STATE OF OKLAHOMA
DEPARTMENT OF TRANSPORTATION
GEOTECHNICAL SPECIFICATIONS FOR ROADWAY DESIGN

June 29, 2011

APPENDIX 2. - GUIDELINES FOR ANALYSIS, BORING, SAMPLING, AND TESTING

Purposes: These guidelines provide the basic criteria for:

(1) Geotechnical engineering analysis for roadway embankments and retaining walls

(2) Boring, sampling and testing

These guidelines are intended to provide, to the Geotechnical Engineer, a minimum approach to providing geotechnical information based upon the various soil types encountered at the project location. The Geotechnical Engineer is not limited to these guidelines if site conditions warrant the need for further sampling, testing, and/or analysis.

TABLE 1: GEOTECHNICAL ENGINEERING ANALYSIS REQUIRED FOR EMBANKMENTS, AND RETAINING WALLS

Soil Classification			Embankment and Cut Slopes		Retaining Walls Conventional, Crib & Reinforced Soil	
Unified	**AASHTO(1)**	**Soil Type**	**Slope Stability(2) Analysis**	**Embankment Settlement Analysis**	**Lateral Earth Pressure**	**Stability Analysis**
GW	A-1-a	Gravel well graded	Stability analysis generally not required if cut or fill slope is 1-1/2 Horizontal to 1 Vertical or flatter and water table in cut slope is drawn down by underdrains. Erosion of slopes may be a problem for SW or SM soils.	Settlement analysis generally not required except possibly for SC soils.	GW, SP, SW, & SP soils generally suitable for backfill behind or in retaining or reinforced soil walls. GM, GC, SM, & SC soils generally suitable if have less than 15% fines. Lateral earth pressure analysis required using soil angle of internal friction.	All walls should be designed to provide minimum F.S. =2 against overturning and minimum F.S. =1.5 against sliding along base. External slope stability considerations same as previously given for cut slopes and embankments.
GP	A-1-a	Gravel poorly graded				
GM	A-1-b	Gravel silty				
GC	A-2-6 A-2-7	Gravel clayey				
SW	A-1-b	Sand well graded				
SP	A-3	Sand poorly graded				
SM	A-2-4 A-2-5	Sand silty				
SC	A-2-6 A-2-7	Sand clayey				
ML	A-4	Silt inorganic Silt sandy	Stability analysis required unless non-plastic Erosions of slopes may be a problem.	Settlement analysis required unless non-plastic	These soils are not recommended for use directly behind or in retaining or reinforced soil walls.	
CL	A-6 Lean Clay	Clay in-organic	Required	Required		
OL	A-4	Silt	Required	Required		

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Unified	**AASHTO(1)**	**Soil Type**	**Slope Stability(2) Analysis**	**Embankment Settlement Analysis**	**Lateral Earth Pressure**	**Stability Analysis**
MH	A-5	Silt inorganic	Stability Analysis required Erosion of Slopes may be a problem	Required	These soils are not recommended for use directly behind or in retaining walls.	All walls should be designed to provide minimum F.S. =2 against overturning and minimum F.S. =1.5 against sliding along base. External slope stability considerations same as previously given for cut slopes and embankments
CH	A-7	Clay inorganic "fat clays"	Required	Required		
OH	A-7	Clay organic	Required	Required		
PT	---	PEAT	Required	Required Long-term settlement can be significant.		
Rock			Fills-Analysis not required for slopes 1-1/2 Horizontal to 1 Vertical or Flatter. Cuts-Analysis required but depends on spacing, orientation, and strength of discontinuities, durability of the rock.	Not Required	Lateral earth pressure analysis required using rock backfill angle of internal friction.	

REMARKS:
Soils -Temporary ground water control may be needed for foundation excavation in GW through SM soils.
Rock - Durability of shales (silt-stones, clay-stones, mud-stones, etc.) to be used in fills, should be checked. Non-durable shales should be embanked as soils, i.e., placed in maximum 12" looses & compacted with heavy sheepsfoot or grid rollers.

(1) Approximate correlation to United (Unified Soil Classification system is preferred for geotechnical engineering usage – AASHTO system was developed for rating pavement subgrades).

(2) These are general guidelines – detailed slope stability analysis may not be required where past experience in area in similar soils or rock gives required slope angles.

TABLE 2: GUIDELINE "MINIMUM" BORING, SAMPLING AND TESTING CRITERIA

Sand-Gravel Soils

SPT (split-spoon) samples should be taken at 5-foot (2m) intervals (2m) Intervals or at significant changes in soil strata.

SPT jar or bag samples shall be taken for classification testing and verification soil identifications.

Silty-Clay Soils

SPT and "undisturbed" thin wall tube samples should be taken at 5 foot (2m) intervals or at significant changes in strata.

Take alternate **SPT** and thin wall tube samples in the same boring or take thin wall tube samples in a separate undisturbed boring.

SPT jar or bag samples shall be taken for classification testing and verification of field visual soil identification.

Thin wall tube samples should be sent to the lab to conduct consolidation testing (for settlement analysis) and strength testing (for slope stability and foundation bearing capacity analysis).

Field vane shear testing is also recommended to obtain in-place sheer strength of soft clays, silts, and well rotted peats.

Rock

Continuous cores should be obtained in rock or shales using double or triple tube core barrels.

In structural foundation investigations, core a minimum of 10 feet (3m) into rock to insure it is bedrock and not a boulder.

Core samples should be sent to the lab for possible strength testing (unconfined compression) for foundation investigation.

Percent core recovery and **RQD** value should be determined in field or lab for each core run and recorded on boring log.

Ground Water

Water level encountered during drilling, at completion of boring, and at 24 hours after completion of boring should be recorded on boring log.

In low permeability soils such as silts and clays, a false indication of the water level may be obtained when water is used for drilling fluid and adequate time is not permitted after hole completion for the water level to stabilize (more than one week may be required). In such soils a plastic pipe water observation well shall be installed to allow monitoring of the water level over a period of time.

Artesian pressure and seepage zones, if encountered, should also be noted on the boring logs.

The top foot or so of the annual space between water observation well pipes and boreable wall should be backfilled with grout, bentonite, or sand-cement mixture to prevent surface water inflow which can cause erroneous groundwater level readings.