



INDIANA DEPARTMENT OF TRANSPORTATION

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GEOTECHNICAL DESIGN MEMORANDUM No. 2010-03

August 5, 2010

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

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

SUBJECT: Geotechnical Seismic Uplift Design Criteria for the I-69 Extension Project, Sections 2, 3, and 4

EFFECTIVE: Immediately

Geotechnical Seismic Uplift Design Criteria

For each multi-span bridge structure in Seismic Zones, 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 AASHTO *LRFD Bridge Design Specifications*, Article 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. This is most often taken as the box perimeter of the pile used in design multiplied by the unit length of the pile. Where rock sockets or drilled shafts are considered, A_s will be controlled by the diameter of the rock socket or shaft. For sockets in rock, *INDOT Standard Specifications* Section 701.09(a)2 should be used to determine the minimum diameter of a pre-cored hole of pile diameter plus 4 in., and that the skin friction in the overburden soils should be neglected. The cored-hole diameter can be increased to accommodate the required uplift resistance.

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

The structural designer should 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 should not be used for uplift resistance.

If you have questions, please contact Mir Zaheer at (317) 610-7251 ext 224, or via e-mail at, MZaheer@indot.in.gov

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