



CASE STUDY 06182015



Drilled Shaft Stabilization & Freezing Temp

PROJECT:	I-29 Over Bacon Creek & Floyd River
LOCATION:	Sioux City, IA
CLIENT:	Case Foundation
PRODUCTS USED:	BIG-FOOT® Polymer Slurry, M-BOOSTER® Dry pH Adjuster, MESH-SET® Granular Sealing Material, FORTIFY® Slurry Loss Additive, GEO-NET® Slurry Loss Circulation Material and MO's-MUD® Strong Viscosity Booster

The I-29 corridor improvements project in the Sioux City, IA area includes new bridges over Bacon Creek and the north and south bound lanes of Floyd River. These new improvements will provide 12-foot wide lanes in each direction. MATRIX evaluated the site geology and the overall project, together with the Case Project Manager Keith Miles, the following changes were noted:

1. Prior work in the vicinity had resulted in trouble when installing drilled shafts under slurry.
2. The north and south bound lanes needed to be constructed at different times involving winter drilling and the need to winterize the polymer drilling slurry from freezing.
3. Artesian groundwater conditions were noted and needed to be addressed.
4. The fine sand needed to be stabilized and slurry loss controlled.
5. The 85-90-foot length of the sand zones could create material building up within the polymer slurry that would interfere with the sand content % requirement testing required by the Iowa Department of Transportation.
6. The Missouri River water to be used as mix water had elevated hardness. This has a negative effect on polymer slurry.

The river will serve as a source of mix water for the slurry. A total of 16-5 ft diameter and 31-6.5 ft diameter drilled shafts for a total of 47 drilled shafts existed. A total of 7,204 Lineal feet using the average depth of 153.3 ft per shaft length.

SITE GEOLOGY: The geology consisted of brown soft silty clay layers with gravelly sand and fine sand zones from 50-feet down to tip at 153 feet. Some cobbles were embedded within.

GEOLOGICAL CONDITIONS		
PROPERTY	VALUE	DESCRIPTION
GROUNDWATER (ft)	8-18 ft	8-18 ft water table
SOIL LOG AVAILABLE	yes	Brown silty clay with gravelly fine sand and gravel. Some cobbles inter-bedded. Limestone and shale bedrock.

CHALLENGE 1: Just below the soft silty clay layer at 52-feet, the groundwater was under hydraulic pressure. This is normally formed when a confining layer (clay) traps groundwater beneath it. The origin of this confined groundwater is recharged beneath the restricting layer of clay at a higher elevation point causing the groundwater to develop hydraulic force. When the drilled shaft excavations on the I-29 location penetrated this deposit of clay the hydraulic strain triggers this trapped groundwater to flow in to the lower pressure excavation drawing the fine sand along with it. The fine sand and gravelly sand was controlled by adding the product FORTIFY® Slurry Loss Additive to create a seal to control loss of slurry. **SEE FIG 1.**



To overcome this site condition changes had to be made. The top casing was elevated 10-ft. This extra length of casing allowed the BIG-FOOT® drilling slurry to be kept at a raised level within the casing creating a greater pressure than the confined pressure with the ground.

With the BIG-FOOT polymer slurry at 8.40 lb/gal just a little more than water it was necessary to maintain the slurry level (6-8 ft) above the new piezometric level. This 6 to 8 feet of hydrostatic pressure, or head, exerted the pressure necessary to support the walls of the excavation and assure drill shaft stability. Without this positive pressure exerted by the slurry column against the sidewall, hydraulic overburden pressures would have caused the sand to keep flowing into the excavation.

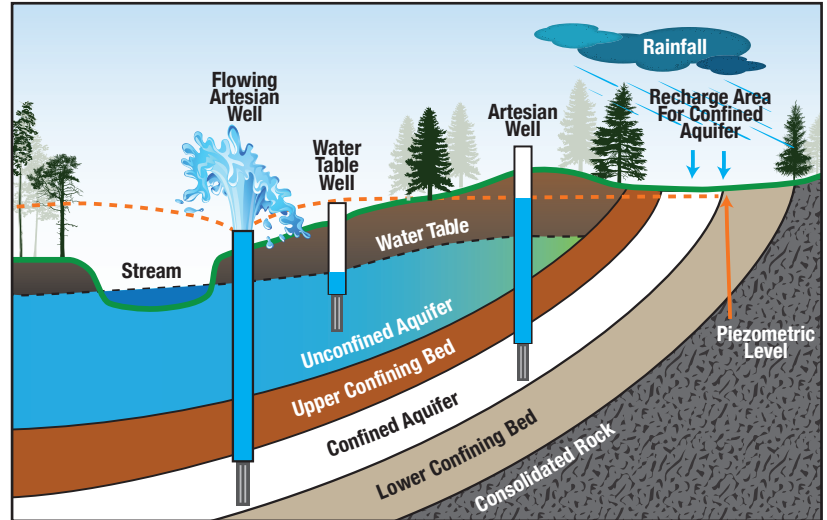
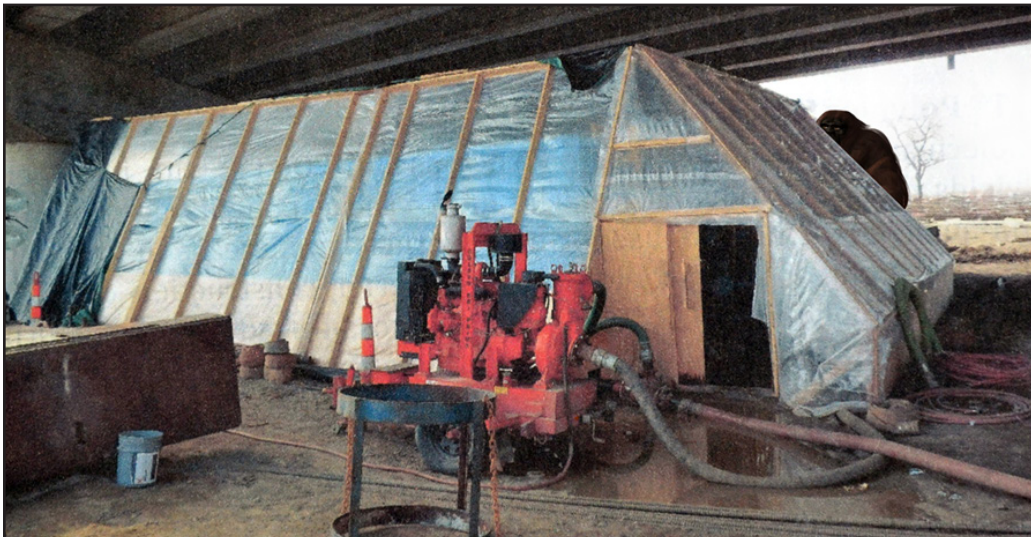


FIG 1 A confining layer creates hydraulic pressure within groundwater.

CHALLENGE 2: Freezing temperatures. Construction drilling using slurry and cold weather don't mix that well. In the drilling industry when using slurry a number of things can go wrong when the temperature drops below 32° F. The polymer slurry will freeze. Taking a few simple precautions easily prevents damage and equipment failure due to expanding from freezing.

The solution on this project was to fully enclose the slurry tanks with a wood and insulated walled structure made from 2x4 plywood and panels of insulation with portable gas heaters used within to maintain a warmer temperature.



Enclosure built to prevent the slurry tanks, pumps and hoses from freezing.





DOSAGE TO MIX A FULL NEW TANK OF SLURRY

PER 19,000 GALLON SLURRY MIX TANK		
PRODUCT	VALUE	DESCRIPTION
M-BOOSTER®	150 lb	Dry pH booster to achieve proper balance (3-Pails)
FORTIFY®	125 lb	Slurry loss additive prevents seepage into slurry wall. (5-Pails)
BIG-FOOT®	210 lb	Polymer Slurry (6-Pails)

The dry polymer (BIG-FOOT) was the primary building block of the drilling slurry with FORTIFY as the second polymer. The mix water was treated with M-BOOSTER to prepare the proper balance prior to mixing in the slurry drilling products. The 47 shafts were estimated to have a total of 7,562 cubic yards and 204,174 ft³ for 1,527,328 gallons of slurry volume.

ADDED DIRECTLY AT THE DRILL SHAFT EXCAVATION AS NEEDED

PER 19,000 GALLON SLURRY MIX TANK		
PRODUCT	VALUE	DESCRIPTION
GRID-LOCK®	20 lb	Prevents slurry loss
MESH-SET®	50 lb	Controls loss of slurry into surrounding formation
GEO-NET®	30 lb	Controls slurry loss just below the casing @ 25 ft depth
MO's-MUD®	5 gal	Preserves slurry. STIRRED WITH KELLY BAR

BIG-FOOT is a water-soluble polymer packaged as a granular material which is part of a total system process. A BIG-FOOT slurry fluid is designed to be a primary drilling fluid offering ease-of-use and dependable field success when used in the construction of drilled shafts and bored piles.

BIG-FOOT Polymer Slurry Properties

A high molecular weight polymer slurry such as BIG-FOOT, with its superior control, yields numerous advantages. The most crucial benefits are; improved excavation quality; simplicity of use for the field worker; increased savings in time and improved productivity due to superior construction quality. A second stabilizing polymer (FORTIFY) is cross-linked to seal the drilled shaft excavation and control sidewall slurry loss from the excavation. Cross-linking forms a superior polymer slurry that stabilizes the saturated silty sand and inter layered sandy silt formation. This also builds a more resistant slurry to any form of impact from the water and soil along this project.

The concentration of BIG-FOOT polymer, where ideal concentration occurs, is between 8.0 to 9.0 lbs/1,000 gal or 1.0 to 1.1 kg/m³ of water. At these concentrations, the Marsh Funnel viscosity/qt of BIG-FOOT Polymer Slurry ranges between 70 to 85 sec/qt.



3" Jet Mixing Hopper Rugged steel mixer to ensure consistent reliable slurry mixture, critical for successful operations using BIG-FOOT Polymer Slurry.

BIG-FOOT® Polymer Slurry is so good you won't believe it!

For more information regarding this project or any other MATRIX products and services please visit our website at matrixcp.com or call 877.591.3137.