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Updates on 0-7236: Development of Standardized LRFD Design Methods for Ancillary Highway Structure Foundations

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Types of Ancillary Structure

Structure	Standard	Soil Strength Parameters	Design Loading Conditions
Large Road Signs	SMD (8W2) – 08	N_{TCP}, C, ϕ	Not Specified
Overhead Sign Bridge	OSB – FD OSB – FD – SC	N_{TCP}, C, ϕ	Uplift Loading and Moment
Monotube Sign Structure (Cantilever)	MC(7) – 22	N_{TCP}	Axial, Moment, Torsion, and Shear
Monotube Sign Structure (Span)	MS(7) – 22	N_{TCP}	Axial, Moment, Torsion, and Shear
Cantilever Overhead Sign Support	COSS – FD	N_{TCP}, C, ϕ	Moment and Torsion
Roadway Illumination Pole	RID(2) – 20	N_{TCP}	Not Specified
High Mast Illumination Pole	HMIF(2) – 98	N_{TCP}	Not Specified
Traffic Signal Pole	TS – FD – 12	N_{TCP}	Moment and Shear
Intelligent Transportation Systems Pole	ITS(4) – 15	N_{TCP}	Not Specified

Transition to LRFD

- TxDOT published (April 2024) a new Geotech Manual - LRFD.
  - Split barrel sampling with SPT - AASHTO T206 or ASTM D1586 (every 5ft.)
  - In cohesive soils Thin-Walled (Shelby) Tube samples - AASHTO T207 or ASTM D1587.
  - In rock - rock core samples in accordance with AASHTO T225.
  - SPT based friction angle, ϕ correlations

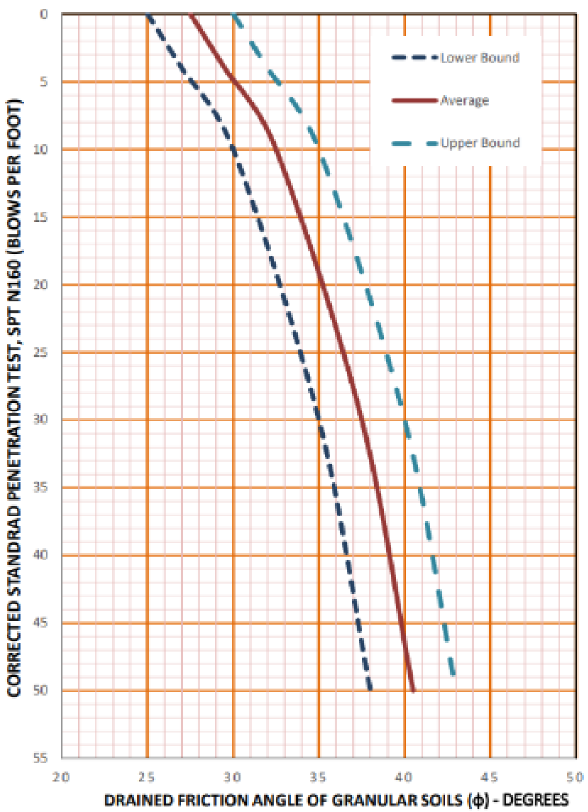
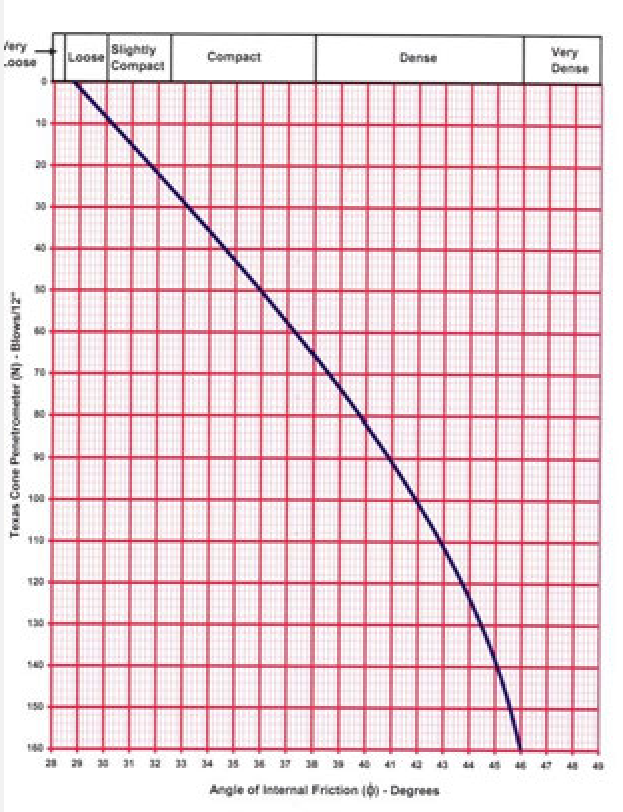


Figure 2-2. SPT vs. Angle of Internal Friction for Cohesionless Soils

Status of foundations for Ancillary Structures

- Current standards for foundation design of ancillary highway structures:
  - Primarily based on blow counts from TCP – TEX-132-E.
  - Not based on LRFD.
- TCP blow counts are also used to obtain friction angle, ϕ correlations.
- Shear strength, C (mostly based on lab test results and this may not change)
  - UU triaxial
  - Unconfined compression tests

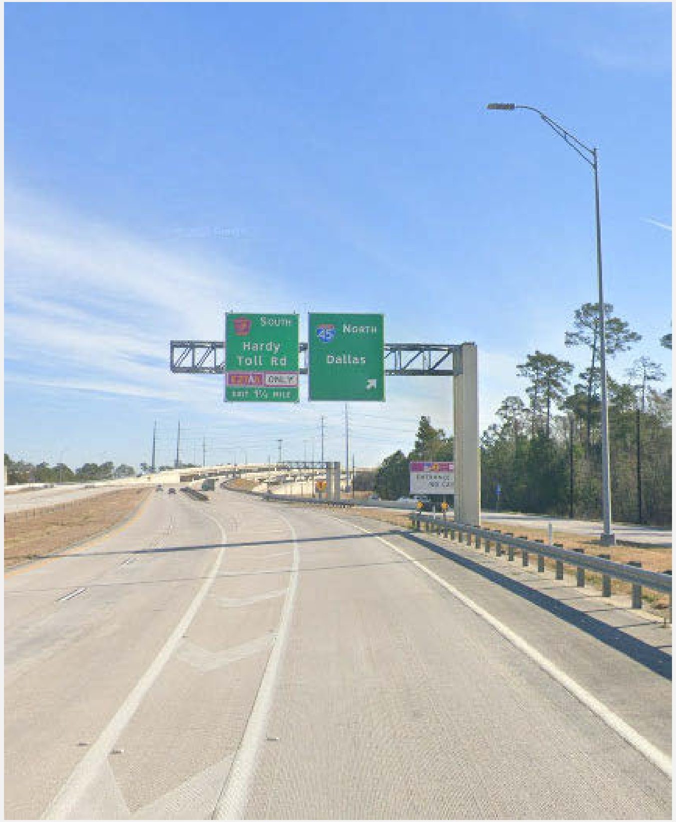


What’s Research Project 0-7236 about?

- Project Title: Develop Standardized LRFD Design Methods for Ancillary Structure Foundations
- Project No.: 0-7236
- Project Start: 09/01/2024
- Project End: 08/31/2026
- Principal Investigator (PI): Hoyoung Seo, Ph.D., P.E.
- Texas Tech University

What are the Objectives?

- To develop standardized LRFD design method for foundations of ancillary structures.
  - Compliant with AASHTO LRFD requirements.
- To update/replace the current TxDOT Standards.
  - Compliant with AASHTO LRFD requirements.



What’s in the scope?

- Review of other DOT’s practice

State DOT	Limit states considered
Florida DOT	Extreme I
Ohio DOT	Strength I; Extreme I; Service I; Fatigue I; Fatigue II
Colorado DOT	Strength I; Extreme Ia; Extreme Ib ; Service I
Wisconsin DOT	Strength I; Extreme I (Load Case 1); Extreme II (Load Case 2)
Oregon DOT	Extreme I; Fatigue I
Minnesota DOT	Strength I; Service I
Nevada DOT	Strength I; Service I; Fatigue I; Fatigue II
Hawaii DOT	Strength I; Fatigue I

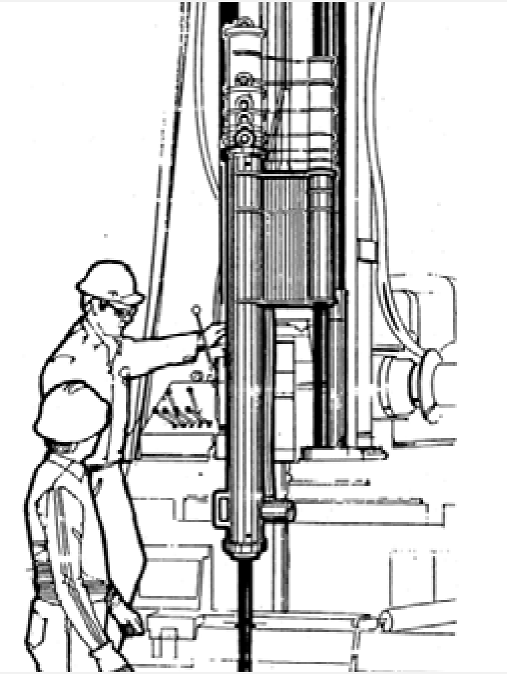
What's in the scope? Ct'd

- Review of other DOT's practice

State DOT	Axial capacity analysis method	Lateral/ Overturning capacity analysis method	Frictional resistance for Torsional capacity analysis
Florida DOT	α method for clay; Modified β method for sand	Broms method	α method for clay; Modified β method for sand
Ohio DOT	α method for clay; β method for sand	p-y analysis or Broms method	α method for clay; β method for sand
Colorado DOT	α method for clay; β method for sand	p-y analysis or Broms method	Theoretical method assuming full mobilization of s_u for clay; CDOT method for sand
Oregon DOT	α method for clay; β method for sand	p-y analysis; to determine the length to fixity and the maximum lateral deflection of 0.50 inch at the top of the shaft.	AASHTO friction resistance methods to find nominal torsion side resistance.

What’s in the scope? Ct’d

- Evaluates existing correlations between TCP and SPT blow counts
  - In Appendix 2:
    - In Clay: $N_{TCP} = 1.5*N_{SPT}$
    - In Sand: $N_{TCP} = 2.0*N_{SPT}$
  - N_{SPT} with shear strength & friction angle, ϕ
  - N_{TCP} with shear strength & friction angle, ϕ
- Recommendations of soil parameters and test methods for obtaining them.



ASTM D1586

What's in the scope? Ct'd

- Evaluates in-situ and laboratory test methods suitable for the new Standards.

TABLE 3-5 COMMON IN-SITU TESTS USED FOR INTERPRETATION OF S_u

In-Situ Test	Conventional Interpretation of s_u	Comments
VST	$s_u = \frac{6T}{7\pi(D)^3}$ for H/D = 2	Static equilibrium analysis $\mu \approx 2.5(PI)^{-.3} \leq 1.1$
CPT	$s_u = \frac{q_c - \sigma_{vo}}{N_K}$	N_K based on bearing capacity theory, cavity expansion theory, or correlation
SPT	$s_{u(N_{60})} = \frac{f_1 N_{60} p_a}{100}$	Empirical: $f_1 = 4.5$ for PI = 50 Empirical: $f_1 = 5.5$ for PI = 15

GEC 10

What’s in the scope? C’td

- Compare designs performed using current standards with those performed using the LRFD approach.
  - Assess potential correlations.
- Compare performance of the Standards with finite element analysis (FEA) models.
- Recommendations limit states and associated load factors.
- Recommendations for resistance factors.
- Recommendations of analysis methods for axial, lateral, moment, torsional capacities.

Questions?