FOUNDATION DESIGN DATA:

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- GEOTECHNICAL REPORT BY: ECS SOUTHWEST, LLP
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- A DRILLED PIER FOUNDATION SYSTEM WILL BE UTILIZED TO SUPPORT THE PROPOSED STRUCTURE. DRILLED PIERS NEED BE PROPORTIONED AND FOUNDED AT SUFFICIENT DEPTHS TO PROVIDE BOTH AXIAL COMPRESSIVE LOAD CAPACITY AND UPLIFT RESISTANCE. BASED ON THE RESULTS FROM THE FIELD EXPLORATION AND LABORATORY TEST RESULTS DATA THE ALLOWABLE LOADS FOR THE DRILLED PIERS ARE AS:

DRILLED PIERS RECOMMENDATIONS	
FOUNDATION TYPE	UNDERREAMED
MINIMUM DEPTH BELOW EXISTING GRADE	8 FEET
NET ALLOWABLE BEARING PRESSURE FOR DEAD LOAD (DEAD AND SUSTAINED LIVE LOAD)	2,500 PSF
NET ALLOWABLE BEARING PRESSURE FOR TOTAL LOAD (DEAD AND LIVE LOAD)	3,750 PSF

- THE ABOVE DRILLED PIER ALLOWABLE END BEARING PRESSURES INCORPORATE A DESIGN SAFETY FACTOR OF 3 AGAINST AXIAL COMPRESSION DEAD LOADS PLUS SUSTAINED LIVE LOADS AND A DESIGN SAFETY FACTOR OF 2 AGAINST AXIAL COMPRESSION DEAD LOADS PLUS SUSTAINED AND TRANSIENT LIVE LOADS. THE MINIMUM CLEAR SPACING BETWEEN EDGES OF ADJACENT PIERS SHOULD BE AT LEAST ONE (1) BELL DIAMETER, WITH LARGER BELL SIZE GOVERNING. DRILLED PIER FOUNDATIONS THAT ARE DESIGNED AND CONSTRUCTED IN ACCORDANCE WITH THE RECOMMENDATIONS IN THIS REPORT COULD BE SUBJECTED TO LONG TERM TOTAL AND DIFFERENTIAL MOVEMENTS OF ABOUT 1.0 AND 0.5 INCH, RESPECTFULLY.

- THE FOLLOWING ITEMS SHOULD BE CONSIDERED DURING THE DESIGN AND CONSTRUCTION OF THE DRILLED PIERS:

- THE BELL TO SHAFT RATIO SHOULD BE BETWEEN 2:1 TO 3:1.

- BASED ON SOIL ENGINEER CURRENT GROUNDWATER OBSERVATIONS, THE DRILLED PIER EXCAVATIONS SHOULD NOT ENCOUNTER GROUNDWATER. IF GROUNDWATER IS ENCOUNTERED DURING CONSTRUCTION, WATER INFLOW MUST BE PUMPED OUT IMMEDIATELY USING A SUMP-PUMP. THE DRILLING CONTRACTOR MUST BE PREPARED FOR THIS CONDITION AND BE PREPARED TO CASE THE PIERS.

- WE ANTICIPATE THAT THE DRILLED PIER MAY BE INSTALLED USING DRY METHOD OF CONSTRUCTION. HOWEVER, A SLURRY METHOD OF CONSTRUCTION MAY BE REQUIRED FOR THE DRILLED PIER INSTALLATIONS DUE TO THE POTENTIAL SEASONAL VARIATIONS IN GROUNDWATER DEPTH, VARIATIONS IN THE SUBSOILS STRATIGRAPHY, STRENGTHS AND CORRESPONDING POTENTIAL BOREHOLE COLLAPSING. THE DRILLING CONTRACTOR SHOULD BE PREPARED TO ENCOUNTER FOR ANY SUCH SITUATIONS.

- DUE TO THE POTENTIAL SUBSOIL VARIATIONS AND POTENTIAL GROUNDWATER FLUCTUATIONS, SOIL ENGIEER RECOMMEND THAT THE FOUR CORNER AND TWO CENTER PIERS BE DRILLED FIRST TO BETTER EVALUATE THE CONSTRUCTABILITY OF THE DRILLED PIERS RECOMMENDED HEREIN. ONCE THIS INFORMATION IS FIELD VERIFIED, OTHER PIERS NEED TO BE CONSTRUCTED ACCORDINGLY.

- THE DRILLED PIER EXCAVATIONS NEED TO BE FREE OF LOOSE MATERIALS AND WATER PRIOR TO CONCRETE PLACEMENTS. CONCRETE SHOULD BE POURED IMMEDIATELY AFTER DRILLING THE PIER HOLES. THE DRILLED PIERS INSTALLATIONS SHOULD BE FOLLOWED IN ACCORDANCE WITH THE AMERICAN CONCRETE INSTITUTE (ACI) REFERENCE SPECIFICATIONS FOR THE CONSTRUCTION OF DRILLED PIERS (ACI 336.1) AND COMMENTARY (ACI 336.1R-98). ADDITIONALLY, THE U.S. DEPARTMENT OF TRANSPORTATION PUBLICATION NO. FHWA-NHI-10- 016, “DRILLED SHAFTS: CONSTRUCTION PROCEDURES AND LRFD DESIGN METHODS” SHOULD BE FOLLOWED DURING THE DESIGN AND CONSTRUCTION OF THE DRILLED PIERS.

- THE CONSTRUCTION OF THE PIERS NEED TO BE OBSERVED AS A MEANS TO VERIFY COMPLIANCE WITH DESIGN ASSUMPTIONS AND TO VERIFY: (1) THE BEARING STRATUM; (2) LENGTH AND DIAMETER; (3) THE REMOVAL OF SMEAR ZONES AND CUTTINGS; (4) THAT GROUNDWATER SEEPAGE, WHEN ENCOUNTERED, IS CORRECTLY HANDLED; AND (5) THAT THE PIERS ARE VERTICAL (WITHIN THE ACCEPTABLE TOLERANCE).

- THE DRILLED PIERS NEED TO CONTAIN SUFFICIENT REINFORCING STEEL THROUGHOUT THEIR ENTIRE LENGTH TO RESIST UPLIFT (TENSILE) FORCES DUE TO POST-CONSTRUCTION HEAVE OF THE CLAY SOILS. THE MAGNITUDE OF UPLIFT IS DIFFICULT TO PREDICT AND WILL VARY WITH THE INSITU MOISTURE CONTENTS AT THE TIME OF CONSTRUCTION. BASED ON THE PLANNED BUILDING SUBGRADE PREPARATION, WE RECOMMEND USING A UNIFORM UPLIFT OF 800 PSF OVER THE ENTIRE PIER PERIMETER TO A DEPTH OF 8 FEET.

- THE UPLIFT FORCES CREATED DUE TO THE EXPANSIVE SOILS AND IMPOSED STRUCTURAL LOADINGS CAN BE RESISTED BY THE UNDERREAMED PORTION THE PIER, WEIGHT OF THE PIER ITSELF AND THE DEAD LOAD ON THE PIER. THE UPLIFT RESISTANCE OF UNDERREAMED DRILLED PIERS AT THE SITE CAN BE ESTIMATED USING THE FOLLOWING EQUATION:

- UR = BR + WP + PDL
- WHERE: UR = UPLIFT RESISTANCE OF THE PIER (KIPS)
- BR = RESISTANCE CONTRIBUTED BY THE UNDERREAMED PORTION OF THE PIER (KIPS) WP = WEIGHT OF THE PIER (KIPS)
- PDL = DEAD LOAD ACTING ON THE PIER (KIPS)
- THE RESISTANCE CONTRIBUTED BY THE UNDERREAMED PORTION OF THE PIER SHOULD BE CALCULATED AS SHOWN IN THE FOLLOWING EQUATIONS. THE FOLLOWING FORMULAS INCORPORATE A FACTOR OF SAFETY OF APPROXIMATELY 2.
- $B = 1\bullet(D^2 - D^2)$ PIERS AT LEAST 12 FEET BELOW ADJACENT FINISHED GRADE
- $B = 3\bullet(D^2 - D^2)$ PIERS AT LEAST 15 FEET BELOW ADJACENT FINISHED GRADE
- $B = 7\bullet(D^2 - D^2)$ PIERS AT LEAST 18 FEET BELOW ADJACENT FINISHED GRADE
- B_R SHOULD BE IGNORED SHOULD THE PIER DEPTH IS LESS THAN 12 FEET BELOW ADJACENT FINISHED GRADE
- WHERE: D = DIAMETER OF THE UNDER-REAM (FEET)
- D = DIAMETER OF THE PIER SHAFT (FEET)
- RESISTANCE TO LATERAL LOADS AND THE EXPECTED PIER BEHAVIOUR UNDER THE APPLIED LOADING CONDITIONS WILL DEPEND NOT ONLY ON THE SUBSURFACE CONDITIONS, BUT ALSO ON LOADING CONDITIONS, THE PIER SIZE, AND THE ENGINEERING PROPERTIES OF THE PIER. THE SOIL ENGINEER RECOMMEND THE DESIGNER USE A PERFORMANCE BASED DESIGN METHODOLOGY USING NON-LINEAR SOIL SUPPORT SPRINGS (“P-Y CURVES”) TO MODEL THE SOIL BEHAVIOUR. SEVERAL COMPUTER PROGRAMS ARE COMMERCIALLY AVAILABLE FOR THIS PURPOSE; SOIL ENGINEER RECOMMEND LPILE (ENSOFT, INC.) SINCE THE SOFTWARE IS RELATIVELY CURRENT AND ACTIVELY SUPPORTED.

- THE GRAPHICAL RELATIONSHIP BETWEEN THE SOIL RESISTANCE (P) AND PILE DEFLECTION (Y) IS COMMONLY REFERRED TO AS A “P-Y CURVE”. ALONG THE DEPTH OF THE SHAFT, SOIL RESISTANCE (P) IS EXPRESSED AS A NON-LINEAR FUNCTION OF LATERAL SHAFT DEFLECTION (Y). VARIOUS RESEARCHERS DEVELOPED “P-Y” CRITERIA FOR DIFFERENT KINDS OF SOILS. THE “P-Y” CURVES CAN BE AUTOMATICALLY GENERATED BY LPILE. RECOMMENDED DESIGN SOIL PROPERTIES NEEDED FOR GENERATING “P-Y” CURVES ARE PROVIDED IN THE TABLE BELOW.

DESCRIPTION	APPROXIMATE DEPTH (FT)	EFFECTIVE UNIT WEIGHT (PCF)	ALLOWABLE PASSIVE PRESSURE (PSF)	COHESION	FRICTION ANGLE (DEGREE)	E50	K_S (PCI)
CLAY	0 TO 4	115	DISREGARD CAPACITIES				
CLAY	4 TO 8	115	1,000	1,000	-	.007	100
CLAY	8 TO 12	115	1,500	1,500	-	.007	200

SUBGRADE PREPARATION CONT:

- UPON ADDRESSING THE UNDOCUMENTED FILL SOILS, THE FLOOR SLAB CAN BE SUPPORTED ON ENGINEERED FILL SOILS FOR THE SURFACE SUPPORTED STRUCTURE. THE SOIL ENGINEER RECOMMEND THAT THE UPPER SIX-INCH OF SUBGRADE SOILS IN THE FLOOR SLAB AREAS BE COMPACTED TO AT LEAST 95% OF STANDARD DENSITY (ASTM D 698) AT A MOISTURE CONTENT BETWEEN ±2% OF THE OPTIMUM VALUE. POSITIVE DRAINAGE SHOULD ALWAYS BE MAINTAINED TO DRAIN SURFACE WATER AWAY FROM THE STRUCTURE. A SOIL MODULUS OF SUBGRADE REACTION (KS) OF 120 PCI CAN BE USED IN THE DESIGN OF FLOOR SLAB. POSITIVE DRAINAGE SHOULD BE DEVELOPED AND STRICTLY MAINTAINED DURING THE LIFETIME OF THE STRUCTURE TO DIRECT SURFACE WATER AWAY FROM THE FOUNDATION AREA.

- THE SOIL ENGINEER RECOMMEND THAT FLOOR SLABS BE ISOLATED FROM THE FOUNDATION FOOTINGS SO DIFFERENTIAL SETTLEMENT OF THE STRUCTURE WILL NOT INDUCE SHEAR STRESSES IN THE FLOOR SLAB. FURTHERMORE, THE EXISTING NEAR SURFACE LOOSE OR POORLY COMPACTED SOILS NEED TO BE REMOVED AND COMPACTED PRIOR TO THE SLAB CONSTRUCTION. IN ORDER TO MINIMIZE THE CRACK WIDTH OF SHRINKAGE CRACKS THAT MAY DEVELOP NEAR THE SURFACE OF THE SLAB, WE RECOMMEND MESH REINFORCEMENT BE INCLUDED IN THE DESIGN OF THE FLOOR SLAB. THE MESH SHOULD BE IN THE TOP HALF OF THE SLAB TO BE EFFECTIVE.

- A BEDDING LAYER OF LEVELING SAND, ONE TO TWO INCH IN THICKNESS, MAY BE PLACED BENEATH THE FLOOR SLAB. IF FLOOR TREATMENTS THAT ARE SENSITIVE TO MOISTURE WILL BE USED, A 10-MIL VAPOR BARRIER OF POLYETHYLENE SHEETING OR SIMILAR MATERIAL SHOULD BE PLACED BENEATH THE SLAB TO MINIMIZE MOISTURE MIGRATION THROUGH THE SLAB. IF A VAPOR BARRIER IS CONSIDERED TO PROVIDE MOISTURE PROTECTION, SPECIAL ATTENTION SHOULD BE GIVEN TO THE SURFACE CURING OF THE SLABS TO MINIMIZE UNEVEN DRYING OF THE SLABS AND ASSOCIATED CRACKING AND/OR SLAB CURLING. THE USE OF A BLOTTER OR CUSHION LAYER ABOVE THE VAPOR BARRIER CAN ALSO BE CONSIDERED FOR PROJECT SPECIFIC REASONS. PLEASE REFER TO ACI 302.1R96 *GUIDE FOR CONCRETE FLOOR AND SLAB CONSTRUCTION* AND ASTM E 1643 *STANDARD PRACTICE FOR INSTALLATION OF WATER VAPOR RETARDERS USED IN CONTACT WITH EARTH OR GRANULAR FILL UNDER CONCRETE SLABS* FOR ADDITIONAL GUIDANCE ON THIS ISSUE.

- WHILE SITE GRADING WAS NOT PROVIDED, WE ANTICIPATE THAT PLANNED GRADING WILL LARGELY BE WITHIN 2 FEET OF THE EXISTING CONTOURS ACROSS THE SITE. IN THE EVENT THAT FILL IS PLACED ON THE SITE, SPECIFICATIONS SHOULD REQUIRE PLACEMENT IN ACCORDANCE WITH GEOTHECH RECOMMENDATIONS GIVEN IN THE "SITE PREPARATION" SECTION.

- SOILS PLACED ALONG THE EXTERIOR OF GRADE BEAMS NEED TO BE ON-SITE CLAY SOILS PLACED AND COMPACTED IN ACCORDANCE WITH THIS REPORT. THE PURPOSE OF THIS BACKFILL IS TO REDUCE THE OPPORTUNITY FOR SURFACE OR SUBSURFACE WATER INFILTRATION BENEATH THE STRUCTURE. THE OVERBUILD ZONE OF SELECT GRANULAR SOILS NEED TO BE REMOVED OUTSIDE OF THE PERIMETER GRADE BEAMS AND BACKFILLED WITH ON-SITE CLAY SOILS.

- THE GEOTECHNICAL ENGINEER RECOMMEND PAVING/SIDEWALKS BE PLACED ADJACENT TO THE STRUCTURES TO REDUCE SEASONAL DRYING OF THE MOISTURE CONDITIONED SOILS NEAR THE PERIMETER OF THE STRUCTURES. IRRIGATION OF LAWN AND LANDSCAPED AREAS SHOULD BE MODERATE, WITH NO EXCESSIVE WETTING OR DRYING OF SOILS AROUND THE PERIMETER OF THE STRUCTURES ALLOWED. POSITIVE DRAINAGE AWAY FROM THE STRUCTURES SHOULD ALSO BE PROVIDED.

- TREES AND BUSHES/SHRUBS PLANTED NEAR THE PERIMETER OF THE STRUCTURES CAN WITHDRAW LARGE AMOUNTS OF WATER FROM THE SOILS. THE GEOTHECHNICAL ENGINEER RECOMMEND TREES NOT BE PLANTED OR LEFT IN PLACE (EXISTING TREES) CLOSER THAN HALF THE CANOPY DIAMETER OF MATURE TREES FROM THE GRADE BEAMS, TYPICALLY A MINIMUM OF 20 FEET. IF VEGETATION IS PLANTED CLOSER THAN THE ANTICIPATED MATURE HEIGHT AWAY FROM THE BUILDINGS THEN A ROOT BARRIER SHOULD BE INSTALLED TO A DEPTH OF AT LEAST 5 FEET BELOW FINISHED GRADE.

- THE FLOOR SLAB SHOULD BE INSTALLED AS SOON THE STRUCTURE PAD IS PREPARED. THE SLAB SHOULD BE PROTECTED FROM INCLEMENT WEATHER ALWAYS BY PROVIDING PROPER DRAINAGE AND PLACING PLASTIC SHEETING ON TOP OF THE SLAB. IF THE STRUCTURE PAD IS LEFT EXPOSED TO RAINFALL, PERCHED GROUNDWATER CONDITIONS MAY DEVELOP WHICH WILL UNDERMINE THE INTEGRITY OF THE FLOOR SLAB. THEREFORE, THE FLOOR PAD NEED TO BE COVERED WITH A PLASTIC SHEET, IF THE FLOOR SLAB IS NOT PLACED IMMEDIATELY.

BUILDING SLAB AND PERIMETER CONDITIONS:

- THE PAVING/SIDEWALKS BE PLACED ADJACENT TO THE STRUCTURES TO REDUCE SEASONAL DRYING OF THE NEAR SURFACE SOILS NEAR THE PERIMETER OF THE STRUCTURES. IRRIGATION OF LAWN AND LANDSCAPED AREAS SHOULD BE MODERATE, WITH NO EXCESSIVE WETTING OR DRYING OF SOILS AROUND THE PERIMETER OF THE STRUCTURES ALLOWED. SPRINKLER SYSTEMS SHOULD BE USED ALL AROUND THE PERIMETER OF THE STRUCTURE TO MAINTAIN A UNIFORM MOISTURE DISTRIBUTION AROUND THE FOUNDATION SLAB.

- POSITIVE DRAINAGE AWAY FROM THE STRUCTURES SHOULD BE PROVIDED AND STRICTLY MAINTAINED DURING THE LIFE OF THE STRUCTURES. WHERE FLATWORK IS PLACED AGAINST OR NEAR THE STRUCTURE, A POSITIVE SEAL MUST BE INSTALLED AND ADEQUATELY MAINTAINED TO MINIMIZE WATER INTRUSION. DOWN SPOUTS AND GUTTERS SHOULD BE USED TO COLLECT AND DISTRIBUTE WATER AT LEAST 10 FEET AWAY FROM THE STRUCTURE.

- TREES AND BUSHES/SHRUBS PLANTED NEAR THE PERIMETER OF THE STRUCTURES CAN WITHDRAW LARGE AMOUNTS OF WATER FROM THE SOILS. THE TREES NOT BE PLANTED OR LEFT IN PLACE (EXISTING TREES) CLOSER THAN HALF THE CANOPY DIAMETER OF MATURE TREES FROM THE GRADE BEAMS, TYPICALLY A MINIMUM OF 20 FEET. IF VEGETATION IS PLANTED CLOSER THAN THE ANTICIPATED MATURE HEIGHT AWAY FROM THE BUILDINGS THEN A ROOT BARRIER SHOULD BE INSTALLED TO A DEPTH OF AT LEAST 5 FEET BELOW FINISHED GRADE.

SUBGRADE PREPARATION:

- A PORTION OF THE PROJECT SITE IS UNDERLAIN BY UNDOCUMENTED FILL SOILS TO A DEPTH OF ABOUT 2 FEET BELOW THE EXISTING SITE GRADES. THE PRESENCE OF LOOSE AND POORLY COMPACTED UNDOCUMENTED FILL WITHIN STRUCTURAL AREAS MAY RESULT IN LOWER NET AVAILABLE BEARING CAPACITIES AND SETTLEMENTS THAT MAY EXCEED TOLERABLE LIMITS. THEREFORE, THE DEGREE OF COMPACTION MUST BE CAREFULLY EVALUATED WITHIN THE STRUCTURAL AREAS PRIOR TO THE CONSTRUCTION OF THE FOUNDATIONS. IF THERE ARE ANY SOFT/UNSTABLE SOILS PRESENT DURING CONSTRUCTION, THESE SOILS SHOULD BE REMOVED, REWORKED AND/OR REPLACED.

- DURING FIELD EXPLORATION, MOISTURE SENSITIVE SURFICIAL SEMI-COHESIVE SILTY CLAY FILL (CL-ML FILL) TYPE SOIL WAS ENCOUNTERED NEAR BORING B-10 TO A DEPTH OF ABOUT 2 FEET BELOW THE EXISTING SITE GRADES. THESE PERMEABLE SOILS, UNDERLAIN BY LOW PERMEABILITY CLAYS, MAY CREATE PERCHED WATER CONDITION THAT CAN LEAD TO THE REDUCED BEARING PRESSURE UNDER THE BUILDING PAD DURING THE WET SEASON. ADDITIONALLY, PRESENCE OF THESE SEMI-COHESIVE SOILS MAY POSE UNDESIRABLE CONSTRUCTION DELAYS THROUGH (PUMPING AND RUTTING) DURING WET SEASON. THESE CONDITIONS SHOULD BE ANTICIPATED BEFORE COMMENCING THE CONSTRUCTION OPERATION DURING WET SEASON. HOWEVER, THESE SOILS CAN BE OPENED UP FOR NATURAL DRYING PURPOSES AND/OR REMOVED AND REPLACED WITH SELECT FILL. ADDITIONAL SUBSOIL STABILIZATION/IMPROVEMENTS MAY BE REQUIRED IF A VERY AGGRESSIVE CONSTRUCTION SCHEDULE IS EXPECTED.

- GOOD SITE DRAINAGE SHOULD BE MAINTAINED DURING EARTHWORK OPERATIONS, WHICH WOULD HELP MAINTAIN THE INTEGRITY OF THE SOIL. THE SURFACE OF THE SITE SHOULD BE KEPT PROPERLY GRADED IN ORDER TO ENHANCE DRAINAGE OF THE SURFACE WATER AWAY FROM THE PROPOSED BUILDING AREAS DURING THE CONSTRUCTION PHASE. WE RECOMMEND THAT AN ATTEMPT BE MADE TO ENHANCE THE NATURAL DRAINAGE WITHOUT INTERRUPTING ITS PATTERN.

- THE SOILS AT THE SITE ARE MOISTURE AND DISTURBANCE SENSITIVE, AND CONTAIN FINES WHICH ARE CONSIDERED MODERATELY ERODIBLE. THEREFORE, THE CONTRACTOR SHOULD CAREFULLY PLAN HIS OPERATION TO MINIMIZE EXPOSURE OF THE SUBGRADE TO WEATHER AND CONSTRUCTION EQUIPMENT TRAFFIC, AND PROVIDE AND MAINTAIN GOOD SITE DRAINAGE DURING EARTHWORK OPERATIONS TO HELP MAINTAIN THE INTEGRITY OF THE SURFICIAL SOILS. EROSION AND SEDIMENTATION SHALL BE CONTROLLED IN ACCORDANCE WITH SOUND ENGINEERING PRACTICE AND CURRENT JURISDICTIONAL REQUIREMENTS.

PROOFROLLING

- AFTER STRIPPING AND REMOVING ALL UNSUITABLE SURFACE MATERIALS, CUTTING TO THE PROPOSED GRADE, AND PRIOR TO THE PLACEMENT OF ANY STRUCTURAL FILL, THE EXPOSED SUBGRADE SHOULD BE EXAMINED BY THE GEOTECHNICAL ENGINEER OR AUTHORIZED REPRESENTATIVE. THE EXPOSED SUBGRADE SHOULD BE THOROUGHLY PROOF ROLLED WITH PREVIOUSLY APPROVED CONSTRUCTION EQUIPMENT HAVING A MINIMUM AXLE LOAD OF 25 TONS (E.G. FULLY LOADED TANDEM-AXLE DUMP TRUCK). THE AREAS SUBJECT TO PROOF ROLLING SHOULD BE TRAVERSED BY THE EQUIPMENT IN TWO PERPENDICULAR (ORTHOGONAL) DIRECTIONS WITH OVERLAPPING PASSES OF THE VEHICLE UNDER THE OBSERVATION OF THE GEOTECHNICAL ENGINEER OR AUTHORIZED REPRESENTATIVE.

- THIS PROCEDURE IS INTENDED TO ASSIST IN IDENTIFYING ANY LOCALIZED YIELDING MATERIALS. IN THE EVENT THAT UNSTABLE OR “PUMPING” SUBGRADE IS IDENTIFIED BY THE PROOF ROLLING, THOSE AREAS SHOULD BE MARKED FOR REPAIR PRIOR TO THE PLACEMENT OF ANY SUBSEQUENT STRUCTURAL FILL OR OTHER CONSTRUCTION MATERIALS. METHODS OF REPAIR OF UNSTABLE SUBGRADE, SUCH AS UNDERCUTTING OR MOISTURE CONDITIONING OR CHEMICAL STABILIZATION, SHOULD BE DISCUSSED WITH THE GEOTECHNICAL ENGINEER TO DETERMINE THE APPROPRIATE PROCEDURE WITH REGARD TO THE EXISTING CONDITIONS CAUSING THE INSTABILITY.

EARTHWORK OPERATIONS

- THE ONSITE COHESIVE SOIL MAY RESULT IN DIFFICULTIES DURING ACCESS AND WORKABILITY FROM POOR SITE DRAINAGE, WET SEASON, OR SITE GEOHYDROLOGY. SHOULD THIS CONDITION DEVELOP, DRYING OF THE SOILS FOR SUPPORT OF PAVEMENT AND FLOOR SLABS MAY BE IMPROVED BY THE ADDITION OF 4% LIME BY DRY WEIGHT, AS A MINIMUM. THE APPLICATION RATE CORRESPONDING TO THIS ADDITIVE AMOUNT WOULD BE APPROXIMATELY 18 POUNDS PER SQUARE YARD FOR EACH SIX-INCH OF COMPACTED THICKNESS. TEXAS DEPARTMENT OF TRANSPORTATION (TXDOT) SPECIFICATIONS, ITEMS 260 AND 263, SHALL BE USED AS PROCEDURAL GUIDES FOR PLACING, MIXING, AND COMPACTING LIME STABILIZER AND THE SOILS.

- PRIOR TO PLACEMENT OF NEW FILL, SUBGRADES SHOULD BE SCARIFIED TO A MINIMUM DEPTH OF 6 INCHES, MOISTURE CONDITIONED AND COMPACTED TO AT LEAST 95% OF MAXIMUM DRY DENSITY AS OBTAINED BY THE STANDARD PROCTOR METHOD (ASTM D 698) MOISTURE CONDITIONED WITHIN ±2% OF THE OPTIMUM VALUE.

- SOIL MOISTURE LEVELS SHOULD BE PRESERVED (BY VARIOUS METHODS THAT CAN INCLUDE COVERING WITH PLASTIC, WATERING, ETC.) UNTIL NEW FILL, PAVEMENTS OR SLABS ARE PLACED. FILL SOILS SHOULD BE PLACED IN 8 INCH LOOSE LIFTS FOR MASS GRADING OPERATIONS AND 4 INCHES FOR TRENCH TYPE EXCAVATIONS WHERE WALK BEHIND OR “JUMPING JACK” COMPACTION EQUIPMENT IS USED.

- UPON COMPLETION OF THE FILLING OPERATIONS, CARE SHOULD BE TAKEN TO MAINTAIN THE SOIL MOISTURE CONTENT PRIOR TO CONSTRUCTION OF FLOOR SLABS AND PAVEMENTS. IF THE SOIL BECOMES DESICCATED, THE AFFECTED MATERIAL SHOULD BE REMOVED AND REPLACED, OR THESE MATERIALS SHOULD BE SCARIFIED, MOISTURE CONDITIONED AND RECOMPACTED.

- UTILITY CUTS SHOULD NOT BE LEFT OPEN FOR EXTENDED PERIODS OF TIME AND SHOULD BE PROPERLY BACKFILLED. BACKFILLING SHOULD BE ACCOMPLISHED WITH PROPERLY COMPACTED ON-SITE SOILS, RATHER THAN GRANULAR MATERIALS. IF GRANULAR MATERIALS ARE USED, A UTILITY TRENCH CUT-OFF AT THE STRUCTURE LINE IS RECOMMENDED TO HELP PREVENT WATER FROM MIGRATING THROUGH THE UTILITY TRENCH BACKFILL TO BENEATH THE PROPOSED STRUCTURE.

- FIELD DENSITY AND MOISTURE TESTS SHOULD BE PERFORMED ON EACH LIFT AS NECESSARY TO VERIFY THAT ADEQUATE COMPACTION IS ACHIEVED. AS A GUIDE, ONE TEST PER 2,500 SQUARE FEET PER LIFT IS RECOMMENDED IN THE FOUNDATION SLAB AND PAVING AREAS (TWO TESTS MINIMUM PER LIFT). UTILITY TRENCH BACKFILL SHOULD BE TESTED AT A RATE OF ONE TEST PER LIFT PER EACH 150 LINEAR FEET OF TRENCH (TWO TESTS MINIMUM PER LIFT). CERTAIN JURISDICTIONAL REQUIREMENTS MAY REQUIRE TESTING IN ADDITION TO THAT NOTED PREVIOUSLY. THEREFORE, THESE SPECIFICATIONS SHOULD BE REVIEWED AND THE MORE STRINGENT SPECIFICATIONS SHOULD BE FOLLOWED.

MATERIAL SPECIFICATIONS FOR SELECT FILL

- FINAL SITE GRADING PLAN WAS NOT AVAILABLE AT THE TIME OF THIS REPORT’S PREPARATION. HOWEVER, WE ANTICIPATE THAT IMPORTED FILL SOILS MAY BE REQUIRED TO RAISE THE SITE GRADE.

- FOR THE PURPOSES OF THIS REPORT, SELECT FILL SOIL MAY CONSIST OF IMPORTED MATERIAL THAT IS FREE OF DEBRIS AND ORGANIC MATTER AND HAVE A PLASTICITY INDICES (PI) RANGING 8 TO 20. SOILS CLASSIFIED AS CH, MH, ML, SM, GM, OH, OL AND PT IN ACCORDANCE TO USCS SHOULD NOT BE CONSIDERED AS SUITABLE MATERIAL AS SELECT FILL MATERIALS. BASED ON OUR LIMITED TEST INFORMATION PERFORMED DURING THE CURRENT GEOTECHNICAL STUDY, WE ANTICIPATE THAT MAJORITY OF THE ONSITE LEAN CLAY FILL (CL FILL) AND NATURAL LEAN CLAY (CL) MATERIALS SHOULD QUALIFY TO BE USED AS SELECT FILL MATERIAL WITHIN THE STRUCTURAL AREA. THE PROPERTIES OF THE IMPORTED MATERIALS MUST BE VERIFIED PRIOR TO USE AS ‘SELECT FILL’ WITHIN THE STRUCTURAL AREA BY AN AUTHORIZED REPRESENTATIVE OF GEOTECHNICAL ENGINEER OF RECORD (GER) AT THE TIME OF CONSTRUCTION.

- CRUSHED LIMESTONE MAY BE USED FOR THIS PURPOSE. THE CRUSHED LIMESTONE USED FOR THIS PROCESS SHOULD HAVE A MINIMUM DRY DENSITY OF 115 PCF. THE PROPERTIES OF THIS MATERIAL SHOULD BE EVALUATED BY ECS AT THE TIME OF CONSTRUCTION AND WILL LARGELY BE BASED ON THE GRADATION, RATHER THAN THE PI. THE CRUSHED LIMESTONE SHOULD HAVE A MAXIMUM DIMENSION OF 1 INCH (IF USED WITHIN THE FINAL 4 FEET OF FILL) OR 4 INCHES IF USED DEEPER THAN 4 FEET BELOW THE SLAB SUBGRADE.

- THIS MATERIAL SHOULD BE PLACED AND COMPACTED AT WORKABLE MOISTURE CONTENTS WITHIN ±2% OF OPTIMUM MOISTURE CONTENT AND COMPACTED TO AT LEAST 95% OF THE MAXIMUM DRY DENSITY WITHIN THE STRUCTURAL AND PAVING AREA AS OBTAIN USING THE STANDARD PROCTOR METHOD (ASTM D 698).

CONSTRUCTION GROUNDWATER CONTROL

- GROUNDWATER WAS NOT ENCOUNTERED DURING FIELD EXPLORATION. THESE CONDITIONS SHOULD BE ANTICIPATED AND CAN BE HANDLED THROUGH THE USE OF TRENCHING AND PUMPING. ONE OF THE MORE COST EFFECTIVE TECHNIQUES THAT CAN BE UTILIZED IS THROUGH THE PRUDENT UTILIZATION OF SPOT DRAINS, AND IN PLANNING UTILITY INSTALLATIONS. FOR EXAMPLE, ANY UTILITY INSTALLATION THAT REQUIRES A GRAVITY FEED CAN BE EFFECTIVELY CONVERTED INTO A DRAINAGE LINE TO HELP ASSIST IN GROUNDWATER CONTROL DURING CONSTRUCTION.

- IF GROUNDWATER IS ENCOUNTERED DURING CONSTRUCTION OF FOOTINGS OR BURIED UTILITIES, AN ECS GEOTECHNICAL ENGINEER SHOULD BE CONSULTED TO DETERMINE IF ADDITIONAL PERMANENT DRAINAGE PROVISIONS ARE NECESSARY IN THE DESIGN AND CONSTRUCTION. GROUNDWATER LEVELS SHOULD BE MAINTAINED AT LEAST 3 FEET BELOW SUBGRADE LEVELS TO PROVIDE DRY WORKING CONDITION AND FIRM BEDDING. SUMP PUMPING AND SURFACE RUNOFF DITCHES MAY BE ADEQUATE FOR TEMPORARY CONTROL OF SURFACE RUNOFF AND GROUNDWATER DURING CONSTRUCTION.

- THE SURFACE OF THE SITE SHOULD BE KEPT PROPERLY GRADED TO ENHANCE DRAINAGE OF SURFACE WATER AWAY FROM THE PROPOSED CONSTRUCTION AREA DURING CONSTRUCTION. ECS RECOMMENDS THAT AN ATTEMPT BE MADE TO ENHANCE THE NATURAL DRAINAGE WITHOUT INTERRUPTING ITS PATTERN.

EXCAVATION

- BASED ON SOILS STRENGTH DATA, TEMPORARY (LESS THAN 24 HOURS), OPEN TRENCHED, NON-SURCHARGED AND UNSUPPORTED EXCAVATIONS CAN BE BUILT ON A SLOPE FLATTER THAN 1.5(H):1(V) PROVIDED THIS WILL NOT IMPACT THE STABILITY OF THE EXISTING/NEARBY STRUCTURES. FLATTER SLOPES MAY BE REQUIRED IN THE AREAS WHERE SOFT SOILS OR A LARGE AMOUNT OF SANDS ARE ENCOUNTERED. VERTICAL CUTS CAN BE CONSTRUCTED, PROVIDED SHORING AND BRACING IS USED FOR EXCAVATION WALL STABILITY. BENCHED EXCAVATION CAN ALSO BE USED WITH AVERAGE SLOPES OF ABOUT 1(H):1(V) AND STEPS SHOULD NOT BE HIGHER THAN FIVE-FT. IN ALL CASES, EXCAVATION CONSTRUCTION SHOULD CONFORM TO OSHA (OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION) GUIDELINES.

- EXCAVATIONS SHOULD BE PERFORMED WITH EQUIPMENT CAPABLE OF PROVIDING A RELATIVELY CLEAN BEARING AREA. EXCAVATION EQUIPMENT SHOULD NOT DISTURB THE SOIL BENEATH THE DESIGN EXCAVATION BOTTOM AND SHOULD NOT LEAVE LARGE AMOUNTS OF LOOSE SOIL IN THE EXCAVATION. FOUNDATION EXCAVATIONS SHOULD BE PROTECTED AGAINST SIGNIFICANT CHANGE IN SOIL MOISTURE CONTENT AND DISTURBANCE BY CONSTRUCTION ACTIVITY. SPECIFICATION SHOULD REQUIRE THAT WATER NOT BE ALLOWED TO POND IN EXCAVATIONS.

SLAB ON GRADE

- MAXIMUM SIZE OF AGGREGATE SHALL BE 1 INCH. AGGREGATE PER ASTM C57 OR C33.
- CALCIUM CHLORIDE OR ADMIXTURES CONTAINING CALCIUM CHLORIDE SHALL NOT BE USED AS ADDITIVES.
- CONCRETE CAST ON SOILS WITH SEVERE OR VERY SEVERE LEVELS OF SOLUBLE SULFATE SHALL BE TYPE V CEMENT.
- FLY ASH MAY BE USED PROVIDED IT MEETS ASTM C618 TYPE F AND DOES NOT EXCEED 20% OF THE WEIGHT OF TOTAL CEMENTITIOUS MATERIAL FOR CONCRETE STRENGTH UP TO AND INCLUDING 3000 P.S.I., AND 25% OF THE WEIGHT OF TOTAL CEMENTITIOUS MATERIAL FOR CONCRETE STRENGTH OF 4000 P.S.I.
- CEMENTITIOUS MATERIALS AND SHALL HAVE A REPLACEMENT FACTOR OF 1.2 RELATIVE TO CEMENT REPLACED.
- NO FLY ASH ADDITIVES SHALL BE USED IN FLATWORK OR ARCHITECTURALLY EXPOSED CONCRETE.
- MAXIMUM SLUMP 4 1 /2" FOR CONCRETE WITHOUT PLASTICIZER. IF PLASTICIZER IS USED, A HIGHER FINAL SLUMP MAY BE ALLOWED UPON STRUCTURAL ENGINEER'S APPROVAL.
- FOUNDATIONS SUPPORTING WOOD SHALL EXTEND TO AT LEAST 8 INCHES ABOVE ADJACENT FINISH GRADE.
- CURING OF CONCRETE SHALL BE MAINTAINED ABOVE 50°F AND IN A MOIST CONDITION FOR AT LEAST THE FIRST SEVEN DAYS AFTER PLACEMENT.
- THE CONTRACTOR SHALL PROVIDE PROPER CURING TO MINIMIZE SHRINKAGE CRACKING AND ENSURE PROPER STRENGTH GAIN.
- PROTECT CONCRETE FROM DAMAGE OR REDUCED STRENGTH FROM COLD OR HOT WEATHER IN COMPLIANCE WITH ACI 305 AND ACI 306.
- EVALUATION AND ACCEPTANCE OF CONCRETE SHALL BE BASED ON CYLINDER STRENGTH TESTS AS OUTLINED IN THE APPLICABLE BUILDING CODE.
- CONVENTIONALLY REINFORCED SLABS ON GRADE SHALL HAVE CONTROL OR CONSTRUCTION JOINTS ON COLUMN CENTERLINES IN EACH DIRECTION. ADDITIONAL CONTROL OR CONSTRUCTION JOINTS SHALL BE ADDED SO THAT THE JOINTS ARE AT MOST 15 FEET ON CENTER. THE AREA BOUNDED BY THE JOINTS SHALL INCLUDE NO MORE THAN 225 SQUARE FEET AND THE LENGTH SHALL NOT EXCEED 1.5 TIMES THE WIDTH.
- WHERE THE SLAB IS TO RECEIVE SENSITIVE FLOOR MATERIAL SUCH AS TILE, THE JOINTS SHALL BE ALIGNED WITH THE JOINTS IN THE FINISHED FLOORING MATERIAL.
- THE CONTRACTOR SHALL EXAMINE THE ARCHITECTURAL PLANS FOR THE AREAS WHERE THE SLAB ON GRADE IS STAINED, STAMPED OR TO RECEIVE A PATTERN OF CONTROL JOINTS. UNLESS THE JOINT LAYOUT IS SHOWN IN THE DRAWINGS. JOINTS SHALL BE A MINIMUM DEPTH OF 1/4 OF THE SLAB THICKNESS FOR CONVENTIONAL SLABS.
- CAST CLOSURE POUR AROUND COLUMNS AFTER COLUMN DEAD LOAD IS APPLIED.
- KEYED CONTROL JOINTS NEED ONLY OCCUR AT EXPOSED EDGES DURING POURING, ALL OTHER JOINTS MAY BE SAW CUT. CONTRACTOR SHALL SUBMIT PROPOSED LOCATIONS FOR APPROVAL PRIOR TO CONSTRUCTION.
- DO NOT LOAD THE SLAB ON GRADE OR SUPPORTED SLAB AT THE GROUND LEVEL WITH ERECTION CRANES OR ERECTION EQUIPMENT. THE SLAB HAS NOT BEEN DESIGNED FOR CRANE LOADS AND WILL REQUIRE AN INCREASE IN THICKNESS AND/OR REINFORCEMENT. SUBMIT FOR A/E REVIEW A PROPOSED PLAN FOR CRANE SUPPORT FOR SLABS AT THE GROUND LEVEL PRIOR TO COMMENCING WORK.
- SLAB DEPRESSIONS ARE SHOWN ON THE DRAWINGS. THE CONTRACTOR SHALL EXAMINE THE ARCHITECTURAL DRAWINGS FOR REQUIRED SLAB RECESSES AS HE SHALL PROVIDE WHETHER SHOWN ON DRAWINGS OR NOT. All RECESS REVISIONS REQUIRED BY ALTERNATE SUBMITTALS SHALL BE COORDINATED BY THE CONTRACTOR.
- TOP OF ALL FLOOR DRAINS SHALL BE AT ELEVATION (-1 /2" FROM FINISHED FLOOR) OR AS OTHERWISE NOTED ON PLAN. SLOPE SURFACE FOR AREAS AROUND THESE DRAINS OR AS INDICATED ON THE ARCHITECTURAL FLOOR PLANS.
- ALL PIPES IN CONCRETE MEMBERS SHALL BE SCHEDULE 40, GALVANIZED STEEL PIPE UNLESS SHOWN OTHERWISE ON THE STRUCTURAL DRAWINGS. LOCATION OF SLEEVES SHALL BE APPROVED BY THE STRUCTURAL ENGINEER. ADDITIONAL REINFORCING MAY BE REQUIRED.
- NO CONDUIT OR PIPING LARGER THAN 3/4 “DIAMETER SHALL BE RUN IN STRUCTURAL CONCRETE MEMBERS UNLESS SHOWN ON STRUCTURAL DRAWINGS
- PIPING MAY PASS VERTICALLY THROUGH THE FOOTINGS WITHOUT SLEEVES. PIPING PASSING THROUGH THE FOOTINGS HORIZONTALLY REQUIRE PVC SLEEVES. IN NO INSTANCE IS THE PIPING TO BE CAST LONGITUDINALLY WITHIN THE FOOTINGS.
- ALL UNDERGROUND UTILITY AND PLUMBING INSTALLATION ADJACENT TO BUILDINGS SHALL BE COMPLETED IN ADVANCE OF FOUNDATION CONSTRUCTION AND TRENCHES AT THE PERIMETER OF THE FOUNDATIONS SHALL BE PLUGGED WITH BENTONITE.
- FILL PLUMBING BOXES WITH 3 1 /2" MINIMUM SLAB OF 3000 PSI CONCRETE.

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07/22/2019

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07.22.2019

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BUILDING TITLE
GH SCHOOL
4724 N MAIN STREET

SHEET TITLE
FOUNDATION - GENERAL STRUCTURAL NOTES

SHEET NO.
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