Trenchless Technology Center

Vol. II, No. 2, April 1992

Update on TTC's long-term CPAR project

Status of Long-Term Pressure Test

The work associated with the long term pressure test CPAR project can be broken down into three main areas. A brief summary of the status in each area is presented below.

End Seal Design

The final end seal design that will be used has not been determined. Several different designs have been examined. One option was an off the shelf device from England. These end seals are made by a company called WASK-RMF. Although these units are off the shelf, the delivered price in quantity would have been around $630 per test section. We had only budgeted $400-500 per test casing, including casing, end seals, and control system. Therefore, these end seals were not acceptable.

A preliminary design was sent to Powerseal Corporation for suggestions and a price quote. The particular design that is being quoted by Powerseal uses items from their stock, except for the o-ring type gasket and an expandable ring on the interior of the test casing which will press the liner material against the outside of the casing, sealing off the unit. A quote is expected by the first week of April. The end seal being quoted involves a 150 pound flange welded on the exterior of the casing at each end. A circular flange will be bolted to this flange with a gasket between the two. This will seal off the small annular space existing at the ends of the test casing. In order to insure that no fluid escapes, an expandable circular ring will be inserted into the casing located at the end and expanded, pressing the liner material against the end seal and sealing the casing. The steel casings which will hold the liner material can be supplied with the flange already welded on so Powerseal is quoting both with and without the exterior flange.

Control System for Casings

The control system for the test needs to be able to supply water at several different pressures to 200 individual casings. When one of the units fails, the control system needs to recognize that a unit has failed and shut off the flow to the unit while not disturbing the rest of the units which might be in the same batch. The supply system for the pressurized water will be an air over water system in which the water will be supplied from a reservoir which pressurized from an air compressor. As individual units fail and the water level begins to decrease, the air compressor will supply enough air to hold the pressure constant until the water level falls to a preset level at which a pump feeding from the city tap will activate bringing the water level back to full at the same time the excess air pressure is bled off.

Different methods of controlling the individual test casings, and shutting off the units when failure occurs have been examined. One option involved using acoustical emissions monitoring of the test casings as they deflect to recognize imminent failure. The data from the readings would be fed into a data collection system run from a PC. Once failure occurred the system would isolate the test casing from the rest of the system and notify that a failure had occurred. This system would have been in excess of $150,000 and was not acceptable due to our budget constraints.

A more mechanical system was proposed by C.C. Lynch & Associates. This system would involve monitoring each individual test casing for flow by placing a flow meter in the supply line. If the flow is above a certain rate, which would indicate failure (allowances will be made for leaking end seals) a solenoid valve would be closed by a signal from a control unit cutting off the supply to that casing. As a leak or failure occurs in a bank of units at the same pressure, a pressure transducer would monitor the drop in pressure and cycle a normally closed solenoid valve open and closed until the correct pressure is restored to that bank of test casings. The supply pressure from the air compressor and water reservoir would be set a little higher than the highest pressure at which any

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individual bank would be tested. This system would constantly monitor the activity of the solenoid valves and would collect data which would be periodically dumped to one of our computers on a program such as Lotus 1,2,3 or DBASE. Two systems are being quoted by C.C. Lynch. One allows more control of the testing but would be more expensive. Both systems are being quoted by C.C Lynch and the bids should be received by April 5. If the system by C.C. Lynch is used, the piping supplying the water to the casings would have to be supplied by someone else.

Miscellaneous

Casing Support System

A design for supporting the casings which would enable the casings to be placed by overhead lifting equipment has been developed. This design has been priced by the Louisiana Tech University Machine Shop and they would charge only material cost to construct the pipe racks. The price would run around $100 per rack. The same drawing has been forwarded to Tripp Machine Works for pricing and possible changes.

Steel Casings

Prices for supplying the steel casings are being obtained, both with and without the flange. This price would include supplying for the 200 unit test and the initial test in April (less than 10 casings).

Test Location

The initial intent was to have the long-term test situated here at Tech. Depending on whether or not a facility can be obtained, the test might be run at the Waterways Experiment Station at Vicksburg. The amount of space required for the test is about 3500 square feet if overhead lifting equipment is available or about twice that if the casings must be placed by forklifts. WES is looking into space available. One building at WES has been located but the floor plan might necessitate placing the test samples on the racks outside the building and rolling racks inside. If this is the case, lockable wheels would be placed on the racks.

Initial Test

By the end of April it is expected that a small test system will be built, involving perhaps only one pipe rack system. If the control system proposed by C.C. Lynch is acceptable, they are prepared to bring a small control system to Tech for evaluation purposes. This small scale test run would enable TTC to:

1) Evaluate the control system and insure that the system is operational and performs as required;

2) Examine the end seal and make any changes that are necessary;

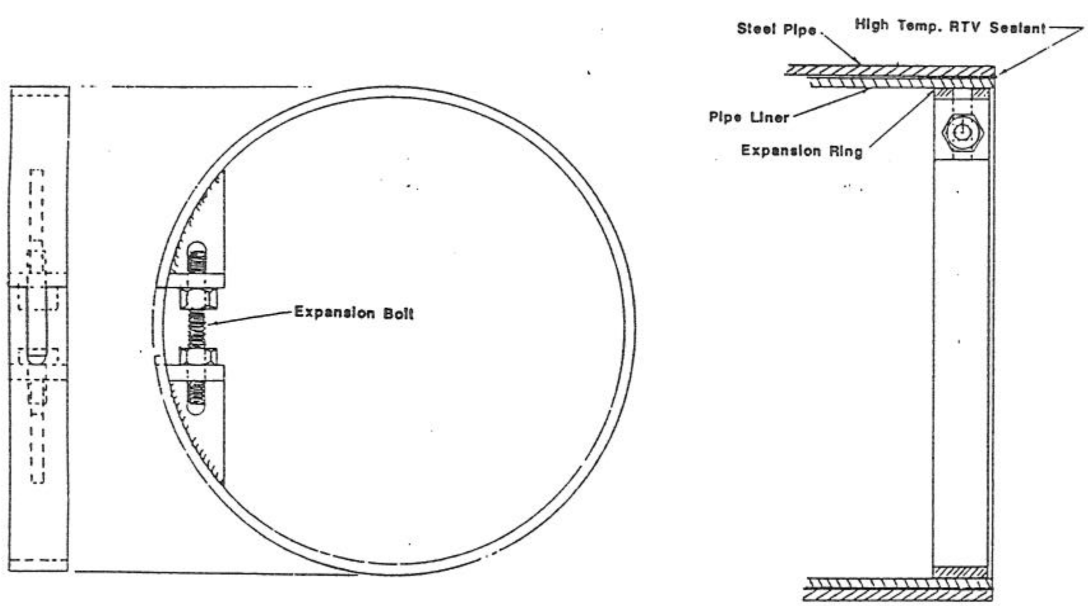
3) Determine what effect having different lengths (6,8,10 feet) of one diameter pipe has on the buckling pressure; (End Effects)

4) Determine what happens to the buckling pressure if the casings are 8 inches instead of 12 inches;

5) Establish a definition for failure to be used for our testing purposes;

6) Come up with some idea as to the range and upper limit of the different test pressures needed for the long-term test. The number of different test pressures needed has a direct bearing on the number and complexity of the control system. The greater the number of different test pressures the greater the number of control units required.

Tentative End Seal Design



Long–Term Tests of Pipe Lining Rehabilitation Systems

End Seal Details

NSF to make site visit

Louisiana Tech's Trenchless Technology Center has been selected by the National Science Foundation for a site visit April 27-28 to make a decision whether to establish the center as a State/Industry University Cooperative Research Center.

"The fact that NSF has decided to visit us gives us a good indication that we are on the "short list" for funding," Les Guice, head of Tech's Civil Engineering Department, said. "NSF is the most prestigious of all federal funding organizations in the U.S., and their backing would not only provide us with a significant amount of resources to fulfill our goals, but it can carry a lot of clout when we are trying to leverage funds from other federal groups."

Guice added, "We need this type of support to get the trenchless technology industry where it needs to be."

If established as an NSF center, TTC's level of funding for the first year would be $150,000 each from industry, NSF and the State of Louisiana, as well as other funds from the university. In future years, the funding could go as high as $300,000 from each source, provided TTC can secure the industrial commitments.

First-year funding would be used for administration of the center, including technology transfer activities and a new associate staff person to support these activities. The funding would also cover supporting generic and fundamental research for industrial needs and research directed for a specific need for a specific company or group of companies in an effort to advance the development of new technologies.

Research activities which would be conducted during the first year include a long-term evaluation of plastic pipes under hydrostatic loadings, development of a ground penetrating radar, and development of a line-and-grade auger boring steering system.

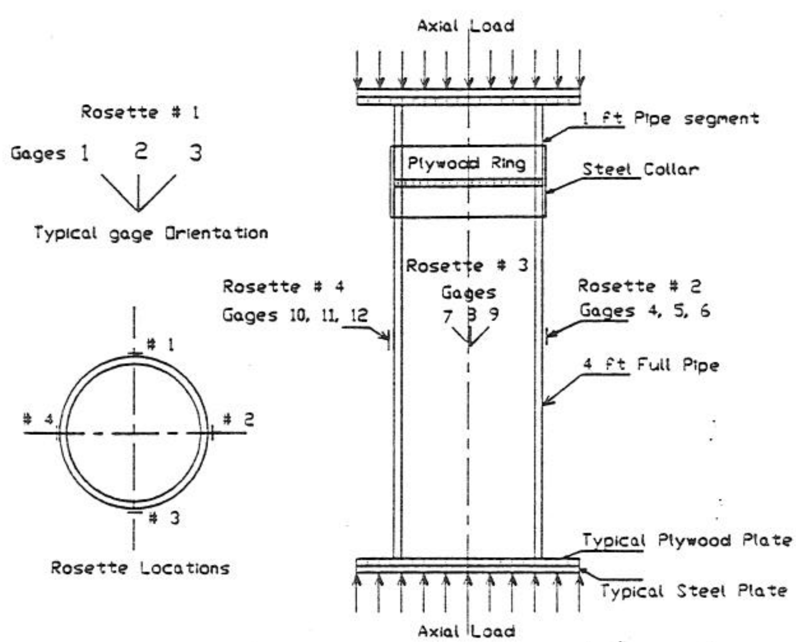
Center conducts research for Mission Clay Products

Mission Clay Products, a division of MCP Industries Inc., in Pittsburg, Kan., contracted in Feb. 1991 with Louisiana Tech to conduct a series of tests on the "Load Carrying Capacity of No-Dig Vitrified Clay Pipes."

The tests were performed in the structures laboratory of the civil engineering department under the supervision of Dr. Fred Akl. Axial loads of up to 400,000 pounds were applied using a Tinius-Olsen hydraulic universal testing machine. Strain measurements from 12 channels mounted on four rectangular rosettes were recorded using an automated PC-based data-acquisition system. Each test specimen consisted of an assembly of two pipe segments and an intermediate joint. A final report on the results of the tests was submitted to Mission Clay Products in June 1991.

This project and similar projects with industries have proven to be mutually beneficial both to the university and the industry, Akl noted. He added that as part of its mission, TTC is interested in pursuing research, development, testing and evaluation of products with industries. He pointed out Tech has testing facilities and the technical expertise to work with industrial partners on projects which will hopefully lead to increased competitive posture to industries both in the national and the international arenas.

Clay Pipe Testing at TTC



WES to conduct tests for CPAR

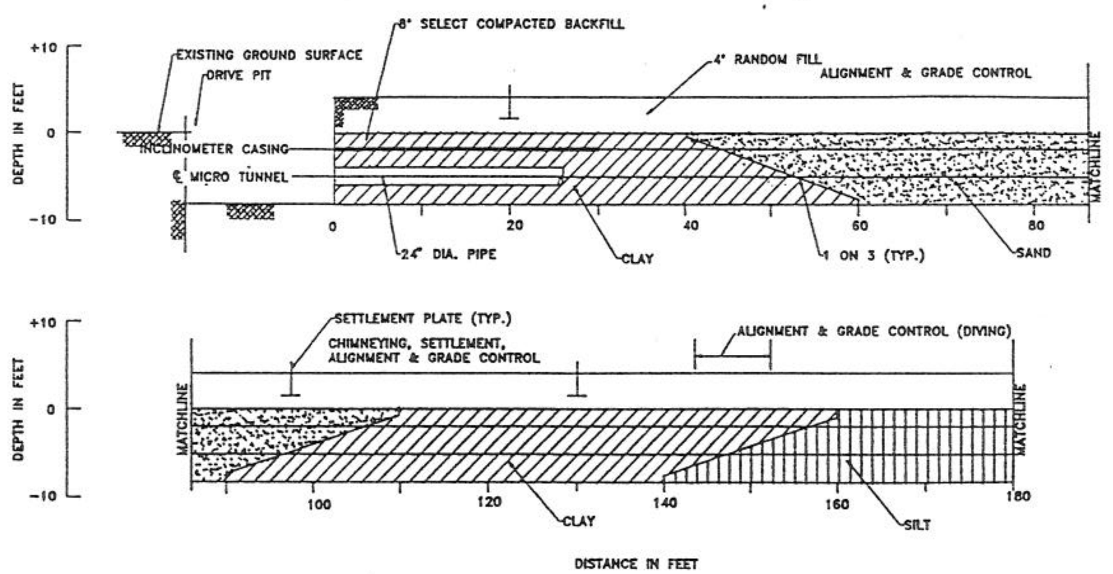
A testing facility will be constructed at WES for the evaluation of mini horizontal directional drilling equipment. The test bed will be approximately 300 feet long, with a cross section of approximately 56 feet wide and 10 feet deep. Along the test bed five sections, each 25 square feet, will be excavated and filled with compacted sand, clay, silt, gravel and clay gravel with cobbles. Each manufacturer will bore three holes which will be 2 feet, 5 feet, and 8 feet deep. The testing parameters will include measurement of behavior important for small diameter HDD applications such as the following:

* Soil-machine interaction for different soils
* Ground behavior and disturbance from the drilling, reaming and utility installation process for different soils.
* Impact of different soil conditions on machine performance
* Tracking and guiding systems effectiveness.

Another test facility will be constructed at WES for the evaluation of auger and slurry micro-tunnel boring machines. The test bed will be approximately 360 feet long with a cross section 15 feet wide and 8 feet deep. Each section will be divided into four parts and each part will be filled and compacted with clay, sand, silt and clay gravel with boulders. The drive pit will be approximately 15 feet by 20 feet by 10 feet deep. With each machine, instrumented 24 inch diameter reinforced fiberglass pipe (Hobas) will be installed.

The test bed will be instrumented and monitored during the evaluation process to determine:

* Soil-machine-pipe interaction during the pipe installation process, such as, friction loads in different ground conditions, load/deflection characteristics of the joints and the effect of lubricants in reducing friction along a pipe.
* Impact of different soil types including wet and dry conditions.
* Methods to monitor and control parameters monitored throughout the installation process, such as settlement and heave, jacking thrust, machine torque, slurry flow rates, face pressure and volume of material removed.
* Jacking force
* Speed of connection time and jacking time.



PROFILE ALONG MICRO TBM TEST BED
SHOWING LOCATION OF MICRO TUNNEL, INSTRUMENTATION AND VARIOUS
ZONES OF SELECT BACKFILL