating seismic uplift design, the following procedures should be used:

Any questions please contact Mir Zaheer at (317) 610-7251 ext 224 or via email, MZaheer@indot.in.gov

Geotechnical Seismic Uplift Design Criteria:

For multi-span bridge structures in Seismic Zones, we understand that lateral loads at the bridge foundations are such that large uplift loads are being generated at interior piers during an extreme event (i.e., seismic load case). The pile skin friction resistance (R_s) should be considered for resistance to uplift.

Per 10.7.3.8.6(a-4), $R_s = q_s * A_s$, where:

q_s = nominal unit side resistance along the length of the pile (psf) which will be provided by the geotechnical consultant for each soil layer; and

A_s = surface area of pile side (sq ft)

A_s is a function of the pile size. In most cases, this is taken as the box perimeter of the pile used in design multiplied by the unit length of the pile. For cases where rock sockets or drilled shafts are considered, A_s will be controlled by the diameter of the rock socket/shaft. For sockets in rock, we recommend that ISS Section 701.09a (2) be used to determine the minimum diameter of a pre-cored hole (pile dia. + 4 in.) and that the skin friction in the overburden soils be neglected. The cored hole diameter could be increased to accommodate for the required uplift resistance.

In the extreme load case, a resistance factor (ϕ) of 0.8 shall be considered for uplift resistance of piles and shafts. The resistance factor shall be provided in the geotechnical recommendations. For evaluating uplift, the geotechnical engineer shall provide the nominal (unfactored) unit side resistance, q_s , per foot of the pile length.

The structural designer shall include the design unfactored and factored uplift loads and a minimum tip elevation (indicating whether compression or uplift controls) on the Foundation Review form and on the contract plans. ~~The designer should also consider geotechnical losses due to scour and liquefaction if applicable. Soils in liquefiable zones shall not be used for uplift resistance.~~ The designer should consider GL due to liquefaction if not mitigated. The designer may also elect to consider GL due to scour using 50% of the total scour in combination with seismic loads (AASHTO).